

MEMO



TO: MAG Specs and Details Committee

DATE: June 5, 2013

FROM: Troy Tobiasson

SUBJECT: Section 610 updates,
Case: 13-20

PURPOSE: To make Section 610 Hydrostatic Test Methods consistent with AWWA C600-10.

REVISIONS:

1. Revised hydrostatic testing to be more consistent with AWWA C600 (2010):
 - Pressure testing: +5 psi max, “stable” pressure, reiterate “minimum” pressure
 - “Leakage” – Changed terms to “testing allowance” and “makeup water”, consistent with AWWA C600; changed formula to that found in AWWA C600, and changed “L” to “M” so as to not imply “leakage”.
2. Removed references to installation of asbestos-cement pipe and cast iron pipe; suggest addition of installation of PVC (AWWA C900) pipe.
3. Removed references to specific manufacturers, replaced with performance specs (sections 610.6.2 and 610.13(A)).
4. Corrected various grammatical and punctuation errors.

SECTION 610

WATER LINE CONSTRUCTION

610.1 DESCRIPTION:

The construction of all water lines shall conform to applicable standard specifications and details, except as otherwise required on the plans or as modified in the special provisions.

610.2 GENERAL:

All pipes shall be delivered, handled and installed in accordance with the manufacturer's recommendations and/or applicable provisions of AWWA standards for installation of the various types of water mains specified, insofar as such recommendations and provisions are not in variance with the standard specifications and details.

Where water lines are to be constructed in new subdivisions or in conjunction with street repaving projects, the streets shall be pre-graded to within 6 inches of the new street subgrade prior to trenching or cut stakes shall be set for trenching.

610.3 MATERIALS:

All pipes for water lines shall be of the classes shown on the plans or as specified below.

(A) The ~~4 inches through 16 inches~~ (4-inch through 16-inch) diameter pipe may be ~~asbestos-cement~~ **PVC C900** or ductile iron, except where a particular material is specified **by the agency or contract documents**. All pipes shall be minimum 150 ~~P.S.I.~~ psi design unless otherwise specified.

(B) Pipe 16 inches and larger may be either ductile iron, or concrete pressure pipe-steel cylinder type.

Ductile iron water pipe and fittings - Section ~~750. Asbestos-cement water pipe and fittings~~ ~~Section 752~~. Concrete pressure pipe-steel cylinder type - Section ~~758. C900 PVC - AWWA C900-07~~.

Service Material containing Brass or Bronze must comply with the current NSF 61-8 Standards at the time the Project begins.

All Brass or Bronze service material must meet the current AWWA C-800 Standards.

Any product used in water line construction containing brass or bronze that comes in contact with potable water shall meet the current NSF Standards and Federal Law.

610.4 CONSTRUCTION METHODS:

All water mains in major streets shall have a minimum cover of 48 inches over the top of the pipe. Water mains in other locations shall have a minimum cover over the top of the pipe as follows:

(A) 36 inches for mains smaller than 12 inches.

(B) 48 inches for mains 12 inches and larger.

Cover for water mains will be measured from existing or proposed finished grade of pavement or from natural ground, whichever is deeper.

No water main shall be deflected, either vertically or horizontally, in excess of that recommended by the manufacturer of the pipe or coupling, without the appropriate use of bends or offsets.

If adjustment of the position of a length of pipe is required after it has been laid, it shall be removed and rejoined as for a new pipe.

Every precaution shall be taken to prevent foreign material from entering the pipe. When on the project site, the ends of the pipe section shall be plugged, wrapped or tarped at all times when pipe laying is not in progress, which includes storage and staging at the site. The pipe shall be stored on a pallet, blocking or other means to prevent foreign materials from entering the

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pipe. The pipe line shall be protected by a water-tight plug or other means approved by the Engineer when the pipe is in the trench if pipe laying is not in progress.

Where restrained joints are specified on mains sixteen (16) inches in diameter and smaller, ductile iron pipe shall be used with an approved joint restraint method.

On mains sixteen (16) inches in diameter and larger where plans specify welding joints and where ductile iron pipe is furnished, joints shall be restrained by an approved joint restraint method for the distance specified.

Except as otherwise required in this specification, the special provisions, or by the Engineer, trench excavation, backfilling and compaction shall be in accordance with the requirements of Section [601](#). Backfilling may be accomplished as soon as the pipe line has been installed to the satisfaction of the Engineer, subject to the requirements for testing, as contained below.

Hydrostatic testing shall be in accordance with this specification.

All corporation stops used for testing and chlorination shall be left in the pipe line with the stop closed and all connecting pipe removed.

Curb stops with flushing pipes or fire hydrants shall be installed at the ends of dead-end mains according to standard details. Thrust blocks shall be installed in accordance with this specification.

Valve boxes and covers shall be according to standard details.

~~Asbestos cement pipe shall be installed in accordance with AWWA C 603, except pipe and fittings shall be in accordance with Section [752](#).~~

~~Cast iron pipe shall be installed in accordance with AWWA C 600, except pipe and fittings shall be in accordance with Section [750](#).~~

Ductile iron pipe shall be installed in accordance with this specification and pipe and fittings shall be in accordance with Section [750](#).

PVC C-900 pipe shall be installed in accordance with AWWA C900 and Section 601.

610.5 SEPARATION:

610.5.1 General: Water lines and sewer lines shall be separated to protect water lines from contamination by sewer lines.

The angle of a water line and sewer line crossing shall be limited to between (45) forty-five degrees and (90) ninety degrees. Intersection angles of less than (45) forty-five degrees shall not be allowed.

Separation distances are measured from the outside diameter of the water or sewer line, or the centerline of a manhole.

When water and sewer lines cannot meet separation requirements, extra protection is required as described in Subsection [610.5.5](#) and shown in Standard Details 404-1, 404-2 and 404-3.

Extra protection requirements for line crossings are measured from the closest outside surfaces of the sewer and water line.

Water line service connections to individual building supply and distribution plumbing shall not be placed below sewer lines, and shall otherwise comply with the separation requirements of the applicable plumbing code as applied by the Agency (Administrative Authority). Methods described for extra protection do not apply to these service lines.

Water and sewer lines shall not be constructed parallel within a common trench.

610.5.2 Water Line Separation from Gravity Sewer Lines: Water lines shall not be placed within two (2) feet horizontal and one (1) foot vertical above and two (2) feet vertical below gravity sewer lines.

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Extra protection is required where a water line is placed within six (6) feet horizontal and two (2) feet vertical above a gravity sewer line.

Extra protection is required where a water line is placed within six (6) feet horizontal and any distance below a gravity sewer line.

610.5.3 Water Line Separation from Pressurized Sewer Lines: Water lines shall not be placed within six (6) feet horizontal and within two (2) feet vertical below or within two (2) feet vertical above a pressurized sewer line.

Extra protection is required where a water line is placed within six (6) feet horizontal and within six (6) feet vertical above a pressurized sewer line.

Extra protection is required where a water line is placed within (6) feet horizontal and any distance below a pressurized sewer line.

610.5.4 Water Line Separation from Manholes: Water lines shall not pass through or come into contact with any part of a sewer manhole and shall be separated six (6) feet horizontal from the center of a sewer manhole.

610.5.5 Extra Protection: New water lines that require extra protection from new sewer lines, shall have extra protection provided by using ductile iron pipe for both lines. Lines of standard pipe length shall be centered at the point of crossing so that no joints exist within six (feet) horizontal and only restrained or mechanical joints exist within ten (10) feet horizontal.

New water lines that require extra protection from sewer lines, shall have identification wrap and/or tape installed on the water and sewer lines for the length that requires extra protection for each line.

New water lines that require extra protection from existing sewer lines shall be constructed using the extra protection specified for new water lines, and the existing sewer line:

(1) shall be reconstructed using a standard length of ductile iron pipe centered at the point of crossing so that no joints exist within six (feet) horizontal and only restrained or mechanical joints exist within ten (10) feet horizontal, or

(1) shall be encased in 6 inches of concrete for the horizontal distance of the line that requires extra protection but for a distance no less than ten (10) feet horizontal.

Existing water lines that require extra protection from new sewer lines shall provide for extra protection by:

(1) constructing the new sewer line and reconstructing the existing water line using ductile iron pipe for both lines with standard pipe lengths centered at the point of crossing so that no joints exist within six (feet) horizontal and restrained or mechanical joints exist within ten (10) feet horizontal, or

(2) encasement of both the existing water line and the new sewer line in six (6) inches of concrete for the horizontal distance of the lines that require extra protection but for a distance no less than ten (10) feet horizontal.

(3) Extra protection for existing ductile iron water lines can be met by the installation of restrained or mechanical joints on the existing water line within **ten** (10) feet horizontal of the crossing and either

(a) construction of new sewer line using a standard pipe length of ductile iron pipe centered at the point of crossing so that no joints exist within ~~six (feet)~~ six (6) feet horizontal and restrained or mechanical joints exist within ten (10) feet horizontal, or

(b) encasement of the new sewer line in 6 inches of concrete for the horizontal distance of the line that requires extra protection but for a distance no less than ten (10) feet horizontal.

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610.6 POLYETHYLENE CORROSION PROTECTION

610.6.1 General: Where called for in the plans and specifications or directed by the Engineer, pipe, valves and fittings shall be protected from corrosion by encasement in a polyethylene protective wrapping referred to hereafter as polywrap. Although not intended to be a completely air and water tight enclosure the polywrap shall provide a continuous barrier between the pipe and surrounding bedding and backfill.

610.6.2 Materials: The polywrap shall be of virgin polyethylene, not less than 8 *mils* in thickness, formed into tubes or sheets as may be required. Naturally pigmented material may be used where exposure to ~~ultra-violet~~ ultraviolet light will be less than 48 hours. Otherwise the material shall be pigmented with 2 to 2 ½ percent of well dispersed carbon black with stabilizers.

The polywrap shall be secured as specified below with ~~2-inches~~ 2-inch wide pressure sensitive ~~plastic~~ tape not less than 10 mils thick. ~~Tape shall be Scotchrap No. 50, Polyken No. 900, Tapecoat CT, Johns Manville No. V 10 Trantex, or approved equal. This flexible tape shall consist of a polyethylene or polyvinyl chloride backing with a synthetic elastomeric adhesive film comprised of butyl rubber. Tape shall remain flexible over a wide range of temperatures, with tensile strength and elongation properties in conformance with ASTM D-1000.~~

The minimum tube size for each pipe diameter shall be per Table [610-1](#).

TABLE 610-1		
POLYWRAP FLAT TUBE WIDTHS		
Nominal Pipe Diameter (Inches)	Cast Iron Or Ductile Iron With Push-On Joints (inches)	Cast Iron or Ductile Iron With Mechanical Joints (inches)
4	14	16
6	17	20
8	21	24
10	25	27
12	29	30
14	33	34
16	37	37
18	41	41
20	45	45
24	53	53

610.6.3 Installation: The polyethylene tubing shall be cut into lengths approximately 2 feet longer than the pipe sections. With the pipe suspended from the center the tube shall be slipped over the spigot end and bunched up between the point of support and the spigot end. After the pipe is installed into the bell of the adjacent pipe the pipe shall be lowered to the trench bottom and the supporting sling removed from the center of the pipe. The pipe shall then be raised at the bell end enough to allow the tube to be slipped along the full length of the barrel with enough left at each end to overlap the adjoining pipe about 1 foot. A shallow bell hole must be made at each joint to facilitate installation of the polywrap.

Pull the bunched-up polywrap from the preceding length of pipe, slip it over the end of the new length of pipe, and secure in place with one circumferential turn of tape plus enough overlap to assure firm adhesion. Then slip the end of the polywrap from the new pipe section over the end of the first wrap until it overlaps the joint at the end of the preceding length of pipe. Tape it in place.

The loose wrapping on the barrel of the pipe shall be pulled snugly around the barrel of the pipe, and excess material folded over the top of the pipe and the folds held in place by means of short strips of adhesive tape, at about 3 foot intervals along the pipe.

Repair any rips, punctures or other damage to the tube with the adhesive tape or pieces of tube material secured with tape.

Bends and reducers in the line shall be covered with polyethylene in the same manner as pipe.

Valves, tees, crosses and outlets shall be wrapped with flat sheets of the same material. The sheets shall be passed under valves and brought up around the body to the stem. Edges shall be brought together, folded twice and secured with the

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adhesive tape.

610.6.4 Payment: Payment for this item shall be per the provisions of Subsections [109.4](#) and [109.5](#) of the specifications unless this item is specifically called for on the plans or in the supplemental specifications or special provisions as a specific component and pay item for a given project.



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610.7 VALVES:

Valves shall be installed in accordance with AWWA C-600 or AWWA C-603 modified as follows:

All tapping sleeves, gate valves, butterfly valves, air release and vacuum valves and corporation stops shall be in accordance with Section [630](#).

Just before installation in the trench, valves shall be fully opened and closed to check the action, and a record made of the number of turns required to fully open or close the valve. For valves 16 inches and larger, a member of the water utility shall be present to check the action and record the number of turns. The inside of all valves shall then be thoroughly cleaned and the valve installed.

Valves 12 inches and smaller in size shall be supported by concrete blocks, in accordance with the standard details.

Valves 16 inches and larger in size along with their bypass valves, shall be supported on concrete slabs, and/or concrete piers, as indicated on the plans.

Concrete supports shall be provided under valves in vaults and manholes, and shall be constructed an inch low, then grouted with non-shrink grout. Adjustable pipe supports shall be as indicated on the plans. Buried valves shall be supported on concrete blocks as detailed on the plans.

Valve boxes shall be installed over all buried valves in accordance with standard details.

Standard couplings or matching joints shall be used when more than one length of pipe is required, or when two or more pieces are joined, to form the valve box riser. Install extension stems on all valves where the operating nut is 5 feet or more below grade.

610.8 MANHOLES AND VAULTS:

Construction shall consist of furnishing all materials and constructing manholes or vaults complete in place, as detailed, including foundation walls, cast iron steps, frames, covers, and any incidentals thereto, at location shown on the plans.

Manholes shall be constructed to conform with the requirements of Section [625](#) and standard details, except the inside diameter shall be 60 inches.

Vaults shall be constructed of reinforced concrete conforming to Section [725](#) and of concrete pipe conforming to ASTM C76 Wall A or B. Vaults shall be kept moist for 7 days before backfilling.

610.9 FIRE HYDRANTS:

The Contractor shall furnish all labor, materials, and equipment necessary to install fire hydrants complete in place at locations shown on the plans in accordance with the standard details and special provisions. Fire hydrants furnished by the Contractor shall conform to the requirements of Section [756](#).

If paint is chipped, scuffed, or otherwise damaged during handling and installation, the Contractor shall touch up such spots as may be designated by the Engineer.

All hydrants must be flushed and left in good working condition with the control valve open.

610.10 CONNECTION TO EXISTING MAINS:

Existing pipe to which connections are to be made shall be exposed by the Contractor as directed by the Engineer, to permit field changes in line, grade or fittings, if necessary.

All connections to existing mains shall be constructed according to the plans.

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Valves connecting new work to the existing system shall be kept closed at all times.

Only Agency personnel shall operate existing valves. The Contractor shall not operate valves in the existing system.

After disinfected samples have been taken and the new work passes the bacteriological tests, the new line shall then be turned over to the Contracting Agency with all branch lines and tie-in valves closed.

When shutdown of an existing water main is necessary in order to connect to the new lines, the Contractor shall make application and pay the required charges to the Contracting Agency. A conference between the Contractor's representative, Engineering Inspection, and Water Distribution personnel shall establish the time and procedures to insure that the shutdown will be for the shortest possible time. If necessary to minimize inconvenience to customers, shutdowns may be scheduled during other than normal working hours. The water supply to some customers, such as hospitals, cannot be shut off at any time. Provisions to furnish a continuous supply of water to such establishments will be required. After the procedures and time for a shutdown are agreed upon, it shall be the Contractor's responsibility to notify all customers in advance that the water will be turned off. When possible, customers shall be notified 24 hours in advance and in no case, except in emergency, shall notification be less than 30 minutes. Notification shall be in writing, giving the reason for the shutdown and the time and duration the water service will be shut off.

The Contracting Agency will close existing valves, but will not guarantee a bone-dry shutdown.

610.11 METER SERVICE CONNECTIONS:

All new meters must be installed by the Contracting Agency after the proper application as required by Code with fees paid at prevailing rates.

When plans call for connections from a new water main to an existing water meter, the work shall include new copper pipe and fittings except as follows:

(A) Wrapped galvanized pipe shall be used to connect or extend existing galvanized service pipe. Type K soft copper pipe or tubing shall be used to connect or extend existing copper service pipe except when otherwise called for in the plans.

(B) When the existing main is not abandoned, and the existing meter is to be connected to the new line, the corporation stop at the old main shall be closed and the abandoned service line cut 6 inches from the old main.

(C) Taps and service connections to the new main shall be made prior to testing and disinfection of the new line.

(D) Meter service piping may be installed by drilling in place of open cut construction when approved by the Engineer. When called for on the plans, the meter and box shall be relocated by the Contractor as directed by the Engineer. Existing meters which are shown on the plans to be relocated shall be located and installed in accordance with standard details.

Water meter boxes which are broken during construction shall be replaced by the Contractor at no additional cost to the Contracting Agency. Existing meter boxes which are already broken prior to start of construction shall be replaced by the Contractor with boxes furnished by the Contracting Agency. Boxes may be picked up by the Contractor after written authorization is received from the Engineer. The written authorization shall include the street address of each broken meter box and the size of meter box required. All water meter boxes shall conform to the standard details.

610.12 FIRE LINE SERVICE CONNECTIONS:

Fire line service connections shall be installed in accordance with standard details.

The fire line from the control valves at the main to the detector check valve shall be constructed of ~~cast iron or~~ ductile iron pipe to Section [750](#).

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610.13 COUPLINGS, JOINTS, GASKETS AND FLANGES:

(A) Couplings: The couplings used to join the pipe to flanged valve adapters shall ~~be Dresser Style 38, Smith Blair 411 or an approved equal~~ have a minimum working pressure of 150 psi, and shall have a fusion-bonded epoxy finish. The coupling sleeves shall be carbon steel with a minimum yield of 30,000 psi. The flanges shall have a minimum yield of 30,000 psi and be ductile iron or carbon steel for sizes up to 12", or high-strength, low-alloy steel for sizes 14" and larger.

(B) Joints: The joints and fitting shall conform to Sections [750](#) and [752](#).

(C) Bolts and Nuts:

- (1) Bolts, studs, and nuts used in underground field flanged connections or for connecting fittings shall be carbon steel compliant with ASTM A307, Grade A unless Grade B is specified. Bolts, studs, and nuts shall be in accordance with AWWA C111. Bolts and studs shall have Class 2A thread tolerance with the corresponding nuts having Class 2B tolerance. Bolts, studs and nuts shall have a hot-dipped zinc coating in accordance with ASTM F2329. All bolt diameters shall normally be 1/8 inch smaller than the bolt hole diameter. If specified, allowable exceptions to zinc coating shall be bolts, studs, and nuts made from 316 stainless steel per ASTM F593 or cadmium plated per ASTM B766. All bolts shall be hexagonal heads.
- (2) The minimum requirement for underground mechanical joint connections using T-head bolts shall meet the requirements of AWWA C111 using a high strength low alloy steel manufactured for atmospheric corrosion resistance per ASTM A242.

These bolted joints shall be protected as follows: Following installation and before backfilling, all couplings, steel flanges, bolts, nuts, anchor bolts and rods, bolting of all flanged valves, and all exposed steel shall be protected from corrosion by either of the two methods outlined below at the Contractor's option.

(A) Below ground installations shall be coated with NO-OX-ID "A" with a film of not less than 1/32 inch thick and then coated with cement mortar not less than 1 inch thickness before backfilling. Cement mortar shall be composed of 1 part cement, ASTM C150, Type II, low alkali, to 3 parts sand. Before application of the cement mortar coating the area to be protected shall be covered with a layer of 2 x 2 inch No. 14 gage welded wire fabric, firmly wired in place.

(B) Below ground installations shall be protected by the application of hot coal-tar enamel. The coal-tar enamel shall be in accordance with AWWA C-203 and shall be applied to the top part of the pipe or fittings by daubers for at least 2 coats for a total minimum thickness of 1/16 inch. The coal-tar for under side of the pipe flanges or fittings shall be applied by the pan or cocoon method as described below and in AWWA Manual M-11, Steel Pipe.

Pan Method: The coating pan is securely anchored in place on the underside of the pipe and straddling the connection to be coated. The pan shall be wide enough so that the entire connection will be coated.

Hot coal-tar enamel is poured into the pan, from one side only, until the pan is completely filled. The drain plug or valve is then opened and the excess coal-tar drained out. The pan can then be removed. Details of the coating pan and corresponding dimensions are given in AWWA Manual M-11.

The upper portion of the connection, and all remaining exposed steel pipe, will then be coated by the use of a dauber. The coal-tar coating shall be applied in at least 2 coats for a minimum thickness of 1/16 inch. The daubers and method of application **shall** conform to AWWA C-203. No thinning will be allowed.

(C) Cocoon Method: The cocoon is formed by placing glass fiber cloth or roofing paper, of the proper width, around the underside of the connection and adjacent exposed steel pipe. The edges of the cocoon shall be securely fastened to the pipe. Backfill is lightly placed to the spring line, and the top of the cocoon is opened and layed back on the filled area and hot coal-tar enamel poured, from one side only, until the cocoon is completely filled. The loose backfill prevents rupture of the cocoon. The upper portion of the connection and remaining exposed steel pipe shall be coated as above.

(D) Gaskets: Except as otherwise provided, all gaskets for pipe lines shall be one piece full faced gaskets from one-ply cloth inserted SBR rubber material. Gaskets for flanges 20 inches and smaller shall be from 1/16 inch thick material. Gaskets for flanges 24 inches and larger shall be from 1/8 inch thick material. Gasket material shall be J-M 109 as manufactured by

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Johns-Manville Corporation or an approved equal. Physical characteristics of the rubber compound shall meet ASTM D2000, Class 4AA805A13.



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(E) Flanges: Cast iron flanges shall conform to AWWA C-110 as to material, diameter, thickness, drilling, etc. Steel flanges shall be ring or hub type, and shall conform to AWWA C-207, Class D. All flanges shall be drilled and have flange diameters and bolt circles conforming to AWWA C-110, except bolt holes will be 1/8 inch larger than the bolts given for the various sizes. All bolts shall be as specified above and all flanges shall have a flat facing.

610.14 BLOCKING:

All pipe lines, valves and fittings 16 inches and smaller in diameter shall be blocked with concrete thrust blocks in accordance with standard details. Thrust block areas for pipe, valves and fittings larger than 16 inches in diameter shall be calculated for each size pipe, valve and fitting to be installed and shown on the plans.

Thrust block areas shall be calculated on the basis of 200 psi test pressure bearing against undisturbed 3,000 psf soil.

If soil or pressure conditions other than those stated above are encountered, the thrust block areas shall be calculated and submitted for approval. The areas stipulated in the standard details are minimums and shall not be decreased.

When restrained/welded joints are specified to resist thrust forces, blocking is not required.

With the Engineers approval, restrained/welded joints may be used in lieu of thrust blocks to resist thrust forces.

610.15 HYDROSTATIC TESTING:

Water lines, including all fittings and connections to the water mains shall be tested for watertightness by subjecting each section to hydrostatic ~~tests~~ testing in accordance with applicable provisions ~~of~~ of AWWA C-600, except as modified below, and shall consist of pressure ~~test~~ testing and ~~leakage tests~~ allowance testing.

The test section shall be slowly filled with potable water and all air shall be vented from the line. The rate of filling shall be as determined by the Superintendent of Water Distribution, with at least 24-hour notice required before tests are scheduled (moved from original 610.15(A) below).

The Contractor shall provide all vents, piping, plugs, bulkheads, valves, bracing, blocking, pumps, and including measuring devices and all other equipment (except such as pressure gages) such as which may be necessary for making the tests, and shall pay the Contracting Agency for water used in the tests.

~~Pressure Tests:~~ Hydrostatic Testing: The test Pressure testing may be made before or after backfilling, but backfilling must be completed before allowance testing. If the pipe is center-loaded, a visual inspection for leaks may be made along the pipe line while the test section is under test pressure, and all visible leaks repaired. However, if mechanical compaction is to be used in the backfilling operations as spelled out in AWWA C-600, the tests shall not be made until the backfilling is completed and compacted. (moved from original 610.15(A) below). Backfill and compaction for the full distance encompassed by restrained welded joints shall be completed prior to testing. (moved from 610.15(B) below). All connections, blowoffs, hydrants and valves shall be tested with the main as far as is practicable. Hydrostatic testing shall not begin until the pipe has been filled with water for at least 24 hours to allow for ~~absorption~~ air venting. (moved from original 610.15(A) below).

(A) Pressure ~~Tests~~ Testing: Unless otherwise noted in the contract documents, the minimum prescribed test pressure shall be at least 200 psi for lines smaller than 16 inches and 150 psi for lines 16 inches or larger, not to exceed 5 psi over the minimum prescribed test pressure, as measured at the lowest end of the section under test (moved from 610.15(B) below). The duration of each pressure test shall be at least 2 hours, during which time the test section shall not drop below the minimum prescribed test pressure. If the pressure in the pipe test section has not stabilized by the end of the testing period, a hydrostatic retest will be required.

Each section of a new line between sectionalizing valves or between the last sectionalizing valve and the end of the project shall be tested separately as required in AWWA C-600, and/or as modified in these specifications, except that any such section less than 500 feet in length may be tested with the adjacent section, if both sections of line have the same pipe class rating. No section greater than $\frac{1}{2}$ mile in total pipe length shall be tested without special written permission of the Engineer.

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(B) ~~Leakage Tests~~ Testing Allowance/Makeup Water: ~~Leakage tests shall be made~~ Makeup water volume shall be determined after the pressure test has been satisfactorily completed and all backfilling and compaction ~~is has been~~ completed to top of trench. ~~Leakage is defined as the quantity of water~~ Testing Allowance shall be defined as the maximum quantity of makeup water necessary to be supplied into the pipe line section under test to ~~maintain~~ restore the ~~specified leakage~~ ending test pressure to the beginning test pressure, after the pipe line has been filled with water and all air expelled. The Contractor shall furnish the necessary apparatus and assistance to conduct the test.

The duration of each makeup water test shall be at least 2 hours. To pass the allowance testing, the quantity of makeup water from the pipe line shall not exceed the makeup water quantity allowed by the following formula, from AWWA C-600:

$$L = \frac{ND\sqrt{P}}{4500}$$

in which

~~L~~ = ~~allowable leakage~~ in gallon per hour.

~~N~~ = ~~number of joints in the pipe line being tested, this "N" being the standard length of pipe furnished divided into the length being tested, with no allowance for joints at branches, blowoff, fittings, etc.~~

D = nominal diameter of pipe in inches.

~~P~~ = ~~average observed test pressure of the pipe being tested, equal to at least 100 percent of the class rating of pipe being tested, in psi gage, based on the elevation of the lowest point in the line or section under test and corrected to the elevation of the test gage,~~

P = test pressure of the pipe being tested, per 610.15 (A)

$$M = \frac{SD\sqrt{P}}{148,000}$$

Taken from AWWA C600 (2011) (Eq 1), in which:

M = Testing Allowance (makeup water), in gallons per hour.

S = length of pipe tested, in feet

D = nominal diameter of pipe, in inches.

P = average observed test pressure of the pipe being tested, equal to at least 100 percent of the class rating of pipe being tested, in psi gage, based on the elevation of the lowest point in the line or section under test and corrected to the elevation of the test gage.

Should the test on any section of the pipe line ~~show leakage greater than specified above~~ require more makeup water than allowed by the above formula, the Contractor shall locate and repair the defective pipe, fittings, or joint until ~~the leakage is~~

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~~within the specified allowance of 2-hour duration~~ **the makeup water volume is within the specified allowance.** All repairs and retests, if required, shall be made at the Contractor's expense.

Connections to the existing pipelines or existing valves shall not be made until after that section of new construction has satisfactorily passed the hydrostatic tests.

~~Cast iron and ductile~~-Ductile **iron** pipe used in conjunction with ACP will be tested to the ACP standards, unless otherwise directed by the Engineer. High pressure systems of all ~~cast iron or Ductile ductile~~ iron **pipe** will be tested in accordance with AWWA C-600, Section 4.1.

610.16 DISINFECTING WATER LINES:

After pressure testing and before placing in service, all water lines shall be disinfected. Disinfection shall be accomplished in accordance with Section [611](#). All valves in the lines being disinfected shall be opened and closed several times during the 24 hour period of disinfection.

610.17 PAVEMENT AND SURFACING REPLACEMENT:

Pavement and surfacing replacement shall be in accordance with the requirements of Section [336](#).

610.18 CLEANUP:

When testing, chlorination, compaction, and cleanup do not follow pipe laying in an orderly manner, the Engineer reserves the right to close down trenching and pipe laying until these operations are adequately advanced.

610.19 MEASUREMENT AND PAYMENT:

(A) Pipe:

- (1) Measurement of all pipe shall be of the linear feet of pipe installed, measured along the centerline of the pipe, through all valves and fittings, from the centerline of the fittings or centerline of valves on ends of pipe to the centerline of fittings, centerline of valves on ends of pipe or to the end of pipe, as the case may be, for all through runs of pipe. Measurement shall be to the nearest 0.1 foot.

Measurement of branch line pipe shall start at the centerline of valve at connection to the main. Branches of tees that are valued and capped will not be measured.

Measurement of meter service pipe shall be from the centerline of the new main to the connection at the meter, along the centerline of service pipe.

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(2) Payment will be made at the unit price bid per linear foot of each type and size of pipe called for in the proposal. Such payment shall be compensation in full for furnishing and installing the pipe and fittings, specials, adapters, etc., complete in place, as called for on the plans and/or on the standard details, and shall include all costs of excavation, removal of obstructions, shoring and bracing, bedding, backfilling, compaction, maintenance of traffic, testing, disinfecting, connections to existing lines or works, and all work not specifically covered in other pay items.

A contingent item ~~forecast iron~~ for fittings not shown on the plans shall be included in the proposal. Payment will be made at the unit price bid per pound on the theoretical weight of the fittings installed, which shall be compensation in full for furnishing and installing the fittings.

(1) Service Connection To Existing Water Meters: Measurement shall be of the number of unit connections made for water meter services, as called for in the proposal. Each proposal item unit shall consist of the connection to the water main and to the meter, as required in standard details.

(2) Payment will be made at the unit price bid for each unit water meter service connection and shall be compensation in full for labor materials (other than pipe) equipment, tapping, and all necessary incidentals. Payment for new service pipe required to make the connection will be made separately, as stipulated above.

(B) Relocation of Existing Meters and Boxes: Measurement shall be of the number of meters and boxes moved and reinstalled. Payment will be made at the unit price bid in the proposal for each meter and box relocated and installed.

(C) Permanent Pipe Supports and Encasement of Existing Pipes: Measurement shall be of each unit included in the proposal, and payment shall be compensation in full for supporting or encasing existing pipe, as required on the plans, including excavation, form work, reinforcing, concrete, handling and controlling flows in the existing pipe, removing and replacing existing pipe where necessary, supporting, backfilling and compaction, and pavement and/or surfacing replacement required in excess of pay width(s) allowed in Section [336](#).

(D) Concrete Thrust Blocks: Concrete thrust blocks and anchors for all pipe 16 inches and larger shall be measured by the cubic yard(s) of concrete placed, as required on the plans and/or as directed by the Engineer. Payment will be made at the unit price bid per cubic yard, and shall be compensation in full for excavation, formwork, placing and finishing concrete, reinforcing, backfilling and compaction, and pavement and/or surfacing replacement required in excess of pay width(s) allowed in Section [336](#). All thrust blocks and anchors for 12 inches and smaller pipe shall be included in the linear foot cost of the pipe.

(E) Valves: Measurement of and payment for valves, tapping sleeves and valves, and valve boxes shall be for each item furnished and installed, as designated in Section [630](#).

(F) Fire Hydrants: Measurement shall be the number of fire hydrants installed. Payment will be at the unit price bid for the installation of each fire hydrant complete in place and in operating condition. The 6 inches cast iron pipe and fittings, required for making the connection from the main to the hydrant, shall be a separate pay item in the proposal as described above.

(H) Pavement and/or Surfacing Replacement: Payment for pavement and/or surfacing replacement will be made as stipulated in Section [336](#), except as otherwise established in this specification. The cost of pavement and/or surface replacement required for meter service installations shall be included in the price bid for meter service pipe.

- End of Section

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WATER LINE CONSTRUCTION

610.1 DESCRIPTION:

The construction of all water lines shall conform to applicable standard specifications and details, except as otherwise required on the plans or as modified in the special provisions.

610.2 GENERAL:

All pipes shall be delivered, handled and installed in accordance with the manufacturer's recommendations and/or applicable provisions of AWWA standards for installation of the various types of water mains specified, insofar as such recommendations and provisions are not in variance with the standard specifications and details.

Where water lines are to be constructed in new subdivisions or in conjunction with street repaving projects, the streets shall be pre-graded to within 6 inches of the new street subgrade prior to trenching or cut stakes shall be set for trenching.

610.3 MATERIALS:

All pipes for water lines shall be of the classes shown on the plans or as specified below.

(A) The 4-inch through 16-inch diameter pipe sizes may be PVC C900 or ductile iron, except where a particular material is specified by the agency or the contract documents. All pipes shall be minimum 150 psi design unless otherwise specified.

(B) Pipe 16 inches and larger may be either ductile iron, or concrete pressure pipe-steel cylinder type.

Ductile iron water pipe and fittings – Section [750](#).

Concrete pressure pipe-steel cylinder type – Section [758](#).

C900 PVC – AWWA C900-07.

Service Material containing Brass or Bronze must comply with the current NSF 61-8 Standards at the time the Project begins.

All Brass or Bronze service material must meet the current AWWA C-800 Standards.

Any product used in water line construction containing brass or bronze that comes in contact with potable water shall meet the current NSF Standards and Federal Law.

610.4 CONSTRUCTION METHODS:

All water mains in major streets shall have a minimum cover of 48 inches over the top of the pipe. Water mains in other locations shall have a minimum cover over the top of the pipe as follows:

(A) 36 inches for mains smaller than 12 inches.

(B) 48 inches for mains 12 inches and larger.

Cover for water mains will be measured from existing or proposed finished grade of pavement or from natural ground, whichever is deeper.

No water main shall be deflected, either vertically or horizontally, in excess of that recommended by the manufacturer of the pipe or coupling, without the appropriate use of bends or offsets.

If adjustment of the position of a length of pipe is required after it has been laid, it shall be removed and rejoined as for a new pipe.

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Every precaution shall be taken to prevent foreign material from entering the pipe. When on the project site, the ends of the pipe section shall be plugged, wrapped or tarped at all times when pipe laying is not in progress, which includes storage and staging at the site. The pipe shall be stored on a pallet, blocking or other means to prevent foreign materials from entering the pipe. The pipe line shall be protected by a water-tight plug or other means approved by the Engineer when the pipe is in the trench if pipe laying is not in progress.

Where restrained joints are specified on mains sixteen (16) inches in diameter and smaller, ductile iron pipe shall be used with an approved joint restraint method.

On mains sixteen (16) inches in diameter and larger where plans specify welding joints and where ductile iron pipe is furnished, joints shall be restrained by an approved joint restraint method for the distance specified.

Except as otherwise required in this specification, the special provisions, or by the Engineer, trench excavation, backfilling and compaction shall be in accordance with the requirements of Section [601](#). Backfilling may be accomplished as soon as the pipe line has been installed to the satisfaction of the Engineer, subject to the requirements for testing, as contained below.

Hydrostatic testing shall be in accordance with this specification.

All corporation stops used for testing and chlorination shall be left in the pipe line with the stop closed and all connecting pipe removed.

Curb stops with flushing pipes or fire hydrants shall be installed at the ends of dead-end mains according to standard details.

Thrust blocks shall be installed in accordance with this specification.

Valve boxes and covers shall be according to standard details.

Ductile iron pipe shall be installed in accordance with this specification and pipe and fittings shall be in accordance with Section [750](#).

610.5 SEPARATION:

610.5.1 General: Water lines and sewer lines shall be separated to protect water lines from contamination by sewer lines.

The angle of a water line and sewer line crossing shall be limited to between (45) forty-five degrees and (90) ninety degrees. Intersection angles of less than (45) forty-five degrees shall not be allowed.

Separation distances are measured from the outside diameter of the water or sewer line, or the centerline of a manhole.

When water and sewer lines cannot meet separation requirements, extra protection is required as described in Subsection [610.5.5](#) and shown in Standard Details 404-1, 404-2 and 404-3.

Extra protection requirements for line crossings are measured from the closest outside surfaces of the sewer and water line.

Water line service connections to individual building supply and distribution plumbing shall not be placed below sewer lines, and shall otherwise comply with the separation requirements of the applicable plumbing code as applied by the Agency (Administrative Authority). Methods described for extra protection do not apply to these service lines.

Water and sewer lines shall not be constructed parallel within a common trench.

610.5.2 Water Line Separation from Gravity Sewer Lines: Water lines shall not be placed within two (2) feet horizontal and one (1) foot vertical above and two (2) feet vertical below gravity sewer lines.

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Extra protection is required where a water line is placed within six (6) feet horizontal and two (2) feet vertical above a gravity sewer line.

Extra protection is required where a water line is placed within six (6) feet horizontal and any distance below a gravity sewer line.

610.5.3 Water Line Separation from Pressurized Sewer Lines: Water lines shall not be placed within six (6) feet horizontal and within two (2) feet vertical below or within two (2) feet vertical above a pressurized sewer line.

Extra protection is required where a water line is placed within six (6) feet horizontal and within six (6) feet vertical above a pressurized sewer line.

Extra protection is required where a water line is placed within (6) feet horizontal and any distance below a pressurized sewer line.

610.5.4 Water Line Separation from Manholes: Water lines shall not pass through or come into contact with any part of a sewer manhole and shall be separated six (6) feet horizontal from the center of a sewer manhole.

610.5.5 Extra Protection: New water lines that require extra protection from new sewer lines, shall have extra protection provided by using ductile iron pipe for both lines. Lines of standard pipe length shall be centered at the point of crossing so that no joints exist within six (feet) horizontal and only restrained or mechanical joints exist within ten (10) feet horizontal.

New water lines that require extra protection from sewer lines shall have identification wrap and/or tape installed on the water and sewer lines for the length that requires extra protection for each line.

New water lines that require extra protection from existing sewer lines shall be constructed using the extra protection specified for new water lines, and the existing sewer line:

- (1) shall be reconstructed using a standard length of ductile iron pipe centered at the point of crossing so that no joints exist within six (feet) horizontal and only restrained or mechanical joints exist within ten (10) feet horizontal, or
- (2) shall be encased in 6 inches of concrete for the horizontal distance of the line that requires extra protection but for a distance no less than ten (10) feet horizontal.

Existing water lines that require extra protection from new sewer lines shall provide for extra protection by:

- (1) constructing the new sewer line and reconstructing the existing water line using ductile iron pipe for both lines with standard pipe lengths centered at the point of crossing so that no joints exist within six (feet) horizontal and restrained or mechanical joints exist within ten (10) feet horizontal, or
- (2) encasement of both the existing water line and the new sewer line in six (6) inches of concrete for the horizontal distance of the lines that require extra protection but for a distance no less than ten (10) feet horizontal.
- (3) Extra protection for existing ductile iron water lines can be met by the installation of restrained or mechanical joints on the existing water line within ten (10) feet horizontal of the crossing and either
 - (a) construction of new sewer line using a standard pipe length of ductile iron pipe centered at the point of crossing so that no joints exist within six (6) feet horizontal and restrained or mechanical joints exist within ten (10) feet horizontal, or
 - (b) encasement of the new sewer line in 6 inches of concrete for the horizontal distance of the line that requires extra protection but for a distance no less than ten (10) feet horizontal.

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610.6 POLYETHYLENE CORROSION PROTECTION

610.6.1 General: Where called for in the plans and specifications or directed by the Engineer, pipe, valves and fittings shall be protected from corrosion by encasement in a polyethylene protective wrapping referred to hereafter as polywrap. Although not intended to be a completely air and water tight enclosure the polywrap shall provide a continuous barrier between the pipe and surrounding bedding and backfill.

610.6.2 Materials: The polywrap shall be of virgin polyethylene, not less than 8 *mils* in thickness, formed into tubes or sheets as may be required. Naturally pigmented material may be used where exposure to ultra-violet light will be less than 48 hours. Otherwise the material shall be pigmented with 2 to 2 ½ percent of well dispersed carbon black with stabilizers.

The polywrap shall be secured as specified below with 2-inch wide pressure sensitive tape not less than 10 mils thick. This flexible tape shall consist of a polyethylene or polyvinyl chloride backing with a synthetic elastomeric adhesive film comprised of butyl rubber. Tape shall remain flexible over a wide range of temperatures, with tensile strength and elongation properties in conformance with ASTM D-1000.

The minimum tube size for each pipe diameter shall be per Table [610-1](#).

TABLE 610-1		
POLYWRAP FLAT TUBE WIDTHS		
Nominal Pipe Diameter (Inches)	Cast Iron Or Ductile Iron With Push-On Joints (inches)	Cast Iron or Ductile Iron With Mechanical Joints (inches)
4	14	16
6	17	20
8	21	24
10	25	27
12	29	30
14	33	34
16	37	37
18	41	41
20	45	45
24	53	53

610.6.3 Installation: The polyethylene tubing shall be cut into lengths approximately 2 feet longer than the pipe sections. With the pipe suspended from the center the tube shall be slipped over the spigot end and bunched up between the point of support and the spigot end. After the pipe is installed into the bell of the adjacent pipe the pipe shall be lowered to the trench bottom and the supporting sling removed from the center of the pipe. The pipe shall then be raised at the bell end enough to allow the tube to be slipped along the full length of the barrel with enough left at each end to overlap the adjoining pipe about 1 foot. A shallow bell hole must be made at each joint to facilitate installation of the polywrap.

Pull the bunched-up polywrap from the preceding length of pipe, slip it over the end of the new length of pipe, and secure in place with one circumferential turn of tape plus enough overlap to assure firm adhesion. Then slip the end of the polywrap from the new pipe section over the end of the first wrap until it overlaps the joint at the end of the preceding length of pipe. Tape it in place.

The loose wrapping on the barrel of the pipe shall be pulled snugly around the barrel of the pipe, and excess material folded over the top of the pipe and the folds held in place by means of short strips of adhesive tape, at about 3 foot intervals along the pipe.

Repair any rips, punctures or other damage to the tube with the adhesive tape or pieces of tube material secured with tape.

Bends and reducers in the line shall be covered with polyethylene in the same manner as pipe.

Valves, tees, crosses and outlets shall be wrapped with flat sheets of the same material. The sheets shall be passed

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under valves and brought up around the body to the stem. Edges shall be brought together, folded twice and secured with the adhesive tape.

610.6.4 Payment: Payment for this item shall be per the provisions of Subsections [109.4](#) and [109.5](#) of the specifications unless this item is specifically called for on the plans or in the supplemental specifications or special provisions as a specific component and pay item for a given project.

610.7 VALVES:

Valves shall be installed in accordance with AWWA C-600 or AWWA C-603 modified as follows:

All tapping sleeves, gate valves, butterfly valves, air release and vacuum valves and corporation stops shall be in accordance with Section [630](#).

Just before installation in the trench, valves shall be fully opened and closed to check the action, and a record made of the number of turns required to fully open or close the valve. For valves 16 inches and larger, a member of the water utility shall be present to check the action and record the number of turns. The inside of all valves shall then be thoroughly cleaned and the valve installed.

Valves 12 inches and smaller in size shall be supported by concrete blocks, in accordance with the standard details.

Valves 16 inches and larger in size along with their bypass valves, shall be supported on concrete slabs, and/or concrete piers, as indicated on the plans.

Concrete supports shall be provided under valves in vaults and manholes, and shall be constructed an inch low, then grouted with non-shrink grout. Adjustable pipe supports shall be as indicated on the plans. Buried valves shall be supported on concrete blocks as detailed on the plans.

Valve boxes shall be installed over all buried valves in accordance with standard details.

Standard couplings or matching joints shall be used when more than one length of pipe is required, or when two or more pieces are joined, to form the valve box riser. Install extension stems on all valves where the operating nut is 5 feet or more below grade.

610.8 MANHOLES AND VAULTS:

Construction shall consist of furnishing all materials and constructing manholes or vaults complete in place, as detailed, including foundation walls, cast iron steps, frames, covers, and any incidentals thereto, at location shown on the plans.

Manholes shall be constructed to conform with the requirements of Section [625](#) and standard details, except the inside diameter shall be 60 inches.

Vaults shall be constructed of reinforced concrete conforming to Section [725](#) and of concrete pipe conforming to ASTM C76 Wall A or B. Vaults shall be kept moist for 7 days before backfilling.

610.9 FIRE HYDRANTS:

The Contractor shall furnish all labor, materials, and equipment necessary to install fire hydrants complete in place at locations shown on the plans in accordance with the standard details and special provisions. Fire hydrants furnished by the Contractor shall conform to the requirements of Section [756](#).

If paint is chipped, scuffed, or otherwise damaged during handling and installation, the Contractor shall touch up such spots as may be designated by the Engineer.

All hydrants must be flushed and left in good working condition with the control valve open.

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610.10 CONNECTION TO EXISTING MAINS:

Existing pipe to which connections are to be made shall be exposed by the Contractor as directed by the Engineer, to permit field changes in line, grade or fittings, if necessary.

All connections to existing mains shall be constructed according to the plans.

Valves connecting new work to the existing system shall be kept closed at all times.

Only Agency personnel shall operate existing valves. The Contractor shall not operate valves in the existing system.

After disinfected samples have been taken and the new work passes the bacteriological tests, the new line shall then be turned over to the Contracting Agency with all branch lines and tie-in valves closed.

When shutdown of an existing water main is necessary in order to connect to the new lines, the Contractor shall make application and pay the required charges to the Contracting Agency. A conference between the Contractor's representative, Engineering Inspection, and Water Distribution personnel shall establish the time and procedures to insure that the shutdown will be for the shortest possible time. If necessary to minimize inconvenience to customers, shutdowns may be scheduled during other than normal working hours. The water supply to some customers, such as hospitals, cannot be shut off at any time. Provisions to furnish a continuous supply of water to such establishments will be required. After the procedures and time for a shutdown are agreed upon, it shall be the Contractor's responsibility to notify all customers in advance that the water will be turned off. When possible, customers shall be notified 24 hours in advance and in no case, except in emergency, shall notification be less than 30 minutes. Notification shall be in writing, giving the reason for the shutdown and the time and duration the water service will be shut off.

The Contracting Agency will close existing valves, but will not guarantee a bone-dry shutdown.

610.11 METER SERVICE CONNECTIONS:

All new meters must be installed by the Contracting Agency after the proper application as required by Code with fees paid at prevailing rates.

When plans call for connections from a new water main to an existing water meter, the work shall include new copper pipe and fittings except as follows:

- (A) Wrapped galvanized pipe shall be used to connect or extend existing galvanized service pipe. Type K soft copper pipe or tubing shall be used to connect or extend existing copper service pipe except when otherwise called for in the plans.
- (B) When the existing main is not abandoned, and the existing meter is to be connected to the new line, the corporation stop at the old main shall be closed and the abandoned service line cut 6 inches from the old main.
- (C) Taps and service connections to the new main shall be made prior to testing and disinfection of the new line.
- (D) Meter service piping may be installed by drilling in place of open cut construction when approved by the Engineer.

When called for on the plans, the meter and box shall be relocated by the Contractor as directed by the Engineer. Existing meters which are shown on the plans to be relocated shall be located and installed in accordance with standard details.

Water meter boxes which are broken during construction shall be replaced by the Contractor at no additional cost to the Contracting Agency. Existing meter boxes which are already broken prior to start of construction shall be replaced by the Contractor with boxes furnished by the Contracting Agency. Boxes may be picked up by the

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Contractor after written authorization is received from the Engineer. The written authorization shall include the street address of each broken meter box and the size of meter box required. All water meter boxes shall conform to the standard details.

610.12 FIRE LINE SERVICE CONNECTIONS:

Fire line service connections shall be installed in accordance with standard details.

The fire line from the control valves at the main to the detector check valve shall be constructed of ductile iron pipe to Section [750](#).

610.13 COUPLINGS, JOINTS, GASKETS AND FLANGES:

(A) Couplings: The couplings used to join the pipe to flanged valve adapters shall have a minimum working pressure of 150 psi, and shall have a fusion-bonded epoxy finish. The coupling sleeves shall be carbon steel with a minimum yield of 30,000 psi. The flanges shall have a minimum yield of 30,000 psi and be ductile iron or carbon steel for sizes up to 12", or high-strength, low-alloy steel for sizes 14" and larger.

(B) Joints: The joints and fitting shall conform to Sections [750](#) and [752](#).

(C) Bolts and Nuts:

- (1) Bolts, studs, and nuts used in underground field flanged connections or for connecting fittings shall be carbon steel compliant with ASTM A307, Grade A unless Grade B is specified. Bolts, studs, and nuts shall be in accordance with AWWA C111. Bolts and studs shall have Class 2A thread tolerance with the corresponding nuts having Class 2B tolerance. Bolts, studs and nuts shall have a hot-dipped zinc coating in accordance with ASTM F2329. All bolt diameters shall normally be 1/8 inch smaller than the bolt hole diameter. If specified, allowable exceptions to zinc coating shall be bolts, studs, and nuts made from 316 stainless steel per ASTM F593 or cadmium plated per ASTM B766. All bolts shall be hexagonal heads.
- (2) The minimum requirement for underground mechanical joint connections using T-head bolts shall meet the requirements of AWWA C111 using a high strength low alloy steel manufactured for atmospheric corrosion resistance per ASTM A242.

These bolted joints shall be protected as follows: Following installation and before backfilling, all couplings, steel flanges, bolts, nuts, anchor bolts and rods, bolting of all flanged valves, and all exposed steel shall be protected from corrosion by either of the two methods outlined below at the Contractor's option.

(A) Below ground installations shall be coated with NO-OX-ID "A" with a film of not less than 1/32 inch thick and then coated with cement mortar not less than 1 inch thickness before backfilling. Cement mortar shall be composed of 1 part cement, ASTM C150, Type II, low alkali, to 3 parts sand. Before application of the cement mortar coating the area to be protected shall be covered with a layer of 2 x 2 inch No. 14 gage welded wire fabric, firmly wired in place.

(B) Below ground installations shall be protected by the application of hot coal-tar enamel. The coal-tar enamel shall be in accordance with AWWA C-203 and shall be applied to the top part of the pipe or fittings by daubers for at least 2 coats for a total minimum thickness of 1/16 inch. The coal-tar for under side of the pipe flanges or fittings shall be applied by the pan or cocoon method as described below and in AWWA Manual M-11, Steel Pipe.

Pan Method: The coating pan is securely anchored in place on the underside of the pipe and straddling the connection to be coated. The pan shall be wide enough so that the entire connection will be coated.

Hot coal-tar enamel is poured into the pan, from one side only, until the pan is completely filled. The drain plug or valve is then opened and the excess coal-tar drained out. The pan can then be removed. Details of the coating pan and corresponding dimensions are given in AWWA Manual M-11.

The upper portion of the connection, and all remaining exposed steel pipe, will then be coated by the use of a

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dauber. The coal-tar coating shall be applied in at least 2 coats for a minimum thickness of 1/16 inch. The daubers and method of application shall conform to AWWA C-203. No thinning will be allowed.

(C) Cocoon Method: The cocoon is formed by placing glass fiber cloth or roofing paper, of the proper width, around the underside of the connection and adjacent exposed steel pipe. The edges of the cocoon shall be securely fastened to the pipe. Backfill is lightly placed to the spring line, and the top of the cocoon is opened and layed back on the filled area and hot coal-tar enamel poured, from one side only, until the cocoon is completely filled. The loose backfill prevents rupture of the cocoon. The upper portion of the connection and remaining exposed steel pipe shall be coated as above.

(D) Gaskets: Except as otherwise provided, all gaskets for pipe lines shall be one piece full faced gaskets from one-ply cloth inserted SBR rubber material. Gaskets for flanges 20 inches and smaller shall be from 1/16 inch thick material. Gaskets for flanges 24 inches and larger shall be from 1/8 inch thick material. Gasket material shall be J-M 109 as manufactured by Johns-Manville Corporation or an approved equal. Physical characteristics of the rubber compound shall meet ASTM D2000, Class 4AA805A13.

(E) Flanges: Cast iron flanges shall conform to AWWA C-110 as to material, diameter, thickness, drilling, etc. Steel flanges shall be ring or hub type, and shall conform to AWWA C-207, Class D. All flanges shall be drilled and have flange diameters and bolt circles conforming to AWWA C-110, except bolt holes will be 1/8 inch larger than the bolts given for the various sizes. All bolts shall be as specified above and all flanges shall have a flat facing.

610.14 BLOCKING:

All pipe lines, valves and fittings 16 inches and smaller in diameter shall be blocked with concrete thrust blocks in accordance with standard details. Thrust block areas for pipe, valves and fittings larger than 16 inches in diameter shall be calculated for each size pipe, valve and fitting to be installed and shown on the plans.

Thrust block areas shall be calculated on the basis of 200 psi test pressure bearing against undisturbed 3,000 psf soil.

If soil or pressure conditions other than those stated above are encountered, the thrust block areas shall be calculated and submitted for approval. The areas stipulated in the standard details are minimums and shall not be decreased.

When restrained/welded joints are specified to resist thrust forces, blocking is not required.

With the Engineers approval, restrained/welded joints may be used in lieu of thrust blocks to resist thrust forces.

610.15 HYDROSTATIC TESTING:

Water lines, including all fittings and connections to the water mains shall be tested for watertightness by subjecting each section to hydrostatic testing in accordance with applicable provisions of AWWA C-600, except as modified below, and shall consist of pressure testing and allowance testing.

The test section shall be slowly filled with potable water and all air shall be vented from the line. The rate of filling shall be as determined by the Superintendent of Water Distribution, with at least 24 hour notice required before tests are scheduled.

The Contractor shall provide all vents, piping, plugs, bulkheads, valves, bracing, blocking, pumps, and measuring devices and all other equipment necessary for making the tests, including pressure gages, and shall pay the Contracting Agency for water used in the tests.

Hydrostatic Testing: Pressure testing may be made before or after backfilling, but backfilling must be completed before allowance testing. If the pipe is center-loaded, a visual inspection for leaks may be made along the pipe line while the test section is under test pressure, and all visible leaks repaired. However, if mechanical compaction is to be used in the backfilling operations as spelled out in AWWA C-600, the tests shall not be made until the backfilling is completed and compacted. Backfill and compaction for the full distance encompassed by restrained/welded joints shall be completed prior to testing. All connections, blowoffs, hydrants and valves shall be tested with the main as

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far as is practicable. Hydrostatic testing shall not begin until the pipe has been filled with water for at least 24 hours to allow for air venting.

(A) Pressure Testing: Unless otherwise noted in the contract documents, the minimum prescribed test pressure shall be at least 200 psi for lines smaller than 16 inches and 150 psi for lines 16 inches or larger, not to exceed 5 psi over the minimum prescribed test pressure, as measured at the lowest end of the section under test. The duration of each pressure test shall be at least 2 hours, during which time the test section shall not drop below the minimum prescribed test pressure. If the pressure in the pipe test section has not stabilized by the end of the testing period, a hydrostatic retest will be required.

Each section of a new line between sectionalizing valves or between the last sectionalizing valve and the end of the project shall be tested separately as required in AWWA C-600, and/or as modified in these specifications, except that any such section less than 500 feet in length may be tested with the adjacent section, if both sections of line have the same pipe class rating. No section greater than 1/2 mile in total pipe length shall be tested without special written permission of the Engineer.

(B) Testing Allowance/Makeup Water: Makeup water volume shall be determined after the pressure test has been satisfactorily completed and all backfilling and compaction has been completed to top of trench. Testing allowance shall be defined as the maximum quantity of makeup water necessary to be supplied into the pipe line section under test to restore the ending test pressure to the beginning test pressure, after the pipe line has been filled with water and all air expelled. The Contractor shall furnish the necessary apparatus and assistance to conduct the test.

The duration of each makeup water test shall be at least 2 hours. To pass the allowance testing, the quantity of makeup water from the pipe line shall not exceed the makeup water quantity allowed by the following formula, from AWWA C-600:

$$M = \frac{SD \sqrt{P}}{148,000}$$

in which

- M = testing Allowance (makeup water), in gallons per hour.
- S = length of pipe tested, in feet
- D = nominal diameter of pipe, in inches.
- P = test pressure of the pipe being tested, per 610.15 (A)

Should the test on any section of the pipe line require more makeup water than allowed by the above formula, the Contractor shall locate and repair the defective pipe, fittings, or joint until the makeup water volume is within the specified allowance. All repairs and retests, if required, shall be made at the Contractor's expense.

Connections to the existing pipelines or existing valves shall not be made until after that section of new construction has satisfactorily passed the hydrostatic tests.

Ductile pipe used in conjunction with ACP will be tested to the ACP standards, unless otherwise directed by the Engineer. High pressure systems of all ductile iron will be tested in accordance with AWWA C-600, Section 4.1.

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610.16 DISINFECTING WATER LINES:

After pressure testing and before placing in service, all water lines shall be disinfected. Disinfection shall be accomplished in accordance with Section [611](#). All valves in the lines being disinfected shall be opened and closed several times during the 24 hour period of disinfection.

610.17 PAVEMENT AND SURFACING REPLACEMENT:

Pavement and surfacing replacement shall be in accordance with the requirements of Section [336](#).

610.18 CLEANUP:

When testing, chlorination, compaction, and cleanup do not follow pipe laying in an orderly manner, the Engineer reserves the right to close down trenching and pipe laying until these operations are adequately advanced.

610.19 MEASUREMENT AND PAYMENT:

(A) Pipe:

(1) Measurement of all pipe shall be of the linear feet of pipe installed, measured along the centerline of the pipe, through all valves and fittings, from the centerline of the fittings or centerline of valves on ends of pipe to the centerline of fittings, centerline of valves on ends of pipe or to the end of pipe, as the case may be, for all through runs of pipe. Measurement shall be to the nearest 0.1 foot.

Measurement of branch line pipe shall start at the centerline of valve at connection to the main. Branches of tees that are valued and capped will not be measured. Measurement of meter service pipe shall be from the centerline of the new main to the connection at the meter, along the centerline of service pipe.

(2) Payment will be made at the unit price bid per linear foot of each type and size of pipe called for in the proposal. Such payment shall be compensation in full for furnishing and installing the pipe and fittings, specials, adapters, etc., complete in place, as called for on the plans and/or on the standard details, and shall include all costs of excavation, removal of obstructions, shoring and bracing, bedding, backfilling, compaction, maintenance of traffic, testing, disinfecting, connections to existing lines or works, and all work not specifically covered in other pay items.

A contingent item for fittings not shown on the plans shall be included in the proposal. Payment will be made at the unit price bid per pound on the theoretical weight of the fittings installed, which shall be compensation in full for furnishing and installing the fittings.

(1) Service Connection To Existing Water Meters: Measurement shall be of the number of unit connections made for water meter services, as called for in the proposal. Each proposal item unit shall consist of the connection to the water main and to the meter, as required in standard details.

(2) Payment will be made at the unit price bid for each unit water meter service connection and shall be compensation in full for labor materials (other than pipe) equipment, tapping, and all necessary incidentals. Payment for new service pipe required to make the connection will be made separately, as stipulated above.

(B) Relocation of Existing Meters and Boxes: Measurement shall be of the number of meters and boxes moved and reinstalled. Payment will be made at the unit price bid in the proposal for each meter and box relocated and installed.

(C) Permanent Pipe Supports and Encasement of Existing Pipes: Measurement shall be of each unit included in the proposal, and payment shall be compensation in full for supporting or encasing existing pipe, as required on the plans, including excavation, form work, reinforcing, concrete, handling and controlling flows in the existing pipe, removing and replacing existing pipe where necessary, supporting, backfilling and compaction, and pavement and/or surfacing replacement required in excess of pay width(s) allowed in Section [336](#).

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(D) Concrete Thrust Blocks: Concrete thrust blocks and anchors for all pipe 16 inches and larger shall be measured by the cubic yard(s) of concrete placed, as required on the plans and/or as directed by the Engineer. Payment will be made at the unit price bid per cubic yard, and shall be compensation in full for excavation, formwork, placing and finishing concrete, reinforcing, backfilling and compaction, and pavement and/or surfacing replacement required in excess of pay width(s) allowed in Section [336](#). All thrust blocks and anchors for 12 inches and smaller pipe shall be included in the linear foot cost of the pipe.

(E) Valves: Measurement of and payment for valves, tapping sleeves and valves, and valve boxes shall be for each item furnished and installed, as designated in Section [630](#).

(F) Fire Hydrants: Measurement shall be the number of fire hydrants installed. Payment will be at the unit price bid for the installation of each fire hydrant complete in place and in operating condition. The 6 inches cast iron pipe and fittings, required for making the connection from the main to the hydrant, shall be a separate pay item in the proposal as described above.

(H) Pavement and/or Surfacing Replacement: Payment for pavement and/or surfacing replacement will be made as stipulated in Section [336](#), except as otherwise established in this specification. The cost of pavement and/or surface replacement required for meter service installations shall be included in the price bid for meter service pipe.

- *End of Section* -

