IRVINE RANCH WATER DISTRICT 15600 Sand Canyon Ave., P.O. Box 57000, Irvine, CA 92619-7000 (949) 453-5300

April 18, 2012

Attention: IRWD General Technical Specification Holders

Subject: IRWD General Technical Specifications – 2012 Revision No. 1

This letter is to provide notice of revisions made to the Irvine Ranch Water District's (IRWD's) General Technical Specifications. The following sections have been revised:

Section	Description	Revision Date
--	Table of Contents	03/05/2012
15089	Combination Air Release and Vacuum Relief Valves	03/05/2012
15100	Manual Valves	03/05/2012
15120	Hydraulically Controlled Diaphragm-Actuated Valves	03/05/2012
15151	Facilities Identification	03/05/2012
16150	Electric Motors	03/05/2012
16640	Cathodic Protection and Joint Bonding	03/05/2012

Holders of the IRWD's General Technical Specifications shall remove the abovementioned table of contents and specifications from their existing specifications manual and replace them with the revised table of contents and specifications provided herein or completely replace their existing specifications manual with the latest manual located on the IRWD website.

The latest General Technical Specifications can be accessed by going to http://www.irwd.com, clicking "Engineering & Planning" under the "Doing Business" tab. At the "Engineering & Planning" page, the "Engineering Documents" link can be selected that will take you to the page where the General Technical Specifications are located. You can also select or type in the address below:

http://www.irwd.com/assets/files/engfiles/irwdgeneraltechnicalspecs.pdf.

The following is a summary of the major substantive changes of the specifications provided in the first revision for 2012.

Section 15089 – Combination Air Release and Vacuum Relief Valves

- A.R.I. D-040 ST is an acceptable combination air release and vacuum relief valve.

Section 15100 – Manual Valves

- Acceptable manufacturer and product updates for: resilient seated gate valves, butterfly valves, lubricated plug valves, eccentric plug valves, and check valves.
- Valve component materials were updated for the various valves.
- Acceptable manufacturer and products for gaskets were updated.
- Dezurik and Mueller were added as an acceptable traveling nut actuator.

Section 15120 – Hydraulically Controlled Diaphragm-Actuated Valves

- The pilot control system, piping, and tubing shall all be Type 303 stainless steel. Cast bronze for the pilot control system and copper for the piping and tubing are no longer acceptable materials.

Section 15151 – Facilities Identification

- Red warning tape shall be used for cathodic protection wiring.

Section 16150 – Electric Motors

- The requirement for stator wire wraps to be dipped and baked three times was removed. Stators shall be vacuum-impregnated and baked a minimum of two times.

Section 16640 – Cathodic Protection and Joint Bonding

- Acceptable manufacturer and product updates for: alumino-thermic weld caps, test station boxes, flange insulation kits, above ground insulating flange external coatings, utility markers, casing seals, reference electrodes, and dielectric coatings over thermic weld connection.
- Square test station boxes 13"x24"x12" are no longer acceptable. Test station boxes shall be 10-inch in diameter and 12-inch deep.
- Identification tags will now be plastic tags instead of brass tags. Blank plastic tags will be housed in the IRWD warehouse and furnished to the contractor for engraving.
- Minimum measured open circuit potential provided for anode and pipe lead wire integrity tests based on anode types.

If you have questions or suggestions for revisions, please contact Jacob Moeder, Chairman of the General Technical Specifications Committee at (949) 453-5554 or at Moeder@irwd.com.

Sincerely,

Kevin L. Burton, P.E.
Executive Director of Engineering & Planning

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SECTION 15089: COMBINATION AIR RELEASE AND VACUUM RELIEF VALVES

PART 1 - GENERAL

A. Description

This section describes materials and installation of combination air release and vacuum relief valves, hereafter referred to as "valves", for 4-inch and smaller valves used for potable and non-potable water systems.

B. Related Work Specified Elsewhere

1. Painting and Coating: 09900

2. Hydrostatic Testing of Pressure Pipelines: 15042

3. Manual Valves: 15100

C. Submittals (For Contracts Between District and Contractor)

1. Shop drawings shall be submitted in accordance with the General Provisions and as specified herein.

2. Submit manufacturer's catalog data. Show dimensions, materials of construction by ASTM reference and grade, and protective coating and lining.

PART 2 - MATERIALS

A. Valves

1. Valves shall be 1-inch, 2-inch, 3-inch or 4-inch in diameter and shall include:

   a. A float assembly and large venting orifice to exhaust large quantities of air from pipelines when being filled and to admit large quantities of air when pipelines are being drained. Valves shall have a body with a flanged or threaded top containing the air release orifice. The float shall rise with the water level in the valve body to close the orifice by sealing against a synthetic rubber seat. The float shall withstand an external pressure of 1,000 psig without collapsing.

   b. 1-inch and 2-inch valves and shall include a 3/8-inch threaded outlet with stainless steel plug in the top cover or near the bottom of the valve body. 3-inch and 4-inch valves shall include a 1-inch threaded outlet with stainless steel plug near the bottom of the valve body or on the side of the valve body above the minimum water level.

2. Materials of construction for valves shall be as follows:

Item	Material	Specification
Body and cover	Cast iron or stainless steel with reinforced nylon	ASTM A 126, Class B
Float	Stainless steel or foamed polypropylene	Stainless steel: AISI Type 316, ASTM A 240 or A 276 Foamed Polypropylene: ASTM-1895-89
Guide rod, guide bushings	Stainless steel	AISI Type 316, ASTM A 240 or A 276
Seat	EPDM	---
Valve trim	Stainless steel	AISI Type 316, ASTM A 240 or A 276
Cover bolts	Stainless steel	AISI Type 316, ASTM A 193, GR B8M

3. Valves shall be designed for an operating pressure of 150 psi unless otherwise specified in the plans or specifications. Valves shall be APCO 140C/150C series; Val-Matic Model 200C series, A.R.I. D-040 ST, or Crispin UL series, or for contracts between District and Contractor, approved equal.

B. Valve End Connections

1. Applications: 1-inch and 2-inch valves shall have threaded ends at the bottom of the body. 3-inch and 4-inch valves shall have flanged ends.

2. Threaded Connections: Threaded ends shall comply with ANSI B1.20.1.

3. Flanged Connections: Flanges for Class 150 valves shall comply with ANSI B16.1, Class 125. Flanges for Class 300 valves shall comply with ANSI B16.1, Class 250.

C. Bolts and Nuts for Flanged Valves

1. Bolts and nuts for flanged valves and flanges shall be Type 316 stainless steel conforming to ASTM A 193, Grade B8M, for bolts and ASTM A 194, Grade 8M, for nuts.

2. Washers shall be provided for each nut, shall be of the same material as the nut, and shall be installed adjacent to the nut, between the nut and the flange.

3. The length of each bolt or stud shall be such that between 1/4 inch and 1/2 inch will project through the nut when drawn tight.

D. Gaskets

Gaskets for flanged end valves shall be as described in the individual piping specifications.

E. Coating

Valves shall be coated on the exterior in accordance with Section 09900, Painting and Coating. Prime coat shall be shop-applied at the place of manufacture. Finish coat shall be applied in the field. Color of finish coat shall match the color of the adjacent piping.

F. Lining

Interior surfaces of the valves shall be coated in accordance with Section 09900, Painting and Coating, System No. G-1. Seating areas and plastic, stainless steel, or other high alloy parts shall not be coated.

G. Vented Cover

1-inch and 2-inch valves shall be enclosed inside a removable vented cover as shown in the IRWD Standard Drawings. Vented covers shall be manufactured of linear-low-density polyethylene (LLDPE) as made by Armorcast Products or by Pipeline Products, Inc.

3-inch and 4-inch valves shall be enclosed inside a removable, cylindrically-shaped, vented cover fabricated of welded steel pipe, hot dip galvanized after fabrication and painted in accordance with Section 09900, Painting and Coating.

PART 3 - EXECUTION

A. Installation

Valves shall be installed in accordance with the IRWD Standard Drawings.

1. Tap: The tap for the valves shall be made in a level section of pipe no closer than 18 inches to a bell, coupling, joint, or fitting.

2. Threaded Connections: Threaded joints shall be cleaned by wire brushing or swabbing. Teflon joint compound or Teflon tape shall be applied to pipe threads before installing threaded valves. Joints shall be watertight.

3. Flanged Connections: Flanges shall be cleaned by wire brushing before installing flanged valves. Flange bolts and nuts shall be cleaned by wire brushing, and threads shall be coated with anti-seize compound. Nuts shall be tightened uniformly, and in the sequence pattern and torque setting recommended by the manufacturer. If flanges leak under pressure testing, nuts and bolts shall be loosened or removed, the gasket reseated or replaced, the bolts and nuts reinstalled or retightened, and joints retested. Joints shall be watertight.

B. Valve Pressure Testing

Valves shall be pressure tested at the same time that the connecting pipelines are pressure tested. See Section 15042, Hydrostatic Testing of Pressure Pipelines, for pressure testing requirements. Valves, operators, or control and instrumentation systems whose pressure rating is less than the test pressure shall be protected or isolated during pressure testing.

END OF SECTION

SECTION 15100: MANUAL VALVES

PART 1 - GENERAL

A. Description

This section describes materials, testing, and installation of manually operated valves and check valves.

B. Related Work Specified Elsewhere

1. Painting and Coating: 09900
2. Hydrostatic Testing of Pressure Pipelines: 15042

C. Submittals (For Contracts Between District and Contractor)

1. Shop drawings shall be submitted in accordance with the General Provisions and as specified herein.

2. Submittals shall include the following information at a minimum. Factory signed and dated certification of compliance shall accompany all submittals. Signatures of agents or distributors of the factory will not be accepted.

    a. Manufacturer's catalog data and detail construction sheets showing all valve parts and describing materials of construction by material and specification (such as AISI, ASTM, SAE, or CDA).

    b. Valve dimensions including laying lengths.

    c. Dimensions and orientation of valve actuators, as installed on the valves.

    d. Valve linings and coatings.

    e. Factory torque sheets minimally supplying actuator output and valve input torque requirements. Method for calculating input torque shall be the same as per AWWA Class 150B designation.

    f. Manufacturer’s warranty. Where electric motor actuators are used, the valve manufacturer shall include the electric motor actuator warranty and shall be the responsible party for both the valve and the electric actuator. Electric motor actuators shall be installed by the valve manufacturer to maintain both manufacturer warranties.

D. Valve Selection Criteria

Selection of the type of valve for a given application within IRWD's distribution and transmission system shall follow the criteria defined below.

Selection Criteria			
Nominal Valve Diameter (inches)	**Normal System Static Operating Pressure (0 to 100 psi)**	**Normal System Static Operating Pressure (100 to 150 psi)**	**Normal System Static Operating Pressure (150 to 250 psi)**
3 and smaller	Ball	Ball	Ball
4	Gate	Gate	CL 250 Butterfly
6	Gate	Butterfly	CL 250 Butterfly
8	Gate	Butterfly	CL 250 Butterfly
10	Gate	Butterfly	CL 250 Butterfly
12 and larger	Butterfly	Butterfly	CL 250 Butterfly

PART 2 - MATERIALS

A. General

Valves shall be provided complete with operating hand-wheels, levers, chain-wheels, extension stems, floor stands, worm gear actuators, operating nuts, chains, and wrenches as required for operation.

Valves shall have the name of the manufacturer and the size of the valve cast or molded onto the valve body or bonnet or shown on a permanently attached corrosion-resistant plate.

B. Resilient Seated Gate Valves, 4-inch through 10-inch:

Resilient seated wedge-type, gate valves shall conform to AWWA C-509 and the following requirements.

1. Valves shall have a wedge-type resilient seat fully encapsulated in peroxide-cured EPDM.

2. Valves shall be designed for a minimum working pressure of 200 psi.

3. Valves shall have non-rising stems fabricated of Type 304 or 316 stainless steel. As an alternate, stem material may be high strength bronze alloy. Stem nuts shall be independent of the gate and shall be made of bronze.

   Materials of construction shall be as follows:

Component	Material	Specification
Body, Operating Nut, Bonnet, Seal Plate	Cast Iron or Ductile Iron	ASTM A-126, Class B; or ASTM A-536, Grade 65-45-12
Gate	Cast Iron or Ductile Iron	ASTM A-126, Class B; or ASTM A-536, Grade 65-45-12
Stem	Stainless Steel or high-strength, low zinc Bronze	AISI 430F; ASTM A-582 or Type 316; ASTM B-584 CDA 867
Stem Nut	Bronze	ASTM A-116 CDA 844
Nuts & Bolts	Stainless Steel	ASTM A-276, Type 316
Valve Seat	EPDM Rubber	ASTM D-412

O-Rings	Synthetic Rubber	ASTM D-2000

Low friction, torque reduction thrust bearings shall be provided both above and below the stem collar. Stuffing boxes shall be O-ring seal type with two rings located in stem above thrust collar.

Each valve shall have a smooth unobstructed waterway free from any sediment pockets. Gates shall be of the wedge-type and shall be encapsulated in peroxide-cured EPDM rubber.

Valves shall be American AVK, Clow RW, M&H Style 4067, Matco Norca, Mueller A2360, U.S. Pipe or for contracts between District and Contractor, approved equal.

C. Butterfly Valves 4-inch and Larger:

Butterfly valves shall be short body, flanged type, conforming to AWWA C-504, Class 150B. Wafer style valves shall not be used.

Unless otherwise noted, minimum working differential pressure across the valve disc shall be 150 psi.

Valve ends shall be as shown on the drawings and in all cases shall match the class rating of the valve. For example, Class 150 valves shall have 150-lb flanges and Class 250 valves shall have 250-lb flanges. Flanged ends shall be Class 125, ANSI B-16.1 unless otherwise specified. Note that all butterfly valves 12-inch in diameter and larger are required to have flanged ends to meet the requirements for valve leakage testing. Refer to Part 3, sub-section D, paragraph 2 for testing requirements.

Valve shafts shall be Type 304 or 316 stainless steel for Class 150 valves and 17-4 PH stainless steel for Class 250 valves. Valve shafts may be stub shaft or one-piece units extending completely through the valve disc.

Materials of construction shall be as follows:

Component	Material	Specification
Body	Cast Iron or Ductile Iron	ASTM A-126, Class B; or ASTM A-536, Grade 65-45-12
Valve Shaft (CL 150)	Stainless Steel	Type 304 or Type 316
Valve Shaft (CL 250)	Stainless Steel	Type 17-4
Exposed body cap screws, bolts & nuts (including squeeze-pins)	Stainless Steel	ASTM A-276, Type 316
Discs	Cast Iron or Ductile Iron	ASTM A-48, Class 40; or ASTM A-536, Grade 65-45
Valve Seat	EPDM Rubber	ASTM D-412
O-Rings	Synthetic Rubber	ASTM D-2000

The rubber seat shall be made from peroxide-cured EPDM rubber and shall be fastened integrally within the valve body. Rubber seats fastened to the disc by any means shall not be allowed.

Valves shall be Crispin K-Flo Series 47 or 500, Dezurik BAQ, Mueller Lineseal, Pratt Groundhog, or for contracts between District and Contractor, approved equal.

D. Other Valves

The following valves shall be used as specified in the Contract Documents.

1. Above Ground Valves 3-inch and Smaller:

Ball valves shall be used for above ground valves 3-inch and smaller.

Ball valves for water service shall be the three-piece body style and shall be Type 316 stainless steel. The minimum design operating pressure rating shall be 300 psi WOG at a temperature of 150° F.

Valves shall have plastic coated stainless steel lever actuators with a locking mechanism. Valves shall have full-bore ports, female iron pipe thread screwed ends, and non-blowout stems.

Materials of construction shall be as follows:

Component	Material	Specification
Body, Ball, Stem	Stainless Steel	Type 316, ASTM A-276
Seat, Seals	Teflon	--

Valves shall be Apollo, Sharpe, Stockham Figure S-127, Xomox, or for contracts between District and Contractor, approved equal.

2. Ball Valves 4-inch through 12-inch:

Ball valves 4-inch through 12-inch shall be rated for a minimum working pressure of 150 psi. Ball valves shall meet or exceed the requirements of AWWA C-504 and C-507 and shall have flanged ends. Valves shall have Proof of Design testing with documentation per AWWA C507.

Valves shall be of the "double-seated" style and shall provide drip-tight closure in both directions.

Materials of construction shall be as follows:

Component	Material	Specification
Body, Ball	Ductile Iron	ASTM A-536, 65-45-12; ASTM A-395/395M
Stem, Shaft	Stainless Steel	18-8 Type 304 or 17-4 Type 630
Seat, Seals	EPDM Rubber	--

External valve trim and all exposed threaded components shall be corrosion resistant alloys of stainless steel, Type 316L or District approved equival.

Valves shall be Jamesbury Series 9000, Pratt rubber-seated, or for contracts between District and Contractor, approved equal.

3. Lubricated Plug Valves 6-inch through 20-inch:

Lubricated plug valves of sizes 6-inch through 20-inch shall have cast iron (ASTM A-126, Class B) bodies and plugs. Valves shall be of the regular pattern with bolted glands and resilient packing. Plug coating shall be Teflon, permanently bonded to the plug. Unless noted otherwise on the drawings, valve ends shall be flanged, with face-to-face dimensions conforming to ANSI B-16.1, Class 125. Valve shall have a pressure rating of 200-psi WOG. Valves shall be enclosed worm gear operated and watertight for submerged service. Valves shall be lubricated with the manufacturer's recommended lubricant for cold-water service.

External valve trim and all exposed threaded components shall be corrosion resistant alloys of stainless steel, Type 316L.

Valves shall be Galli & Cassina, Nordstrom, or for contracts between District and Contractor, approved equal.

4. Eccentric Plug Valves, 4-inch through 12-inch:

Eccentric plug valves, 4-inch through 12-inch shall be of the non-lubricated type. Minimum pressure rating shall be 175 psi. Unless noted otherwise on the drawings, ends shall be flanged, Class 125 per ANSI B-16.1. Plugs shall be provided with Polytetrafluoroethylene (PTFE) grit excluders to protect the upper and lower journal bearings. Materials of construction shall be as follows:

Component	Material	Specification
Body	Cast Iron	ASTM A-126, Class B
Plug	Cast Iron, Ductile Iron	ASTM A-126, Class B; ASTM A-536, Grade 65-45-12
Journal Bearings	Sintered Stainless Steel	ANSI 316

Plugs shall have neoprene, Buna-N facing to provide drip-tight shutoff.

Valve body seats shall have a raised welded-in overlay of not less than 90 percent nickel. Plug shall be of the one-piece design. Proof of design shall accompany submittals and leak tests shall accompany shipment.

External valve trim and all exposed threaded components shall be corrosion resistant alloys of stainless steel, Type 316L.

Valves shall be Dezurik Series 100 PEC, Pratt-Milliken 600 series, or for contracts between District and Contractor, approved equal.

5. Check Valves 4-inch and Larger:

a. Swing Check Valves: Swing check valves shall conform to AWWA C-508, and shall be iron body, bronze mounted with the following materials of construction:

Component	Material	Specification
Disc, disc seat ring, valve body seat ring	Bronze or Brass	ASTM B-62, B-16, or B-584 (alloys C-84400 or C-87600)
Body and Cap	Cast Iron or Ductile Iron	ASTM A-126, Class B; or ASTM A-536, Grade 65-45-12
Hinge or Arm	Cast Iron	ASTM A-126, Class B
Hinge Pin	Stainless Steel	ASTM A-276, Type 303, 304 or 410
Cover Bolts & Nuts	Stainless Steel	ASTM A-193, Grade B8M; ASTM A-194, Grade 8M

Ends shall be flanged, Class 125, ANSI B-16.1. Valves shall be designed for a minimum working pressure of 150 psi.

Valve shall be equipped with outside lever and spring.

Valves shall be Clow 1106 M&H Style 259, Pratt Series 8001, or for contracts between District and Contractor, approved equal.

b. Silent Check Valves, Class 150: Silent check valves shall be designed to be installed between the flanges of the adjoining pipe. Valves shall be equipped with a spring mechanism to provide for non-slam closure of the valve without backflow, in any position, and shall not be dependent on gravity or backflow for closure.

Materials of construction shall be as follows.

Component	Material	Specification
Body	Cast Iron or Ductile Iron	ASTM A-126, Class B; or ASTM A-536, Grade 65-45-12
Plug and Seat	Bronze or aluminum bronze	ASTM B-584 or ASTM B-148
Spring, Pin, Stops	Stainless Steel	ANSI Type 316
AISI Type 316	EPDM Rubber	ASTM D-412

Valves shall be APCO Series 600, Pratt Series 821, Titan CV 50-DI-B or for contracts between District and Contractor, approved equal.

6. Solenoid Valves 1-1/2-inch and Smaller:

Solenoid valves of sizes 1/4-inch through 1-1/2-inch for water and air service shall have forged brass (Alloy C-23000) or bronze (ASTM B-62) bodies with Teflon main seats. Internal plunger, core tube, plunger spring, and cage assembly shall be stainless steel (Types 302, 304, or 305). Solenoid enclosures shall be NEMA Type 4. Valve actuators shall be 120-volt AC or 24-volt DC as stated on the plans. Seals shall be Teflon. Valves shall have a maximum operating pressure and a maximum differential pressure of 250 psi.

Solenoid valves shall be energized to open or close, as required. Valves shall be ASCO "Red Hat" only, and there are no equals.

7. Tapping Valves:

Tapping valves shall conform with the requirements for resilient wedge gate valves 4-inch and larger. Valve ends shall be flanged, and the flange at one end shall have slotted bolt holes to fit standard tapping machines. Seat rings shall be oversized to permit the use of full-size cutters. Tapping valves shall be Kennedy, Mueller, or for contracts between District and Contractor, approved equal.

E. Valve Actuators

1. General Requirements for Gear Actuators:

   a. Gear actuators shall be enclosed, suitable for operating in grease with seals provided on shafts to prevent entry of dirt and water into the actuator.

      i. External trim and all threaded parts of the actuator shall be Type 316 stainless steel material.

   b. Gear actuators shall be of the totally enclosed design, proportioned to permit operation of the valve under full operating head in either direction, with a maximum pull of 80 pounds on the handwheel or with a maximum input of 150 ft-lbs applied to the AWWA wrench nut. Design and torque capacity shall consider flow and shut-off in "BOTH" directions.

   c. Actuators shall be provided with "open" and "closed" position stop limiting devices. Actuators shall be of the self-locking type to prevent the valve disc or plug from creeping.

2. Standard Opening Direction: Valve actuators, handwheels, or levers shall open by turning counterclockwise. (Commonly stated as, "open-left – close-right".)

3. AWWA wrench nut: Valves for buried and submerged applications shall be provided with a 2-inch square AWWA wrench nut. The wrench nut shall have an arrow cast thereon, indicating the direction of opening. The wrench nut shall be suitably fastened to the actuator input shaft. If the shaft is smooth, the wrench nut shall be fastened to the input shaft by means of a 5/16-inch diameter stainless steel pin passing entirely through the shaft and the wrench nut. Key with keyway shall also be acceptable. If the shaft is splined, the wrench nut shall be formed to fit the splined shaft.

   a. Operating Torque Requirement: The actuator shall be designed to produce the specified torque with a maximum input of 150 ft-lbs applied to the wrench nut (at the maximum rated pressure and a velocity of 16 cfs.)

4. Handwheels: Valves for aboveground applications shall be provided with a handwheel with a minimum diameter of 12-inches. The handwheel shall have an arrow thereon, indicating the direction of the opening. The handwheel shall be suitably fastened to the actuator input shaft.

   a. Operating Torque Requirement: Actuators equipped with handwheels shall be designed to produce the specified torque with a maximum pull of 80 pounds of the handwheel rim.

5. Position Indicators: Valve position indicators shall be provided for all above ground valves. Submerged and buried valves shall have a water tight seal plate in place of the valve position indictor. No rotating part indicating position shall be allowed for valves intended for buried service.

6. Operators for Exposed Valves Smaller than 6-inch: Unless otherwise called for on the plans or specifications, lever or wrench actuators having adjustable, open stop memory positions shall be provided for exposed valves smaller than 6-inch.

7. Actuators for Valves 4-inch and Larger

    a. Butterfly Valves

        i. 4-inch through 20-inch diameter butterfly valves shall have gear actuators of the "traveling nut type". Traveling nut actuators shall be furnished on all valves in this size range unless torque or pressure conditions dictate a “worm gear type”.

        ii. 24-inch through 54-inch diameter butterfly valves shall have gear actuators of the "worm gear type". Worm gear actuators shall be furnished on all valves in this size range.

    b. Ball and Plug Valves

        i. Ball and plug valves 6-inch and larger shall have actuators of the "worm gear type"

8. Requirements for Traveling Nut Gear Actuators

    a. Traveling nut actuators shall withstand 450 foot pounds of input torque against the stop limiting devices without causing damage.

    b. Signed factory compliance shall accompany submittals stating that these specifications and applicable standards have been adhered to.

    c. All exposed threaded parts, including cap screws, case bolts, carriage bolts, cover screws, machine screws, set screws, bonnet bolts on the housing or any other exterior location on the actuator, its cover or housing shall be Type 316 stainless steel.

    d. Traveling nut type gear actuators shall be able to rotate the valve element (disc, plug, or ball) from the fully "closed" position to the fully "open" position with a number of turns of the actuator nut or wheel. For 4-inch through 10-inch valves, the number of turns shall not be fewer than twenty nine (29) turns. For 12-inch through 20-inch valves, the number of turns shall not be fewer than twenty nine (29) turns and not more than three (3) times the number of diameter inches.

        i. Where the number of turns may fall outside of the range for turn limits, the use of a factory attached spur gear reducer shall be used to provide the appropriate number of rotations from the fully "open" to the fully "closed" position. Spur gear assemblies shall be mounted integrally to the actuator by approved means and shall

meet all of the other component and torque requirements listed herein.

e. Actuators shall be Dezurik M-Series, Mueller MDT, Pratt MDT, or for contracts between District and Contractor, approved equal.

f. Refer to the following table for actuator selection and characteristics for traveling nut gear operators for 150 and 250 psi:

Valve Actuator Selection – Traveling Nut							
Nominal valve diameter (inches)	**IRWD Specified Range of Valve Turns (number)**	**Dezurik Actuator Model**	**Actuator Turns – open to close (number)**	**Mueller Actuator Model**	**Actuator Turns – open to close (number)**	**Pratt Actuator Model**	**Actuator Turns – open to close (number)**
4	29	MB-3	29	MDT-2S	32	MDT2S	32
6	29	MB-3	29	MDT-2S	32	MDT2S	32
8	29	MB-3	29	MDT-2S	32	MDT2S	32
10	29	MB-3	29	MDT-2S	32	MDT2S	32
12	29 - 36	MB-3	29	MDT-2S	32	MDT2S	32
14	29 - 42	MB-3	29	MDT-3S	30	MDT3S	30
16	29 - 48	MB-7	42	MDT-3S	30	MDT3S	30
18	29 - 54	MB-7	42	MDT-4S	40	MDT4S	40
20	29 - 60	MB-7	42	MDT-4S	40	MDT4S	40

9. Requirements for Worm Gear Actuators

a. Worm gears shall be of the "self-locking" one-piece design of gear bronze material (ASTM B-427), accurately machine cut.

b. The worm shall be hardened alloy steel (ASTM A-322, Grade G 41500; or ASTM A-148, Grade 105-85), with threads ground and polished.

i. The reduction gearing shall run in a proper lubricant inside a ductile iron housing.

c. All exposed (at the exterior of the actuator) threaded parts, including cap screws, case bolts, carriage bolts, cover screws, machine screws, set screws, bonnet bolts on the housing or any other exterior location on the actuator, its cover or housing shall be Type 316 stainless steel.

d. Actuator components shall be designed to withstand a pull of 200 pounds for handwheel or chain wheel actuators between the input and stop limiting devices without damage, and an input torque of 300-foot-pounds for operating nuts when operating against the stops.

e. Gear actuators shall be able to rotate the valve element (disc, plug, or ball) from the fully "closed" position to the fully "open" position with a number of turns of the actuator nut or wheel, not fewer than one-and-a-half (1.5) times the number of diameter inches and not more than three (3) times the number of diameter inches.

i. Where the number of turns may fall outside of the range for turn limits, the use of a factory attached spur gear reducer shall be used to provide the appropriate number of rotations from the fully "open" to the fully "closed" position. Spur gear assemblies shall be mounted integrally to the actuator by approved means and shall meet all of the other component and torque requirements listed herein.

g. Actuators shall be Auma GS Series, EIM Model WB Series, or Limitorque Model HBC or PT Series, and there are no equals.

h. Refer to the following tables for actuator selection and characteristics for worm gear actuators for 150 psi valves and for 250 psi valves:

150 psi Valve Actuator Selection – Worm Gear							
Nominal valve diameter (inches)	**IRWD Specified Range of Turns (number)**	**AUMA Make & Model [model/gear]**	**Turns open - close (number)**	**EIM Actuator Make & Model**	**Turns open - close (number)**	**Limitorque Make & Model [model/gear]**	**Turns open - close (number)**
24	36 - 72	GS125.3	* 13	EIM WB52	64	PTA30/3.5	60
30	45 - 90	GS 160.3/GZ 160.3 4:1	* 54.5	EIM WB52	64	PTA65/3.1	47
36	54 - 108	GS 160.3/GZ 160.3 4:1	* 54.5	EIM WB54	70	PTA120/6.3	95
42	63 - 126	GS 200.3/GZ 200.3 8:1	* 108.5	EIM WB54	70	PTA120/6.3	95
48	72 - 144	GS 250.3/GZ 250.3 8:1	* 103	EIM WB65	* 148	PTA250/6	96
54	81 - 162	GS 250.3/GZ 250.3 8:1	* 103	EIM WB65	148	PTA250/18	* 288
250 psi Valve Actuator Selection – Worm-Gear							
Nominal valve diameter (inches)	**IRWD Specified Range of Turns (number)**	**AUMA Make & Model [model/gear]**	**Turns open - close (number)**	**EIM Actuator Make & Model**	**Turns open - close (number)**	**Limitorque Make & Model [model/gear]**	**Turns open - close (number)**
24	36 - 72	GS125.3	* 13	EIM WB52	64	PTA30/3.5	60
30	45 - 90	GS 160.3/GZ 160.3 4:1	* 54.5	EIM WB52	64	PTA65/3.1	47
36	54 - 108	GS 160.3/GZ 160.3 4:1	* 54.5	EIM WB54	70	PTA120/6.3	95
42	63 - 126	GS 200.3/GZ 200.3 8:1	* 108.5	EIM WB65	* 148	PTA120/6.3	95
48	72 - 144	GS 250.3/GZ 250.3 8:1	* 103	EIM WB65	* 148	PTA250/6	96
54	81 - 162	GS 250.3/GZ 250.3 8:1	* 103	EIM WB74	* 270	PTA250/18	* 288

* indicates number of turns does not meet IRWD requirement and spur-gear reduction is required to correct. Spur-gear submittal is required. See paragraph 9.e.i above.

F. Valve Boxes, Risers and Lids for Buried Valves

1. General:

   Valve riser shall be 8-inch Schedule 40 PVC pipe, or 8-inch SDR 35 PVC pipe.

2. Valve Box Lids:

   Valve box lids shall be cast-iron and shall be designed to rest without a frame on a cast-in-place concrete ring surrounding the valve extension pipe. The lid skirt shall be 6 inches deep. The minimum weight of nominal 10-inch lid shall be 40 pounds. The lids shall be in accordance with IRWD Standard Drawing W-22.

   Lids shall be coated per Section 09900, Painting and Coating, System No. C-1.

3. Manufacturers:

   Valve boxes for potable water lines shall be round in shape and shall be Brooks 3-RT, Eisel Enterprises, Inc. H & C No. 10, or for contracts between District and Contractor, approved equal.

   Valve boxes for recycled and raw water lines shall be triangular in shape and shall be Brooks 4-TT, Eisel Enterprises, Inc. H & C 4TT, or for contracts between District and Contractor, approved equal.

G. Extension Stems for Buried Valve Operators

Where the depth of the valve is such that its operating nut is more than 5 feet below grade, operating extension stems shall be provided to bring the operating nut to a point between 24 to 36 inches below the surface of the ground and/or box cover.

Extension stems shall be solid Type 316 stainless steel, and shall be complete with 2-inch square operating nut.

No pinned couplings are permitted.

Extension stems shall conform to IRWD Standard Drawings.

H. Bolts, Nuts, and Washers for Flanged Valves

1. Bolts and nuts for flanged valves and flanges shall be Type 316 stainless steel conforming to ASTM A 193, Grade B8M, for bolts and ASTM A 194, Grade 8M, for nuts.

2. Washers shall be provided for each nut, shall be of the same material as the nut, and shall be installed adjacent to the nut, between the nut and the flange.

3. The length of each bolt or stud shall be such that between 1/4 inch and 1/2 inch will project through the nut when drawn tight.

I. Gaskets for Valves

Gaskets for flanged end valves shall be as described in the individual piping specifications.

J. Painting and Coating for Valves and Extensions:

1. Exterior Coating:

   Metal valves (except bronze and stainless steel valves) shall be coated in accordance with Section 09900, System No. D-1 or System No. G-1 and shall be holiday free.

   a. The specified prime coat shall be applied at the place of manufacture.

   b. Finish coat shall match the color of the adjacent piping.

   c. Exposed portions of the valve shaft shall not be coated.

2. Interior Coating:

   Metal valves shall be coated on the interior metal parts, excluding seating areas and bronze and stainless steel pieces, per Section 09900, Painting and Coating, System No. G-1 or System No. G-2.

   a. Coating shall be factory applied by the valve manufacturer.

   b. Valve coatings will be field spark tested and shall be holiday-free.

PART 3 - EXECUTION

A. Joints

1. Flanged Joints: Bolt holes of flanged valves shall straddle the horizontal and vertical centerlines of the pipe run to which the valves are attached. Flanges shall be cleaned by wire brushing before installing flanged valves. Flange bolts and nuts shall be cleaned by wire brushing, threads shall be lubricated with anti-seize compound, and nuts shall be tightened uniformly and progressively.

   If flanges leak under pressure testing, nuts and bolts shall be loosened or removed, the gasket shall be reseated or replaced, the bolts and nuts shall be reinstalled or re-tightened, and the joint retested. Joints shall be watertight.

2. Threaded Joints: Threaded joints shall be cleaned by wire brushing or swabbing. Teflon joint compound or Teflon tape shall be applied to pipe threads before installing threaded valves. Joints shall be watertight.

B. Valve Installation

1. Valves in Vertical Piping: Valves on vertical runs of pipe that are next to walls shall be installed with their stems horizontal, away from the wall. Valves on

vertical runs of pipe that are not located next to walls shall be installed with their stems horizontal, oriented to facilitate valve operation.

2. Buried Valves: Buried valves shall be wrapped with two layers of 8-mil polyethylene wrap per AWWA C-105.

3. Valve Supports: Valves shall be anchored in concrete as shown on IRWD Standard Drawing W-16 or on the valve detail drawings. Supports are not required for buried valves bolted to flanged pipe or other fixed or supported fittings. Supports shall be installed prior to pressurizing the system.

C. Valve Boxes

Valve boxes shall be firmly supported and shall be kept centered and plumb over the operating nut of the valve.

Beveled sections of pipe shall not be allowed at the top of the valve riser pipe. The top cut shall be square and machine made.

In new tracts, and where pavement has not been placed, the valve extension risers for "key valves" shall extend well above the ground level to permit ease of location in the event of the need for emergency shut-off. The final valve box elevation shall be flush with the finished pavement surface, or at the level shown on IRWD Standard Drawing W-22.

D. Valve Leakage Testing

1. Field Hydrostatic Testing:

   Valves shall be tested for leakage at the same time that the connecting pipelines are hydrostatically tested. See Section 15042, Hydrostatic Testing of Pressure Pipelines, for pressure testing requirements.

2. Pressure Testing:

   All butterfly valves 12-inch in diameter and larger, shall be flanged to facilitate testing. Valves 12-inch through 30-inch in diameter shall be tested in a horizontal position. Valves 36-inch in diameter and larger shall be tested in the vertical position (valve flange face oriented 90 degrees from the horizontal ground surface plane; with the shaft axis parallel to the ground).

   All valves shall be tested bi-directionally after the actuator is installed and the adjustment stops are set. Each side of the valve shall be tested for a duration of at least
   5 minutes at the pressure class rating of the valve with zero loss or leakage. Valve bodies shall be tested at a pressure equal to twice the design working pressure.

   The pressure test shall be witnessed by an IRWD representative. Final tests shall be performed within 20 miles of the project site. The Contractor shall provide a minimum of 72 hours notice to IRWD in advance of the pressure test.

Factory hydrostatic testing shall be conducted in advance of the final leakage testing. The District shall be given an opportunity to send a representative to witness the factory test. The Contractor shall notify an IRWD representative in writing 28 days in advance of all factory leakage tests.

END OF SECTION

SECTION 15120: HYDRAULICALLY CONTROLLED DIAPHRAGM-ACTUATED VALVES

PART 1 - GENERAL

A. Description

This section describes materials and installation of hydraulically controlled diaphragm-actuated valves acting as pressure reducing valves, pressure sustaining valves, solenoid control valves, booster pump control valves, and altitude valves.

B. Related Work Specified Elsewhere

1. Painting and Coating: 09900

2. Hydrostatic Testing of Pressure Pipelines: 15042

C. Submittals (For Contracts Between District and Contractor)

1. Shop drawings shall be submitted in accordance with the General Provisions and as specified herein.

2. Submit dimensional drawings for each size and type of valve provided.

3. Provide listing of materials of construction, with ASTM reference and grade. Show valve lining and paint primer coating with coating manufacturer and coating system number or designation.

4. Submit electrical drawings, (including P&ID's) showing wire and terminal connections, for valves that are electrically controlled.

5. Submit manufacturer's recommended maximum operating pressure and minimum and maximum recommended flows.

PART 2 - MATERIALS

A. Valve Design

1. General: Valves shall be hydraulically actuated diaphragm type. The body shall contain a removable seat insert. A resilient rubber disc shall form a drip-tight seal with the valve seat when pressure is applied above the diaphragm. The diaphragm assembly shall form a sealed chamber in the upper portion of the valve, separating operating pressure from line pressure.

2. Component Parts: The pilot control system shall include a fixed or variable orifice, and all major components of this system, except solenoid pilots, shall be manufactured by the same company that manufactures the main valve.

   Elastomers shall be EPDM rubber material. The diaphragm shall not be used as a seating surface.

The valve stem shall be center guided or top and bottom guided. The stem orientation is to be vertical. For top and bottom stem guides, bearings in the valve cover and in the valve seat shall be provided. For center guided valve stems, a bearing in the valve cover shall be provided. Stem sleeves or bearings shall have an anti-scale treatment or other approved friction reducing surface.

A valve position indicator shall be provided.

Repairs and modification other than the replacement of the main valve body shall be possible without removing the main valve from the line.

B. Valves

1. Class 125 (150 psi) or Class 250 (300 psi) Pressure-Reducing Valves: Pressure reducing valves shall automatically maintain a constant downstream pressure regardless of changing flow rates and/or varying inlet pressures. The pilot control shall be direct-acting, spring loaded, diaphragm valve, designed to permit flow when controlled pressure is less than the spring setting. The pilot control system shall be provided with a strainer, isolation valves, opening speed control, closing speed control, and, where required for low flow, a flow stabilizer or V-port throttling plug. See General Requirements, Division 1 for pressure ranges and initial pressure settings. The valve shall be globe pattern Cla-Val 90-01 Series or Ames ACV 910 Series "Mustang Valve" and there is no equal.

2. Class 125 (150 psi) or Class 250 (300 psi) Pressure Sustaining or Pressure Relief Valves: Pressure sustaining/relief valves shall maintain a constant upstream pressure by relieving excess pressure without causing surges. The pilot control system shall operate such that as excess line pressure is dissipated, the valve shall slowly close. The pilot control shall be a direct acting, spring-loaded, diaphragm valve, designed to permit flow when controlling pressure exceeds a spring setting. The pilot control system shall be provided with a strainer, isolation valves, opening speed control (pressure sustaining valves only), and closing speed control. See General Requirements, Division 1 for pressure ranges and initial pressure settings. The valve shall be globe pattern Cla-Val 50-01 Series or Ames ACV 920 Series "Mustang Valve" and there is no equal.

3. Class 125 (150 psi) or Class 250 (300 psi) Solenoid Control Valves: Solenoid control valves shall provide on or off service for controlling flow. The pilot control shall be a three-way solenoid valve as specified herein. The pilot control system shall be provided with strainers, isolation valves, opening speed control, and closing speed control. See General Requirements, Division 1 for energized-to-open or de-energized-to-open requirements. The valve shall be globe pattern Cla-Val Series 136-03 or Ames ACV 300 Series, "Mustang Valve" and there is no equal.

4. Class 125 (150 psi) or Class 250 (300 psi) Booster Pump Control Valve: Booster pump control valves shall be designed for installation on the discharge of booster pumps to eliminate pipeline surges caused by starting and stopping of pumps. Control of valve operation shall be by means of an externally mounted solenoid pilot valve. The solenoid pilot valve shall be as specified herein. Self-cleaning strainers shall be used to protect the control system. Valves shall utilize line pressure for operation. A limit switch shall be provided to be adjustable over entire valve travel. Valve shall be equipped with a check feature to prevent

reversal of flow. The valve shall be globe pattern Cla-Val 60-11 Series or ACV 980 Series "Mustang Valve" and there is no equal.

5. Class 125 (150 psi) or Class 250 (300 psi) Altitude Valve: Altitude valves shall be designed to control the high water level in reservoirs. The valve shall be a non-throttling type, remaining fully open until the set-point in the reservoir is reached. Unless noted otherwise, the valve shall provide one-way flow, opening when the water level in the reservoir lowers below the set-point level, and shall be equipped with a check feature to prevent reverse flow. The pilot control shall be a three-way diaphragm valve that operates on the differential force between the height of the water in the reservoir and an adjustable spring load. The valve shall be globe pattern Cla-Val 210 Series or Ames ACV 960 Series, "Mustang Valve" and there is no equal.

C. Materials of Construction

Materials of construction for Class 125 and Class 250 valves shall be as follows:

Item	Material
Main valve body and cover	Ductile Iron, ASTM A 536 Grade 60-40-18
Main valve trim and seat	Type 303 Stainless Steel, ASTM A 276, or A 351
Pilot control system	Type 303 Stainless Steel, ASTM A 276, or A 351
Piping and tubing	Type 303 Stainless Steel, ASTM A 276, or A 351
Bonnet studs	Type 304 Stainless Steel
Bonnet nuts & Body plugs	Type 316 Stainless Steel

D. Valve End Connections

1. Applications: 1-inch and 2-inch valves shall have threaded ends at the bottom of the body. 3-inch and 4-inch valves shall have flanged ends.

2. Threaded Connections: Threaded ends shall comply with ANSI B1.20.1.

3. Flanged Connections: Flanges for valves shall be ductile-iron meeting the requirements of ASTM A 536. Flanges shall be Class 125 flanges (for 150 psi) and Class 250 flanges (for 300 psi) conforming to ANSI B16.1.

E. Bolts, Nuts and Washers for Flanged Valves

1. Bolts and nuts for flanged valves and flanges shall be Type 316 stainless steel conforming to ASTM A 193, Grade B8M, for bolts and ASTM A 194, Grade 8M, for nuts.

2. Washers shall be provided for each nut, shall be of the same material as the nut, and shall be installed adjacent to the nut, between the nut and the flange.

3. The length of each bolt or stud shall be such that between 1/4 inch and 1/2 inch will project through the nut when drawn tight.

F. Gaskets

Gaskets for flanged end valves shall be as described in the individual piping specifications.

G. Coating

Valves shall be coated on the exterior in accordance with Section 09900, Painting and Coating. Prime coat shall be shop-applied at the place of manufacture. Finish coat shall be applied in the field. Color of finish coat shall match the color of the adjacent piping.

H. Lining

Interior surfaces of the valve shall be coated in accordance with Section 09900, Painting and Coating, System No. G-1. Seating areas, stainless steel, or other high alloy parts shall not be coated.

PART 3 - EXECUTION

A. Installation

1. Threaded Connections: Threaded joints shall be cleaned by wire brushing or swabbing. Teflon joint compound or Teflon tape shall be applied to pipe threads before installing threaded valves. Joints shall be watertight.

2. Flanged Connections: Flanges shall be cleaned by wire brushing before installing flanged valves. Flange bolts and nuts shall be cleaned by wire brushing, and threads shall be coated with anti-seize compound. Nuts shall be tightened uniformly, and in the sequence pattern and torque setting recommended by the manufacturer. If flanges leak under pressure testing, nuts and bolts shall be loosened or removed, the gasket reseated or replaced, the bolts and nuts reinstalled or retightened, and joints retested. Joints shall be watertight.

B. Valve Pressure Testing

Valves shall be pressure tested at the same time that the connecting pipelines are pressure tested. See Section 15042, Hydrostatic Testing of Pressure Pipelines, for pressure testing requirements. Valves, operators, or control and instrumentation systems whose pressure rating is less than the test pressure shall be protected or isolated during pressure testing.

END OF SECTION

SECTION 15151: FACILITIES IDENTIFICATION

PART 1 - GENERAL

A. Description

This section describes materials and installation of potable and recycled water facilities identification for pipe, valves, valve boxes, and other pipeline appurtenances.

B. Related Work Specified Elsewhere

1. Painting and Coating: 09900
2. Manual Valves: 15100
3. Cathodic Protection and Joint Bonding: 16640

C. Submittals (For Contracts Between District and Contractor)

1. Shop drawings shall be submitted in accordance with the General Provisions and as specified herein.
2. Submit material samples of warning tape.
3. Submit drawings showing location and size of warning labels and signs.

PART 2 - MATERIALS

A. Buried Piping Warning and Locator Tape

Warning tape shall be an inert plastic film specifically formulated for prolonged underground use. The minimum thickness shall be 4 mils and the overall width of the tape shall be 12-inches (for 8-inch diameter pipe and larger) and 6-inches (for 6-inch diameter and smaller pipe).

Locator tape shall be installed over non-metallic pipe, shall be similar to warning tape, and shall include a metallic substance that can be registered by a magnetic field location device. Locator tape shall be 3-inches wide. Warning tape and locator tape shall be as supplied by Griffolyn Co., Inc., Terra Tape, Division of Reef Industries, or for contracts between District and Contractor, approved equal.

1. Potable Water Pipelines: Blue warning tape with white lettering identifying the potable waterline, shall be used on all metallic pipelines 1-inch and larger. For copper services, warning tape shall be placed over the top of the pipe and shall be taped to the copper pipe at 5 foot intervals. The warning tape shall extend up into the meter box, air-vacuum release assembly or other appurtenances a minimum of 12-inches, so that it can be read clearly by opening the box or enclosure. Lettering shall be a minimum of 2-inch high letters with the wording: "CAUTION: DOMESTIC WATERLINE BURIED BELOW".
2. Recycled Water Pipelines: Purple warning tape with black lettering identifying the recycled waterline, shall be used on all metallic pipelines 1-inch and larger. For copper services, warning tape shall be placed over the top of the pipe and shall be taped to the copper pipe at 5 foot intervals. The warning tape shall

extend up into the meter box, air-vacuum release assembly or other appurtenances a minimum of 12-inches, so that it can be read clearly by opening the box or enclosure. Lettering shall be a minimum of 2-inch high letters with the wording: "CAUTION: RECYCLED WATER – DO NOT DRINK".

3. Cathodic Protection Wiring: Red warning tape with black lettering shall be used for cathodic protection wiring. The warning tape shall be 3-inch wide. The tape shall have a minimum tensile strength of 60 pounds per 3-inch strip. The ink used to print the lettering on the tape shall be permanent and not be removable by normal handling or upon prolonged underground burial. Lettering shall be a minimum of 2-inch high letters with the wording: "CAUTION CATHODIC PROTECTION CABLE BURIED BELOW".

B. Warning Encasement for Underground Recycled Metallic Water Pipelines

Unless otherwise specified, pipe and fittings shall be polyethylene encased in accordance with ANSI/AWWA C-105/A-21.5 and shall be "purple" in color and shall bear the water identification markings called for in Section D, Warning Labels and Tags, sub-paragraph 2, Recycled Water Identification.

C. Purple PVC Pipe for Recycled Water Pipelines

1. General: PVC pipe used for recycled water use shall conform to the requirements of Section 15064, PVC Pressure Distribution Pipe and Fittings, and shall be colored purple.

2. PVC Pipe Coloring and Markings: PVC pipe shall be purple, and shall be marked on both sides of the pipe with the wording: "CAUTION: RECYCLED WATER - DO NOT DRINK." Lettering shall be a minimum of 1/2-inch high black letters, and shall be repeated every 12-inches. The purple pipe color shall be achieved by adding pigment to the PVC material as the pipe is being manufactured.

D. Warning Labels and Tags

Labels shall be inert plastic film specifically formulated for prolonged exposure. The minimum thickness shall be 4 mils for adhesive backed labels and 10 mils for tag type labels. Tag type labels shall have reinforced tie holes and shall be attached with heavy-duty nylon fasteners. The size, type of label and location shall be dictated by each individual application and subject to acceptance by the District Representative.

1. Potable Water Identification: Labels shall be prepared on a blue field, and shall have the words: "POTABLE WATER" printed on the field in black letters. Minimum letter height shall be 1/2-inch.

2. Recycled Water Identification: Labels shall be prepared on a purple field, and shall have the words: "CAUTION: RECYCLED WATER - DO NOT DRINK" printed on the field in black letters. Minimum letter height shall be 1/2-inch.

3. Identification Tags: The water service meter identification tag shall identify the address or unit number served by the meter. The identification tag shall be rotary engraved with identifying letters and numbers. The circular plastic tag shall be 1/16-inch thick, 2-inch diameter, and the exterior shall be UV resistant 3 ply (color on both sides) lamicoid plastic by Rowmark, Gravoply or approved equal. Color shall be Blue with a white core for potable, Purple with a white core for recycled, Light-Blue with white core for untreated, or Green with white core for

sewer. IRWD shall provide the un-engraved plastic tags to the Contractor for engraving. The Contractor shall engrave the address and/or unit number into the plastic tag.

PART 3 - EXECUTION

A. Installation of Pipe Warning Tape and Locator Tape

1. Warning Tape: Warning tape shall be installed directly on the top of the pipe longitudinally and shall be centered. The warning tape shall be installed continuously for the entire length of the pipe and shall be fastened to each pipe length by plastic adhesive tape banded around the pipe and warning tape at no more than 5-foot intervals. Taping attached to the sections of pipe before laying in the trench shall have 5-foot minimum overlap for continuous coverage. All risers between the main line and control valves shall be installed with warning tape.

2. Locator Tape: Locator tape shall be installed directly on top of the pipe zone backfill layer, and shall be centered over non-metallic pipelines.

B. Installation of Warning Labels and Signs

1. Method of Attachment: Warning labels shall be firmly attached using heavy-duty nylon fasteners, and shall be sized and installed at locations as shown on the plans.

2. Equipment Requiring Labels or Tags: Warning labels shall be installed on all appurtenances in vaults, such as, but not limited to, air release valves, blowoffs, and meters, and on designated facilities, such as, but not limited to, controller panels and washdown or blowoff hydrants for water trucks and temporary construction services. Pumps and pipe shall be identified with a painted label. Within a fenced area, at least one sign shall be posted on the fence which can be readily seen.

3. Painted Labels: Painted labels may, at the District Representative's discretion, be acceptable in lieu of plastic labels.

C. Installation of Water Identification Tags

Identification tags shall be securely attached to water meters using UV rated zip ties rated to hold 50 pounds.

END OF SECTION

SECTION 16150 - ELECTRIC MOTORS

PART 1 - GENERAL

A. Description

1. This section describes materials, testing, and installation of electric motors that are provided as part of mechanical equipment described in other sections. When it applies, this section will be referenced in other equipment specifications.

B. Related Work Specified Elsewhere

1. Painting and Coating: 09900

2. General Electrical Requirements: 16010

C. Submittals

1. Submit shop drawings in accordance with the General Provisions and Section 16010.

2. Show ratings, characteristics, and mounting arrangement. For motors 40 horsepower and larger, submit efficiency and power factor at full, 3/4 and 1/2 load and locked rotor current.

3. Submit copies of certified test reports for factory no load current and speed, locked rotor current, and high potential tests.

4. Certification: When motors are supplied as part of a variable speed drive system, submit certification that selected motor:

   a. Is capable of satisfactory performance under the intended load.

   b. Is suitable for operation with the proposed variable speed drive unit.

PART 2 - MATERIALS

A. Electric Motors

1. General:

   a. Manufactured with cast iron frames in accordance with NEMA MG-1, and in accordance with requirements specified in this Section.

   b. Alternating Current Motors: Squirrel cage induction type suitable for 60-hertz power.

   c. Where not Otherwise Specified or Indicated on the Drawings:

      i. Motors 1/2 Horsepower and less: single phase, 120 volt.

      ii. Motors greater that 1/2 Horsepower to 300 Horsepower: three phase, 460 volt.

      iii. Motors greater than 300 Horsepower: three phase 4000 volt.

d. 2-speed motors: Dual winding design.

e. Temperature Rating and Altitude Requirements: Where not otherwise specified or indicated on the Drawings, provide motors that are rated suitable for continuous operation in 40 degree Celsius ambient temperature at project site altitude.

i. Temperature rise under full load: Not to exceed that for Class B insulation (80 degrees Celsius).

f. Motor Data: Specific motor data including horsepower, speed, and enclosure type are indicated on the Drawings and specified under equipment for which motor is required.

g. Torque and Power of Motors:

i. Provide motors that develop sufficient torque for required service throughout acceleration range at voltage 10 percent less than motor nameplate rating.

ii. Provide motors that develop sufficient torque when started using reduced voltage starters.

h. Motor leads and insulating material: Insulated leads with non-wicking, non-hygroscopic material. Class F insulation.

i. Grounding lugs: Provide inside conduit boxes for motor frame grounding.

j. Hardware: Type 316 stainless steel.

k. Non-Reversing Ratchet: Pump motors shall be provided with a non-reversing ratchet.

2. Provide motors that are special premium efficiency type, except motors that are to be used on hoisting equipment heat pumps, unit heaters, sump pumps, and lubricating oil transfer pumps.

a. Provide premium efficiency type motors having nominal full load efficiencies and power factors as specified in Schedule A appended to this Section.

b. Actual full load efficiency of individual motors within the nominal efficiency band shall not be less than the minimum efficiency value specified in Schedule A.

3. Condensation Heaters:

a. Use: Required in motors in outdoor applications.

b. Type: Cartridge or flexible wrap-around type installed within motor enclosure adjacent to core iron.

c. Rating, Phase and Wattage: Rated for 120 volt, single phase with wattage as required.

d. Bring power leads for heaters into conduit box.

4. Winding Temperature Detectors:

a. Switch Type:

i. When specified for individual equipment and on alternating current motors sized less than 150 horsepower, provide factory installed winding temperature detectors with leads terminating in conduit box.

ii. Provide detectors that protect motor against damage from overheating caused by single phasing, overload, high ambient temperature, abnormal voltage, locked rotor, frequent starts, or ventilation failure. Provide detector that has normally closed contacts.

iii. Auxiliary Relay and Controls: Provide relays and controls and mount them in controller enclosure that is suitable for the environment.

b. RTD Type:

i. On alternating current motors sized 150 horsepower and greater, provide factory installed RTD type winding temperature detectors with leads terminating in conduit box.

ii. RTD Type Temperature Detectors: Provide six- (6) 100-ohm platinum RTD's embedded in the motor windings, two per phase. Provide two each (2) 100-ohm platinum RTD's embedded in the motor bearings, one on each set of bearings.

iii. Provide detectors that protect motor against damage from overheating caused by single phasing, overload, high ambient temperature, abnormal voltage, locked rotor, frequent starts, or ventilation failure.

5. Internal Cooling of Motors: Design motors having speeds of 900 revolutions per minute and less, and motors that are connected to solid state motor controllers with special attention to internal cooling.

6. Coating: Coat motors per Section 09900, System No. 15. Apply prime coat at factory. Apply finish coat in field. Color of finish coat shall match the equipment to which the motor is attached. Motors housed within equipment enclosures, such as exhaust fans and air handling units may have factory's standard prime and finish coats in lieu of field painting.

B. Single Phase Motors

1. Capacitor start type rated for operation at 115 volts, 60 Hertz, unless otherwise specified or indicated on the Drawings.

2. Totally enclosed, fan cooled motors manufactured in accordance with NEMA MG 1-10.35.

3. Ball Bearings: Sealed.

4. 1/2 Horsepower or Less Fan Motors:

   a. Split-phase or shaded pole type when standard for the equipment.

   b. Open type when suitably protected from moisture, dripping water, and lint accumulation.

5. Wound rotor or commutator type single-phase motors only when their specific characteristics are necessary for application and their use is acceptable to the Engineer.

C. Direct Current Motors

1. Designed to operate from 90 volts direct current.

2. Sealed ball bearings having AFBMA B-10 life of 60,000 hours or more.

3. Insulation System: NEMA 1-1.65, Class F, resistant to attack by moisture, acids, alkalis, and mechanical or thermal shock.

4. Totally enclosed fan cooled enclosures.

D. Three Phase Motors

1. Suitable for 460 three-phase power or 4000 volt three phase power unless otherwise specified or indicated on the Drawings.

2. NEMA Design B except where driven load characteristics requires other than normal starting torque.

   a. Starting kilovolt ampere per horsepower (locked rotor) are not to exceed values specified in NEMA MG-1-10.37.

3. Motors over 50 HP shall be capable of reduced voltage starting with 50% to 80% of rated voltage applied.

4. Motor Bearings: Antifriction, re-greasable, and filled initially with grease suitable for ambient temperatures to 40 degrees Celsius.

   a. Suitable for intended application and have AFBMA B-10 rating life of 60,000 hours or more.

   b. Fit bearings with easily accessible grease supply, flush, drain, and relief fittings using extension tubes where necessary.

   c. Motors operated in a vertical position shall be designed for vertical operation. The thrust bearings shall be able to handle 150% of the maximum calculated down-thrust with a rated B-10 life of 5 years as defined by AFBMA standards.

   d. Provide two pole motors with ball type bearings.

5. Insulation Systems:

   a. Comply with NEMA 1-1.65.

b. Class F system with Class B temperature rise.

c. Resistant to attack by moisture, acids, alkalies, and mechanical or thermal shock.

6. Conduit Boxes:

a. Provide gaskets between following:

i. Frames and conduit boxes.

ii. Conduit boxes and box covers.

b. Provide oversized conduit box.

c. Motors rated for 4000 volts shall be provided with conduit boxes suitably sized to house all motor leads, power cables and stress cones.

7. Motor Enclosures: As specified herein or as indicated on the Drawings.

a. Open Drip Proof: Stamped steel conduit boxes; 1.15 service factor at 40 degrees Celsius. Motors 7 1/2 horsepower and larger shall have screens over openings.

b. Totally Enclosed Fan Cooled: Cast iron conduit box; 1.15 service factor at 40 degrees Celsius ambient; tapped drain holes with Type 316 stainless steel plugs for frames 286T and smaller, and automatic breather and drain devices for frames 324T and larger. Motors 7 1/2 horsepower and larger shall have screens over openings. The stator shall be vacuum-impregnated or vacuum pressure impregnated in an insulating polyester resin, and then baked to a cure for a minimum of 4-6 hours at 350 degrees F in accordance with procedures recommended from the resin manufacturer. The stator shall be impregnated with the polyester resin a minimum of two times.

c. Explosion-proof: 1.15 service factor at 40 degrees Celsius; tapped drain holes with corrosion resistant plugs for frames 286T and smaller, and automatic breather and drain devices for frames 324T and larger; UL label for Class I, Division I, Group D hazardous area.

d. Severe Duty: Corrosion resistant type conforming to motors designated by manufacturer as "Chemical Duty", "Mill and Chemical", "Custom Severe Duty", or similar applicable manufacturer's quality designation with 1.15 service factor at 40 degrees Celsius; tapped drain holes with Type 316 stainless steel plugs for frames 286T and smaller, and automatic breather and drain devices for frames 324T and larger; epoxy finish; and upgraded insulation using encapsulated or dip and bake windings.

e. Submersible: Water tight casing with insulated windings which are moisture resistant.

i. Pump Motors specified to be submersible: Provide motors having cooling characteristics suitable for continuous operation in totally, partially, or non-submerged condition without overheating or other damage.

ii. Moisture Detector: Provide complete moisture detection control with the moisture sensing probes in the motor.

iii. Electrical Cables: Provide cables of adequate length to allow unit to be wired without splices.

E. Motor Sizes

1. Motor sizes specified in the Specifications and indicated on the Drawings are minimum sizes.

2. Provide motors, electrical circuits, and equipment of ample horsepower capacity to operate equipment without exceeding rated nameplate horsepower, full-load current at rated nameplate voltage, or overheating at maximum load capacity.

F. Factory Tests

1. Factory Testing of three phase Motors:

   a. When specified in individual equipment specifications, factory test motors. Include testing of:

      i. No load current.

      ii. Locked rotor current.

      iii. Winding resistance.

      iv. High potential.

   b. Perform in accordance with NEMA Standards.

   c. Furnish copies of test reports.

   d. The insulating resin shall be tested by the resin manufacturer at regular intervals and records kept of condition and changes. The records shall be supplied to IRWD upon request.

PART 3 - EXECUTION

A. Installation

1. Install motors in accordance with manufacturer instructions.

B. Operating Tests

SCHEDULE A

FULL LOAD MOTOR EFFICIENCY AND POWER FACTOR RATING REQUIREMENTS FOR PREMIUM EFFICIENCY, 460 VOLT, 3 PHASE HORIZONTAL AND VERTICAL MOTORS

		Protected (open Drip Proof)[1]			Totally Enclosed Fan Cooled		
Nominal Horsepower (Horsepower)	Syn. (revolutions per minute)	Minimum Efficiency (Percent)	Nominal Efficiency (Percent)	Power Factor (Percent)	Minimum Efficiency (Percent)	Nominal Efficiency (Percent)	Power Factor (Percent)
1	1800	91.5	84	70.9	81.5	84	77.7
	1200	78.5	81.5	57	78.5	81.5	57
1 1/2	3600	81.5	84	86	81.5	84	86
	1800	81.5	84	73	81.5	84	77.4
	1200	81.5	84	67.8	84	86.5	67.8
2	3600	81.5	84	87.7	84	86.5	87.7
	1800	81.5	84	76.7	81.5	84	78.8
	1200	84	86.5	68.1	85.5	87.5	68.1
3	3600	80	82.5	90.4	84	86.5	82.8
	1800	86.5	88.5	78.9	86.5	88.5	79.2
	1200	87.5	89.5	71	87.5	89.5	71
5	3600	86.5	81.5	84.5	86.5	88.5	87
	1800	87.5	88.5	80.4	86.5	88.5	81
	1200	88.5	89.5	73	87.5	89.5	74.4
	900	87	87.5	70	87.5	89.5	70.5
7 1/2	3600	86.5	88.5	86.7	87.5	89.5	86.3
	1800	87.5	89.5	83.3	88.5	91.2	84.4
	1200	88.5	90.2	78.2	88.5	90.2	78.3
	900	87.5	89.5	72	87.5	89.5	72
10	3600	88.5	90.2	85.5	89.5	91	87.5
	1800	88.5	90.2	82.8	88.5	90.2	86
	1200	89.5	91	80.5	89.5	91	81
	900	89.5	91	75.8	88.5	90.2	76
15	3600	88.5	90.2	86.7	89.5	91	87.4
	1800	90.2	91.7	81.9	91	92.4	82.7
	1200	89.5	91	80.5	89.5	91	81
	900	89.5	91	76.8	88.5	91.2	77

SCHEDULE A

FULL LOAD MOTOR EFFICIENCY AND POWER FACTOR RATING REQUIREMENTS FOR PREMIUM EFFICIENCY, 460 VOLT, 3 PHASE HORIZONTAL AND VERTICAL MOTORS

		Protected (open Drip Proof)[1]			Totally Enclosed Fan Cooled		
Nominal Horsepower (Horsepower)	Syn. (revolutions per minute)	Minimum Efficiency (Percent)	Nominal Efficiency (Percent)	Power Factor (Percent)	Minimum Efficiency (Percent)	Nominal Efficiency (Percent)	Power Factor (Percent)
20	3600	90.2	91.7	87.1	90.2	91.37	88.7
	1800	91	92.4	73.1	97	92.4	84.2
	1200	90.2	91.7	83.7	90.2	91.7	79
	900	90.2	91.7	77.2	89.5	91	77.2
25	3600	90.2	91.7	88.1	91	92.4	85.5
	1800	91.7	93	82.7	92.4	93.6	84.3
	1200	91	92.4	79.2	91	92.4	83.5
	900	90.2	91.7	76.3	90.2	91.7	76.4
30	3600	91.7	93	88.3	91	92.4	73.9
	1800	91.7	93	83.3	92.4	93.6	83.1
	1200	91.7	93	82.1	91.7	93	83.5
	900	91.7	93	76	91	92.4	76.5
40	3600	92.4	93.6	89.2	92.4	93.6	87.5
	1800	93	94.1	80.8	93	94.1	82.3
	1200	92.4	93.6	82.2	92.4	93.6	80.5
	900	91.7	93	75	91.7	93	75.5
50	3600	91.7	93	86.3	94.7	93	87.7
	1800	93	94.1	83.3	93	94.1	84.2
	1200	92.4	93.6	83	95.4	93.6	80.6
	900	92.4	93.6	79.2	91.7	93	79.5
60	3600	92.4	93.6	88.8	92.4	93.6	88.9
	1800	94.1	95	84.5	94.1	95	84.2
	1200	93.6	94.5	84.4	93	94.1	85.4
	900	92.4	93.6	78.8	91.7	93	79.3
75	3600	93.6	94.5	87.5	93.6	94.5	89.7
	1800	94.1	95	85	94.1	95	85.5
	1200	94.1	95	85	94.1	95	85
	900	93.6	94.5	84.5	93	94.1	78.6
100	1800	94.5	95.4	85	94.5	95.4	85
	1200	94.1	95	85	94.1	95	81.3
	900	93.6	94.5	90.2	93	94.1	77.8

SCHEDULE A

FULL LOAD MOTOR EFFICIENCY AND POWER FACTOR RATING REQUIREMENTS FOR PREMIUM EFFICIENCY, 460 VOLT, 3 PHASE HORIZONTAL AND VERTICAL MOTORS

		Protected (open Drip Proof)[1]			Totally Enclosed Fan Cooled		
Nominal Horsepower (Horsepower)	Syn. (revolutions per minute)	Minimum Efficiency (Percent)	Nominal Efficiency (Percent)	Power Factor (Percent)	Minimum Efficiency (Percent)	Nominal Efficiency (Percent)	Power Factor (Percent)
125	1800	94.5	95.4	86.9	94.5	95.4	88.5
	1200	94.1	95	81.5	94.1	95	85.8
	900	94.1	95		93.6	94.5	80.4
150	1800	95	95.8	86.4	95	95.8	86.3
	1200	94.5	95.4	77.6	94.5	95.4	83.9
	900	94.1	95		93.6	94.5	79.7
200	1800	95	95.8	84.6	95	95.8	87.5
	1200	94.5	95.4	78.5	94.5	95.4	87.3
	900	94.5	95.4		94.1	95	80

NOTES:

(1) Motor data for continuous duty, NEMA Design B, 1.15 service factor, 40 degrees Celsius ambient, Class F insulation, 3 phase, 460 volt, at listed speed rating.

END OF SECTION

SECTION 16640: CATHODIC PROTECTION AND JOINT BONDING

PART 1 - GENERAL

A. Description

This section describes materials and installation of cathodic protection and testing equipment including wiring, zinc anodes, joint bonding, test stations, reference cells, alumino-thermic welds, and flange insulation kits.

B. Related Work Specified Elsewhere

1. Trenching, Backfilling, & Compacting: 02223
2. Concrete: 03300
3. Painting & Coating: 09900
4. Facilities Identification: 15151

C. Submittals (For Contracts Between District and Contractor)

1. Shop drawings shall be submitted in accordance with the General Provisions and as specified herein.
2. Submit manufacturer's catalog data on wire and cables, test stations, reference cells, thermic welds, insulation kits, dielectric coatings, and anodes.
3. Submit qualifications of company performing required testing and record keeping. The testing shall be performed under the direction and oversight of a registered corrosion engineer or certified NACE Cathodic Protection (CP) specialist.

PART 2 - MATERIALS

A. Alumino-Thermic Weld Materials

Cartridges and sleeves for welding test lead wires, joint bonding wires and anode lead wires to the pipe, shall be "Cadweld," "Thermoweld," or for contracts between District and Contractor, approved equal. Based on the type of pipe (steel, ductile iron, or cast iron) to which the wire is to be welded, the cartridge type, size and weight shall be as recommended by the manufacturer.

B. Alumino-Thermic Weld Caps

Alumino-thermic weld caps shall incorporate a high-density polyethylene plastic sheet, 10 mils (minimum) thick with a protective adhesive, 165 mils (minimum) thickness, as manufactured by Farwest Corrosion Control Company, Chase Corporation’s Royston Products, or for contracts between District and Contractor, approved equal. Design shall incorporate an elastomeric or a mastic-filled dome and a tunnel portion to contain lead wire from the alumino-thermic weld connection. The mastic coating shall be Carboline Bitumastic 50, Tnemec 46-465, Tnemec 46H-413 or for contracts between District and

Contractor, approved equal. Prior to application of the mastic coating, the manufacturer's recommended primer shall be applied to exposed metal.

Weld caps shall be Royston Handy Cap IP, Royston Handy Cap XL IP or for contracts between District and Contractor, approved equal.

C. Test Station Boxes

Test station boxes shall be a minimum 10-inch diameter, 12-inch deep, precast concrete with a cast iron lid designed for H-20 traffic loading. "CPTS" shall be cast on the lid. Test boxes shall be Brooks Products 3-RT, Christy G05T, or for contracts between District and Contractor, approved equal. Test box lids shall be painted in accordance with Section 09900, Painting and Coating.

D. Pipe Leads

Unless noted otherwise, pipe leads shall be stranded copper wire with high molecular weight polyethylene (HMW/PE) insulation specifically designed for cathodic protection service and suitable for direct burial in corrosive soil or water. Wire gauge shall be as shown on IRWD Standard Drawings CP-1, CP-2, and CP-3. Polyethylene insulation shall conform to ASTM D-1248, Type 3, Class C, Grade 5. Each pipe lead shall be of sufficient length to extend from the attachment to the pipe to the test box or anode test box without a splice. Wires with cut or damaged insulation shall be rejected. Insulation color shall be as shown on the plans or IRWD Standard Drawings.

E. Joint Bonding Wires

Pipe joint bonding wires shall be AWG No. 4 stranded copper wire with minimum 7/64-inch thick high molecular weight polyethylene (HMW/PE) insulation rated for 600 volts. The number of conductors shall be as shown on the plans and/or IRWD Standard Drawings. Polyethylene insulation shall conform to ASTM D-1248, Type 3, Class C, Grade 5. Each bond wire shall be 18 inches in length for 18-inch pipes or less and 24 inches for pipes larger than 18-inch.

F. Flange Insulation Kits

Insulating material shall be of the type designated by the manufacturer as suitable for the operating temperature and pressure of the service. Flange insulation kits shall consist of:

1. Insulating Gaskets: Gaskets shall be Type E full-faced, 1/8-inch minimum thickness, dielectric neoprene faced phenolic. Gaskets shall be Pipeline Seal & Insulator, Inc. (PSI), George Fischer Central Plastics, Advance Products & Systems, Inc. (APS), or for contracts between District and Contractor, approved equal.

2. Insulating Sleeves and Washers: Insulating stud sleeves and washers shall be one-piece and full-length, made of Minlon or Mylar. One 1/8-inch thick gasket shall be attached to the sleeve, while the other shall be loose. Single insulating washers and sleeves shall be used on buried insulating flanges. Double insulating washers and sleeves shall be used on insulating flanges above ground, in structures, or in vaults.

3. Insulating Washers for Bolts: Insulating washers shall be 1/8-inch thick glass-clad phenolic. Single insulating washers shall be used on buried insulating

flanges. Double insulating washers and full length sleeves shall be used on insulating flanges above ground, in structures, or in vaults.

4. Steel Washers Over Insulating Washer: Steel backing washers shall be 1/8-inch thick Type 316 stainless steel.

5. Compatibility with Valves: Insulating flange kits are not compatible with most valve flanges. Where cathodic isolation is required near a valve, a flanged spool shall be installed adjacent to the valve; and the required insulating joint shall be installed at the opposite end of the spool from the valve. Refer to the project plans for specific details.

6. Manufacturers: Flange insulation kits shall be as manufactured by Pipeline Seal & Insulator, Inc. (PSI), George Fischer Central Plastics, Advance Products & Systems, Inc. (APS), or for contracts between District and Contractor, approved equal.

G. Buried Insulating Flange External Coating

1. Primer: Primer shall be a blend of microcrystalline waxes, plasticizers and corrosion inhibitors having a paste-like consistency. The material shall have the following properties:

Pour Point	100°F -115°F
Flash Point	350°F min
Coverage (approx.)	1 gallon/100 sq. ft.
Color	Brown

The primer shall be Trenton Wax-Tape Primer, or for contracts between District and Contractor, approved equal.

2. Wax-Tape: Flange covering material shall be a plastic-fiber felt tape, saturated with a blend of microcrystalline waxes, plasticizers and corrosion inhibitors that is easily formable over irregular surfaces. The tape shall have the following properties:

Tape Width	6-inches
Saturant Pour Point	115°F - 125°F
Thickness	70 - 90 mils
Dielectric Strength	170 Volts/mil
Weight	4 lbs/sq yd
Color	Brown

The Wax-Tape shall be Trenton #1 Wax-Tape, or for contracts between District and Contractor, approved equal.

3. Outer Covering: The primed and wax-tape wrapped flange shall be covered with a plastic wrapper consisting of three each of 50 gauge, clear, polyvinylidene chloride, high cling membranes wound together as a single sheet. The material shall have the following properties:

Width	6-inches
Thickness	1 1/2 mils
Dielectric Strength	2000 Volts/mil

Water Absorption	negligible
Color	Clear

The outer covering shall be Trenton Poly-Ply, or for contracts between District and Contractor, approved equal.

H. Above Ground Insulating Flange External Coating

Above ground insulating flange coating shall consist of self-fusing elastic putty tape and vinyl plastic electrical tape. The self-fusing elastic putty tape shall be Scotchfil™ Electrical Insulation Putty and there is no equal. The vinyl plastic electrical tape shall be 7 mil thick premium grade vinyl adhesive electrical tape, brand Scotch® Super 33+ Vinyl Electrical Tape and there is no equal.

I. Internal Insulating Flange Coating

Coating for the interior lining of the pipeline at the insulating flange shall be a two-part smooth white, thixotropic liquid epoxy consisting of 100 percent solids. Coating shall be Aquatapoxy Paint as manufactured by American Chemical Corporation, or for contracts between District and Contractor, approved equal.

J. Zinc Anodes

1. Zinc Anode: Anode shall conform to ASTM B-418, Type II and shall be a prepackaged zinc alloy ingot having a chemical composition not exceeding the following limits:

Lead	0.003% Max.
Aluminum	0.005% Max.
Cadmium	0.003% Max.
Iron	0.0014% Max.
Copper	0.002% Max.
Zinc	Remainder

2. Anode Weight and Dimensions: Ingot weight and dimensions of the pre-packaged zinc anode shall be as listed in the table below. Weights are minimum.

ZINC ANODE SIZES FOR 1-INCH & 2-INCH BARE COPPER PIPE SERVICES

Copper Pipe Size (inches)	Copper Pipe Length (feet)	Zinc (Bare) Anode Size (inches)	Zinc (Bare) Anode Weight (lbs.)
1	0 to 45	1.4x1.4x30	15
1	45 to 90	2.0x2.0x30	30
2	0 to 22	1.4x1.4x30	15
2	22 to 45	2.0x2.0x30	30
2	45 to 70	2.0x2.0x48	45
2	70 to 90	2.0x2.0x60	60

Note: For copper pipe length greater than that listed above, additional Zinc Anodes of appropriate size shall be added as approved by the District.

3. Anode Backfill: Each zinc anode shall either be prepackaged in a permeable cloth bag with backfill of the following composition or installed bare and backfilled with material having the following composition:

Gypsum	5%
Powdered Bentonite	20%
Anhydrous Sodium Sulfate	5%

Backfill grains shall be capable of 100% passing through a 20 mesh screen and 50% passing through a 100 mesh screen.

The backfill shall be firmly packed around the anode by mechanical vibration, which will maintain the zinc ingot in the center of the cloth bag and surrounded by at least 1-inch of backfill. The packaged weight of the zinc anode and backfill shall be approximately twice the weight of the zinc anode ingot weight.

4. Steel Core: Anode shall be cast full length with an electro-galvanized 1/4-inch diameter steel core, which shall be exposed at one end for connection of the anode lead wire.

5. Anode Lead Wire: Anode lead wire shall be AWG No. 8 stranded copper wire with high-molecular weight polyethylene (HMW/PE) insulation suitable for direct burial use. HMW/PE insulation shall conform to ASTM D-1248, Type 1, Class "C", Category 5, Grades E4 and E5 with tensile strengths J1, J3.

Wire shall be attached to the steel core with silver solder by the anode manufacturer. The connection shall be encapsulated in a heat-shrinkable sleeve. Anode lead wire shall be a minimum of 15 feet long and shall be of sufficient length to extend from the anode to the designated termination point without a splice and 3-feet of coiled wire shall be provided in the test box. Wires with cut or damaged insulation shall be rejected and replacement of the entire lead shall be required at the Contractor's expense.

6. Anode Manufacturer's: Pre-packaged anodes, with lead wire and bagged backfill shall be supplied by Northtown Company, Far West Corrosion Control Company or Galvotech Alloys, Inc. or for contracts between District and Contractor, approved equal.

K. Identification Tags

The identification tag shall be rotary engraved with identifying letters and numbers. The circular plastic tag shall be 1/16-inch thick, 2-inch diameter, and the exterior shall be UV resistant 3 ply (color on both sides) lamicoid plastic by Rowmark, Gravoply or approved equal. Color shall be Blue with a white core for potable, Purple with a white core for recycled, Light-Blue with white core for untreated, or Green with white core for sewer. IRWD shall provide the un-engraved plastic tags to the Contractor for engraving. See IRWD Standard Drawing CP-6 for details.

L. Warning Tape

Warning tape shall comply with Section 15151, Facilities Identification and per the IRWD Standard Drawings.

M. Mortar

Mortar used to repair concrete coated pipe after attachment of the various bond or test wires shall be fast drying, non-shrinkable type. Refer to Section 03300, Concrete.

N. Marker Paddles – Utility Marker

Brown colored polycarbonate marker paddles shall be installed adjacent to the location of each test station, anode bed, shunt box, and reference cell location. Marker paddles shall be as manufactured by Carsonite Composites, a Phillips Group Brand. Marker paddles shall have an IRWD logo and 1-inch high yellow letters affixed, indicating the particular cathodic appurtenance. Both logos and decal letters are available from the District upon request. Refer to the IRWD Standard Drawing G-2.

O. Pipe Clamps

Pipe clamps used to attach the zinc anode lead wire to the above ground copper riser portion of the copper water tubing shall be brass or copper and of a size to fit the tubing. The pipe clamp shall have a screw terminal suitable for an AWG No. 8 copper stranded wire.

P. Insulating Blanket

The insulating blanket shall be a 1/8-inch thick neoprene or butyl insulating material. The width and length of the blanket will vary due to diameter of the pipelines to be insulated. The width and length shall be 12-inches larger than the diameter of the largest pipeline to be insulated.

Q. Casing Seal

The casing seal shall be composed of an irradiated, semi-rigid polyolefin sleeve which when exposed to temperatures in excess of 250°F will shrink from its original diameter to a predetermined recovered diameter. Casing seal shall be as manufactured by Pipeline Seal & Insulator, Inc. (PSI), Advance Products & Systems, Inc. (APS), or for contracts between District and Contractor, approved equal.

R. Reference Electrodes

Reference electrodes shall be copper-copper sulfate type, suitable for direct burial, and shall remain stable for at least ten years. The reference cell shall be capable of maintaining a potential within 15 millivolts of a freshly made cell while drawing 2 microamperes. Reference cells shall contain a barrier to inhibit migration of chloride ions from the soil into the reference cell.

Reference cell lead wires shall be AWG No. 8, stranded copper wire with high-molecular weight polyethylene (HMW/PE) insulation suitable for direct burial use. HMW/PE insulation shall conform to ASTM D-1248, Type 1, Class "C", Category 5, Grades E4 and E5 with tensile strengths J1, J3.

The lead wire shall be silver soldered to the copper core of the reference cell with the connection epoxy sealed according to the manufacturer's recommendations. Copper-copper sulfate reference cells shall be located next to the pipe in "native soil" near the "spring line" of the pipe.

The reference cells shall be EDI Model UI-CUG manufactured by Electrochemical Devices, Inc.; IonX40 Catalogue No. 14669 by M. C. Miller Company; Model CU1-UG by GMC Electrical, Inc.; Stelth Model SRE-002-CFY by Borin Manufacturing, Inc. or for contracts between District and Contractor, approved equal.

PART 3 - EXECUTION

A. General

Cathodic protection installation shall conform to NACE Publication RP0169 (Latest Revision) – *"Recommended Practice, Control of External Corrosion on Underground and Submerged Metallic Piping Systems"* and to NACE Publication RP0286 (Latest Revision) – "*Recommended Practice, Electrical Insulation of Cathodically Protected Pipelines".*

B. Wire Attachments

Wire leads shall be attached to the pipe and shall terminate at the test box without a splice. A minimum of 3-feet of slack wire from each lead shall be coiled and remain in each test box.

C. Attachment of Wire to Pipe

1. Surface Preparation for Alumino-Thermic Welding: Any existing coating on the pipe shall be removed by making a 3-inch square window in the coating. The exposed metal surface shall be cleaned to produce a bright metal finish, equivalent to SSPC SP-10, "near-white".

2. Alumino-Thermic Weld: The attachment of copper wire shall be made using an alumino-thermic weld as shown on IRWD Standard Drawing CP-9. Remove only enough insulation from the wire to allow the weld connection to be made. The wire shall be held at a 30°- 45° angle to the surface when welding. One wire only shall be attached to each weld.

3. Weld Test: As soon as the weld is cool, the weld shall be tested by striking a sharp blow with a 3-pound hammer while pulling firmly on the wire. All unsound welds shall be rewelded and retested.

4. Wire Locations: Wires shall be attached to the top (horizontal) surface of the pipe. Where two or more wires are required, welds shall be at least 6-inches apart.

5. Alternative Attachment Methods: The weld mold may not fit between the pretension bars of concrete cylinder pipe, depending on the diameter and pressure class of the pipe. Alternate methods of attachment may include:

    a. thermite welding the test wire to the bell ring at a joint; or

    b. arc welding a 1/4-inch diameter steel bar, with test wire pre-attached, to the steel cylinder between pretension bars.

D. Dielectric Coating Over Thermic Weld Connection

After completing the thermic weld connection between the wire and the pipe, the connection shall be coated in accordance with the following table:

Pipe Material	Connection Coating
Cement-mortar coated steel	Carboline Bitumastic 50, Tnemec Series 46H-413 or for contracts between District and Contractor, approved equal and cement mortar
Carbon steel, Ductile iron	Thermic weld cap, Royston Handy Cap XL IP or Royston Handy Cap IP

Repairs to the cement mortar coating shall be of the same material and thickness as specified for the pipe.

E. Backfill Over Wire

Buried wires shall be installed at a minimum depth of cover of 36-inches below the street section, or 36-inches below finished grade for un-paved areas. The trench bottom shall be level and free of exposed rocks. The first 12-inches of backfill above and the first 12-inches below the cable shall be sand per District bedding requirements. The remainder of the trench zone shall be backfilled in accordance with Section 02223, Trenching, Backfilling and Compaction. Plastic warning tape shall be installed 12-inches above the wire.

F. Test Stations

1. Test Station Boxes: Test boxes shall be located as shown on the plans or IRWD Standard Drawings, and shall be positioned in the parkway or raised median, as close to above the pipeline as practical. Boxes shall be installed in accordance with the IRWD Standard Drawings.

2. Two-Wire Test Station Spacing: Two-wire test stations with boxes shall be placed at intervals not to exceed 500 feet and at the end-points of all metallic pipelines and casings.

G. Joint Bonding Wires

Joint bonding wires shall be installed on ferrous metal pipelines at all unwelded joints, fittings, valves, and flanges (excluding insulated flanges) as shown on IRWD Standard Drawing CP-10. Two bond wires shall be welded across each joint for pipe diameters less than 18-inches. Three bond wires shall be welded across joint for pipe diameters 18-inches and larger. Bond wires shall be attached using the alumino-thermic weld process. Bond wires shall not be attached to valve bodies, but instead to the valve flanges.

H. Flange Insulation Kits

Flange insulation kits shall be installed as follows:

1. Cleaning: Faces of flange pairs shall be cleaned of all dirt, rust or fouling materials which would interfere with a watertight joint and insulating properties of the flange kit.

2. Alignment: Alignment pins shall be used to properly align the flange and gasket. The manufacturer's recommended bolt tightening sequence shall be followed. Bolt insulation sleeves shall be centered within the insulation washers so that the insulating sleeve is not compressed and damaged.

3. Locations: A bonding test station shall be installed at each buried flange insulation. Two test wires shall be installed on each side of the buried insulator according to the details of the plans, these specifications, and IRWD Standard Drawings.

4. Insulation Kits at Valves: Flange insulation kits shall not be installed directly against valve flanges. A 24-inch long spool shall be installed adjacent to the valve so that the insulating flange kit may be installed on a standard pair of flanges.

I. External Insulating Flange Coating

1. Buried Insulating Flange Coating:

   a. Primer: Surface shall be cleaned of all dirt, dust, and loose rust or mill scale by wire brush and by wiping with a clean cloth. The surface shall be dry. Apply primer by hand or brush. A thick coating of primer shall be worked into all crevices, around bolts and in threads, and shall completely cover all exposed metal surfaces. The primer should overlap the pipe coating by 3inches minimum.

   b. Wax-Tape: The wax-tape can be applied immediately after primer application. Short lengths of tape shall be cut and formed completely around each individual bolt and stud-end. After all bolts are covered, the tape shall be applied circumferentially and formed by hand into all voids and spaces. There shall be no gaps or air spaces under the tape. The tape shall be applied with at least 55% overlap.

   c. Outer Covering: The clear plastic outer covering shall be applied by hand such that the material conforms and adheres to the wax-tape surface. Two layers of plastic outer wrapping shall be applied.

2. Above Ground Insulating Flange Tape Coating: All flange and pipe surfaces shall be clean and free of all dirt, grease, water, and other foreign material prior to installation of tape coating. The two separate tapes shall be half-lapped twice over the outer surface of the flange.

J. Internal Coating at Insulating Flange

The interior of the pipeline shall be coated for a distance of two pipe diameters in each direction away from the insulating flange. At an insulated valve flange, interior of pipeline shall be coated away from the valve for a distance of two pipe diameters. Coating shall be in accordance with Section 09900, Painting and Coating, System No. B-1 or B-2 as appropriate.

1. Surface Preparation: The surface preparation of the mortar lining shall consist of wire brushing to remove all loose mortar to provide a suitable surface for adhesion of the coating.

2. Application: Coating shall be applied by brushing until a minimum coating thickness of 20 mils is achieved. Each ensuing coat shall be applied before subsequent coat cures, usually within 3 to 6 hours after subsequent coat has been applied.

K. Zinc Anodes

Where called for on the drawings, prepackaged zinc anodes shall be installed in excavated, drilled, or punched holes a minimum of 3-inches larger in diameter than the prepackaged anode diameter. Anodes shall be installed below the level of the service main, with a minimum separation of 2-feet between the copper water tubing and the zinc anode maintained at all times. Anodes shall not be lowered, transported, handled, or lifted by the lead wire.

1. Backfilling: After the prepackaged anode is placed in the hole, water shall be poured into the hole so that the anode is completely covered with water. Stone-free native soil shall then be used to backfill the anode hole in accordance with Section 02223, Trenching, Backfilling and Compacting. Imported sand shall not be used for backfilling. The anode hole shall be backfilled in stages and carefully compacted to ensure that no voids exist around the bag and that the bag and anode wire are not damaged. After backfill is level with the top of the anode, a minimum of 15 gallons of water shall be poured into the hole to completely saturate the soil backfill. More water shall be added if it is suspected that the backfill is not completely saturated. Care shall be taken to avoid damage to the anode and anode lead wires.

2. Anode Lead Wire: The anode lead wire shall run to the point of connection at the end of the pipe run in the meter box. The anode lead wire shall be clamped to the copper-tubing riser. Sufficient slack shall be provided in the wire, and it shall be coiled in the meter box for attachment to a future point of connection at the water meter. At combination air release and vacuum relief valves the anode lead wire shall run through the concrete pad and shall be clamped to the riser as shown in the IRWD Standard Drawings. At blow-offs and manual air releases, anode lead wire shall be coiled in the valve box and clamped to the riser.

L. Identification Tags

Identification tags shall be securely attached to each of the wires in the test box using UV rated zip ties rated to hold 50 pounds.

M. Marker Paddles – Utility Markers

Utility markers shall be installed per IRWD Standard Drawing G-2 at locations shown on IRWD Standard Drawing CP-7 or as directed by the District Representative.

N. Insulating Blanket

Install an insulating blanket as shown in the Project Plans between any metallic pipelines that cross or parallel each other when the distance between the two pipelines is less than 18-inches.

O. Earthwork

Trenching, backfilling, and compacting shall be in accordance with Section 02223, Trenching, Backfilling, & Compacting.

P. Required Test and Record Keeping

The Contractor shall furnish all necessary equipment, material and qualified personnel required to perform all tests described herein.

1. Continuity Tests: The Contractor shall notify the District Representative when continuity bonding has been completed and all test boxes have been completed. A registered corrosion engineer or certified NACE CP specialist retained by the Contractor shall oversee and certify the testing and measuring of the electrical continuity of metallic pipelines. The pipeline shall be considered electrically continuous when the measured longitudinal resistance of the pipeline between each pair of adjacent test stations is no greater than 20 percent higher than the theoretical resistance of that section of pipeline.

   If tests indicate that adequate electrical continuity has not been achieved, the Contractor shall excavate to investigate and locate improperly bonded joints and shall make repairs until electrical continuity is achieved to the satisfaction of the District.

2. Test Stations: The Contractor shall notify the District Representative when test station wires are ready for testing. The wires shall remain disconnected to facilitate testing. A registered corrosion engineer or certified NACE CP specialist retained by the Contractor shall oversee and certify the tests to certify that none of the wires were damaged during the installation. If the test indicates damage, the entire wire shall be replaced and retested at the Contractor's expense.

   Records shall be made of all test stations and reference electrodes tested and submitted to the District.

3. Insulation Joints: The Contractor shall test each insulated joint with the insulator tester in accordance with the manufacturer's written instructions. All damaged or defective insulation parts shall be replaced and retested. Records shall be kept of all insulated joint tests and shall be submitted to the District.

4. Anode and Pipe Lead Wire Integrity Tests: After the pipe and anodes are buried, the pipe lead wire and anode lead wire trenches are backfilled, and the test boxes are installed, the Contractor shall notify the District Representative that the anode and pipe lead wires are ready for testing. The wires shall remain disconnected to facilitate testing. A registered corrosion engineer or certified NACE CP specialist retained by the Contractor shall oversee and certify the tests to confirm that none of the anode wires or pipe lead wires were damaged during the installation. Each anode lead wire will be tested for electrical continuity to the anode by measuring the anode's potential with respect to a copper copper-sulfate reference electrode. The measured open circuit potential of the anode shall be as specified in the table below or as specified by the manufacturer and approved by the District Representative.

Measured Open Circuit Potential for Anodes	
Anode Type	**Minimum Measured Open Circuit Potential (Volts)**
High Potential Magnesium Anode	1.7
Standard Magnesium Anode	1.4
Zinc Anodes	1.0

5. Acceptance: The Contractor shall submit a certified report by the corrosion engineer stating that the facilities are performing satisfactorily. All tests made must be reviewed and approved by the District before the corrosion control work is accepted. The District reserves the right to spot check any or all tests performed by the Contractor. All construction defects must be repaired and retested before the final acceptance is made. All unacceptable tests must be re-performed by the Contractor at no additional cost to the District. Contractor shall hook up all lead wires after testing is completed.

END OF SECTION