## SECTION 500

## 500. WATER SYSTEM

### 510. General Requirements

#### 510.1. Scope

The following guidelines and specifications are set forth as minimum standards for the planning, design, and construction of public water system improvements. In the event these guidelines and specifications do not address a specific situation, the Water Department shall, at its discretion, determine the appropriate course of action to be followed. The Water Department may revise these requirements at any time without prior notification.

As a part of the design process for public water systems, it is highly recommended that the Engineer meet with a Water Department representative to review criteria and lay out the water system prior to plan submittal (https://www.hillsboro-oregon.gov/our-city/departments/water/contact-us/email-us). It is also recommended that the Engineer meet with the City of Hillsboro fire code official to ensure compliance with any applicable provisions of the Oregon Fire Code.

#### 510.2. General Design Requirements

When designing public water system improvements, system hydraulics are to be analyzed using projections and data from the current City *Water System Master Plan* (WMP). The water system analysis shall include the fire demand and a simultaneous demand for the maximum (peak) day demand or peak hour non-fire demand, whichever is greater.

Data used to calculate available water supply for fire or non-fire demand shall be obtained from hydrant flow tests conducted by Water Department. The flow test information will provide a "snap shot" of the flow and pressure measured in the water system at a given location and time. The Engineer shall recognize the actual flow and pressure available will vary depending on the time of day, water system demands, and future development. The flow test information provided by the Water Department does not relieve the Engineer of the responsibility to ensure the adequate long-term viability of any development.

The fire flow demand shall be as specified by the Fire Marshal as applicable for the location, land use type, proposed buildings, and occupancy hazard.

Required fire flow shall be determined based on the proposed building size, construction type and occupancy hazards and shall be approved by the fire code official in accordance with Oregon Fire Code [2012 ICC International Fire Code] or current version adopted by the State of Oregon and any local amendments adopted by the City of Hillsboro.

If a water system flow test and analysis is required as a condition of approval, the hydrant flow test is to be conducted by the City of Hillsboro Water Department and analyzed by the developer's Engineer. The following steps are to be performed by the Engineer in order to obtain the flow test data and produce the water system analysis:

1. A written request for a hydrant flow test must be submitted by the applicant/engineer to the City of Hillsboro Water Engineering staff (https://www.hillsboro-oregon.gov/our-city/departments/water/contact-us/email-us). Allow 10 to 14 working days for flow test results, unless an extended 7-day Static Hydrant Pressure Logging (ESHPL) is requested. Allow an additional 7 calendar days for results if the ESHPL is requested.

2. Two stamped copies of the design calculations and other relevant documentation, including all assumptions and hydrant flow test results, are to be provided by a registered professional engineer to the City Building and Fire Departments for review and evaluation.

510.2.1. Public Water Easement

All water infrastructure is to be located within a dedicated public right-of-way. When it is not practical or possible, or a situation exists where the Water Department requires the improvements to be placed outside of site right-of-way, an easement shall be provided. The minimum water main easement shall be 15 feet wide (when placed in a roadway or parking area) and a minimum 20 feet wide if vehicular access is not normally available.

The easement shall be exclusive for water mains and appurtenances and not shared with other utilities or structures (unless otherwise approved by the Water Department). The easement shall allow the City to construct, inspect, operate, maintain, replace, reconstruct, or remove the water distribution system. Water services or facilities located on private property shall be in a recorded easement measuring 5 feet to 10 feet from each outside wall of the meter vault or box, depending on water service size. Easement shall be titled “CITY OF HILLSBORO WATER EASEMENT”.

Private water service lines (downstream from the water meter) which cross another private property or which may be located within and running parallel to the Public Utility Easement (PUE), must be placed in an easement identified as “Private Water Easement”.

Meter boxes or other public water infrastructure shall not be located in a Public Utility Easement (PUE).

All easements shall be recorded prior to City acceptance.

See Subsection 130 “Easements” for additional information and requirements.

510.3. General Material Requirements

All materials shall be new and undamaged. No rebuilt, reconditioned, or used material will be allowed. Any internal or external imperfections found with the product must be returned to the manufacture and replaced at no cost to the City.

The same manufacturer of each item shall be used throughout the project.

All materials not specifically referenced shall comply with applicable sections of ANSI, ASTM, or the AWWA Standard Specifications with review approval from the Water Department.

Request the latest City of Hillsboro Water Department Approved Product List through the City of Hillsboro website.

## 510.4. General Construction Requirements

Improvements shall be constructed as shown on the plans and in accordance with these Standards and Standard Drawings. Equipment and materials shall be installed in compliance with the manufacturer's recommendations, except where a higher quality of workmanship is required by the Plan Specifications and/or these Standards.

All materials and work shall be in strict accordance with any applicable regulations and requirements of Federal, State, and local authorities. The Contractor may be required to arrange for inspection by these agencies and submit evidence of their approval, when required or requested by the Water Department.

Take care to prevent damage to pipe, fittings, and other materials and equipment during transportation, unloading, and final placement for installation. Manufacturer recommended product handling shall be followed to protect coatings, linings, and structural integrity of materials used in public water system construction. Under no circumstances shall materials be dropped or dumped into the trench.

All damaged materials and equipment during construction shall be replaced or repaired to the satisfaction of the Water Department at no cost to the City.

The Contractor shall maintain safe working conditions for employees, City staff, and the general public in and around trench excavations. Precautions shall be taken to avoid damage to franchise utilities, adjacent properties, existing water infrastructure, and public or private landscapes/hardscapes. If any underground utilities are damaged, report damage to Water Department Operations and inspector.

### 510.4.1. Maintaining Existing Service

It is required to maintain continuous water service to existing water users at all times. The Contractor shall schedule construction work accordingly. When it becomes necessary to shut down service to make required inter-ties or repairs, the Contractor shall notify and get shut-off date approval from the Water Department so affected customers can be timely notified in advance.

If a fire system is affected, the Property Owner is required to contact the approved fire code official for alternate fire protection requirements.

### 510.4.2. Non-Emergency Water Shut-off Notification

Water main and service shut-offs are to be coordinated through a Water Department representative. Customers are required to be notified a minimum of 48-hours prior for residential properties and 72-hours for commercial or industrial properties. Weekends and holidays are not to be counted as part of notification time. Final shut-off dates to be approved by the Water Department.

### 510.4.3. Bulk Water

Water will be available for the Contractor's use from approved fire hydrants upon purchase of a Bulk Water Permit from the Water Department. Site specific hydrants for Bulk Water usage may be allowed on a case-by-case basis, at the sole discretion of the Water Department. The Contractor

or developer shall submit a written request to the Water Department, including: project name, location, and reason for request.

All bulk water usage shall be metered and include an approved backflow assembly when required. Bulk Water meters are supplied by the Water Department with the permit.

Bulk Water Permits and tanker vehicle inspections shall be administered at the Water Departments Operations Building at 390 West Main Street or by an approved Water Department representative.

Bulk water tank filling is also available at the above location, at regular business hours, for a fixed fee.

**Related Standard Drawing: 640-1**

510.4.4. Valve Operation

No Hillsboro water system valves within the City's water service area shall be operated without authorization by the City of Hillsboro Water Department.

510.4.5. Staking Requirements

Construction staking is required for all water system improvements. Staking shall be performed by or under the supervision of an Oregon Registered Professional Land Surveyor or Registered Professional Engineer.

Staking shall be in place prior to installation of water system improvements. Staking shall be preserved and shall not be disturbed until the Construction Inspector authorizes it to be removed. If staking is disturbed or removed prior to the Inspector's approval, it shall be promptly replaced.

Line and grade stakes for water mains shall be provided on an offset line at intervals not exceeding 50 feet. Offset distances shall not be greater than 20 feet. Stakes shall be marked with stationing as well as Hub elevations and elevation references (cut/fill) to finished grade, i.e., and/or to top of pipe.

Locations of taps, valves, fittings, hydrants, water meters, and other appurtenances shall be stake with offset stakes. Hydrant and meter stakes shall be marked with elevation references (cut/fill) to top of curb or to finished grade if no curb will be installed. Meter stakes shall be marked with lot numbers.

At the end of each project all survey staking material must be removed from site before being declared complete.

## 520. Trenching, Backfill, and Surface Restoration

### 520.1. Design Requirements

#### 520.1.1 Erosion/Sediment Control

An erosion control plan shall be designed and approved for all water related projects. Requirements for design of the plan shall conform to Subsection 115.4.11 "Site Grading and Erosion Control" of this manual.

### 520.2. Materials

#### 520.2.1. Foundation Stabilization Materials

2 inch to 3 inch dense graded crushed rock meeting ODOT Section 00641, Section 02630, and is approved by the Water Department.

Geotextile fabric is to meet Oregon Standard Specifications for Construction Table 02320-1 (Drainage) for Type 2 geotextiles.

#### 520.2.2. Bedding and Pipe Zone Materials

Class "B"

¾ inch-0 inch dense graded crushed rock, with no more than 5% passing the No.200 sieve and meeting ODOT Section 00641 and Section 02630.

Class "E"

Controlled Low-Strength Material (CLSM) conforming to ODOT Section 00442. All CLSM mix designs are to be submitted for approval and must include 28 day cylinder break report from test batch as evidence of compressive strength, not exceeding 150 psi.

#### 520.2.3. Backfill Materials

Class "B"
¾ inch-0 inch dense graded crushed rock, with no more than 5% passing the No.200 sieve and meeting ODOT Section 00641 and Section 02630.

Class "A"
Clean native or imported earth material free of organics, rock, stones, wood, and other debris.

### 520.3. Construction

#### 520.3.1. Excavation

The Contractor is to provide all materials, labor, and equipment necessary to protect trench excavations at all times.

Excavations within the public right-of-way are required to be backfilled by the end of the work shifts, unless another method for safely covering the excavation is approved by the Water Department.

Disposal of all excavated materials shall be at an approved permitted dumpsite meeting all State and local requirements.

520.3.2. Trenching Requirements

The allowable open trench length is typically 300 feet. This distance may be reduced within public right-of-way areas based on safety concerns, work conditions, vehicle access, or lack of Contractor resources for trench area management.

The minimum trench width allowed is 24 inches and increases based on the pipe diameter. Consideration shall be taken to ensure trench is wide enough to accommodate shoring, protective structures, pipe installation, backfilling and compaction.

The Contractor shall provide means and equipment for trench dewatering and shoring as necessary during all construction. Water shall be disposed of in an approved manner to reduce impact and prevent all facility and property damage. Water discharge shall meet the requirements of the Clean Water Services (CWS) "Erosion Prevention and Sediment Control Planning and Design Manual". The Contractor is responsible for all permits and approvals.

**Related Standard Drawings: 520-1**

520.3.3. Pipe Bedding and Trench Backfill

Compaction of trench backfill materials shall be according to Oregon Standard Specifications for Construction Section 00330.43a, b, and c.

Foundation Stabilization Material Placement

If the material at the bottom of an excavation is deemed by the Water Department as unsuitable for support, the Contractor shall over excavate as directed and replace with foundation drain rock with gradation as requested by the Engineer. Foundation stabilization material shall be placed in 6-inch lifts and compacted up to the required grade.

Geotextile fabric may be approved for use in place of or in addition to over excavation and stabilization rock. A registered Geotechnical Engineer must be consulted if deemed necessary by the Water Department.

Pipe Bedding Placement

Place pipe bedding material to a minimum thickness of 4 inches below the outside bottom of the pipe barrel then spread smoothly to the proper grade so that the pipe is uniformly supported along the entire barrel length. Pipe bedding material shall be compacted to a minimum 95% maximum density, in accordance with AASHTO T-99.

Excavate bell holes for each joint to permit proper assembly and inspection.

Pipe Zone Material

Place material in loose lifts, not exceeding 6 inches, compacting by hand under the haunches of the pipe and in areas not accessible to mechanical tampers. Bring lifts up evenly to a minimum of 8 inches above the top of pipe. Pipe zone material shall be compacted to a minimum 95% maximum density, in accordant with AASHTO T-99.

Trench Backfill

Backfill the trench in loose lifts of 12 inches to 24 inches depending on compaction method. Compact material to a minimum 95% of maximum density as determined by AASHTO T-99.

For Class A native backfill, compact material to a minimum 90% of maximum density as determined by AASHTO T-99.

Water settling methods are not allowed.

CLSM Backfill

Discharge CLSM material from the mixing truck into the trench in a way that prevents dislodging or the shifting of water mains or other infrastructure from intended elevation and alignment. This may require multiple pours to accomplish, especially if buoyancy is a factor. The flowability (slump) shall be adjusted, as needed, to guarantee all voids within the trench are filled as required.

CLSM is not to be placed in temperatures 38° F or less, or poured on frozen ground.

Use sandbags, wood forms, or other barriers to contain CLSM mix as needed. Such barriers may require removal before burial. Properly seal and protect culverts, pipelines and other effected utilities from CLSM infiltration.

All ground and surface water in the trench shall be controlled during placement of CLSM. At no time will CLSM be allowed to be poured in submerged conditions.

Allow CLSM to firmly set prior to placement of additional lifts. To prevent rutting and displacement CLSM shall set a minimum of 24 hours before traffic or construction equipment come into contact with the material. In roadway areas where traffic will need to be restored at the end of the work shift, steel sheeting shall be used until CLSM has hardened and road surface has been rebuilt.

Test cylinders shall be prepared according to ASTM D-4832. Field testing of CLSM shall include 1 set of 4 3-inch x 6-inch cylinders. 2 cylinders are for break at 7 day and 2 for break at 28 day.

**Related Standard Drawings: 520-1**

520.3.4. Compaction Testing

For quality control, a third party ODOT certified testing company shall be contracted to perform nuclear density testing and any other applicable testing. Compaction test requirements shall be in accordance with ASTM D698.

A standard proctor is to be obtained through an approved certified testing laboratory for all materials used by the Contractor.

Generally, 1 test is to be performed for every 100 feet of linear trench for pipeline trenches, and minimum 1 test for each water service or other lateral appurtenance trench. Trenches 5 feet deep and greater will require compaction testing at depths every 2-feet. Frequency of in field testing will be determined by excavation type, depth of excavation, and the Contractor's compaction methods and equipment.

If trench backfill does not pass compaction testing it shall be evaluated for deficiencies, such as inadequate moisture, material inconsistencies, and contamination. The Contractor shall discuss a plan for correcting these deficiencies by means of increased compaction effort, addition of water,

or the removal and replacement of backfill material. Plan must be approved by the Water Department.

Trench backfill within an existing roadway is to be visually tested for soft spots at finish grade of the rock subgrade, according to ODOT TM 158 in ODOT Manual of Field Test Procedures.

## 530. Water Main Piping

### 530.1. Design Requirements

#### 530.1.1. Pipe Sizes

All hydraulic calculations to determine pipeline sizing are to be made using Hazen-Williams "C" coefficient of 100 and velocity not exceeding 5 fps. The following pipe sizes are accepted for use in the Hillsboro water system: 4, 6, 8, 12, 18, and 24-inch. Distribution water mains typically have a minimum 8-inch diameter.

Water piping serving dead-end streets may be reduced in size below 8 inches if all of the following conditions apply to the waterline:

1. It is under 300 feet in length.
2. It has no more than 8 service connections.
3. There is no possibility for future extension.
4. Design is accompanied by hydraulic calculations validating that the minimum fire flow required by the fire code official can be met.

The Engineer is encouraged to meet with a Water Department representative prior to design to discuss the size of water mains and any other matters particular to the project (www.hillsboro-oregon.gov/departments/water). Pipeline size shall be determined based on service area and system requirements, or as established in the current City WMP.

#### 530.1.2. Pipe Location

Water mains shall be located in the roadway, typically 6 feet from the South or East curb face. If the roadway does not currently have a curb, the Engineer is to use the proposed future location of the curb. Future curb locations can be found in the City's *Transportation System Plan* which is available from the Planning Department. Water mains along looped or curved streets shall not switch sides and be located on either the inside or outside of the loop.

**Related Standard Drawings: 530-1, 530-9**

#### 530.1.3. Pipe Depth

Minimum required cover over water main piping is 36 inches in improved areas and 48 inches in unimproved areas.

Care shall be taken to maintain the required cover depth over water system piping and appurtenances in all easement areas.

#### 530.1.4. Pipe Deflection

Location and degree of deflection at joints shall be shown on plans for all vertical and/or horizontal pipe deflection. See Subsection 530.3.2. “Pipe Joining”.

530.1.5. Clearances from Other Utilities

All clearances listed below are measured from the edge of each pipe and/or utility.

Water services and sewer laterals shall have a 5 foot minimum horizontal separation.

Maintain minimum vertical and horizontal clearances. Avoid crossing at highly acute angles.

Horizontal clearances from water piping and appurtenances:

| | |
|---|---|
| Cable TV | 5’ |
| Natural Gas | 5’ |
| Electrical | 5’ |
| Storm Sewer | 5’ |
| Sanitary Sewer | 10’ or as allowed by OAR 333-061-0050 |
| Telephone, Fiber Optics | 5’ |
| Other (not specified) | 5’ or as required by the Water Department |

Vertical clearances from water piping and appurtenances (for crossing only):

| | |
|---|---|
| Cable TV | 12” |
| Natural Gas | 12” |
| Electrical | 12” |
| Storm Sewer | 12” |
| Sanitary Sewer | 18” or as allowed by OAR 33-061-0050 |
| Telephone Fiber Optics | 12” |
| Other (not specified) | 12” or as required by the Water Department |

All utilities shall cross under water piping and appurtenances unless otherwise authorized by the Water Department Engineering Manager.

Where a water pipe crosses below a sanitary sewer line, one full length of water pipe shall be used with the pipe centered for maximum joint separation. Spacing and separation may be modified as allowed by OAR 333-061-0050 and approved by the Water Department Engineering Manager.

530.1.6. Pipeline Extensions

If the need for an extension of public water system results from property development, the extension shall be at the expense of the owner(s) of the parcel(s) for which the extension is necessary. The condition is applicable to the full length of all street frontages.

Water systems shall be installed through new development or improvements to existing infrastructure. Water system improvements shall take into consideration future development and effects to adjacent and downstream properties.

The layout of extensions shall provide for the future continuation, water quality and/or "looping" of the existing system. Specific looping requirements shall be determined during plan review by the City. Dead end mains shall only be installed if looping is impractical due to topography, geology or as determined by the City. At a minimum, two connection points on separate mains to provide dual feeds for the development shall be required.

530.1.6.A Developer Reimbursements

On occasion, the City of Hillsboro will utilize the opportunity of development and request the project proponent to install pipelines or other water related appurtenances outside the boundaries of the project or request the project proponent install a larger diameter line than necessary by code or for the project. In certain circumstances the project proponent may request reimbursement for this additional scope. The City of Hillsboro Water Department will establish a value for the out of scope work which will be included in a developer reimbursement agreement prior to the issuance of permits. The agreement will be negotiated on a case-by-case basis but should be in amount solely for the costs of the additional work and associated costs. The list below identifies cases that justify developer reimbursement:

i. COH requests the installation of pipes or water related appurtenances outside the boundaries of the project that are not required by standard or for water service to the property.

ii. COH requests the installation of a larger diameter pipe to support future development and the pipe is not identified within the COH Water Master Plan. Example: A 12-inch pipe is required per standard to serve the project. In order to support future development COH requests the installation of 18-inch pipe and the 18-inch pipe is not identified as needed within the COH Water Master Plan. If the pipe "to and through" the project property is identified as 18-inch in the COH Water Master Plan, the installation of the pipe will be at the expense of the project proponent.

530.1.7. Dead-End Mains

Dead-end waterlines shall be avoided whenever possible. Considerations for allowances of dead-end water mains are: future development, cul-de-sacs, or when the looping of the water system or banking of water meters is not practical.

A line size valve shall be installed on all dead-end water mains where future extensions are probable. Dead-end water mains shall terminate prior to property boundary and be equipped with a blow-off assembly.

**Related Standard Drawings: 540-7**

530.1.8. Blow-off Assemblies

Blow-off assemblies shall be required on all dead-end water mains for flushing, disinfection, and operational flushing necessary for maintaining stormwater management facilities. For blow-off sizing requirements refer to the flow chart in Subsection 530.4.1. "Filling and Flushing".

**Related Standard Drawings: 530-3, 530-4, 530-5**

530.1.9. Auto-Flushers

An auto-flusher may be required for maintaining stormwater management facilities on dead-end water mains and large water mains designed for future water supply needs. The projected usage necessary for meeting the Oregon Health Division's minimum standards for safe drinking water will be evaluated in determining auto-flusher requirements.

Proper drainage shall be considered when planning installation of an auto-flusher. If installed within 1,000 feet of a waterway or designated wetland, water shall discharge into a public sanitary or storm sewer, unless otherwise approved by the Water Department.

**Related Standard Drawings: 530-6A, 530-6B**

530.2. Materials

530.2.1. Ductile Iron Pipes

Ductile iron pipe shall be Class 52 thickness, conforming to the latest revision of ANSI/AWWA C151/A21.51.

An Affidavit shall be provided with each shipment stating the ductile iron pipe was cast from a domestic raw material source consisting of at least 75% recycled ferrous metals. The Affidavit shall be signed by a Professional Engineer registered in the state of the source manufacturing facility.

All ductile iron pipes shall be factory cement-lined and seal-coated conforming to ANSI/AWWA C104/A21.4.

The exterior of the ductile iron pipe shall be coated with a layer of arc-applied or paint-applied zinc coating per ISO 8179. The mass of the zinc shall be 200 $g/m^2$ of the pipe surface area. The outside coating of the pipe shall consist of an asphaltic seal coat approximately 1 mil thick conforming to ANSI/AWWA C151/A21.51. Pipe markings shall include the word "Zinc" in the pipe markings or label required by AWWA C-151 and/or other markings as deemed appropriate by the manufacturer.

Pipe shall be furnished in 18-foot or 20-foot lengths.

All ductile iron pipe shall be sourced and manufactured in the United States of America. No exceptions will be allowed.

530.2.2. Push-on Joints

All push-on gaskets shall be restraining gaskets designed for use in either Fastite or Tyton joint manufactured pipe. Push-on gaskets shall conform to ANSI/AWWA C11/A21.11. Gaskets for pipe sizes 4-inch to 12-inch shall be rated for 350 psi. Gaskets for 18-inch to 24-inch pipes shall be rated for 250 psi.

530.2.3. Ductile Iron Fittings

All ductile iron fittings shall be manufactured in the United States of America. Any exceptions shall require prior written approval from the Water Department Engineering Manager.

All fittings shall conform to ANSI/AWWA C110/A21.10 and ANSI/AWWA C153/A21.53. Fittings shall have cast upon them the manufacturer's identification, pressure rating, nominal diameters of openings, and the number of degrees or fractions of a circle for all bends.

Fittings shall be coated inside with an approved epoxy or cement mortar with an asphaltic seal coat conforming to AWWA C104. Fittings shall be coated outside with an approved epoxy or a bituminous coating at least 1 mil thick, as specified in Section 4.4 of AWWA C110.

The exterior of the ductile iron fittings shall be coated with a layer of arc-applied or paint-applied zinc coating per ISO 8179. The mass of the zinc shall be 200 $g/m^2$ of the pipe surface area. The outside coating of the pipe shall consist of an asphaltic seal coat approximately 1 mil thick conforming to ANSI/AWWA C151/A21.51. Pipe markings shall include the word "Zinc" in the pipe markings or label required by AWWA C-151 and/or other markings as deemed appropriate by the manufacturer.

Fittings shall be ductile iron mechanical joint (MJ) or flange joint (FLG) conforming to AWWA C153 or C110.

Specialized fittings , such as TR-Flex or approved equal, may be required by the Water Department when involving bridge infrastructure, casing pipe or pipes with high vibration exposure. All bridge crossings shall be reviewed by the COH Water Principal Engineer.

530.2.4. Mechanical Joint Fittings and Restraints

All mechanical joint fittings shall include mechanical restraints. All mechanical restraints shall be manufactured in the United States of America. Any exception shall require prior written approval from the Water Department Engineering Manager.

Ductile iron mechanical joint fittings and accessories shall conform to ANSI/AWWA C11/A21.11, ANSI/AWWA C110/21.20, and ANSI/AWWA C153/A21.53. Fittings for pipe sizes 4-inch to 24-inch shall be rated for 350 psi working pressure.

Bolts shall be T-head bolts, constructed from corrosion-resistant, high-strength alloy steel that conforms to ANSI/AWWA C111/A21.11, coated with ceramic-filled fluorocarbon resin that can hold up in highly corrosive soil conditions or constructed from Type 316 stainless steel. Nuts and washers shall conform to the same coating requirements and shall match bolt material.

Mechanical joint restraints shall be an integral part of the follower gland. Restraint shall be provided by individually activated wedges that increase resistance to pullout as the force of pressure is increased. Joint restraint ring and wedge components shall be constructed of grade 65-45-12 ductile iron, conforming at ASTM A536. Wedges shall be heat-treated to a minimum hardness of 370 BHM. The dimensions of the follower gland shall be compatible with joint bells conforming to ANSI/AWWA C111/A21.11. Mechanical restraint systems shall be pressure rated to a minimum 350 psi for sizes up to 16-inch and 250 psi for pipe sizes 18-inch and larger.

530.2.5. Flange Joints

Flange fittings are allowed only where shown on the Standard Drawings, or as approved by the Water Department.

Flange bolt holes and pattern shall conform to ANSI B16.1 for class 125 flanges or ANSI B16.5 for class 150 flanges. Class 250 flanges are not compatible with classes 125 and 150 bolt pattern.

Gaskets for flanged joints shall be full face, 1/8-inch thick rubber or synthetic rubber, with holes for passing bolts through and conforming to ANSI/AWWA C110/A21.10 and ANSI/AWWA C153/A21.53.

Bolts for flanged joints shall be the size and quantity shown on Table 14 of AWWA C110. Bolts and nuts shall conform to ANSI B18.2 and ASTM A307, with threads conforming to ASME B1.1.

Flange joints are to have a minimum pressure rating of 250 psi.

530.2.6. Restrained Flange Coupling Adaptors/Dismantling Joints

Gland and flange body shall be ductile iron per ASTM A536, grade 65-45-12, and compatible with ANSI class 125 and 150 bolt circles.

Restraining bolts and lugs shall be ductile iron per ASTM A536.

T-Bolts and nuts shall be high strength low alloy steel which meets AWWA C111.

Gasket materials shall conform to ASTM D20.

Steel bolts shall meet or exceed the requirements of ASTM A307 or ASTM F568M for carbon steel or ASTM F593 or ASTM F738M for stainless steel.

530.2.7. Tapping Sleeves

Tapping sleeves shall conform to ANSI/AWWA C223 unless otherwise specified.

The tapping sleeve body and flange shall be stainless steel Type 304, conforming to ASTM A240. Flange class shall conform to Subsection 530.2.5 “Flanged Joints” and accommodate tapping flanges per MSS SP-60.

Gaskets shall seal the full circumference of the pipe conforming to ASTM D2000.

Bolts and hardware shall be stainless steel Type 304 and be coated to reduce galling. This includes the bolts connected to the gate valve.

Tapping sleeves shall be equipped with a ¾-inch NPT brass or stainless-steel test plug for seal testing prior to tapping.

**Related Standard Drawings: 530-2**

530.2.8. Casing Pipe, Spacers, and Seals

Casing pipe shall be smooth steel conforming to ASTM A36. The minimum wall thickness shall be as required by the jurisdiction governing the highway, railway, or waterway crossed. Casing pipe shall not have a wall thickness less than ¼-inch.

Casing spacers shall be used to support the carrier pipe within the casing and help resist movement of the pipeline. Casing spacers and hardware shall be manufactured from stainless steel, be of 2-piece construction, and a minimum 12 inches wide.

Skids are to be manufactured out of polyethylene for insulation and abrasion resistance.

The spacer shall have a minimum of 4 runners for carrier pipe sizes up to 12-inch, and 6 runners for carrier pipe sizes through 24-inch.

Casing seals are to be either a slip-on boot style or split wrap-around style. Slip-on boot style seals are to be manufactured out of 1/8-inch synthetic neoprene rubber and be secured by 2 stainless steel bands and clamps. Split wrap-around style seals are to be manufactured from 1/8-inch flexible coal tar, reinforced with fiberglass and include 2 stainless steel bands and clamps.

530.2.9. Blow-off Assemblies

2-inch Blow-off Assembly (Permanent)
The blow-off assembly shall be self-draining, non-freeze type.

Design of the blow-off shall allow for repair and maintenance work to be performed without excavation. The size of the device shall allow for installation within a “Portland” style valve box. See Subsection 540.3.6 “Valve Boxes”.

The inlet and outlet connections and all internal working parts of the assembly shall be constructed of brass. Inlet shall be a vertical 2-inch female iron pipe thread connection. The outlet shall be a male iron pipe thread connection.

Pipe and fittings between the ductile main and the self-draining blow-off assembly shall be 2-inch brass. An independent curb valve is to be installed just downstream of the ductile iron pipe to aid in maintenance of the blow-off assembly. All piping, fittings, and meter stops shall meet requirements of Section 560 “Water Service Connections”.

4-inch Blow-off Assembly (Temporary)
All pipe and fittings are to meet requirements of this Subsection. The 4-inch gate valve must meet requirements of Subsection 540.2.1. “Gate Valves”. Refer to section 530.1.7 Dead End Mains for additional blow off assembly requirements for future extensions.

**Related Standard Drawings: 530-3, 530-4, 530-5**

530.2.10. Auto-Flushers

Auto-flusher assembly inlets shall be either FIPT or MIPT connection manufacture from brass or stainless steel.

Piping and electronics are to be rated at 150 psi or greater.

Piping for auto-flushers is to be 2-inch type K rigid copper with an isolation valve located at the water main.

Device controller is to be stand-alone 9-volt DC powered, programmable for up to 12 flushing cycles per day.

**Related Standard Drawings: 530-6A, 530-6B**

530.3. Construction

If a project contains multiple connection points to the City's existing water system, only one connection will be allowed until all testing, disinfection, and acceptance of water improvements has been completed to the satisfaction of the Water Department. The Contractor is to install a temporary blow-off at the end of each leg prior to the tie-in point to allow for flushing of the system.

Proper equipment, tools, and facilities shall be provided and used by the Contractor for the safe and convenient execution of the work.

530.3.1. Pipe Installation

All pipe and appurtenances shall be installed at the location, elevation, and grade shown on the plans, or as directed by the Water Department. At no time shall the water line deviate more than 1-inch vertically or horizontally from the approved design, without prior approval from the Water Department.

Pipe configuration shall be with the bell pointed in direction of installation whenever practical.

Every precaution shall be taken to prevent foreign material from entering the pipe while it is being placed. During installation no debris, tools, clothing, or other materials shall be placed in the pipe. When pipe installation is not in progress, the ends of the pipe shall be closed by a watertight plug or equivalent mechanical means.

Full lengths of pipe shall be used whenever possible to limit the number of joints. Pipe lengths less than 2 feet shall not be used unless approved by the Water Department.

The cutting of pipe must be executed in a neat manner without damage to the pipe or the lining. Cuts shall be smooth, straight, and at right angles to the pipe axis. After cutting, the pipe ends shall be dressed with a file or power grinder to remove all rough and sharp edges. Cut ends of push-on joint pipe shall be suitably beveled. Approved cutting equipment includes abrasive cut-off saw, rotary wheel cutter, a guillotine pipe saw, or milling wheel saw.

530.3.2. Pipe Joining

<u>Cleaning</u>
Before joining, all pipe contact surfaces are to be thoroughly cleaned, wire brushed if necessary, and kept clean until joining is completed. Remove all lumps, blisters, excess coal tar coating and any debris from the bell and spigot ends of each pipe and fitting.

<u>Mechanical Joints</u>
All mechanical joints shall be installed with joint restraints.

Installation of mechanical joints shall be as recommended by the manufacturer and in accordance with ANSI/AWWA C111/A21.11 Appendix A. If effective sealing is not obtained, the joint shall be disassembled, thoroughly cleaned, and reassembled.

Bolts shall be uniformly tightened to the torque valves listed below or according to manufacturer's instructions, whichever is greater.

**Table 530.1 – Mechanical Joint Bolt Torque**

| Joint Size (in.) | Bolt Size (in.) | Range of Torque (ft-lbs) |
|---|---|---|
| 3 | 5/8 | 45-60 |
| 4-24 | ¾ | 75-90 |
| 30-36 | 1 | 100-120 |
| 42-48 | 1¼ | 120-150 |

The above torque loads may be applied with torque measuring or indicating wrenches.

If effective sealing is not attained by the maximum torque indicated above, disassemble the joint and reassemble after thorough cleaning. Overstressing of bolts to compensate for poor installation is not permitted.

Impact drills are not allowed while installing restraints on valves.

Push-on Joints

All push-on joints shall be restrained.

Installation of push-on joints shall be according to manufacturer's recommendations and AWWA C600.

All joint surfaces shall be lubricated immediately before joining of pipe with an NSF approved joint lubricant, as recommended by the gasket manufacturer.

The Contractor shall take precaution not to damage the pipe, gasket, or fittings when pushing pipe together. Pipe spigot is to be squared with pipe bell prior to the joining process. If deflection is needed at a push-on joint, deflection shall take place after pipe is shoved home in the bell.

Deflection

Pipe deflection shall not exceed the values listed in the table below, or the manufacture's maximum allowable pipe joint deflection, whichever is less.

**Table 530.2 – Maximum Allowable Deflection for D.I. Pipe Restrained Joints**

| (18-foot pipe length) | | |
|---|---|---|
| Pipe Diameter (inches) | Push-On Joint Maximum Deflection | |
| | Angle (degrees) | Offset per 18-foot pipe length (in.) |
| 4 | 5 | 18 |
| 6 | 5 | 18 |
| 8 | 5 | 18 |
| 12 | 5 | 18 |
| 18 | 3 | 15 |
| 24 | 2.5 | 9.5 |

Flange Joints

Installation of flange joints shall be according to manufacturer's recommendations and ANSI/AWWA C111/A21.11 Appendix C.

Flange faces shall be flat and perpendicular to the pipe center line. Flange faces must be cleaned with a wire wheel prior to installation of the valve. Flange bolts shall be tightened in a progressively crisscross pattern, such as by first tightening the bottom bolt; then the top bolt; next the bolts on either side; finally, the remaining bolts. This process should be repeated until all bolts are sufficiently tightened. Bolts for flange fittings shall be long enough to tighten through the nut and have three threads exposed beyond the nut.

530.3.3. Thrust and Straddle Blocks

The Water Department will only accept concrete thrust blocking where shown on Standard Drawings or for applications where joint restraints are not feasible. Cost is not a determining factor in feasibility.

When permitted, install thrust blocking according to the Standard Drawings. Concrete shall have a slump of 2 to 4 inches and shall comply with ODOT Section 00440 "Commercial Grade Concrete", 3,000 psi, 28 days. Any field mixing of concrete must be approved by the Water Department staff.

Concrete blocking shall extend from the fitting to solid undisturbed earth and installed so that all joints are accessible for repair. Prior to using high-early concrete for thrust blocking, the Contractor shall submit a mix design from the supplying concrete plant for Water Department approval.

Concrete thrust restraint for vertical bends shall include embedded steel rebar hooks as shown in the Standard Drawings.

All pipe and fittings in contact with concrete shall be completely wrapped in 2 layers of 4-mil polyethylene sheets or 1 layer of 8-mil polyethylene prior to the placement of the concrete.

Straddle blocks installed on existing waterlines 8-inch and smaller require U.G. clamps or mid span restraint glands. Straddle blocks on waterlines 10 inches and larger require designed rebar reinforcement stamped by a registered professional engineer and approved by the Water Department.

**Related Standard Drawings: 530-7A, 530-7B, and 530-8**

530.3.4. Connection to Existing Water System

Connections to the existing water system shall be made at a time and under conditions which minimize service interruption to customers, as authorized by the Water Department. See Subsection 510.4.2. “Non-Emergency Water Shut-off Notification”.

Facilities shall be provided for the proper dewatering and disposal of all water removed from water mains and excavations to avoid damage to adjacent property.

Connection to an existing water system shall only take place after the new improvements are leak tested, flushed, disinfected, and satisfactory bacteriological test results are obtained. All connections to the existing water system shall be authorized by and executed in the presence of a Water Department representative.

Special care shall be taken to prevent contamination while dewatering, cutting into, and making connections with existing water pipe. Trench water, mud, or other contaminating substances shall not be permitted to enter the water pipes. The interior of all pipe, fittings, and valves installed in water connections shall be thoroughly cleaned and then swabbed, sprayed, or dipped in a 1% hypochlorite solution prior to assembly.

Wet Tapping

Connection to existing water pipe may be made by means of a wet tap. The cutting in of tees will not be permitted unless approved and signed off by the Water Department Engineering Manager.

All wet taps shall be installed by a contractor approved by the Water Department and installed under the direction of Water Department representative. Contact the Water Department for a list of approved tapping contractors.

Wet taps 10 inches and larger require a horizontally installed gate valve with bevel gear actuator, unless bury depth allows for a minimum 24 inches of cover over valve nut.

Connection to Existing Valves

Water improvements that include connection to the City water system by means of an older existing valve may require the replacement of said valve if the valve’s condition is determined by the Water Department to be questionable in performing the necessary pressure testing and disinfection.

530.3.5. Abandoning Facilities

The Contactor shall seal the open ends of all pipes, fittings, etc. that are to be abandoned with an end cap, coupling, or a concrete plug with a thickness equal to the diameter of the pipe. The Water Department requires that all abandoned piping be severed as close to active piping as practical.

All service lines are required to be severed at the main and for the corporation stops to be capped if not required to be removed. A 4 inch diameter by 4 inch long piece of PVC pipe is to be installed over all capped corporation stops that remain as part of abandonment. All other parts of the service lines and other appurtenances are to be cut off and removed at 24 inches minimum below finish grade.

Structures (vaults, meter boxes, etc.) shall be removed completely to eliminate conflict with any future utility improvements. Abandonment of structures shall be completed only after piped systems have been properly abandoned.

Abandoned valve boxes in pavement areas shall be cut off 24 inches below grade, removed, gravel filled, and plugged with compacted asphalt. Valve boxes outside of pavement areas shall be cut off 24 inches below grade, removed, and filled with native backfill. Landscaping shall be restored to pre-existing or better conditions.

The Water Department has first claim to any removed or abandoned water materials (valves, hydrants, fittings, etc.). The Contractor shall dispose of all unwanted materials in an approved manner.

530.4. Flushing, Hydrostatic Testing, and Disinfection

530.4.1. Filling and Flushing

Filling

At the completion of water improvements, the water main shall be slowly filled while removing air through air release valves, hydrants, blow-offs, and water services.

Flushing

Prior to disinfection of water improvements, all water mains, services, and appurtenances shall be flushed to remove all trapped air and any foreign material or debris which may remain in the pipelines following installation.

The Contractor shall provide hoses and temporary pipes as required to dispose of flushed water into a storm sewer system. The Contractor shall make provisions to dechlorinate the flushed water as required.

Flushing velocities shall be a minimum 3-fps for water mains 12-inch and smaller. For water mains larger than 12-inch, where it is impractical or impossible to flush the pipe at a velocity of 3 fps, the flushing procedure shall be reviewed by Water Department staff.

Water for Filling and Flushing

The Water Department will furnish all water necessary for initial testing, flushing, and disinfection. If additional water is needed due to unsatisfactory tests, the Contractor will be billed for the water used.

Water needed for other construction activities shall be obtained as described in Subsection 510.4.3. "Bulk Water".

**Table 530.3 – Required Flow and Openings to Flush Pipelines**
**40 psi Residual Pressure in Water Main**

| Pipe Diameter | Flow Required to Produce 3 ft/s (approx.) Velocity in Main | Size of Tap, in.(blow-off) 1" 1 ½" 2" 4" | | | | Number of Hydrant Outlets | |
|---|---|---|---|---|---|---|---|
| Inches: | GPM: | Number of Taps in Pipe | | | | 2½" | 4½" |
| 4 | 120 | 1 | - | - | - | 1 | 1 |
| 6 | 260 | - | 1 | - | - | 1 | 1 |
| 8 | 470 | - | 2 | - | - | 1 | 1 |
| 12 | 1060 | - | - | 3 | - | 2 | 1 |

With 40-psi pressure in the main with the hydrant flowing to atmosphere, a 2½-inch hydrant outlet will discharge approximately 1,000 gpm; and a 4½-inch hydrant outlet will discharge approximately 2,500 gpm. Number of taps on pipe based on discharge through 5 feet of galvanized iron (GI) pipe with one 90° elbow. Data conforming with ANSI/AWWA C651 Table 3.

530.4.2. Hydrostatic Testing

Prior to hydrostatic testing, all water improvements shall be completed including water mains, services, blow-offs, and any other appurtenances.

The Contractor shall perform hydrostatic (pressure) and leakage tests on all newly laid pipes and valves in accordance with OAR 333-061-0050, the latest methods outlined in AWWA C600, and these Standards.

The Water Department Engineer or Inspector shall be notified a minimum of 24 hours prior to testing, and shall be present to monitor all tests.

The Contractor shall furnish all necessary equipment, material, and labor required to conduct the testing.

Provide the following equipment and materials for hydrostatic testing:

i. A clean 55-gallon barrel and 5-gallon bucket.

ii. One injection pump approved by the Water Department.

iii. Suitable hose and any additional equipment necessary to perform the testing correctly.*

*The Water Department will provide a NIST calibrated pressure gauge for hydrostatic testing.

The test shall be conducted after the trench has been partially backfilled with the joints left exposed for inspection, or completely backfilled and compacted. Where a section of pipe is to be tested with newly poured concrete thrust blocking, the Contractor shall not apply test pressure

until a minimum of **72 hours** have elapsed after the concrete was installed. Any deviation shall be reviewed by the Water Department staff.

The following procedure shall be used to conduct a pressure test, unless otherwise approved by the Water Department.

**Note: The Water Department does not guarantee existing water system valves against leakage. The Contractor is advised to test new improvements independent of the existing water system:**

i. The pipe shall be filled with water using an approved method that protects the existing distribution system from contamination. The new piping being tested shall remain isolated from the existing water system.

ii. After the trench has been backfilled or partially backfilled, slowly fill the pipe with water, expelling all air during the filling.

iii. The test pressure shall be a minimum of 150 psi for the 2-hour test.

iv. Apply the specified test pressure by pumping additional water into the new piping system with a hydrostatic pump.

v. Valve off the pump and hold the pressure in the line for the 2-hour test period. If the pressure falls below 145 psi, the line shall be pumped back up to 150 psi. The amount of water used to re-obtain 150 psi shall be measured and counted against the allowable leakage.

vi. At the end of the test period, again operate the pump until the test pressure of 150 psi is obtained, measuring the water used.

vii. The pump suction shall be in a barrel or similar container, or metered so that the amount of water required to restore the test pressure may be measured accurately.

viii. Leakage shall be defined as the quantity of water necessary to restore the specified test pressure at the end of the test period. No pipe installation will be accepted if the leakage is greater than the number of ounces lost in a 2-hour period as determined by the following formula:

$$L = \frac{256 * S * D * \sqrt{P}}{148{,}000}$$

Where L = Allowable leakage (ounces/2 hours)

S= Length of pipe tested (feet)

D = Nominal diameter of pipe (inches)

P = Average pressure during the leakage test (static pressure times 2) (psi)

Should any section of pipe being tested account for leakage greater than that allowed, the Contractor shall locate and repair the defective joints, pipe, or appurtenances and retest that section of pipe. Leakage must be within the specified allowance and approved prior to disinfection.

At the satisfactory completion of Hydrostatic testing, all line valves are to be tested to assure effective seal and proper operation. While under full test pressure, start with the furthest valve from the test gauge and test each valve in succession up to, and including, the closest valve. The testing procedure is to close the valve being tested and release pressure beyond. Valves are considered acceptable when no loss is observed on the test gauge.

530.4.3. Disinfection of Pipes

Disinfection of water improvements shall be done in accordance with all Oregon Health Authority regulations and AWWA C651 Standards.

Methods

Hypochlorite Solution
Disinfection shall be accomplished using the continuous feed method with a mixture of hypochlorite (calcium or sodium) and water resulting in a free chlorine residual of 25-50 MG/L in the pipeline.

Bleach
Use only 12.5% commercial food grade bleach, NSF-certified for potable water use. Liquid bleach shall be applied by means of an approved chlorination pump device. Bleach shall be fed through proper devices for regulating the rate of flow and providing effective diffusion of disinfectant to obtain a free chlorine residual of 25-50 MG/L.

Spraying, Swabbing, or Dipping
If the calcium hypochlorite procedure is used, first mix the dry powder with water to make a thick paste, and then thin to approximately a one-percent solution (10,000 MG/L chlorine). If the sodium hypochlorite procedure is used, dilute the liquid with water to obtain a one-percent solution.

The following chart outlines the amount of sodium or calcium hypochlorite required to obtain a 50 MG/L disinfection mixture for various pipe diameters.

**Table 530.4 – Requirements for Pipe Disinfection**

| Pipe Diameter (inches) | Volume in Pipe per 100-foot segment (gallons) | Calcium Hypochlorite (Granular form) 65% Available Chlorine (cups) | Commercial Food Grade Bleach 12½% Cl² (gallons) |
|---|---|---|---|
| 4 | 65 | 0.10 | .013 |
| 6 | 147 | 0.23 | .03 |
| 8 | 261 | 0.40 | .053 |
| 12 | 588 | 0.90 | .12 |
| 18 | 1321 | 2.03 | .32 |
| 24 | 2349 | 3.60 | .47 |

Procedure

The Contractor shall schedule disinfection no later in the week than Wednesday, to allow for completion of bacteriological sampling on Friday.

The Contractor shall mix the hypochlorite granules or liquid in large plastic containers with sufficient water to obtain the required dilution. The containers must have sufficient capacity to ensure that the solution will mix thoroughly with the water when injected into the pipeline.

Inject the disinfectant into the pipeline to be treated through a corporation stop or other suitable appurtenance, at a point close to the feed source. Maintain the required flow of fresh water by manipulating water main and blow-off valves to mix and pull the disinfectant throughout the system at a maximum pressure of 20 psi. **Under no circumstances will the Contractor be allowed to operate the isolation valve unless instructed in person by a Water Department Representative.** The rate the disinfectant is injected into the piping shall be in such proportion to the rate of water entering the pipe that the combined mixture shall contain 25-50 MG/L of free available chlorine. Operate all newly installed valves, hydrants, and other appurtenances during disinfection to ensure that the disinfection mixture is dispersed into all parts of the system including dead-ends, new services, and similar areas that otherwise may not receive the treated water.

At the completion of chlorine injection, close all valves and remove the pump. The pressure in a chlorinated pipeline shall not be more than 10 psi.

Water improvements that are 1 pipe length or less may, at the Water Department's discretion, be swabbed or sprayed with a 1% hypochlorite solution as an approved disinfection method.

Contact Time

The chlorine-water mixture shall remain in the pipeline for a minimum period of 24-hours (or as directed by the Water Department) in order to destroy all non-spore-forming bacteria. The disinfection mixture contact time shall not exceed a 36-hour time period in order to minimize damage to ductile iron pipe and fittings. At the end of the 24-hour period, the disinfection mixture must have a chlorine residual of 10 MG/L or greater. If the chlorine residual is less than the required minimum, the Contractor shall repeat the disinfection procedure.

Disposal of Disinfection Water

Dispose of the chlorine water mixture in an approved manner. Methods of disposal shall be as follows:

a. Discharge water into a sanitary sewer system: The Contractor shall provide all hoses, fittings, and temporary pipes required to discharge into an approved public sanitary system. All hoses and piping shall be tied off and secured, and include an acceptable air gap between the discharge point and sanitary flow line. Check with the local sewer department for required conditions of disposal to the sanitary sewer system.

b. Discharge water into a storm sewer system: If the Contractor desires to dispose of water in a public storm system, the water is to be dechlorinated prior to discharge. The Contractor shall provide hoses, temporary pipes and an approved air gap, as required, for discharge. See AWWA C652 Appendix C for chemicals required to neutralize the chlorine residual. Ascorbic acid is included as an acceptable chemical for dechlorinating.

c. Discharge water to ground surface or ditches: If the Contractor desires to dispose of water to the environment, and the Water Department approves the request, the water shall be dechlorinated prior to discharge. The Contractor shall provide hoses and temporary pipes as required. See AWWA C652 Appendix C for chemicals required to neutralize the chlorine residual. Ascorbic acid is included as an acceptable chemical for dechlorinating.

530.4.4. Bacteriological Testing

After flushing and disposal of the disinfection mixture, 2 bacteriological samples will be drawn by the Water Department. The first sample will be drawn following a 16-hour retention period. The second sample will be drawn at a minimum of 15 minutes later. Both water samples must pass the bacteriological tests before the water line(s) will be accepted. The Contractor shall provide a representative to assist the Water Department when samples are taken.

All corporation stops used for testing and chlorination shall be removed at the completion of work and replaced with brass plugs prior to final backfilling and surface restoration.

## 540. Valves and Valve Boxes

### 540.1. Design Requirements

#### 540.1.1. Isolation Valve Size, Spacing, and Location

A sufficient number of valves shall be provided to facilitate water system isolation and minimize impact to surrounding customers. All system appurtenances shall include a valve for isolation during general maintenance and repair operations.

Generally, valves shall be installed at water main intersections in groups of 3 for tee applications and 4 for cross applications. Valves shall be MJ style and include restraints.

The maximum distance between main line valves shall be 800 feet.

All valves 8-inch and smaller shall be gate valves.

All valves 10-inch and larger shall be butterfly valves, with the exception of wet taps.

All valves shall be full size. No reduced port valves will be allowed.

Valves shall be installed in areas adequate to allow for a 3-foot clear zone maintained around all water system valve boxes. Fencing, trees, large bushes, retaining walls, and anything else that may interfere with the operation of a water valve is prohibited within the clear zone.

Valves shall not be located within a curb, gutter, driveway, sidewalk surfaced area or ADA ramp.

Valve operator extensions are required on all valves with operating nuts more than 6 feet below finish grade. Oversized valve cans and risers are to be included with all operator extension installations.

Valve box lids located in roadways with high-volume traffic or speed limits 35 mph and greater shall have locking lids, to prevent lid from being dislodged.

**Related Standard Drawings: 540-1, 540-2, 540-3, 540-4**

540.1.2. Combination Air Release Valves (CARV)

CARV valves are required at all high points on all transmission and distribution piping where elevation changes are equal to or greater than the diameter of the pipe being installed.

**Related Standard Drawings: 540-5A, 540-5B, 540-5C, 540-6**

540.1.3. Insertable Valve

At the discretion of the Water Department Engineering Manager, an approved insertable valve may be used on a case-by-case basis.

540.2. Materials

All valves shall be marked with valves size, class, manufacturer, and year of manufacture. Markings shall be cast in raised letters on the valve body.

All gate and butterfly valves shall be manufactured in the United States of America. Any exceptions shall require prior written approval from the Water Department Engineering Manager.

All valves located inside vaults require a handwheel.

540.2.1 Gate Valves

Gate valves shall be resilient-wedge type conforming to AWWA C509 and/or C515, and shall be UL listed and FM approved.

All gate valves shall be hydrostatically tested at the factory and have a minimum rated working pressure of 200 psi.

The wedge shall be ductile iron or cast iron completely encapsulated with resilient material. The sealing material shall be permanently bonded to the wedge with a rubber tearing bond which meets ASTM D429.

Direct Bury

All direct bury gate valves shall be furnished with a 2-inch square operating nut and open counterclockwise when viewed from above. All buried valves shall have non-rising stems made of solid bronze and include integral or non-integral collars in compliance with AWWA.

Non-Direct Bury

Gate valves installed in backflow vaults or above-ground backflow assemblies shall be outside screw-and-yoke type valves, equipped with a bronze stem, and supplied with a hand wheel.

540.2.2. Butterfly Valves

Butterfly valves shall be rubber-seated type conforming to AWWA C504. Valves shall be bubble tight at rated pressures with flow in either direction, and shall be designed for applications involving valve operation after long periods of inactivity. Valves employing a complete rubber liner or with sprayed or plated seating surfaces are not acceptable.

The valves shall be Class 150B as shown in AWWA C504, Table 2. All butterfly valves shall be hydrostatically tested at the factory and have a minimum rated working pressure of 150 psi.

Butterfly valves shall be furnished with a 2-inch square operating nut and shall open counterclockwise when viewed from above. All manual operators shall be approved for direct bury applications. Valve actuators shall be totally enclosed worm gear or the traveling nut self-locking type, and shall be designed to hold the valve in any intermediate position between fully open or fully closed without creeping or fluttering. All valve actuators shall be capable of withstanding an overload input torque of 450 ft-lbs at full-open or full-closed position without damage to the valve or valve operator.

540.2.3. Valve Operator Extensions

Valve operator extensions can be fabricated using 2-inch by 2-inch by .120-inch square steel tubing or 1-inch schedule 80 steel pipe and ¼-inch steel plate, with 2-inch socket made from ¼-inch thick steel plate or 2½-inch by 2½-inch by .180-inch square steel tubing, then hot dip galvanized.

Valve operator extensions can also be fabricated using fiberglass valve stem extensions. The cantering ring is adjustable for 8, 6, or 4½-inch valve can risers. Attach with a 2-inch lower operating nut and a 2-inch upper operating nut with a versatile size centering ring. Fiberglass adhesive shall remain out of the sun at all times until installation.

**Related Standard Drawings: 540-4**

540.2.4. Valve Boxes

Standard

Valve box tops shall be 18-inch tall "Vancouver" style constructed of cast iron and shall be factory cast with the word "Water." Valve box castings shall be a smooth and uniform cylinder and top rim. Valve boxes of uneven thickness, pitted, or otherwise flawed in the casting will not be accepted. Debris caps are required in all valve boxes unless otherwise stated by the Water Department.

Oversized

Valve box tops shall be 12 inches in height with an inside diameter of 9 5/8 inches. Lids are to be inset and have a 10 5/8-inch outside diameter and include a pick notch in top surface for removal. Valve box castings shall be a smooth and uniform cylinder and top rim. Valve boxes of uneven thickness, pitted, or otherwise flawed in the casting will not be accepted. Debris caps are required in all valve boxes unless otherwise stated by the Water Department.

Locking Traffic Lid

Valve box tops shall be 18-inch tall "Vancouver" style (same casting as the Standard valve box) with 2 3/8-inch diameter, 16 thread, 1¼-inch long stainless-steel slotted screws for securing lid to main casting. "City of Hillsboro" shall be cast into the lid in ½-inch lettering.

Valve Box Riser

The riser, or bottom section of the valve box, shall be 6-inch or 8-inch diameter SDR 35 PVC pipe (ASTM D3034) as required for valve box size.

**Related Standard Drawing: 540-2, 540-3**

540.2.5. CARV

¾-inch, 1-inch, and 2-inch CARV's shall have a minimum working pressure rating of 230 psi.

CARV body shall be made of high strength plastic.

The inlet connection shall be male NPT. The vent outlet shall be 3/8-inch female NPT (for ¾-inch and 1-inch valves) and 1½-inch (for 2-inch valves).

All valves, copper tubing, fittings, saddles, and vaults shall meet the material requirements of Section 560 “Water Service Connections”.

**Related Standard Drawings: 540-5A, 540-5B, 540-5C, 540-6**

540.3. Construction

540.3.1. Handling

The Contractor shall follow the manufacturer’s instructions and protect valves from damage while transporting, unloading, and during installation. The valve operating shaft shall not be used for lifting. Care shall be taken not to damage the interior and exterior coating on valves. Valves that have chipped or damaged coating shall be repaired or replaced, at the sole discretion of and at not cost to the Water Department.

540.3.2. Storage

Store valves inside if possible. Valves stored outside shall be protected from the weather and accumulation of dirt, rocks, and other debris. Do not expose rubber seats to sunlight.

540.3.3. Valve Installation

Valves are to be installed in accordance with the manufacturer’s instructions and comply with applicable AWWA requirements.

Thoroughly clean valves, including flange faces of all foreign matter of debris. Prior to installation, the Contractor shall inspect each valve for proper opening and closing operation, and verify that the valve seats properly.

The joining of valves with pipes or fittings shall comply with Subsection 530.3.2. “Pipe Joining”.

Valves shall be installed so the stem is plumb with finish grade.

Center the PVC riser pipe on the axis of the operating nut, set plumb and adjust the top of the valve box to finish grade. Any valve boxes found to be off center, out of plumb or not flush with finish grade shall be removed and reinstalled in the proper position.

Refer to section 530.4.2 for hydrostatic testing procedures.

**Related Standard Drawings: 540-1**

540.3.4. CARV Installation

CARV’s are to be installed in accordance with these Standards and the manufacturer’s recommendations. CARV’s shall be located as shown on plans or as directed by the Water Department.

Install CARV's at the required elevation to maintain a minimum 1% positive grade for the copper tubing from the water main to the CARV.

Refer to section 530.4.2 for hydrostatic testing procedures.

**Related Standard Drawings: 540-5A, 540-5B, 540-5C, 540-6**

540.3.5. Valve Operator Extensions

Where depth of the operating nut is more than 6 feet below finish grade, a valve operator extension shall be provided to bring the operating nut to within 18 to 24 inches of the surface. Each valve shall have no more than one continuous-piece valve operator extension. (Multiple piece extensions are not allowed.)

**Related Standard Drawings: 540-4**

540.3.6. Valve Boxes

Where the valve is located outside of asphalt or concrete finished surfaces, the Contractor shall install a 24-inch by 24-inch by 5½-inch concrete pad around the valve box with No.4 rebar.

All valve box lids shall be tightly fitted and approved by the Water Department.

Valve boxes for valves requiring an operator extension and permanent blow-off assemblies, shall be 8-inch diameter "Portland" style constructed of cast iron with the word "Water" factory cast and the words "Portland OR" removed from the casting. The related bottom section shall be cut from a single piece of 8-inch riser material.

**Related Standard Drawings: 540-2, 530-3, 530-4**

## 550. Fire Hydrants

### 550.1. Design Requirements

Generally, fire hydrants shall be located such that no part of any one- or two-family residential building is more than 600-feet from a hydrant, and no part of a commercial, industrial, or multi-family building is more than 400-feet from a hydrant (when measured along an accessible route).

When new water mains are extended along streets where hydrants are not required for the protection of surrounding structures or other fire concerns, fire hydrants shall be provided at a spacing not exceeding 1,000 feet, for transportation hazards. When streets are provided with median dividers which cannot be crossed by fire fighters pulling hose lines, or where arterial streets are provided with four or more traffic lanes and have a traffic count of more than 30,000 vehicles per day, hydrant spacing shall average 500 feet on each side of the street and be arranged on an alternating basis up to a fire-flow requirement of 1,500 gallons per minute and 400 feet for higher fire-flow requirements.

On-site fire hydrants and systems shall be provided where required by the fire code officials when a portion of the facility or building hereafter constructed or moved into or within the jurisdiction, is more than 400 feet from a hydrant on a fire apparatus access road (as measured by an approved route around the exterior of the facility or building).

Fire hydrants shall not be connected to a water main with less than an 8-inch diameter. However, a 6-inch water main may be approved if the design hydraulic calculations validate the ability to provide for the minimum fire flow regulated by the fire code official.

Each hydrant must be equipped with an independent gate valve for isolation during replacement or repair.

When placed at mid-block locations, fire hydrants are to be installed at a common property line. For ease of operation, fire hydrants shall also be located in areas that allow for the required clear zone.

All efforts shall be made to place fire hydrants outside of new or existing sidewalk and out of proximity to driveways or other vehicle accesses.

**Related Standard Drawing: 530-1, 550-1, 550-2, 550-3A, 550-3B, 550-4**

550.2. Materials

All fire hydrants shall be a dry barrel, traffic breakaway type, and be UL listed and FM approved conforming to AWWA C502.

The main opening valve shall be 5¼ inches compression type, opening against pressure and closing with pressure. The main valve shall open when turned counterclockwise. The valve operating nut shall be a 1½-inch National Standard pentagon nut.

Fire hydrants are to have a minimum pressure rating of 200 psi and be factory tested at twice the rated pressure.

The hydrant shoe must have 2 positive acting bronze drain valves that completely drain the hydrant by opening when the main valve is closed.

The nozzle section shall consist of 2 2½ inch hose connections and 1 4½ inch pumper connection. All nozzles shall be field replaceable. The thread type shall be National Standard Fire Hose Coupling Screw Threads.

The ground line connection, between the nozzle section and the barrel, shall incorporate the use of breakable lugs and be designed such that the nozzle section can be rotated to any increment of 360°.

The inside of all hydrants, except for bronze and machined surfaces, shall be coated in accordance with AWWA C502 standards. The exterior coating on the hydrant nozzle is to be painted yellow. The following paint products are approved for use in the City of Hillsboro water system: Rust-Oleum Corporation (Strust QT 4PK Gloss Sunburst Yellow, #V7747504 and Acrylic 1-GL 2PK 3700 Safety Yellow, #3744402); Sherwin-Williams Company (Controls Rust Spray Enamel Safety Yellow, #140-0571 and DTM ACRYLIC Gloss Acrylic Coating, #B66Y37) or an approved equal.

Fire hydrants shall be permanently marked with the manufacturer's name, size of valve opening, and year of manufacture.

Granular drain backfill material shall conform to ODOT Section 00430.11 for 1¼ to ¾-inch material.

## 550.3. Construction

### 550.3.1. Handling

The Contractor shall take care not to damage interior or exterior hydrant coatings. A strap or approved lifting device shall be used for lifting and setting hydrants, chains and cables are not allowed. Any repair of damaged surfaces below ground level shall be executed as required by the Water Department.

Surface damage repairs to coatings of nozzle area (above ground) shall include applying 2 coats of yellow enamel hydrant paint or as required by the Water Department.

### 550.3.2. Installation

Hydrants are to be installed in accordance with AWWA C600, AWWA Manual M17 and the manufacturer's recommendations. Hydrants shall be located as shown on the approved plans or as directed by the fire code official.

Backfill of hydrants shall comply with Subsection 520 "Trenching Backfill and Surface Restoration".

Any hydrant removed from service are required to be covered with a labeled plastic bag. Out of service hydrants are to be reported to the City of Hillsboro Fire Department by the end of the business day.

Hydrant bury depth shall be no more than 6 feet and no less than 30 inches below finished grade.

Hydrants installed in planter strips are to be located in the center of the planter strip, with a minimum distance of 24 inches (from center of hydrant barrel) from all sidewalks, wheelchair ramps or curb lines. At the sole discretion of the Water Department, hydrants may be allowed to be closer if conflicts or limitations are present.

Set hydrant elevation so that the traffic breakaway flange is between 3 and 6 inches above finish grade. Fire hydrant extension kits are not allowed for field height adjustments unless approved by the Water Department.

All hydrants are to stand plumb with ports parallel or at right angles to the curb, with the pumper connection facing the curb. The Water Department shall determine final position of port orientation.

**Related Standard Drawing: 530-1, 550-1, 550-2, 550-3A, 550-3B, 550-4**

### 550.3.3. Joints

Joint restraints shall be installed on all joints between the water main and the hydrant.

### 550.3.4. Base Blocks

Hydrants shall be placed on a 12-inch by 12-inch by 8-inch H solid concrete pier block set on 6 inches of compacted Class B backfill per Subsection 520 "Trench Backfill and Surface Restoration".

550.3.5. Drainage

For hydrant drainage, place clean granular drain backfill material around the base block, under the hydrant, and to a minimum elevation of 6 inches above hydrant drain openings (4 CF minimum).

550.3.6. Reflectorized Buttons

The Contractor is required to place a blue reflectorized button for each hydrant installed. Buttons are to be adhered to the roadway surface by thermoplastic pads, at the completion of final street surfacing.

**Related Standard Drawings: 550-4**

## 560. Water Service Connections

560.1. Design Requirements

560.1.1. Water Services

The City of Hillsboro Water Department is responsible for serving and maintaining water pipes from the water main to the customer's side of the water meter. Maintaining the piping between the water meter and the property being served is the customer's responsibility.

Developers requesting credit for existing water services that are to be removed as part of development, shall contact the Water Department prior to abandonment for information and eligibility. The Developer is responsible for removal of the existing meter box or vault, termination of the connection at the water main, and all necessary street repair and restoration of disturbed areas.

Water Department policy is to provide one water service per single tax lot for residential properties. Duplex structures on a single tax lot may be served by two water services. If a structure contains more than two dwelling units or customers on a single tax lot, a master meter must be installed. Subject to Water Department approval, commercial, industrial, and multi-family tax lots may be allowed additional services.

Standard water meter sizes available from the Water Department are 5/8x3/4-inch, 1-inch, 1½-inch, 2-inch, 3-inch, 4-inch, 6-inch, and 8-inch. The Engineer is responsible to properly size water meters for adequate service for the development, as required by the Oregon Plumbing Specialty Code (OPSC).

Single 5/8x3/4-inch, double 5/8x3/4-inch, and double 1-inch meters shall be served by a 1-inch copper service line. For flag lots and private tracts, no more than 4 5/8x3/4-inch meters are allowed to be grouped together, unless approved by the Water Department. A manifold assembly is required to reduce the number of water main taps and help minimize congestion within the public right-of-way for other infrastructure. Private service lines from meters shall be installed sequentially, i.e. the lines shall not cross when connected to the customer/lot.

Water meters are to generally be located in the public right-of-way adjacent to the street curb (6 inches off back of curb). Depending on the water service size and location, meters located on private property are to be in a recorded easement measuring 5 to 10 feet from each outside wall of the meter vault or box. The Water Department has final authority regarding the location of meters to best serve the City's requirements.

Water meters shall not be placed in driveways without prior approval from the Water Department. If approved, a traffic rated box and lid will be required.

All water meters 2-inch and smaller must be installed by the Water Department; 3-inch and larger meters are the responsibility of the Contractor.

All meters 1½-inch and larger will require a meter bypass (except for irrigation services).

Minimum required cover for service lines between the water main and meter is 30 inches in improved areas and 42 inches in unimproved areas.

**Note:** The numerical dimensional value describing the water service is the size of the water meter and may or may not correspond with the size of the required pipe or copper tubing.

560.1.2. Fire Services

Commercial and industrial properties where multiple water services are required as part of development (fire, domestic, irrigation) are to be supplied by a common pipe designed to meet maximum water demands for all services. Valves are required to be installed at each service branch for isolation. Fire services are to be designed with an inline valve at the property line to separate public piping from the private fire system.

**Related Standard Drawing: 560-1**

560.1.3. Fire Flushing

A controlled flush is required on all commercial/industrial fire sprinkler systems per the current adopted edition of NFPA-24. Contact and arrange for a Water Department representative to be on-site during the flushing process. A portable flow meter will be installed by the Water Department to monitor water flow rate and water usage of all flushed water.

A cleared area shall be left accessible on the fire system riser pipe for installation of the flow meter sensor. The necessary clear area distances between the flow meter sensor and miscellaneous fire system valves and fittings are shown in the table below.

**Table 560.1 – Required Fire Service Flow Meter Clearance Distances**

| Subject | Distance Away (Diameter) |
|---|---|
| Valves | ≥20 x D |
| Pumps | ≥20 x D |
| 90° Bend | ≥15 x D |
| Inlet Run | ≥15 x D |
| Outlet Run | ≥3 x D |

If adequate space is unavailable on the fire system riser pipe an alternate sensor location will need to be determined, requiring Water Department approval.

560.2. Materials

All materials for water services with 5/8x3/4-inch through 2-inch meters shall conform to AWWA C800 and be new and undamaged.

Brass products furnished under this specification, which are not in contact with potable water shall have an alloy composition of copper, tin, lead and zinc in accordance with ASTM B62. The material is to be copper alloy UNS C83600, commonly referred to as 85-5-5-5.

All brass components that are designed to be in contact with potable water must be made from either CDA/UNS Brass Alloys C89520 or C89833 with a maximum lead content of 0.25% by weight and comply with ANSI/AWWA C800 and ANSI/NSF Standard 61 Annex G.

Brass fittings shall comply with the Safe Drinking Water Act, as amended, and the U.S. Environmental Protection Agency (EPA).

Unless otherwise noted, all fittings and valves shall have a minimum working pressure of 150 psi.

All fittings shall either be stamped or embossed with the manufacturer's name or trademark.

560.2.1. Water Meters

Water meters must be ANSI/NSF 61 (Annex G) certified.

Water meters shall have straight-read, permanently sealed registers reading only in cubic feet increments. The water meter size shall be permanently marked on the register dial face.

Water meter housings shall be permanently cast or stamped identifying the size, model, serial number, and arrow showing direction of flow. The Water Department will designate serial numbers for meters.

All water meters shall be pressure tested at 300 psi. To be acceptable for installation meter registers must be accuracy tested between 98.55% and 101.5%.

All water meters are to be equipped with automated meter reading (AMR) capability. The meter reading system shall conform to AWWA C707.

Contact the Water Department for specific AMR model numbers and installation requirements.

Small Water Meters (5/8 x 3/4 through 2-inch)
Water meters 5/8 x 3/4-inch through 2-inch shall be the positive displacement nutating disc or oscillating piston type meters and conform to AWWA C700. The Water Department will supply all meters 2-inch and smaller.

All 5/8 x 3/4-inch and 1-inch water meters shall be designed with freeze protection. Breakable covers shall be made of cast iron, stainless steel, copper alloy, or engineering plastic per AWWA C700.

Connections for 5/8 x 3/4-inch and 1-inch meters shall be external straight threads conforming to ANSI/ASME B1.20.1. Connections for 1-1/2-inch and 2-inch meters shall be oval flange per Table 3 of AWWA C700.

**Related Standard Drawings: 560-3, 560-4, 560-5, 560-6, 560-7, 560-8, 560-9, 560-10**

Large Water Meters (3 through 8-inch)
All water meters 3-inch and larger shall be purchased and installed by the Contractor.

Water meters 3-inch to 6-inch shall be the compound type meters and conform to AWWA C702. Subject to Water Department approval, 8-inch water meters may be compounded type or turbine type, depending on customer flow requirements and meter accuracy parameters. Turbine water meters shall conform to AWWA C701.

Connections for 3-inch through 8-inch water meters shall be round flange type, conforming to ANSI/ASME B16.1 for cast iron pipe flange (class 125) and ANSI/ASME B16.24 for copper alloy flange (class 150).

Combination fire flow and domestic water meters shall be UL listed or FM approved and conform to AWWA C703/C702. The use and type of combination fire flow and domestic water meters can only be approved by the Water Department on a case-by-case basis.

**Related Standard Drawings: 570-3 Series & 570-4 Series**

560.2.2. Copper Tubing

All 3/4-inch and 1-inch tubing shall be annealed, seamless, type K soft copper tubing conforming to ASTM B88. All copper for 1½-inch and 2-inch meter water services shall be hard drawn temper (rigid), type K copper tubing, in 20-foot lengths conforming to ASTM B88.

The tubing shall be coupled using compression fittings having a positive gripping feature to prevent tubing pull-out.

560.2.3. Corporation Stops

All corporation stops shall be full port opening, ball-valve design and have a flow passage area equivalent to the fitting outlet flow area.

Corporation stops for ¾-inch and 1-inch direct taps shall be manufactured with AWWA CC tapered inlet threads and CTS compression type outlets with positive gripping feature.

1-inch corporation stops requiring tapping saddles shall be manufactured with external CC thread inlet and TLS compression type outlet.

560.2.4. Copper Meter Setters

2-inch copper meter setters are required on all water services with 1½-inch and 2-inch meters. These shall be designed for vertical inlet and horizontal outlet FIPT connections.

The vertical height of a copper meter setter shall be 15 inches for all water services with 1½-inch and 2-inch meters, and include a high or elevated by-pass assembly.

Copper meter setters shall include 2 angle ball valves, 1 at the inlet to the meter, and 1 at the outlet of the meter. Angle ball valves are to be full port and include drilled wings for padlock installation.

All solder used in the manufacturing of copper meter setters shall be lead free.

**Related Standard Drawings: 560-7, 560-8**

560.2.5. Tapping Saddles

Tapping saddle bodies shall be cast from ductile iron, meeting or exceeding ASTM A536, and have a minimum pressure rating of 150 psi.

Tapping saddles shall have double straps. Each strap shall have a minimum width of 1½ inches. Straps, bolts, nuts and washers shall be heavy duty type 304 stainless steel. Pipe sizes 4 inches and greater are to have 5/8-inch diameter bolts. Pipe sizes 3 inches and less may use 1/2-inch diameter bolts.

Tapping saddle outlet shall be internal CC thread to match the corporation stop threads. Tapping saddle thread much always match corps.

Tapping saddle gaskets shall be rubber or approved synthetic rubber. Saddles shall have a minimum pressure rating of 150 psi.

Tapping saddles are required to have an epoxy coating.

Tapping saddles are required for all 1-inch taps on a 4-inch pipe, taps on a 2-inch pipe and all 2-inch taps. For taps 3-inch and larger see Subsection 530.2.7. “Tapping Sleeves”.

560.2.6. Coupling and Elbows

Joints shall be CTS compression type with positive gripping feature or iron pipe thread (NPT).

Copper sweat fittings may be allowed on 1½-inch and 2-inch services on a case-by-case basis only. The Contractor shall contact the Water Department for approval.

560.2.7. Repair Bands

Repair bands shall be manufactured from Type 304 Stainless Steel and include ductile iron lugs per ASTM A536.

Bolts shall be made of high strength, low alloy, corrosion resistant steel conforming to AWWA C111/A21.11.

Gasket shall be Nitrile or virgin styrene-butadiene (SBR) rubber.

560.2.8. Sample Stations

Sample stations shall be above-ground freeze-proof type with a locking aluminum cover. Sample station exteriors shall be painted with OSHA Safety Blue and include City of Hillsboro logo, when required by the Water Department.

The inlet connection shall be female iron pipe thread (NPT).

All interior parts shall be extractable for maintenance without excavation.

**Related Standard Drawing: 560-2**

560.2.9. Meter Box and Covers

All meter box lids shall have the word “Water Meter” cast into the exterior surface.

See the Approved Products List for meter box and lid requirements.

5/8-3/4-inch and 1-inch Meter
Boxes shall be 12 inches wide by 20 inches long by 12 inches deep.

Meter box lids for installation in traffic areas are to be H-20 load rated concrete or cast iron traffic lids.

1½-inch and 2-inch Meter
Meter boxes and lids shall be 17 inches wide by 30 inches long by 18 inches deep.

Meter boxes and lids for installation in traffic areas shall be H-20 load rated.

3-inch to 8-inch Meter
Meter vault required see Subsection 570 “Precast Concrete Vaults”.

560.2.10. Water Service Valves (3/4-inch through 2-inch)

All angled or straight meter valves shall be full port opening, ball valve design, and have a flow passage area equivalent to the fitting outlet flow area. Both angle and straight meter valves shall have drilled wings for padlock installation.

Straight meter valves (curb stops) are to be either CTS compression or FIPT on both the inlet and outlet sides of the valve.

All angled meter valve inlet connections shall be CTS compression type with positive gripping feature.

560.3. Construction

Meter boxes and vaults for water services shall remain at finish grade and accessible at all times. Customers are responsible for maintaining a minimum 3-foot clear zone around these facilities, including landscape, fencing, retaining walls, signs etc.

The methods employed for handling and placing materials and equipment for construction of water service installation shall ensure that all piping and appurtenances are in good condition after installation and testing. Should damage occur to pipe, tubing, fittings, or other equipment, repairs and/or replacement will be required to the satisfaction of the Water Department.

Backfilling of water services shall comply with Subsection 520 “Trenching Backfill and Surface Restoration”.

Water services may be installed using trenchless installation methods such as boring or “Hole-Hawgs”. Trenchless installation may be required for new or replacement services within existing roadways.

560.3.1. Installation of Water Meters

The Water Department will furnish and set all water meters 2-inch and smaller. The Contractor is to furnish and install all water meters 3 inches and larger. Water services shall be activated by a Water Department representative, not the Contractor. Service activation will take place following approval of plumbing inspection, testing and approval of any required backflow prevention assemblies, and confirmation of all fees paid in full to the Water Department.

AMR shall be installed according to the meter manufacturer’s recommendations.

560.3.2. Service Placement

Water meter boxes shall be located in the public right-of-way adjacent to the street curb (6 inches from back of curb). Meter vaults shall be installed in the public right-of-way and per Section 570 “Precast Concrete Vaults”.

Meters located on private property shall be in a recorded public water easement measuring 5 to 10 feet from each outside wall of the meter vault or box. The Water Department has final authority regarding the location of meters to best serve the City.

Water services shall be installed perpendicular to the street centerline or curb line and located where shown on plans.

Meter boxes are to be placed outside of traffic areas (such as driveways, sidewalks and roadways) whenever possible. When a meter box is approved to be installed in a traffic area, the box and lid shall be H-20 load rated. See Subsection 560.2.9. “Meter Box and Covers”.

560.3.3. Service Taps

Service taps shall be a minimum of 18-inches from water main joints and fittings and minimum 12 inches from another tap. Multiple direct taps in, 1-inch size, shall be staggered if installed closer than 2 feet apart.

All service wet taps must be installed by an approved tapping contractor and under the direction of a Water Department representative. Contact the Water Department for a list of approved contractors.

Service taps on 4-inch and smaller water main pipe shall be tapped through a tapping saddle, with the exception of 1-inch taps on 4-inch pipe which may be direct tapped. Service taps on 6-inch and larger ductile or cast-iron water main pipe can be directly tapped for 1-inch per tubing, and tapped with a tapping saddle or sleeve for 1½-inch and larger meter water services.

560.3.4. Small Water Services (5/8-3/4-inch through 2-inch meters)

Service lines for 5/8x3/4-inch meters shall be 1-inch type K soft copper tubing with compression fittings. Service lines for double 5/8x3/4-inch meters or single 1-inch meters shall be 1-inch type K soft copper tubing with compression fittings. Service lines shall consist of one continuous piece of copper. No splices will be allowed unless the service is over 60 feet in length and/or is approved by the Water Department.

Service lines for both 1½-inch and 2-inch meters shall be 2-inch type K rigid copper tubing with compression fittings, and shall have a 2-inch curb stop valve installed at the water main connection. Curb stop valves for 2-inch service lines shall be supported by an 8-inch by 8-inch by 8-inch concrete pier block placed on undisturbed earth or compacted pipe zone material.

See Subsection 520 “Trenching Backfill and Surface Restoration”.

The Contractor shall follow the manufacturer’s recommended tightening method for brass compression fittings. Do not exceed the manufacturer’s recommended torque specifications for each specified fitting type.

The Contractor shall prepare all iron pipe (NPT) and CC threads (AWWA) with Teflon tape or pipe thread compound prior to installation.

The cutting of copper tubing shall be done in a neat and precise manner. Cuts shall be smooth, straight, and at right angles. After cutting, the tubing shall be reamed with a copper reaming tool to remove all roughness and sharp edges.

All services with meters 2 inches and less shall be marked on the adjacent top of curb. New curb shall be stamped with a minimum 1-inch tall, ¼-inch deep, “W” mark, directly on top of the curb. Existing curb shall be etched with a minimum 1-inch tall “W”, minimum 1/8-inch deep.

**Related Standard Drawings: 560-3, 560-4, 560-5, 560-6, 560-7, 560-8, 560-9, 560-10**

560.3.5. Large Water Services (3-inch through 8-inch meters)

For meters 3-inches and larger, service lines shall be minimum 4-inch class 52 ductile iron pipe. (3-inch meters shall be installed using 4-inch by 3-inch flanged reducers.) Ductile iron pipe must

extend a minimum of 5 feet beyond the downstream exterior wall of all domestic or fire service backflow vaults.

3-inch water services shall include a 2-inch diameter bypass pipe inside the meter vault with a curb stop valve inside. All other large water services are to be installed with a bypass pipe outside the meter vault with a gate valve inside unless otherwise approved by the Water Department. The bypass pipe for 4-inch and larger meters shall match the service size.

All large water services shall include either a 1½-inch or 2-inch meter test port installed on the customer side of the meter and a 1-inch sampling port on the meter bypass.

All large water services shall include adjustable pipe supports in the meter vault. Pipe supports shall be anchored into the floor of the vault using stainless steel anchors.

For large water service vaults, see Subsection 570 "Precast Concrete Vaults".

**Related Standard Drawings: 570-3 Series, 570-4 Series**

560.3.6. Service Testing and Disinfection

Water services that are installed along with water main improvements must be hydrostatic tested and disinfected prior to use, in accordance with Subsection 530.4 "Flushing, Hydrostatic Testing, and Disinfection".

If the water services are 20 feet long or less and not installed with other water system improvements they may, at the Water Department's discretion, be treated with 1% hypochlorite solution prior to assembly. The interior of all pipe, fittings, and valves shall be thoroughly cleaned and then swabbed, sprayed, or dipped in 1% hypochlorite solution.

All corporation stops used for testing and chlorination shall be removed prior to service availability, after testing, and later replaced with brass plugs.

560.3.7. Fire Service Installation

When installing private fire mains, the underground piping from the water supply to the system riser, lead-in connections to the system riser, and all hydrants shall be completely flushed before a connection is made to downstream fire protection system piping.

Coordinate with the Building and Water Department for underground piping inspection and fire riser installation. The Water Department will install a temporary flow meter on the system for the duration of the flushing procedure. When flow rates utilizing a temporary flow meter are unattainable, an alternate solution may be approved by the Water Department.

## 570. Precast Concrete Vaults

570.1. Design Requirements

Vaults are required with all 3-inch and larger water meter and backflow assemblies. All vault assemblies shall be equipped with an approved gravity drain line to a storm sewer or drained to daylight. When adequate gravity drainage is not available, a plumbed sump pump assembly may be approved by the Water Department.

Vaults shall be equipped with electrical power and adequate lighting when required by the Water Department.

Vault assemblies shall not be placed in sidewalks or other pedestrian walkways, unless absolutely necessary. At the sole discretion of the Water Department, installation in these restricted zones may be approved on a case-by-case basis. All vaults in walkways shall include a non-slip coating on the access hatch and the hatch drain plumbed to a storm system or other approved location. Contact the Water Department for vault lid/hatch requirements in and around vehicle access areas.

All vaults in high ground water levels shall be designed against floating with a safety factor of 1.50. The Engineer shall contact the Water Department regarding vault installation in high groundwater areas. Approval of these vaults is on a case-by-case basis only.

570.2. Materials

570.2.1. Precast Concrete Vaults

Vault structural design shall conform to ASTM C-857 and be constructed to withstand an H-20 load rating with a 30% impact factor.

Concrete for the manufacturing of vaults shall conform to ACI-318 and have a minimum compressive strength of 4500 psi after 28 days.

Vault rebar shall conform to ASTM A615 Grade 60 and wire mesh shall conform to ASTM A185 Grade 65.

Horizontal vault joints shall be sealed using a butyl resin sealant.

Where shown on the Standard Drawings, pipe blockouts shall be provided in vault walls.

Vaults shall be manufactured with a minimum 12-inch diameter by 3-inch depth sump, in the location shown on the applicable Standard Drawing.

Exterior walls and base of the vault must be waterproofed. Asphalt compounds of brush or spray consistency conforming to ASTM D449 may be used with the City's approval. Vaults waterproofed using clear compounds shall be marked in black paint or permanent marker which indicates the type of waterproofing material used.

Precast concrete vaults shall be furnished to the dimensions shown and as specified on the Standard Drawings.

570.2.2. Ladders

Vaults shall be equipped with fabricated steel ladders meeting the applicable OSHA requirements and drawings. Steel ladders and accessories are to be hot-dipped galvanized after fabrication.

Aluminum ladder extensions are required and must extend at least 3 ½ feet above vault lid.

Mounting bolts for ladders shall be ½-inch stainless steel provided by the manufacturer or product vendor.

All required hardware for vault ladders and other vault accessories shall be supplied or approved by the vault manufacturer.

**Related Standard Drawing: 570-1**

570.2.3. Sump Pumps

All sump pumps must be 115-volt plug-in type, not hard wire installed.

Sump pumps shall be furnished with an oil-filled, 0.3 hp energy efficient, 115 volt, 8-10 amp motor. Motor windings are to contain automatic thermal overload protection.

All sump pumps must be UL listed.

The pump shall be controlled by a wide angle float switch incorporating a three pronged piggyback plug arrangement.

Pump casing shall be watertight with a 1½-inch NPT discharge that is able to pass up to ½-inch solids.

Sump pumps shall include a 1½ -inch PVC check valve/ball valve/union combination unit on the discharge pipe.

If there is no electrical power accessible or there is a safety hazard in trying to get power, a high and water powered (hydraulic) pump may be installed, at the discretion of the Water Department.

**Related Standard Drawing: 570-2**

570.2.4. Vault Access Hatches

Pedestrian rated access hatches shall be manufactured from type 6061-T6 aluminum for bars, angles, and extrusions and type 5086 aluminum for diamond plate exterior surface. Provide a recessed lift handle with lock latch assembly. The slam lock keyway shall be protected by a threaded removable plug that sits flush with the exterior surface. All aluminum in contact with concrete shall be coated with a bituminous coating.

Vault lids shall be treated with an approved non-slip surface having a static coefficient of friction between 0.80 and 1.00 as specified by ASTM C1028.

For pipe connection, the access hatch channel drain shall be supplied with a 1½-inch PVC coupler on the underside of the channel frame for drain pipe connection.

Backflow Assembly vaults shall be furnished with heavy duty, hot-dipped galvanized diamond plate steel access hatches (doors) with spring assist and locking latches.

All hatch doors for areas with potential vehicle impacts, including pedestrian walkways, are to be H-20 rated.

570.2.5. Access Manholes

A manhole-style access lid will be required for applications where vaults are installed within public streets and roadways or high density traffic areas. Provide a 30-inch frame and lid together with

any required concrete riser rings. Riser rings shall be H-20 load rated with a max height of 12 inches. The manhole lid shall have the letter "W" cast in the exterior surface.

To provide a water tight seal, joint sealant shall be applied between the manhole casting/riser ring joints and riser ring/vault joints.

570.2.6. Pipe Supports

Pipe supports shall be manufactured from corrosion resistant galvanized steel and be bolted directly to a class 125 pipe flange.

Pipe supports shall be tested to a minimum compressive strength of 10,000 pounds.

All pipe supports are to be adjustable and include stainless steel hardware for anchoring the base to the vault floor.

570.3. Construction

Install all vaults according to the applicable Standard Drawings.

Carefully inspect all precast vault sections prior to installation. Do not use vault sections with chips or cracks in the tongue. Install gasket material in accordance with manufacturer's instructions and only use primer furnished by the gasket manufacturer.

Vaults are to be placed on a minimum 6-inch layer of compacted Class "B" backfill material per applicable Standard Drawing. Where poor ground conditions unsuitable for vault support are encountered, over-excavate and add foundation stabilization material, per Subsection 520.3.2 "Pipe Bedding and Trench Backfill".

Vault lid elevation shall be 3 to 5-inches above the finished ground surface, with the exception of a vault approved by the Water Department for installation within a sidewalk or other pedestrian walkway which should be flush with the walkway. Vault hatches within walkways are to have hatch drains plumbed to an approved storm system, or as required by the Water Department.

Installation of sump pumps shall include a line sized check valve, ball valve, union fitting and a Schedule 40 PVC pipe and fittings. Sump pumps shall not discharge water into the public right-of-way hardscape due to potential freezing. Sump pump discharge points shall be approved by COH Water.

If approved, provide electrical service to the vault with a voltage compatible with the sump pump motor, any vault lighting, and in accordance with applicable electrical codes. Conduit for power shall maintain minimum two feet separate from all other pipe penetration.

Pipe inlet and outlet penetrations shall be made through manufactured pipe block-outs. Holes shall be made by core drilling or by drilling a series of small diameter drill holes no more than 2 inches apart along the circumference of the opening. Openings shall be no larger than 2 inches greater than the pipe being installed. All wall penetrations for pipe or conduit shall be sealed with non-shrink grout, a mechanical pipe seal, or approved equal.

All pick holes created during manufacturing are to be filled with non-shrink grout prior to completion.

Vaults shall be watertight throughout the full depth, including pipe inlets and outlets.

**Related Standard Drawings: 570-1, 570-2A, 570-2B, 570-3 Series, 570-4 Series**

## 580. Corrosion Protection

### 580.1. Design Requirements

All transmission and distribution lines made of ductile iron or steel pipes shall be protected against corrosion per the following standards.

#### 580.1.1. Minimum Corrosion Protection Requirements

Minimum Cathodic protection for all critical and noncritical pipes and fittings shall include zinc-coating per ISO 8179-1 (Ductile Iron Pipes - External zinc-based coating - Part 1: Metallic Zinc with Finishing Layer) and shall be incased in polyethylene V- Bio encasement.

#### 580.1.2. Critical and Large Pipelines Corrosion Protection Requirements

Ductile iron pipelines that are determined by the City to be non-critical, and with a diameter of 10 inches or less, do not require soil resistivity testing but must satisfy minimum corrosion protection requirements.

Steel and ductile iron pipelines that are 10 inches in diameter and greater or are determined by the City to be critical (primary or secondary backbone pipelines, primary or secondary distribution mains) require soil resistivity testing and a cathodic protection system design, including a preliminary design report.

Critical pipes are described in the 2019 Water Master Plan. For future development, critical facilities will be define by the City's engineer specifically in South Hillsboro, North Hillsboro, Witch Hazel and other future urban growth areas.

#### 580.1.3. Additional Corrosion Protection Requirements, nearby Utilities and/or Corrosive Soils

Corrosion protection may be required where water systems are in close proximity to utility infrastructure carrying electrical current or where the natural soil has aggressive corrosive elements. Protection measures may include: minimum separation requirements, application of protective coverings and coatings, pipe joint bonding, and installation of dielectric isolation and galvanic anodes. Cathodic protection (CP) test stations will typically be required with anode installation and stray current mitigation methods to evaluate and monitor corrosion protection effectiveness.

Franchise utility installations that are in close proximity and considered a corrosion risk by the Water Department, will require the utility to submit a mitigation plan addressing liability and means and methods for reducing stray current impact to the Water Department's water system infrastructure. Utilities that are of primary concern for stray current include: NW Natural Gas piping (infrastructure utilizing an induced current cathode protection system), high voltage power lines such as BPA and PGE (overhead and underground transmission installations), and TriMet MAX Light Rail electrical system (area within 100-feet either side of tracks).

All corrosion protection equipment, materials and workmanship shall conform to the National Electrical Code, National Association of Corrosion Engineers, and manufacturer's installation recommendations.

580.1.4. Soil Sampling & Testing Plan

If soil resistivity testing and cathodic protection system design are required, the corrosion protection designer shall prepare and provide the following information for review and approval by the City Engineer prior to conducting any soil investigation including:

1. A map of the proposed project area, including the locations of any proposed water facilities, with the locations and types of soil investigations clearly indicated.

2. A description of each of the soil investigation methods to be used.

3. Qualifications and certifications for laboratories that will perform analysis and/or field personnel to conduct the investigations.

580.1.5. Soil Investigation Requirements

If soil resistivity testing and cathodic protection system design are required, the soil investigation shall be performed prior to pipeline design to determine the resistivity and potential for corrosion. The following recommendations are the minimum investigation requirements; however, the corrosion protection designer may recommend alternative methods within the sampling plan.

1. Both the Wenner Four-Electrode Method and the Two-Electrode Soil Box Method are accepted methods of performing soil resistivity measurements. Testing shall be performed in accordance with the latest version of ASTM G57 or ASTM G187.

2. Soil resistivity measurements shall be performed along the proposed pipe alignment at a minimum of two tests per block (or proposed block) in developed (or developing) areas, with spacing 500 feet maximum.

3. The measurements shall be performed at proposed pipe depths in accordance with ASTM requirements. If performed using the Wenner Four-Electrode Method, measurements shall be taken at 2.5-foot depth increments until a depth of 2.5 feet below the proposed pipe depth is reached (note that when using the Wenner Four-Electrode Method, "depth" refers to the spacing between the test electrodes). Resistivity of each 2.5 foot thick layer shall be calculated using the "Barns Layer" method.

4. Soil resistivity data records shall include a drawing showing test locations, as well as a data sheet containing the following information:

    a. Name of tester

    b. Date of test

    c. Test ID number

    d. Make and model of the testing equipment

    e. General description and location of the test

f. Pin spacing measurements in centimeters

g. Soil resistance measurements in ohms

h. Calculated soil resistivity in ohm-centimeters

5. Soil Evaluation and Lab testing

6. After gathering and analyzing the soil resistivity data collected in the field, the soil resistivity sample exhibiting the most resistance along the pipeline route will be selected as the representative sample and send to lab for additional soil testing.

580.1.6. Corrosion Protection System Report & Design

The preliminary design report shall include results from the resistivity testing, and shall identify other potential site-specific corrosion factors such as groundwater fluctuation, potential sources of stray electrical current, etc. which may impact the longevity of the pipe. Preliminary Design Report that will be reviewed by the COH Water Principal Engineer.

Design of a cathodic protection system shall be performed by a Professional Engineer with a minimum of 5 years of experience performing cathodic protection work (design and testing), or either a NACE International certified Cathodic Protection Specialist or a NACE International certified Corrosion Specialist.

Design shall be based on site soil electrical and chemical characteristics including soil resistivity, soil moisture content, soil pH, chlorides, sulfide, sulfates and redox potential values, determined by lab testing.

Design shall also consider other site-specific characteristics including influence of nearby power transmission lines and other metallic parallel or crossing utilities that may or may not be protected by anodes or other active corrosion protection systems.

The corrosion protection designer shall recommend the appropriate corrosion control measures to achieve a minimum service life of 50 years for the proposed facilities, including pipe material type and other cathodic protection design components. The corrosion protection designer shall provide and submit design details to the City, for review and approval.

580.2. Materials

580.2.1. CP Test Stations

<u>Wire and Cable</u>
Wire for test stations shall be insulated with high molecular weight polyethylene (HMWPE), thermoplastic heat and water resistant nylon coated (THWN), cross-linked high heat water resistant insulated wire (XHHW), or rubber insulated building wire (RHW) and be American wire gage (AWG) stranded copper with a 600-volt service rating. Wire size and color requirements can be found on the applicable Standard Drawing or as directed by the Water Department.

<u>Flush Mount (Type C)</u>
Test stations are to be installed in a traffic valve box, shall be 18-inches long with a 7-inch minimum inside diameter, Black Model 3639Z1 manufactured by Jordon Iron Works, or equal. The valve box

coating shall be polyethylene tape per AWWA C209. The tape shall be Polyken 930-35, or equal. The traffic box cover shall be cast iron with a weld bead legend “CP TEST”..

A phenolic terminal board, ¼-inch thick, shall be waterproof and sufficiently sized to accommodate termination of all required wire and connectors. Terminals shall be provided with studs, fasteners, stand-offs, and other hardware and shall be brass or copper, UL 486. Terminal labeling shall be engraved in the panel board, 1/4-inch high letters, 1/32 to 1/16-inch deep.

All CP test stations installed in combination with an monitoring coupons shall be equipped with a seal magnetically operated toggle switch, in a closed position, and adjustable mount, Model SM-ADJ-C as manufactured by Electrochemical Devices, Inc. (EDI), or equal. A minimum of 2 switch operators shall be supplied to the City. The operator shall be Model SM-MAG as manufactured by EDI, or equal.

580.2.2. Exothermic Welding

Cable and wire connections to pipe and fitting shall be made with an exothermic weld kit specifically designed by the manufacturer for welding the material type. Supply all necessary molds, cartridges, tools and supplies for performing exothermic welding as required. Manufacturer’s equipment and supplies are not to be interchanged with another manufacturer’s products.

Welder molds shall be graphite, ceramic molds will not be allowed. Cartridge load size recommendations from the manufacturer shall be followed closely with regard to pipe size, pipe material type, and wire or cable size Welding charges for use on cast and ductile iron are different from those used on steel.

Portable pin brazing equipment is an approved method for bonding cable and wire to pipe and fittings. Follow manufacturer’s recommended procedure and use appropriate equipment for the size of wire being attached and type of pipe material being bonded.

All exothermic welding and pin brazing equipment and supplies are to be submitted to and approved by the Water Department prior to performing work.

580.2.3. Exothermic Caps

Exothermic caps shall be electrically insulated elastomeric mastic caps that are soft and pliable for molding around exothermic welds. Exothermic caps shall include all manufacturer’s recommended primers and coatings for cap bonding on pipe surfaces.

580.2.4. Wire and Cable

Joint Bonds

Wire/Cable for joint bonds shall be HMWPE insulated, AWG stranded copper rated for 600 volts. Wire/Cable size and color requirements can be found on the applicable standard drawing or as directed by the Water Department.

580.2.5. Reference Electrodes and Monitoring Coupons

Copper-Sulfate reference cells shall be “permanent” type, designed for direct burial with a minimum 30 year life and stability of ± 5 mV.

a) Reference cells shall have a minimum of 28 square inch of sensing surface and capable of maintaining a potential within ± 10 mV of a freshly made cell while draining 3 microamperes.

b) Reference cells for transmission piping shall measure 10 inches diameter by 16 inches long minimum and weigh approximately 25 pounds. Reference cells for distribution piping shall measure 6 inches in diameter by 14 inches long and weigh 15 pounds.

c) Reference cells are to be equipped with No. 14 AWG stranded copper lead wire with yellow HMWPE or RHH-RHW insulation of suitable length to reach test station for proper installation without splicing (plus an additional 10 feet). Monitoring coupons shall be ductile iron with 10 $cm^2$ of exposed metal. The coupons shall have 2-#12 AWG wires with green THHN insulation. The wire shall be connected by a silver solder potted connection with a minimum length to reach the test station box, plus an additional 10-feet. The coupons shall be Model COU200 (ductile iron), as manufactured by M.C. Miller Co., or equal.

580.2.6. Galvanic Anodes

Supply high potential magnesium anodes meeting the requirements of ASTM B843. The anodes shall be 20-inches long and have a bare weight of 32 pounds.

Lead Wire:
Anode shall be No. 10 AWG furnished with stranded copper wire with black HMWPE insulation, minimum 10 feet long. Lead wire shall be unspliced and be attached by the manufacturer's connection, which shall be more durable than the wire itself.

Anodes shall be prepackaged in a permeable cloth bag containing the manufacturer's prescribed backfill. The backfill shall be a minimum of 2.5 times the bare weight of the anode.

580.2.7. Flange Insulating Kits

Gaskets shall be full faced, 1/8-inch, Type E with elastomeric sealing element and rated for maximum operating and test pressures of the water system. Sealing element shall be retained in a groove within the retainer portion of the gasket.

Insulating sleeves shall be full length fiberglass reinforced epoxy National Electrical Manufacturers Association (NEMA) G-10 grade.

Washers shall be NEMA G-10 insulating style, 1/8-inch thick. All accessories shall be as recommended by the manufacturer.

Flexible Coupling with Insulated Boot
The coupling body and end rings shall be manufactured from ductile iron per ASTM A536, grade 65-45-12. Gasket and insulating boot shall be manufactured of styrene-butadiene rubber (SBR) compound for water service. Bolts and nuts shall be 5/8-inch high strength, low alloy corrosion-resistant steel meeting AWWA C111-80. Couplings shall meet AWWA C219 standards.

580.2.8. Wire Connectors and Splice Connections

Wire Connectors (Test station terminals):
One-piece, tin-plated crimp-on lug ring connectors.

Splice Connectors (AWG 10 and larger wire):
Splice connections shall be made using copper or bronze split bolt connectors.

Splice Connectors (AWG 12 and smaller wire):
One-piece, tin-plated crimp-on connectors.

580.2.9 Tapes and Coatings

Electrical Tape:
Vinyl electrical tape shall be 7 or 8.5 mil, minimum thickness, and be designed for primary insulation and jacketing for splices/repairs rated up to 600V.

Insulating Putty:
Insulating putty is to be 125 mil self-fusing tape for connections rated up to 600V.

Corrosion Prevention Tape:
Tape shall be designed for use in underground applications with a minimum 50 mil thickness. Product is to be designed for cold application, incorporate an integrated primer and meet all applicable requirements of AWWA C209.

Mastic Coatings:
Approved bitumastic coatings can be found on the Approved Products List.

Rubber Splicing Tape:
30-mil Ethylene Propylene self-bonding tape.

Corrosion Protection Tape:
10 and 20 mil all-weather corrosion protection PVC tape, including quick-drying, non-sag rubber based primer.

580.2.10 Conduit and Fittings

PVC:
Conduit shall be Schedule 40 PVC, NEMA type II, UL listed for concrete encasement and underground direct burial. Fittings shall be Schedule 40 PVC, NEMA type II, solvent-weld conduit connections as recommended by conduit manufacturer.

Rigid Steel:
Conduit shall meet requirements of and be installed in accordance with NFPA Code 70. Fittings shall meet requirements of UL 514B. Connections shall be thread type. Both conduit and fittings shall be hot-dip galvanized with chromate protective layer, conforming to UL 6.

Cable Warning Tape:
Cable warning tape shall be 3-inch wide, yellow with black letters to say “CATHODIC PROTECTION CABLE BURIED BELOW”.

580.2.11 Pipe and Fittings Encasement Materials

Polyethylene (pipe bagging):
Encasement sleeves are to be minimum 8-mil thickness, low density (LLD), V-Bio enhanced polyethylene conforming to AWWA C105, Method A. The use of polyethylene sheets will not be allowed.

580.3. Construction

580.3.1. CP Test Stations

Installation of CP test stations may be required on any water infrastructure with the potential for being impacted by corrosion activity. This can include stray current mitigation sites, transmission pipelines and appurtenances, isolation points separating cathodically protected systems from unprotected infrastructure, and any other water infrastructure which may be highly impacted by corrosion activity.

Place test stations within a permanent waterline easement or dedicated public right-of-way. Only by approval are test stations to be placed in vehicular traffic and roadway areas. When pipelines and appurtenances are under paved surfaces, test stations shall be extended and placed in planter strips or sidewalks adjacent to the curb or edge of pavement. Test stations outside of traffic areas are to be placed immediately adjacent to the pipeline or appurtenance.

Flush Mount Stations:

Type C
The foundation for the test station box shall be a minimum of 6-inches of class “B” backfill.

The terminal board, complete with hardware, shall be laid in the box along with 24 inches coil of slack wire.

Take care to install test station so that lid sets flush with finish surface.

Reference Electrodes and Monitoring Coupons

Remove plastic shipping bag and install reference electrode 6 inches below spring line of pipe, and no more than 18 inches from outside edge of pipe.

The monitoring coupons to be installed 2-inches from the end of the reference electrode and 18-iches from outside edge of pipe.

Route wire through conduit and terminate in test station.

Place native soil free of rocks, clods and other debris around the reference electrode, backfilling in 6-inch lifts.

**Related Standard Drawings: 580-4 Series**

580.3.2 Galvanic Anode

All anodes to be connected directly to the pipe, at pipe joints, using either the exothermic weld or pin brazing method.

1. Galvanic anodes to be installed at the ends of the pipe runs and every 140- feet between the ends. No anode to be installed within 10- feet of a test station, reference electrode, or monitoring coupon.

2. The anodes to be installed either 5 feet below the pipe or 1-foot below the pipe and 5- feet to the side of the pipe.

3. Pour 10 gallons of water over the anode prior to backfilling.

4. Place native soil (free of rocks, clods and other debris) around the anode, backfilling in 6-inch lifts.

**Related Standard Drawings: 580-5 Series**

580.3.3. Exothermic Welding and Pin Brazing

Exothermic Welding

All connections of copper wire and/or cable to steel, ductile, and cast iron surfaces shall be made by exothermic (thermite) weld method or pin brazing.

1. Take precaution to ensure that pipe and fitting wall thickness is sufficient so that the thermite weld method will not damage the integrity of the pipe or fitting. Only the manufacturer's recommended equipment and supplies for each specific thermite weld application will be allowed. Note: Welding charges for use on cast and ductile iron are different from those used on steel.

2. Prior to making the weld connection, a 3-inch by 3-inch window shall be prepared by removing the outside surface coating down to bare metal. File or grind surface to a bright metal finish. Only vitrified type grinding wheels are acceptable for use; resin wheels will not be allowed.

3. Trim insulation to sufficient length and then install copper sleeves on the ends of the cables or wires. Proceed with thermite welding in strict accordance with the manufacturer's written instructions. Surface shall be completely dry prior to attempting a thermite weld.

4. After the connection has cooled, clean slag, and then strike weld with a hammer, while pulling on the wire at a 45 degree angle to test for defects. Remove and replace any defective connections.*

5. Lead wires shall have no less than 4 to 6 inches (depending on the weld) of separation between welds. A separate weld shall be made for each wire connection.

6. Install prefabricated thermite weld cap over each completed connection or specified insulating materials, as shown on the applicable Standard Drawing.

7. All thermite weld connections shall be inspected and approved by a Water Department representative prior to backfill.

**Related Standard Drawings: 580-7 Series**

Pin Brazing

1. Make wire connections to the pipeline or other structure with pin braze process per manufacturer's recommendations.

2. Remove a minimum amount of the existing coating required for placement of the pin braze mold on the steel structure. The steel surface must be completely clean and dry (near white metal surface preparation).

3. To prevent the steel surface from re-oxidizing, brazing must take place as soon as possible after grinding; no more than a 5 minutes delay.

4. Test the weld integrity by striking it from the side with a two pound hammer, while pulling on the wire at a 45 degree angle. If the weld comes off or cracks, move away a minimum of 6 inches and repeat welding process. Do not re-weld in the same location.

5. Apply primer and weld cap per manufacturer's recommendation.

6. Apply generous coat of bitumen over the weld cap and weld area, overlapping the pipe coating by 3 inches. Allow bitumen to cure per manufacturer's recommendation prior to repair of pipe coating.

7. Wet or damp exothermic weld molds will produce porous welds. The mold shall be completely dry before attempting to weld.

8. All connections shall be placed at distances specified in the Detail Drawing.

**Related Standard Drawings: 580-7 Series**

580.3.4. Wire and Cables

Test Station Installation

1. The bottom of the trench shall be free from stones, roots, or other materials. Use care to avoid abrasions, cuts, punctures, or any other damage to wire or cable during installation.

2. Each wire and/or cable shall be continuous in length and free of joints or splices unless otherwise specified or shown on the drawings.

3. Place wire in a rigid PVC conduit as required. Allow a minimum 2 foot slack loop in each cable/wire between the pipe connection and the conduit. Any conduit extending above finish grade shall be rigid steel for the full vertical length.

4. All buried wire, except for joint bond cables, shall have cable warning tape placed 12 inches directly above the entire length of run during backfill operations.

5. Wire shall be color coded as shown on the Standard Drawing. Each color is to be impregnated into the insulation material. Colored tape or paint will not be accepted.

6. Joint bonds shall be bonded as shown on the Drawings and shall be installed with the detail noted cable.

7. Wire connectors for test stations are to be crimp-type and sized for connecting ring terminals.

8. At least 24 inches of slack shall be left for each terminal at each test station. Slack shall be made available for wire extension beyond the test station enclosure.

9. Continuity testing shall be performed by the Contractor on all CP test stations following completion of backfilling and hydrostatic testing of the water system. The Water Department is required to be present during all continuity testing.

Splicing and Insulation Repair

Wire/Cable splices will generally not be permitted, except with Water Department approval. When a splice is approved by the Water Department, use the following method:

Splicing Method “A” (#12 and smaller wire)

1. Splices shall be made using a suitable sized copper alloy compression connector. All splice connections are to be inspected by the Water Department, prior to being wrapped.

2. Spiral wrap, in both directions, a minimum of 4 inches beyond the splice connection with two layers of rubber splicing tape. Tape shall be applied using a 50% overlap application method.

3. Spiral wrap the area covered by rubber splicing tape with two layers of electrical tape, using a 50% overlap application method.

Splicing Method "B" (#10 and larger wire/cable)

1. Splices shall be made using a suitable sized split bolt connector. All splice connections shall be inspected by the Water Department, prior to being wrapped.

2. Apply insulating putty to the entire splice connection, molding edges to a smooth surface.

3. Spiral wrap the connection area with two layers of electrical tape, using a 50% overlap application method.

Insulation Repair

Damage to wire/cable insulation shall be inspected by the Water Department to determine whether a repair can be made or replacement is required. To repair insulation, follow steps 2 and 3 of Splice Method "A" listed above.

580.3.5. Dielectric Insulation

Electrical isolation is required at all connections between galvanically dissimilar pipe materials, new and existing pipe sections, protected and unprotected metallic structures, or any other locations deemed necessary by the Water Department.

Flange Isolation

All insulating flange components are to be clean and free of grease and oil prior to assembly.

Bolt holes in mating flanges shall be properly aligned at the time bolts and insulating sleeves are inserted to prevent damage. After flange bolts have been tightened, each insulating washer and bolt sleeve shall be inspected for cracks or other damage. Damaged washers and sleeves shall be replaced as required.

Insulating Couplings

Clean each pipe end for a distance of 2 inches greater than length of insulating boot. Check area where gaskets will seat to make sure there are no dents, projections, gouges, or other defects that will interfere with the gasket seal. Grind welds flush with pipe surface.

Take extra care to follow the manufacturer's bolt tightening procedures and torque recommendations.

Cover all bare metal with two coats of mastic protective coating.