

Section 823. WATER MAINS

823.01. Description. This work consists of excavating, installing, testing, disinfecting, and backfilling ductile iron water mains and appurtenances, and providing as built plans of the completed work.

823.02. Materials. Provide materials in accordance with the following:

Pipe.....	<u>923</u>
Water Services	<u>923</u>
Gate Wells	<u>923</u>
Gate Valves	<u>923</u>
Tapping Valves.....	<u>923</u>
Valve Boxes and Curb Boxes.....	<u>923</u>
Corporation Stops and Curb Stops	<u>923</u>
Service Saddles.....	<u>923</u>
Fire Hydrants	<u>923</u>
Backfill Material	<u>902</u>
Polyethylene Encasement.....	<u>923</u>

823.03. Construction. Install pipe materials required by the contract in accordance with AWWA Standards.

A. **General.** The plans show the locations of existing utilities in accordance with available data. If the work requires precise information on the location of existing utilities, the Contractor will expose utilities shown on the plans to determine the actual locations.

Do not disturb or cut into existing in-service water mains. If the operation of valves in existing water mains is required, notify the Engineer in advance so the Engineer may give the Municipality 3 working days advance notice. Coordinate scheduling of water main connections with the Municipality. Secure the Engineer's approval of the schedule before beginning the work. The Municipality is responsible for customer notifications.

The Municipality will open or close valves, as required to perform the work, without charge to the Contractor. In case of an emergency, the Contractor, with the approval of the Engineer, may operate valves to resolve the emergency.

Minimize the out of service time for existing water mains. Make connections at night, on Sundays, or on holidays, as conditions require or as approved by the Engineer. Minimize interference with the water supply if abandoning existing water mains and incorporating new water mains into the water system.

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B. Trench Excavation. Excavate water main trenches to the lines and grades shown on the plans in accordance with modifications approved by the Engineer, or to meet or bypass existing utility structures. Excavate trenches to the depths shown on the plans to provide at least 5½ feet of cover from top of water main to the final grade. Excavate trenches to the widths shown on Standard Plan R-83 Series.

Excavate the bottom of the trench to the required grade to allow 6 inches of bedding for the pipe. Do not block under the pipe.

Maintain trenches for water mains free of ground or surface water by pumping or as otherwise approved by the Engineer.

Install, and later remove, temporary timber bracing, as required to prevent movement or damage to new or existing water mains or adjacent utilities.

During backfilling, carefully remove supports for sheeted and braced excavations to prevent earth banks or adjacent streets from collapsing.

The Contractor may leave sheeting and bracing in place during backfilling and remove after completing backfilling operations. The Contractor may leave sheeting and bracing in place, if approved by the Engineer and the Contractor cuts it off 5 feet below the ground surface.

C. Disposal. Dispose of waste material as specified in section 205.

D. Laying the Pipe. Install the pipe joint restraint system in accordance with the manufacturer's recommendations. Assemble the pipe in the trench. If deflections at joints are required by changes in grade, alignment, or to plumb valve stems, ensure deflections of bell and spigot joints do not exceed the manufacturer's recommendations. Ensure the deflection at the joints of mechanical joint fittings does not exceed three-quarters of the maximum deflection recommended by the joint manufacturer or that allowed by AWWA C600, whichever is less. Do not store or leave tools or other objects in the pipe.

Provide joint restraint at fittings and deflections of 11¼ degrees and larger. Provide joint restraint in accordance with the Joint Restraint Schedule shown on the plans.

The Engineer may require thrust blocks in accordance with the Municipality's standards, or if making connections to existing water mains.

Construct thrust blocks to bear on undisturbed earth. Perform the work, including cold weather protection, in accordance with section 706.

E. Abandoning Water Mains. Remove and dispose of abandoned pipe, gate boxes, or other appurtenances, as necessary for placement of a new water main at no additional cost to the Department. Remove portions of gate boxes to at least 3 feet below the pavement surface under the road, and to at least 12 inches below the planned grade outside the road. If the Engineer determines abandoned mains may remain in place, block the ends of the abandoned mains with concrete. If shown on the plans or directed by the Engineer, fill abandoned water mains with non-structural flowable fill.

F. Valves. Set and join valves to the water mains as required for cleaning, laying, and jointing the required type of pipe, as shown on the plans. Install valves as required by the contract, or as approved by the Engineer. Place the valve stems plumb. Install self-supporting valves that do not bear on the pipe.

G. Live Taps. Hand-chlorinate tapping sleeves and gate valves before installation. Perform a wet tap into live water mains according to the manufacturer's recommended procedures.

H. Valve Boxes. Provide valve boxes that do not transmit shock or stress to the valve. Place valve boxes plumb over the operating nut of the valve, with the box cover flush with the pavement, or as approved by the Engineer. Provide firm support for valve boxes.

I. Adjusting and Reconstructing Water Shutoffs or Gate Boxes. Adjust and reconstruct water shutoffs or gate boxes to the final grade or as approved by the Engineer. Replace shutoff or gate box materials damaged during adjustment or reconstruction, as determined by the Engineer.

J. Water Services. Construct water services from the distribution main to the right-of-way line, or as approved by the Engineer.

Construct the service pipe with at least 5 feet of cover.

Make all service connections, and transfers. Maintain and protect, at no additional cost to the Department, existing service connections requiring transfer, but not shown on the plans, until reconnection or disposal.

If relocating a portion of water service, shut down the water service by freezing, or other method approved by the Engineer.

K. Gate Wells. Build gate wells as shown in the contract and in accordance with section 403. Mix mortar for masonry work in quantities that will be used before initial set. Do not use mortar that requires retempering.

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Position the valve nut to allow access through the opening in the manhole. Construct wells to allow minor valve repairs. Protect the valve and pipe from impact where passing through the well walls.

L. **Water Mains, Cut and Plug.** If the plans show cutting and plugging water mains, arrange for the Municipality to shut down the main. Remove the section of pipe and plug the water main as shown on the plans or approved by the Engineer. Construct the required thrust block and complete backfilling operations.

M. **Fire Hydrants.** Set fire hydrants at the locations shown on the plans, or as coordinated with the Municipality and directed by the Engineer. Equip the hydrant with auxiliary valves, as shown on the plans. Stand hydrants plumb, with nozzles parallel, or normal to the curb, and with the pumper nozzle normal to the curb. Place the nozzles at the height specified by the manufacturer, and at least 16 inches above the curb grade, or as approved by the Engineer.

Paint hydrants in accordance with the Municipality's standard requirements.

N. **Fire Hydrant Removal.** If the plans show removal of a fire hydrant, remove the entire hydrant assembly, including the following:

1. Auxiliary gate valve and box, unless otherwise approved by the Engineer;
2. Internal valve assembly;
3. Top bonnet;
4. Standpipe; and
5. Hydrant inlet body, if not encased in concrete.

If the Engineer approves leaving the auxiliary gate valve and box in place, remove to at least 3 feet below the pavement surface under the road, or at least 12 inches below planned grade outside the road.

Stockpile the removed material at a location approved by the Engineer. The Municipality will maintain ownership of the hydrant, and will remove the assembly from the project site.

O. **Relocating Fire Hydrants.** If the plans show relocating a hydrant, arrange for the Municipality to shut down the existing main. Remove the hydrant and reinstall at the required location. Add extension sections as necessary to adjust the hydrant to the required elevation. Reconnect the hydrant to the water main by shutting down the main, tapping a new hydrant outlet, or using the existing outlet. Install piping as required.

P. Abandoning Gate Wells. Abandon existing gate wells in accordance with section 203. Salvage the cover if requested by the Municipality.

Q. Gate Wells, Remove. Remove existing gate wells in accordance with section 203 and salvage existing gate valve. Stockpile the removed material at a location approved by the Engineer. The Municipality will maintain ownership of the gate valve, and will remove it from the project site.

R. Miscellaneous Fittings. Install the following at the locations shown on the plans and in accordance with good construction practices:

1. Elbows,
2. Tees,
3. Corporation stops,
4. Blow offs,
5. Pipe adapters,
6. Pipe couplings,
7. Threaded rods,
8. Retaining glands, and
9. Other miscellaneous fittings.

S. Backfill. Protect trench backfill material against freezing, or thaw frozen material before using. Backfill in accordance with Standard Plan R-83 Series.

Place backfill around the pipe, and to 12 inches above the pipe, in horizontal layers no greater than 6 inches deep. Compact each successive layer by tamping. Completely fill and compact spaces beneath the pipe. During backfill operations around the pipe, avoid damaging pipe joints and coating, or displacing the pipe from its original position.

T. Hydrostatic Testing. Perform hydrostatic testing of water mains in accordance with AWWA C600.

Ensure Municipality personnel witness pressure testing. Give the Municipality personnel at least 1 full working day notice before testing.

Provide the personnel, temporary timber bracing, plugs, test pumps, temporary connections to the Municipal water system, and other required apparatus. Provide the water for hydrostatic testing if not available from the Municipality. Water must be from a measurable source in order to determine leakage.

Before applying test pressure, expel air from the pipe. To expel air, make taps at the highest elevation points in the pipe. Plug these

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openings before the test with tight threaded brass plugs. Pressure test each section of water main in increments of no greater than 1,000 feet. Do not perform testing against a closed valve that is in service.

Maintain test pressure at 150 psi by pumping water into the pipe for at least 2 hours. Leakage, as measured by the quantity of water pumped into the pipe to maintain 150 psi during the test period, must not exceed the allowable leakage.

Allowable leakage is determined using Formula 823-1.

$$L = \frac{SD\sqrt{P}}{148,000} \quad \text{Formula 823-1}$$

Where:

L = allowable leakage in gallons per hour,

S = length of pipe in feet,

D = Actual pipe diameter in inches, and

P = 150 psi.

If leakage above the allowable limit occurs during hydrostatic testing, remove backfill to expose pipe and repair the joints and service taps. Repeat testing after repairs are complete.

Correct visible leaks regardless of the amount of leakage. Replace faulty pipes, fittings, gate valves, or other accessories disclosed by testing. Repeat the test until the pipes, fittings, gate valves, and other accessories meet the requirements.

U. Disinfection, Flushing and Bacteriological Testing. Disinfect the water main in accordance with AWWA C651 and applicable MDNRE regulations after successful hydrostatic testing.

Disinfect and flush new, and portions of existing, water mains as required by the MDNRE.

Use blow offs, fire hydrants, or other means as shown on the plans or approved by the Engineer to flush water mains. Provide hoses and other equipment and arrange a means of disposing of the water without damaging the work or adjacent property.

The Department prefers the continuous feed method for disinfecting mains but the Engineer may approve other methods. Use the continuous feed method with chorine added simultaneously with the water. Add chlorine or liquid hypochlorite to meet the requirement of at

least 25 milligrams per liter of chlorine. Slowly add the water to the main and allow to stand for at least 24 hours. At the end of the 24-hour period, ensure the chlorine residual is a minimum of 10 milligrams per liter. If not met, re-chlorinate and flush the water main until a minimum 10 milligrams per liter residual remains after 24 hours.

After completing disinfection, initially flush the water mains with water at a velocity of at least 2½ feet per second to replace the entire volume of chlorinated water in the pipeline. After initial flushing, perform final flushing until the residual chlorine content meets the standard level for the water distribution system. The Municipality may require a waiting period after flushing and before bacteriological sampling.

Dispose of chlorinated water in accordance with applicable state and local requirements. If necessary, apply a reducing agent to the water to neutralize the chlorine and create a chlorine residual of no greater than 1 ppm.

After flushing, perform bacteriological testing in accordance with AWWA C651 and MDNRE requirements. Test chlorine residuals before taking each bacteriological sample. Ensure the chlorine residual is less than 0.5 milligrams per liter before taking a bacteriological sample. Collect samples from each branch of pipe in the presence of the Engineer and Municipality personnel. The Municipality will be responsible for the transportation of the samples to a State of Michigan approved lab for testing. Two consecutive bacteriologically safe tests at 24-hour intervals for each section of pipe are required. Acceptable tests are negative for bacteria and as otherwise defined by AWWA C651 and MDNRE regulations.

If a bacteriological test fails, repeat disinfection, flushing, and testing.

V. **As-Built Plans.** Prepare as-built plans as work progresses. Provide two complete sets of as-built plans to the Engineer within 30 days following completion of water main work. Include, in the as-built plans, the following information:

1. Pipe sizes,
2. Pipe locations,
3. Fittings,
4. Valve locations,
5. Hydrant locations,
6. Service tap locations, and
7. The locations of underground obstructions that required relocation of the water main installation.

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W. **Polyethylene Encasement.** Install polyethylene encasement on water mains and fittings in accordance with the manufacturer's installation instructions and ANSI A21.5 or AWWA C105.

823.04. Measurement and Payment.

Pay Item	Pay Unit
Water Main, DI, __ inch, Tr Det __	Foot
Gate Valve, __ inch	Each
Live Tap, __ inch x __ inch	Each
Gate Valve and Box, __ inch	Each
Gate Well, __ inch dia	Each
Water Main, __ inch, Cut and Plug	Each
Fire Hydrant	Each
Hydrant, Rem	Each
Hydrant, Relocate, Case __	Each
Gate Well, Abandon	Each
Gate Well, Rem	Each
Water Serv	Each
Water Serv, Long	Each
Water Serv, Conflict	Each
Water Shutoff, Adj, Temp Case __	Each
Gate Box, Adj, Temp, Case __	Each
Water Shutoff, Reconst, Case __	Each
Gate Box, Reconst, Case __	Each
Water Shutoff, Adj, Case __	Each
Gate Box, Adj, Case __	Each
Polyethylene Encasement	Foot

A. **Water Main, DI.** The Engineer will measure **Water Main, DI**, of the sizes and trench details required, along the centerline of the pipe, with no deductions for fittings. The unit price of **Water Main, DI** includes the cost of the following:

1. Excavation and backfill;
2. Dewatering operations (trench and/or pipe);
3. Provide temporary water system to maintain service during construction;
4. Hydrostatic testing;
5. Disinfecting and flushing the water main and bacteriological testing;
6. All material, labor and equipment necessary to remedy an unsatisfactory hydrostatic test, including removing and replacing any backfill;

7. Providing and installing fittings, gaskets, bracing or sheeting, blocking and miscellaneous items for installing pipe and reconnecting to the Municipal Water System;
8. Material, labor, and equipment to remedy unsatisfactory hydrostatic tests, including removing and replacing backfill;
9. Live taps, used at the Contractor's option to expedite connecting to an existing water main; and
10. Preparing and providing as-built plans.

The Department may withhold payment until the Engineer accepts the as-built plans.

The cost of dewatering of trenches, pipe, or both associated with alterations to the Municipal Water System, is included in the unit price for relevant items of work.

The cost of excavating, disposing of excess material, and providing, placing, and compacting the backfill, is included in the unit price for related items of work.

The cost of removing or abandoning existing water mains, gate valve boxes, and other appurtenances to provide clearance for the proposed water main or roadway, is included in the unit price for relevant items of work.

The Department will pay separately for Non-Structural Flowable Fill.

B. Gate Valves, Gate Boxes, Live Taps and Water Shutoffs.

1. The unit prices of **Gate Valve**, and **Gate Valve and Box**, of the types and sizes required, include the cost of providing and installing the valve and valve box, complete and ready for use.
2. The unit price for **Live Tap**, of the size required, includes the cost of providing and installing the valve, tapping sleeve, all necessary restraints, and valve box, complete and ready for use. This work includes the complete live tapping procedure.
3. The Engineer will measure and the Department will pay for **Gate Box, Adj, Case __** and **Water Shutoff, Adj, Case __** of the case required, as follows:
 - a. Case 1 refers to structures located in hard surfaced travel areas and unit price includes saw cutting, removing and replacing existing pavement, curb, or curb and gutter, and adjusting the water shutoff or gate box to final grade.

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- b. Case 2 refers to structures located outside existing pavement, curb or curb and gutter and unit price includes restoring disturbed vegetated or sidewalk areas.
- 4. The Engineer will measure and the Department will pay for **Gate Box, Reconst, Case __** and **Water Shutoff, Reconst, Case __** of the case required, as follows:
 - a. The unit prices for **Gate Box, Reconst, Case __** and **Water Shutoff, Reconst, Case __** of the case required, include the cost of providing and placing new sleeves, castings, and other materials above the existing valve.
 - b. Case 1 refers to structures located in hard surfaced travel areas and in addition to costs shown in subsection 823.04.B.4.a unit prices include saw cutting, removing and replacing existing pavement, curb, or curb and gutter, and adjusting the water shutoff or gate box to final grade.
 - c. Case 2 refers to structures located outside existing pavement, curb or curb and gutter and in addition to costs shown in subsection 823.04.B.4.a unit prices include restoring disturbed vegetated or sidewalk areas.
- 5. **Gate Box, Adj, Temp, Case __**, or **Water Shutoff, Adj, Temp, Case __**, will be measured and paid for if temporarily lowering the water shutoff or gate box. The unit prices for these **Temp, Case __** pay items include the costs described for Case 1 pay items and the cost of temporary lowering work.

The Department will pay for replacing damaged gate boxes or water shutoffs, in accordance with subsection 823.03.i as the relevant gate box or water shutoff adjustment pay item. If the Engineer determines gate boxes or water shutoffs were in poor condition, or damaged despite Contractor precautions, the Department will pay for the work as the relevant gate box or water shutoff reconstruct pay item.

C. Gate Well.

- 1. The unit price for **Gate Well**, of the diameter required, includes the cost of the concrete footing and up to 10 feet of structure depth. Any cover placed on the gate well will be paid for as **Drainage Structure Cover** as specified in section 403.
- 2. The unit price for **Gate Well, Abandon** includes the cost of abandoning the structure, and salvaging the valves, if requested by the Municipality.

3. The unit price for **Gate Well, Rem** includes the cost of removing the structure and salvaging valves for the Municipality.

D. **Water Service.** **Water Serv** refers to services no greater than 30 feet long. **Water Serv, Long** refers to services greater than 30 feet long. **Water Serv, Conflict** refers to relocating only a portion of a water service. Services with a diameter larger than 2 inches will be measured and paid for as water mains.

The unit prices for **Water Serv, Water Serv, Long** and **Water Serv, Conflict** include the cost of the following:

1. Earth excavation;
2. Removing pavement;
3. Replacing pavement;
4. Jacking and boring;
5. Providing and installing type K copper tubing, service saddle, corporation stops, service stops, and service boxes;
6. Disinfecting;
7. Providing, placing, and compacting backfill; and
8. Miscellaneous material, equipment, or operations.

The Department will pay for additional service connections, not shown on the plans, but maintained, protected, and reconnected or disposed of by the Contractor as **Water Serv**, or **Water Serv, Long**.

The pay item **Water Serv, Conflict** will apply only to portions of water services requiring relocation due to direct conflict with utilities, other items of work, or as otherwise approved by the Engineer. The Department will pay for all other relocations requiring replacement of corporation or service stops as **Water Serv** or **Water Serv, Long**.

E. **Water Main, Cut and Plug.** The unit price for **Water Main, Cut and Plug** includes the cost of cutting the existing water main, providing and placing the required plug, and thrust blocks.

F. **Fire Hydrant.** The unit price for **Fire Hydrant** includes the cost of providing and installing the hydrant, including the coarse gravel and concrete base, at the locations shown on the plans in a ready-for-use condition.

The Department will pay separately for auxiliary valves, or other items included in the contract as separate pay items.

The unit price for **Hydrant, Rem**, includes the cost of breaking down the auxiliary gate valve, gate box, the hydrant assembly, backfilling, and plugging the opening in the existing main.

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The unit price for **Hydrant, Relocate, Case ___** of the case required, includes the cost of vertically adjusting the relocated hydrant to final grade and the following:

1. Case 1 includes the cost of removing the hydrant, extending the existing hydrant lead from the gate valve, reinstalling the hydrant in a ready-for-use condition, adjusting the existing gate box and hydrant to final grade, and providing and installing sleeves, fittings, and thrust blocks or joint restraints.
2. Case 2 includes the cost of removing the existing hydrant, gate valve and box, and reinstalling the hydrant and gate valve in a ready-for-use condition, adjusting the existing gate box and hydrant to final grade, and providing and installing the cutting-in-sleeve, pipe coupling, tee, elbow, thrust blocks or joint restraints. If used at the Contractor's option, the cost of Live Taps is included in the unit price for **Hydrant, Relocate, Case 2**.

The Department will pay separately for Live Taps and additional pipe greater than 10 feet, where detailed on the plans.