SECTION 663 WATER SUPPLY UTILITIES

BACKGROUND
Water supply utilities typically belong to municipalities or water districts. The organization, staffing and capabilities of these organizations vary widely, as well as their material and construction requirements. The Engineer-in-Charge will frequently represent the interests of the Owner, though some Owners will require that their staff or consultant be present to observe work on the water supply system. These arrangements are spelled out in the Utility Agreement between the Owner and the State. Installation of new water main as a betterment or relocation/replacement due to other work requires a State Department of Health (DoH) permit. The DoH permit will outline disinfection, testing and certification requirements.

GENERAL REQUIREMENTS
The requirements of the System Owner are contained in Special Notes entitled “Owner Requirements for Water Mains and Appurtenances”. Read these notes to determine any Owner requirements for materials, installation, valve operation, testing, etc. A utility agreement may also contain requirements for inspection by Owner personnel, tapping requirements (some Owners will not allow wet tapping of a live main by Contractor personnel), valve operation requirements, etc. Contractor personnel should not operate valves outside the project limits, or valves within the project limits after they are placed in service, without Owner approval.

The following documentation is required for ductile iron water pipe, steel water pipe, valves, hydrants, tapping sleeves, line stop fittings, bolted couplings, wedge type mechanical restraint glands, high deflection restrained joint fittings, iron water main fittings, etc:

1. The Contractor shall provide Manufacturer’s certification that the material is domestically manufactured in conformance with Standard Specification §106-11, Buy America (this need not be a separate certification). The Contractor shall notify the Engineer-in-Charge of any ductile iron water pipe, steel water pipe, valves, hydrants, tapping sleeves, line stop fittings, bolted couplings, wedge type mechanical restraint glands, high deflection restrained joint fittings or iron water main fittings from foreign producers. If the bid was not based on using foreign steel and/or iron, the Engineer-in-Charge will determine whether the total quantity of foreign steel and/or iron for all items surpasses the maximum allowed in §106-11. The entire quantity of any material above the maximum allowed will be rejected, unless a waiver is obtained by the Contractor from the approving authority. System owners are not the approving authority, and Buy America provisions supersedes any local requirements regarding foreign steel and/or iron. If the Contractor’s bid was based on using foreign steel and/or iron, no certification of domestic manufacture is required.

2. The Contractor shall provide Manufacturer’s Certification identifying the material as one of the following and the bare fitting weight as listed in the appropriate AWWA Standard (currently listed only in lbs.). Some fittings are not listed under the above standards and the weight cannot be certified under these standards (though manufacture of the fitting can). The weight of those fittings shall be provided by the Manufacturer.

<table>
<thead>
<tr>
<th>Cast Material</th>
<th>AWWA Standard</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gray Iron and Ductile Iron Full Body Fittings</td>
<td>C110</td>
</tr>
<tr>
<td>Ductile Iron Compact Fittings</td>
<td>C153</td>
</tr>
</tbody>
</table>

Note: The AWWA Standards are available on the IntraDot under Organizations> Design Division> DQAB > Specifications and Standards Section > AWWA Standards. The AWWA Standards contain a significant amount of information that may be valuable to the Engineer-in-Charge, however they are copyrighted, and may not be reproduced here.
Removals
Unused/abandoned water supply pipe should be removed, but it may be abandoned in place. If abandoned in place, the ends shall be capped in accordance with the contract documents. All pipe abandoned in place shall be shown on the contract record plans. Removal and storage can become problematic if the Owner does not arrive to take the materials. The Contractor is not required to deliver, but if the Owner does not accept the responsibility to remove the material, the Contractor may dispose of it (properly). Requiring a Contractor to deliver removed materials outside of the contract limits is a violation of federal policy. The Owner should be notified by Certified Mail that the material will be disposed of if not removed in a specified time period. Iron or steel pipe has residual value, and may be scrapped. Iron, steel or plastic pipe may also be disposed of as Construction and Demolition (C&D) Debris at an approved facility.

Asbestos-Cement Pipe
Large quantities of water supply pipe fabricated from asbestos-cement (AC) were installed across the State prior to the banning of asbestos containing products. AC pipe was originally white, but may be discolored, the surface is smooth, and has a texture similar to concrete pipe. AC pipe is non-metallic and will crack if struck with a hammer. In place, the material poses no health threat, but the material should never be cut, ground, tapped, swept or any other operation performed that may create dust. Dust from AC pipe poses a severe health hazard. Any operation, including cutting, tapping, removal, etc., may be performed only by a licensed asbestos abatement contractor under an asbestos removal permit from the Department of Labor (DOL). If AC pipe is encountered in the field, and not identified in the contract documents, stop all associated work adjacent to the pipe, backfill the area and contact the Regional Construction Environmental Coordinator for assistance. The Contractor shall ensure that workers, inspection staff and the public are protected from potentially objectionable and/or hazardous airborne dust and/or by-products in accordance with §107-05 and §107-15.

Shutdowns
The Contractor shall only shut down a portion of the water supply system with the consent of the Owner. The Contractor shall provide a minimum of 48 hours notice to each customer, which may be provided by posting a written notice on the building entrance. The Contractor should attempt to schedule work, particularly for commercial customers, during days or hours that minimize impact on customers. The Contractor should provide the Engineer-in-Charge a plan for work, and confirmation that notifications were made. The temporary water service item is typically used to supply critical facilities (hospitals, commercial/industrial users, etc.) and should not be paid for to meet the Contractor’s selected construction schedule or to correct Contractor created deficiencies.

Existing Valves
The Owner should be asked to operate and exercise any existing valves that will need to be operated during construction, prior to the Contractor beginning work. The Owner may refuse to operate an existing valve if there is a chance that the valve will malfunction during operation, leaving the risk of failure and subsequent replacement cost to the State. If the valve breaks during operation, and the failure is not due to negligence by the Contractor, replacement of the valve may be a State responsibility. If there is a water main betterment as a part of the contract, the replacement of the valve should be the Owner’s responsibility.

Excavation and Backfill
Trench widths for water supply pipe excavation, installation and backfill are shown on the Standard Sheets. Safety related requirements for trench protection must be addressed. Materials containing fly ash or slag are corrosive to cast and ductile iron, and shall not be allowed to come into contact with cast or ductile iron water supply pipe or appurtenances. Pipe bedding shall only be installed when called for in the contract documents (typically in the Owner Requirements), or where unsuitable or unstable material is encountered during excavation.
Thrust Restraint

Thrust restraint is required to prevent a pressurized pipe from separating due to movement. Many Owners will require redundant thrust restraint. External threaded rods are the least effective, due to corrosion and potential failure. Concrete thrust blocks are common, but can be expensive. The most effective types are restrained joints, where the joints are firmly bolted together. Restrained joints can be provided for existing pipe through the use of wedge type mechanical restraint glands. The thrust block sizes shown on Standard Sheet M663-2 are for standard conditions ONLY (1.5m burial, 1380kPa (200 psi) test pressure, 96kPa (2,000 psf) soil bearing capacity, and 1440 kg/cm (90 pcf) soil unit weight). These values are conservative for most applications. See the standard sheet for adjustment method, and refer to the Owner Requirements for test pressure. The Regional Geotechnical Engineer can provide assistance in evaluating soil conditions.

Example: Assuming the standard values for bury depth, soil bearing capacity and soil unit weight are acceptable, for a test pressure of 690kPa (100 psi), reduce the thrust block area by 50% (100psi/200psi). Maintain the minimum dimensions shown on the Standard Sheet.

Water Supply Pipe Installation

Ductile iron pipe is available with three types of joints, as shown on the Standard Sheets. Push-on joints are assembled by simply pushing the plain end of a length of pipe into the bell end of another piece of pipe with a gasket installed. This provides no thrust restraint. A mechanical joint provides a limited amount of thrust restraint. A restrained joint mechanically locks a retainer ring welded to the plain end of a pipe.

The Contractor shall follow the Standard Sheets for pipe installation and installation procedures outlined in the pertinent AWWA Standards (C600, C603, C605). Care must be used in the handling of pipe, as the lengths are typically too heavy to be handled manually. Pipe shall be kept clean and free of dirt, typically by using temporary pipe plugs. Ductile iron pipe is supplied in 5.5m (18 ft) or 6.1m (20 ft) standard laying lengths, and installation of uncut lengths need not be field measured, but rather may be counted. Plastic pipe may also be measured in this manner, based on a standard full length. Pipes that are field cut must be field measured, deducting the amount of plain end that is inserted into the bell of the next section. The length of fittings must be deducted from field measurements of installed lengths, as fittings are paid for by weight.

Installation of steel water pipe is different from iron or plastic. Steel pipe is typically used for very large diameters (48 NPS and larger). Rather than gasketed joints and fittings, steel water pipe is installed with fully welded joints and the fittings are shop fabricated from lengths of steel pipe. Steel pipe is typically coated, on the inside and outside, and some of the coating will need to be done in the field. The use of steel water pipe normally requires a cathodic protection system to prevent corrosion. Follow the contract documents for installation and inspection of cathodic protection systems.

Water supply pipe of any kind should be kept as clean as possible during storage and installation. Pipe lengths should be visually inspected for debris prior to installation. If debris remains in the pipe, or enters from a wet trench, joint make-up will be difficult, joints may leak and hydrostatic testing and disinfection will likely be problematic. Dewatering of trenches and the use of pipe plugs will aid in keeping the pipe clean.

Polyethylene Encasement and Insulation

Ductile iron pipe is frequently encased in polyethylene when installed in corrosive soil conditions. The encasement may be done using sheets or tubes, in accordance with AWWA Standard C105. Ends should be overlapped and taped. Fittings shall be encased using plastic sheets cut, fit and taped to encase the fitting.

Thermal insulation for buried water pipe is used when the bury depth over the pipe is less than the desired, typically 1.5 m (5 ft). This typically occurs when a water pipe is installed under a culvert or over some underground obstacle which reduces the bury depth. The insulation should extend along the water supply pipe to a point on either end that has a minimum 1.5 m ground clearance. The item for bridge mounted water mains includes insulation, and is not paid for separately.
**SECTION 663 WATER SUPPLY UTILITIES**

**Valves**

Valves shall be installed with firm, even bearing. The Owner may require concrete blocks, pavers, crushed stone, gravel, etc. to support the valve. The valve box is placed over the operating nut on the top of the valve, but not bearing on the valve. Some Owners will require that concrete, concrete block or similar walls be installed to support the edges of the valve box, to prevent it from bearing on the valve. Screw type valve boxes are easier to install, but may transmit wheel loads to the body of the valve if not properly installed. The separate pieces of slide type valve boxes will telescope together under pressure, preventing damage to the valve. The slide type is the preferred type of valve box and shall be provided unless the Owner requires otherwise.

**Hydrants**

New hydrants shall not be connected to a main with a lateral pipe smaller than 6 NPS. Hydrants shall be supplied with a length(s) of anchor pipe up to 2.0 m long at no additional cost to the State. Anchor pipe, which is typically available in 300 mm increments up to 1 800 mm, may be provided from the supplier with retainer rings and glands installed, to reduce field cutting and welding. Use of the correct length anchor pipe will allow proper placement of the hydrant. Larger offsets from the main to the hydrant will require installation of additional lengths of pipe, typically 6 NPS. An anchor pipe is a short length of pipe with two plain ends, and retainer rings welded to either end. Glands are installed prior to welding on the second retainer ring, allowing the anchor pipe to be bolted to both the tee and to the valve, and another bolted to both the valve and the hydrant. This provides a fully restrained valve and hydrant without the use of external rods or thrust blocks.

Hydrants shall be installed so that the lower barrel does not extend more than 100mm above grade over a 1.5m span, to prevent snagging on the bottom of an errant vehicle. The groundline is identified by the Manufacturer using an offset from the flange, because hydrant barrels are typically manufactured from ductile iron, and the groundline cannot be cast on the exterior as previously done with cast iron barrels. The hydrant shall be installed with groundline within 25mm of finished grade, to provide adequate restraint of the lower barrel, which allows the upper barrel to break off if struck by an errant vehicle. Barrel extensions to adjust the height of the upper barrel are available in 150mm increments; no more than one extension will be allowed. Small adjustments of a hydrant barrel are difficult, and localized minor adjustments of finished grade may be necessary.

**Hydrant Fenders**

Hydrant fenders should only be installed behind a raised curb, in a low speed (urban) setting.

**Dry Hydrants**

A dry hydrant consists of a length of pipe with strainer on one end that is in a pond or other year round source of water, and a fitting on the other end that allows quick connection to a fire department pumper truck. Dry hydrants shall be installed as detailed on the plans. The maximum allowable static lift for a dry hydrant is 7.0m (23ft) at sea level and decreases to 5.7m (18.8ft) at an altitude of 1525m (5,000ft). This does not take into account friction losses in the pipe or fittings. The lift is measured from the centerline of the pumper (0.6m above ground) to the water elevation in the pond or water source. Care must be taken to ensure that the riser, which will have water in it up to the source water level, is at least 1.5m below grade, measured both vertically and horizontally.
Iron Water Main Fittings

Iron water main fittings include bends, tees, crosses, reducers, plugs, etc. Fittings are available in mechanical joint (MJ), push on joint (POJ) and plain end (PE). Bends are referred to as a 1/4 bend (90°), 1/8 bend (45°), 1/16 bend (22-1/2°) and 1/32 bend (11-1/4°). Tees typically have the same size on the two ends opposite each other (run), and the same or a smaller size on the opposing end (branch). The size of a tee is written “run x branch”, ie a 12x6 Tee has two 12 NPS ends opposite each other (run) and a 6 NPS on the opposing end (branch).

Iron water main fittings are available in two basic types, “full body” fittings (AWWA Std C110) and compact fittings (AWWA Std C153). Unless specifically noted otherwise in the Owner Requirements, “full body” fittings may be supplied in either gray iron or ductile iron. Compact fittings are only available in ductile iron. In accordance with AWWA Standards C110 and C153, all fittings shall have the following distinctly cast on them: pressure rating, nominal opening diameters, manufacturer’s ID, country where cast and the number of degrees or fraction of circle on all bends. Ductile iron fittings shall have the letters “DI” or “Ductile” cast on them.

Iron water main fittings are paid for by weight. Fitting weights for payment are those listed in the appropriate AWWA Standard, when available (not all fittings or sizes are covered by the AWWA Standards). Total the weights in pounds, convert the contract total to kilograms and round to the nearest whole kilogram.

The material certification required under §722-01 shall list a fitting description, quantity, bare fitting weight and source of fitting weight (AWWA C110, C153 or Manufacturer, if fitting is not listed in either standard). Payment will be made based on material weight listed on the material certification.

Wedge Type Mechanical Restraint Glands

These glands are often known by their trade names, “Megalug”, “Ford 1100”, etc. The radial wedge bolts are tightened, and when the proper torque is reached, the outer portion of the bolt head snaps off, making the installation simple and reliable. The reliability may be compromised if the surface of the pipe opposite the wedges is dirty, or if the nuts are turned in the wrong direction with an air wrench, as the outer bolt heads will snap off. If this happens, or the device must be removed and re-installed, the bolts must be installed to the proper torque using a torque wrench.

Water Service Connections

A water service connection consists of a corporation stop, a length of small diameter service pipe, a curb stop and curb box and another length of small diameter service pipe to the customer. A corporation stop is a brass fitting that is either direct tapped (threaded) into a water main, or installed through a tapping sleeve or saddle. A corporation stop is a small valve that allows the water to be shut off after installing the device on a pressurized main. The service line is then attached to it and the curb stop is installed. This then allows the curb stop to be shut off, while the corporation stop is turned on, and the main backfilled.

A variety of tapping machines are available to install corporation stops. Care shall be taken to ensure that the machines are safely operated when tapping active mains under pressure.

Water Meter Pits

Water meter pits may be used in larger, commercial applications or when multiple structures on a single property are served from one service line. Meter pits are typically installed on the customers property, and will require a release. If a property owner does not grant a release, the (System) Owner may opt to discontinue service to that location. Unless otherwise noted in the Owner Requirements, meters shall be supplied by the Owner at no additional cost to the State or the Contractor.

Adjust Valve Box Elevation

Valve boxes may be adjusted using adjustment rings or frames, or by adjusting the existing box to the required grade. Valve box construction, either slide type or screw type, facilitates adjustment.
Hydrostatic Testing

Unless otherwise noted in the Owner Requirements, newly installed water supply pipe must be pressure tested to 1035kPa (150 psi) for a minimum of 2 hours. Allowable leakage amounts must be determined per AWWA Standard C600. Care must be taken to ensure that the main is restrained prior to pressurization, yet joints should be observed for visible leaks. No personnel should be allowed in a trench, excavation, meter pit or any confined space during the initial pressurization of a newly installed water supply pipe. Failure of a large diameter, high pressure water supply pipe may be hazardous to personnel in these locations. Valve operation to pressurize a newly installed water supply pipe shall be done gradually to prevent pressure fluctuations, if the valves are operated too quickly, or blow-off points are opened too quickly, escaping air pockets may cause water hammer, which may damage the system. The higher the system pressure, the greater the potential for problems and damage.

Disinfection

Disinfection and testing shall be conducted in accordance with AWWA Standard C651 and the project DoH permit, if applicable. The testing results typically must be completed prior to activation and use. This may require that the existing main be left in service until the new main is approved. Testing results must be received from the Contractor prior to final progress payment.

Highly chlorinated or neutralized water used for disinfection should not be directly discharged to an environmentally sensitive water body or into a storm drainage system (open or closed) that outlets directly into a sensitive stream or water body. Highly chlorinated or neutralized water should be discharged to a sanitary sewer or municipal wastewater treatment facility if available. Highly chlorinated or neutralized water may be discharged into vegetated upland areas at least 100 feet from any surface water body. If this is not possible, contain highly chlorinated or neutralized water and aerate on site to allow chlorine to volatilize. If containing highly chlorinated or neutralized water on site is not feasible, discharge the water into a tank truck to be disposed of. Contact the Regional Environmental Contact for assistance.

RELATED CONTRACT PROVISIONS

§715-02 Steel Castings
§715-07 Proof Loaded Iron Castings
§715-09 Malleable Iron Castings
§719-01 Galvanized Coatings and Repair Methods
Section 722, Water Supply

REFERENCES

American Water Works Association (AWWA) Standards
Special Notes - “Owner Requirements for Water Mains and Appurtenances”
Highway Design Manual (HDM) Chapter 13; Utilities
Standard Sheets M663-1 to M663-7
Contract Administration Manual (CAM) §106-11, Buy America