SECTION II: Work Associated with Water Main Construction

A. GENERAL

1. MAIN EXTENSION AGREEMENT:

After final plans depicting the approved water main configuration and right of way and or easements have been received, the District and the developer/contractor shall enter into a main extension agreement. At this time, the developer will deposit the following estimated fees:

a) Public Fire Protection Fee:
A fee applies in the amount of $4.00/ft for all towns except Raymond and Scarborough, $8.00/ft for these two towns. This fee applies when a main can be extended in the future beyond the end of a main extension in a local or state road. The amount is based on the average, per-foot cost of installing a public hydrant in each municipality. The footage is the distance from the last hydrant installed to the end of the main. This allows the prorated share of the cost of a future hydrant to be escrowed and applied to the installation cost when installed.

b) Planning & Engineering Fee:
This fee of $600/day represents non-inspection time spent by PWD's Asset Management and Planning Department to develop inspection plans, update record information, and complete As-Built record drawings. This estimate is based on the size and complexity of the project.

c) Inspection Fee:
$320/day (estimated at the beginning of the project and reconciled at the end of the project based on actual time that PWD spent inspecting the project)

d) Service Application Fee:
$58/service line

e) Meter Installation Fee:
$230.31 (typical residential meter) and up. Costs for larger size meters available on PWD website – www.pwd.org)

f) Main Extension Application Fee:
$192/project

g) Valve Box Adjustment Deposit:
$25/valve box (collected on main extensions). Deposit is refunded to Applicant when valve boxes are raised to final grade by Applicant's Contractor upon application of final paving surface. Should final paving not be completed after expiration of the one-year main warranty period, responsibility for raising valve boxes and deposit transfer to the Portland Water District.

h) M.D.O.T. Street Opening Permit Fees (if applicable).
State opening permit must be obtained by P.W.D.

After the project is completed, the District will reconcile all costs associated with the project and will either provide a refund if total costs are less than the deposited amount or request payment for costs in excess of the deposited amount.

2. LEGAL LOCATION PERMITS:

The Developer or agent shall submit a legal location permit (state or municipal) to the District. The District will sign the permit and submit to the State or Municipality.

3. INSPECTION:

An inspector from the District or a consultant working for the District will be assigned to each project to ensure that all work is completed and materials are installed in compliance with these specifications. All work must be inspected prior to backfilling. During the course of the work the inspector will report to the Engineering Supervisor on the progress of the work. Any deviation from the approved plans or specifications must be approved by the District before incorporation into the work.

The Contractor shall schedule with the District for inspection services a minimum of 5 working days prior to construction.

B. DESIGN CRITERIA

1. PIPE SIZE/TYPE:

All distribution mains 4" and larger shall be ductile iron per material specifications except under special site conditions where the District will specify a different pipe type. Beginning in 2007, all ductile iron pipe and services shall be wrapped in polyethylene encasement per AWWA Standards, PWD material specifications, and DIPRA's Polyethylene Encasement Installation recommendations. All distribution mains smaller than 4" shall be PVC per PWD material specifications.

All requests for a modification of the standard pipe material shall be made during the plan review phase of a project, not during the pre-construction phase, and shall be approved by the Business Development Engineer. The District will review leak history, available soil mapping, wetland delineations, plans showing cathodically protected utility crossings, and may require soil sampling prior to approving the change. Should it be shown that highly corrosive soils exist, PWD will specify the type of pipe to be used.

All main distribution pipe lines shall be of a size to adequately serve the needs of the proposed development and any potential extensions thereof, but in any event shall not be less than eight (8) inches in diameter except as may otherwise be permitted herein:

The minimum size of the pipe where public fire protection is to be provided or required shall be eight (8) inches in diameter. Dead-ends shall be minimized by looping all mains where practical. Where dead-ends are necessary they shall be terminated with a fire hydrant, or blow-off assembly. The nominal pipe diameter of water mains without public fire protection shall not be less than four (4) inches.

The District may request that the size of the main be increased beyond the required size for the project. This is sometimes necessary to facilitate the future expansion of the system beyond the scope of the developer's project. In this case the District will pay to the developer the difference in cost of the material between the two sizes.

2. DEPTH OF COVER:

Water pipe shall be laid with a cover of five and one-half (5 ½') feet measured from established finished grade to the top of the pipe in all towns except Standish, Windham and Raymond. In those towns water pipe shall be laid with a cover of six (6') feet measured from finished grade to the top of pipe. The contractor shall establish adequate elevation control to ensure that upon final grading appropriate cover over water lines has been maintained. It shall be the Contractor's responsibility and expense to verify the cover at any location questioned by the District. Any potential changes in alignment or grade of roadways shall be considered in the original utility design. Any deviation from the required cover shall be approved by the Engineering Supervisor.

3. GATE VALVE LOCATIONS:

Gate valves shall be installed at all pipe junctions and street intersections in such a manner as to control and cut off flows in all segments of the system. A minimum of two (2) valves are required at tees. A valve may be required beyond the last service if the main can be extended in the future. In all other areas gate valves will be required every 1000 feet, except as otherwise may be approved by the District. All new mains and services connecting to a main over 50 years old will require a valve at the main and an additional gate valve located at the property line. Additional gate valves may be required under certain situations, such as looped systems, where it is necessary to isolate certain sections of the system.

4. PRESSURE/FLOW REQUIREMENTS:

All distribution systems shall be capable of providing a minimum working pressure of 40 p.s.i. at each service connection under maximum day demand conditions, plus the required fire flow as determined by the Insurance Services Office (ISO) or the local fire department. The consultant will provide the estimated peak demand for the project and the District will determine whether the project meets the pressure/flow requirements.

In the event that the 40 p.s.i. minimum pressure cannot be met, the developer/owner can request limited service for each service connection in question. The District will determine whether adequate conditions exist to grant limited service.

C. WATER LINE CONSTRUCTION

1. DUTIES OF THE CONTRACTOR:

Install the water mains so as to supply the District, upon completion, with a satisfactory, watertight pipeline, laid to proper line and grade, and in accordance with these specifications and approved plans to the satisfaction of the District, and will leave the site in condition which is suitable, not only to the District, but to those abutting the right-of-way, right-of-way grantors, and any municipal or state authorities having jurisdiction over the areas involved.

Obtain all street opening permits from cities or towns covering any pipelines to be laid in the public way and shall be responsible for fees levied by any regulatory agencies which are applicable to the work covered by this specification.

Establish line and grade for the pipeline and right-of-way boundaries where the pipeline is to be laid in right-of-way outside of a public way.

Familiarize himself with all obstructions which he can foresee, such as existing pipes, services, conduits, ducts, sewers or any other such obstructions which might interfere with the construction, and he agrees to make arrangements with the owners of such facilities so as to save the District harmless from any damages thereto caused by his operations and to make whatever arrangements might be necessary to move or remove and replace these facilities so as to permit the construction of this pipeline, all at his own expense.

Purchase all pipe, fittings, valves, gaskets and piping accessories, including but not limited to services, air valves and hydrants, in accordance with District specifications.

Make any changes which may be required, such as the removing or restoring of the property of others in the land through which this line will cross in right-of-way or otherwise. The Contractor will place all pipe, fittings, valves and all the attendant facilities in place in the proper trench, to proper line and to proper grade, as called for in the plans and specifications and to the satisfaction of the District's representative.

Make all connections to the District system in accordance with standard District practice and under District inspection. The Contractor must disinfect all tools or equipment coming in contact with the water in a 5% hypochlorite solution.

Provide trench and excavation for the purpose of testing, chlorinating, and connecting the new main into existing pipe and promptly backfill such trench and patch and restore the surface as necessary. Provide and maintain trench barricades, warning signs, warning lights, traffic control, as required by applicable safety regulations and organizations with jurisdiction over traffic control.

Shall perform leakage tests and disinfect the completed main.

Upon completion of the work to the District's satisfaction, transfer to the District, free and clear of liens, damage claims or law suits all right, title and interest to all piping and appurtenances.

The following specifications for the performance of the work are part applicable, but do not necessarily constitute the full and complete specifications for the work. Such reasonable additional requirements as the Engineer may specify must be followed.

No valve, hydrant or other facility of the Portland Water District shall be operated by the Contractor or his agents. The District will, upon reasonable request of the Contractor, furnish men and equipment for such activity.

Provide a minimum of 4 days notice to the District prior to any required shutdown.

2. INSTALLATION OF TEMPORARY WATER SYSTEMS:

In order to maintain uninterrupted water service to District customers, the Contractor shall provide temporary above ground water systems. The temporary water systems consist of mains, services and fire department outlets. The above ground systems shall be installed only for the duration of deep water main replacement and removed promptly after main replacement is complete. Connections to an existing water source shall be installed and provided by the District. All material for the temporary water systems, except as otherwise indicated, shall be supplied by the contractor. Currently the District has approved 2 manufacturers for the temporary mains and 100-psi poly tube for individual services. Only authorized District personnel shall operate control valves attached to these systems.

Temporary Water Systems Approved Pipe

Certainteed Certa-Lok Yellowmine	Restrained Joint PVC pressure pipe and fittings
AquaMine (Victaulic Co)	Restrained Joint PVC pressure pipe and fittings

Temporary above ground water mains shall be installed in a manner to both protect the public water supply and to minimize customer service interruption. To allow the District to notify its affected customers, the Contractor shall provide the District a minimum of 5 working days notice prior to installing any temporary lines.

The size and approximate location of the temporary systems are shown on the drawings. The Contractor must obtain the approval of the District for any changes prior to installation of the system.

Temporary mains shall typically be installed behind sidewalks or along the edge, and within the public right of way. The mains shall follow a uniform straight course and shall not bow to accommodate long sections of pipe. Temporary mains shall not be installed on private property. The route of services lines installed from the mains to houses shall be acceptable to the property owner.

The Contractor shall follow the pipe manufactures installation guidelines when installing temporary systems. Additionally, an approved joint lubrication for the installation of potable water pipe shall be used on all joints prior to connecting pipe.

Source: The District will provide necessary connections at fire hydrants including an approved backflow device and meter. A chlorine tap will also be provided.

Disinfections: All 2" diameter and larger temporary mains shall be chlorinated, sampled, and tested for bacteria prior to activating any portion of the temporary mains. (See disinfection specification for deep mains).

Leakage test: All systems shall be watertight. A static pressure test shall be performed on all systems prior to disinfecting any portion of the system.

<u>Test Procedure</u>

1. Install a pressure gauge at furthest end of the system.
2. Open main feed valve to fully charge the system with water and bleed all air.
3. Record the static pressure reading.
4. Close main feed valve.
5. The system must hold static pressure for a minimum of 30 minutes.

Driveway crossings: A gravel or cold patch raised berm shall be placed over temporary mains to prevent vehicles from dragging along the ridge.

Sidewalk crossings: A gravel or cold patch raised berm shall be placed over temporary mains to eliminate tripping hazards. In areas where the berm would prevent rainwater drainage plywood ramps shall be installed the full width of the sidewalk and over the temporary mains

Roadway crossings: Temporary mains shall be buried just below the surface of the roadway. The pipe shall be protected with clean sand or material free from rocks, as the rocks tend to punch through the pipe when exposed to heavy traffic. The use of cold patch or QPR as fill material is acceptable.

Curbing or esplanade rise: To accommodate curb rise, pre-fabricated certa-lock bends and/or elbows shall be used. Sweeping or bending the actual pipe is not an acceptable method unless the sweep lies flat on the ground and is not obstructing walkways. A traffic barrel shall be placed near the curb at offset connections to protect the offsets from being damaged by vehicles.

Cutting pipe: Follow manufacturer's installation instructions. All joints, including those on cut lengths of pipe, shall be grooved to provide a restrained joint. Pre-fabricated bends, elbows, and tees shall be used when changing direction.

Blow off: A 1" blow off shall be installed at the ends of all temporary mains. The blow off shall be constructed using a 1" brass female curb stop.

Isolation valves: Shall be 2" brass female curb stops for 2" mains and 4" resilient wedge valves for 4" mains (grip rings shall be used for 4" valves). Valves shall be located as shown on the plan. The valves are attached to the mains using pre-fabricated adapters.

Service line connections: All temporary individual service lines shall be ¾" poly tube rated at a minimum working pressure of 100 psi. The service lines shall be connected to a 2"x 3/4" factory tapped restrained joint coupling, then a ¾" close brass nipple, a ¾" female curb stop and a brass poly tube adapter ¾" insert x male. The tube shall be extended to a sill cock (outside faucet) and connected using the same poly tube adapter. Prior to connecting the service, a garden hose connection, including a brass boiler drain or sill cock valve shall be installed in the line. All service lines shall be flushed prior to activating mains. *See Detail sheets (1,2,3)*

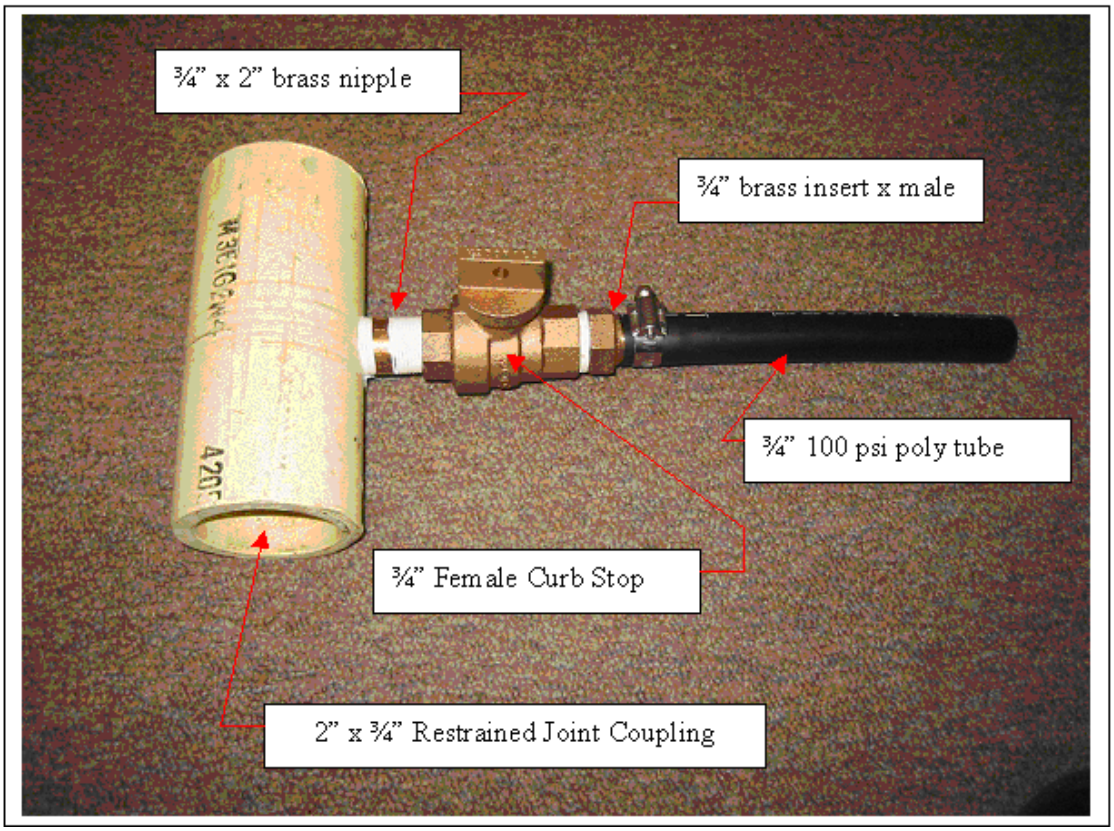
Anti-siphon sill cocks: Only District authorized personnel shall disassemble anti-siphon sill cocks. Excavating and connecting into existing deep service lines may be required where properties have malfunctioning sill cocks or no exterior plumbing.

Shutting off meters: After activating the temporary lines, all meters shall be shut off. Only District authorized personnel may de-activate meters.

Maintenance of temporary water systems: The contractor shall be responsible for maintaining the temporary systems during the regular workday including making repairs to the systems. The District's Inspector must be on site prior to any work, or repairs being performed on the temporary water systems. District crews will respond to all after hour's emergencies. All affected customers shall be notified as soon as possible prior to any service interruption.
It is expected that contractors will keep an inventory of readily available repair parts on hand enabling them to quickly respond to any type of problem. Restrained joints shall be maintained. The use of non-restrained joint couplings is prohibited. Joint leaks shall be cut out. The use of stainless steel wrap around repair clamps over pinholes is acceptable.

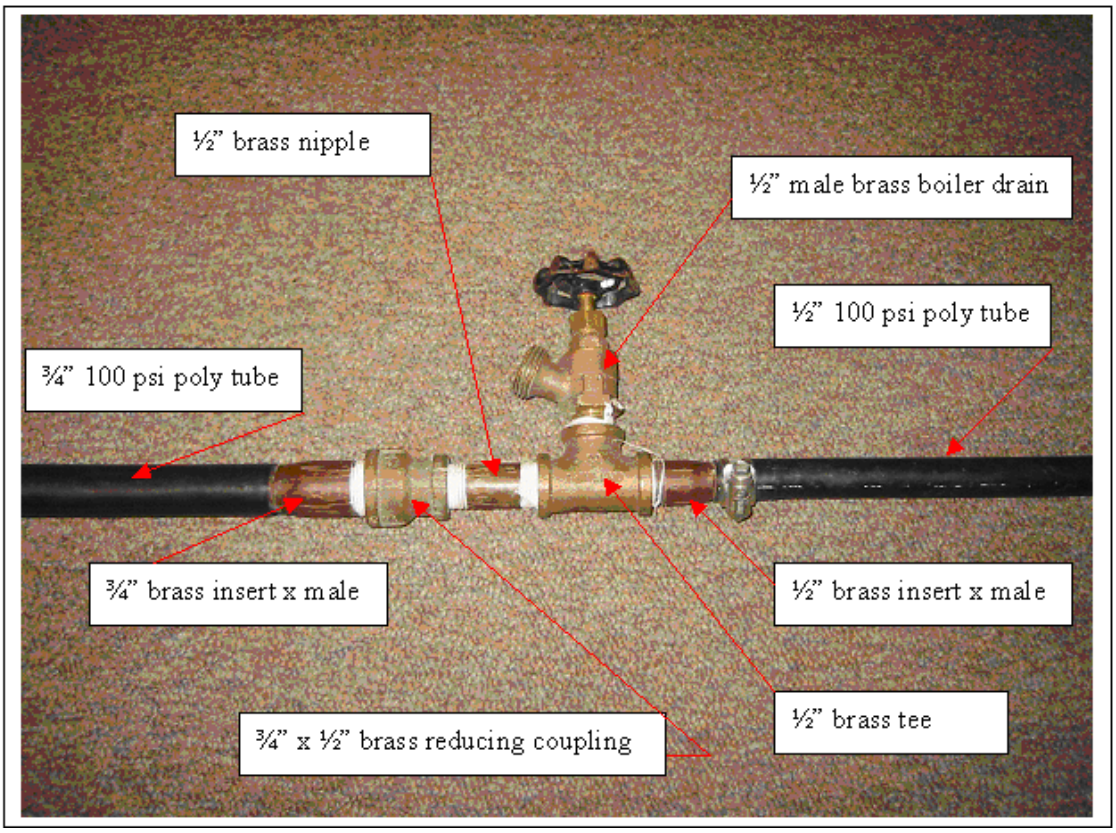
2" x ¾" Factory Tapped Restrained Joint Coupling and associated fittings.

(Section 1)



Temporary service line boiler drain assembly used for customer garden hose connection.

(Section 2)



Temporary water Service – Final Connection to customer sill cock

The final house connection shall be a non-swivel, rigid connection as shown.

(Section 3)

revised 7-10-03

3. EXCAVATION:

The Contractor will make application for all necessary street or highway opening permits necessary for the pursuit of the work. No street or highway opening shall be made by the Contractor until the appropriate permit has been received and is in hand, and when such opening shall be made, it shall be done in strict accordance with the terms of the permit.

When any pavement, regardless of type, must be cut, it shall be done in a neat and symmetrical manner by use of a saw, chisel, or other suitable method. In no case shall pavement be torn up with a backhoe bucket except between and inside of cuts previously made as above. Should any further pavement be broken, outside of the cuts, as by blasting, such damaged pavement shall be cut out in a neat and orderly fashion.

The trench shall be dug so that the pipe can be laid to the alignment and depth required and shall be excavated in advance only to the extent necessary for the proper pursuit of the work; the amount excavated ahead may be controlled by the District representative. The trench shall be kept dewatered, such that no drainage water shall enter the pipe, and the end of the pipe shall be temporarily plugged off at night or over weekends, or whenever the work is suspended, or in cases where unstable material could cause a cave-in to enter into the exposed end of the pipe. The trench width shall be the minimum necessary to properly lay and joint the pipe, permitting whatever bracing or sheathing may be necessary in unstable material. The bottom of the trench shall be smooth and even and should be as nearly undisturbed as possible so that the barrel of the pipe may be laid in a flat bottom trench on good solid material. Shallow holes should be dug at the joints so that the barrel of the pipe shall be in contact as much as possible with the solid floor of the trench. In ledge installation or in boulders or other large stones, there shall be at least 6” clearance between the barrel of the pipe and any ledge. These clearances are the minimum to be permitted between any part of the pipe or appurtenance being laid and any part or projection or point of a rock, boulder or stone. The bottom of the trench may for a short distance, near the center of the pipe length, be left slightly low to permit the withdrawal of the slings with which the pipe is placed in the trench. This material shall be replaced and compacted mechanically when the pipe is in place. Likewise, if for any reason the bottom of the trench should be excavated below the desired grade, suitable material may be replaced to bring the bottom of the trench up to the proper grade before pipe is put in place. This material is to be mechanically compacted so as to give it a smooth, solid base for the pipe, subject to the approval of the District representative. When the bottom of the trench at subgrade is found to be unstable or to include cinders or other types of refuse, or vegetable or other organic material, or large pieces or fragments of inorganic material or stone or rock, any such undesirable material shall be removed and replaced with suitable material before the pipe is placed. Such material as is used to replace unsuitable material in a trench bottom shall be compacted in layers of no more than 8” by mechanical means before the pipe is placed on it. In the case of unstable material, the District inspector may, at his discretion, order crushed stone or gravel to be used to stabilize the pipe bed before pipe is placed in the trench.

All structural excavations and trenches shall be sheeted or braced as required for the safe pursuit of the work, the protection of structures, the protection of other utilities, and as required by any Federal, state or municipal laws, ordinances or regulations.

The Contractor shall be responsible for the design, adequacy and maintenance of all sheeting, sheet piling, bracing or other temporary structures or supports required.

When the sheeting or shoring cannot be removed without endangering the new work, other structures or the security of the banks, it shall be left in place.

4. PIPE LAYING:

<u>4.1 Handling of Materials into Trench</u>
Proper implements, tools and facilities shall be provided and used by the Contractor for the safe and convenient handling of all materials. Pipe fittings and accessories shall be carefully lowered into the trench, piece by piece, by means of derrick, crane, slings and other suitable tools and equipment, in a

manner such as to prevent damage to the material or to its protective coating and linings. No chain or slings shall be passed through the inside bore of any pipe or valve or fitting. Under no circumstances shall piping materials be dropped or dumped into the trench.

4.2 Cleaning of Materials

All lumps, blisters, excess coating material or other foreign matter shall be removed or cleaned from the pipe, with particular attention being given to the spigot end, which enters into the bell of the next adjacent pipe. Also, the inside of the bell shall be cleaned and wiped dry and clean before any joint material is applied to it. All foreign matter shall be removed from the inside of pipe, fittings, valves, and the interior cleaned and kept clean. Particular attention shall be given to the cleaning of surfaces to which gaskets are to be applied, and especially to the inside grooving of the push-on pipe bells.

4.3 Laying Pipe

Every possible precaution shall be taken to prevent foreign material from entering into the pipe as it is being placed in the trench. Likewise, no foreign matter shall be allowed to enter into the joint area between pipes. If there is any question as to foreign material having gotten into the joint, the joint shall be taken apart and checked and made up again in the proper manner. The inside of every pipe, as it is lowered into the trench, shall be checked for any dirt or stone or other debris, or any material whatsoever which may be inside the pipe, and such extraneous material shall be cleared out and the pipe made completely clean before it is jointed into the next pipe in the trench. Precautions shall be taken such that no backfill material shall enter the open end of the pipe already laid in the trench, and every effort shall be made to prevent trench water from entering the pipe. Whenever pipe laying is not in progress, a watertight plug or other effective means shall be used for keeping any extraneous material from entering into the pipe. Any water in the trench shall be kept down by pumps, such that it will be below the invert of the pipe already laid. Sump holes may be dug in the bottom of the trench, off center of the pipe, for the purpose of keeping the pump suction below the gradient of the bottom of the pipe. No pipe shall be laid in water or when, in the opinion of the PWD representative, conditions are not suitable for laying.

4.4 Cutting Pipe

Any pipe which must necessarily be cut on the job in order to put fittings, valves or other accessories in the proper place shall be done in a workmanlike manner satisfactory to the District. In case of “push-on” joint pipe, proper chamfering must be done on the ends of any cut pipe before an attempt is made to enter it into a bell. In the case of mechanical joints, a smooth, square, neat cut must be made. On Ductile iron pipe a saw or abrasive wheel type of equipment shall be used. On cast iron pipe smaller than 12”, wheel cutters or other approved method may be used, but in no case shall any cement lining of iron pipe be harmed in the cutting. No so-called “cold cutters” will be allowed on the job. All cuts shall be square and even, with no ragged, rough ends. Any unevenness shall be ground smooth. Pipe shall be cut no closer than 2’ from the bell.

4.5 Bell Ends to Face Direction of Laying

The pipe shall be laid with the bell ends facing the direction of the laying, unless otherwise permitted by the District.

4.6 Blocking

Permanent blocking necessary to support the pipe in the trench shall be done only with specific authorization and approval of the District. Temporary blocking under valves and fittings for support prior to the building of permanent supports or anchors is allowed.

4.7 Jointing Of Pipe

All joint areas on the pipe shall be cleaned and free from irregularities before an attempt is made to make up any joints. Joints, when made, shall be done in the manner prescribed by the manufacturer of the pipe.

In the case of rubber gasket joints, these joints shall be made up in accordance with the American Standard specifications for the jointing of cast iron pressure pipe and fittings including torque. ASA #A21.11 (AWWA #C111).

Consult the Portland Water District for guidance in the proper selection of pipe gaskets in areas of contaminated soils. The Portland Water District reserves the right to specify the use of specialty gaskets, including nitrile and viton gaskets.

In the case of flanged joints, flange faces shall be thoroughly cleaned before making up such joints, so that no paint globs or any other projections or rust or other foreign matter remain on the faces of the flanges and that they are smooth, clean iron. Bolts and nuts shall be tightened evenly, being tightened in pairs on opposite sides of the pipe, until all are equally torqued. When completely tightened, the bolts should be long enough so that all nuts are "full".

Solid long body sleeves per specifications shall be used when connecting new pipe of all sizes. When joining a new section of pipe to an existing section of unknown O.D., a "duo" sleeve shall be used for sizes up to and including 16". The "duo" sleeve will accommodate the increased O.D. of older cast iron pipe. For connecting to a section of pipe with an unknown O.D. above 16", an approved steel coupling may be used. The existing pipe O.D. shall be measured prior to ordering the coupling.

4.8 Permissible Deflection of Joints

Whenever it may be necessary to deflect pipe from a straight line, either vertically, horizontally, or other direction to change the direction of laying, in all sizes 12" and smaller, the allowable deflection shall be 3 degrees per joint, or 16 inches per 20' length; in larger sizes, 1 1/2 degrees, or 6 inches per 20' length. Every possible precaution shall be taken to be sure that each joint is properly made up and that the pipe is "home".

4.9 Setting Valves & Fittings

All valves, fittings, plugs and/or caps shall be set and jointed into the pipe, and blocked and anchored as shown on the plans. The location of these features along the line shall be in accordance with the general plans for the pipeline. Any unconnected outlets shall be valved and securely plugged with adequate and appropriate pipe plugs or blind flanges, as called for on the plans (See Sec 4.14). 'Mechanical Joint' bends, plugs, sleeves and caps shall be restrained with a PWD approved restrainer.

4.10 Valve Boxes (See Standard Detail and Materials Section)

All valves 12" and smaller shall be fitted with a standard valve box set so as to not come in contact with the valve body and concentric with the operating nut, straight, square and plumb. The top shall be set to the proper surface grade and, after backfilling and settlement have taken place, these valve box top sections shall be straightened, reset or adjusted as necessary. All valves shall be supplied with proper boxes and/or chambers, as called for in the plans and these specifications. At least two permanent location measurements to the valve must be obtained. Backfill around valve boxes shall be mechanically tamped within a five-foot radius of the valve box. Backfill at valve chambers shall be mechanically tamped for a distance of 30 feet along the trench, both upstream and downstream from the ends of the chamber.

4.11 Hydrants

Hydrants shall be installed in accordance with the District's standard details. The hydrant tee and the hydrant base shall be appropriately braced. Trenching for hydrant and branch shall be done in accordance with Section 3 herein. All appurtenant piping and jointing shall be done in accordance with Section 4 herein.

4.12 Services

Services shall be tapped on the side of the main in accordance with the District's standard details. Service piping shall be copper with a minimum size of 1" and conform to the Maine State Plumbing Code for buried cold water service lines. Enough slack shall be placed in the material to prevent stretching or pulling from main. A service shut off (curb stop) with rod shall be placed in a service box 6" from the right of way line in the public way. Any service box located in a paved area except sidewalks shall be installed inside a full sized gate box top section. At least two permanent location measurements to the service shut off must be obtained. Services shall have 5-1/2 feet of cover along the entire length of the service. For new main extensions, the service shall be installed at the center of

the lot to be served. The only exception will be when a foundation is already on the lot. In that case, the service can be installed anywhere along the foundation frontage to the road. For new services installed on existing mains, the service shall be installed a minimum of 10 feet from the property line. Trenching and backfilling shall be done in accordance with Sections 3 and 5 herein.

Standard small service sizes include 1", 1-1/2" and 2" diameters. 1-1/2" and 2" services shall consist of a corporation threaded into an approved tapping saddle. One inch and three quarter inch corporations (where allowed) shall be threaded into the main.

Domestic and fire services to the same building shall consist of completely separate lines beginning at the main. Combined services (fire services greater than 2" that have a domestic service tapped at the street line) shall require approval during the plan review process of a project. If approved, combined services shall have individual shut-off valves for both the fire and domestic service at the street line. Additional gate valves may be necessary under certain situations.

All domestic services 2" and larger and all combined services shall require chlorination/dechlorination. Any service with a joint between the main and the end of service for live taps shall require a restrained joint gasket at each joint; methods for pressure relief on private property are recommended in these instances.

4.13 Protective Wrapping
As required, special plastic sleeves or envelopes shall be slipped over the pipe and sealed together with plastic adhesive tape. Care shall be exercised such that these sleeves shall be intact and sealed together when backfill is placed, and during the backfill operation, likewise, care shall be taken not to puncture the material.

4.14 Pipe Endings
ALL dead-end sections of pipe shall end with a hydrant where possible; otherwise a blow off valve. This shall include all main stubs into subdivisions in addition to the main runs. Fire services 4" and larger that require pressure testing shall also end with a blowoff valve, however a 2" ball valve may be substituted for the 2" gate valve for service stubs.

4.15 Abandoning Pipe & Services
All abandoned water mains shall be terminated with a mechanical joint cap or push-on plug. No brick and mortar will be allowed. Abandon service pipe by shutting corporation and cutting pipe close to the corporation. The associated curb stop, box and rod shall be removed. For water service lines larger than 2", and all hydrants, mains and valves, the connection at the main shall be excavated and removed and a solid piece of pipe sleeved into its place.

5. BACKFILLING:

5.1 Material
All backfill material shall be free from cinders, ashes, refuse, organic matter, boulders, rocks, stones or other material which, in the opinion of the District, is unsuitable for the purpose. However, from one foot above the top of the pipe to the top of the trench, material containing stones up to 8" in their greatest dimension may be used unless otherwise directed by the District. When the type of backfill material is not otherwise specified on the drawings, the material excavated from the trench may be used as backfill upon its approval by the District, provided that unsuitable stone, etc., as above, are sorted out. Where any specific type of backfill material is indicated on the plans, such notation shall be followed and native material will be hauled away and disposed of to make way for the specified material. Pipe in ledge trench is to be backfilled with select material.

5.2 Backfill In Right-Of-Way (Untraveled)
From a point one foot above the pipe to the surface, backfill material may be placed by machine, but shall be worked over in such a manner as to minimize future settlement of this material. The backfill material shall be mounded up to an excess depth of 3" to 6" over the trench to allow for future settlement, and before the Contractor finishes and the job is accepted, this situation shall be reviewed

and any necessary fill added so that there is no depression left due to settlement of the trench at any point. The above is the minimum requirement, and when highway or street requirements are more stringent, such requirements shall be met.

5.3 Backfill within Public Streets, Highways and Traveled Areas

Backfilling in public right-of-way, along the streets or highways in or along shoulder, berm or backslope shall be done in accordance with the specifications and requirements of the state or municipality, whichever is responsible for the street or highway involved. Responsibility for the fulfillment of permit conditions or any other applicable requirements of the street or highway authority shall be the obligation of the Contractor. Surface restoration shall be carried out to the satisfaction of the street or highway authority or as shown on the plans. The trench shall be topped out with gravel a depth meeting municipal or state specifications.

Where the trench crosses or follows highways, streets or other areas such as driveways, parking areas, etc., or wherever there will be vehicular traffic with or without a pavement over the trench the backfill from a point one foot above the pipe shall be placed in 8" layers if compacted by manual plate equipment or 24" lifts with approved roller type equipment. Compaction of granular material shall be by means of a mechanical vibratory compactor. Other material shall be compacted by pneumatic or other mechanical compaction methods. In all cases a gravel or stone base shall be placed to a depth at least equal to the existing road base, but in no case less than one foot of depth.

5.4 Backfill in Ledge Trenches

Backfill around the pipe in ledge trench shall be either sand or fine gravel (6" below and 12" above the pipe), but in cases where corrosive conditions may prevail due to the type of ledge or other material which has been excavated, clay may be specified on the plans or by the Engineer. In cases where granular material is used, a complete clay dam shall be put in the backfill at least every 100' along the trench where the surface gradient is other than horizontal.

5.5 Backfilling – Structures

The excavation for thrust blocks and other structures shall be refilled with such of the excavated materials and in such order as may from time to time be directed by the District. Whenever the excavated materials are unsuitable, the Contractor shall furnish suitable backfill materials. This material shall be a uniformly graded bankrun gravel having no stones larger than 6 inches.

The backfill around structures must be carefully placed in layers not to exceed 8" and tamped and brought up evenly around all sides of the structure. The material shall be thoroughly tamped with mechanical or vibratory compactors and water added, if necessary, to obtain 90 percent laboratory density as determined by the Standard Method of Test for Compaction and Density of Soils AASHO Designation T-99.

Backfilling around pipes outside the structures shall be in accordance with the pipe laying specifications.

5.6 Operation in Freezing Weather

In freezing weather, no backfill material which is frozen shall be placed in the trench, but if backfilling must be done, new unfrozen material must be brought to the site and the frozen material disposed of elsewhere.

Should the excavation take place in sustained periods of freezing weather, the sides and bottom of the trench shall be protected to prevent freezing of the material to the satisfaction of the District.

5.7 Open Trench

Backfilling shall follow pipe laying as closely as reasonable, so that a minimum of trench shall be open at any time. The regulations of the highway authorities shall be observed as regards the amount of trench to be open at any one time. Over night, and especially over weekends and holidays, the amount of open trench shall be kept at an absolute minimum. Any caved-in trench, especially after heavy rain and flooding, shall be cleaned out and the bottom consolidated before any additional pipe shall be laid.

6. FILLING AND TESTING:

6.1 Upon completion of backfilling, the Contractor shall fill the pipeline with water from the Portland Water District's system and conduct a pressure and leakage test in accordance with Section 4 of AWWA Standard C600-82 and the following procedures.

6.2 The Contractor shall not operate any existing District valves for filling, flushing or testing the new main. The District will provide the necessary personnel upon request.

6.3 Under the inspection of the District, the Contractor shall slowly fill the new main and ensure that all air has been expelled from the main, hydrants, air valves and service leads. Once all air is expelled, the Contractor shall flush the new main at a minimum velocity of 2.5 feet per second turning the over the volume of water in the main a minimum of 3 times. The "scour" flow rate shall be calculated by the District and verified in the field. The Contractor shall be responsible for all dechlorination and disposal of all flushing water and providing any necessary hoses or equipment for flushing and prevent unnecessary erosion.

6.4 The Contractor shall excavate and provide a tap for pressure and leak testing and chlorination. The chlorine tap shall be installed within ten feet of the source if practical. Otherwise, install the tap immediately outside of existing pavement. The Contractor is responsible for all work associated with the excavation, including proper trench protection, barricades, traffic control and proper backfilling and compaction upon successful completion of the test. Upon completion of the test all fittings and pipe shall be removed and all corporations shut.

6.5 The Contractor shall conduct the pressure and leak test and provide the required testing equipment after the new main has been properly filled and flushed, unless otherwise arranged with the District. The Portland Water District reserves the right to determine the geographic limits of pressure testing water mains.

The pressure and leak test shall be conducted as follows:

a) Purge all air from the line.

b) Decrease pressure in the main to be tested approximately 20 p.s.i. Observe test gauge to ensure the pressure doesn't rise due an existing valve or tapping valve leaking by. This is done to ensure that no undisinfected water from the installed main enters the existing main while performing the actual test.

a) A pressure test pump will be connected to the new main at the testing point. The pressure will be slowly increased to 150 psi and allowed to stabilize (+/- 2.5 psi) for a minimum of 15 minutes.

b) A reservoir of potable water shall be connected to the test pump and the initial level of water recorded.

c) The pump pressure shall be maintained at 150 psi for one hour with all makeup water withdrawn from the reservoir.

d) After one hour, the water level in the reservoir will be measured and the volume of water drawn from the reservoir calculated and compared with the following allowable leakage:

$$\text{Allowable leakage (gal/hr)} = \frac{\text{Pipe length (feet)} \times \text{Nominal diameter (inches)}}{10{,}900}$$

e) If any test discloses leakage greater than that specified above, the Contractor shall, at his own expense, locate and make repairs as necessary until the leakage is within the specified allowance.

No repair clamps of any kind will be allowed. Repair shall consist of removing leaking section and replacing with couplings and pipe.

7. DISINFECTION:

Products:

Acceptable Disinfectants:

Sodium hypochlorite (NaOCl):

- Shall conform to the provisions of AWWA B300 'Standard for Hypochlorites' and
- Shall be certified to meet NSF/ANSI Standard 60 - *latest revision*, Drinking Water Treatment Chemicals – Health Effects.

Acceptable Dechlorination (neutralizing) Agents:

As defined in AWWA C651 'Standard for Disinfecting Water Mains', Appendix C

7.1 Scope

This specification becomes a standard part of the contract documents and covers the disinfecting and flushing of water mains within the Portland Water District distribution system. Unless specified otherwise, all procedures apply to new mains, cleaned mains, cleaned and relined mains, repaired mains, and mains which have been out of service for a long period of time.

In certain circumstances, the Director of Water Services or designee may waive or alter the requirements in this specification where it is determined that no reasonable threat of contamination constituting a health hazard or aesthetic deterioration exists in the water main in question.

7.2 Keeping the Pipe Clean and Dry

Precautions shall be taken by the Contractor to protect the interiors of pipes, fittings, and valves against contamination:

- Pipe delivered for construction shall be strung and protected so as to prevent entrance of any foreign material.
- Pipe shall not be laid in water, or when trench conditions or weather conditions are unsuitable for such work.
- All openings in the pipeline shall be closed with watertight plugs when pipe laying is stopped at the close of the day's work or for other reasons.
- Joints of all pipe in the trench shall be completed before work is stopped.
- The surface of the joint rings shall be thoroughly cleaned with an approved soap solution and all foreign matter removed from the pipe and fittings before the pipe is lowered in the trench.
- If dirt enters the pipe, it shall be removed and the interior of all affected pipe and fittings shall be swabbed with a 5% Hypochlorite solution or other commercially available household bleach immediately before they are installed.
- Pipes and services in the ground shall be closed off when not under construction.

7.3 Pre-Flushing

The District shall flush the source water, as near the shut off as possible prior to tying-in to ensure that contaminants or debris are not introduced into the new pipe.

7.4 Flushing

The main shall be flushed through a hydrant at the end of the main at a velocity not less than 2.5 ft./sec. If no hydrant is installed at the end of the main, the Contractor shall provide a tap large enough to develop a velocity in the main of at least 2.5 ft./sec. The gallons per minute to achieve 2.5 ft./sec velocities for different diameter pipes are provided in Table 1.

Table 1 Gallons per minute required to obtain 2.5 feet per second flushing velocity

Main Size (in.)	Gallons per minute
6	200
8	400
12	900
16	16000

District water at no cost to the Contractor will be available to the work site for use in disinfecting and flushing mains. The Contractor shall furnish all necessary pipe and hose connections. The Contractor shall exercise care in the use of the water to prevent contamination of the existing water supply. Measures shall be taken prior to flushing to provide adequate drainage during flushing. Drainage shall be away from the main, and flooding of the trench shall be prevented. The volume of water flushed shall be measured or calculated and reported to the District Inspector.

Wherever the conditions allow, the new water main shall be kept isolated from the active distribution system using a physical separation until satisfactory bacteriological testing has been completed and the disinfectant water flushed out. Water required to fill the new main for hydrostatic pressure testing, disinfection, and flushing shall be supplied through a temporary connection between the distribution system and the new main. The temporary connection shall include a double check valve assembly backflow preventer and shall be disconnected (physically separated) from the new main during the hydrostatic pressure test. It will be necessary to reestablish the temporary connection after completion of the hydrostatic pressure test to flush out the disinfectant water prior to final connection of the new main to the distribution system.

7.5 Methods of Disinfection

The Contractor shall disinfect all portions of the water main that was worked on as well as any portion(s) of the network that was taken out-of-service to allow completion of the contract. The chlorine solution to be used must be Sodium Hypochlorite.

NOTE – The use of Calcium Hypochlorite granules left in the main to be dissolved on filling of the main is not an approved method.

7.5.1 Continuous Feed Method

The continuous feed method consists of completely filling the main to remove all air pockets, flushing the completed main to remove particulates, and filling the main with chlorinated potable water so that after a 24±4-hour holding period in the main there will be a free chlorine residual of not less than 10 mg/L at all locations of the main.

Prior to being chlorinated, the main shall be filled to eliminate air pockets and shall be flushed to remove particulates. The flushing velocity in the main shall be not less than 2.5 ft/sec unless the Director of Water Services or designee determines that conditions do not permit the required flow to be discharged to waste.

NOTE – Flushing is no substitute for preventive measures during construction.

At a point not more than 10 ft. downstream from the beginning of a new main, water entering the new main shall receive a dose of chlorine pumped at a constant rate such that the water at any location will have not less than 25 mg/L of chlorine. To assure that this concentration is provided, the District representative shall measure the chlorine concentration at regular intervals at available blow-offs or hydrants in accordance with procedures described in the current editions of “Standard Methods for the Examination of Water and Wastewater” or using an appropriate chlorine test kit.

Table 2 gives the amount of chlorine required for each 100 ft. of pipe of various diameters. Solutions of 1% chlorine shall be prepared with Sodium Hypochlorite. During the application of chlorine, valves shall be closed so that the strong chlorine solution in the main being treated will not flow into water mains in active service. Chlorine application shall not cease until the entire main is filled with heavily chlorinated water. The chlorinated water shall be retained in

the main for at least 24±4 hours, during which time all valves and hydrants in the section treated shall be operated in order to disinfect the appurtenances. At the end of this 24±4-hour period, the treated water in all the portions of the main shall have a residual of not less than 10 mg/L of free chlorine.

Table 2 Chlorine Required to Produce 25 mg/L Concentration in 100 feet of Pipe by diameter

Pipe size (in.)	Volume (gals in 100 feet of Pipe)	15% Chlorine solution gals per 100 feet of Pipe	1% Chlorine solution gals per 100 feet of Pipe
4	65	2 oz.	0.2 (1 ½ pts)
6	150	3 oz.	0.4(1 ½ qts)
8	260	5 oz.	0.6 (2 ½ qts)
10	410	1 cup	1.0 Gal
12	590	1 Pint	1.4
16	920	1Quart	2.3
24	2350	1 ½ Quarts	5.8
30	3680	2 ½ Quarts	9.1
36	5290	0.9	13.0
42	7200	1.2	18.0
48	9400	1.5	23.0
54	11900	2.0	30.0
60	14690	2.5	36.0

NOTE: To make 1% chlorine solution. Using Sodium Hypochlorite, dilute the hypochlorite according to the percent available chlorine on the container. For example, if you have 5% household bleach, place 1 gallon in 4 gallons of water. You then have 5 gallons of 1% solution.

7.5.2 Slug Method (Emergency Use Only)

At a point not more than 10 ft. downstream from the beginning of the new main, water entering the new main shall receive a dose of chlorine fed at a constant rate such that the water will have not less than 100 mg/L of free chlorine. To assure that this concentration is provided, the District representative shall measure the chlorine concentration at regular intervals along the main where taps and/or hydrants have been provided. The chlorine shall be applied continuously and for sufficient period to develop a solid column or 'slug' of chlorinated water that will, as it moves through the main, expose all interior surfaces to a concentration of approximately 100 mg/L for at least 3 hours.

The free chlorine residual shall be measured in the slug as it moves through the main. If at any time it drops below 50 mg/L, the Contractor shall stop the flow, chlorination equipment shall be relocated at the head of the slug, and as flow is resumed, chlorine shall be applied to restore the free chlorine in the slug to not less than 100 mg/L.

As the chlorinated water flows past fittings and valves, related valves and hydrants shall be operated so as to disinfect appurtenances and pipe branches.

7.6 Flushing After Disinfection

After the applicable retention period, the heavily chlorinated water shall be flushed from the main into the sewer until chlorine measurements show that the concentration in the water leaving the main is no higher than that generally prevailing in the system. Where domestic sewers are not available, the heavily chlorinate shall be dechlorinated. The replacement water shall be allowed to remain in the pipeline for 24 hrs.(+/- 4 hrs.) prior to sampling for physical, bacteriological, and chemical testing.

7.7 Analytical Tests

After the appropriate retention time (24±4 hours or 3 hours for the slug method), after flushing and before the water main is placed into service, a sample or samples shall be collected for sanitary analysis by a

District representative. Suitable sample piping shall be furnished by the Contractor to allow sample collection. The sampling point or points shall provide samples, which are representative of the water in all sections of the main for which sanitary approval is requested. All samples shall be collected in a manner as to avoid contamination from the environment surrounding the main. Rubber or synthetic hose shall not be connected to the main to collect a representative sample. The area around the sampling point of the main shall not be filled with water. At least one sample shall be taken from each main, and in the case where a main is greater than 1000 feet, one sample from each 500 feet of line. The samples shall be submitted to the District Laboratory for bacteriological, chemical, and physical analysis. The following analyses shall be completed and reported on the appropriate form. Total chlorine residual, Total Coliform (Membrane Filtration method), pH, and turbidity.

7.8 Final Flushing

Disinfected water mains shall be flushed within 4 hours of being placed into service. Flushing shall be designed to restore water quality to that of the source water, immediately prior to being placed into service. The length of time of flushing shall depend on the size and length of the water main, however at least three volumes of water should flow through the entire length of the main. Pipe volumes can be calculated by using Table 2 and adjusting for the full length of the main.

7.9 Redisinfection

If the initial disinfection and flushing fail to produce satisfactory analytical results, the main may be reflushed and shall be resampled. If check samples show the presence of coliform organisms, then the main shall be rechlorinated by the Contractor, using the continuous feed method of chlorination, until satisfactory results are obtained.

7.10 Miscellaneous

The District Laboratory, at no expense to the Contractor, will analyze two sets of samples. However, should the initial disinfection fail to produce satisfactory samples, a charge of $100 will be made to the Contractor for each set of additional samples required.

7.11 Final Connection

Water mains and appurtenances must be completely installed, flushed, tested for leakage, disinfected, and satisfactory bacteriological sample results received prior to permanent connections being made to the active distribution system where the new main was isolated from the existing system. Sanitary construction practices must be followed during installation of the final connection to insure that there is no contamination of the new or existing water main with foreign material or groundwater.

The new pipe, fittings, and valve(s) required for the connection will be spray-disinfected or swabbed with a minimum 1 – 5% solution of chlorine just prior to being installed.

7.12 Dechlorination

Contact the local sewer authority before discharging the highly chlorinated water to the sewer. The discharge of water to the environment with chlorine concentrations greater than the ambient distribution system chlorine residual is prohibited. The highly chlorinated water must be dechlorinated before being discharged to the environment.