

Standard Specifications for Construction of Sanitary Sewer

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SECTION 09 90 00
BASIC COATING AND PAINTING SPECIFICATION
FOR WATER AND WASTEWATER FACILITIES

PART 1 General

1.01 *Scope*

- A. The work included in this section consists of furnishing all labor, materials, apparatus, scaffolding and all appurtenant work in connection with coating and painting, as indicated on the drawings and as specified herein.
- B. In general, the following surfaces are to be coated or painted:
 - 1. Exposed piping and other metal surfaces, interior and exterior.
 - 2. All submerged and intermittently submerged metal surfaces, except stainless steel.
 - 3. All structural and miscellaneous steel, including tanks.
 - 4. The interior of wet wells, manholes, junction structures, headworks, and similar structures.
 - 5. All exterior above ground concrete and masonry.
 - 6. The interior of certain structures as specified in the Painting and/or Coating Schedule.
 - 7. Equipment furnished with and without factory finish surfaces.
 - 8. Doors, frames, woodwork and architectural trim work.
- C. The following surfaces shall not be coated or painted unless shown or specified herein, or elsewhere in the Contract Documents.
 - 1. Stainless steel.
 - 2. Equipment nameplates, machined surfaces and grease fittings.
 - 3. Non-ferrous and galvanized ferrous metal, including: (a) floor gratings, plates and frames, (b) handrailing, (c) stair treads, stringers and supports, (d) ladders and supports, (e) chain link fencing and appurtenances, (f) conduits.

- D. In no case shall any concrete, wood, metal or any other surface requiring protection be left uncoated or unpainted, even though not specifically defined herein.

1.02 *Reference Specifications and Standards*

Without limiting the general aspects of other requirements of these specifications, all surface preparation, coating and painting of surfaces shall conform to the applicable requirements of the National Association of Corrosion Engineers (NACE), the Steel Structures Painting Council (SSPC), the American Concrete Institute, the Forest Products Research Society, and the manufacturer's printed recommendations.

In the event of a conflict between codes, reference standards, drawings, and these specifications, the most stringent requirements shall govern. All conflicts shall be brought to the attention of the Owner for clarification and direction prior to ordering or providing any materials or labor.

1.03 *Painting Subcontractor*

Where protective coatings are to be performed by a subcontractor, said subcontractor must possess a valid state license as required for performance of the painting and coating work called for in this specification and shall have a minimum of five years practical experience and successful history in the application of specified products to surfaces and facilities of water and wastewater treatment facilities. Upon request, the subcontractor shall substantiate this requirement by furnishing a list of references.

1.04 *Submittals*

For each coating system to be used, the Contractor shall submit shop drawings in accordance with the General Conditions. Contractor shall submit complete information and technical data for all material and components, including, but not limited to, the following:

1. Paint manufacturer's data sheets for each product used, including statements on the suitability of the material for the intended use.
2. Paint manufacturer's instructions and recommendations on surface preparation and application.
3. Samples of colors and finishes available for each product. Where custom mixed colors are specified (e.g. to match colors of existing coated surfaces), the submitted color samples shall be made using color formulations prepared to match the color samples furnished or specified by the Owner. The color formula shall be provided with each color sample.
4. Compatibility of shop and field applied coatings (where applicable).
5. Material safety data sheets for each product used.

1.05 *Quality Assurance*

A. Surface Preparation:

Surface preparation will be based upon comparison with "Pictorial Surface Preparation Standards for Painting Steel Surfaces," SSPC-Vis 1 ASTM Designation 0220; "Standard Methods of Evaluating Degree of Rusting on Painted Steel Surfaces," SSPC-Vis 2 ASTM Designation D610; Visual Standard for Surfaces of New Steel Airblast Cleaned with Sand Abrasive," NACE Standard TM-01-70; and as described below. Anchor profile for prepared surfaces shall be measured by use of a non-destructive instrument such as a Keane-Tator Surface Profile Comparator.

To facilitate inspection, the Contractor shall on the first day of sandblasting operations, sandblast metal panels to the standard specified. Plates shall be 1/8" (3.75 mm) plate stock and shall measure a minimum of 8-1/2" x 11" (216 mm x 280 mm). After mutually agreeing a specific panel meets the requirement of the specification, it shall be initialed by the Contractor and Inspector and securely sealed in clear plastic with desiccant to prevent rusting. Panels shall be prepared for each type of sandblasting specified and shall be utilized by the Inspector throughout the duration of sandblasting operations.

B. Coating and Painting Application:

No coating or paint shall be applied: when the surrounding air temperature or the temperature of the surface to be coated or painted is below 40°F (4.4°C); to wet or damp surfaces or in rain, snow, fog, or mist; when the temperature is less than 5°F (2.8°C) above the dew point; when it is expected the air temperature will drop below 40°F (4.4°C) or less than 5°F (2.8°C) above the dew point within 8 hours after application of coating or paint. Dewpoint shall be measured by use of an instrument such as a Sling Psychrometer in conjunction with U.S. Department of Commerce Weather Bureau Psychrometric Tables.

If the above conditions are prevalent, coating or painting shall be delayed or postponed until conditions are favorable. The day's coating or painting shall be completed in time to permit the film sufficient drying time prior to damage by atmospheric conditions.

C. Inspection:

Concrete, non-ferrous metal, plastic and wood surfaces shall be visually inspected to insure proper and complete coverage has been attained. A destructive testing instrument, such as a Tooke Gage, shall be used if deemed necessary. Thickness of coatings and paint on ferrous metal surfaces shall be checked with a non-destructive, magnetic type dry film thickness gauge. Coating integrity of Systems A and C surfaces shall be tested with an approved inspection device. Holiday detectors shall not exceed the voltage recommended by the manufacturer of the coating system. For film thicknesses between 10 and 20 mils (0.25 mm and 0.50 mm) a non-sudsing type wetting agent such as Kodak Photo-Flo, shall be added to the water prior to wetting the detector sponge. All pinholes shall be marked, repaired in accordance with the manufacturer's printed recommendations and retested. No pinholes or other irregularities will be permitted in the final coating.

In cases of dispute concerning film thickness or "holidays," the Owner's calibrated instruments and measurements shall predominate. Wide film thickness discrepancies shall be measured and verified with a micrometer or other approved measuring instrument.

Contractor shall give the Owner a minimum of 3 working days advance notice of the start of any field surface preparation work or coating application work, and a minimum of 7 working days advance notice of the start of any shop surface preparation work or coating application work.

D. Inspection Devices:

The Contractor shall furnish, until final acceptance of coating and painting inspection devices in good working condition for detection of holidays and measurement of dry-film thickness of coating and paint. The Contractor shall also furnish U.S. Department of Commerce, National Bureau of Standards certified thickness calibration plates to test the accuracy of dry-film thickness gauge and certified instrumentation to test the accuracy of holiday detectors.

Dry-film thickness gauges shall be made available for the Owner's use at all times until final acceptance of application. Holiday detection devices shall be operated by the Contractor in the presence of the Owner. Acceptable devices for ferrous metal surfaces include, but are not limited to K-D "Bird-Dog" holiday detector for coatings to 20 mils (0.50 mm) dry film thickness, Tinker-Razor Models AP and AP-W holiday detectors for coatings in excess of 20 mils (0.50 mm) dry-film thickness, and "Owner" units for dry-film thickness gauging. Nonferrous metal surfaces shall be checked with an instrument such as an Elcometer "Eddy Current" Tester. Inspection devices shall be operated in accordance with the manufacturer's instructions.

E. Warranty Inspection:

Warranty inspection shall be conducted during the eleventh month of the Contract warranty period. The Contractor and a representative of the coating material manufacturer shall attend this inspection. All defective work shall be repaired in accordance with this specification and to the satisfaction of the Owner.

1.06 *Safety and Health Requirements*

A. General:

Surface preparation and application of coatings shall be performed by the Contractor in compliance with all applicable federal, state, and local occupational safety, health, and air pollution control regulations. The Contractor shall obtain and comply with all safety precautions recommended by the paint manufacturer in printed instructions or special bulletins. The Contractor shall provide and require use of personnel protective lifesaving equipment for persons working in or about the project site.

B. Head and Face Protection and Respiratory Devices:

Equipment shall include protective helmets which shall be worn by all persons while in the vicinity of the work. In addition, workers engaged in or near the work during sandblasting shall wear eye and face protection devices and air-purifying, half-mask or mouthpiece respirator with appropriate filter.

C. Ventilation:

Where ventilation is used to control hazardous exposure, all equipment shall be explosion-proof. Ventilation shall reduce the concentration of air contaminants to the degree a hazard does not exist.

D. Sound Levels:

Whenever the occupational noise exposure exceeds the maximum allowable sound levels, the Contractor shall provide and require the use of approved ear protective devices.

E. Illumination:

Adequate illumination shall be provided while work is in progress, including explosion-proof lights and electrical equipment. Whenever required by the Owner, the Contractor shall provide additional lighting and necessary supports to illuminate all areas to be inspected. The level of illumination for inspection purposes shall be determined by the Owner.

F Temporary Ladders and Scaffolding:

All temporary ladders and scaffolding shall conform to applicable safety requirements. They shall be erected where requested by the Owner to facilitate inspection and be moved by the Contractor to locations requested by the Owner.

1.07 *Extra Stock*

Upon completion of all coating and painting work, Contractor shall deliver to the Owner a minimum of two 1 gallon cans of each type and color of finish paint and coating used on the project and two 1 gallon cans of each primer. Each container shall be unopened and properly labeled for identification and have a manufacture date within two months of the date of delivery to the Owner.

PART 2 Products

2.01 *General*

- A. Products specified are those which have been evaluated for the specific service and are listed to establish a standard of quality. Requests for product substitution are subject to the requirements of the General Conditions.
- B. All materials shall be brought to the job site in original sealed containers. Contractor shall provide coating material name, formula or specification number, batch number, color and date of manufacture to the Owner. Coating materials shall not be used until the Owner has inspected contents and checked information on containers or label. Materials exceeding storage life recommended by the manufacturer shall be rejected.
- C. All coatings and paints shall be stored in enclosed structures to protect them from weather and excessive heat or cold. Flammable coatings or paints must be stored to conform with city, county, state, and federal safety codes for flammable coating or paint materials. Water based coatings or paints shall be protected from freezing.
- D. Protective coatings shall be as manufactured by PPG Protective and Marine Coatings, Carboline Company, or Tnemec Company, or equal. Contractor shall use products of same manufacturer for all coating systems unless approved in writing by the Owner.
- E. It is the intent of this specification that all coatings used meet local, state, and federal air pollution control regulations. These regulations change frequently. If a listed coating does not meet local, state, and federal air pollution control regulations at the time the work is *actually* performed, the Contractor shall provide the manufacturer's compliant, recommended substitute coating at no additional cost to the Owner. All coatings shall comply with South Coast Air Quality Management District (SCAQMD) Rule 1113.

2.02 Service Condition A

Ferrous metals (excluding stainless steel) subject to outdoor exposure, corrosive moisture, or atmosphere and condensation such as outside of tanks, out-of-doors piping, valves, and equipment, bridges over process units, etc. shall receive the following surface preparation and coating:

A. Surface Preparation:

All surfaces shall be field sandblasted in conformance with Steel Structures Painting Council Specifications SSPC-SP10 and National Association of Corrosion Engineers Surface Finish NACE No. 2 (Near-White Blast Cleaning) to achieve a 1.5-2.5 mil (40-60 micron) blast profile.

B. Application:

Application shall be in strict accordance with manufacturer's recommendations. The minimum and maximum required times between coats shall be per the manufacturer's product data sheet. Written requests for shop surface preparation and application of the prime coat shall be reviewed and approved by the Owner on a case-by-case basis. If approved by the Owner, shop applied prime coat surface shall be field scarified by brush-blasting prior to the application of intermediate coat.

C. Coating System:

Except as otherwise noted, the prime coat shall have a minimum dry film thickness (MDFT) of 4.0 mils. The intermediate coat shall have a MDFT of 4.0 mils and the finish coat shall have a MDFT of 2.0 mils. The total dry film thickness of the complete system shall be 10.0 mils, minimum.

Carboline System	Primer - Carboguard 890 VOC Intermediate - Carboguard 890 VOC Finish - Carbothane 134 MC
PPG System	Primer - Amerlock 2 VOC Intermediate - Amerlock 2 VOC Finish - Amershield VOC
Tnemec System	Primer - L69 Epoxoline Intermediate - L69 Epoxoline Finish - Series 80 Endurashield

2.03 Service Condition B

Ferrous metals not subject to corrosive moisture or atmosphere and condensation; normal indoor or outdoor exposure such as metal doors, other architectural items; piping, valves, and pumps indoors, etc., shall receive the following surface preparation and coating:

A. Surface Preparation:

All surfaces shall be field sandblasted in conformance with SSPC-SP6 and NACE No. 3 (Commercial Blast Cleaning).

B. Application:

Application shall be in strict accordance with manufacturer's recommendations. The minimum and maximum times required between coats shall be per the manufacturer's product data sheet. Written requests for shop surface preparation and application of the prime coat shall be reviewed and approved by the Owner on a case-by-case basis. If approved by the Owner, shop applied prime coat surface shall be scarified by brush-blasting prior to application of the finish coat.

C. Coating System:

Except as otherwise noted, the prime coat shall have a MDFT of 4.0 mils. The finish coat (one or more) shall have a MDFT of 3.0 mils. The total dry film thickness of the complete system shall be 7.0 mils, minimum.

Carboline System	Primer - Carboguard 890 VOC Intermediate - Carboguard 890 VOC Finish - Carbothane 134 MC
G System	Primer - Amerlock 2 VOC Intermediate - Amerlock 2 VOC Finish - Amershield VOC
Tnemec System	Primer - L69 Epoxoline Intermediate - L69 Epoxoline Finish - Series 80 Endurashield

2.04 *Service Condition C*

Ferrous metals submerged or intermittently submerged in sewage or similar corrosive liquid, shall receive the following surface preparation and coating:

A. Surface Preparation:

All surfaces shall be field sandblasted in conformance with SSPC-SP5 and NACE No. 1 (White Metal Blast Cleaning) to achieve a 3 mil (75 micron) angular anchor blast profile.

B. Application:

Application shall be in strict accordance with manufacturer's recommendations. If recoating is required to correct pinholes, holidays or insufficient coating thickness; surfaces shall be scarified by brush-blasting prior to recoat.

C. Coating System:

Except as otherwise noted, one coat shall be an airless sprayer applied at a MDFT of 30.0 mils.

Carboline System	Phenoline 341 or Carboguard 954 HB (brush/roller applied - two coats)
G System	Sigma Novaguard 840
Tnemec System	Series 435 Perma-Glaze

2.05 *Service Condition D*

Buried metal surfaces shall receive the following surface preparation and coating:

A. Surface Preparation:

All surfaces shall be cleaned in conformance with SSPC-SP10 and NACE No.2 (Near - White Blast Cleaning) to achieve a 2 mil anchor profile.

B. Application:

Application shall be in strict accordance with manufacturer's recommendations. The minimum time required between coats and prior to backfilling shall be per the manufacturer's product data sheet.

C. Coating System:

Except as otherwise noted, two or more coats shall be applied to a minimum total dry film thickness of 30 mils.

Carboline System	Phenoline 341 or Carboguard 954 HB (brush/roller applied - two coats)
G-System	Sigma Novaguard 840
Tnemec System	Series 435 Perma-Glaze

2.06 *Service Condition E*

Ferrous metals subject to high temperature exposure (resistant to 1,000°F, continuous) shall receive the following surface preparation and coating:

A. Surface Preparation:

All surfaces shall be field sandblasted in conformance with SSPC-SP10 and NACE No. 2 (Near-White Blast Cleaning) to achieve a 1.0 mil (25 micron) blast profile.

B. Application:

Application shall be in strict accordance with manufacturer's recommendations. The maximum dry film thickness of this system shall not exceed the limits established by the manufacturer.

C. Coating System:

Except as otherwise noted, two coats shall be applied at 1.0 mil per coat to a total 2.0 mil dry film thickness for the system.

Carboline System	Primer - Carboline 4631 Finish - Carboline 4631
G System	Primer - Amercoat 892 HS Finish - Amercoat 892 HS
Tnemec System	Primer - Series 39 Silicone Aluminum Finish - Series 39 Silicone Aluminum

2.07 *Service Condition F*

Non-ferrous or galvanized ferrous metals, specifically identified in the Contract Documents as requiring coating, shall receive the following surface preparation and coating:

A. Surface Preparation:

All surfaces shall be cleaned in conformance with Steel Structures Painting Council Specifications SSPC-SP1 (solvent cleaning).

B. Application:

Application shall be in strict accordance with manufacturer's recommendations.

C. Coating System:

Except as otherwise noted, one pre-treatment coat shall be applied to a minimum dry film thickness of 0.5 mils and shall be self-priming on non-ferrous metals and galvanized surfaces. The primer and finish coats shall be the system recommended for the specific Service Condition.

Carboline System	Pre-Treatment Coat - Rustbond L T or Rustbond Penetrating Sealer SG
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G System	Pre-Treatment Coat - Galvaprep (Parker Amchem)
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2.08 *Service Condition G*

Metals finished with asphalt, coal tar, or other bleeding type finish, specifically identified in the Contract Documents as not requiring removal prior to field coating, shall receive the following surface preparation and coating:

A. Surface Preparation:

All surfaces shall be cleaned in conformance with Steel Structures Painting Council Specification SSPC-SP1 (Solvent Cleaning).

B. Application:

Application shall be in strict accordance with manufacturer's recommendations.

C. Coating System:

Except as otherwise noted, one barrier coat shall be applied to a MDFT of 3.0 mils. Finish coats shall be the system recommended for the specific Service Condition.

Carboline System	Barrier Coat - Carboline 890
PPG System	Barrier Coat - Amerlock 400
Tnemec System	Barrier Coat - Series 69 Hi-Build Epoxoline II

2.09 *Service Condition H*

Submerged moving parts where resistance to sewage or chemicals is required and drying coatings cannot obtain proper bond or effective film thickness (includes cables, chains, gears, pulleys, etc.), shall receive the following surface preparation and coating:

A. Surface Preparation:

All surfaces shall be cleaned in conformance with Steel Structures Painting Council Specification SSPC-SP2 (Hand Tool Cleaning).

B. Application:

Application shall be in strict accordance with manufacturer's recommendation.

C. Coating System:

One coat of grease coating applied at the rate of coverage of 40 square feet per gallon.

Carbolinel	Kop-Coat Intertol Grease Coating
Kop-Coat System	

2.10 *Service Condition I*

Concrete subject to continuous or intermittent submergence in sewage, scum, sludge or other corrosive liquid where specified shall receive the following surface preparation and coating:

A. Surface Preparation:

All surfaces shall be thoroughly cleaned by sandblasting or other approved methods, removing all traces of previous materials. Remove all loose concrete by chipping, etc. to leave only sound firmly bonded concrete. All cracks and voids shall be filled with the specified epoxy filler and surfacer. Final surface shall be smooth and free of voids, cavities, dirt, dust, oils, grease, laitance or other contaminants.

B. Application:

Application shall be in strict accordance with manufacturer's recommendations. The minimum and maximum required times between coats shall be per the manufacturer's product data sheet. If recoating is required to correct pinholes or insufficient system coating thickness, surfaces shall be brush-blasted prior to recoat.

C. Coating System:

The prime coat shall be applied at a coverage rate not to exceed 200 S.F. per gallon. Finish coats shall be two or more coats to a total dry film thickness of 16.0 mils (minimum) for the system.

Carboline System	Filler - Sentry 610 Primer - Bitumastic 300M Finish - Bitumastic 300M
G System	Filler - NU-KLAD 114A Primer - Amercoat 385 Finish - Amercoat 351
Tnemec System	Filler - Series 63-1500 Epoxy Filler and Surfacer Primer - Series 46H-413HB Tneme-Tar Thinned 30% with Tnemec #2 Thinner Finish - Series 46H-413HB (undiluted)

2.11 *Service Condition J*

Concrete surfaces subject to corrosive spillage and mechanical wear shall receive the following surface preparation and coating:

A. Surface Preparation:

All surfaces shall be thoroughly cleaned by sandblasting or other approved methods, removing all traces of previous materials. Remove all loose concrete by chipping, etc. to leave only sound firmly bonded concrete. All cracks and voids shall be filled with the specified filler and surfacer. Final surface shall be smooth and free of voids, cavities, dirt, dust, oils, grease, laitance or other contaminants.

B. Application:

Application shall be in strict accordance with manufacturer's recommendations. The minimum and maximum required times between coats shall be per the manufacturer's product data sheet. If recoating is required to correct pinholes of insufficient system coating thickness, surfaces shall be brush-blasted prior to recoat.

C. Coating System:

Total dry film thickness of the complete system shall be 24.0 mils, minimum.

Carboline System	Filler - Sentry 610 Primer - Sentry 140 (15 mils MDFT) Finish - Sentry 140 (15 mils MDFT)
G System	Filler - NU-KLAD 114A Primer - Amercoat 385 (6 mils MDFT) Finish - Amercoat 351 (9 mils MDFT, each coat)
Tnemec System	Filler - Series 120-5003 Vinester F&S Primer - Series 120-5002 Beige Vinester (12 mils MDFT) Finish - Series 120-5001 Gray Vinester (12 mils MDFT)

2.12 *Service Condition K*

Interior and exterior concrete surfaces exposed to view, not subject to immersion and not subject to pedestrian traffic, and concrete block and masonry without integral color or architectural treatment, shall receive the following surface preparation and coating:

A. Surface Preparation:

All surfaces shall be thoroughly cleaned by sandblasting or other approved methods, removing all traces of previous materials. Remove all loose concrete, mortar splatter and protrusions by chipping, etc. to leave only sound firmly bonded concrete, concrete block, or masonry. All cracks and voids shall be filled with an approved concrete and masonry patching compound. Final surface shall be smooth and free of voids, cavities, dirt, dust, oils, grease, laitance or other contaminants.

B. Application:

Application shall be in strict accordance with manufacturer's recommendations. A minimum of 12 hours is required before additional coats may be applied to the prime coat and two hours for the finish coats.

C. Coating System:

Prime coat shall be applied at a rate of 75-100 square feet per gallon. A minimum of two finish coats shall be applied at a coverage rate not to exceed 150 square feet per gallon per coat.

Carboline System	Primer - Flexxide Block Filler Finish - Flexxide HB (Smooth)
G System	Primer - Amerlastic 172 Finish - Amerlastic 290 L T (Smooth) or Amerlastic 290 TC (Textured)
Tnemec System	Primer - Series 130 Envirofill Finish - Series 180 (Smooth) or 181 (Textured)

2.13 *Service Condition L*

Concrete floors subject to corrosive moisture and pedestrian traffic where specified shall receive the following surface preparation and coating:

A. Surface Preparation:

All surfaces shall be thoroughly cleaned by sandblasting or other approved methods; removing all traces of previous materials. Remove all loose concrete by chipping, etc. to leave only sound firmly bonded concrete. Cracks and voids shall be repaired or filled with the specified filler and surfacer. Final surfaces shall be smooth and free of voids, cavities, dirt, dust, oils, grease laitance or other contaminants.

B. Application:

Application shall be in strict accordance with manufacturer's recommendation. Where a non-skid finish is specified broadcast #50 dry washed silica sand onto primer coat while still wet and follow with finish coat after required drying time.

C. Coating System:

Prime coat shall be thinned 15-20 percent with manufacturer recommended thinner and applied at a coverage rate not to exceed 250 square feet per gallon. Finish coat shall be applied at a coverage rate not to exceed 200 square feet per gallon. Total dry film thickness of the complete system shall be a minimum of 10 mils.

Carboline System	Filler - Sentry 610 Primer - Carboline 890 Finish - Carboline 890
G System	Filler - NU-KLAD 114A Primer - Amerlock 400 Finish - Amerlock 400
Tnemec System	Filler - Series 63-1500 Filler and Surfacer Primer - Series 104 H.S. Epoxy Finish - Series 104 H.S. Epoxy

2.14 *Service Condition M*

Concrete and concrete block masonry furnished with an approved architectural finish (e.g. integral color or architectural treatment) shall receive the following surface preparation and clear sealing system:

A. Surface Preparation:

All surfaces shall be cleaned of all dirt, dust, grease, and other foreign matter before sealing.

B. Application:

Application shall be in strict accordance with manufacturer's recommendations.

C. Coating System:

Apply one coat at a coverage rate not to exceed 100 square feet per gallon.

Carboline System	Floorshield 2000
Monopole System	Monochem Aquaseal

2.15 Service Condition N

Interior and exterior architectural woodwork and interior gypsum board shall receive the following surface preparation and coating:

A. Surface Preparation:

1. Interior and Exterior Woodwork

Sand new and bare wood to remove any surface contamination and surface cells. For previously coated surfaces sand loose paint to a tight, adherent surface. Cracks, nail holes, and other defects shall be filled with putty or plastic wood after priming. All knots shall be sealed with an approved knot sealer. Prior to coating, all surfaces shall have a moisture content below level recommended by coating manufacturer and be thoroughly cleaned and free of all foreign matter.

2. Interior Gypsum Board

Tape new gypsum board joints and top with a total of three applications of joint compound. Sand joints after each coat. Spray gypsum board with a light texture coat. Owner shall approve a test section prior to texture coating.

B. Application:

Application shall be in strict accordance with manufacturer's recommendations.

C. Coating System:

Prime coat shall be applied at a coverage rate not to exceed 280 square feet per gallon. The finish coat shall be applied at a coverage rate not to exceed 280 square feet per gallon.

Carboline System	Primer - Carboline 3359 (semi-gloss) Finish - Carboline 3359 (semi-gloss)
G System	Primer - Amercoat 220 (satin or gloss) Finish - Amercoat 220 (satin or gloss)
Tnemec System	Primer - Series 6 (flat) or 7 (semi-gloss) Finish - Series 6 (flat) or 7 (semi-gloss)

Prior to application of coating system, new gypsum board shall be coated with a sealer recommended by the coating manufacturer and approved by the Owner, or an additional prime coat of the specified system shall be applied.

2.16 *Service Condition O*

Exposed plastic and fiberglass surfaces, specifically identified in the Contract Documents as requiring coating, shall receive the following surface preparation and coating (coating to be used for this category shall be certified by the plastic and fiberglass manufacturer to be completely acceptable and non-injurious to the material):

A. Surface Preparation:

Surface preparation shall consist of hand sanding to remove gloss. All remaining dust shall be removed with vacuum brushing or tack rag. Sanded surfaces shall not be washed with either solvent or water.

B. Application:

Application shall be in strict accordance with manufacturer's recommendations.

C. Coating System:

Except as otherwise noted, two coats shall be applied at 2.0 mils per coat to a total 4.0 mil MDFT for the system.

Carboline System	Carbothane 134 MC
PPG System	Amershield VOC
Tnemec System	Series 80 Endurashield

2.17 *Service Condition P*

Manufactured items furnished with shop-applied coat of primer requiring field touch-up or with a shop applied primer which is not compatible with the required coating system shall receive the following surface preparation and coating system:

A. Surface Preparation:

All surfaces shall be cleaned in conformance with Steel Structures Painting Council Specification SSPC-SP2 (Hand Tool Cleaning), including hand sanding and feathering of damaged areas. If determined by the Owner that damage is too extensive for touch-up, the item shall be recleaned and coated or painted as directed by the Owner.

B. Coating System:

Prime and finish coats shall be the system recommended for the specific Service Condition. Prime coat shall be compatible with the required system. If not (as determined by the Owner) the prime coat shall either be removed by sandblasting or coated with a suitable primer which is compatible with the shop primer utilized and the coating system required. Costs incurred for repair or replacement of shop-applied primers shall be the sole responsibility of the Contractor.

2.18 *Service Condition Q*

Manufactured items finished with shop-applied primer and finish coats requiring field touch-up shall receive the following surface preparation and coating system:

A. Surface Preparation:

All surfaces shall be cleaned in conformance with Steel Structures Painting Council Specification SSPC-SP2 (Hand Tool Cleaning), including hand sanding and feathering of damaged areas. If determined by the Owner that the damage is too extensive for touch-up, the item shall be recleaned and coated or painted as directed by the Owner.

B. Coating System:

Prime and finish coats shall be the system recommended for the specific Service Condition. Costs incurred for repair or replacement of shop-applied coatings or finishes shall be the sole responsibility of the Contractor.

2.19 *Service Condition R*

Ferrous metal tanks, vessels, or equipment containing raw water or potable water shall receive the following surface preparation and coating:

A. Surface Preparation:

All interior surfaces, including miscellaneous accessories and components, submerged or unsubmerged, shall be field sandblasted in conformance with SSPC-SP10 and NACE No. 2 (Near-White Blast Cleaning) to achieve a 2-4 mil (50-100 micron) blast profile.

All exterior surfaces, including miscellaneous accessories and components, shall be field sandblasted in conformance with SSPC-SP6 and NACE No. 3 (Commercial Blast Cleaning).

B. Application:

Application shall be in strict accordance with manufacturer's recommendations. The minimum and maximum required times between coats shall be per the manufacturer's product data sheet. Written requests for shop surface preparation and application of the prime coat shall be reviewed and approved by the Engineer on a case-by-case basis. If approved by the Engineer, shop applied prime coat surface shall be field scarified by brush-blasting prior to application of the finish coat.

C. Coating System:

Interior Surfaces:

Interior coating system shall be certified by the National Sanitation Foundation to be in accordance with ANSI/NSF Standard 61 for potable water contact. Except as otherwise noted, the prime coat shall have a MDFT of 6.0 mils. The finish coat shall have a MDFT of 6.0 mils. The total dry film thickness of the complete system shall be 12.0 mils, minimum.

Carboline System	Primer - Super Hi-Gard 891 Finish - Super Hi-Gard 891
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Tnemec System	Primer - Series 139 Pota-Pox II Finish - Series 139 Pota-Pox II
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Exterior Surfaces:

Except as otherwise noted, the prime coat shall have a MDFT of 6.0 mils. The finish coat (one or more) shall have a MDFT of 3.0 mils. The total dry film thickness of the complete system shall be 9.0 mils, minimum.

Carboline System	Primer - Super Hi-Gard 891 Finish - Carbothane 134 HG
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Tnemec System	Primer - Series 139 Pota-Pox II Finish - Series 74 Endurashield II
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2.20 *Service Condition S*

Concrete seallwater proofing shall be Vandex Super or Xypex.

2.21 *Miscellaneous Coatings*

A. Aluminum Metal Isolation

All aluminum bearing on, or embedded in, concrete shall be coated with a wash primer (0.5 mils) followed by one coat (8 mils) of heavy bodied bituminous paint, Carboline Bitumastic Super Service Black or Tnemec 46-465.

PART 3 Execution

3.01 *General*

- A. All surface preparation, coating and painting shall conform to applicable standards of the National Association of Corrosion Engineers, the Steel Structures Painting Council, the American Concrete Institute, the Forest Products Research Society, and the Manufacturer's printed instructions. Material applied prior to approval of surface preparation by the Owner shall be removed and reapplied to the satisfaction of the Owner at the expense of the Contractor.
- B. All work shall be performed by skilled craftsmen qualified to perform the required work in a manner comparable with the best standards of practice. Continuity of personnel shall be maintained and transfers of key personnel shall be coordinated with the Owner.
- C. Unless otherwise specified, dust, dirt, oil, grease or any foreign matter that will affect the adhesion or durability of the finish must be removed by washing with clean rags dipped in an approved cleaning solvent and wiped dry with clean rags.
- D. Coating and painting systems include surface preparations, prime coatings and finish coatings. Surface preparation for a specific Service Condition shall be as specified for that coating or painting system. Unless otherwise specified, prime coatings shall be field applied. Where prime coatings are shop applied, they shall be thoroughly cleaned and touched up in the field as specified. If shop coatings are deficient or damaged too extensively for adequate repair, they shall be removed and coated and painted as directed by the Owner. Contractor shall instruct suppliers to provide prime coats compatible with the finish coats specified. Any off site work which does not conform to this specification is subject to rejection by the Owner.
- E. The Contractor's coating and painting equipment shall be designed for application of materials specified and shall be maintained in first class working condition. Compressors shall have suitable traps and filters to remove water and oils from the air. Contractor's equipment shall be subject to approval by the Owner.

3.02 Surface Preparation, Ferrous Metal

A. General:

The latest revision of the following surface preparation specifications of the Steel Structures Painting Council and the National Association of Corrosion Engineers shall form a part of this specification:

1. Solvent Cleaning (SSPC-SP1). Removal of oil, grease, soil and other contaminants by use of solvents, emulsions, cleaning compounds, steam cleaning or similar materials and methods which involve a solvent or cleaning action.
 2. Hand Tool Cleaning (SSPC-SP2). Removal of loose rust, loose mill scale and other detrimental foreign matter to a degree specified by hand chipping, scraping, sanding and wire brushing.
 3. Power Tool Cleaning (SSPC-SP3). Removal of loose rust, loose mill scale and other detrimental foreign matter to a degree specified by power wire brushing, power impact tools or power sanders.
 4. White Metal Blast Cleaning (SSPC-SP5). Blast cleaning to a gray-white uniform metallic color until each element of surface area is free of all visible residues.
 5. Commercial Blast Cleaning (SSPC-SP6 and NACE NO.3). Blast cleaning until at least two-thirds of each element of surface area is free of all visible residues.
 6. Brush-Off Blast Cleaning (SSPC-SP7 and NACE No.4). Blast cleaning to remove loose rust, loose mill scale and other detrimental foreign matter to degree specified.
 7. Near White Blast Cleaning (SSPC-SP10 and NACE No.2). Blast cleaning to nearly white metal cleanliness, until at least 95 percent of each element of surface area is free of all visible residues.
- B. Slag and weld metal accumulation and spatters not removed by the fabricator, erector, or installer shall be removed by chipping and grinding. All rough welds shall be ground smooth and sharp edges shall be ground to approximately 1/8 inch radius.
- C. Field blast cleaning for all surfaces shall be dry sandblasting unless otherwise directed.
- D. The Contractor shall comply with all applicable local, state, and federal air pollution control regulations for blast cleaning.

- E. All oil, grease, welding fluxes and other surface contaminants shall be removed by solvent cleaning per SSPC-SP1 prior to blast cleaning.
- F. Maximum particle size of abrasives used in blast cleaning shall be that which will produce a surface profile in accordance with these specifications and the recommendations of the manufacturer of the specified coating system to be applied.
- G. Sand used in blast cleaning operations shall be washed, graded and free of contaminants that would interfere with adhesion of coating or paint and shall not be reused.
- H. Shop applied temporary coatings or shop applied coatings of unknown composition shall be completely removed before the specified coatings are applied.
- I. During blast cleaning operations, caution shall be exercised to insure that existing coatings or paint are not exposed to abrasion from blast-cleaning.
- J. The Contractor shall keep the area of his work in a clean condition and shall not permit blasting materials to accumulate as to constitute a nuisance or hazard to the prosecution of the work or the operation of the existing facilities.
- K. Surfaces shall be cleaned of all dust and residual particles of the cleaning operation by dry air blast cleaning, vacuuming or another approved method prior to application of specified coatings or paint. No coatings or paint shall be applied over damp or moist surfaces.
- L. All welds shall be neutralized with a suitable chemical compatible with the specified coating materials.

3.03 *Surface Preparation, Galvanized Ferrous Metal*

Prior to application of specified pretreatment coating, galvanized ferrous metal shall be alkaline cleaned per SSPC-SP1 to remove oil, grease and other contaminants detrimental to adhesion of the protective coating system to be used.

3.04 *Surface Preparation, Ferrous Metal with Existing Coatings*

- A. All grease, oil, heavy chalk, dirt, or other contaminants shall be removed by solvent or detergent cleaning prior to abrasive blast cleaning. The generic type of the existing coatings shall be determined by laboratory testing.

- B. The Contractor shall provide the degree of cleaning specified in the coating system schedule for the entire surface to be coated. If the degree of cleaning is not specified in the schedule, deteriorated coatings shall be removed by abrasive blast cleaning to SSPC-SPB, Commercial Blast Cleaning. Areas of tightly adhering coatings shall be cleaned to SSPC-SP7. Brush-off Blast Cleaning, with the remaining thickness of existing coating not to exceed 3 mils.
- C. If coatings to be applied are not compatible with existing coatings the Contractor shall apply intermediate coatings per the paint manufacturer's recommendation for the specified coating system or shall completely remove the existing coating prior to abrasive blast cleaning. A small trial application shall be conducted for compatibility prior to painting large areas.
- D. Coatings of unknown composition shall be completely removed prior to application of new coatings.

3.05 *Surface Preparation, Concrete and Masonry*

- A. Surface preparation shall not begin until at least 30 days after the concrete or masonry has been placed.
- B. All oil, grease and form release and curing compounds shall be removed by detergent cleaning per SSPC-SP1 before abrasive blast cleaning.
- C. Concrete and masonry surfaces and deteriorated concrete surfaces to be coated shall be abrasive blast cleaned to remove existing coatings, laitance, deteriorated concrete, and to roughen the surface. The abrasive used should be dry and clean with the maximum particle size that will pass through a 16 mesh screen. Cracks and voids shall be repaired or filled with the specified filler and surfacer. Final surface shall be sound, firmly bonded, smooth and free of voids, cavities, dirt, dust, oils, grease, laitance, or other contaminants.
- D. Residual abrasive, dust and loose particles shall be removed from the surface by vacuuming or blowing off with dry high pressure air.
- E. Unless required for proper adhesion, surfaces shall be dry prior to coating. The presence of moisture shall be determined with an approved moisture detection device.

3.06 *Surface Preparation, Wood and Composition Materials*

All surfaces shall be cleaned of dirt, oil, or other foreign substances with mineral spirits, scrapers, sandpaper, or wire brushes. Finished surfaces exposed to view shall, if necessary, be made smooth by planing or sandpapering. Small, dry, seasoned knots shall be surface scraped, sandpapered, and thoroughly cleaned, and shall be given a thin coat of WP-578 Western Pine Association knot sealer before application of the priming coat. Large, open unseasoned knots, and all beads or streaks of pitch shall be scraped off, or if the pitch is still soft, it shall be removed with mineral spirits or turpentine and the resinous area shall be thinly coated with knot sealer. After priming, all holes and imperfections shall be filled with putty or plastic wood (colored to match the finish coat), allowed to dry, and sandpapered smooth. Existing surfaces shall be cleaned of all loose or flaking paint and sandpapered to a tight, adherent surface.

3.07 *Coating and Painting Application, General*

- A. Coating and painting application shall conform to the requirements of the Steel Structures Painting Council Paint Application Specifications SSPC-PA1, latest revision, for "Shop, Field and Maintenance Painting," and recommended practices of the National Association of Corrosion Engineers, the American Concrete Institute, the Forest Products Research Society, and the Manufacturer of the coating and paint materials.
- B. Application of the first coat shall follow immediately after surface preparation and cleaning and within an eight hour working day. Any cleaned areas not receiving first coat within an eight hour period shall be re-cleaned prior to application of the first coat. Cleaned surfaces and all coats of the specified system shall be inspected prior to application of each succeeding coat. Contractor shall schedule such inspection with the Owner in advance.
- C. Prior to assembly, all surfaces made inaccessible after assembly shall be prepared as specified herein and shall receive the coating or painting system specified.
- D. Thinning shall be permitted only as recommended by the Manufacturer and approved by the Owner.
- E. Coating materials shall be protected from exposure to cold weather, and shall be thoroughly stirred, strained, and kept at a uniform consistency during application.
- F. Each application of coating or paint shall be applied evenly, free of brush marks, sags, runs, and variations in color, texture and finish with no evidence of poor workmanship. Care shall be exercised to avoid lapping on glass or hardware. Coatings and paints shall be sharply cut to lines. Finished surfaces shall be free from defects or blemishes.

- G. Protective coverings or drop cloths shall be used to protect floors, fixtures and equipment. The working parts of all mechanical and electrical equipment shall be protected from damage during surface preparation and coating operations. Openings in motors shall be masked to prevent entry of coating or other materials. Care shall be exercised to prevent coatings or paints from being spattered onto surfaces which are not to be coated or painted. Spray painting shall be conducted under carefully controlled conditions. The Contractor shall be fully responsible for and shall promptly repair any and all damage to adjacent facilities or adjoining property occurring from blast cleaning or coating operations.
- H. When two or more coats of coating or paint are specified, each coat shall be of a slightly different shade to facilitate inspection of surface coverage of each coat.
- I. Specified film thicknesses per coat for the Service Conditions are minimum required. Contractor shall apply additional coats as necessary to achieve the specified thickness.
- J. All material shall be applied as specified.
- K. All welds and irregular surfaces shall receive a brush coat of the specified product prior to application of the first complete coat.
- L. Cleaning and coating shall be coordinated so that dust and other contaminants from the cleaning process will not fall on wet, newly-coated surfaces.
- M. Drying time between coats and surface curing shall be as recommended by the coating manufacturer depending upon field conditions of temperature and humidity. Times shall be submitted with the shop drawings based on 70°F and relative humidity of 50 percent.
- N. In the case of enclosed areas, the forced air ventilation system shall operate continuously to provide air circulation and exhausting of solvent vapors.

3.08 *Shop Coating*

- A. All items of equipment, or parts of equipment which are not submerged in service, shall be shop primed and then finish coated in the field, after installation, with the specified or approved color. The methods, materials, application equipment and all other details of shop painting shall comply with these specifications. If the shop primer requires top coating within a specified period of time, the equipment shall be finish coated in the shop and then touch-up painted after installation.

- B. All items of equipment or parts and surfaces of equipment which are submerged or inside an enclosed hydraulic structure when in service, with the exception of pumps and valves, shall have all surface preparation and coating work performed in the field.
- C. For certain pieces of equipment it may be undesirable or impractical to apply finish coatings in the field. Such equipment may include engine generator sets, equipment such as electrical control panels, switchgear or main control boards, submerged parts of pumps, ferrous metal passages in valves, or other items where it is not possible to obtain the specified quality in the field. Such equipment shall be shop primed and finish coated and touched up in the field with the identical material after installation. The Contractor shall require the manufacturer of each such piece of equipment to certify as part of its shop drawings that the surface preparation is in accordance with these specifications. Copies of applicable coating manufacturer's material data sheets shall be submitted with equipment shop drawings.
- D. For certain small pieces of equipment the manufacturer may have a standard coating system which is suitable for the intended service conditions. In such cases, the final determination of suitability will be made during review of the shop drawing submittals. Equipment of this type generally includes only indoor equipment such as instruments, small compressors, and chemical metering pumps.
- E. Shop painted surfaces shall be protected during shipment and handling. Primed surfaces shall not be exposed to the weather for more than 6 months before top coated, or less time if recommended by the coating manufacturer.
- F. Damage to shop-applied coatings shall be repaired in accordance with these specifications and the coating manufacturer's printed instructions.
- G. The Contractor shall make certain that the shop primers and field topcoats are compatible and meet the requirements of these specifications.

3.09 *Protective Coating and Painting Schedule*

The protective coating and painting schedule provided herein or on the drawings shall indicate the coating system to be used. The schedule shall not be construed as a complete list of all surfaces to be coated but rather as a guide as to the application of the various coating systems. All surfaces shall be coated and painted except those specifically excluded herein or on the drawings.

3.10 Color Scheme

All colors and shades of colors of all coats of paint and protective coating material shall be as selected by the Owner, except as noted below under "Pipe Color Coating." The Contractor shall submit a current chart of the manufacturer's available colors to the Owner at least forty-five days prior to the start of coating and painting operations.

3.11 Pipe Color Coding and Labeling

All exposed piping shall be color coded and labeled to conform to all OSHA requirements and "Scheme for the Identification of Piping Systems" (ANSI A13.1). "State (10) Standards" color scheme shall be used to further identify specific commodity. As a guideline the following color coding schedule is provided. Color codes shall be confirmed with the Owner prior to commencing work.

A. Color Code Schedule:

Item	Color Code
Aeration Air	Safety Green
Aftercooler Return	Safety Red
Aftercooler Supply	Safety Red
Air Scour	Safety Green
Alum	Safety Yellow/Red Bands
AWT Bypass	Safety Red
Belt Press Return Water	Gray
Caustic Soda	Safety Orange
Chemical Drain	Safety Orange
Chlorine Gas	Safety Orange
Chlorine Liquid	Safety Orange
Chlorine Solution	Safety Orange
Chlorine Vacuum	Safety Orange
Cold Sludge	Brown
Digested Sludge	Brown
Digested Sludge Exchange	Brown
Drain	Gray
Engine Cooling Water	Safety Red
Engine Exhaust	Safety Red

Item	Color Code
Filter Backwash	Safety Red
Filter Backwash Return	Safety Red
Filter Effluent	Safety Red
Filter Influent	Safety Red
Fire Water	Safety Red
Flotation Thickener Overflow	Brown
Flotation Thickener Return	Gray
Foul Air	White
Froth Spray	Safety Red
Fuel Oil	Black
Fuel Oil Return	Black
Fuel Oil Supply	Black

B. Color Code Schedule:

Item	Color Code
Gravity Thickener Overflow	Brown
Ground Water Drainage	Gray
Grit	Brown
Grit Chamber Influent	Brown
Grit Washer Overflow	Gray
Heat Recovery Return	Safety Blue/Orange Bands
Heat Recovery Supply	Safety Blue/Orange Bands
Heated Sludge	Brown/Yellow Bands
Holding Tank Overflow	Brown
High Pressure Digester Gas	Light Yellow
High Temperature Wash Water	Safety Blue/Orange Bands
Hydrogen Peroxide	Safety Orange
Industrial Water	Safety Red
Industrial Water	Brown
Influent Force Main	Safety Red
Jacket Water Return	Safety Red
Jacket Water Supply	Safety Red

Item	Color Code
Liquid Propane Gas	Light Yellow
Low Pressure Digester Gas	Light Yellow
Lube Oil Return	Black
Lube Oil Supply	Black
Lube Oil Waste	Black
Methanol	Safety Yellow/Red Bands
Natural Gas	Light Yellow
Plant Air	Safety Green/Yellow Band
Plant Effluent	Safety Red
Polymer	Safety Yellow/Blue Bands
Potable Water	Safety Blue
Primary Influent	Brown
Primary Skimmings	Brown
Primary Sludge	Brown
Pumped Drainage Water	Gray
Raw Influent	Brown
Return Activated Sludge	Brown
Return Water	Safety Red

C. Color Code Schedule:

Item	Color Code
Sample	Safety Red
Sanitary Drain	Gray
Seal Water	Safety Red
Secondary Effluent	Safety Red
Secondary Skimmings	Brown
Secondary Sludge	Brown
Skimmings	Brown
Sludge Heater Bypass	Brown
Sludge Return	Brown
Sludge Transfer	Brown
Spray Wash	Safety Red
Storm Drain	Gray
Sulfer Dioxide Gas	Safety Orange
Sulfer Dioxide Liquid	Safety Orange
Sulfer Dioxide Solution	Safety Orange
Sulfer Dioxide Vacuum	Safety Orange
Tank Drain	Brown
Tertiary Effluent	Safety Red
Thickened Digested Sludge	Brown
Thickened Sludge	Brown
Thickened Waste Activated Sludge	Brown
Thickener Dilution Water Safety	Safety Red
Vent White	White
Ventilation Air	White
Wash Water	Safety Red
Waste Activated Sludge	Brown
Waste Sludge	Brown

D. Label Coding:

Pipe labels (or markers) shall be pressure-sensitive, self-adhesive, vinyl film pipe markers as manufactured by Seton Name Plate Corporation, or equal. Background colors, letter colors, letter heights and spacing shall conform with ANSI A 13.1. Pipe designation labels and direction-of-flow arrows shall be placed at 10 foot intervals (maximum) and at every change in direction. Pipe designation wordings shall be selected by the Owner and may not correspond to standard wordings available from the manufacturer.

3.12 *Cleanup*

Upon completion of the work, all staging, scaffolding, and containers shall be removed from the site or destroyed in a manner approved by the Owner. Coating or paint spots and oil or stains upon adjacent surfaces shall be removed and the job site cleaned. All damage to surfaces resulting from the work of these specifications shall be cleaned, repaired or refinished to the satisfaction of the Owner and at no additional cost to the Owner.

END OF SECTION 09 90 00

SECTION 31 23 19
DEWATERING

PART 1 General

1.01 *Description*

- A. Design, furnish, install, operate, monitor, maintain and remove a temporary dewatering system as required to lower and control water levels at least 5 feet below subgrades of excavations and to permit construction to proceed in-the-dry.
- B. Furnish and maintain temporary surface water runoff control measures adequate to capture and remove surface water entering excavations.
- C. Retain the services of a professional engineer registered in the State of California to prepare dewatering system designs and submittals described herein.
- D. Work shall include the design, equipment, materials, installation, protection, and monitoring of the performance of the dewatering system as required herein.
- E. Collect and properly dispose of all discharge water from the dewatering systems in accordance with all State, County, and Local requirements and applicable water quality standards. Under no circumstances shall water from dewatering systems be discharged into the existing or new sanitary sewer systems.
- F. Obtain and pay for all permits required for dewatering systems.
- G. Repair damage caused by dewatering system operations.
- H. Remove temporary surface water runoff control measures after the completion of the excavation and backfilling work, and when approved by the Owner's Representative.

1.02 *Related Work*

Not used.

1.03 *Submittals*

- A. Dewatering system designs shall be prepared by a licensed professional engineer ("Dewatering Engineer") retained by the Contractor and shall, as a minimum, comply with recommendations and/or requirements in the project's Geotechnical Investigation Report. The Contractor is responsible for investigating the soil and groundwater conditions at the site prior to submitting a dewatering plan. The Contractor shall submit the Dewatering Engineer's and the dewatering subcontractor's qualifications for review and approval by CVWD's Representative and the Engineer of Record (CVWD/Engineer).
- B. The Contractor shall submit a dewatering system design plan developed and signed and sealed by the Dewatering Engineer. The plan shall include a description of the proposed dewatering system and include the proposed installation methods to be used for dewatering system elements and for observation wells. The plan shall include equipment, drilling methods, hole sizes, filter sand placement techniques, sealing materials, development techniques, the number and location of dewatering points and observations wells, headers, sumps, ditches, size and location of discharge lines, capacities of pumps and standby units, and detailed description of dewatering methods to be employed to convey the water away from the site to an adequate disposal area, etc. Include the dewatering system design calculations in the plan.
- C. The plan shall identify the anticipated area influenced by the dewatering system and address impacts to adjacent existing and proposed structures.
- D. Coordinate dewatering submittals with the excavation and support of excavation submittals. The dewatering submittal shall show the areas and depths of excavation to be dewatered.
- E. Submit drawings and data showing the method to be employed in dewatering excavated areas 30 days before commencement of excavation. Do not proceed with any excavation or dewatering activities until the dewatering submittal has been reviewed and accepted in writing by the CVWD/Engineer.
- F. Prior to excavation activities, the Dewatering Engineer shall certify in writing that the dewatering system has been installed according to the accepted plan and that it is functioning properly. However, acceptance by the CVWD/Engineer shall not relieve the Contractor of the responsibility for the adequacy of the dewatering system to achieve the required results.
- G. Include a written report outlining control procedures to be adopted if dewatering problems arise.

- H. Materials submitted shall be in a format acceptable for inclusion in required permit applications to any and all regulatory agencies for which permits for discharge water from the dewatering system are required due to the discharge reaching regulated bodies of water.
- I. Insure compliance with all conditions of regulating permits and provide such information to the CVWD/Engineer. Obtain written approval from the CVWD/Engineer before discontinuing operation of the dewatering system.

1.04 *References*

Not used.

1.05 *Quality Assurances*

- A Regulations: Perform all work in accordance with current applicable regulations and codes of all Federal, State and local agencies.
- B. The Contractor shall have at least 5 years of experience with work compatible to the Work shown and specified, employing labor and supervisory personnel who are similarly experienced in this type of work.
- C. The Contractor's Dewatering Engineer shall be registered in the State of California and have a minimum of five (5) years of professional experience in the design and construction of dewatering systems and shall have completed not less than five (5) successful dewatering projects of equal type, size, and complexity that is required for the work.

1.06 *Design Requirements*

- A. The Contractor is responsible for the proper design and implementation of methods for controlling surface water and groundwater.
- B. Prior to excavation, the Contractor shall lower the groundwater to at least 5 feet below the lowest excavation subgrade elevation. Additional groundwater lowering may be necessary beyond the 5-foot requirement, depending on construction methods and equipment used and the prevailing groundwater and soil conditions. The Contractor is responsible for lowering the groundwater as necessary to complete construction in accordance with the plans and specifications at no additional cost to CVWD.
- C. Design wells, well points and sumps, and all other groundwater control system components to prevent loss of fines from surrounding soils. Sand filters shall be used with all dewatering installations unless screens are properly sized by the Contractor's Dewatering Engineer to prevent passage of fines from surrounding soils.

- D. The Contractor shall be responsible for damage to properties, buildings or structures, wet wells, sewers and other utility installations, pavements and work that may result from dewatering or surface water control operations.
- E. Design review and field monitoring activities by CVWD/Engineer shall not relieve the Contractor of his/her responsibilities for the work.
- F. Plan the wells to meet the requirements of Section 1.06.B in the transverse and the longitudinal directions. Submit dewatering plan and calculations to identify the wells to be kept operational in front of, behind, and sides of the active excavation zone.
- G. The dewatering duration should be adequate to allow for soil to be exposed within the excavation bottom to adequately drain and attain stable moisture content prior to excavation.
- H The groundwater level should be maintained an adequate distance ahead and behind the working area to prevent water from migrating into the excavation during pipeline installation.

1.07 *Definitions*

- A. Where the phrase "in-the-dry" is used in this Section, it shall be defined as an excavation subgrade where the groundwater level has been lowered to at least 5 feet below the lowest level of the excavation, is stable with no ponded water, mud, or muck, is able to support construction equipment without rutting or disturbance and is suitable for the placement and compaction of fill material and pipe.

PART 2 Products

2.01 *Piping and Equipment*

- A. Pipe for observation wells shall consist of a minimum 1-inch I.D., Schedule 40 PVC pipe and machine slotted PVC wellpoints, maximum slot size 0.020 inch or as shown on the dewatering Drawings.
- B. Piping, pumping equipment and all other materials required to provide control of surface water and groundwater in excavations shall be suitable for the intended purpose.
- C. Standby pumping systems and a source of standby power shall be maintained at all sites.

PART 3 Execution

3.01 General

- A. Control surface water and groundwater such that excavation to final subgrade is made in-the-dry, the natural undisturbed condition of the subgrade soils are maintained, and softening and/or instability or disturbance due to the presence or seepage of water does not occur. All construction and backfilling shall proceed in-the-dry and flotation of completed portions of work shall be prohibited.
- B. The method and timing of groundwater control shall be such that the groundwater shall be lowered to the required levels starting at a minimum of 48 hours prior to excavation. Achieving the required dewatering level only after excavation (e.g. sump pumping inside an initially wet trench bottom) is not permitted.
- C. Where groundwater levels are above the proposed bottom of the excavation level, a pumped dewatering system will be required prior to excavation, and for maintaining the lowered groundwater level until construction has been completed to such an extent that the structure, pipeline or fill will not be floated or otherwise damaged.
- D. It is expected that the type of system, spacing of dewatering units and other details of the work will have to be varied depending on soil/water conditions at a particular location. Any such field changes or deviations shall be approved in writing by the Dewatering Engineer and CVWD/Engineer.
- E. All work included in this section shall be done in a manner which will protect adjacent structures and utilities and shall not cause loss of ground or disturbance to the pipe bearing soils, lateral pipe support soils, or to soils which support overlying or adjacent structures.
- F. Install, monitor and report data from observation wells. Evaluate the collected data relative to groundwater control system performance and modify systems as necessary to dewater the site in accordance with the Contract requirements.
- G. Locate groundwater control system components where they will not interfere with construction activities adjacent to the work area or interfere with the installation and monitoring of observation wells. Excavations for sumps or drainage ditches shall not be made within or below slopes extending downward and out from the edges of existing or proposed foundation elements or from the downward vertical footprint of the pipe.

3.02 *Surface Water Runoff Control*

- A. Construct surface water runoff control measures, including dikes, ditches, sumps and other methods to prevent, as necessary, flow of surface water runoff into excavations and to allow construction to proceed without delay.

3.03 *Excavation Dewatering*

- A. At all times during construction, provide and maintain proper equipment and facilities to promptly remove and properly dispose of all water entering excavations. Excavations shall be maintained in-the-dry. Groundwater levels shall be kept at least 5 feet below the lowest *excavation* level.
- B. Excavation dewatering shall maintain the subgrade in a natural undisturbed condition and until the fill, structure or pipes to be built thereon have been completed to such extent that they will not be floated or otherwise damaged by allowing water levels to return to natural elevations.
- C. Pipe, fabric, bedding, Controlled Low Strength Material (CLSM), Controlled Density Fill (CDF), or concrete shall not be placed in water or water shall not flow over them, or any unbalanced water pressure exerted over them for a minimum of two (2) days after their placement.
- D. Dewatering shall at all times be conducted in such a manner as to preserve the in place condition of the subgrade soils at the proposed bottom of excavation.
- E. If the subgrade of the trench or excavation bottom becomes disturbed due to inadequate dewatering or drainage, excavate below normal grade as directed by the CVWD/Engineer and refill with structural fill, CLSM, CDF or other material as approved by CVWD/Engineer at the Contractor's expense.
- F. The *initial* dewatering plan may have to be modified to suit the variable soil/water conditions to be encountered during construction. This modification shall be designed by the Dewatering Engineer and shall be accepted by CVWD/Engineer. Dewater and excavate, at all times, in a manner which does not cause loss of ground or disturbance to the pipe bearing soil or soil which supports overlying or adjacent structures.
- G. If the method of dewatering does not properly dewater the excavation as specified. install additional wells as required and do not place any pipe or structure until the readings obtained from the observation wells indicate that the groundwater has been lowered a minimum of 5 feet below the bottom of the final excavation within the excavation limits.

- H. Dewatering units used in the work shall be surrounded by suitable filter sand and no fines shall be removed by pumping. Pumping from the dewatering system shall be continuous until pipe or structure is adequately backfilled. Stand-by pumps shall be provided.
- I. Water entering the excavation shall be drained to a sump and pumped from the excavation to maintain a bottom free from standing water. Surface runoff water shall be collected in shallow ditches around the excavation and prevented from entering the excavated area.
- J. Prior to any excavation below the ground water table, place the dewatering system into operation to lower the ground water table as required and provide CVWD/Engineer proof that the dewatering system is operating as required. The dewatering system shall operate continuously 24 hours a day, 7 days a week until utilities and structures have been satisfactorily constructed, which includes the placement of backfill materials and dewatering is no longer required.
- K. The Contractor shall provide complete standby equipment, installed and available for immediate operation. as may be required to adequately maintain dewatering on a continuous basis and in the event that all or any part of the system may become inadequate or fail.
- L. Water removed from dewatering operations shall be disposed of in an approved area in accordance' with local, state and federal requirements related to the discharge of dewatering water. Existing or new sanitary sewers shall not be used to dispose of dewatering.

3.04 *Well Point Systems*

- A. Where necessary, install a vacuum wellpoint system around the excavation to dewater the excavation. Each wellpoint and riser pipe shall be surrounded by a sand filter. Sand shall be of such a gradation that, after initial development of the wellpoints, the quantity and size of soil particles discharged shall be negligible. Wellpoint systems shall be capable of operating continuously under the highest possible vacuum.
- B. Installation of well point systems shall be in accordance with the accepted submittal in the presence of the CVWD/Engineer. The installation shall be certified in writing by the Dewatering Engineer that it complies with the design and that it is functioning properly.

3.05 *Deep Wells*

- A. Where necessary, install a deep well system around the excavation to dewater the excavation. Each well shall be surrounded by a sand or gravel filter with adequate gradation such that after development, the quantity and size of soil particles discharged are negligible. A sufficient number of wells shall be installed to lower the groundwater level to allow excavation to proceed in-the-dry.
- B. Installation of a deep well shall be in accordance with the accepted dewatering system design plan submittal. The installation shall be certified in writing by the Dewatering Engineer that it complies with the design and that it is functioning properly.

3.06 *Observation Wells*

- A. Install observation wells to monitor and measure the success of the dewatering prior to commencement of excavations. The number and location of the monitoring wells should be adequate to demonstrate that the water table has been lowered to the required level as required under this Section or in accordance with the accepted dewatering system design plan submittal. Monitor and verify adequately low groundwater levels beneath and around the excavated area until pipelines are completed and backfilled.
- B. Observation Well Locations and Depths:
 - 1. A minimum of one well every 500 feet of pipe shall be installed within approximately 5 feet (+ 1 foot) of the pipe centerline, staggered in an alternating fashion on either side of the pipe to monitor performance of dewatering systems designed by the Contractor's Dewatering Engineer.
 - 2. Observation wells required shall be installed to a depth of at least 10 feet below the deepest level of excavation, unless otherwise approved by the CVWD/Engineer, and to whatever depth is necessary to indicate that the groundwater control system designed by the Contractor's Dewatering Engineer is performing as intended. Additional observation wells may be required by the CVWD/Engineer if deemed necessary to monitor the performance of the Contractor's groundwater control system.
 - 3. Locations and depths of observation wells are subject to approval by CVWD/Engineer.
- C. Protect the observation wells at the ground surface by providing a lockable box or outer protective casing with lockable top and padlock. Design the surface protection to prevent damage by vandalism or construction operations and to prevent surface water from infiltrating.

1. Provide two copies of keys for each padlock to the CVWD/Engineer for access to each well.
2. Observation wells shall be developed so as to provide a reliable indication of groundwater levels. Wells shall be re-developed if well clogging is observed, in the event of apparent erroneous readings, or as directed by the CVWD/Engineer.
3. Submit observation well installation logs, top of casing elevation, and well locations to CVWD/Engineer within 24 hours of completion of well installation.

D. Observation Well Maintenance:

1. The Contractor shall maintain each observation well until pipelines are completed and backfilled. Clean out or replace any observation well which ceases to be operable before adjacent work is completed.
2. It is the Contractor's obligation to maintain observation wells and repair or replace them at no additional cost to CVWD, whether or not the observation wells are damaged by the Contractor's operations or by third parties.

E. Monitoring and Reporting of Observation Well Data:

1. The Contractor shall begin daily monitoring of groundwater levels in work areas prior to initial operation of the dewatering system. Daily monitoring in areas where groundwater control is in operation shall continue until the time that adjacent pipelines are completed and backfilled and until the time that groundwater control systems are turned off.
2. The Contractor is responsible for processing and reporting observation well data to the CVWD/Engineer on a daily basis. Data shall be provided to the CVWD/Engineer on a form that includes the following information: observation well number, depth to groundwater, total depth of well, top of casing elevation, groundwater level elevation and date and time of reading.

3.07 *Removal of Systems*

- A At the completion of the excavation and backfilling work, and when approved by CVWD/Engineer, all pipe, deep wells, wellpoints, pumps, generators, observation wells, other equipment and accessories used for the groundwater and surface water control systems shall be removed from the site. All materials and equipment shall become the property of the Contractor. All areas disturbed by the installation and removal of groundwater control systems and observation wells shall be restored to their original condition.

- B. Leave in place any casings for deep wells, wellpoints or observation wells located within the plan limits of pipelines or within the zone below 1 H:1 V planes extending downward and out from the downward vertical footprint of the pipe, or where removal would otherwise result in ground movements causing adverse settlement to adjacent ground surface, utilities installed pipe, or existing structures.
- C. Where casings are pulled, holes shall be filled with sand or cement slurry. Where left in place, casings shall be filled with cement grout and cut off a minimum of 3 feet below finished ground level.
- D. When directed by the CVWD/Engineer, observation wells shall be left in place for continued monitoring. When so directed, cut casings flush with final ground level and provide protective lockable boxes with locking devices. The protective boxes shall be suitable for traffic and for any other conditions to which the observation wells will be exposed.
- E. Well abandonment or removal shall comply with all conditions of permits required for the dewatering systems and the County well abandonment requirements.

3.08 *Water Disposal*

- A. The Contractor shall be responsible to dispose of water removed from the excavations in such a manner that will
 - 1. Not endanger portions of work under construction or completed.
 - 2. Not cause any inconvenience to others working or residing near site.
 - 3. Not cause or contribute to a violation of water quality standards.
 - 4. Comply with the stipulations of required permits for disposal of water.
 - 5. Control runoff in all work areas including, but not limited to, excavations, access roads, parking areas, laydown, and staging areas. The Contractor shall provide, operate, and maintain all ditches, basins, sumps, culverts, site grading, and pumping facilities to divert, collect, and remove all water from the work areas. All water shall be removed from the immediate work areas and shall be disposed of in accordance with applicable permits.
- B. Excavation Dewatering:
 - 1. The Contractor shall be responsible for providing all facilities required to divert, collect, control, and remove water from all construction work areas and excavations.

2. Drainage features shall have sufficient capacity to avoid flooding of work areas.
 3. Drainage features shall be arranged and altered as required to avoid degradation of the final excavated surface(s).
 4. The Contractor shall utilize all necessary erosion and sediment control measures as described herein to avoid construction related degradation of the natural water quality.
- C. The Contractor shall comply with best management practices as described in the storm water pollution prevention plan for the project. Dewatering fluids shall be disposed of in an approved area in accordance with local, state and federal requirements. Existing or new sanitary sewers shall not be used to dispose of dewatering water or surface runoff water.
- D. Water removed from the dewatering operation and conveyed to a municipal separate storm sewer system or receiving water shall not cause or contribute to an exceedance of the current Colorado River Basin Water Quality Control Plan. The Contractor will be responsible for obtaining appropriate local, state and federal permits related to the discharge of dewatering water.

3.09 *Corrective Action*

- A. If dewatering requirements are not satisfied due to inadequacy or failure of the dewatering system (loosening of the foundation strata, or instability of slopes, or damage to foundations or structures), the Contractor shall be responsible to perform the necessary work for remediation, repair or strengthening of foundation soil and damaged structure resulting from such inadequacy or failure by Contractor, at no additional cost to CVWD.
- B. As the Contractor obtains information about the soil and groundwater conditions in the field, the Contractor is responsible to update and revise the dewatering plan and dewatering system to continue to meet the requirements of this specification.
- C. All corrective actions and applicable repairs of damages caused by dewatering operations shall be completed immediately, at no cost to CVWD.

END OF SECTION 31 23 19

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SECTION 33 01 30.13

SANITARY SEWER SYSTEM TESTING

Part 1 – General

1.01 *Description*

- A. This section describes the requirements and procedures for leakage (air, infiltration, exfiltration, vacuum) and deflection testing and inspection of gravity sewer, including manholes, and sewer forcemain systems as specified herein and in accordance with the requirements of the Contract Documents.
- B. The Contractor shall furnish all tools, equipment, materials, and supplies and shall perform all labor required to complete the Work as indicated on the Drawings and specified herein.

1.02 *Related Work Specified Elsewhere*

- A. The requirements of the following sections and divisions apply to the Work of this section. Other sections and divisions of the Specifications, not referenced below, shall also apply to the extent required for proper performance of this Work.
 - 1. Section 31 21 17, Trenching Excavation Backfill and Compaction
 - 2. Section 33 01 30.16, TV Inspection of Sewer Pipelines
 - 3. Section 33 14 00, Hydrostatic Testing of Pressure Pipelines

1.03 *Reference Specifications, Codes, and Standards*

- A. All Work specified herein shall conform to or exceed the applicable requirements of the referenced portions of the following publications to the extent that the provisions thereof are not in conflict with other provisions of these Specifications.
- B. Comply with the applicable editions of the following codes, regulations and standards.
 - 1. Industry Standards:
 - a. ASTM C 828 Standard Test Method for Low-Pressure Air Test of Vitrified Clay Pipe Lines

- b. ASTM C 1244 Standard Test Method for Concrete Sewer Manholes by the Negative Air Pressure (Vacuum) Test Prior to Backfill
 - c. AWWA M55 – PE Pipe - Design and Installation
 - d. SSPWC Subsection 306-7.8 “Green Book”, Standard Specifications for Public Works Construction, Gravity Pipeline Testing
 - e. SSPWC Subsection 306-8.9 “Green Book”, Standard Specifications for Public Works Construction, Pipeline Pressure Testing, Disinfection, and Commissioning
- C. Comply with the applicable reference Specifications as directed in the General Conditions and other applicable parts of the Contract Documents.

1.04 *Contract Submittals*

- A. Submittals shall be made in accordance with the General Conditions, other applicable parts of the Contract Documents, and as specified herein.
- B. The Contractor shall submit in writing all proposed comprehensive plans for testing (gravity pipeline and laterals, manholes, and forcemains), and for water conveyance, control, and disposal. After the plans have been accepted by CVWD, the Contractor shall also submit written notice seven (7) days in advance of the proposed testing schedule for review and acceptance of CVWD.
- C. Testing equipment and appurtenances for all testing methods employed in Part 3 of this specification.
- D. Calibration certifications of testing gauges.
- E. Deflection test mandrel.
- F. Sag measurement device.
- G. Length of gravity sewer main and laterals to be tested between each manhole and the corresponding allowed air pressure drop per SSPWC Table 306-7.8.2.4.

1.05 *Warranty*

- A. Contractor shall comply with all warranty requirements as specified in the General Conditions, other applicable parts of the Contract Documents, and as specified herein.

Part 2 – Products

2.01 General

- A. Temporary valves, plugs, bulkheads, measuring devices, and other required testing and water control equipment and materials shall be provided by the Contractor and subject to CVWD's review. No materials shall be used that will be injurious to pipeline structure and future function. Air test gages shall be laboratory-calibrated annually and shall be recalibrated by a certified laboratory at the Contractor's expense prior to the leakage test.

2.02 Manhole Vacuum Testing

A. Plugs

- 1. Manhole vacuum test plugs shall be Lansas Multi-Size Domehead Back and Front Plugs Model 050 Series Plugs, or equal.

B. Manhole Test Heads

- 1. Manhole test heads shall be Lansas Bladder Style Assembly Series 110, Lansas Flat Plate Assembly Series 110, or equal.

2.03 Deflection Test Mandrel

- A. The deflection test mandrel shall be a full circle, solid cylinder, or a rigid, nonadjustable, odd-numbered leg (9-leg minimum) steel cylinder, accepted by CVWD as to design and manufacture. The circular cross section of the mandrel shall have a diameter of at least 95 percent of the specified average inside diameter of the pipe and the minimum length of the circular portion of the mandrel shall be equal to the nominal diameter of the pipe.

- B. Mandrel shall be Hurco, or equal.

2.04 Sag Measurement Device

- A. Sag measurement device shall be as specified in Part 3 of this specification for gravity pipelines.

2.05 Water for Testing Manholes

- A. Potable or recycled water shall be used for testing manholes as described in the Contract Documents.

Part 3 – Execution

3.01 General

- A. Unless otherwise specified, the Contractor shall furnish and pay for water for testing in accordance with the General Conditions and other applicable parts of the Contract Documents.
- B. All pipeline trenches shall be backfilled and compacted (except permanent resurfacing) per Section 31 21 17, Trenching, Excavation Backfill and Compaction, prior to testing of pipe.
- C. Release of water from pipelines, after testing has been completed, shall comply with CVWD requirements and State Regulations.
- D. All testing operations shall be performed in the presence of CVWD's representative.

3.02 Testing of Gravity Pipelines

A. General

1. All gravity sewer pipes and service laterals shall be tested for exfiltration and/or infiltration, deflection, and sags as specified. At the District's option, either the hydrostatic (exfiltration) or the air test may be used.
2. All manholes shall be tested for leakage as specified in Article entitled "Testing of Manholes".
3. Manholes shall be tested prior to backfill placement; whereas, all pipe shall be backfilled and compacted prior to testing.
4. All leakage and tests of sanitary sewer systems (pipe and laterals) shall be in conformance with SSPWC Subsection 306-7.8 Gravity Pipeline Testing and as specified herein.
5. Should any testing activities specified herein indicate any pipe installation either faulty or unacceptable to CVWD, the Contractor shall make the necessary repairs or replacements at the Contractor's expense by a method acceptable to CVWD. Repaired or replaced pipe and/or pipe segments shall be retested. The retest shall be subject to acceptance by CVWD. All costs for scheduling, preparing for inspection, testing, retesting, installing, reinstalling, repairing, cleaning, re-cleaning,

administrative costs, delays or activities by the Contractor relating to the pipe shall borne by the Contractor at no additional cost to CVWD, until testing results are acceptable as defined by the Contract Documents.

B. Water Exfiltration Test

1. General

- a. If shown on the Drawings or at the District's option, each section of sewer between two successive manholes shall be tested for leakage and the leakage test shall be made on all sections of sewer. The water exfiltration test shall be in conformance with SSPWC Subsection 306-7.8.2.2.

2. Test Section

- a. Each section of sewer between two successive manholes shall be tested by plugging all pipe outlets with suitable test plugs. All test plugs shall be secured in place to prevent movement or slippage.
- b. Fill the pipe and manhole with water to a point four feet (4') below the ground surface of the upper manhole, but in no case less than four feet (4') above the pipe invert. If ground water is present, the water surface in the upper manhole shall be at least four feet (4') above the level of the ground water.
- c. The line and manhole shall be filled at least one (1) hour prior to testing and shall be tested for at least two (2) hours, maintaining the head specified above with measured additions of water. The sum of these additions shall be the leakage for the test period.

3. Allowable leakage shall be determined as follows:

$$E = 0.000012 LD(H)^{1/2}$$

Where:

E = Allowable leakage in gallons per minute of sewer tested.

L = Length of sewer and lateral connections tested, in feet.

D = Internal diameter of the pipe in inches.

H = Difference in elevation in feet between the water surface in the upper manhole and the invert of the pipe at the lower manhole; or if ground water is present above the invert of the

pipe in the lower manhole, the difference in elevation between the water surface in the upper manhole and the ground water at the lower manhole.

C. Water Infiltration Test

1. If, in the opinion of CVWD or CVWD's Representative, excessive groundwater is encountered during construction of a section of sewer, the air pressure and exfiltration tests for leakage shall not be used. An infiltration test shall be performed instead in accordance with SSPWC Subsection 306-7.8.2.3.
2. Unless otherwise specified, infiltration will be measured by the Contractor using measuring devices accepted by CVWD.
3. Preparation of Test Section
 - a. The end of the sewer at the upper structure shall be closed to prevent the entrance of water, and pumping of groundwater shall be discontinued for at least three days, after which the section shall be tested for infiltration.
 - b. Test duration shall be at least two (2) hours.
4. Allowable Infiltration Rate
 - a. The infiltration shall not exceed the amount determined by the formula listed in SSPWC Subsection 306-7.8.2.3, which is provided below.

$$E = 0.000012 LD(H)^{1/2}$$

5. Excessive Infiltration
 - a. Where infiltration in excess of the allowable amount is discovered before completion and acceptance of the sewer, the sewer shall be immediately uncovered and the amount of the infiltration reduced to a quality within the specified amount of infiltration, before the sewer is accepted.
6. Individual Leaks
 - a. Even if the infiltration is less than the allowable amount, any individual leaks that may be observed shall be stopped as ordered by the District's Representative.

7. Completion of Tests

- a. All tests must be completed before the street or trench is resurfaced, unless otherwise directed by the District's Representative.

D. Air Pressure Test

1. General

- a. Air pressure testing of gravity sewer mains and laterals shall be in accordance with SSPWC Subsection 306-7.8.2.4 except that air shall be introduced into the pipeline until 4.0 psig, instead of 30 psig, has been reached.
- b. Contractor shall submit length of main and laterals to be tested between each manhole and the corresponding allowed pressure drop per SSPWC Table 306-7.8.2.4.
- b. The pressure gauge used shall be supplied by the Contractor, shall have minimum divisions of one-tenth pound per square inch gauge (0.10 psig), and shall have an accuracy at least of four-hundredths of a pound per square inch gauge (0.04 psig). The gauge shall have been calibrated within forty-five (45) calendar days of the air test and the calibration tag shall be affixed to the gauge.
- c. The gauge assembly shall be equipped with three-quarter inch (3/4") IPT nipple and isolation valve to allow the District to install a second gauge.

2. Test Section

- a. Each section of sewer between two successive manholes shall be tested by plugging all pipe outlets with suitable test plugs. All test plugs shall be secured in place to prevent movement or slippage.

3. Internal Pressure

- a. An internal pressure between 2.5 and 3.5 psig shall be maintained for at least two minutes to allow the air temperature to stabilize, after which the air supply shall be disconnected and the pressure allowed to decrease to 2.5 psig.

- b. When the prevailing groundwater is above the line being tested, air pressure shall be increased forty-three hundredths (0.43) psig for each foot the water table is above the invert of the line.

4. Minimum Time for Allowable Pressure Drop

- a. The time in seconds that is required for the internal air pressure to drop from 2.5 psig to 1.5 psig shall be measured and the results compared with the minimum permissible pressure holding times indicated in SSWPC Table 306-7.8.2.4.

5. Retest

- a. If the pressure drop from 2.5 psig to 1.5 psig occurs in less time than specified in SSWPC Table 306-7.8.2.4, the pipe shall be repaired and, if necessary, replaced and re-laid until the joints and pipe shall hold satisfactorily under this test.

6. Individual Joint Testing Option

- a. At the Contractor's option, joints may be air-tested individually, joint by joint, with the use of specialized equipment. The Contractor shall submit its joint testing procedure for CVWD's review and acceptance prior to testing. Prior to each test, the pipe at the joint shall be wetted with water. The maximum test pressure shall be 3.0 psi. The minimum allowable pressure drop shall be 1.0 psi over a 30-second test period.

E. Deflection Test

1. All flexible and semi-rigid main line pipe shall be tested in accordance with SSPWC Subsection 306-7.8.3 for deflection, joint displacement, or any other obstruction by passing a rigid mandrel through the pipe by hand, not less than 30 days after completion of the trench backfill, but prior to permanent resurfacing.
2. Obstructions and deflections, greater than the percentage listed in SSPWC Table 306-7.8.3.1 for the applicable pipe material, encountered by the mandrel shall be corrected by the Contractor at no additional cost to CVWD.
3. The Contractor shall make the necessary repairs or replacements at the Contractor's expense by a method acceptable to CVWD's Representative. Pipe sections not meeting the deflection requirements shall be subject to an additional 30-day deflection test at no additional

cost to CVWD. The cost for the deflection test shall be included in the unit price bid item for the sanitary sewer pipe.

4. Any pipe section failing two mandrel tests shall be replaced in its entirety.

F. Pipeline Sags

1. Measurement of sags in gravity sewers shall be by CCTV inspection. For new underground sewer installations, the maximum operational tolerance for sag shall be 1/2" or as specified in the Contract Documents. A calibrated 1/4" diameter steel bar/"sag gage" or approved equal device, mounted in front of the camera, shall be used to measure the depth of sag.
2. The Contractor may submit an alternate means of measuring sags. Review and acceptance by CVWD is required prior to use.
3. Pipelines exceeding the sag tolerance shall be replaced in accordance with the Contract Documents.

G. Sewer/House Laterals

1. New Laterals
 - a. When sewer laterals are added after the sewer main has been constructed by connecting to a previously installed wye fitting or to a newly cut-in wye-branch fitting, the new sewer lateral shall be plugged at the sewer main by use of a test plug and air tested as specified herein to the satisfaction of the District's Representative.
 - b. When sewer laterals are connected to a new sewer main, the new sewer lateral shall be air tested as specified herein to the satisfaction of the District's Representative.

3.03 *Testing of Sewer Forcemains*

A. General

1. Hydrostatic testing of sewer forcemains shall be in accordance with SSPWC Subsection 306-8.9 and Section 33 14 00, Hydrostatic Testing of Pressure Pipelines.

B. PVC and Ductile Iron Forcemains – Hydrostatic Pressure Test

1. Unless otherwise required by the Contract Documents, pressure testing of PVC and Ductile Iron forcemains shall be in accordance with SSPWC Subsection 306-8.9.2 "Hydrostatic Pressure Test."

C. HDPE Forcemains – Hydrostatic Pressure Test

1. Unless otherwise required by the Contract Documents, pressure testing of HDPE forcemains shall be in accordance with AWWA M55 (latest edition).

3.04 *Testing of Manholes*

A. General

1. All manholes shall be tested for leakage, as specified.
2. Manholes shall be tested prior to backfill placement; whereas, all pipe shall be backfilled and compacted prior to testing.
3. Prior to testing, all manholes shall be visually inspected for leaks and cracks. All leaks or cracks shall be repaired by the Contractor, prior to testing. The repair shall be subject to acceptance by CVWD's Representative.

B. Vacuum Testing

1. Unless otherwise shown on the Drawings, all sewer manholes shall be vacuum tested for leakage per ASTM C 1244 Standard Test Method for Concrete Sewer Manholes by the Negative Air Pressure (Vacuum) Test after installation, but prior to being backfilled.
2. Prior to testing, manholes shall be visually inspected for cracks. Cracks shall be repaired prior to testing. Repairs shall be subject to the approval of CVWD's Representative. Pipes entering the manhole shall be sealed at a point outside the manhole walls so as to include testing of the pipe/manhole joints.
3. All lift holes shall be plugged with an approved grout and all pipes entering the manhole shall be plugged and braced to prevent the plug from being drawn into the manhole so as to include testing of the pipe/manhole joints. Test head shall be placed inside the top of the cone section and the seal inflated per manufacturer's recommendations.

4. A vacuum of 10-inch of mercury shall be drawn and time measured for the vacuum to drop to 9-inch of mercury. The time for vacuum drop shall not exceed the values listed in Table 1 of ASTM C1244-11 below. The Contractor shall then be required to make all necessary repairs and retest the manhole. The exterior of the manhole shall be inspected during this period for visible evidence of leakage.

ASTM C 1244 - 11: TABLE 1
Minimum Test Times for Various Manhole Diameters (30 – 72 in.) in Seconds

Depth (ft)	<i>Diameter, in.</i>								
	30	33	36	42	48	54	60	66	72
<i>Time, in seconds</i>									
<4	6	7	7	9	10	12	13	15	16
6	9	10	11	13	15	18	20	22	25
8	11	12	14	17	20	23	26	29	33
10	14	15	18	21	25	29	33	36	41
12	17	18	21	25	30	35	39	43	49
14	20	21	25	30	35	41	46	51	57
16	22	24	29	34	40	46	52	58	67
18	25	27	32	38	45	52	59	65	73
20	28	30	35	42	50	53	65	72	81
22	31	33	39	46	55	64	72	79	89
24	33	36	42	51	59	64	78	87	97
26	36	39	46	55	64	75	85	94	105
28	39	42	49	59	69	81	91	101	113
30	42	45	53	63	74	87	98	108	121

C. Hydrostatic Testing

1. General

- a. At the Contractor's option (if approved by CVWD) or as specified on the Drawings, project manholes shall be hydrostatically tested in lieu of being vacuum tested.
- b. Water tightness of manholes shall be tested in connection with tests of sanitary sewers, or at the time the manhole is completed but prior to being backfilled
- c. All joints shall be exposed prior to testing. PVC joints shall be welded post testing, probed with a putty knife, and spark tested by the Contractor in the presence of the District's Representative.

2. Plugs

- a. Each manhole tested shall have all piping inlets and outlets tightly sealed with approved stoppers or plugs. Safety lines shall be secured to all plugs.

3. Fill Level

- a. The manhole shall be filled with water to 2-inches below the bottom of the tapered cone section, with a minimum depth of 4 feet and a maximum depth of 20 feet.
- b. The water shall stand in the manhole for a minimum of one (1) hour, or as directed by CVWD's Representative, to allow the manhole material to reach maximum absorption. Before the test is begun, the manhole shall be refilled to the original depth as needed.
- c. Any manholes displaying unacceptable leakage shall be repaired and retested at no additional cost to CVWD.

4. Test Requirements

- a. The water level shall again be checked after a period of 4 hours. If the water level is reduced by more than 1/4-inch, the leakage shall be considered excessive, and the manhole shall be repaired and retested at no additional cost to CVWD.

5. Visible Leaks

- a. Even though the leakage is less than the specified amount, the Contractor shall stop any leaks that may be observed, to the satisfaction of the District's Representative.
- b. The exterior of the manhole shall be inspected during this period for visible evidence of leakage. Moisture, sweating, or beads of water on the exterior of the manhole shall not be considered leakage, but any water running across the surface will be considered leakage and the manhole shall be repaired to the acceptance of CVWD and at no additional cost to CVWD.

3.05 *Closed Circuit Television (CCTV) Video Inspection and Cleaning*

A. General

- 1. In addition to the regular leakage and infiltration tests, CCTV inspection and cleaning of all new and rehabilitated gravity sewer mains and lateral

connections shall be in accordance with Section 33 01 30.16, TV Inspection of Sewer Pipelines.

B. Labor

1. All labor and equipment necessary to conduct this inspection and cleaning shall be furnished by the Contractor.

C. Notification

1. Requests for sewer line CCTV inspection and cleaning shall be made to CVWD's Representative a minimum of two working days in advance of the requested inspection date.

D. Repair of Defects

1. Even though the sewer line may have successfully passed the leakage and infiltration tests, any defects in the line shall be repaired to the satisfaction of CVWD. Following repair, mandrel testing, and CCTV inspection shall again be conducted for the repaired pipeline section and these re-inspection costs shall be the sole responsibility of the Contractor.

END OF SECTION 33 01 30.13

SECTION 33 01 30.16

TV INSPECTION OF SEWER PIPELINES

Part 1 - General

1.01 *Description and Scope*

- A. This section covers furnishing all materials and equipment and performing all operations necessary to produce DVDs, inspection reports, databases, and other items specified herein during Closed Circuit Television inspection (CCTV), inspection for gravity sewer pipelines, and for lateral connections on new and existing sewer pipelines in accordance with the requirements of these specifications and shown on the drawings.
- B. Contractor shall perform all CCTV inspection per the current version of National Association of Sewer Services Companies (NASSCO) standards from manhole to manhole for pipe alignment, slope, and damaged or defective pipeline. In new pipeline alignment, CCTV inspection shall be performed after the pipe has been installed, backfilled and compacted to grade, tested for leakage, manholes raised to grade, but prior to final resurfacing.
- C. The work of this Section includes pre-cleaning and performing CCTV inspection of the indicated reaches of sewers.
- D. Information concerning depths of flow, manhole depths, air quality in the sewers, accessibility of manholes, traffic conditions, permits, and other safety considerations are to be the sole responsibility of the Contractor to obtain and to incorporate the necessary provisions into the overall contract price to complete the specified work under the conditions existing in the sewers to be inspected.
- E. The Contractor is cautioned that sewage will continue to flow to the sewers and that the work must be performed under a confined space entry program in accordance with California code of Regulations Title 8, Section 5157.
- F. The Contractor shall prepare a bypass plan and control the flow. The Contractor must also consider weather conditions to obtain the best video image of the sewer. This may require the Contractor to delay any video work after major rain events until the system can return to lower dry weather flow.
- G. Contractor shall be responsible for maintaining sewer flows and preventing sewer spills.
- H. The Contractor is responsible for traffic control and it shall include all material, labor and equipment to provide safe and effective work areas to warn, control, protect and expedite vehicular, bicycle and pedestrian traffic. Unless otherwise required by the

Contract Documents, all work and material provided under this section shall be performed or furnished in accordance with SSPWC Part 6 Temporary Traffic Control and the entity (City, County, State, etc.) having jurisdiction. Traffic control shall also be in accordance with **Section 33 11 00**, Basic Pipeline Specifications.

1.02 *Related Work Specified Elsewhere*

A. The requirements of the following sections and divisions apply to the Work of this section. Other sections and divisions of the Specifications, not referenced below, shall also apply to the extent required for proper performance of this Work.

1. **Section 31 23 19.10**, Sewer Bypass System
2. **Section 33 01 30.13**, Sanitary Sewer System Testing
3. **Section 33 11 00**, Basic Pipeline Specifications

1.03 *Reference Specifications, Codes, and Standards*

A. All Work specified herein shall conform to or exceed the applicable requirements of the referenced portions of the following publications to the extent that the provisions thereof are not in conflict with other provisions of these Specifications.

B. Comply with the applicable editions of the following codes, regulations and standards.

1. CVWD Detail Drawings for the Construction of Sanitary Sewer Systems
2. Industry Standards
 - a. Standard Specifications for Public Works Construction (SSPWC), Section 2-5.3, Submittals
 - b. SSPWC, Section 7-8.5, Sanitary Sewers
 - c. SSPWC, Section 7-8.5.2, Sewage Bypass and Pumping Plan
 - c. SSPWC, Section 306-7.8, Gravity Pipeline Testing
 - d. SSPWC, Section 500-1.1.4, Cleaning and Preliminary Inspection
 - e. SSPWC, Section 500-1.1.5, Television Inspection
 - f. SSPWC, Section 500-1.2, Pipeline Point Repair/Replacement
 - g. SSPWC, Part 6, Temporary Traffic Control
 - h. PACP – Pipeline Assessment and Certification Program by NASSCO

2. Other Standards

a. NASSCO – National Association of Sewer Service Companies

C. Comply with the applicable reference Specifications as specified in the General Conditions and other applicable parts of the Contract Documents.

1.04 *Contractor Submittals*

A. Submittals shall be made in accordance with the General Conditions, other applicable parts of the Contract Documents, and as specified herein.

B. The following shall be submitted in compliance with SSPWC and NASSCO.

1. Documentation of Certification of PACP Software.
2. Name of the project supervisor and resumes.
3. Documentation of NASSCO PACP certification for all CCTV operators, database and software.
4. Schedule for cleaning and inspection of each sewer reach.
5. Sewer cleaning methods and equipment.
6. Temporary Sewage Bypass Plan showing the details of the temporary handling of sewage flow.
7. Two copies of each CCTV recording and associated CCTV report/log shall be submitted (digital files and one DVD backup) in accordance with Article entitled "Documentation" of this specification section. Submittals will be reviewed by CVWD twice (one initial review and one revision review). All additional costs incurred for subsequent reviews will be charged to the Contractor. Such charges will be deducted from payment due to Contractor for the billing period when such additional review services have been provided.
8. CCTV inspection recordings and reports shall be submitted to and approved by CVWD prior to final acceptance of the project.
9. Confined space entry program in accordance with California code of Regulations Title 8, Section 5157.
10. If requested by CVWD, documentation of the cleaning work that is performed, and the type of debris removed, as well as authorized landfill permits and disposal documentation.

1.05 *Quality Assurance*

A. All CCTV operators shall be NASSCO certified by passing the three-day Pipeline Assessment and Certification Program (PACP). NASSCO CCTV operator certification shall be current and in good standing throughout the project. The

Contractor shall provide a PACP certified operator on site at all times during the entire survey. The methodology of evaluation, data collection, and reporting criteria used for the latest NASSCO certification shall be practiced for all CCTV evaluations in this work. The Contractor's (or Subcontractor's) supervisors performing the work must be qualified to perform the work, and have a minimum of five (5) years of experience in video recording sewer line inspections.

- B. Database shall be an NASSCO-PACP (Current Version) Certified Access Database.
- C. CCTV Software shall be NASSCO-PACP (Current Version) certified.
- D. CCTV inspections (Video and Data Collected) will be delivered entirely in digital format.
- E. The camera, television monitor, and other components of the video system shall be capable of producing picture quality to the satisfaction of the District; and if unsatisfactory, equipment shall be removed and no payment will be made for an unsatisfactory inspection.

Part 2 - Materials

2.01 General

- A. Televising equipment shall include the television camera, television monitor, cables, power source, sag gauge, lights and other equipment necessary, to the televising operation.
- B. The Contractor shall furnish and maintain, in good condition, all cleaning and televising equipment necessary for proper execution of the work.

2.02 Television Camera

- A. The camera shall be specifically designed and constructed for operation in connection with sewer inspection. The camera shall be operative in one hundred percent (100%) humidity conditions and shall be capable of spanning 360-degrees circumference and 270-degrees on horizontal axis to televise sewer lines 4-inch diameter or larger so that service connections, pipe ends, and maintenance or structural defects can be properly inspected. Focal distance shall be adjustable through a range from one inch to infinity. The camera shall be mounted on skids or tracks suitably sized for each pipe diameter to be investigated.
- B. The transporter and camera assembly shall be equipped with a slope measuring device (inclinometer) capable of detecting pipe grade variations ± 5 degrees from true horizontal ($\pm 8.7\%$ grade) with a maximum error of ± 0.1 degree with readings taken at minimum intervals of two (≤ 2) feet. Inclinometer data shall be capable of being displayed in both numerical and graphical formats that can be printed or exported to an external database. The inclinometer data submitted shall allow easy identification

of any high and/or low sections, correlated with the proper footage, that exceed the limits per Part 3 of this specification.

2.03 *Lighting*

- A. Lighting for the camera shall minimize reflective glare. Camera and lighting quality shall be suitable to provide clear, continuously in-focus picture of the entire inside periphery of the sewer pipe for all conditions encountered during the work.

2.04 *Remote Footage Counter*

- A. The remote footage counter shall be accurate to two tenths of a foot (2/10') over the length of the particular section being inspected and shall be mounted over the television monitor.

2.05 *Sag Measurement*

- A. Measurement of sags in gravity sewers shall be by CCTV inspection. Sag measurement device shall be as specified in Section 33 01 30.13, Sanitary Sewer System Testing.

2.06 *DVDs*

- A. The DVDs shall be high quality color. CCTV inspection shall be recorded on DVD in high quality color, and recording procedures shall conform to the requirements of SSPWC, Section 500-1.1.5, Television Inspection, except that the production shall have a minimum resolution of 500 lines. Any out of focus recordings, or portions thereof, shall be cause for rejection of the recording and will necessitate re-televising.
- B. Each disk shall have a protective case and be permanently labeled with the Contractor's name, date recorded, project name, street name(s), identification of the sewer reach or reaches inspected, and run number. Labeling shall consist of computer printed information in non-water soluble ink on a circular disk label that equally covers the surface of the disk. All video recordings shall become the property of CVWD.

PART 3 - Execution

3.01 *General*

- A. The Contractor shall schedule a CCTV video inspection with the District's Representative by submitting a fifteen (15) calendar-day minimum advance written notification to the District for all sections of sanitary sewer pipe to be CCTV inspected. The inspection will be scheduled for a date after the pipe has been installed, backfilled and compacted to grade, cleaned, tested for leakage; and manholes raised to grade but prior to the introduction of wastewater to the pipe and

the final resurfacing (placement of pavement) of the street or surface directly over the pipe, unless otherwise approved by CVWD.

3.02 *Cleaning*

- A. Prior to CCTV inspection and pipeline rehabilitation, the Contractor shall clean the pipeline in accordance with SSPWC Subsection 500-1.1.4 Cleaning and Preliminary Inspection and as modified herein.
- B. The Contractor shall have a CCTV camera in the sewer, during all cleaning operations to include: Lateral Cut and Deposit Cut. The camera shall be used for the Contractor's verification that the cleaning equipment is not damaging the public sewer. No submittal is required for this item and the cost for monitoring the cleaning equipment operation shall be included in the associated unit cost for cleaning the item. This in no way waives the Contractor's responsibility in the event the sewer pipeline is damaged but is intended to bring the resulting damage to the Contractor's attention so that the operation can be stopped in a timely manner.
- C. It shall be the Contractor's responsibility to remove materials and equipment that has been lodged in the sewer from cleaning, television inspection, or point repair excavations.
- D. The Contractor shall provide equipment that is specifically designed and constructed for sewer cleaning. Solids and debris resulting from the cleaning operation shall be collected and removed from the downstream manhole and disposed of in a legal manner. Under no circumstances shall sewage solids be dumped onto the surface, street, or into ditches, inlets, or storm drains. The Contractor shall dispose of all sanitary debris and material in a legal manner. The Contractor shall not be reimbursed for disposal costs.
- E. The Contractor shall use the manufacturer's recommended size tools for the various size pipes. Equipment recommended by the manufacturer to protect the manhole and pipe, such as pull-in slant jack rollers and roller and yoke assembly, roller manhole jacks, etc. shall be utilized.
- F. The Contractor shall select the cleaning equipment and method for cleaning based on the age, the material, and the probable condition of the sewer. More than one type of equipment or attachments may be required on a single reach or at a single location. The Contractor shall not damage the sewer or any manhole during cleaning.
- G. When requested by CVWD, the Contractor shall demonstrate the performance capabilities of the cleaning equipment and method proposed for use. If results obtained by the demonstration are not satisfactory, the Contractor shall select other methods or equipment that will clean the sewer line, and shall perform another demonstration.

- H. For water pressure cleaning equipment, the Contractor shall install a gauge to monitor working pressure on the discharge of high-pressure water pumps.
- I. The Contractor shall remove dirt, debris, and grease from the entire circumference of the sewer between manholes.
- J. Acceptance of sewer cleaning work is contingent upon the successful completion of the television inspection. If television inspection shows debris, solids, sand, grease, or grit remaining in the line, the cleaning will be considered unsatisfactory, and the Contractor shall repeat cleaning and televising of the sewer line at no additional cost to CVWD until cleaning is acceptable to CVWD.
- K. The Contractor shall remove sludge, dirt, sand, rocks, grease, roots, and other solid or semisolid material resulting from the cleaning operation at the downstream manhole of the section being cleaned. A suitable sand trap, weir, dam, or suction in the next downstream manhole shall be installed so that solids and debris are trapped for removal. Passing debris from one sewer section to any other sewer section shall not be allowed. Debris from the manholes shall be loaded into a leak-proof, enclosed container that is permitted by applicable regulations for liquid waste hauling. All solids or semi-solid wastes shall be removed from the Site at the end of each work day. Debris, liquid waste, or sludge shall not accumulate at the Site.
- L. The Contractor shall secure any and all necessary documentation of the cleaning work that is performed, the type of debris removed, as well as authorized disposal documentation. The Contractor shall submit any of this documentation upon CVWD's request.

3.03 Sewer Bypassing

- A. The Contractor shall prepare a bypass plan and control the flow in accordance with Section 31 23 19.10, Sewer Bypass System and as required by the Contract Documents. A sewage bypass plan shall be submitted to CVWD for approval prior to construction. The Contractor shall at all times, be responsible for the operations of this bypass system, including furnishing all the necessary equipment and making arrangements to obtain power as required. The Contractor shall not be permitted to trench public or private streets for bypass purposes without the approval of the entity (State, County, City, etc.) having jurisdiction.
- B. Sewer flows shall be maintained at all times.
- C. Contractor shall be responsible for cost, planning, and operation of any bypassing required.
- B. Television inspection shall be done one section at a time. The Contractor shall be responsible for the preparation of the sewer before televising. If the flow is such that bypassing of the sewage is required, the Contractor shall make appropriate

arrangements with the District to bypass the sewage flow. The Contractor shall be responsible for preparing and submitting a bypass plan for review and approval by CVWD. Only after the bypass submittal has been accepted, shall the Contractor notify CVWD of their intent to begin cleaning and/or conducting the CCTV inspection. The Contractor shall perform the bypass operation or secure a Subcontractor to perform the bypass operation under District supervision. The Contractor shall provide all necessary bypasses at Contractor's expense. The Contractor shall submit for CVWD approval a proposed method of bypassing for each case not detailed on the Drawings or Specifications.

3.04 *CCTV Inspection Requirements*

- A. Prior to performing closed circuit television inspection activities, the Contractor shall thoroughly clean the sewer line(s) designated to be televised per Article entitled "Cleaning" of this Specification.
- B. All sewer television inspection activities shall be in conformance with SSPWC Subsection 500-1.1.5 Television Inspection and as modified herein.
- C. CCTV inspection is required prior to rehabilitation to document the existing condition (vertical misalignments, sags, holes, cracks, or other defects) of the pipeline and to verify the pipeline was cleaned per SSPWC Sub Section 500-1.1.4.
- D. Post-installation CCTV inspection is required immediately following clean water flowing in the pipe to determine if the work was completed in conformance with the Contract Documents.
- E. If required by the Contract Documents, Contractor shall also perform an additional CCTV recording during peak flow conditions, during hours approved by the District.
- F. CVWD's Representative shall be present during the entire televised inspection process. The Contractor shall submit the original DVD as a formal submittal to CVWD.
- G. The CCTV inspection shall stop at every joint and provide a clear video of the pipe connections. The recording shall continuously display the following on-screen data; contract number, project name, date, time, distance (in feet) from the insertion manhole, and manhole identification codes.
- H. It shall be the Contractor's responsibility to remove materials and equipment that has been lodged in the sewer from cleaning, television inspection, or point repair excavations.

3.05 *CCTV Inspection*

- A. Contractor shall thoroughly clean the sewer line(s) designated to be televised per Article entitled "Cleaning" of this Specification and as specified herein.

- B. Television inspection shall be done one section (Manhole to Manhole) at a time; each section isolated from the remainder of the sewer line as required via sewer bypassing.
- C. The camera must be centered in the pipe to provide accurate distance measurements to provide locations of features in the sewer and these footage measurements shall be displayed and documented on the video. All PACP observations shall be identified by audio and on PACP log. All video must be continuously metered from manhole. The pipe should be clean enough to ensure all defects, features and observations are seen and logged.
- D. The camera shall be moved through the line in either direction at a uniform rate, stopping when necessary to ensure proper documentation of the condition of the sewer line, but in no case shall the television camera be pulled at a speed greater than 15 feet per minute. Manual winches, power winches, TV cable and powered rewinds or other devices that do not obstruct the camera view or interfere with proper documentation of the sewer line conditions shall be used to move the camera through the sewer line.
- E. If the television camera encounters an obstruction within a section not accessible to a manhole, the Contractor shall first notify CVWD and CVWD's representative before proceeding with obstruction removal. After CVWD and the Contractor have agreed on the method of removal, the Contractor shall be responsible for removing the obstruction by excavation, or other appropriate means, and replacing whatever pipe section is necessary. The Contractor shall re-televise the entire section following obstruction removal.
- F. Whenever non-remote powered and controlled winches are used to pull the television camera through the line, telephones, radios or other suitable means of communication shall be set up between the two (2) manholes of the section being inspected to ensure that adequate communications exist between members of the crew.
- G. The importance of accurate distance measurements is emphasized. Measurement for location of defects shall be above ground by means of a meter device. Marking on the cable, or the like, which would require interpolation for depth of manhole, will not be acceptable.
- H. The accuracy of the measurement meters shall be checked daily by use of a walking meter, roll-a-tape or other suitable device. Footage measurements shall begin at the center line of the upstream manhole, unless permission is given to do otherwise. Footage shall be shown on the DVDs data view at all times.
- I. Any sags exceeding the maximum amount listed in Section 33 01 30.13, Sanitary Sewer System Testing shall be reported in the submittal report. Sags shall be noted

on the DVD with an audio description of same and included in the report to be submitted.

3.06 Pipeline and Construction Deficiencies

- A. Should the CCTV video inspection indicate any pipe installation either faulty or unacceptable to CVWD, the Contractor shall make the necessary repairs or replacements at the Contractor's expense by a method acceptable to CVWD. Repaired or replaced pipe and/or pipe segments shall be retested and cleaned by the Contractor, before giving a seven (7) calendar day notice requesting re-inspection. The retest and cleaning shall be subject to acceptance by CVWD. The new work shall be re-inspected by the Contractor per NASSCO PACP standards and as specified herein. All costs for scheduling, preparing for inspection, testing, retesting, installing, reinstalling, repairing, cleaning, re-cleaning, administrative costs, delays or activities by the Contractor relating to the pipe shall be provided for and paid by the Contractor at no additional cost to the District, until final acceptance of the pipe by CVWD.
- B. Pipelines exceeding the sags allowance specified in Section 33 01 30.13, Sanitary Sewer System Testing shall be replaced in accordance with Section 33 01 30.13, Sanitary Sewer System Testing.
- C. Any areas of sewer with separated joints or cracks shall be removed and replaced. Any areas of sewer with debris shall be cleaned. After all deficiencies are repaired including sags, separated joints, cracks, and debris, Contractor shall test and then television inspect areas a second time. This procedure of repair, cleaning, testing, and performing subsequent sewer television inspections shall be repeated until all areas are approved by the District.
- D. The following imperfections in a pipe or special fitting shall be considered injurious and shall be cause for rejection without consideration of any tests results:
 - 1. A single crack in the pipe barrel.
 - 2. If a pipe or a fitting has surface imperfections, such as lumps, blisters, pits or flakes, on the interior surfaces.
 - 3. If the diameter of the bore, socket or spigot of a pipe or a fitting varies from a true circle by more than 3% of its nominal diameter.
 - 4. (Rigid pipe) If a pipe or a fitting is designated to be straight and it deviates from a straight line more than 1/16-inch per lineal foot. Deviation shall be measured from a straight edge at a point midway between the ends of the pipe or fitting.
 - 5. If a pipe or a fitting has a broken piece on either the socket or spigot.

6. If a pipe or a fitting has tramp clays, grog or other foreign matter permanently flushed to the exterior or interior surface of the pipe or fitting.
7. Dropped, offset or separated joints including failed welds;
8. Excessive gap between pipe ends within a coupling or fitting (greater than 0.5" to 0.75", depending upon materials, size and conditions);
9. Oversized, raised or protruding internal weld beads including melted pipe material ($\leq 0.25"$ for pipe $\leq 8"$, $\leq 0.50"$ for 10" to 18" pipe);
10. Unless otherwise required by the contract Documents, any sags in the sewers greater than the amount specified in Section 33 01 30.13, Sanitary Sewer System Testing;
10. Infiltration/leaking joints; or
11. Other CVWD or CVWD's Representative noted deficiencies.

3.07 Documentation

- A. The documentation of the work shall consist of PACP CCTV Reports, PACP certified database, logs, electronic reports, worksheets, etc. noting important features encountered during the inspection. All PACP Header information shall be completed in accordance with PACP Guidelines.
- B. Audio and written documentation shall accompany all DVDs. The DVD containers shall have printed labels containing the report number, DVD number, date of TV inspection, location and upstream and downstream manhole or station numbers.
- C. The audio portion of the DVD shall include date of inspection, description of pipe size, type and pipe joint length, upstream and downstream manhole or station numbers, description and location of each service connection and other discernible features (as defined in the NASSCO PACP defect codes), and description and location of each defect, including cracked pipe, protruding service tape, offset joints, collapsed section, presence of scale and corrosion.
- D. Television Inspection Logs: an electronic report per NASSCO standards is required. The electronic report shall be in PDF format, bookmarked, and include a table of contents. Each report shall include the following, at a minimum:
 1. Date of inspection
 2. DVD number
 3. Location
 4. Size

5. Type and length of pipe
 6. Direction of flow
 7. Beginning and end DVD counter numbers
 8. Map showing street and cross streets where the TV inspection was made
 9. Description and station location of each lateral
 - 10 Description and location of each defect (NASSCO PACP defect codes), such as misalignment, infiltration, offset joints, protruding service connections, cracked pipe and split pipe.
- E. Digital photographs of the pipe condition and all defects shall be taken by the Contractor and included with the inspection logs. Photographs shall be located by distance in 1/10 of a foot from the manhole wall, in relation to an adjacent manhole.

END OF SECTION 33 01 30.16

SECTION 33 01 30.71
CURED-IN-PLACE PIPE

Part 1 – General

1.01 *Description and Scope*

- A. The Work of this Section includes furnishing and installing cured-in-place pipe (CIPP) liner for rehabilitation of sanitary sewer pipelines. The liner shall be a smooth, hard, strong, and chemically inert interior surface closely following the contours of the host pipe.
- B. It is the intent of this specification to provide for the reconstruction of pipelines and conduits by the installation of a resin-impregnated flexible tube that is either inverted or pulled into the original pipeline/conduit and expanded to fit tightly against said pipeline by the use of air pressure. The resin system shall then be cured by elevating the temperature of the fluid (air) used for the inflation to a sufficient enough level for the initiators in the resin to affect a reaction. The finished pipe shall be such that when the thermosetting resin cures, the total wall thickness shall be a homogeneous and monolithic felt and resin composite matrix, chemically resistant to withstand internal exposure to domestic sewage.
- C. The Contractor shall provide all materials, labor, equipment, and services necessary for traffic control, bypass pumping and/or diversion of sewage flows, cleaning and television inspection of sewers to be lined, liner installation, reconnection of service connections, all quality controls, provide samples for performance of required material tests, final television inspection, testing of lined pipe system and warranty work, all as specified herein.

1.02 *Related Work Specified Elsewhere*

- A. The requirements of the following sections and divisions apply to the Work of this section. Other sections and divisions of the Specifications, not referenced below, shall also apply to the extent required for proper performance of this Work.
 - 1. Section 31 23 19.10, Sewer Bypass System
 - 2. Section 33 01 30.13, Sanitary Sewer System Testing
 - 3. Section 33 01 30.16, TV Inspection of Sewer Pipelines
 - 4. Section 33 05 15, Manholes and Precast Vaults

5. Section 33 39 XX, House Laterals

1.03 Reference Specifications, Codes, and Standards

- A. All Work specified herein shall conform to or exceed the applicable requirements of the referenced portions of the following publications to the extent that the provisions thereof are not in conflict with other provisions of these Specifications.
- B. Comply with the applicable editions of the following codes, regulations and standards.
 - 1. CVWD Development Design Manual
 - 2. CVWD Detail Drawings for the Construction of Sanitary Sewer Systems
 - 3. Industry Standards:

SSPWC Section 500	Standard Specifications for Public Works Construction, Pipeline
SSPWC Section 500-1.4	Standard Specifications for Public Works Construction, Cured-In-Place Pipe Liner (CIPP)
SSPWC Section 500-1.7.1	Standard Specifications for Public Works Construction, Miscellaneous (Service Connection, End Seals)
ASTM D 543	Standard and Practice for Evaluating the Resistance of Plastics to Chemical Reagents
ASTM D 638	Standard Test Method for Tensile Properties of Plastics
ASTM D 790	Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials.
ASTM D 2122	Standard Test Method for Determining Dimensions of Thermoplastic Pipe and Fittings
ASTM F 2561	Standard Practice for Rehabilitation of a Sewer Service Lateral and Its Connection to the Main Using a One Piece Main and Lateral Cured-in-Place Liner

ASTM D 2990	Standard Test Methods for Tensile, Compressive, and Flexural Creep and Creep-Rupture of Plastics
ASTM D 3567	Standard Practice for Determining Dimensions of Fiberglass (Glass-Fiber-Reinforced Thermosetting Resin) Pipe and Fittings
ASTM D 3681	Standard Test Method for Chemical Resistance of “Fiberglass (Glass Fiber Reinforced Thermosetting Resin) Pipe in a Deflected Condition
ASTM D 5813	Standard Specification for Cured-In-Place Thermosetting Resin Sewer Pipe
ASTM F 1216	Standard Practice for Rehabilitation of Existing Pipelines and Conduits by the Inversion and Curing of a Resin-Impregnated Tube.
ASTM F 1743	Standard Practice for Rehabilitation of Existing Pipelines and Conduits by the Pull in and inflate and Curing of a Resin-Impregnated Tube
ASTM F 2019	Standard Practice for Rehabilitation of Existing Pipelines and Conduits by the Pulled in Place Installation of Glass Reinforced Plastic (GRP) Cured-in-Place Thermosetting Resin Pipe (CIPP)

- C. Comply with the applicable reference Specifications as specified in the General Conditions and other applicable parts of the Contract Documents.

1.04 *Contractor Submittals*

- A. Submittals shall be made in accordance with the General Conditions, other applicable parts of the Contract Documents, and as specified herein.
- B. The following shall be submitted in a three-ring binder of appropriate size with a table of contents and tabbed sections which clearly defines the CIPP product delivery in conformance with the requirements of these contract documents.

1. Manufacturer's certification that all the materials to be used meet the referenced standards and the project specifications.
2. A detailed installation plan describing all preparation work, cleaning operations, pre-CCTV inspections, bypass pumping (in accordance with Section 31 23 19.10, Sewer Bypass System and as required by the Contract Documents), traffic control, installation procedure, method of curing, service reconnection, quality control, testing to be performed, final CCTV inspection, warranties furnished and all else necessary and appropriate for a complete CIPP liner installation. A detailed installation schedule that conforms to the above and the requirements of this specification.
3. Description of the proposed CIPP lining technology, including a detailed plan for identifying all active service connections maintaining service, during mainline installation, to each home connected to the section of pipe being lined, including temporary service if required by the Contract Documents.
4. A description of the CIPP materials to be furnished for the project. Materials shall be fully detailed in the submittals and conform to these specifications and/or shall conform to the pre-approved product submission.
5. Information from the resin manufacturer including specifications, characteristics, properties, and methods of application, including a written certification that the resin material is appropriate for the intended application.
6. Certified copies of test reports on physical properties and chemical resistance of the proposed resin.
7. Manufacturers' shipping, storage and handling recommendations for all components of the CIPP System.
8. License or certificate verifying Manufacturer's/Licensor's approval of the installer.
9. A statement of the Contractors experience in accordance with the "Quality Assurance" section of this specification. The lead personnel including the superintendent, the foreman and the lead crew personnel for the CCTV inspection, resin wet-out, the CIPP liner installation, liner curing and the robotic service reconnections each must have demonstrated competency and experience to perform the scope of work contained in this contract. The name and experience of each lead individual performing work on this contract shall be included. Personnel

replaced by the contractor, shall have similar, verifiable experience as the personnel originally submitted for the project.

10. Engineering design calculations, in accordance with the Appendix X1 (fully deteriorated gravity pipe condition, unless otherwise specified or shown) of ASTM F1216, for each length of liner to be installed including the thickness of each proposed CIPP. It will be acceptable for the Contractor to submit a design for the most severe line condition and apply that design to all of the line sections. These calculations shall be performed and certified by the CIPP Design Engineer, provided by the Contractor, which shall be a, qualified Professional Civil Engineer registered in the State of California. All calculations shall include data that conforms to the requirements of these specifications or has been pre-approved by CVWD.
11. Information on the cured-in-place pipe intended for installation and all tools and equipment required for a complete installation. Identify which tools and equipment will be redundant on the job site in the event of equipment breakdown. All equipment, to be furnished for the project, including proposed back-up equipment, shall be clearly described. The Contractor shall outline the mitigation procedure to be implemented in the event of key equipment failure during the installation process.
12. Tube wet-out and cure method including the Manufacturer's recommended cure method for each diameter and thickness of CIPP liner to be installed. It shall also contain a detailed curing procedure detailing the curing medium and the method of application. Also, update the insertion and heating schedule/plan at least 24 hours in advance of installation.
13. A detailed description of the Contractor's proposed procedures for removal of any existing blockages in the pipeline that may be encountered during the cleaning process.
14. A detailed public notification plan per Part 3 of this specification that includes detailed staged notification to residences affected by the CIPP installation.
15. If required by the District, an odor control plan that will ensure that project specific odors will be minimized at the project site and surrounding area.
16. Project safety plan in accordance with the "Safety" section of this specification.

17. Include a section for the certified of test reports of CIPP coupons obtained during installation.
 18. Pipeline cleaning and CCTV inspection video and reports prior to installation of CIPP in accordance with Section 33 01 30.16, TV Inspection of Sewer Pipelines.
 19. CCTV inspection and reports post-installation of CIPP in accordance with Section 33 01 30.16, TV Inspection of Sewer Pipelines.
 20. A report documenting all pipeline and/or manhole defects or obstructions that will interfere with liner installation.
- C. Submit certified copies of test reports on CIPP coupons obtained during installation. Testing shall be completed by an accredited, independent laboratory. Testing results shall be provided to CVWD within seven (7) days of receipt.
- D. The Contractor shall not permit any CIPP liner components to be brought onto the job site until submittals have been approved by CVWD or CVWD's Representative.

1.05 *Safety*

- A. The Contractor shall conform to all work safety requirements of pertinent regulatory agencies, and shall secure the site for the working conditions in compliance with the same. The Contractor shall erect such signs and other devices as necessary for the safety of the work site.
- B. The Contractor shall perform all of the Work in accordance with applicable OSHA standards. Emphasis shall be placed upon the requirements for entering confined spaces and with the equipment being utilized for pipe renewal.
- C. The Contractor shall submit a proposed Safety Plan to CVWD, prior to beginning any work, identifying all competent persons. The plan shall include a description of a daily safety program for the job site and all emergency procedures to be implemented in the event of a safety incident. All work shall be conducted in accordance with the Contractor's submitted Safety Plan.

1.06 *Quality Assurance*

A. General

1. The Installation Contractor shall operate under a quality management system that is third party certified to ISO 9001 or equivalent standards.

Proof of certification or quality management system shall be submitted along with the submittal items of this specification section.

2. Comply with the requirements for the certifications, licenses, and other qualifications specified herein.
 3. Contractor shall have successfully installed a minimum of 10,000 feet of CIPP liner of largest nominal pipe diameter indicated on the Drawings, or larger, in California. The Contractor and proposed Contractor's lead personnel including the superintendent, the foreman and the lead crew personnel for the CCTV inspection, resin wet-out, the CIPP liner installation, liner curing, and the robotic service reconnections each shall have at least five (5) years of continuous experience in CIPP liner installation and shall have at least two (2) other successful projects within California during the last five (5) years, similar in size, scope and complexity, including sewage bypass. The Contractor shall have performed at least 80% of the contracted work with its own forces. Documentation of experience and demonstrated competency shall be submitted.
- B. All CCTV inspection shall be performed by a CCTV inspection operator who is NASSCO PACP certified. The Contractor shall submit a copy of the operator's certificate.
- C. If required by the Contract Documents, all CIPP installation leads shall be NASSCO ITCP certified for CIPP. The Contractor shall provide a copy of the lead's certificate. The lead shall be present on site at all times during the installation of the CIPP.
- D. Neither the CIPP system, nor its installation, shall cause adverse effects to any of CVWD's processes or facilities. The use of the product shall not result in the formation or production of any detrimental compounds or by-products at any CVWD facility. The Contractor shall notify CVWD and identify any by-products produced as a result of the installation operations, test and monitor the levels, and comply with any and all local waste discharge requirements. The Contractor shall cleanup, restore existing surface conditions and structures, and repair any CIPP segments determined to be defective. The Contractor shall conduct installation operations and schedule cleanup in a manner to cause the least possible obstruction and inconvenience to traffic, pedestrians, businesses, and property owners or tenants.

1.07 *Removal and Restoration of Existing Improvements and Landscaping*

- A. Existing improvements, removed or damaged, shall be replaced, repaired or reconstructed in accordance with the applicable provisions of these Specifications and permits from other agencies.

- B. All curbs, gutters, and sidewalks damaged in any manner shall be removed and replaced to the next expansion joint line beyond that actually damaged or broken. In the event a joint does not exist, the existing concrete shall be removed and reconstructed to neat plane faces as directed by CVWD or CVWD's Representative and in accordance with Section 33 11 00, Basic Pipeline Specifications.

1.08 Warranty

- A. The Contractor shall warrant and guarantee the contracted work against defects in design, materials and workmanship for a period of one (1) year from and after the date of issuance by CVWD of the Certificate of Completion and Final Acceptance. When defects occur, within the time period described herein, the Contractor shall repair the same and the warranty period required shall, with relation to such required repair, be extended for a period of one (1) year from the date of completion of such repair. The Contractor shall include an appropriate amount in his bid to cover sewage bypass during the warranty inspection as no additional allowance will be paid by CVWD.
 - 1. Repairs: During the one (1) year warranty period, the Contractor, at no expense to CVWD shall repair or replace the CIPP liner for any of the following conditions:
 - a. Leakage through the CIPP or between the CIPP and the host pipe.
 - b. A reduction of the CIPP thickness of more than ten percent (10%) caused by corrosion or abrasion.
 - c. Separation of the CIPP from the host pipe.
 - d. Failures due as a result of faulty material or improper installation.
 - 2. Warranty Inspection: Prior to the end of the one (1) year warranty period (approximately one (1) month prior), the Contractor shall again clean and video inspect the sewer line and provide the District with the original video of the entire completed work. If the Contractor desires to have an original copy of the video inspection, then two (2) DVD's shall be simultaneously recorded during the inspection. CVWD's Representative shall be present during the cleaning and video inspection. It shall be the responsibility of the Contractor to coordinate the cleaning and video inspection with CVWD.
 - 3. Schedule: Upon completion of the warranty inspection, the District will approve a date for the Contractor to proceed with remedial work, if any. Any delay on the Contractor's part to meet the approved schedule shall

constitute a breach of this contract and the District may proceed to seek such remedies as are available under the law.

4. Costs: All costs for the Contractor's inspection and repairs shall be entirely borne by the Contractor. During the preparation of its bid, the Contractor shall include an appropriate amount for the warranty cleaning, video inspection and repairs, as no additional allowance will be paid by the District for said warranty cleaning, video inspection and repairs. Any additional cleaning, video inspection and repair services shall be the responsibility of the Contractor.

Part 2 - Materials

2.01 General

- A. All materials, labor and equipment for CIPP shall conform to ASTM F1216 and SSPWC Subsection 500-1.4.
- B. The installed CIPP system shall have previously passed the SSPWC Chemical Resistance Test Section 211-2 and ASTM D5813 and accepted for inclusion in the Green Book as an acceptable rehabilitation material per Green Book Part 5 System Rehabilitation Section 500 – Pipeline. Evidence of having met the Green Book chemical resistance testing for the proposed system shall be provided as part of the shop drawings.
- C. All materials, shipped to the project site, shall be accompanied by test reports certifying that the material conforms to the ASTM standards listed herein. Materials shall be shipped, stored, and handled in a manner consistent with written recommendations of the CIPP system manufacturer to avoid damage. Damage includes, but is not limited to, gouging, abrasion, flattening, cutting, puncturing, or ultra-violet (UV) degradation. On site storage locations, shall be approved by CVWD. All damaged materials shall be promptly removed from the project site at the Contractor's expense and disposed of in accordance with all current applicable agency regulations.

2.02 Flexible Tube

- A. The fabric tube shall consist of one or more layers of absorbent non-woven felt fabric, felt/fiberglass or fiberglass and meet the requirements of ASTM F1216, ASTM F1743, ASTM D5813, and ASTM F2019. The fabric tube shall be capable of absorbing and carrying resins, constructed to withstand installation pressures and curing temperatures and have sufficient strength to bridge missing pipe segments, and stretch to fit irregular pipe sections. The contractor shall submit certified information from the felt manufacturer on the nominal void volume in the felt fabric that will be filled with resin.

- B. The wet-out fabric tube shall have a uniform thickness and excess resin distribution that when compressed at installation pressures will meet or exceed the design thickness after cure.
- C. The fabric tube shall be manufactured to a size and length that when installed will tightly fit the internal circumference, meeting applicable ASTM standards or better, of the original pipe. Allowance shall be made for circumferential stretching during installation. The tube shall be properly sized to the diameter of the existing pipe and the length to be rehabilitated and be able to stretch to fit irregular pipe sections and negotiate bends. The Contractor shall determine the minimum tube length necessary to effectively span the designated run between manholes. The Contractor shall verify the lengths in the field prior to ordering and prior to impregnation of the tube with resin, to ensure that the tube will have sufficient length to extend the entire length of the run. The Contractor shall also measure the inside diameter of the existing pipelines in the field prior to ordering liner so that the liner can be installed in a tight-fitted condition.
- D. The outside and/or inside layer of the fabric tube (before inversion/pull-in, as applicable) shall be coated with an impermeable, flexible membrane that will contain the resin and facilitate, if applicable, vacuum impregnation and monitoring of the resin saturation during the resin impregnation (wet-out) procedure.
- E. No material shall be included in the fabric tube that may cause de-lamination in the cured CIPP. No dry or unsaturated layers shall be acceptable upon visual inspection as evident by color contrast between the tube fabric and the activated resin containing a colorant.
- F. The tube shall contain no intermediate layers which delaminate after resin curing. It shall not be possible to separate any layers with a probe or knife blade such that the layers separate cleanly or the probe or knife blade moves freely between the layers.
- G. The wall color of the interior pipe surface of CIPP after installation shall be a light reflective color so that a clear detailed examination with closed circuit television inspection equipment may be made. The hue of the color shall be dark enough to distinguish a contrast between the fully resin saturated felt fabric and dry or resin lean areas.
- H. Seams in the fabric tube, if applicable, shall meet the requirements of ASTM D5813.
- I. The outside of the fabric tube shall be marked every five (5) feet with the name of the manufacturer or CIPP system, manufacturing lot and production footage.

- J. The minimum length of the fabric tube shall be that deemed necessary by the installer to effectively span the distance from the starting manhole to the terminating manhole or access point, plus that amount required to run-in and run-out for the installation process.
- K. The nominal fabric tube wall thickness shall be constructed, as a minimum, to the nearest 0.5 mm increment, rounded up from the design thickness for that section of installed CIPP. Wall thickness transitions, in 0.5 mm increments or greater as appropriate, may be fabricated into the fabric tube between installation entrance and exit access points. The quantity of resin used in the impregnation shall be sufficient to fill all of the felt voids for the nominal felt thickness.

2.03 *Resin*

- A. The resin shall be a corrosion resistant polyester or vinyl ester resin and catalyst system or epoxy and hardener system that, when properly cured within the tube composite, meets the requirements of SSPWC Subsection 500-1.4, ASTM F1216, ASTM F1743 or F2019, the physical properties herein, and those, which are to be utilized in the design of the CIPP for this project. The resin shall produce CIPP which will comply with or exceed the structural and chemical resistance requirements of this specification.
- B. The resin to tube ratio, by volume, shall be furnished as recommended by the manufacturer.

2.04 *Structural Requirements*

- A. The physical properties and characteristics of the finished liner will vary considerably, depending on the types and mixing proportions of the materials used, and the degree of cure executed. It shall be the responsibility of the Contractor to control these variables and to provide a CIPP system which meets or exceeds the minimum properties specified herein.
- B. The CIPP shall be designed as per ASTM F1216 Appendixes. The CIPP design shall assume no bonding to the original pipe wall C. The CIPP Design Engineer, provided by the Contractor, shall set the long term (50 year extrapolated) Creep Retention Factor at 50% of the initial design flexural modulus as determined by ASTM D790 test method. This value shall be used unless the Contractor submits long term test data (ASTM D2990) to substantiate a higher retention factor.

2.05 *Physical Properties*

- A. The cured pipe material (CIPP) shall, at a minimum, meet or exceed the structural properties per ASTM F1216, as listed below.

Property	Test Method	Polyester System	Vinyl Ester System
Flexural Strength (Short Term) (Felt Tubes) Felt/Fiberglass, Fiberglass as recommended by the Manufacturer	ASTM D790	4,500 psi	4,500 psi
Flexural Modulus of Elasticity (Short Term) (Felt Tubes) Felt/Fiberglass, Fiberglass as recommended by the Manufacturer	ASTM D790	250,000 psi	250,000 psi
Flexural Modulus of Elasticity (50-yr) (Felt Tubes) Felt/Fiberglass, Fiberglass as recommended by the Manufacturer	ASTM D790	125,000 psi	125,000 psi
Tensile Strength (Short Term) (Felt Tubes) Felt/Fiberglass, Fiberglass as recommended by the Manufacturer	ASTM D638	3,000 psi	3,000 psi
Tensile Modulus of Elasticity (Short Term) (Felt Tubes) Felt/Fiberglass, Fiberglass as recommended by the Manufacturer	ASTM D638	250,000 psi	250,000 psi

B. Unless otherwise specified, the required structural CIPP wall thickness shall be based, as a minimum, on the physical properties of the cured composite, the design of the CIPP Design Engineer per section 1.04, B, 10, and in accordance with the Design Equations for “Fully Deteriorated Pipe” given in Appendix X1 of ASTM F1216 using the following design parameters.

Design Safety Factor	Design Safety Factor: 2.5 for $H/D \geq 2$, or 3.0 for $H/D < 2$, where H is the height in feet of the fill over the pipe and D is the outside diameter of the pipe in feet.
Creep Retention Factor	Creep Retention Factor 50%
Ovality	Ovality 2% or as measured by field inspection
Enhancement Factor, K	7.0
Constrained Soil Modulus	Constrained Soil Modulus per Project Geotechnical Report, AASHTO LRFD Section 12, and AWWA

	Manual M45
Groundwater Depth (above invert of pipe)	As specified or indicated in the Contract Documents
Soil Depth (above the crown of the pipe)	As specified or indicated in the Contract Documents
Live Load	As specified or indicated in the Contract Documents (highway, railroad, or airport, as applicable)
Soil Load (assumed)	Per the Project Geotechnical Report (if none is provided 120 lb/cu. ft. may be used).

- C. The Contractor shall submit, prior to installation of the lining materials, certification of compliance with these specifications and/or the requirements of the pre-approved CIPP system. Certified material test results shall be included that confirm that all materials conform to these specifications and/or the pre-approved system. Materials not complying with these requirements will be rejected.
- D. The design soil modulus shall be adjusted based on data determined from detailed project soil testing results as provided by CVWD in the Contract Documents.

2.06 *Liner Manufacturers*

- A. Liner for sewer pipe shall be the product of one of the following manufacturers or approved equal:
1. Inliner Technologies, LLC.
 2. Insituform as manufactured by Insituform of North America, Inc.
 3. Sancon Engineering CIPP.

Part 3 – Execution

3.01 *General*

- A. Preparation, cleaning, inspection, sewage by-passing and public notification. The Contractor shall clean the interior of the existing host pipe prior to installation of the CIPP liner. All debris and obstructions, that will affect the installation and the final CIPP product delivery to CVWD, shall be removed and disposed of in a legal manner.
- B. The CIPP liner shall be constructed of materials and methods, that when installed, shall provide a joint-less and continuous structurally sound CIPP able to withstand all imposed static, and dynamic loads on a long-term basis.

- C. The Contractor may, after submitting written notification and receiving approval from CVWD, utilize any of the existing manholes in the project area as installation access points. If a street must be closed to traffic because of the location of the sewer, the Contractor shall furnish a detailed traffic control plan and all labor and equipment necessary. The plan shall be in accordance with the requirements of SSPWC Part 6 Temporary Traffic Control and the entity (City, County, State, etc.) having jurisdiction.
- D. The CIPP shall be continuous and joint-less from manhole to manhole or access point to access point and shall be free of all defects that will affect the long-term life and operation of the pipe.
- E. The CIPP shall fit sufficiently tight within the existing pipe so as to not leak at the manholes, at the service connections or through the wall of the installed pipe. If leakage occurs at the manholes or the service connections the Contractor shall seal these areas to stop all leakage using a material compatible with the CIPP. The proposed material shall be submitted to the Owner for approval and provided by the Contractor at no additional cost to CVWD. If leakage occurs through the wall of the pipe the liner shall be repaired or removed as recommended by the CIPP manufacturer at no additional cost. Final approval of the liner installation will be based on a leak tight pipe.
- F. The Contractor shall be responsible for furnishing and paying for all temporary utilities. The Contractor may use water from a fire hydrant owned by CVWD in the project vicinity when available and only after contacting CVWD and receiving approval of a request for a temporary construction water meter. Contractor shall pay current market price for all water usage.
- G. Inspection during installation shall be executed by CVWD. Any defects found shall be repaired or replaced by the Contractor at no additional cost.

3.02 *Delivery, Storage, and Handling*

- A. Delivery of tools, equipment and material shall be coordinated by the Contractor to minimize storage time and not delay the Work.
- B. If a staging area is necessary, the Contractor shall be responsible for negotiating directly with the local jurisdiction (city or county) to secure a staging area for the duration of the Work. The Contractor shall be solely responsible for costs and security measures associated with their staging area.
- C. All materials, shipped to the Project site, shall be accompanied by test reports certifying that the material conforms to the ASTM standards listed herein. The Contractor shall handle and store the CIPP liner as recommended by the

manufacturer to ensure installation in a sound undamaged condition. Damage includes, but is not limited to, gouging, abrasion, flattening, cutting, puncturing, or ultra-violet (UV) degradation. All damaged materials shall be promptly removed from the Project site at the Contractor's expense and disposed of in accordance with all current applicable agency regulations. The Contractor shall follow the resin manufacturer's requirements for handling and storage of the resin prior to, during and following impregnation of the tube

- D. The Contractor and manufacturer shall exercise extreme care during transportation, handling, storing and installation of the CIPP lining to ensure that the material is not torn, cut or otherwise damaged. If any part or parts of the CIPP liner material becomes torn, cut or otherwise damaged before or during installation, it shall be repaired or replaced before proceeding with further installation at no additional cost to CVWD.

3.03 *Notification*

- A. The Contractor shall be responsible for notification of the local residents a minimum of seven (7) days prior to the commencement of any work in the immediate area. Notices to the local residents will be supplied by the District. The Contractor shall be required to complete the notice as to the date the work will be performed and deliver a copy to each residence within the affected area. All costs associated with the notification of the residents shall be borne by the Contractor.

3.04 *Sound Attenuation*

- A. Normal working hours are defined in the General Conditions. The Contractor and/or subcontractor shall make every effort to complete work within this time period to avoid impacts to residents within the project area. Any additional noise restrictions are outlined in the Special Conditions. The Contractor and/or subcontractor shall provide means for sound attenuation for its equipment at all times to maintain noise levels to ambient and residential noise impacts to a minimum.

3.05 *Traffic Control*

- A. The Contractor is responsible for traffic control and it shall include all material, labor and equipment to provide safe and effective work areas to warn, control, protect and expedite vehicular, bicycle and pedestrian traffic. Unless otherwise required by the Contract Documents, all work and material provided under this section shall be performed or furnished in accordance with SSPWC Part 6 Temporary Traffic Control and the entity (City, County, State, etc.) having jurisdiction. Traffic control shall also be in accordance with Section 33 11 00, Basic Pipeline Specifications.

3.06 Access

- A. The Contractor shall be responsible for site preparation and access to the work location. This includes but is not limited to access for the bypass, video camera and all incidental equipment to the necessary access points on the sewer line or any other areas as required. CVWD's responsibility will be limited to exposing, opening or closing manhole covers as necessary for the Contractor to complete the work and for providing rights of access to the sewer line and construction areas.

3.07 Entry Pits

- A. The Contractor shall include in the detailed installation plan under section 1.4, a plan for the location, size, and depth of proposed entry pits and proposed method of installing liner. The entry pits and proposed method of installation shall not block side street access or access to business or private residences. Entry pits will not be permitted 250 feet either side of arterial highways. The Contractor's entry pit location shall also conform to applicable city, county, or state permit requirements.
- B. On all excavations where the liner has been exposed, there shall be placed, prior to backfilling, an encasement of 12-inch-thick, two-sack cement stabilized sand below, around, and above the pipe.
- C. Cost for construction and backfilling of entry pits and restoring surface improvements shall be included in the bid price for CIPP.

3.08 Sewage Bypassing

- A. The existing sewer lines, laterals and manholes are currently in use and it is the Contractor's sole responsibility for providing continued sewage bypass service. The flows in the sewer lines are provided on the Drawings for the Contractor's use in designing the bypass system.
- B. The Contractor shall prepare a bypass plan and control the flow in accordance with Section 31 23 19.10, Sewer Bypass System and as required by the Contract Documents. A sewage bypass plan shall be submitted to CVWD for approval prior to construction. The Contractor shall at all times, be responsible for the operations of this bypass system, including furnishing all the necessary equipment and making arrangements to obtain power as required. The Contractor shall not be permitted to trench public or private streets for bypass purposes without the approval of the entity (State, County, City, etc.) having jurisdiction.
- C. Installation of the liner shall not begin until the Contractor has installed the required plugs or a sewage bypass system and all pumping facilities have been installed and tested under full operating conditions including the bypass

of mainline and side sewer flows. Once the lining process has begun, existing sewage flows shall be maintained, until the resin/felt tube composite is fully cured, cooled down, fully televised and the CIPP ends finished. The Contractor shall coordinate sewer bypass and flow interruptions with CVWD and with the property owners and businesses. The pump and bypass lines shall be of adequate capacity and size to handle peak flows.

- D. With most small diameter pipelines, particularly on terminal sewers, plugging will be adequate but must be monitored on a regular basis to prevent backup of sewage into adjacent homes. Service connection effluent may be plugged only after proper notification to the affected residence and may not remain plugged overnight.
- E. The bypass system shall be manned 24 hours a day by a qualified pumping technician. Any equipment failure, power failure or other type of failure shall not relieve the Contractor of its responsibility to ensure adequate bypassing operations. The Contractor shall supply 100% backup pumping capacity to ensure uninterrupted bypass operations.
- F. Under no circumstances will the dumping of raw sewage on private property, streets, storm drains or storm channels be allowed. The Contractor shall be solely responsible for any releases of raw sewage due to any failure of the bypass pumping system or by other means, including but not limited to clean-up, repair, property damage cost, claims and fines. The Contractor shall submit a spill response and notification procedure including emergency phone numbers of the Contractor's staff for CVWD approval in advance of performing the work.
- G. If rainfall is predicted during the contract period, the Contractor shall adequately protect all existing structures, equipment, materials, and tools to the satisfaction of CVWD.

3.09 *Cleaning and Inspection*

- A. Within seven (7) days of the installation of the CIPP liner the Contractor shall jet clean, per SSPWC Section 500-1.1.4 and Specification Section 33 01 30.16, TV Inspection of Sewer Pipelines, the existing sewer to be lined, but no sooner than seven (7) days. CVWD's Representative shall be present during the pipe cleaning operation.
- B. Immediately after the existing pipeline has been cleaned, the pipeline shall be televised in accordance with SSPWC Section 500-1.1.5 and Specification Section 33 01 30.16, TV Inspection of Sewer Pipelines. Television inspection shall document all leaks, breaks, obstacles, and service connections. A report documenting all defects or obstructions that will interfere with liner installation shall be immediately submitted to CVWD for review CVWD.

- C. The Contractor shall remove all internal debris from the pipe line that will interfere with the installation and the final product delivery of the CIPP as required in these specifications. Solid debris and deposits shall be removed from the system and disposed of in a proper legal manner by the Contractor. Moving material from manhole section to manhole section shall not be allowed. As applicable the contractor shall either plug or install a flow bypass pumping system to properly clean the pipe lines. Precaution shall be taken, by the Contractor in the use of cleaning equipment to avoid damage to the existing pipe. The repair of any damage, caused by the cleaning equipment, shall be the responsibility of the Contractor. Unless otherwise specified by CVWD, the Contractor shall legally dispose of all debris at no additional cost.
- D. Line Obstructions - It shall be the responsibility of the Contractor to clear the line of obstructions that will interfere with the installation and long-term performance of the CIPP. If pre-installation inspection reveals an obstruction, misalignment, broken or collapsed section or sag that was not identified as part of the original scope of work and will prohibit proper installation of the CIPP, the Contractor shall notify CVWD to correct the problem(s) prior to lining by utilizing open cut repair methods per SSPWC Section 500-1.2 and/or as directed by CVWD. The cost of removal of obstructions that do or do not appear on pre-bid video documentation and made available to the Contractor, prior to the bid opening, shall be compensated on a unit price basis in accordance with the contract documents.
- E. Contractor shall perform post-cleaning video inspections of the pipelines in accordance with SSPWC Section 500-1.1.5 of the Section 33 01 30.16, TV Inspection of Sewer Pipelines. Only PACP certified personnel trained in locating breaks, obstacles and service connections by closed circuit television shall perform the inspection. The Contractor shall provide CVWD a copy of the pre-cleaning and post-cleaning video and suitable log, and/or in digital format for review prior to installation of the CIPP and for later reference by CVWD.

3.10 *Lateral Location*

- A. The Contractor shall be responsible for confirming locations of all lateral service connections prior to installing the CIPP. All existing and active lateral service connections shall be reinstated per SSPWC Section 500-1.1.7 Miscellaneous, Service Connections.
- B. If required by the Contract Documents, service connection sealing shall be performed in accordance with SSPWC Section 500-4 Service Lateral Sealing Connection. The lateral sealing connection shall be compatible with the CIPP material and ensure a positive connection to the lateral section.

- C. It shall be the responsibility of the Contractor to clear the sewer of obstructions, including protruding laterals that will interfere with the installation and long-term performance of the liner.

3.11 *Installation of Liner*

- A. The CIPP Liner shall be installed and cured in the host pipe per the manufacturer's specifications as described and submitted in the approved product submittal binder.
- B. CIPP installation shall be in accordance with the applicable ASTM standards with the following modification:
 - 1. The wet-out tube shall be positioned in the pipeline using the method specified by the manufacturer. Care should be exercised not to damage the tube as a result of installation. The tube should be pulled-in or inverted through an existing manhole or approved access point and fully extend to the next designated manhole or termination point.
- C. Prior to installation and as recommended by the manufacturer remote temperature gauges or sensors shall be placed inside the host pipe to monitor the temperatures during the cure cycle. Liner and/or host pipe interface temperature shall be monitored and logged during curing of the liner.
- D. To monitor the temperature of the liner wall and to verify correct curing and where specified by the contract documents, temperature sensors can be placed between the host pipe and the liner in the bottom of the host pipe (invert) throughout its length to monitor the temperature on the outside of the liner during the curing process. The temperature sensors can be placed at intervals as recommended by the sensor manufacturer. Additional sensors can be placed where significant heat sinks are likely or anticipated. The sensors, if installed, should be monitored by a computer using a tamper proof data base that is capable of recording temperatures at the interface of the liner and the host pipe.
- E. Curing shall be accomplished by utilizing steam in accordance with the manufacturer's recommended cure schedule. The curing source or in and output temperatures shall be monitored and logged during the cure cycles if applicable. The manufacturer's recommended steam cure method and schedule shall be used for each line segment installed, and the liner wall thickness and the existing ground conditions with regard to temperature, moisture level, and thermal conductivity of soil, per ASTM as applicable, shall be taken into account by the Contractor.

- F. For heat cured liners, if any temperature sensor or multiple sensors do not reach the temperature as specified by the manufacturer to achieve proper curing or cooling, the installer can make necessary adjustments to comply with the manufacturer's recommendations. The system computer should have an output report that specifically identifies each installed sensor station in the length of pipe, indicates the maximum temperature achieved and the sustained temperature time. Each sensor should record both the maximum temperature and the minimum cool down temperature and comply with the manufacturer's recommendations. The cure procedure shall be in accordance with the manufacturer's recommendation as included in the approved submitted information by the contractor.

3.12 *Cool Down*

- A. The Contractor shall cool the CIPP in accordance with the approved CIPP manufacturer's recommendations as described and outlined in the approved project submittal binder.
- B. Temperatures and curing data shall be monitored and recorded, by the Contractor, throughout the installation process to ensure that each phase of the process is achieved as approved in accordance with the CIPP System manufacturer's recommendations.

3.13 *Finish*

- A. The installed CIPP shall be continuous over the entire length of a sewer line section and be free from visual defects such as foreign inclusions, dry spots, pinholes, major wrinkles and de-lamination. The CIPP shall be impervious and free of any leakage from the pipe to the surrounding ground or from the ground to inside the lined pipe.
- B. Any defect, which could affect the structural integrity or strength of the linings, shall be repaired at the Contractor's expense, in accordance with the procedures submitted under Section 1.04 "Contractor Submittals."
- C. The beginning and end of the CIPP shall be sealed to the existing host pipe. The sealing material shall be compatible with the pipe end and shall provide a watertight seal.
- D. If any of the service connections leak water between the host pipe and the installed liner, the connection mainline interface shall be sealed to provide a water tight connection.
- E. If the wall of the CIPP leaks, it shall be repaired or removed and replaced with a watertight pipe as recommended by the manufacture of the CIPP system.

- F. Compensation shall be at the actual length of cured-in-place pipe installed. The length shall be measured from center of manhole to center of manhole. The unit price per linear foot installed shall include all materials, labor, equipment and supplies necessary for the complete CIPP liner installation. Compensation for service connection sealing and pipe sealing at the manhole/wall interface, shall be at the unit price bid therefore in the Proposal.

3.14 *Manhole Connections and Reconnections of Existing Services*

- A. The beginning and end of the new pipe liner shall be sealed to the host pipe with a hydrophilic epoxy or other material end seal. Hydrophilic end seals for use at non-pressure manholes shall be epoxy or other material. The end seals shall be compatible with the lining material and host pipe and shall provide a watertight seal. End seal shall be in accordance with SSPWC Subsection 500-1.1.7 and submitted with the CIPP shop drawings for review and acceptance.
- B. Use Class 560-C-3250 concrete according to SSPWC subsection 201-1.1.2 to form a smooth transition with a reshaped invert and a raised manhole bench to eliminate sharp edges of CIPP, concrete bench, and channel invert. Build up and smooth invert of manhole to match flow line of new CIPP.
- C. Existing services shall be internally or externally reconnected unless indicated otherwise in the Contract Documents in accordance with SSPWC Subsection 500-1.1.7.
- D. Reconnections of existing services shall be made after the CIPP has been installed, fully cured, and cooled down. It is the Contractor's responsibility to make sure that all active service connections are reconnected.
- E. External reconnections are to be made with a tee fitting in accordance with CIPP System manufacturer's recommendations. Saddle connections shall be seated and sealed to the new CIPP using grout or resin compatible with the CIPP.
- F. A CCTV camera and remote cutting tool shall be used for internal reconnections. The machined opening shall be at least 90 percent of the service connection opening and the bottom of both openings must match. The opening shall not be more than 100 percent of the service connection opening. All cut lateral and service connections shall be free of burrs, frayed edges, pipe fragments or liner fragments, or any restriction preventing free flow of wastewater or snag debris. In all cases the invert of the sewer connection shall be cut flush with the invert entering the mainline.
- G. In the event that service reinstatements result in openings that are greater than 100 percent of the service connection opening, the Contractor shall

install a CIPP type repair, sufficiently in size to completely cover the over-cut service connection. No additional compensation will be paid for the repair of over-cut service connections.

- H. Coupons of pipe material resulting from service tap cutting shall be collected at the next manhole downstream of the pipe rehabilitation operation prior to leaving the site. Coupons may not be allowed to pass through the system.
- I. If required by the Contract Documents, all sewer laterals encountered where cured-in-place pipe lining is being performed shall be sealed using "Top Hat" connection liners, which shall have a minimum of 3" brim around the connection and extend a minimum of 6" inside the lateral from the main line. "Top Hat" connection liners shall be as manufactured by Cosmic Top Hat, AMerik Engineering, or approved equal.

3.15 *Testing of Installed CIPP*

- A. Testing and inspection shall include CCTV inspection in steam cured reaches, and other items as required. If required by the Contract Documents, low pressure air test shall also be used in steam cured reaches in accordance with Section 33 01 30.13, Sanitary Sewer System Testing.
- B. Chemical Resistance
 - 1. Components of the CIPP system installed shall meet the chemical resistance requirements of SSPWC and the ASTM standards. Evidence of passing these chemical resistance tests shall be provided together with the shop drawings for review and acceptance prior to installation of these materials.
- C. The physical properties of the installed CIPP shall be verified through field sampling and laboratory testing. All materials for testing shall be furnished by the Contractor. All materials testing shall be performed by an independent third-party laboratory approved by CVWD as recommended by the CIPP manufacturer. All tests shall be in accordance with applicable ASTM test methods (ASTM F1216, ASTM D790, ASTM D5813, etc.) to confirm compliance with the short-term flexural strength and short-term flexural modulus requirements specified in Article entitled "Physical Properties" of this Specification
 - 1. Laboratories that will be considered for acceptance include: Ramtech Laboratories, Paramount, CA phone (562) 633-4824; Hauser Laboratory, a Division of Microbac Laboratories, Boulder, CO phone (720) 406-4800; or equal.

- D. All curing, cutting and identification of samples will be witnessed by a CVWD's Representative and transmitted by the Contractor to the testing laboratory.
- E. The opening in the CIPP produced from all samples shall be repaired in accordance with manufacturer's recommended procedures.
- F. The installed CIPP thickness shall be measured for each CIPP section installed. If the CIPP thickness does not meet the accepted design tolerance defined below, the CIPP shall be repaired or removed. The CIPP thickness shall have tolerance of minus 5% and plus 10% of the accepted design thickness. The Contractor shall remove a minimum of one sample from every CIPP section of installed CIPP to be used to check the CIPP thickness. The samples shall be taken by core drilling 2-inch diameter test plugs at accessible locations near manholes. As an alternative, the Contractor may submit for CVWD review and acceptance, industry proven non-destructive methods for confirming the thickness of the installed CIPP.
- G. The Contractor shall provide samples for testing under field inspection by CVWD from the actual installed CIPP. One restrained sample and one plate sample shall be provided for each inversion. Restrained samples shall be cut from a section of cured CIPP that has been inverted or pulled through a like diameter sewer which has been held in place to cure for the same time and under the same heat and pressure conditions as the CIPP. Plate samples shall be contained in a sample box and made from the same carrier tube material (same nominal thickness) and resin as used for the CIPP. Plate samples shall be cured in the same heat environment and for the same time as the CIPP.
 - 1. Each sample shall be large enough to provide a minimum of six specimens for flexural testing and six specimens for tensile testing. All curing, cutting and identification of all samples shall be performed by the Contractor and be witnessed by CVWD. Three pairs of specimens shall be shipped to the approved testing laboratory for testing and three pairs of specimens shall be delivered to CVWD for record purposes.
 - 2. Specimen sizes shall be of the minimum size required by the laboratory accepted by shop drawing review and shall not be less than: 1) 5-inches wide by 20 times the specimen thickness long for flexural testing; and 2) 10-inches long and 7-inches wide for tensile testing.
 - 3. CVWD may, at its discretion, require that the Contractor remove two samples from the installed CIPP at locations designated by CVWD. The opening produced from the sample shall be repaired in accordance with the manufacture's recommended procedures at no additional cost to CVWD.

4. The laboratory results shall identify the test sample location as referenced to the nearest manhole and station. The approved laboratory shall return formal test results to the Contractor, with an original copy to CVWD, within 24 hours. The Contractor shall maintain the traffic control for the portion of sewer being tested during the laboratory analysis. If properties tested do not meet minimum requirements, the CIPP shall be repaired or replaced by the Contractor, at no additional cost to CVWD.
- H. Hydraulic Capacity – Overall, the hydraulic capacity shall be maintained as large as possible. The installed CIPP shall at a minimum be equal to the full flow capacity of the original pipe before rehabilitation. In those cases where full capacity cannot be achieved after liner installation, the Contractor shall submit a request to waive this requirement, together with the reasons for the waiver request. Calculated capacities may be derived using CVWD’s Development Design Manual accepted roughness coefficient for the existing pipe material.

3.16 *Final Acceptance*

- A. All CIPP sample testing and repairs to the installed CIPP as applicable, shall be completed, before final acceptance, meeting the requirements of these specifications and documented in written form.
- B. Immediately prior to conducting the closed-circuit television inspection, the Contractor shall thoroughly clean the newly installed liner removing all debris and build-up that may have accumulated, at no additional cost to CVWD.
- C. The Contractor shall perform a detailed closed-circuit television inspection in accordance with ASTM standards, SSPWC Section 500-1.1.5 and Specification Section 33 01 30.16, TV Inspection of Sewer Pipelines, in the presence of CVWD after installation of the CIPP liner and reconnection of the side sewers. A radial view (pan and tilt) TV camera shall be used.
- D. The finished liner shall be continuous over the entire length of the installation and shall be free of significant visual defects, damage, deflection, holes, leaks and other defects.
- E. Unedited digital documentation of the inspection shall be provided to CVWD within ten (10) working days of the liner installation. The data shall note the inspection date, location of all reconnected side sewers, debris, as well as any other defects in the liner, including, but not limited to, gouges, cracks, bumps, or bulges. If post installation inspection documentation is not submitted within ten (10) working days of the liner installation, CVWD may at its discretion suspend any further installation of CIPP until the post-installation documentation is submitted. As a result of this suspension, no

additional working days will be added to the contract, nor will any adjustment be made for increase in cost.

- F. Bypass pumping or plugging from the upstream manhole shall be utilized to minimize sewage from entering the line during the inspection. In the case of bellies in the line, the pipe shall be cleared of any standing water to provide continuous visibility during the inspection.
- G. Where leakage is observed through the wall of the CIPP, the Contractor shall repair or replace CIPP as required in Article entitled "Finish" of this Specification.
- H. Wrinkles in the finished CIPP that cause a backwater of 1-inch or more or reduce the hydraulic capacity of the CIPP are unacceptable and shall be removed and repaired by the Contractor at the Contractor's expense.

3.17 *Clean Up*

- A. Prior to Final Completion of the Work, the Contractor shall restore the Project site affected by the operations to a condition at least equal to that existing prior to the Work at no additional expense to CVWD.

END OF SECTION 33 01 30.71

SECTION 33 05 13

MANHOLES AND PRECAST VAULTS

Part 1 – General

1.01 *Scope of Work*

- A. This section covers the work necessary for the construction of sewer manholes and precast vaults (for valves and flowmeters). Manhole and vault details are as shown on the Drawings and CVWD's Detail Drawings for the construction of Sanitary Sewer Systems. This Specification section does not cover precast structures such as lift stations (i.e. hydraulic structures) or electrical manholes and vaults.
- B. Furnish all labor, supervision, materials and equipment and performing all operations necessary to construct manholes for gravity sewers and precast vaults.
- C. Plastic lining for concrete structures involves pre-molded self-anchoring plastic sheet linings and shall be applied, when required by CVWD, to the following interior surfaces of precast and cast-in-place reinforced sewer manholes:
 - a. Reinforced concrete manhole barrels and cones.
 - b. Vertical wall surface above concrete fills (bench and flow channel), and underside of top slab of cast-in-place reinforced concrete structures.
- D. Exterior coating covers coating shall be applied, when required by CVWD, to the following exterior surfaces of sewer manholes and precast vaults.
 - a. Reinforced concrete manhole barrels and cones.
 - b. Vertical wall surface above concrete fills, top slab of cast-in-place reinforced and unreinforced concrete structures.
 - c. Precast vault walls.
- E. The existing sewer lines, laterals, manholes, and sewer force main are currently in use and it is the Contractor's sole responsibility for providing continued sewer bypass service to maintain uninterrupted service.

1.02 *Related Work Specified Elsewhere*

- A. The requirements of the following sections and divisions apply to the Work of this Specification section. Other sections and divisions of the Specifications, not referenced below, shall also apply to the extent required for proper performance of this Work.
 - 1. Section 09 90 00.10, Sewer Painting and Coating
 - 2. Section 31 23 17, Trenching, Excavation, Backfill and Compaction

3. Section 31 23 19.10, Sewer Bypass System
4. Section 33 01 30.13, Sanitary Sewer System Testing
5. Section 33 11 00, Basic Pipeline Specifications
6. Section 33 39 XX, Connection to Sanitary System

1.03 *Reference Specifications, Codes, and Standards*

A. All Work specified herein shall conform to or exceed the applicable requirements of the referenced portions of the following publications to the extent that the provisions thereof are not in conflict with other provisions of these Specifications.

B. Comply with the applicable editions of the following codes, regulations and standards.

1. CVWD Detail Drawings for the Construction of Sanitary Sewer Systems

2. Industry Standards:

ASTM A 48	Standard Specification for Gray Iron Castings
ASTM A 615	Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
ASTM C 14	Standard Specification for Non-reinforced Concrete Sewer, Storm Drain, and Culvert Pipe
ASTM C 33	Standard Specification for Concrete Aggregates
ASTM C 94	Standard Specification for Ready-Mixed Concrete
ASTM C 150	Standard Specification for Portland Cement
ASTM C 387	Standard Specification for Packaged, Dry, Combined Materials for Mortar and Concrete
ASTM C 478	Standard Specification for Precast Reinforced Concrete Manhole Sections
ASTM C 990	Standard Specification for Joints for Concrete Pipe, Manholes, and Precast Box Sections Using Preformed Flexible Joint Sealants
ASTM D 1557	Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort
ASTM D 2922	Standard Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)
SSPWC	Standard Specifications for Public Works Construction

- C. Comply with the applicable reference Specifications as specified in the General Conditions and other applicable parts of the Contract Documents.

1.04 *Submittals*

- A. Submittals shall be made in accordance with the General Conditions, other applicable parts of the Contract Documents, and as specified herein.
- B. The Contractor shall furnish complete shop drawings for all precast manhole sections, cast iron frames and covers and appurtenances, temporary bypass system (in accordance with Section 31 23 19.10, Sewer Bypass System and as required by the Contract Documents, lining products, coating material, and installation methods, concrete, coatings, reinforcement, sealants, epoxy, lining material (if applicable), testing certification for frames and covers, and other items specified herein for review by CVWD.
- C. The drawings of material and equipment showing in sufficient details the dimensions and manufacturer's tolerance and working pressures.
- D. The Contractor shall also obtain and submit to the District, the Manufacturer's Affidavit of Compliance that all materials used in manhole production and construction meet the requirements of the Standards of this Specification.
- E. Complete specifications and data covering the materials to be furnished and detailed drawings covering the installation thereof, including but not limited to the attachment of the linings to the forms, manhole bench, and channel, and the arrangement and sealing or welding of the butt and corner joints, shall be submitted in accordance with the procedure set forth in the submittals section.
- F. The Contractor shall furnish data certified by the manhole and pipe manufacturers that the lining is of the materials specified. No lined manhole sections, pipe or fitting will be accepted for use in the Work on this project until certificates have been submitted and approved by CVWD.
- G. The manufacturer of the sheet lining shall furnish an affidavit attesting to the successful and completely satisfactory use of the materials as a lining for the service intended, before shipment thereof.
- H. Training certification related to the installation of plastic sheet lining shall be submitted by manufacturer in writing.
- I. A sewer bypass plan in accordance with Section 31 23 19.10, Sewer Bypass System and as required by the Contract Documents shall be submitted to the District for approval prior to construction.
- J. If required by CVWD, manhole cover transverse test results.

1.05 *Quality Assurance*

- A. Regulations: Perform all work in accordance with current applicable regulations and codes of all Federal, State and local agencies.
- B. Manholes and vaults shall be designed and manufactured for AASHTO H-20 loading.
- C. The Contractor shall have at least 5 years of experience with work compatible to the Work shown and specified, employing labor and supervisory personnel who are similarly experienced in this type of Work.
- D. The accepted plastic sheet manufacturer's standard printed specifications covering the installation of the lining in concrete structures shall be considered as being incorporated herein, and all work for and in connection with said plastic lining installation shall be strictly in accordance therewith. Such manufacturer's specifications shall include and cover application of sheets to concrete forms, including preparation of forms, joint welding and removal of forms, miscellaneous requirements covering transportation, handling, storing, and inspection; and necessary precautions with respect to ventilation and protection of workmen.
- E. All work in conjunction with the installation of plastic sheet lining, the preparation of surfaces, and the sealing and welding of joints shall be performed by the manufacturer of the lining or by a firm or individual who has been trained and certified by the manufacturer.
- F. The Contractor shall furnish all labor, material and equipment necessary for the preparation of surfaces, application of exterior coating, safety procedures, protection of existing surfaces and equipment and clean up. The Contractor shall have at least 3 years' experience in the application of polyurethane coatings and shall provide a list of similar projects completed within the 3-year period.
- F. Inspection: After installation, the Contractor shall demonstrate that all manholes have been properly installed, level, with tight joints, at the correct elevations and orientations, and that the backfilling has been carried out in accordance with the Contract Documents.

1.06 *Design Requirements*

- A. All structures shall conform to the Drawings with respect to material, size, construction details, elevations and location.

1.07 *Measurement and Payment*

Part 2 — Materials

2.01 *General*

- A. Watertight precast reinforced concrete sections shall be manufactured in accordance with ASTM C478. Riser sections shall be of various heights to bring the top of structures to the established elevations and to permit ease of handling and installation.

- B. All Portland cement concrete, mortar and grout shall conform to the provisions of SSPWC Sections 201, 202, and 303.
- C. In certain circumstances, rapid-setting concrete may be required. Accelerating admixtures shall conform to SSPWC Subsection 201-1.2.4, ASTM C494 and may be used in the concrete mix as permitted by CVWD's Representative. Calcium chloride shall not be used in concrete.
- D. Hand mixed concrete materials type and proportions shall be submitted and approved by CVWD's Representative prior to application on site. The maximum slump shall be 6-inch
- E. All lifting holes, except in manhole covers, and gaps at joints shall be filled with a non-shrink grout.

2.02 *Granular Base*

- A. Granular base shall conform to Section 31 23 17, Trenching, Excavation, Backfill and Compaction and as specified on the Drawings. The thickness of the granular base material used to support concrete manhole bases shall be the same as the adjacent pipeline bedding. If base is not used for the pipe bedding, 3/4-inch crushed rock, over undisturbed soil, shall be used for the manhole. Crushed granular base material shall extend one (1) foot beyond the outside edge of the concrete manhole base and compacted to a relative compaction of ninety percent (90%) per ASTM D1557 and ASTM D2922.

2.03 *Concrete and Asphalt*

- A. The concrete class for manhole bases shall be 560-C-3250. The concrete class for precast manhole and vault walls and top shall be 650-CW-4000 and contain at least 6 sacks of cement per cubic yard. Maximum size of aggregate shall be 1.5 inches. Slump shall be a maximum of 4 inches. All concrete shall have maximum water to cement (w/c) ratio of 0.45, unless otherwise specified.
- B. All cement, concrete, mortar, and grout used in the construction of manholes shall conform to SSPWC Section 201. Portland cement shall be Type V per ASTM 150. Mortar shall be Class C (proportion: 1 part cement to 2 parts sand).
- C. Concrete for collars per Standard Drawing Nos. S-1A and S-1B shall be 560-C-3250 with inert polypropylene fibers.
- D. Asphalt for collars and aggregate per Standard Drawing Nos. S-1A and S-1B and other areas shall be per Section 31 23 17, Trenching, Excavation, Backfill and Compaction and as specified on the Drawings.

2.04 *Forms*

- A. Provide forms on all vertical surfaces. Wood or sandbags are an acceptable form material. Manhole base ring and channel forms shall be per Part 3 of this specification.

2.05 *Reinforcing Steel*

- A. If shown on the Drawings, reinforcement for poured-in-place concrete bases shall be #6 reinforcing bars at 12 inches on center in each direction.
- B. Reinforcement shall conform to ASTM A 615, Grade 60, deformed bars.
- C. Reinforcement for precast sections shall conform to ASTM C 478, unless otherwise shown elsewhere in the Contract Documents.

2.06 *Manhole Bases*

- A. Precast manhole bases shall not be permitted unless accepted by CVWD.
- B. Manhole bases shall be poured in place and constructed of Class 560-C-3250 concrete to the form and dimensions shown on the Drawings and/or Standard Drawing Nos. S-5, S-8A, and S-8B.

2.07 *Poured-In-Place Manholes*

- A. Poured-in-place type manholes may be used if shown on the Drawings and all details of construction are accepted by CVWD.

2.08 *Precast Manhole Sections*

- A. Except as modified elsewhere in the Contract Documents, precast manhole sections, including risers, grade rings, and tops, shall be designed and manufactured in accordance with ASTM C 478.
- B. Precast manhole sections shall be minimum of 48 inches inside diameter for 21 inch or smaller pipe and a minimum of 60 inches inside diameter for 24 inch or larger pipe, conforming to Standard Drawing S-5, S-8A for drop manholes; S-8B for sewer lateral drop manholes.
- C. The precast cylinder units, precast concrete taper sections, and precast eccentric flat-top sections shall be designed and manufactured for continuous AASHTO H-20 loading. The Contractor shall submit shop drawings of all precast manholes. The minimum allowable steel shall be coils of No. 2 wire cast into each unit sufficient for handling.
- D. Provide eccentric cones for all manholes. Cones shall have same wall thickness and reinforcement as manhole sections. The minimum cone height for 48 and 60-inch diameter manholes shall be 30 and 24-inches, respectively. Top and bottom of all sections shall be parallel. Joints shall be cement mortar or Key lock with plastic sealing compound if approved by CVWD.
- E. Prior to the delivery of any size of precast manhole section on the jobsite, yard tests will be conducted at the point of manufacture. The precast sections to be tested will be selected at random from the stockpiled material, which is to be supplied for the job. All

test specimens will be mat tested, and shall meet the permeability test requirements of ASTM C 14.

2.09 *Manhole Extensions*

- A. In general, manhole extensions shall be used on all manholes in roads or streets or in other locations where a subsequent change in existing grade may be likely. Total height of stacked grade rings shall be a minimum of 15 inches and limited to a maximum of 18 inches. The top nine (9) inches of stacked grade rings shall consist of three (3) 3-inch rings and shall be accepted by CVWD before installation. Finish grade for manhole covers in paved areas shall conform to finished ground or street surface level, unless otherwise directed by the District.

2.10 *Mortar*

- A. Unless otherwise specified, mortar shall be used only for key lock joint while adjusting rings to grade in accordance with Standard Drawing No. S-5. Standard premixed mortar conforming to ASTM C 387 or SSPWC Mortar proportion 1 part Portland cement to 2 parts clean, well-graded sand which shall pass a 1/8-inch screen. Admixtures may be used not exceeding the following percentages of weight of cement: Hydrated lime, 10 percent; diatomaceous earth or other inert materials, 5 percent. For the Key lock type joint between grade rings, the consistency shall be such that excess mortar shall be forced out of the groove and finished flush with the surface. Mortar mixed for longer than 30 minutes shall not be used.

2.11 *Sealing Compound*

- A. Sections shall be securely bonded together with preformed plastic sealing compound or cement mortar.
- B. Mortar shall have a minimum thickness of 3/8 inches and be Class C Portland cement mortar in accordance with these Specifications.
- C. Preformed plastic sealing compound shall be 1-1/4-inch square beads, Kent-Seal No. 2 manufactured by Hamilton Kent Manufacturing Company, Kent, OH; Ram-Nek, manufactured by Henry Sealants, Houston, TX; or approved equal.
- D. Joints shall be watertight and neatly pointed on the inside.

2.12 *Joint Wrap for Manhole Sections*

- A. Joint wrap for manhole sections shall be 6 inches wide; of EPDM base and butyl mastic, Rub'R-Nek by Henry Company, Seal Wrap by Sealing Systems, Inc.; or of synthetic polymer, StopAQ EZ Wrap by Amcorr Inc.; or approved equal.

2.13 *Pipe Connections to Manholes*

- A. Connections to new and existing manholes shall be in accordance with Section 33 39 XX, Connection to Sanitary System.

2.14 Pipe Stub-outs for Future Sewer Connections

- A. Pipe stub-outs shall be 8-inch VCP unless otherwise specified on the Drawings. Strength classifications shall be the same class as in adjacent trenches. Where there are two different classes of pipe at a manhole, the higher strength pipe shall govern the strength classification. Rubber gasketed watertight plugs shall be furnished with each stub-out adequately braced against all hydrostatic or air test pressures. Stub-outs shall be installed as shown on Standard Drawing S-5, as applicable, unless otherwise shown on the Drawings. Pipe fittings, including installation thereof, which are a part of a manhole installation shall conform to SSPWC Sections 207 and 208.

2.15 Precast Concrete Vault

- A. The precast concrete vault shall be precast with a 28-day, 4,000-psi minimum compressive strength concrete and designed for AASHTO H-20 loading and the project geotechnical report. Minimum dimensions are shown on the Drawings. Provide openings for pipes, hatches, grating, etc. as shown on the Drawings.
- B. Unless otherwise specified, Concrete vaults shall be manufactured by Brooks Series 500 Quickset, or approved equal. The vault shall be topped with two H-20 load (continuous loading unless otherwise indicated on the Drawings) graded galvanized steel covers with lifting devices or as approved by the District.

2.16 Manhole Frames and Covers

- A. Manhole frames and covers shall be fabricated of cast iron in the size and shape detailed on the Drawings. Castings shall be tough, close-grained gray iron, sound, smooth, clean, free from blisters, blowholes, shrinkage, cold shuts, and all defects, and shall conform to ASTM A 48, Class 30. Plane or grind bearing surfaces to ensure flat, true surfaces. Covers shall be true and seat within ring at all points.
- B. 48-Inch Diameter Manholes
 1. Frame and cover: Type "A" per Standard Drawing S-10A.
 2. Frames shall have a minimum opening diameter of 24 inches.
 3. Diameter tolerance shall be $\pm 1/16$ of an inch.
 4. Cover shall be drilled with two (2) three-fourths inch ($3/4$ ") diameter holes to accept plastic inserts.
 5. Standard manhole frame and cover shall be non-rocking model A-1254 as manufactured by Alhambra Foundry Co., Ltd., or approved equal.
 6. Sealed manhole shall be A-1254B as manufactured by Alhambra Foundry Co., Ltd., or approved equal.
- C. 60 and 72-Inch Diameter Manholes

1. Frame and cover: Type "B" per Standard Drawing S-10B
 2. Frames shall have a minimum opening diameter of 36 inches.
 3. Standard manhole inner opening diameter shall be 22 inches.
 3. Diameter tolerance shall be $\pm 1/8$ of an inch.
 4. Cover shall be drilled with one (1) one inch (1") diameter hole to accept a plastic insert.
 4. Standard manhole frame and cover shall be non-rocking model A-1325 as manufactured by Alhambra Foundry Co., Ltd., or approved equal.
 5. Sealed manhole shall be A-1251 B-6 as manufactured by Alhambra Foundry Co., Ltd., or approved equal.
- D. Frames and covers shall be designed for H-20 loading. Before leaving the foundry, all castings shall be thoroughly cleaned and subjected to a hammer inspection.
- E. Each cover shall be ground or otherwise finished so that it will fit in its frame without rocking. Frames and covers shall be shipped to the site in match-marked sets. Covers shall have "CVWD SEWER" cast thereon per Standard Drawing Nos. S-10A and S-10B.
- F. Certification: When required by the District, covers shall be tested by use of the Transverse Test and be able to sustain a minimum breaking load of 2,200 pounds using a test bar measuring 1.2 inches in diameter and 21 inches long, with a distance between supports of 18 inches. A laboratory certification containing transverse test results for each lot of castings shall be furnished by the foundry.

2.17 **Warning Signs**

- A. The entrance to every unventilated manhole shall be fitted with a plastic warning sign, located 12 inches below the top of the manhole frame, with the inscription "CAUTION - VENTILATE BEFORE ENTERING" in clear letters no smaller than a 1/2-inch in height. The sign shall be attached to the concrete with four Type 316 stainless steel screws and anchors. Screws and anchors installed in coated or PVC lined manholes shall be as recommended by the coating or liner manufacturer and approved by CVWD to ensure the integrity of the system is not compromised. Damage to the coating or lining system shall be tested and repaired to the satisfaction of the District at the Contractor's expense.

2.18 **Manhole PVC Liner**

- A. Where indicated on the Drawings, new manholes shall be lined with ribbed PVC sheet, cast-in-place during manufacturing on precast shaft sections. Concrete bases shall be lined in accordance with the Contract Documents. Existing unlined manholes that are being repaired shall be lined in accordance with the Contract Documents.

- B. All liner plates furnished shall be composed of chemically inert synthetic resin, pigments, and plasticizers suitably compounded and processed; formed under pressure into permanently flexible sheets; white in color, and shall conform to the following:
 - a. Pre-molded Plastic Sheet Linings shall be Amer-Plate "T-Lock," not less than 0.065 inches thick, as manufactured by Ameron, Corrosion Control Division, Brea, California, or approved equal.
 - b. Welding Strip shall be Amer-Plate "T-Lock" welding strip, or approved equal.

2.19 **Manhole Epoxy Lining**

- A. Where specified in the Contract Documents, epoxy coating shall be applied to the manhole interior in accordance with Part 3 of this specification and Service Condition U of Section 09 90 00.10, Sewer Painting and Coating.
- B. Unless otherwise specified, coating shall be a two-component, 100% solid, high build epoxy. The material shall be Raven Lining System 405FS, Quadex Structure Guard, or approved equal.

2.20 **Manhole Polyurethane Lining**

- A. Where specified in the Contract Documents, polyurethane coating shall be applied to the manhole interior in accordance with Part 3 of this specification and Service Condition V of Section 09 90 00.10, Sewer Painting and Coating.
- B. Unless otherwise specified, coating shall be a two-component (epoxy primer and polyurethane system), 100% solid, and high build polyurethane. The material shall be Sancon 100, Zebron or approved equal.

2.21 **Precast Vault Polyurethane Lining**

- A. Where specified in the Contract Documents, polyurethane coating shall be applied to the manhole interior in accordance with Part 3 of this specification and Service Condition V of Section 09 90 00.10, Sewer Painting and Coating.
- B. Unless otherwise specified, coating shall be a two-component (epoxy primer and polyurethane system), 100% solid, and high build polyurethane. The material shall be Sancon 100, Zebron, or approved equal.

2.22 *Backfill Material*

- A. Backfill material shall be as indicated on the Drawings and in accordance with Section 31 23 17, Trenching, Excavation, Backfill and Compaction.

Part 3 — Execution

3.01 *General*

- A. Manholes shall be constructed in accordance with Standard Drawing Nos. S-1A, S-1B, S-5, S-8A, and S-8B.

- B. Manholes and precast vaults shall be built without steps or ladders. Flattop manholes shall only be used in locations specifically shown on the Drawings.
- C. Repair of coatings and linings shall be made with the same material to a minimum thickness equal to the thickness of the original coating or lining on the pipe in accordance with stated manufacturer's recommendation.
- D. The Contractor shall be responsible for notification of the local residents a minimum of seven (7) days prior to the commencement of any work in the immediate area. Notices to the local residents will be supplied by the District. The Contractor shall be required to complete the notice as to the date the work that will be performed and deliver a copy to each residence within the affected area. All costs associated with the notification of the residents shall be borne by the Contractor.
- E. The Contractor is responsible for traffic control and it shall include all material, labor and equipment to provide safe and effective work areas to warn, control, protect and expedite vehicular, bicycle and pedestrian traffic. Unless otherwise required by the Contract Documents, all work and material provided under this section shall be performed or furnished in accordance with SSPWC Part 6 Temporary Traffic Control and the entity (City, County, State, etc.) having jurisdiction. Traffic control shall also be in accordance with Section 33 11 00, Basic Pipeline Specifications.

3.02 *Excavation and Backfill*

- A. As indicated on the Drawings and conform to applicable portions of Specification Section 31 23 17 Trenching, Excavation, Backfill and Compaction.
- B. If required by CVWD, backfill around manholes shall be 1½-sack cement sand slurry.
- C. Unless otherwise specified in the Contract Documents: for trenches installed in paved areas, backfill material should be placed and compacted in horizontal lifts to a relative compaction of at least 90 percent as defined by the ASTM D1557. In non-paved areas, the backfill may be compacted to at least 85 percent relative compaction. Backfill material should be placed at or slightly above the optimum moisture content as defined by ASTM D1557. The appropriate lift thickness of the backfill will depend on the compaction equipment used but generally should not exceed a thickness of eight inches of loose placed material. Special care should be taken to avoid damaging the pipe when compacting trench backfill above the pipe.
- D. Trench resurfacing shall be subject to the requirements of the governing encroachment permits. Private streets and alleys shall be reconstructed by the Contractor to the same dimensions and with the same type of materials used in the original work.

3.03 *Paving*

- A. Pavement removal and replacement for all excavations necessary for the construction or repair of manhole shall conform to Specification Section 31 23 17 Trenching, Excavation, Backfill, and Compaction and as specified on the Drawings.

3.04 *Concrete Bases*

- A. Manhole bases shall be poured in place to the form and dimensions shown on the Contract Documents. Manhole locations are fixed and cannot be moved or relocated from locations shown on the Drawings to accommodate pipe manufacturing or laying. If necessary, special lengths of pipe shall be provided to meet manhole location requirements.
- B. All concrete manhole bases shall be formed and poured on a granular base (12 inches minimum) having the same thickness as the bedding under the sewer on which the manhole base is being built. Place and thoroughly compact base with a mechanical or power vibrating tamper. Compacted to a relative compaction of ninety percent (90%) per ASTM D1557 and ASTM D2922. The Contractor shall not deviate from plan dimensions notwithstanding over-excavation or other detrimental field conditions in accordance with Section 31 23 17, Trenching, Excavation, Backfill and Compaction, unless approved by the District.
- C. That portion of the base above the invert elevation of the sewer pipe shall be shaped with metal forms (no hand forming allowed) to provide a smooth channel section as indicated in the Contract Documents. The radius of the channel shall be no less than the internal radius of the inlet pipe. The forms shall be checked and accepted by the District for accuracy of dimensions and relative smoothness prior to pouring of the base. The concrete shall be vibrated while it is being poured into the form. Channels shall be smooth, accurately shaped, and vary uniformly in size and shape from inlet to outlet for changes in pipe size, if required. The manhole base shall be poured as one monolithic pour. Benching shall be broom finished to provide a non-skid surface.
- D. A metal forming ring shall be used to form a level joint groove in fresh concrete of the manhole base to receive the precast barrel section of the manhole. The metal forming ring shall be removed after the concrete has sufficiently set to eliminate any slump in the joint groove.
- E. Construct concrete base in conformance with the details shown on the Drawings. Vibrate to densify the concrete and screed so that the first precast manhole section to be placed has a level, uniform bearing for the full circumference.
- F. Form a Key lock joint in the base and place cement mortar, or install three beads of plastic sealing, at the joint to assure watertight seal between base and manhole wall. First section shall be properly located and plumb.
- G. If material in bottom of trench is unsuitable for installation of the manhole, excavate below the flow line and backfill to required grade with gravel.

3.05 *Placing Precast Manhole Shaft Sections*

- A. Clean ends of sections of foreign materials. The Key lock joint between precast concrete shaft units, including the joint with the cast-in-place concrete base, shall be filled with plastic sealing compound conforming to ASTM C990, to make a watertight

joint, in accordance with Standard Drawing S-5. Sections of various heights shall be set perfectly plumb and used to bring the top of the manhole ring and cover to the required elevation.

B. Wrap section joints in strict accordance with the manufacturer's instructions.

3.06 *Manhole Invert*

A. Construct manhole inverts in conformance with details shown on the Drawings, and with smooth transitions to ensure an unobstructed flow through the manhole. Remove all sharp edges or rough sections which tend to obstruct flow. Where a full section of pipe is laid through a manhole, saw cut and break out the top section as indicated and cover exposed edge of pipe completely with mortar. Trowel all mortar surfaces smooth.

3.07 *Flexible Joints*

A. Furnish and install two (2), each 2-foot long, pipe joints from all manhole walls per Standard Drawing No. S-5. Lay pipes entering manhole connections on firmly compacted granular base to undisturbed earth. Base materials shall be as previously specified.

3.08 *Pipe Connection to Manholes*

- A. In laying pipe next to structures, the pipe at the horizontal axis shall not project beyond the inside of the wall of the structure except that portion used as a channel invert, and in no case shall the bell/socket of a pipe be built into the wall of a structure.
- B. Install pipe stub-outs in manholes for future sewer connections as shown on the Drawings or as required by the District. Grout pipes in precast walls or manhole base to provide watertight seal around pipes. Construct invert channels in accordance with details shown on the Drawings.
- B. All stubs shall be plugged with a factory made stopper at the socket end per manufacturer's recommendations. Brick and mortar plugs may be used on stubs greater than 21 inches in diameter. Plugs shall be capable of withstanding all internal, external, and test pressures without leakage. Plugs shall be braced as necessary during testing to prevent dislodging.

3.09 *Permanent Plugs*

A. Clean interior contact surfaces of all pipes to be cut off or abandoned as shown. Construct concrete plugs or factory-made stoppers at the end of all pipes 18 inches or less in diameter. Minimum length of concrete plugs shall be 8 inches. For pipe 21 inches and larger, the plugs may be constructed of common brick or concrete block. Plaster the exposed face of block or brick plugs with mortar. All plugs shall be watertight and capable of withstanding all internal and external pressures without leakage.

3.10 *Manhole Extensions*

- A. Install extensions in conformance with the details shown on the Drawings, and to height determined by the District. Seal grade ring joints with mortar as required for final leveling. Seal remaining exterior joints and interior joints of unlined manholes with mortar. Extensions shall be watertight.
- B. Repair of manhole lining shall be as shown on the Drawings.

3.11 *Manhole Frames and Covers*

- A. Install frames and covers on top of manhole to positively prevent all infiltration of surface or groundwater into manholes. Frames shall be set in mortar on top of grade rings in unlined manholes. Frames rest directly on the formed piece of PVC liner in PVC-lined manholes as shown on the Drawings. Set frames so that tops of covers are flush with surface of adjoining pavement unless otherwise shown or directed.
- B. The elevation at which manhole frames and covers are to be set shall be per Standard Drawing Nos. S-1A and S-1B, as shown on the Drawings, and/or as directed by the District.
- C. The frames and covers shall be cleaned of all foreign materials and to a fine appearance and fit. All costs for installing manhole frame and cover sets in place as described herein, including all necessary concrete work, shall be included in the applicable contract price.

3.12 *Manhole Adjustment to Grade*

- A. After compacting the soil around manholes in roadways and pavement is installed, excavate neatly to the required depth and distance out from the frame for access to grade rings for final leveling.
- B. Make the adjustment with mortar between the first and second grade rings.
- C. Fill the excavation with asphalt or rapid set concrete to form a collar around the exterior perimeter of the manhole frame and grade rings as shown on Standard Drawing Nos. S-1A and S-1B.
- D. Complete or repair the manhole liner installation. Make the final weld to the topmost PVC section mounted under the frame for PVC-lined systems. Apply polyurethane coating as required by CVWD for manhole repairs to all exposed concrete below the frame for polyurethane-lined systems.

3.13 *Manhole over Existing Sewers*

- A. Construct manhole over existing operating sewer lines at locations shown in accordance with Standard Drawing Nos. S-1A, S-1B, S-5, S-8A or S-8B, as applicable and elsewhere in the Contract Documents. Perform necessary excavation as specified above around existing line and construct manhole.

- B. Maintain flow through existing sewer lines at all times, and protect new concrete and mortar work for a period of seven (7) days after concrete has been placed. Contractor shall notify the District fourteen (14) days in advance and shall provide the District with a bypass plan for review as specified herein. After the District accepts the proposed plan the Contractor may begin work. District's acceptance shall not relieve Contractor of responsibility for maintaining adequate capacity for flow at all times and adequately protecting new and existing work.
- C. Construct the new base under the existing sewer and the precast sections as specified herein.
- D. Break out the existing pipe within the new manhole, cover the edges with mortar, and trowel smooth. Install liner as necessary to cover all exposed concrete. Pipe breakout shall take place only under direct inspection CVWD's Representative and only after the manhole and sewer have been completed and cleaned. The Contractor shall be required to have an experienced sewer maintenance Contractor if, in the opinion of CVWD, excessive amounts of cuttings or debris have entered the sewer. All equipment and materials shall be securely fastened by a rope at all times while in a manhole.

3.14 *Replacement of Existing Manholes*

- A. When replacing an existing manhole the existing sewer line shall be protected in place or replaced as necessary for the installation of the manhole and as indicated on the Drawings. The portion of the manhole bottom to be constructed shall be removed to a depth sufficient to permit construction of new channels and shelves with concrete at least four (4) inches below the outside of the bell. When a manhole is to be constructed on an existing sewer, the manhole shall be constructed in accordance with Detail Drawing Nos. S-1A, S-5, S-8. Sewage shall be pumped around the manhole per Contractor's wastewater bypass plan. Sewage shall not be permitted to flow over new concrete until they are seven (7) days old.
- B. When new work is to be constructed inside a sewage structure against an existing concrete surface that has been exposed to sewage or a sewage atmosphere, the existing surface shall be prepared as follows:
 - 1. Soft and loose materials shall be removed and the surface cleaned by sandblasting.
 - 2. The surface shall be washed with a three percent solution of soda ash (Na_2CO_3) followed by a rinsing with clear water.
 - 3. The surface shall then be washed with a three percent solution of hydrochloric acid (HCl) followed by a final rinsing with clear water.

3.15 *Connection to Existing Manhole*

- A. To use an existing stub, ensure that lateral enters the stub at the slope of ¼-inch per foot. Remove the plug and install new pipe in the socket.

- B. If no usable stub exists, core drill through the manhole base and install a new stub in accordance with the Drawings and CVWD Standard Drawing No. S-5.
- C. If manhole is PVC lined, after core drilling, install the PVC turn-back, position the pipe in the hole, and grout in place. Repair the PVC liner and attach the turn back.
- D. If manhole is polyurethane or epoxy lined, after core drilling repair the lining as shown on the Drawings.
- E. Maintain flow through existing sewer lines at all times, and protect new concrete and mortar work for a period of 7 days after concrete has been placed. Contractor shall notify the District fourteen (14) days in advance and shall provide the District with a bypass plan for review as specified herein. After the District accepts the proposed plan the Contractor may begin work. District's acceptance shall not relieve Contractor of responsibility for maintaining adequate capacity for flow at all times and adequately protecting new and existing work.
- F. For laterals that are not at the proper elevation, create a drop manhole per Standard Drawing S-8A only upon acceptance by the District. Penetrating the manhole riser wall directly for a lateral is not acceptable.

3.16 *Plastic Lining for Concrete Structures*

- A. Where designated on the Drawings or in the Contract Documents, manholes shall be provided with interior plastic lining. Precast vertical risers and cones shall be completely lined. The entire circumference of the manholes and manhole bench shall be covered with the plastic lining with the longitudinal edges of the lining joined with an overlapping flap or 4-inch wide strip and welding strips. Manhole channel shall also be covered except for lowest 90 of channel invert. Welding shall provide a continuous joint equal in corrosion resistance and impermeability to the liner material.
- B. All Work in connection with the installation of the plastic lining in precast manhole sections and concrete pipe shall be performed in strict conformity with the lining manufacturer's recommendation. Liner sheets shall be fastened in place securely in the forms for the manhole sections and concrete pipe before reinforcing steel or concrete is placed.
- C. Care shall be taken in handling and transporting plastic lined manhole sections and pipe to prevent damage to the liner. No interior hooks or other interior lifting device shall be used in handling the manhole sections and pipe; all handling requiring lifting or suspension shall be done by using exterior slings. No manhole sections or pipe with damaged lining will be accepted until and unless the damage has been repaired to the satisfaction of the District.
- D. Walls of Cast-in-Place Structures. Plastic sheets for wall linings shall be set and properly secured to the concrete contact faces of the forms which form the surfaces to be lined. The sheets shall be placed with the smooth face next to the form and so that the line of tees on the back side of the sheets will be vertical in the walls. The sheets

shall be butt jointed without more than 1/8 inch opening in any joint between adjacent sheets and the sheets held in place with small-headed finishing nails placed within ¼ inch of the edge of the sheets. After all sheets are in place on the form being lined, the joints between sheets shall be sealed on the back side with a one inch wide welding strip heat-welded over the joints. A termination strip shall be provided at the intersection of the walls and bottom slab or one inch below top of concrete fill.

- E. Where possible, the form to be lined shall be set in place, the lining attached, and all lining joints covered before the reinforcing steel is installed. The outer form shall then be set in place and the form ties installed through the liner in the normal manner. The number of form ties used shall be held to the minimum.
- F. The lining installation and sealing shall be such that a continuous plastic lining is provided and that entrance of concrete or mortar between the lining and the form is prevented.
- G. Forms shall be removed in a careful manner and not before the concrete has attained sufficient strength and has been properly cured. Finishing nails used to hold the liners in place on the forms may pull out with the forms but if not, shall be removed afterwards. The small nail heads should come through the plastic liner sheet easily.
- H. After the forms have been removed, the exposed butt joints in the liner, including nail and form tie holes, shall be sealed with welding strip, heat-welded over the areas involved. Sealing shall be such that a continuous plastic lining is provided. Workmanship shall be neat and of the highest quality.
- I. Ceiling of Cast-in-Place Structures. Plastic sheets for the ceiling surface shall be set properly secured, and joints sealed in accordance with the requirements specified above for wall surfaces, and other requirements as may be required to conform to the manufacturer's accepted instructions and recommendations.
- J. Repairs. All repairs to damaged portions of the linings shall be made and all holes in the linings sealed before final acceptance of the work, in conformity with the lining manufacturer's instructions and recommendations. The requirement for neat, high quality work is emphasized.
- K. Testing. All surfaces covered with the lining shall be tested with a manufacturer recommended and CVWD accepted electrical holiday or flaw detector after installation and any imperfections discovered thereby shall be repaired as specified above and Article entitled "Testing and Repair of Plastic Lining" of this Specification.

3.17 *Field Joints in Plastic Lining*

- A. The joint between plastic lined pipes or manhole sections shall be prepared in the following manner before making the lining joints:
 - 1. The inside joint shall be filled and carefully pointed with cement mortar for the full circumference of the pipe or manhole section. The mortar shall not, at any point,

extend into the pipe or manhole section beyond a straight line connecting the surfaces of the adjacent pipe or manhole sections.

2. No lining joint shall be made until after the trench has been backfilled. Pipe and manhole joints must be dry before lining joints are made. All mortar and other foreign material shall be removed from lining surfaces adjacent to the pipe or manhole joint.
- B. Field joints in the lining at pipe or manhole joints may be either of the following described types:
1. The joint shall be made with a separate 4-inch wide joint strip and two, 1-inch wide welding strips. The 4-inch strip shall be centered over the joint, secured to the lining with a manufacturer approved adhesive compound and welded along each edge to adjacent liner sheets. The width of the space between the ends of pipe lining material shall not exceed 2-inches. The 4-inch joint strip shall overlap the lining in each pipe a minimum of 1 inch.
 2. The joint shall be made with a lining flap extending about three inches beyond the spigot end of the pipe. One welding strip is required. The joint flap shall overlap the lining in the adjacent pipe a minimum of one inch. A manufacturer approved adhesive compound shall be used to hold the flap in place during welding. The flap shall be protected from damage during installation. Excessive tension and distortion in bending back the strip to expose the pipe joint during laying and joint mortaring shall be avoided.
 3. All joints between pipe and wall fittings in manholes and between wall fitting and lining of manhole walls, where lining is required, shall be made by one of the two ways described above.
 4. All welding of joints and the adhesive compound shall be in strict conformity with the recommendations of the lining manufacturer.

3.18 *Testing and Repair of Plastic Lining*

- A. After the pipe, manhole, or special structure is installed and backfilled, all surfaces covered with plastic lining, including welds, shall be tested with an electric holiday detector. The voltage and specific methods of testing shall be as recommended by the manufacturer of the lining material. In addition, all welds shall be physically tested by non-destructive probing. All patches over holes, or repairs to the liner wherever damage has occurred, shall be installed in conformity with the instructions and recommendations of the liner manufacturer. Each transverse welding strip which extends to a lower edge of the liner shall be tested. The welding strip shall extend 2 inches below the liner to provide a tab. Force shall be applied normal to the face of the structure by means of a spring balance. Liner adjoining the welding strip shall be held against the concrete during application of the force. The 10-pound pull shall be maintained if a weld failure develops, until no further separation occurs. Defective welds shall be retested after repairs have been made. Tabs shall be trimmed away neatly

after the welding strip has passed inspection. Inspection shall be made within two days after joint has been completed.

3.19 *Manhole Epoxy Lining*

A. General

1. The application of epoxy liners and primer shall be performed by workmen approved by the manufacturer as trained and experienced in applying these types of lining materials.
2. All coating work shall be in accordance with Section 09 90 00.10, Sewer Painting and Coating.

B. Surface Preparation:

1. Concrete surfaces shall be allowed to age for 28 days prior to application of polyurethane lining system.
2. Meet requirements of SSPC SP 13.
3. Remove grease, oil, dirt, salts or other chemicals, loose materials, or other foreign matter by solvent, detergent, or other suitable cleaning methods.
4. Brush-off blast clean to remove loose concrete and laitance, and provide a tooth for binding.
5. Secure coating manufacturer's recommendations for additional preparation, if required, for excessive bug holes exposed after blasting.
6. Unless otherwise required for proper adhesion, ensure surfaces are dry prior to painting.

C. Application:

1. Application shall be in strict accordance with manufacturer's recommendations. The minimum and maximum required times between coats shall be per the manufacturer's product data sheet.

D. Coating System:

1. The coating system shall be applied in one or two coats to a total dry film thickness of 80.0 mils (minimum) for the system.

E. Repair:

1. All holidays found shall be marked and patched by hand troweling and in accordance with Section 09 90 00.10, Sewer Painting and Coating.

3.20 *Manhole Polyurethane Lining*

A. General

1. The application of polyurethane liners and primer shall be performed by workmen approved by the manufacturer as trained and experienced in applying these types of lining materials.
2. All coating work shall be in accordance with Section 09 90 00.10, Sewer Painting and Coating.

B. Surface Preparation

1. Concrete surfaces shall be allowed to age for 28 days prior to application of polyurethane lining system. Surfaces shall be cleaned of dirt, dust, form oil, curing compounds and other deleterious compounds in accordance with Steel Structures Painting Council SSPC-SP7-63 (sweep blasting) on new concrete; and in accordance with SSPWC 500 (pipeline system rehabilitation) on existing concrete cleaning with water blasting using high pressure hydro blast at a minimum pressure of 8,000 psi with a flow of 10 gallons per minute.
2. Following surface blasting, the voids in the concrete greater than 3/16-inch in diameter or depth shall be filled by an approved sacking method where excessive porosity exists. The sacking will be performed in such a manner so as to fill only the voids while wiping clean any excess material on the concrete surface.

B. Priming or Sealing

1. Upon completion of surface preparation, the concrete surface shall be completely blown down using clean, dry, compressed air to remove all dust and loose particles or washed down using clean, fresh water. The concrete surface shall be completely dry before application of the primer, sealer or liner.
2. An epoxy primer shall be applied to the surface at a thickness of 2 mils dry. The primer shall be applied in such a manner that the concrete surface is completely saturated with the primer. Upon sufficient cure time (12 hours at 70 degrees Fahrenheit), the liner may be applied. The primer shall not be applied when ambient temperatures are below 40 degrees Fahrenheit or when ambient temperatures are above 115 degrees Fahrenheit. When concrete surfaces contain abnormal porosity, a second coat of primer may be needed. If this is the case, the application procedures for the second coat of primer are identical to that of the first coat of primer.

C. Liner

1. The coating application shall be performed only by workmen trained and experienced with the specified material. The lining shall be applied by high pressure airless equipment approved by the lining manufacturer. The equipment shall be in good working order to insure correct proportioning and mixing of the components. After priming has been completed, the approved polyurethane liner shall be applied to a thickness of 125 mils (1/8") in one continuous coat, without seams, free from any holes or defects. During the lining application, the

Contractor shall take wet gauge thickness readings as required to insure correct lining thickness. The finished coating shall be free from porosity, without bubbles or pinholes and uniform in color. All areas in question shall be removed and reworked to the satisfaction of the District.

2. All holidays found shall be marked and patched by hand troweling and in accordance with Section 09 90 00.10, Sewer Painting and Coating. Application of the lining shall not take place when exposed to rain, fog or high winds. It is the Contractor's responsibility to ensure protection of the work from the above-mentioned conditions.

3.21 *Vault Polyurethane Lining*

A. General

1. The application of polyurethane liners and primer shall be performed by workmen approved by the manufacturer as trained and experienced in applying these types of lining materials.
2. All coating work shall be in accordance with Section 09 90 00.10, Sewer Painting and Coating.

B. Surface Preparation:

1. Surface preparation shall be SSPC SP-13 for concrete surfaces.

C. Application:

1. Application shall be in strict accordance with manufacturer's recommendations.

D. Coating System:

Unless otherwise noted 100% solids polyurethane system for concrete surfaces. A total dry film consisting of the combined thickness of both a prime coat and finish coat as described herein shall be 50 mils (minimum).

1. Prime Coat: Apply to a dry-film thickness of 2 mils (minimum).
2. Finish Coat: Apply one coat to achieve the total dry-film thickness.

E. Repair:

1. All holidays found shall be marked and patched by hand troweling and in accordance with Section 09 90 00.10, Sewer Painting and Coating.

3.20 *Sewage Bypass*

- A. The Contractor shall prepare a bypass plan and control the flow in accordance with Section 31 23 19.10, Sewer Bypass System and as required by the Contract Documents. A sewage bypass plan shall be submitted to CVWD for approval prior to construction. The Contractor shall at all times, be responsible for the operations of this

bypass system, including furnishing all the necessary equipment and making arrangements to obtain power as required. The Contractor shall not be permitted to trench public or private streets for bypass purposes without the approval of the entity (State, County, City, etc.) having jurisdiction.

3.22 *Precast Concrete Vault*

- A. Install precast concrete vault at the locations shown on the Drawings, as close to the right-of-way line as possible, or as directed by the District. Provide necessary excavation and backfill as specified herein.
- B. The Contractor shall prepare an excavation large enough to accommodate the outside dimensions of the vault as shown on the drawings. Prior to setting, the Contractor shall provide a minimum of 16 inches of 3/4-inch crushed rock in accordance with Detail Drawing No. S-40A to receive the vault. The base shall be compacted (compacted to a relative compaction of ninety percent (90%) per ASTM D1557 and ASTM D2922) and graded level and at proper elevation to receive the vault in relation to the conduit grade or ground cover requirements as designated in the Drawings.
- D. Sealants used between the joints of the vault sections are at the Contractor's discretion, unless otherwise specified. If grout is used, it should consist of two parts plaster sand to one part cement with sufficient water added to make the grout flow under its own weight. The grout should be poured into a water soaked groove, and filled to the top of groove in the previously set section. If mastic joint compound is used, it should be placed at the bottom of the groove unless a double amount is to be used as a further precaution against leakage. In this case the mastic sealant should be placed on the two shoulders of the groove.
- E. The interior of the concrete vault and underside of cover shall be coated with 50 mils (DFT) of high build polyurethane, Sancon 100 polyurethane and primer or approved equal in accordance with Section 09 90 00.10, Sewer Painting and Coating.

3.23 *Testing*

- A. Testing shall be performed for all new or retrofitted manholes in accordance with Section 33 01 30.13, Sanitary Sewer System Testing unless otherwise noted, or unless those manholes are in service. Manholes that are not vacuum or hydrostatically tested shall be visually inspected for infiltration.

3.24 *Manhole Repair*

A. General

- 1. The Contractor shall perform all concrete, mortar, gunite, grout and lining repair; installation of new liner, frame and cover; adjustment to grade; and paving as necessary for a complete repair of manholes as indicated on the Contract Documents. All work shall be performed without restriction or interruption of sewer flows. Detailed plans shall be submitted by the Contractor prior to the beginning of

construction, showing the type of any proposed or required bypass systems to be used.

2. It is the responsibility of the Contractor to take adequate measures to ensure that no debris is allowed to enter the sewer. If at any time debris does enter the sewer, the Contractor shall clean the sewer to a point downstream as determined by and to the satisfaction of CVWD. All costs for cleaning the sewer to remove the debris that was allowed to enter the sewer shall be borne by the Contractor. Existing rings and covers shown to be replaced shall be broken and disposed of by the Contractor in the presence of the District.

B. Surface Preparation

1. All interior surfaces shall be water blasted to remove all deteriorated brick, concrete, or any existing coating until a solid structure of brick or concrete is exposed. All grease and attached residue shall be removed during the surface preparation. Water blasting shall be performed with a high-pressure water blaster with an adjustable pressure range of 5,000 to 8,000 psi. Debris from water blasting shall not be allowed to enter the sewer. Provide additional surface preparation in accordance with the Articles entitled "Plastic Lining for Concrete Structures" and "Polyurethane Lining" of this Specification.

C. Leak Stoppage

1. Prior to the application of the mortar-leveling course for any liner, the Contractor shall stop all leaks in the structure. The method for stopping the leaks shall be the Contractor's option as accepted by CVWD. CVWD's Representative shall not be responsible for any method or procedure that fails to stop leaks.

D. Mortar Application

1. Preparation of the existing surfaces shall be accepted by the District before application of the mortar-leveling course. Mortar or gunite shall be applied to remove all surface irregularities and to provide a smooth surface on which to apply the liner. All surfaces shall be as dry as possible prior to the installation of the liner. Provide mortar leveling in accordance with the Articles entitled "Plastic Lining for Concrete Structures" and "Polyurethane Lining" of this Specification.
2. A mortar-leveling course shall be required on all brick manholes. A mortar-leveling course is not required on precast concrete manholes unless indicated otherwise.

3.25 *Marker Posts*

- A. Locate and install marker posts in accordance with CVWD Standard Drawing S-38 and Section 10 10 10, Utility Marker Post, as directed by CVWD's Representative.

END OF SECTION 33 05 13

SECTION 33 05 17.1
IRRIGATION FLOW METER

PART 1 General

1.01 Description

Contractor shall furnish the flow meter, piping, fittings, miscellaneous materials, equipment, and labor to install the irrigation flow meter and appurtenances as specified by the Owner's Approved Drawings. Design drawings shall consist of construction drawings, standard drawings, detailed drawings, shop drawings, and all clarifying diagrams and/or sketches.

The scope of this project shall include: traffic control, utility location and verification, site preparation, earthwork and excavation, dewatering if necessary, bedding, backfilling, furnishing and installation of the flow meter, pipe, fittings, and appurtenances. The site area shall be returned to pre-construction conditions including finishing all grading, replacing concrete, replacing asphalt, and replacing all landscaped materials.

Upon completion of meter construction and appurtenances required herein, the contractor shall initially operate all components furnished and installed, and make any additional adjustments, corrections, repairs, replacements, and reconstructions necessary to provide the Owner with a complete and functional operating flow meter system.

1.02 Submittals

Complete fabrication, assembly, and installation drawings, together with details and data governing materials used and other accessories furnished, shall be submitted for approval in accordance with Article 6 of Section 00 72 13. Data shall include, but not be limited to, the following:

AWWA Standard C704-02 for the flow meter. The meter reader must provide an instantaneous flow rate indication and a totalization of volume output. The flow meter unit must feature mechanically driven indicator-totalizer and solid state construction. The indicator transmitter must also be able to mount remotely within a vault for ease of reading. Accuracy of the device must be plus or minus 2.0 percent of actual flow within the range specified for each meter size.

Contractor shall, in addition to furnishing other data herein required, submit three signed and dated copies of the list of materials to be used in meter assembly installation which include the meter, piping and appurtenances.

PART 2 Products

2.01 General

A. Construction Materials:

Contractor shall furnish only approved materials as listed in the Owner's approved materials list. All materials shall be new and of the best quality for their intended use. All like materials shall be of one manufacture for any particular project.

2.02 Irrigation Flow Meter

A. Flow Meter:

Irrigation flow meters furnished and installed under these Specifications shall conform to applicable AWWA Standard C704-12 (latest), as modified herein, by the Drawings, or by Owner.

Flow meter shall be a 150 psi flanged tube propeller type meter with sealed meter mechanism and magnetic drive sealed totalizer. The meter shall be constructed of materials that meet or exceed AWWA Standard C704-02. Flanged ends are 150 lb. AWWA class D flat face steel flanges. The accuracy of the meter must be plus or minus 2 percent of actual flow within the range specified for the meter size.

Indicator totalizer-transmitter must be solid state construction with current or pulse rate output. The output reader must provide an instantaneous flow rate indication and a totalization of volume output. The unit features mechanically driven indicator-totalizer and solid state construction. Indicator must also be able to mount remotely with in a vault for ease of reading. Accuracy of the device must be plus or minus 2.0 percent of actual flow within the range specified for each meter size.

All meters shall be manufactured by an organization which has had not less than 10 years successful experience in the manufacture of the type of pipe specified. Owner shall approve manufacturer's product before its use.

The inline flow meter shall be installed in a concrete vault with a two-piece traffic rated spring assisted lid as show on the Drawings. The flow meter is a flanged type with straightening vanes which reads in cfs with a totalizer in acre-feet. The flow meter is to be installed with a minimum of 5 pipe diameters upstream and 2 pipe diameters downstream of any valves, fittings, or other obstructions. The flow meter is to be equipped with a remote read that will be mounted just below the cover with enough clearance to open the reader cover. A minimum 6-inch by 6-inch, hinged opening shall be cut in the vault cover to access the meter reader. See Detail Drawing I-47 for standard layout.

B. Testing:

Flow meter shall be tested inclusive with all piping at a hydrostatic pressure test of 50 psi.

C. Manufacturing Inspection and Certification:

Owner shall at all times have the right to inspect and reject all work and materials in the course of manufacture. Manufacturer shall furnish Owner reasonable facility for obtaining such information as he may desire regarding the progress and manner of the work and the character and quality of materials used.

D. Defective or Damaged Material:

The meter shall be carefully inspected for defects. Any meter found to be defective in workmanship or material or so damaged as to make repair and use impossible shall be rejected and removed from the job site.

PART 3 Execution

3.01 *Meter Installation*

A. Pipelines and Appurtenances:

Pipelines and appurtenances shall be constructed in accordance with these Specifications and the Drawings, and as specified by the Owner.

3.02 *Field Test and Leakage Test*

A. Field and Leakage Test:

Hydrostatic and leakage testing shall be performed in accordance with Section 331400. The meter shall be bench tested by the manufacturer for accuracy and readability upon request by the Owner's Representative.

END OF SECTION 33 05 17.1

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33 05 23.10
OPEN TRENCH PIPE CASING

PART 1 General

1.01 *Description*

This section includes materials for and installation of open trench pipe casings.

1.02 *Service Application*

Generally, pipe casings are used for the protection of CVWD facilities (carrier pipes) and may also be installed for future utility purposes. Pipe casings shall be used for the installation of potable water, non-potable water, sewer mains, agriculture irrigation line, agricultural drain line and where shown on the Approved Drawings or as required by CVWD.

1.03 *Design Requirements*

Pipe casings shall be provided for carrier piping where shown on the Approved Drawings or as required by CVWD. The sizes and material type for pipe casing shall be as detailed in Part 2 of this Section.

The Owner's Representative may select a greater steel thickness and diameter as appropriate for the intended application.

1.04 *Submittals*

If required by the Owner's Representative, the following items shall be submitted to CVWD for review and approval prior to the start of the casing work:

The pipe casing material to be used include casing material type, thickness, and welding details.

Casing spacers and end seals.

Installation procedure.

Welding procedure.

Epoxy coating repair procedure as recommended by manufacturer.

Cathodic Protection.

PART 2 Materials

2.01 Steel Pipe Casing

Steel pipe casing diameter and casing wall thickness shall be in accordance with the Approved Standard Drawings.

Steel pipe casings, unless otherwise approved by CVWD, shall be butt welded sheets (spiral welding of pipe not allowed) conforming to ASTM A 36/A 36M, ASTM A 283/ A 283M, Grade D, or ASTM A 568/A 568M, Grade 33. Other steel grades may be used upon approval of the Engineer.

2.02 Epoxy Coating for Steel Casing

This specification covers the requirements for the plant application of fusion bonded epoxy coatings to steel pipe casings. The epoxy coated steel pipe casing shall be used in locations where both open trench excavation and jack and bore operations are utilized for construction. The coating shall be placed on the outside and inside of the steel casings.

Epoxy coating for steel pipe casing shall be selected from the Approved Materials List. Standard products of manufacturers other than those shown on the Approved Materials List will only be accepted when it is proved to the satisfaction of the Owner's Representative they are equal in composition, durability, and usefulness for the purpose intended.

The Contractor shall perform the work in accordance with the latest editions of the following Steel Structures Painting Council (SSPC) publications.

2.03 Surface Preparations

Prior to blast cleaning, surfaces shall be inspected and pre-cleaned according to SSPC-SP1 to remove oil, grease and loosely adhering deposits.

The exterior pipe surface shall be blast cleaned to SSPC-SP10 near-white finish using steel grit or steel grit-shot mixture after pre-heating of pipe to sufficient temperature to remove all moisture.

The abrasive cleaning media shall be selected to achieve an anchor profile of not less than 1.5 mils or more than 4.0 mils.

Any raised slivers, scabs, laminations or bristles of steel remaining on the newly cleaned surfaces, including on welds, shall be removed using abrasive grinders or hand filing. Care shall be taken not to destroy the anchor pattern.

Prior to coating, the cleaned pipe shall be inspected to ensure that all cleaning steps have been adequately performed. Presence of contaminants shall be cause for rejection of the surface preparation.

2.04 *Coating Materials*

The coating shall be comprised of 100 percent pure thermosetting epoxy coating powder. The coating shall be applied in a multi-step process to a common maximum of three coats. The first and second coats (undercoat) shall consist of a one part Epoxy Coating, heat curable, coating designed for corrosion protection of pipe. The third coat (topcoat) shall consist of Epoxy Coating.

The steel casings that will be jacked shall include a three coat epoxy system. The steel casings installed by trench excavation shall include a two coat epoxy system with no topcoat. On the inside of both steel casing applications, the Contractor shall apply the two coat epoxy system.

The undercoat material shall be selected from the Approved Materials List and applied to the prepared steel surfaces in two coats to a maximum of 12 to 16 mils by electro-static spray in strict accordance with the manufacturer's written instructions.

The topcoat material shall be selected from the Approved Materials List and applied over the gel coat cycle of the undercoating in one coat to a maximum of 15 to 30 mils by electro-static spray in strict accordance with the manufacturer's written instructions.

After the electro-static application, the coatings shall be cured in accordance with the written instructions of the manufacturer.

2.05 *Casing Spacers*

The casing spacers shall be stainless steel insulator selected from the Approve Materials List. The spacers shall have 2-inch wide runners and the height shall provide a 1-inch clearance above the mechanical pipe joint restraint system.

2.06 *Casing End Seals*

The end seals should be 1/8 inch thick synthetic rubber with stainless steel bands for securing the end seal to the steel casing and PVC pipe. The end seal shall be selected from the Approved Materials List. In areas where groundwater is present in the pipe zone, a concrete thrust block will be installed around the end seal. An 8-inch thick brick and mortar bulkhead may be substituted for the synthetic rubber end seal when approved by the Owner's Representative.

2.07 *Polyethylene Materials*

A polyethylene sleeve shall be placed around the steel casing that will be placed under the open trenching method to serve as additional protection against corrosion. Polyethylene sleeves shall be a minimum 8 mil (0.008 inches) thick in accordance with AWWA 105.

PART 3 Execution

3.01 Trench Excavation, Backfill and Compaction

Trenching, bedding, backfilling and compaction operations shall be performed in accordance with Section 31 23 17.

3.02 Dewatering

The Contractor shall provide and maintain at all times during construction ample means and devices to promptly remove and dispose all water from any source entering trench excavations or other parts of the work in accordance with Section 31 23 19. Any damage caused by flooding of the trench shall be the Contractor's responsibility.

Dewatering shall be performed by methods that will maintain a dry excavation, preservation of the final lines and grades and protection of all utilities. If flooding of the trench does occur, the Contractor shall immediately dewater and restore the trench. Damaged or altered pipeline appurtenances or trench materials shall be repaired or replaced as directed by the Owner's Representative.

3.03 Pipe Casing Installation

Installation of pipe casing and carrier pipe shall be as described below and in accordance with the Approved Standard Drawings.

Pipe casing shall be installed in an open trench type excavation.

Pipe casings shall be lowered onto the bedding of the proper lines and grades called for on the Approved Plans.

Pipe casings shall have firm bearing along their full length.

Steel casing sections shall be joined by full-circumference butt welding in the field. Steel casing shall have all areas of damaged coating repaired.

Carrier pipe shall be pushed into the casing incorporating the use of casing spacers as described below.

Ductile-iron carrier pipe joints shall be fully restrained.

Upstream and downstream elevations of the carrier pipe shall be verified prior to installing the end seals.

The portion of carrier pipes installed within casings shall have pressure, leakage, and infiltration testing completed in accordance with Section 33 14 00 prior to installation of the end seals.

The annular space between the carrier pipe and casing for domestic water non-potable force mains that carry product shall not be filled with any material unless otherwise noted on the Approved Plans. The annular space between the carrier pipe and casing for gravity flow pipe systems, when constructed below the water table, shall be backfilled with gunite sand as approved by the Owner's Representative.

3.04 *Casing Spacers*

Casing spacers shall be used to prevent the carrier pipe bell from touching the casing and to maintain a uniform space between the carrier pipe and casing interior. A minimum of three casing spacers shall be installed, equally spaced, on each carrier pipe section at intervals recommended by the manufacturer.

3.05 *Casing End Seals*

Casing end seals shall be installed in accordance with the manufacturer's recommendations. Where approved by the Owner's Representative, brick and mortar bulkheads shall be constructed in accordance with the SSPWC.

Carrier pipe shall pass hydrostatic or leakage tests in accordance with Section 33 14 00 prior to the installation of casing end seals, brick and mortar bulkheads or backfilling operations.

END OF SECTION 33 05 23.10

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33 05 23
JACKED PIPE CASING

PART 1 General

1.01 *Description*

This section includes materials, and all equipment to perform all operations necessary for the installation of jacked pipe casing.

1.02 *Service Application*

Generally, pipe casings are used for the protection of CVWD facilities (carrier pipes) and may also be installed for future utility purposes. Pipe casings shall be used for the installation of potable water, non-potable water, sewer mains, agriculture irrigation line, agricultural drain line and where shown on the Approved Drawings or as required by CVWD.

1.03 *Design Requirements*

Pipe casings shall be provided for carrier piping where shown on the Approved Drawings or as required by CVWD. The sizes and material type for pipe casing shall be as detailed in Part 2 of this Section.

The Owner's Representative may select a greater steel thickness and diameter as appropriate for the intended application.

1.04 *Submittals*

If required by the Owner's Representative, the following items shall be submitted to CVWD for review and approval prior to the start of the casing work:

Configuration of the jacking pits and jacking pit bracing or shoring. Pit excavations deeper than 20 feet require the shoring system to be certified by a Registered Civil Engineer.

The pipe casing material to be used include casing material type, thickness, and welding details.

Casing spacers and end seals.

Jacking plan and profile drawing detailing the placement of the jacked casing.

The jacking machinery and jacking head proposed to be used.

Installation procedure and summary of backfilling method.

Welding procedure.

Epoxy coating repair procedure as recommended by the manufacture.
Manufactures recommendation of an epoxy accelerant to reduce curing time during jacking operations.

Workers Protection and Safety Plan.

Cathodic Protection.

PART 2 Materials

2.01 Steel Pipe Casing

Steel pipe casing diameter and casing wall thickness shall be in accordance with the Approved Standard Drawings.

Steel pipe casings, unless otherwise approved by CVWD, shall be butt welded sheets (spiral welding of pipe not allowed) conforming to ASTM A 36/A 36M, ASTM A 283/ A 283M, Grade D, or ASTM A 568/A 568M, Grade 33. Other steel grades may be used upon approval of the Engineer.

2.02 Epoxy Coating for Steel Casing

This specification covers the requirements for the plant application of fusion bonded epoxy coatings to steel pipe casings. The fusion bonded epoxy coated steel pipe casing shall be used in locations where both open trench excavation and jack and bore operations are utilized for construction. The coating shall be placed on the outside and inside of the steel casings.

Epoxy coating for steel pipe casing shall be selected from the Approved Materials List. Standard products of manufacturers other than those shown on the Approved Materials List will only be accepted when it is proved to the satisfaction of the Owner's Representative they are equal in composition, durability, and usefulness for the purpose intended.

The Contractor shall perform the work in accordance with the latest editions of the following Steel Structures Painting Council (SSPC) publications.

2.03 Surface Preparations

Prior to blast cleaning, surfaces shall be inspected and pre-cleaned according to SSPC-SP1 to remove oil, grease and loosely adhering deposits.

The exterior pipe surface shall be blast cleaned to SSPC-SP10 near-white finish using steel grit or steel grit-shot mixture after pre-heating of pipe to sufficient temperature to remove all moisture.

The abrasive cleaning media shall be selected to achieve an anchor profile of not less than 1.5 mils or more than 4.0 mils.

Any raised slivers, scabs, laminations or bristles of steel remaining on the newly cleaned surfaces, including on welds, shall be removed using abrasive grinders or hand filing. Care shall be taken not to destroy the anchor pattern.

Prior to coating, the cleaned pipe shall be inspected to ensure that all cleaning steps have been adequately performed. Presence of contaminants shall be cause for rejection of the surface preparation.

2.04 *Coating Materials*

The coating shall be comprised of 100 percent pure thermosetting epoxy coating powder. The coating shall be applied in a multi-step process to a common maximum of three coats. The first and second coats (undercoat) shall consist of a one part Epoxy Coating, heat curable, coating designed for corrosion protection of pipe. The third coat (topcoat) shall consist of Epoxy Coating.

The steel casings that will be jacked shall include a three coat epoxy system. The steel casings installed by trench excavation shall include a two coat epoxy system with no topcoat. On the inside of both steel casing applications, the Contractor shall apply the two coat epoxy system.

The undercoat material shall be selected from the Approved Materials List and applied to the prepared steel surfaces in two coats to a maximum of 12 to 16 mils by electro-static spray in strict accordance with the manufacturer's written instructions.

The topcoat material shall be selected from the Approved Materials List and applied over the gel coat cycle of the undercoating (206N) in one coat to a maximum of 15 to 30 mils by electro-static spray in strict accordance with the manufacturer's written instructions.

After the electro-static application, the coatings shall be cured in accordance with the written instructions of the manufacturer.

2.05 *Casing Spacers*

The casing spacers shall be stainless steel insulator to be selected from the Approved Materials List. The spacers shall have 2-inch wide runners and the height shall provide a 1-inch clearance above the mechanical pipe joint restraint system.

2.06 *Casing End Seals*

An 8-inch thick brick and mortar bulkhead shall be constructed unless shown otherwise on the plans. Where indicated on the plans, all end seals shall be a minimum 1/8 inch thick synthetic rubber with stainless steel bands for securing the end seal to the steel casing. The end seal shall be selected from the Approved Materials List. In areas where groundwater is present in the pipe zone, a concrete thrust block will be installed around the end seal.

A polyethylene sleeve shall be placed around the steel casing that will be placed under the open trenching method to serve as additional protection against corrosion. Polyethylene sleeves shall be a minimum 8 mil (0.008 inch) thick in accordance with AWWA 105.

PART 3 Execution

3.01 *Excavation, Trenching, Backfill and Compaction*

All excavation, trenching, bedding, backfilling and compaction operations shall be performed in accordance with Section 31 23 17.

3.02 *Dewatering*

The Contractor shall provide and maintain at all times during construction ample means and devices to promptly remove and dispose all water from any source entering trench excavations or other parts of the work in accordance with Section 31 23 19. Any damage caused by flooding of the trench shall be the Contractor's responsibility.

Dewatering shall be performed by methods that will maintain a dry excavation, preservation of the final lines, and grades and protection of all utilities. If flooding of the trench does occur, the Contractor shall immediately dewater and restore the trench. Damaged or altered pipeline appurtenances or trench materials shall be repaired or replaced as directed by the Owner's Representative.

3.03 *Jacking and Receiving Pits*

The approach trench, jacking and receiving pit excavations shall be adequately shored and comply with Section 31 23 17, Subsection 1.03 "Regulation Compliance". At all times the Contractor shall safeguard existing subgrade facilities and surface improvements against ground movement in the vicinity of jacking and boring operations.

Placement of equipment in the approach trench and jacking pit shall be firmly bedded on the required line and grade to accurately control the jacking alignment and grade. Adequate space shall be provided to insert the casing lengths to be jacked. Jacking equipment shall be properly anchored during jacking operations to maintain the lines and grades shown on the Approved Plans.

After jacking operations have been completed and all equipment, cuttings, and debris have been removed from the approach trench, jacking and receiving pits, the excavated areas shall be completed in accordance with Section 31 23 17.

3.04 *Jacked Pipe Casing Installation*

Installation of jacked pipe casings shall be as described below and in accordance with SSPWC Section 306-2.3 and the Approved Standard Drawings. Only workers experienced in jacking operations shall be used in performing the work of jacking and boring.

Jacked casing for gravity flow pipelines shall be installed to the lines and grade as shown on the Approved Plans. The Contractor's attention is directed to casings for gravity pipelines as they are designed to grades that rarely permit variances from the line and grade that are shown on the Approved Plans.

The leading section of casing shall be equipped with a jacking head to prevent variation in alignment during jacking operations.

Steel casing sections shall be joined by full-circumference butt welding in the field. Steel casing shall have all areas of damaged coating repaired.

Ductile-iron carrier pipe joints shall be restrained.

Upstream and downstream elevations of the carrier pipe shall be verified prior to sealing the casing ends.

The portion of carrier pipes installed within casings shall have pressure, leakage, and infiltration testing completed in accordance with Section 33 14 00 prior to sealing the casing ends.

3.05 *Carrier Pipe Installation*

The installation of carrier pipe shall be as described below.

Carrier pipe shall be pushed into the casing incorporating the use of casing spacers as described below.

Ductile-iron carrier pipe joints shall be fully restrained.

Upstream and downstream elevations of the carrier pipe shall be verified prior to sealing the casing ends.

The portion of carrier pipes installed within casings shall have pressure, leakage, and infiltration testing completed in accordance with Sections 33 14 00 prior to sealing the casing ends.

The annular space between the carrier pipe and casing for domestic water, non-potable force mains that carry product shall be filled with sand unless otherwise noted on the Approved Plans. The annular space between the carrier pipe and casing for gravity flow pipe systems when constructed below the water table shall be backfilled with gunite sand as approved by the Owner's Representative.

3.06 *Casing Spacers*

Casing spacers shall be used to prevent the carrier pipe bell from touching the casing and to maintain a uniform space between the carrier pipe and casing interior. A minimum of three casing spacers shall be installed, equally spaced, on each carrier pipe section at intervals recommended by the manufacturer.

3.07 *Casing End Seals*

Brick and mortar bulkheads shall be constructed in accordance with the SSPWC. Where indicated on the Approved Plans, casing end seals shall be installed in accordance with the manufacturer's recommendations.

Carrier pipe shall pass hydrostatic or leakage tests in accordance with Sections 33 14 00 prior to the installation of casing end seals, brick and mortar bulkheads or backfilling operations.

END OF SECTION 33 05 23

SECTION 33 08 30

CONNECTION TO SANITARY SEWER SYSTEM

PART 1 – GENERAL

1.01 *Description*

- A. This section includes materials, testing, and installation of connections to existing sanitary sewer systems.
- B. The Contractor shall furnish all tools, equipment, materials, and supplies and shall perform all labor required to complete the Work as indicated in the Contract Documents and as necessary to complete the work of this section.

1.02 *Related Work Specified Elsewhere*

- A. The requirements of the following sections and divisions apply to the Work of this section. Other sections and divisions of the Specifications, not referenced below, shall also apply to the extent required for proper performance of this Work.
 - 1. Section 03 30 00, Concrete
 - 2. Section 31 23 17, Trenching, Excavation, Backfill and Compaction
 - 3. Section 31 23 19.10, Sewer Bypass System
 - 4. Section 33 01 30.13, Sanitary Sewer System Testing
 - 5. Section 33 01 30.16, TV Inspection of Sewer Pipelines
 - 6. Section 33 31 15, Fiberglass Reinforced Pipe for Sanitary Sewer
 - 7. Section 33 31 11, PVC Pipe for Sanitary Sewer
 - 8. Section 33 31 14, Vitrified Clay Pipe for Sanitary Sewer
 - 9. Section 33 39 33, House Laterals

1.03 *Reference Specifications, Codes, and Standards*

- A. All Work specified herein shall conform to or exceed the applicable requirements of the referenced portions of the following publications to the extent that the provisions thereof are not in conflict with other provisions of these Specifications.

B. Comply with the applicable editions of the following codes, regulations and standards.

1. CVWD Detail Drawings for the Construction of Sanitary Sewer Systems

2. Industry Standards:

ASTM C923 Standard Specification for Resilient Connectors
Between Reinforced Concrete Manhole Structures,
Pipe, and Laterals.

SSPWC "Green Book", Standard Specifications for Public
Works Construction

C. Comply with the applicable reference Specifications.

1.04 *Submittals*

A. Submittals shall be made in accordance with the General Conditions, other applicable parts of the Contract Documents, and as specified herein.

B. Certifications: The Contractor shall furnish a certified affidavit of compliance for all pipe, fittings, adapters, couplings, resin, and other products or materials furnished under this section, as specified in the referenced standards and the following supplemental requirements:

1. Product drawings and data for pipe, fittings, adapters, couplings, resin, joints, gaskets, tools,

2. Hydrostatic test reports, as applicable.

C. Submit field data of the existing pipe (elevation, horizontal location, material, outside diameter, condition, all connections points, fittings, and any other characteristics deemed necessary by CVWD). Survey shall be performed by a professional land surveyor registered in the state of California. Submit a copy of the electronic survey file.

D. Sewer bypass plan.

E. Traffic control plan.

F. Record drawings for each completed connection in accordance with Article entitled "Record Drawings" of this Specification.

1.05 *Quality Assurance*

A. General

1. Quality assurance shall conform to Section 33 31 14, Vitrified Clay Pipe, Section 33 31 11, PVC Non-Pressure Pipe for Sanitary Sewer, and Section 33 31 15, Fiberglass Reinforced Sewer Pipe.

B. Connections shall be constructed in the presence of CVWD's Representative.

1.06 *Warranty*

- A. Contractor, work and materials, shall comply with all warranty requirements as specified in the Contract Documents.

PART 2 – Products

2.01 *General*

- A. Vitrified Clay Pipe (VCP), Polyvinyl Chloride (PVC) Pipe, and Fiberglass Reinforced Pipe (FRP), fittings and appurtenances shall be in accordance with SSPWC Sections 200 and 300, pipe manufacturer, as required by the Contract Documents.
- B. All ferrous metals shall be 316 stainless steel or fusion bonded epoxy coated per AWWA C116 or C550.
- C. Gravel Base: All bedding and encasement materials shall be as shown on the Drawings and Section 31 23 17, Trenching, Excavation, Backfill, and Compaction.
- D. All cement, concrete, mortar, and grout used in the construction of manholes shall conform to SSPWC Section 201 and Section 03 30 00, Concrete.
 1. Portland cement shall be Type V per ASTM 150. Mortar shall be Class C (proportion: 1 part cement to 2 parts sand).
 2. Concrete class shall be 560-C-3250. The minimum 28-day compressive strength shall be 3,250 psi. Slump shall be a maximum of 5 inches. All concrete shall have maximum water to cement (w/c) ratio of 0.45 unless otherwise specified.
- E. Provide forms on all vertical surfaces. Wood or sandbags are acceptable form material.
- F. Reinforcing Steel shall conform to ASTM A 615, Grade 60, deformed bars. Size and spacing as shown on the Drawings.

2.02 *Connection to Existing VCP Main*

- A. New VCP Main

1. Mission Flex-seal adjustable repair couplings, Fernco Strong Back RC 1001, or approved equal.

B. New PVC Main

1. Mission Flex-seal adjustable repair couplings, Fernco Strong Back RC 1002, or approved equal.

C. New FRP Main

1. Adapter coupling (plain ends) provided by FRP pipe manufacturer, or approved equal.

D. New VCP House Lateral

1. In accordance with Section 33 39 33, House Laterals.

2.03 *Connection to Existing VCP House Lateral*

A. New VCP Main

1. In accordance with Section 33 39 33, House Laterals.

B. New PVC Main

1. In accordance with Section 33 39 33, House Laterals.

C. New FRP Main

1. In accordance with Section 33 39 33, House Laterals.

2.04 *Existing Sewer Manhole*

- A. Sanitary sewer connections to existing manholes shall be core-drilled. Pipe connections and stubs for all structures and manhole connections shall not exceed 2-ft in length. Pipe caps shall be furnished where required. Submit a shop drawing detailing the method of connecting the proposed pipe to the existing manhole for CVWD review and approval.

B. New VCP Main

1. Fill void (between pipe and cored hole) around pipe with approved non-shrink grout or epoxy grout in accordance with Section 03 30 00, Concrete.

C. New PVC Main

1. Water stop grouting ring with stainless steel bands and hardware meeting the requirements of ASTM C 923, C 1244, and C 1478. Water

stop grouting ring shall be A-Lok Water Stop, Kor-N-Seal Water Stop Grout Ring, or approved equal. Fill void with approved non-shrink grout in accordance with Section 03 30 00, Concrete.

2. Where shown on the Drawings, flexible style water stop connectors shall be Kor-N-Seal 106-406 Series, or approved equal.

D. New FRP Main

1. Provide an approved water stop flexible flange boot for connection to existing manholes, as required. Flexible connector shall be Kor-N-Seal 106-406 Series, or approved equal.

2.05 *New Sewer Manhole*

- A. Pipe connections and stubs for all structures and manhole connections shall not exceed 2-ft in length. Caps/plugs shall be furnished for future stub-out connections. Submit a shop drawing detailing the method of connecting the proposed pipe to the manhole.

B. New VCP Main

1. Cast in place with the concrete manhole.
2. Fill void around pipe with non-shrink grout or epoxy grout where not cast into the base or shaft.

C. New PVC Main

1. In accordance with Article entitled "Existing Sewer Manhole" of this Specification.
2. Where shown on the Drawings, flexible style water stop connectors cast with the structure shall meet the requirements of ASTM C 923, C 1478, ASTM C 1644 and ASTM F 2510. A-Lok Z-Lok, or approved equal.

D. New FRP Main

1. In accordance with Article entitled "Existing Sewer Manhole" of this Specification.

PART 3 – Execution

3.01 *Construction*

- A. The Contractor shall be responsible for notification of the local residents a minimum of seven (7) days prior to the commencement of any work in the immediate area. Notices to the local residents will be supplied by CVWD. The Contractor shall be required to complete the notice as to the date the

work will be performed and deliver a copy to each residence within the affected area. All costs associated with the notification of the residents shall be borne by the Contractor.

- B. The Contractor shall notify CVWD's Representative at least two (2) business days prior to making the connection. Connections shall be constructed in the presence of CVWD's Representative.
- C. Existing sewer laterals shall not be out of service for more than 4-hours.
- D. Connections shall be installed in accordance with SSPWC Section 300.
- E. Trench excavation, bracing methods, foundation preparation, pipe bedding, trench backfill, and related operations shall be in accordance with the requirements of Section 31 23 17, Trenching, Excavation, Backfill, and Compaction.
- F. The Contractor is responsible for traffic control and it shall include all material, labor and equipment to provide safe and effective work areas to warn, control, protect and expedite vehicular, bicycle and pedestrian traffic. Unless otherwise required by the Contract Documents, all work and material provided under this section shall be performed or furnished in accordance with SSPWC Part 6 Temporary Traffic Control and the entity (City, County, State, etc.) having jurisdiction. Traffic control shall also be in accordance with Section 33 11 00, Basic Pipeline Specifications.
- G. Unless otherwise shown on the Drawings, install connections in accordance with CVWD Standard Drawings.

3.02 *Connections to Existing Manholes*

- A. Sanitary sewer connections to existing manholes shall be core-drilled and made using a flexible rubber seal/water stop as specified herein. Saw cutting and hammer through taps are prohibited. All connections shall provide for a watertight seal between the pipe and the manhole. The connector shall be the sole element relied upon to assure a flexible water tight seal of the pipe to the manhole. When connecting new pipe to existing manholes, a channel and bench walls shall be installed. The pipe up to the structures shall not project beyond the inside wall of the structure and in no case shall the socket of a vitrified clay pipe be built into the wall of a structure.
- B. Work on Existing Manholes: When work is to be performed above the flow channel of existing manholes, plywood shall be used to cover the entire channel and a drop cloth shall be used to cover the entire base.
- C. The thickness of the granular base material used to support pipe connection shall be the same as the adjacent pipeline bedding. If base is not used for the

pipe bedding, 3/4-inch crushed rock, over undisturbed soil, shall be used for the manhole. Crushed granular base material shall extend beyond the outside edge of the pipe as directed by CVWD's Representative and compacted to a relative compaction of ninety percent (90%) per ASTM D1557 and ASTM D2922. All concrete manhole bases shall be formed and poured on a granular base (12 inches minimum) having the same thickness as the bedding under the sewer on which the manhole base is being built. The Contractor shall not deviate from plan dimensions, notwithstanding over-excavation or other detrimental field conditions, unless approved by CVWD's Representative.

3.03 *Connections to Existing Piping*

- A. Where new pipelines are to be connected to existing lines of CVWD, the Contractor shall verify in the field the location, elevation, pipe material, pipe outside diameter, and any other characteristics of the existing line before proceeding with the pipe installation.
- B. Prior to construction, the Contractor shall submit for review and acceptance detailed procedures for pressure testing and the making of final connections to existing lines.
- C. Connections between new work and existing piping shall be made using fittings submitted and be subject to acceptance for each separate condition encountered.
- D. Each connection to existing pipe shall be made at a time and under conditions that will least impact normal operations, and as authorized in writing by CVWD.
- E. The Contractor shall be responsible for making provisions for cutting of existing pipe when necessary, using approved mechanical means. Flame cutting of pipe will not be allowed.
- F. The Contractor shall be responsible for making provisions for dewatering existing lines and for disposal of water from the dewatering operation.
- G. The Contractor shall make all connections to existing pipelines in the presence of CVWD's Representative. Contractor shall provide all labor, equipment, and materials necessary to perform connection work, including but not limited to, isolation valve, fittings, and adapters.

3.04 *House Laterals*

- A. House laterals and wye branch fittings shall be installed in accordance with Section 33 39 33, House Laterals.

3.05 Sewer Bypass

- A. If the connection will be performed at a location with existing sewer flows, the Contractor shall prepare a bypass plan and control the flow in accordance with Section 31 23 19.10, Sewer Bypass System and as required by the Contract Documents. A sewage bypass plan shall be submitted to CVWD for approval prior to construction. The Contractor shall at all times, be responsible for the operations of this bypass system, including furnishing all the necessary equipment and making arrangements to obtain power as required. The Contractor shall not be permitted to trench public or private streets for bypass purposes without the approval of the entity (State, County, City, etc.) having jurisdiction.

3.06 Inspection

A. General

1. The Contractor shall make all connections to existing pipelines the presence of CVWD's Representative.
2. House lateral markings shall be verified for accuracy by appropriate CVWD personnel. The termination of laterals and the placement of locators shall be witnessed by appropriate CVWD personnel.

B. Television Inspection

1. Connections shall be videoed upon completion of installation. At all connections, the camera shall be stopped and the pan and tilt features shall be used to obtain a clear picture. Where possible, the camera shall be panned to view up each lateral or point of connection. CCTV inspection shall be in accordance with Section 33 01 30.16, TV Inspection of Sewer Pipelines.

3.07 Testing

- A. Field testing of gravity sewer pipe shall conform to the requirements of Section 33 01 30.13, Sanitary Sewer System Testing.

3.08 Record Drawings

- A. The Contractor shall furnish record (as-built) drawings showing pipe diameters, pipe materials, method of connection, staked locations and elevations, backfill/trench details, vertical elevations, and the location of all connections with dimensions to buildings, curbs, trees, or tie points.
- B. Survey shall be performed by a professional land surveyor registered in the state of California using the appropriate datum and coordinates.

END OF SECTION 33 08 30

SECTION 33 11 00
BASIC PIPELINE SPECIFICATIONS

PART 1 General

1.01 Description and Scope

Contractor shall furnish all pipe, fittings, materials, equipment, and labor and perform all operations necessary to construct pipelines and appurtenances as specified by the Owner as shown by the Drawings. Drawings shall consist of construction drawings, installation drawings, laying drawings, standard drawings, detailed drawings, layout drawings, fabrication drawings, shop drawings, and clarifying diagrams or sketches.

The Work shall consist of all traffic control (including furnishing and installing all barricades, signs, delineators, arrow boards, and flagmen); all utility location and verification (excavating, exposing, and verifying locations, depths, and dimensions of utility facilities); all pavement removal and disposal; all earthwork (including trenching, shoring, dewatering if required, blasting if required, bedding, backfilling, and compacting); furnishing and installing all pipe, fittings, appurtenances, and making all related connections; protecting in place or removing and replacing all existing utilities and public and private improvements; removing and replacing all asphalt and Portland cement concrete pavement; pavement striping and restriping as required; disinfecting and testing all pipelines; disposing of excess soil and rock material; and restoring all areas and improvements to pre-construction conditions.

Contractor shall, upon completion of pipeline construction and appurtenances required herein, initially operate all components of the Work installed or furnished and installed by Contractor, and make any additional adjustments, corrections, repairs, replacements, and reconstructions necessary to provide the Owner with complete, correctly operating pipelines and appurtenances.

1.02 Submittals

Complete fabrication, assembly, and installation drawings, together with details and data governing materials used and other accessories furnished, shall be submitted for approval in accordance with Article 6 of Section 00 72 13. Data shall include, but not be limited to, the following:

A. Ductile Iron Pipe:

Contractor shall furnish an Affidavit of Compliance in accordance with Section 51-5, AWWA C151, latest. Contractor shall also furnish certifications of the following:

1. Material Certification

- a. Grade of iron (chemical requirements)
 - b. Flanges
 - c. Nuts and bolts
 - d. Flange gaskets
 - e. Rubber Gaskets
2. Manufacturing Certification
- a. Hydrostatic Test Reports
 - b. Tensile Test Reports
 - c. Impact Test Reports

Unless specified otherwise, Contractor shall furnish detailed installation or laying drawings showing pipe, fittings, appurtenances, station, and elevation for each fitting, and each change in alignment or slope. Contractor shall submit the installation or laying drawings to the Owner for acceptance in all cases in time sufficient to allow review and acceptance, and to accommodate the Contractor's construction schedule.

B. Welded Steel Pipe:

Contractor shall furnish an Affidavit of Compliance in accordance with Section 1.12, AWWA C200, latest, and Section 1.7 AWWA C205, latest. Contractor shall also furnish certifications of the following:

- 1. Material Certification
 - a. Steel Skelp
 - b. Flanges
 - c. Nuts and Bolts
 - d. Flange Gaskets
 - e. Rubber Gaskets
- 2. Manufacturing Certification
 - a. Pipe Mill Reports
 - b. Production Weld Test Reports

- c. Hydrostatic Test Reports
- d. Outlet Reinforcement Calculations*
- e. Pipe Wall Thickness Calculations*

* If not shown by the Drawings.

Unless specified otherwise, Contractor shall furnish detailed layout and shop or fabrication drawings showing pipe, lining, coating, reinforcement, joints, fittings, appurtenances, and station and elevation for each fitting and outlet and for each pipe joint at each change in pipe class, alignment, or slope. Contractor shall submit detailed layout and shop or fabrication drawings to the Owner for acceptance in all cases in time sufficient to allow review and acceptance, and to accommodate the Contractor's construction schedule.

C. Polyvinyl Chloride Pipe:

Contractor shall furnish an Affidavit of Compliance in accordance with Section 6.3, AWWA C900 and C905 (latest). Contractor shall also furnish certified copies of test reports containing results of all physical and chemical tests on pipe and coupling showing compliance with AWWA C900 and AWWA C905 (latest) as modified herein.

Unless specified otherwise, Contractor shall prepare detailed installation or laying drawings showing pipe, fittings, appurtenances, station and elevation for each fitting, and each change in alignment or slope. Contractor shall submit the detailed installation or laying drawings to Owner for approval in all cases in time sufficient to allow review and approval, and to accommodate the Contractor's construction schedule.

Revisions shown on the shop drawings shall be considered changes necessary to meet the requirements of these Specifications and shall not be taken as the basis of claims for extra charges. Contractor shall accept such revisions or submit others for acceptance. When delays are caused by resubmissions of shop drawings, Contractor shall not be entitled to any damages or extensions of time for such delays.

The Owner's acceptance of detailed layout and shop or fabrication drawings shall apply only to general arrangement and general compliance and not to specific details and dimensions and their correctness and compatibility. Contractor shall correct any misfits due to any errors in the detailed shop or fabrication drawings. Any fabrication in advance of receipt of detailed layout and shop or fabrication drawings marked "Accepted" or "Furnish as Corrected" shall be at Contractor's risk. Contractor shall furnish the Owner six sets of all accepted layout and shop or fabrication drawings.

PART 2 Products

2.01 General

A. Construction Materials:

Contractor shall furnish only approved materials as listed in the Owner's approved materials list. All materials shall be new and of the best quality for their intended use. All like materials shall be of one manufacture for any particular project.

Contractor shall, in addition to furnishing other data herein required, submit three signed and dated copies of the list of materials to be used in pipeline and appurtenance construction including but not limited to, pipeline installations, pipeline valve installations, air valve installations, blowoff installations, manway installations, service installations, fire hydrant installations, and related appurtenances.

2.02 Ductile Iron Pipe

A. Scope:

Ductile iron pipe and fittings shall conform with applicable provisions of AWWA C104, C105, C110, C111, C115, C150, C151, and C153, latest, as modified herein, by the Drawings, or by the Owner.

All ductile iron pipe shall be manufactured by organizations which have had not less than ten years successful experience in the manufacture of the type of pipe specified. The Owner shall approve manufacturer's product before its use.

B. Pipe:

All pipe shall be ductile iron and shall conform with AWWA C151 (ANSI A21.5, and applicable portions of ASTM A536, Grade 60-42-10), latest, as modified herein by the Drawings, or by the Owner.

1. Unless specified otherwise, pipe, including standard, random, and special short lengths, shall be Class 350 minimum for pipe diameters 12-inch and smaller and Class 250 minimum for pipe diameters 18-inch and larger and shall have push on joints. Minimum pipe wall thickness shall be as noted by the construction drawings or specified by the Owner; it shall not be less than noted by the standard drawings. Pipe wall thickness shall be increased if necessary to accommodate threads or grooves or if required for extremely shallow (less than 2.5 feet) or excessively deep (more than 14 feet) pipeline cover. 90 percent of all pipe of any specific class and size, excluding special short lengths, shall be furnished in standard lengths. The remaining 10 percent may be furnished in random lengths.

2. Standard lengths shall have nominal lengths of 18 feet up to 36-inch in diameter and 20 feet above 36-inch in diameter, plus or minus 1-inch. Random lengths of pipe may be up to 2 feet shorter than standard lengths. Special short lengths shall only be furnished where needed to accommodate specified fittings.
3. Pipe shall have an interior cement mortar lining in accordance with AWWA C104 (ANSI A21.4), latest, except that interior mortar lining shall not be asphalt seal coated. Said lining shall be full thickness throughout pipe except for bell which shall be cleaned and lightly sprayed or brushed with an asphaltic or bituminous coating in accordance with AWWA C151 (ANSI A21.51). The interior cement mortar lining shall be moisture cured for at least two days before shipment. To prevent moisture loss during the curing period, ends of the pipe shall be kept closed with plastic caps or covers which shall remain in place until installation.

Steam curing may be substituted for moisture curing, provided one hour of steam curing is equivalent to six hours moisture curing and ambient vapor is maintained at a relative humidity of 85 percent with the temperature ranging between 110° F and 150° F for minimum steam curing period of six hours, after which exterior coating may be applied. The lining shall then be cured for another twelve hours before shipment. Other methods of curing the cement mortar lining may be used providing they are acceptable to the Owner.

Temperature and shrinkage cracks in cement mortar lining less than 1/16 inch in width or 24-inch in length need not be repaired. Cracks wider than 1/16 inch or longer than 24-inch shall be repaired unless it can be demonstrated to the satisfaction of the Owner that the cracks will heal autogenously under continuous soaking in water.

4. Pipe shall have an exterior asphaltic or bituminous coating in accordance with AWWA C151 (ANSI A21.51), latest.
5. All pipe shall be furnished with rubber gasketed push-on type joints unless mechanical joints or flanged joints are otherwise specified or permitted. Joint restraints may be required as specified by the Owner. All joints shall comply with AWWA C111 (ANSI A21.11), latest, as approved by the Owner.
6. Rubber gaskets shall conform AWWA C111 (ANSI A21.11) latest.
7. Each pipe shall be marked with the weight, class, or nominal thickness and casting period. The manufacturers mark the year in which the pipe was produced and the letters "DI" or "ductile" shall be cast or stamped on the pipe. All required markings shall be clear and legible and all cast marks shall be on or within 2 feet of bell ends.

8. Where restrained joints are required, they shall be accomplished with boltless restrained joint gaskets or components. Restrained joints shall be ductile iron in accordance with applicable provisions of AWWA C111 and C151 (ANSI A21.11 and A21.51, respectively), latest, except as to manufacturer's proprietary dimensions. Set screws shall not be utilized for any application.

Each restrained joint for pipe 4-inch through 12-inch shall consist of a gasket system where stainless steel locking segments molded within the gasket provide restraint for pipe joints or fitting joints.

Each restrained joint for pipe 14-inch through 24-inch shall consist of a gasket system where stainless steel locking segments molded within the gasket provide restraint for pipe joints or fitting joints, or, alternatively, a boltless restrained push-on joint system where ductile iron locking segments inserted through slots in the bell face provide positive axial lock between the bell interior surface and the spigot retainer weldment or gripper ring.

Each restrained joint for pipe 27-inch and larger shall consist of a boltless restrained push-on joint system where ductile iron locking segments inserted through slots in the bell face provide positive axial lock between the bell interior surface and the spigot retainer weldment or gripper ring.

All restraining components must make full contact around the circumference of the pipe, even if it has deflected. Field cut kits shall be composed of full ring gripper rings with serrated edges and shall be compatible with the pipe joints and fitting joints.

C. Fittings:

All fittings shall be ductile iron except where fabricated cement mortar lined and cement mortar coated welded steel pipe fittings are specifically permitted or specified. Fabricated cement mortar lined and cement mortar coated fittings shall be flanged and they shall conform with the cement mortar lined and cement mortar coated welded steel pipe fittings specified herein.

Ductile iron fittings shall conform with AWWA C110, C111, and C153 (ANSI A21.10, A21.11, and A21.53, respectively), latest. Unless specified otherwise, fittings shall be push-on joint and comply with AWWA C111 (ANSI A21.11).

Fittings shall have an asphaltic outside coating in accordance with AWWA C110 or C153 (ANSI A21.10 or A21.53), latest, and cement mortar lining in accordance with AWWA C104 (ANSI A21.4), latest. Fittings shall have standard lining thickness and shall be seal coated with asphaltic material or other approved material. The lining process must produce a dense, compacted lining that shall be bonded to the interior of the fitting and have a smooth surface.

Where restrained joints are required, they shall be accomplished with boltless restrained joint gaskets or components and shall comply with all requirements of Part 2.02, B8 herein. Restrained joint fittings shall be of same joint design as the restrained joint pipe. Restrained joints shall be ductile iron in accordance with applicable provisions of AWWA C110 and C153 (ANSI A21.10 and A21.53), latest, except as to manufacturer's proprietary dimensions.

D. Testing:

All pipe, including standard, random, and special short lengths, furnished shall be tested in the United States in accordance with AWWA C151, latest.

E. Inspection:

The Owner shall at all times have the right to inspect all Work and materials during the course of manufacture. Manufacturer shall furnish the Owner reasonable facility for obtaining such information as the Owner may desire regarding the progress and manner of the Work and the character and quality of materials used.

F. Loading, Transporting, and Unloading:

After the pipe has been tested in accordance with Section 5 above, it shall be loaded on rubber-tired vehicles, and adequately supported and chocked to prevent any damage during transportation, and delivered to the Work site. During loading, unloading, and stringing operations, pipe and fittings shall be moved with care to prevent damage thereto. Unloading shall be accomplished in a workmanlike manner as directed by the manufacturer. Under no circumstances are pipe and fittings to be dropped or bumped in handling.

G. Defective or Damaged Material:

Pipe and fittings shall be carefully inspected for defects. Any pipe found to be defective in workmanship or materials or so damaged as to make repair and use impossible shall be rejected and removed from the Work site.

In the event that the pipe is damaged, damaged portions may be removed, as approved by the Owner, and discarded. Remaining sound portions may be used with ductile iron fittings. Contractor shall be responsible for any and all damage to material and shall stand the expense of repairing or replacing same. Contractor shall take proper precautions to assure that rubber gaskets are protected from oxidation or undue deterioration.

2.03 *Welded Steel Pipe (Cement Mortar Lined and Cement Mortar Coated)*

A. Scope:

All welded steel pipe shall conform with applicable provisions of AWWA C200, C205, C206, C207, and C208, latest, and applicable portions of M11 "Steel Pipe Manual", latest, as modified herein, by the Drawings, or by the Owner.

All welded steel pipe shall be manufactured by organizations with at least ten years successful experience in manufacturing, fabricating, lining, and coating the type of pipe specified. Owner shall approve manufacturer's methods, equipment, facilities, and operations before performance of any work and manufacturer's completed product before its use,

Standard or special pipe sections and standard or special connections, outlets, and fittings may be manufactured at a single plant, or they may be manufactured at two separate plants (Plant 1: manufacturing of standard sections of lined, coated, and cured steel pipe consisting of steel pipe cylinder formation and lining, coating, and curing; Plant 2: fabricating special pipe sections and standard or special connections, outlets, and fittings using standard sections of manufactured lined, coated, and cured steel pipe), special pipe sections and standard or special connections, outlets, and fittings fabricated at a separate manufacturing plant shall be comprised of standard pipe cylinders that have been formed, lined, coated, and cured at a single manufacturing plant. The separate manufacturing plant shall use facilities and methods for lining and coating repair and curing equal to the facilities and methods of the manufacturer of the standard sections of lined, coated, and cured steel pipe.

B. Pipe and Fittings:

All pipe and fittings furnished shall conform with applicable provisions of AWWA C200, C205, C206, C207, and C208, latest, and applicable portions of AWWA M11, "Steel Pipe Manual", latest, as modified herein, by the Drawings, or by the Owner.

1. Pipe and fittings shall be Class 150 minimum. Minimum steel cylinder thickness shall be as noted by the construction drawings or specified by the Owner; it shall not be less than 10 gage or as noted by the standard drawings. All pipe and fittings shall be machine cement mortar lined and machine cement mortar coated.
2. Curved alignment by use of pulled joints will be permitted. Maximum pull permitted from normal closure on one side of joint shall not exceed $\frac{1}{2}$ inch for 8-inch pipe or smaller, $\frac{3}{4}$ inch for 10-inch through 21-inch pipe, and 1-inch for 24-inch pipe and larger. Maximum joint deflections shall not exceed manufacturer's recommendation or 3 degrees; the more restrictive or lesser deflection shall apply.
3. Where greater curvature is required, Contractor may use fabricated bends as specified by the construction drawings or ordered by the Owner. For the purpose of reducing angular deflections at pipe joints, Contractor may use pipe sections of less than standard length. Closing courses and short sections of pipe shall be fabricated and installed by Contractor as found necessary in the field.
4. All fittings shall be shop fabricated unless the construction drawings indicate that fittings may be field fabricated, Contractor describes methods of fabrication, and the Owner specifically approves field fabrication. All fittings shall be fabricated from individual pipe sections, welded together, and lined and coated as described hereafter.
5. Lining of Fittings
 - a. The application of cement mortar lining to miters, angles, bends, reducers, and other special sections, the shape of which precludes application by the machine spinning process, shall be accomplished by mechanical placement, pneumatic placement, or hand application and finished to produce a smooth, dense surface.
 - b. If the interior of the fitting has not been previously machine lined, wire-fabric reinforcement or ribbon-mesh reinforcement shall be applied to the interior of fittings larger than 24-inch and shall be secured at frequent intervals by tack welding to pipe, by dips or by wire. Repaired areas of machine applied linings at miters, pipe ends, outlets, and other cuts made in the lining for fabrication of the fittings need not be reinforced if the width of the repair area does not exceed 12-inch. Repairs for widths exceeding 6-inch shall be bonded to the steel and adjacent faces of the lining with an approved bonding agent.

- c. Immediately after lining has been completed, pipe and fittings shall be water cured without being disturbed for at least one day before applying the exterior coating, if such a coating is specified. If cement mortar coating is not specified, the lining shall be kept moist for four days before shipment. In either case, the lining shall be cured for at least four days before shipment. To prevent moisture loss during the curing period, ends of the pipe sections shall be kept closed with plastic end caps or covers which will remain in place until time of installation. The date of lining and class of pipe shall be plainly marked on the inside of each fitting.

6. Coatings of Fittings

Mortar coating for pipe bends and other special sections not adaptable to the application of spiral-wire coating reinforcement shall be reinforced with wire fabric or ribbon mesh. The wire fabric or ribbon mesh shall be applied over the surface of the pipe to be coated, and may be held away from the pipe shell with self-furring mesh, furring clips, or an equivalent method. The application of the mortar coating shall be by mechanical or pneumatic means to the specified thickness, except that hand application may be substituted for all specials. After the outside coating has been applied, the pipe and fittings shall be kept continually moist by continuous spraying for at least four days. Provisions shall be made to protect the coating from erosion during sprinkling. The date of coating and class of pipe shall be plainly marked on the inside of each fitting.

C Pipe Joints:

Unless specified otherwise, joints shall conform to the following types. Joints shall be as specified on the construction drawings or by the Owner. All joints shall be continuity bonded.

1. Rubber Gasket Joints

All rubber gasket joints shall conform with AWWA C200, latest.

2. Flanged Joints

All flanges 4-inch through 12-inch shall conform with AWWA C207, latest, Class E (ring) or ANSI 816.5 Class 150. All flanges larger than 12-inch shall conform with AWWA C207, latest, Class E (ring). All flange bolts shall be standard hex head machine and conform with ASTM A325. All flange nuts shall be heavy hex cold pressed semi-finished steel and conform with ASTM A194-2, 2H.

All flanges shall be fully welded to pipe on both faces, one pass minimum on the inside, and two passes minimum on the outside. Pipe linings shall extend to mating faces of flanges. Bolt threads shall be lubricated with an approved anti-seize compound. Flanges together with bolts and nuts, shall be, once installed, coated with an approved bitumastic material.

3. Swedged Lap Welded Joints

Bell ends shall be formed integrally with pipe cylinders, being swedged out by machine. Bell ends shall be designed and fabricated to withstand design pressure of class of pipe specified and to permit spigot ends (plain end) to enter belled ends approximately 1-inch with clearance of approximately 1/32 inch.

4. Banded Lap Welded Joints

Where lap welded joints are required and swedged lap welded joints cannot be fabricated, belled ends shall be formed by welding steel bands to outside circumferences of plain ends of pipe. Bell ends shall be designed and fabricated to withstand design pressure of class of pipe specified and to permit spigot ends (plain ends) to enter belled ends approximately 1-inch with a clearance of approximately 1/32 inch.

5. Sleeve Couplings

Where sleeve couplings are required, they shall conform with the construction drawings. Pipe coatings at pipe ends shall be held back 12-inch and pipe shall have weld seams ground flush within 12-inch from pipe ends, unless specified otherwise. For above ground applications, pipe ends and sleeve couplings shall be painted. For below ground applications, pipe ends and sleeve couplings shall be coated with an approved bitumastic material. An approved bitumastic coating shall be substituted for mortar coating within 12-inch of pipe ends. After joints have been coupled, sleeve couplings shall be coated with an approved bitumastic material.

6. Cut-to-Fit Joints

Where cut-to-fit joints are required, they shall conform with the standard drawings and the construction drawings. Pipe coatings at cut-to-fit joints shall be held back as required to permit construction of joints; pipe coatings shall thereafter be added in the field. Field applied pipe coatings shall match manufactured pipe coatings. Contractor shall provide, at Contractor's expense, cut-to-fit joints, in addition to those specified, if necessary to accommodate Contractor's work and schedule.

7. Shop Testing of Joints and Joint Ends

Every pipe section, standard or special, shall be hydrostatically tested after joint ends have been completely shop formed and attached in place by welding, as applicable, or dye check tested provided pipe cylinders had been previously hydrostatically tested.

D. Cement Mortar Lining and Cement Mortar Coating:

1. General

Cement mortar lining and cement mortar coating shall conform with AWWA C205, latest.

2. Surface Preparation

Prior to lining and coating, pipe shall be cleaned of all loose mill scale, moisture, rust, sand, dust, oil, grease, and other deleterious or objectionable matter both inside and outside.

3. Cement Mortar Lining

a. Mortar

Mortar shall consist of one part Portland cement to three parts (by weight) clean, sharp sand. Unless specified otherwise, cement used for cement mortar shall conform with ASTM C-150, latest, Type II. Sand shall consist of clean, inert, sharp, durable material, maximum grain size being no more than one-half specified minimum lining thickness. Mortar shall be thoroughly mixed and made workable with clear, potable water. All cement mortar shall develop a minimum compressive strength of 2,600 psi minimum at seven days and 4,500 psi minimum at twenty-eight days.

b. Application and Treatment

Cement mortar shall be applied to interior surfaces of pipe with equipment specifically designed for that purpose. Said equipment shall have a retracting feed line that will provide uniform cement mortar distribution throughout pipe length. Pipe shall be slowly rotated in horizontal position while cement mortar is being applied. Each end shall be provided with suitable end dam during spinning operation to control lining thickness and provide square-finished lining end.

Following application of mortar, pipe shall be rotated at sufficient speed to compact lining mortar. Said speed shall be maintained until all excess water has been forced to lining surface. During the spinning operation, surplus water shall be expelled from pipe by blower or other suitable means. Peripheral speed and spinning time shall be sufficient to obtain dense, well compacted lining with smooth surface free from defects. Minimum lining thickness shall be as shown by the standard drawings. Immediately after lining has been completed, pipe shall be water cured without being disturbed for at least one day. Moisture loss shall be prevented during the curing period.

4. Cement Mortar Coating

a. Mortar

Mortar shall consist of one part Portland cement to three parts (by weight) clean, sharp sand. Materials for cement mortar coating shall be the same as materials for cement mortar lining. All cement mortar shall develop a minimum compressive strength of 2,600 psi minimum at seven days and 4,500 psi minimum at twenty-eight days.

b. Application and Treatment

After pipe interior has been lined, cement mortar shall be applied to outside of pipe through fixed nozzles to form an even, dense, and tightly adhering coating. During coating operation, pipe shall be rotated and moved beneath said fixed nozzles to obtain uniform coating free from defects. Minimum coating thickness shall be as shown by the standard drawings.

Cement mortar coating shall be reinforced with spirally wound steel (reinforcing) wire embedded midway within coating. Reinforcing wire shall be bright basic wire comprised of low carbon, open hearth steel, unannealed after the last draw, with an approximate ultimate tensile strength of 80,000 psi. Said wire shall be No. 14 gage minimum and it shall be placed at a pitch of 1 1/2 inch maximum in the middle third of the coating.

Immediately after coating has been completed, each end of each section shall be cleansed to bare metal and cement mortar shall be troweled and shaped suitable for joint being used. All exposed bare metal shall be cleaned and coated and painted for protection against corrosion. Completed pipe shall then be water cured for at least four days without being disturbed.

E. Manufacturing Inspection:

The Owner shall at all times have the right to inspect Work and materials during the course of manufacture. Manufacturer shall furnish the Owner reasonable facility for obtaining such information as it may desire regarding progress and manner of work and character and quality of materials used.

F. Loading, Transporting, and Unloading Pipe and Fittings:

After pipe and fittings have been manufactured as set forth above, they shall be braced at the plant with wooden struts of adequate size to protect against excessive deflection. Each set of struts (two struts minimum to a set) shall be nailed together at right angles as a unit. Wooden wedges may be used to accomplish proper tight fit for the struts. Bracing shall be located 1 foot in from each end of each pipe section for pipe 24-inch and smaller, and additionally at mid-point for pipe 30-inch and larger.

After the struts have been installed, pipe shall be loaded on rubber-tired vehicles, adequately supported and choked to prevent damage during transportation, and delivered to Work site. All bracing shall remain in place until each pipe section has been bedded and backfilled to at least 1 foot above the top of the pipe for pipe 24-inch and larger.

Plastic end caps or covers shall be placed over the ends of pipe following installation of braces to prevent moisture loss during loading, transporting, unloading, and installing; they shall remain in place until installation. If the plastic and caps or covers are damaged (perforated), they shall be replaced immediately.

During loading, unloading, and stringing operations, pipe and fittings shall be moved with care to prevent damage thereto. They shall be moved with nylon chokers or straps of sufficient width, placed at third points (one-third length of pipe from each end), to prevent damage to exterior coating, and they shall be handled in such manner to prevent damage to interior lining. Steel slings shall not be used.

Unloading shall be accomplished in a workmanlike manner by Contractor and every precaution shall be taken to prevent damage to pipe and fittings. Under no circumstances are pipe sections to be dropped or bumped in handling. Any pipe section that becomes damaged shall be repaired if possible and, if not possible in the opinion of the Owner, it shall be replaced with an undamaged pipe section. When strung, pipe shall be adequately supported and choked to avoid movement until it is installed. It shall also be placed to avoid damage during construction.

2.04 Polyvinyl Chloride Pipe

A. Scope:

Polyvinyl chloride (PVC) pipe furnished and installed under these Specifications shall conform to applicable AWWA Standards (latest), as modified herein, by the Drawings, or by Owner.

All pipe furnished shall be manufactured by an organization which has had not less than 10 years successful experience in the manufacture of the type of pipe specified. Owner shall approve manufacturer's product before its use.

B Pipe and Couplings:

All pipe and couplings furnished shall conform to AWWA C900 and C905 (latest) and the following additional requirements:

1. Unless otherwise specified or shown on Drawings, AWWA C900 pipe and couplings (4-inch through 12-inch diameter) shall be minimum Class 235 (maximum dimension ratio of 18). Polyvinyl chloride pipe shall have same dimensions as ductile iron pipe and pipe bell and pipe spigot shall have same thickness as pipe barrel.

Standard lengths of pipe shall have nominal length of 20 feet, 0 inches, plus or minus 1-inch. Standard lengths of pipe shall be furnished with integral bells and spigots and with rubber gaskets. Couplings may be used for closures and curved alignments where permitted by Owner.

Pipe shall have sufficient strength to withstand an internal hydrostatic pressure of four times rated operating pressure for its class per AWWA C900 (latest).

2. Unless otherwise specified or shown on the Drawings, AWWA C905 pipe and couplings (14-inch through 36-inch diameter) shall have maximum dimension ratio of 18 (Class 235). Polyvinyl chloride pipe shall have same dimensions as ductile iron pipe and pipe bell and pipe spigot shall have same thickness as pipe barrel.

Standard lengths of pipe shall have nominal length of 20 feet, 0 inches, plus or minus 1-inch. Standard lengths of pipe shall be furnished with integral bells and spigots and with rubber gaskets. Couplings may be used for closures and curved alignments where permitted by Owner.

Pipe shall have sufficient strength to withstand an internal hydrostatic pressure of two times rated operating pressure for its class per AWWA C905 (latest).

3. Where restrained joints are required (specified or shown on the Drawings), the restraint system shall be a split ring installed on the spigot connected to a solid back-up ring seated behind the bell. Restraint system shall be Series 1350 Uni-Flange, Star Pipe Products Series 1100, or equal. The solid back and split rings shall apply even pressure around the pipe and provide 3600 contact. Restraint device shall be ductile iron with 316 stainless steel rods and nuts. Restraint device shall be rated for full working pressure of the pipe with 2:1 factor of safety.

C. Fittings:

All fittings shall be Class 150 ductile iron unless otherwise specified or shown on the Drawings.

Ductile iron fittings shall conform with AWWA C110, C111, and C153 (ANSI A21.10, A 21.11, and A21.53, respectively), latest. Unless specified otherwise, fittings shall be push-on joint and comply with AWWA C111 (ANSI A21.11). Fittings shall have an asphaltic outside coating in accordance with AWWA C110 or C 153 (ANSI A21.10 or A21.53), latest, and cement mortar lining in accordance with AWWA C104 (ANSI A21.4), latest. Fittings shall have standard lining thickness and shall be seal coated with asphaltic material or other approved material. The lining process must produce a dense, compacted lining that shall be bonded to the interior of the fitting and have a smooth surface.

Where PVC fittings are specified on the Drawings or permitted as an alternative as specified on the Drawings, fittings shall be in compliance with AWWA C907 (4-inch through 8-inch). Affidavits and testing results shall be submitted as required for PVC pipe.

Where "special lining" is specified, it shall be provided in accordance with Part 2.08 herein.

Where restrained joints are required (specified or shown on the Drawings), the system shall be suitable for mechanical joint fittings or push-on fittings and be of split ring design providing even pressure around the pipe with 3600 contact. The rings shall be ductile iron and threaded rods shall be 316 stainless steel. System shall be Uni-Flange Series 1300 or equal.

D. Testing:

All pipe and couplings furnished shall be tested in the United States in accordance with Section 4, AWWA C900 and AWWA C905.

E. Manufacturing Inspection and Certification:

Owner shall at all times have the right to inspect all work and materials in the course of manufacture. Manufacturer shall furnish Owner reasonable facility for obtaining such information as Owner may desire regarding the progress and manner of the work and the character and quality of materials used.

F. Loading, Transporting, and Unloading:

After the pipe has been tested in accordance with Section 5 above, it shall be loaded on rubber-tired vehicles, adequately supported and chocked to prevent any damage during transportation, and delivered to the job site. All pipe and couplings (AWWA C900 and C905) shall be unloaded and stored in accordance with AWWA manual M23 (latest). During the unloading and stringing operations, the pipe shall be moved in such a manner as to prevent injury to the pipe and/or couplings. Unloading shall be accomplished in a workmanlike manner as directed by the manufacturer. Under no circumstances are pipe sections to be dropped or bumped in handling.

G. Defective or Damaged Material:

The pipe and couplings shall be carefully inspected for defects. Any pipe, coupling, sleeve, or rubber ring found to be defective in workmanship or material or so damaged as to make repair and use impossible shall be rejected and removed from the job site.

In the event that pipe is damaged, the damaged portion may be removed, as approved by Owner and discarded. Remaining sound portions may be used with ductile iron fittings or with couplings. Contractor shall be responsible for any and all damage to material and shall stand expense of repairing or replacing same. Contractor shall take proper precautions to assure that the rubber gaskets are protected from oxidation or undue deterioration.

PART 3 Execution

3.01 Pipeline Construction

A. Pipelines and Appurtenances:

Pipelines and appurtenances shall be constructed in accordance with these Specifications and the Construction Drawings, and as specified by the Owner.

B. Valves and Appurtenances:

Pipeline valves at pipeline intersections shall be connected directly to pipeline intersection fittings (cross or tee) and, unless specified otherwise, all mainline or side outlet valves shall be located 3 feet minimum from any curb face. Pipeline valves shall not be placed under curb or gutter or in parkway unless approved by the Owner.

All appurtenances, including but not limited to air valve installations, blowoff installations, and related facilities, such as fire hydrants, fire services, and water services, shall not be installed within 5 feet of curb returns, curb depressions, and driveway approaches, or in inaccessible locations or locations where interferences may restrict facility operation, unless permitted otherwise by the Owner.

Unless specified otherwise, air valve installations shall be constructed at all pipeline high spots and blowoff installations shall be constructed at all pipeline low spots. Contractor shall construct, at Contractor's expense, air valve installations and blowoff installations in addition to those specified, if necessary, to accommodate Contractor's work and schedule.

C. Pipeline Length:

All pipeline lengths noted by the Construction Drawings or otherwise specified or referenced shall mean net horizontal constructed lengths and said lengths shall extend through all fittings and appurtenances including bends, outlets, tees, flanges, and valves. Contractor shall provide all pipe necessary to accommodate any vertical alignment of the pipeline and said pipe shall be represented by the net horizontal constructed length.

D. Pipeline Alignment:

All pipelines shall be constructed with no basic variation in horizontal alignment as shown by the Drawings or as specified by the Owner. Pipelines shall be constructed parallel with centerlines of streets or rights-of-way and appurtenances shall be constructed perpendicular thereto unless the construction drawings specify otherwise. Pipelines may be constructed by the use of pulled joints, short joints, bevels, bends, and elbows, provided pipelines are constructed as specified.

In all non-critical areas and subject to the Owner's approval, pipelines may be constructed at variance with vertical alignment as shown by the construction drawings by the use of pulled joints, short joints, bevels, bends, and elbows provided pipelines are constructed as specified at pipeline connections and underground interferences, and where pipeline cover is limited. The Owner will not approve any variation in vertical alignment until it has determined that proposed alignment is proper and modifications are in order.

E. Pipeline Tolerances:

With regard to vertical alignment, pipelines shall be constructed so that actual flow line elevations, measured at pipe joints, are within 0.1 foot of design flow line elevations. Pipelines, when installed, shall have continuous slope upgrade or downgrade, corresponding with design slope, without any high spots.

With regard to horizontal alignment, pipelines shall be constructed so that actual pipeline centerlines, measured at pipe joints, are within 0.1 foot of design pipeline centerlines. Pipelines, when installed, shall closely follow specified horizontal alignment.

Pipeline construction shall conform with Construction Drawings and layout, shop, fabrication, installation, or laying drawings (design drawings which show flow line elevations and pipeline centerlines) in accordance with the above specified tolerances. Contractor shall make or assist the Owner in making all necessary measurements, as determined by the Owner, to confirm or verify compliance with construction tolerances.

F. Pipeline Cover:

Pipeline cover as shown by the Construction Drawings is hereby defined as design cover over pipeline. If field conditions determined during construction staking show that pipe grade changes are required to provide design cover, Contractor shall, at his expense, make required changes in pipeline grade and construct pipeline accordingly.

Pipeline cover from top of pipe to ground surface over pipeline shall not be less than 36-inch. Where future ground surface elevation over pipeline has been established and where actual ground surface is greater, pipeline cover shall be referenced to future (established) ground surface elevation, not actual ground surface elevation.

3.02 *Survey Monuments and Construction Stakes*

Contractor shall not disturb or destroy any existing monuments or bench marks. If any survey monuments or bench marks need to be removed and replaced, Contractor shall have all necessary services performed by a registered civil engineer or a licensed land surveyor. If Contractor fails to comply, the Owner will have said services performed at Contractor's expense.

Before removing any monuments in preparation for construction, Contractor shall have a registered civil engineer or licensed land surveyor set at least four ties for each monument to be removed and replaced; after construction Contractor shall have the same registered civil engineer or licensed land surveyor replace each monument using the aforementioned ties and file a corner record for each replaced monument.

Unless specified otherwise, Contractor shall use construction stakes and cut sheets for pipeline construction and the Owner will use them for construction inspection. All construction stakes shall be set by a registered civil engineer or licensed land surveyor. The Owner must approve cut sheets before actual construction. Contractor shall protect all construction stakes set for construction and Contractor shall restore any construction stakes destroyed or disturbed. If Contractor fails to comply, the Owner will have services performed at Contractor's expense.

3.03 *Traffic Control*

Contractor shall prepare, submit, and provide traffic control drawings for construction. Said traffic control drawings shall be approved by the Owner and agencies having jurisdiction over highways, thoroughfares, and streets prior to starting construction.

Traffic control requirements may be modified by the Owner or said agencies as conditions warrant. Contractor shall modify traffic control as required by the Owner or said agencies at no additional cost. Throughout the Work, Contractor shall inspect traffic control equipment (signs, barricades, arrowboards, and delineators) and shall maintain same in accordance with said traffic control drawings.

All construction signing, lighting, and barricading shall comply with State of California, Department of Transportation "Manual of Traffic Controls, Warning Signs, Lights, and Devices for Use in Performance of Work Upon Highways", latest edition.

3.04 *Underground Utilities (Subsurface Installations)*

Where underground utility facilities (conductors or conduits for water, gas, sewer, telephone, electric power, cable television, or other utilities) are shown on construction drawings, Contractor shall assume that service facilities (services or laterals for water gas, sewer, telephone, electric power, cable television, or other utilities) extend from each utility facility to each parcel or property whether or not service facilities are shown.

At least two working days but no more than fourteen calendar days before commencing any excavation on the Work, Contractor shall request Underground Service Alert (1-800- 227-2600) and non-member companies or utilities to mark or otherwise indicate the locations of their subsurface facilities including, but not limited to, structures including vaults, main conductors or conduits, and service connections or facilities.

Contractor shall comply with applicable laws pertaining to subsurface installations, especially with respect to excavations and permits. Contractor shall specifically comply with applicable provisions of Sections 4215 through 4216.9 of the Government Code. Contractor shall take all actions necessary to maintain a valid inquiry identification number during the Work.

At least ten days in advance, or 1,000 feet minimum ahead of pipeline trenching, Contractor shall excavate, expose, and determine ("pothole") the exact locations, depths, and dimensions of each and every potential interference, including, but not limited to, all facilities shown specifically (depth and location) on construction drawings, or which have been marked by their respective owners.

Upon learning of the existence or location of any utility facility omitted from or shown incorrectly on construction drawings, or improperly marked or otherwise indicated, Contractor shall immediately notify the Owner, providing full details as to depth, location, size, and function. Contractor shall immediately notify utility having jurisdiction over facility.

Contractor shall not interrupt or disturb any utility facility without written permission from the Utility or written order from the Owner. Where protection is required to ensure integrity of utility facilities located as shown on construction drawings or visible to Contractor or marked or otherwise indicated as stated herein, Contractor shall, unless otherwise provided, furnish and place all necessary protection at his expense.

Contractor is advised that the Owner has no knowledge or information about trench backfill conditions of utility facilities adjacent to or parallel with pipeline being constructed pursuant to these Specifications; therefore, Contractor shall protect against adjacent or parallel trench backfill failure. If adjacent or parallel trench fails, Contractor shall, at Contractor's expense, remove and replace said backfill material in accordance with trench backfill requirements herein and remove and replace asphalt concrete pavement and any other improvements damaged in connection therewith.

3.05 *Storage of Equipment and Materials*

Contractor shall not store equipment or materials on private or public property without written permission from property owner(s) approving such use. Said permission shall be submitted to and approved by the Owner before Contractor moves equipment or materials onto the Site.

Contractor shall not park equipment or store materials in public right-of-way except while performing Work. Contractor shall remove equipment from public right-of-way and place it in Contractor's storage or construction yard by the end of each work day. Contractor shall keep materials in Contractor's storage or construction yard until they are needed for the Work.

Storage site or construction yard shall be completely fenced prior to moving any equipment or materials onto site or into the yard. Contractor shall control dust in construction yard at all times, from establishing construction yard through construction, and until all Work has been completed and Contractor has moved all equipment, materials, and fencing from the Site.

3.06 *Trench Excavation*

A. General:

Unless specified otherwise, pipelines and appurtenances shall be installed in open trench excavations to the depth and in the direction specified by the construction drawings. Excavation for trenches shall include removal of all material of any nature as required for installation of pipe, fittings, or appurtenances and shall include blasting, either sloping or shoring, and all necessary dewatering, if any, all at Contractor's expense.

Contractor is advised that unsuitable earth may be encountered during trenching operations. Where such material is encountered, Contractor shall, at Contractor's expense, remove such material, discard it at legal disposal site(s), and thereafter replace it with approved backfill material.

B. Excavation Safety Drawings:

Before excavating any earth or soil to a depth of five (5) feet or more, Contractor shall, pursuant to Labor Code Section 6705, submit to the Owner detailed drawings (hereafter referred to as excavation safety drawings) showing design of shoring, bracing, sloping, or other provisions to be made for worker, individual, or property protection. Said excavation safety drawings shall comply with OSHA Construction Safety Orders (Cal/OSHA or Federal OSHA, whichever is applicable at time of construction) and shall be prepared and certified by a registered civil or structural engineer, engaged by Contractor at Contractor's expense, who shall affix Contractor's signature and seal to each sheet of said excavation safety drawings. Contractor shall not excavate until the Owner has received and acknowledged properly certified excavation

safety drawings. Contractor shall comply with all other applicable requirements of Labor Code Section 6705 and, as therein provided, no requirements of that Section shall be construed to impose tort liability on Owner or Owner's representatives, including Owner's Engineer.

C. Trench and Bell Hole Sloping or Shoring:

Trenches and bell holes shall be adequately sloped or shored so that earth will not slide or settle into trench, so that all existing improvements and utilities (above and below ground) will be fully protected from damage, and so that workers and individuals are protected from injury. At minimum, Contractor shall keep toe of trench spoil at least 5 feet from top of the trench. Contractor shall assume full responsibility for all damages caused by inadequate sloping or shoring. Contractor shall make all necessary repairs or perform all reconstruction at Contractor's expense and he shall bear all other expenses resulting from such damages.

D. Trench Length, Width and Depth

Unless specified otherwise, trenches shall be excavated not more than 1,000 feet in advance of pipe laying and open trenches shall be properly barricaded and signed as required for individual and property protection. Trenches shall not be excavated or left open nights, weekends, or holidays.

Unless specified otherwise, all pipeline trenches within pipe zone shall, wherever possible, have vertical sides and minimum widths as specified on the standard drawings; however, trenches shall be sloped or shored as required for worker, individual, and property protection.

Whenever maximum allowable trench width, as shown by the Drawings, is exceeded for any reason, the Owner may, at Owner's discretion, require Contractor at Contractor's expense to cradle pipe (Class B Portland cement concrete) or to provide higher class bedding to support pipe as required to limit load on pipe to allowable supporting strength. The Owner shall approve method of support prior to its use.

Trenches shall be excavated to depths specified by or shown on construction drawings or as otherwise directed by the Owner. If trench excavation is carried below grade without direction or permission, Contractor shall, at Contractor's expense, refill trench to proper grade with moist clean sand, sand and gravel, or other suitable material as approved by the Owner, tamped in place to 90 percent relative compaction minimum. Excess excavated material shall be incorporated in backfill or discarded at legal disposal site(s) by Contractor at Contractor's expense.

E. Excavated Materials:

All material excavated from trench shall be placed for minimum obstruction to traffic (automobile and pedestrian). Gutters shall be kept clear and other provisions shall be made for street or road drainage. Excess excavated material, including material rejected by the Owner for use as backfill, shall be discarded at legal disposal site(s) by Contractor at Contractor's expense.

If pipe, fittings, or appurtenances belonging to the Owner are uncovered or removed during excavation, they shall be salvaged and deposited as directed by the Owner. If the Owner determines that certain materials need not be salvaged, said materials shall be discarded at legal disposal site(s) by Contractor at Contractor's expense.

F. Blasting:

Blasting for excavation will be permitted only with approval of the Owner and only after proper precautions have been taken for protection of persons and property, provided Contractor has secured all necessary permits. Blasting shall be limited to specific periods as approved by the Owner. Any damage caused by blasting shall be repaired by Contractor at his expense. Contractor's blasting methods and procedures shall conform with State and local laws and County and municipal ordinances. Contractor shall post signs warning radio equipment operators that blasting operations are in progress and advising that radio transmissions are prohibited during blasting operations.

3.07 *Trench Bedding*

A. General:

Trenches shall have flat bottoms conforming with grades to which pipe is to be laid. Trench bottoms shall be uniform and provide firm and uniform bearing for installed pipeline.

Pipe shall be laid so that pipe barrel bears evenly on trench bottom. Bell holes shall be excavated in trench bottom and sides as necessary to permit satisfactory construction and inspection of pipe joints.

B. Unsuitable Soil:

Where unstable soil consisting of loose, soft, spongy, or organic earth is encountered, it shall be removed from trench bottom to depth determined in field by the Owner and trench shall be refilled to proper grade with moist clean sand, sand and gravel, or other suitable material as approved by the Owner, tamped in place to 90 percent relative compaction minimum. Trench bottom shall be graded flat and prepared to provide firm and uniform bearing for pipe.

Where unyielding soil consisting of rock, rocky earth, or cemented earth is encountered, it shall be removed from trench bottom to at least 9-inch below grade and trench shall be refilled to proper grade with moist clean sand, sand and gravel, or other suitable material as approved by the Owner, tamped in place to 90 percent relative compaction minimum. Trench bottom shall be graded flat and prepared to provide firm and uniform bearing for pipe.

Unless specified otherwise, Contractor shall, at Contractor's expense, remove unsuitable soil, replace it with suitable soil, and discard unsuitable soil at legal disposal site(s). Contractor shall not deposit or store unsuitable soil on private or public property without written permission of property owner(s) and without applicable governmental permits pertaining to earthwork, including compaction, and the environment. Before placing any material on private or public property, Contractor shall provide the Owner with evidence of written permission to do so and Contractor shall then obtain the Owner's written approval for same.

3.08 *Ductile Iron Pipe Installation*

Pipe manufacturer, fitting manufacturer, and material supplier, in addition to the Owner and the Owner's representative, shall have access to the Work during installation. Contractor shall use assistance provided by either manufacturer or supplier where required for proper installation of pipe, fittings, or materials; however, Contractor shall limit role of either manufacturer or supplier to advisory service.

All pipe shall be laid true to line and grade and at the locations shown by the construction drawings or as specified. Pipe shall be installed in accordance with applicable provisions of AWWA C600, latest, applicable provisions of Ductile Iron Pipe Research Association "Guide for the Installation of Ductile Iron Pipe", latest, and manufacturer's directions. Bell ends shall be placed uphill unless otherwise permitted.

After pipe has been set in trench, exterior of spigot and interior of bell shall be thoroughly cleaned. Lubricant recommended by pipe manufacturer and as approved by the Owner shall be applied to rubber gasket. Lubricant shall be water soluble, nontoxic, shall impart no objectionable taste or odor to the water, shall have no deteriorating effects on the rubber gaskets, and shall not support growth of bacteria. Excess lubricant shall be removed. Pipe ends shall be aligned, and spigot shall be pulled into bell with come-along devices, or hoists with chains and slings, unless permitted otherwise. If either the pry bar or the backhoe bucket method is permitted, a timber header shall be placed between the pipe and the pry bar or backhoe bucket before the spigot is pushed into bell.

Curved alignment by use of pulled joints will be permitted. Maximum joint deflection shall be 3 degrees. For purposes of reducing angular deflections at pipe joints, Contractor may install pipe sections of less than standard length.

Whenever cutting of pipe is required, it shall be done with a special cutting tool specifically made for cutting and machining ductile iron pipe. Cut ends and rough edges shall be ground smooth and beveled for push-on joints.

Whenever specified, pipe shall be encased with 8 mil (0.2 mm) thick minimum polyethylene tube lapped 1 foot minimum, and valves and fittings shall be wrapped with polyethylene tube or with polyethylene sheets lapped 1 foot minimum. Polyethylene tube and polyethylene sheets shall be secured in place with suitable adhesive tape. All polyethylene tube and polyethylene sheet encasements shall be installed in accordance with AWWA C105, latest.

As Work progresses, a pipe cleaning tool as approved by the Owner shall be drawn through pipe to remove dirt, rocks, or other foreign material. At the end of each day's work, all openings in the pipeline shall be plugged with watertight expandable plugs or approved equal.

3.09 *Welded Steel Pipe Installation*

A. Pipe Installation:

Pipe manufacturer, fitting manufacturer, and material supplier, in addition to the Owner and the Owner's representative, shall have access to the Work during installation. Contractor shall use assistance provided by either manufacturer or supplier where required for proper installation of pipe, fittings, or materials; however, Contractor shall limit role of either manufacturer or supplier to advisory service.

Contractor shall not move pipe using dozer blades, backhoe buckets, or the like (sharp metal surfaces). Contractor shall use nylon chokers or straps, not steel slings, in moving, placing, or setting pipe. Nylon chokers or straps shall be placed at third points (one-third length of pipe from each end).

All out-of-round pipe shall be rejected and removed from the Work site immediately. Rejected pipe shall be replaced immediately. Contractor shall not use hammers, bars, wrenches, or other tools to modify pipe ends to accommodate installation.

All pipe ends shall be secured with plastic covers. Said plastic covers shall be left in place until pipe is prepared for installation. If any plastic covers are damaged or destroyed before pipe has been installed, they shall be immediately replaced.

All pipe and fittings shall be laid true to line and grade and at the locations shown by the construction drawings or as specified. Pipe and fittings shall be installed in accordance with applicable sections of AWWA M11, "Steel Pipe Manual". Bell ends shall be placed uphill unless otherwise permitted.

All flanges shall be fully welded to pipe on both faces, one pass minimum on the inside and two passes minimum on the outside. Pipe linings shall extend to mating faces of flanges and pipe coatings shall extend to backs of flanges, tapered as necessary for installation of bolts and nuts. All exposed steel shall be field coated with an approved bitumastic material.

Special care shall be taken to avoid damaging lining or coating during lowering of pipe into trench and making of field joints. Unless specified otherwise, field joints shall be bell and spigot rubber gasket joints, continuity bonded (two evenly spaced bonding clips per joint minimum). Flanged joints, welded joints, and mechanical joints may be required for particular applications.

After pipe has been set in trench, exterior of spigot and interior of bell shall be thoroughly cleaned. Lubricant as recommended by pipe manufacturer and as approved by the Owner shall be applied to rubber gasket, and said gasket shall then be snapped into place and excess lubricant removed. Lubricant shall be water soluble, nontoxic, shall impart no objectionable taste or odor to water, shall have no deteriorating effects on the rubber gaskets, and shall not support the growth of bacteria.

Before inserting spigots into bells, to make joints, bells shall be hand mortared with quick setting non-shrink commercial grout mixed with an approved bonding agent. Once spigots have been inserted into bells, joints shall be gauged to ensure that gaskets have been properly seated.

For pipe 24-inch and larger, Contractor shall relieve (equalize) gaskets before laying to prevent gaskets from being tight on one side of pipe and slack on the other side, and adversely affecting seal. Contractor shall lift gaskets with a round blunt tool (like the shaft of a screwdriver) and roll it around the circumference of the spigot end at least once and preferably twice.

For pipe less than 24-inch in diameter, sufficient quantities of moist cement mortar shall be placed on interior joining ends of pipe to completely fill space between respective mortar linings. Moist mortar shall be placed only after respective mortar linings have been properly wetted. Moist mortar shall not be placed against dry mortar linings. Excess mortar shall be removed by drawing an approved pipe cleaning tool through the pipe after joints have been made (pipe sections have been joined). For fully welded joints, pipe sections shall be pulled together and restrained with come-along devices, or hoists with chains and slings, and mortar shall be allowed to set for twenty minutes before welding joint. Once joint has been pulled closed and cleaning tool has been drawn through pipe sections, pipe alignment shall not be adjusted, nor shall pipe be bounced or hammered. Come-along devices, or hoists with chains and slings, shall be removed only after joint has been fully welded.

For pipe 24-inch in diameter and larger, cement mortar shall be placed on interior joining ends from inside pipe after it has been set. Moist mortar shall be applied only after mortar linings have been properly wetted. Moist mortar shall not be placed against dry mortar linings. Excess mortar and debris shall be removed by hand or by other means acceptable to and approved by the Owner.

For cement mortar coated pipe, joint exteriors shall be coated with cement mortar utilizing a joint diaper. Said diaper shall be furnished by pipe manufacturer and shall be centered over joint and securely fastened to pipe. Cement mortar joint mix consisting of one part Portland cement to two parts (by weight) clean, sharp sand, shall contain just enough water to allow mix to be poured into diaper and flow around circumference of joint. Said mix shall be allowed to set prior to backfilling around joint.

Joints shall be completed to provide continuous interior lining and exterior coating. Field lining and coating must equal or exceed shop lining and coating when completed with respect to strength, uniformity, and density and there shall be no voids between lining or coating and steel cylinder.

If cement mortar lining has to be removed, Contractor shall scribe, chisel, and remove the lining using appropriate tools. If cement mortar coating has to be removed, Contractor shall first scribe, then saw cut said coating 3/4 of its thickness, and then remove coating using a chisel driven by a hammer, chipping gun, or other suitable tool. Impact shall be applied parallel with pipe barrel, not perpendicular thereto.

At the end of each day's work, all openings in the pipeline shall be plugged with watertight, expandable plugs or approved equal. Said plugs shall be secured in place so that they cannot be removed by children or animals.

B Field Welding:

Whenever field welding is required, Contractor shall attach welding machine ground to pipe only with clamps or other means acceptable to the Owner unless an alternative means is specified.

Unless specified otherwise, field welded or thrust restrained joints shall consist of flanged joints or fully welded joints. All flanges shall be fully welded to pipe on both faces, one pass minimum on the inside and two passes minimum on the outside. Welded joints shall be made with pipe having ends belled for welding, or alternatively, ends belled for rubber gasket joints, provided pipe manufacturer furnished filler rods of proper diameter, length, and curvature are installed in accordance with pipe manufacturer's recommendations, as approved by Owner. Belled ends shall not be deformed to accomplish fully welded joints. Full welds for all joints shall be accomplished with two welding passes (beads) minimum.

C. Field Cement Mortar Lining and Cement Mortar Coating

Whenever field cement mortar lining and cement mortar coating is permitted by the Owner for either repair or fabrication, Contractor shall comply with the following procedures:

1. Cement Mortar Lining

- a. Contractor shall square the edge of the remaining lining, leaving no feather edge, and shall clean metal surfaces with a stiff wire brush.
- b. Contractor shall apply approved bonding agent to both steel area and edges of adjacent lining. Cement mortar shall then be applied to the area being patched and worked and finished with a trowel until smooth. Contractor shall brush on approved curing compound over the surface of the patch to prevent rapid evaporation of moisture. Otherwise, Contractor shall keep the patched mortar moist by covering it with wet burlap. The pipe shall not be moved until the cement mortar achieves its initial set, not less than three hours.
- c. Cement mortar shall consist of not less than one part cement to three parts sand, thoroughly mixed before any water addition. Cement mortar may be approved commercial, packaged dry mortar mix. Cement mortar shall be mixed separately for each area to be patched. Quantity of water shall be just sufficient so that when mortar is firmly compressed into a ball, it will hold its shape without slump.

2. Cement Mortar Coating

- a. Exterior coating which requires removal around the complete circumference of the pipe shall be repaired by:
 - 1) Removing the coating by chipping with a hammer or chisel, and squaring the edges to accept repair patch.
 - 2) Wrapping the area with 2 x 4 x 14 GA self-furring wire mesh or an approved stucco netting and guniting the area being patched.

or

Wrapping the mesh as above and hand troweling mortar onto the area being patched.

- 3) Applying an approved curing compound to the patched area.
- 4) Avoiding movement and protecting the pipe until the cement mortar achieves its initial set, not less than three hours.

- b. Exterior coating that does not extend around the entire circumference of the pipe shall be repaired by:
 - 1) Removing the coating by chipping with a hammer and chisel, squaring the edges to accept repair patch.
 - 2) Applying by brush an approved bonding agent to both the steel area and the edges of the remaining coating.
 - 3) Applying cement mortar to the area being patched and thoroughly compacting it, with finished patch mounding up above and overlapping (at least 1-inch on all sides) the surrounding coating.
 - 4) Applying an approved curing compound to the patched area. If the repair patch is made on pipe in the ditch, it shall be covered with wet burlap, heavy cloth, or similar material and dirt shall be placed around and over the patched area by hand before proceeding with placing backfill material.
- c. The cement mortar mix proportions shall be the same as for lining repair.
- d. If the area to be patched exceeds over half of the pipe circumference, 2 x 4 x 14 GA self-furring wire mesh or approved stucco netting shall be attached to the pipe prior to the application of the cement mortar.

3. Installation of Repaired Pipe

After the repaired area has achieved initial set, not less than six hours, the pipe section can be installed, providing the patched area of the coating is backfilled with water saturated or wetted soil.

3.10 PVC Pipe Installation

Pipe manufacturer, fitting manufacturer, and material supplier, in addition to the Owner and the Owner's representative, shall have access to the Work during installation. Contractor shall use assistance provided by either manufacturer or supplier where required for proper installation of pipe, fittings, or materials; however, Contractor shall limit role of either manufacturer or supplier to advisory service.

All pipe shall be laid true to line and grade and at the locations as shown by the Construction Drawings or as specified. Pipe shall be installed in accordance with AWWA C605 and Manual M23 (latest) (including AWWA C905 pipe and couplings), applicable provisions of manufacturer's installation guides (latest) and manufacturer's directions. Owner shall approve manufacturer's product before its use. Contractor shall furnish Owner with two manufacturer's installation guides for use during construction. Bell ends shall be placed uphill unless otherwise specified.

Unless otherwise specified or shown on the Drawings, backfill within the pipe zone shall have a minimum sand equivalent of 50 as determined by ASTM D2419 (latest).

After the pipe has been set in trench, exterior of spigot and interior of bell shall be thoroughly cleaned. Lubricant recommended by pipe manufacturer and as approved by the Owner shall be applied to rubber gasket. Lubricant shall be water soluble, nontoxic, shall impart no objectionable taste or odor to the water, shall have no deteriorating effects on the rubber gaskets, and shall not support growth of bacteria. Excess lubricant shall be removed. Pipe ends shall be aligned, and spigot shall be pulled into bell with come-along devices, or hoists with chains and slings, unless permitted otherwise. If either the pry bar or the backhoe bucket method is permitted, a timber header shall be placed between the pipe and the pry bar or backhoe bucket before the spigot is pushed into bell.

Curved alignment of AWWA C900 pipe shall be accomplished by longitudinal bending of the pipe. Minimum allowable bend radii shall be as specified by the pipe manufacturer. Unless otherwise allowed by the pipe manufacturer and approved by the Owner, axial deflection at the pipe joints of AWWA C900 pipe is prohibited. Where closing sections are required, Contractor shall make all necessary measurements to select appropriate pipe lengths and closure couplings for correct installation.

Curved alignment of AWWA C905 pipe by use of longitudinal bending is prohibited; however, curved alignment by use of pulled joints will be permitted. Unless otherwise allowed by the pipe manufacturer and approved by the Owner, maximum joint deflection shall be one (1) degree. For purposes of reducing angular deflections at pipe joints and for closure sections, Contractor may install pipe sections of less than standard length. Where closing sections are required, Contractor shall make all necessary measurements to select appropriate pipe lengths and closure couplings for correct installation.

Whenever cutting of pipe is required, it shall be done with a special cutting tool specifically made for cutting and machining PVC pipe. Cut ends and rough edges shall be ground smooth and beveled for push-on joints.

Pipe locator wire (No. 14 AWS insulated copper) shall be installed in trench with pipe where shown by the Standard Drawings unless it is specifically deleted by the Construction Drawings or by Owner. It shall be held in place by looping the pipe at 20 foot intervals maximum, or as specified.

As work progresses, a pipe cleaning tool as approved by Owner shall be drawn through the pipe to remove dirt, rocks, or other foreign material. At the end of each day's work, all openings in the pipeline shall be plugged with watertight expandable plugs or Owner approved equal.

Unless specified otherwise, polyvinyl chloride pipe shall not be encased with concrete. If protection is necessary it shall be accomplished by the use of conductor casing(s) as approved by Owner.

3.11 Trench Backfill

A. General:

In addition to meeting backfill requirements specified herein, Contractor shall also comply with backfill requirements established through permits issued by jurisdictions (State, County, City) having control over rights-of-way in which construction is taking place. Whenever the separate requirements conflict with one another, the more stringent shall apply. Backfill shall not commence without prior approval of the Owner.

Backfill material shall be either select excavated material, screened or washed if necessary, or commercially processed material. Backfill material shall meet separate specific requirements for backfill within pipe zone and backfill above pipe zone. Backfill material meeting pipe zone requirements may be used for above pipe zone backfill material but not the reverse.

After sheeting, shoring, or shields have been removed, all backfill material including pipe zone backfill material shall be compacted to 90 percent relative compaction minimum except that the upper 12 inches of backfill material shall be compacted to 95 percent relative compaction minimum, as verified by field compaction tests. Relative compaction shall be based on maximum dry density determined in accordance with ASTM D-1557, latest. The Owner will specify where (number & location) compaction tests are to be taken.

Contractor shall assist, at no additional cost to the Owner, soils engineer in taking all compaction tests. Contractor shall furnish all equipment (including shoring), labor, and materials needed for such assistance. Compaction testing shall be completed and accepted by the Owner prior to hydrostatic and leakage testing of pipelines and appurtenances.

Within highways, thoroughfares, and streets, Contractor shall, at the end of each work day and by 5:00 PM, unless permitted otherwise, completely backfill trenches with material sufficiently compacted to support traffic. Contractor shall then place 2-inch minimum thickness temporary asphalt concrete pavement over trench; it shall be compacted, rolled smooth with a steel wheeled pavement roller and placed flush with adjacent pavement. Contractor shall maintain and repair backfilled and paved areas to prevent potholes or pavement failures. Highways, thoroughfares, and streets shall be completely open to traffic at night (after 5:00 PM), on weekends, on holidays, and whenever Contractor is not actively working in a specific area.

Contractor shall not excavate trenches or install pipe in highways, thoroughfares, and streets on weekends and holidays. Holidays include union holidays, Owner holidays, and County and municipal holidays. Contractor shall not leave any excavation open overnight or on weekends or holidays.

B. Backfill Within Pipe Zone:

Unless specified otherwise, select excavated material, screened or washed if necessary, shall be used and it shall consist of moist clean, loose earth, sand, or gravel (1-inch maximum size) free of clay and silt as well as brush, roots, and organic substances.

Initial backfilling shall be performed as soon as possible after pipe has been laid. Loose, moist backfill material shall be placed in trench simultaneously on each side of pipe to a depth not greater than pipe centerline (springline) or 12-inch (loose measurement), whichever is less, and it shall then be tamped under pipe so that all voids are eliminated and material is compacted to 90 percent relative compaction minimum.

Subsequent backfilling shall be performed immediately following initial backfilling. Loose, moist backfill material shall continue to be placed in trench simultaneously on each side of pipe in lifts not exceeding 12-inch in thickness (loose measurement), with each lift being tamped, until the pipe has been covered by at least 12-inch of well compacted material. Alternatively, backfill material may be densified by water settlement until the pipe has been covered by at least 12-inch of well densified material. Backfilled material shall be tamped or settled to 90 percent relative compaction minimum.

Regardless of compaction or densification technique, care in backfilling shall be exercised to avoid any damage to pipe, fittings, and appurtenances, to avoid any damage to persons or property, and to achieve relative compaction of backfilled material of at least 90 percent minimum.

C. Backfill Above Pipe Zone:

Backfill material shall consist of moist clean loose earth, sand, gravel, or rock free of clay and silt as well as brush, roots, and organic substances. From the top of selected backfill in the pipe zone to within 1 foot of ground surface or pavement subgrade, backfill material shall be free of material exceeding 8-inch in greatest dimension. It shall also be compacted to 90 percent relative compaction minimum. Within 1 foot of ground surface or pavement subgrade, backfill material shall be free of material exceeding 2-inch in greatest dimension and it shall be compacted to 95 percent relative compaction minimum. Rocks shall be mixed with suitable soil to eliminate voids; they shall not be nested, Backfill material shall be well graded.

Backfill material shall be placed in lifts not exceeding 12-inch in thickness (loose measurement) and each lift shall be compacted to 90 percent relative compaction minimum by hand tampers, pneumatic tampers, or mechanical compactors except that the upper 12-inch of backfill shall be compacted with mechanical compactors or compaction equipment, excluding stompers, to 95 percent relative compaction.

D. Imported Backfill Material:

Whenever excavated material is unsuitable as backfill material and Contractor is unable to process or screen such material for backfill material or whenever excavated material is insufficient to accomplish backfill and Contractor must secure additional material, Contractor shall import such material and the material and its source shall be approved by the Owner.

Unless specified otherwise, imported backfill material shall be commercially processed and it shall be selected, clean, loose earth, sand, or gravel (1-inch maximum size). Said material shall be granular and it shall be free of clay, silt, and fine sand. It shall be suitable for compaction with minimum effort.

E Backfill Completion:

Where pavement is not required, trench backfill shall be brought to grade of existing surface and dressed to provide firm, stable, and even surface without ruts or irregularities. It shall conform with grades of existing surface. Where pavement is required, trench backfill shall be brought to subgrade for pavement structure. Pavement shall then be placed in accordance with paving requirements.

3.12 *Field Hydrostatic Test and Leakage Test*

A. Hydrostatic and Leakage Test

Hydrostatic and leakage testing shall be performed in accordance with Section 331400.

B. General Requirements:

- 1) Required test pressures shall be applied by pump connected to pipeline sections being tested. The Owner shall approve pump connections to pipeline before testing begins. As part of the Work, and unless specified otherwise, Contractor shall install, at Contractor's expense, top outlets (service taps) required for testing. Contractor shall provide calibrated meters for measurement of leakage, and all pumps, piping, fittings, bulkheads, plugs, valves, gages, power equipment, and manpower necessary for conducting all tests required, all at Contractor's expense. Contractor shall furnish the Owner three copies of all records of all tests performed.

- 2) Unless specified otherwise, Contractor shall test against test plates for pipelines 12-inch and smaller. Contractor shall not remove said test plates until pipelines have been tested, disinfected, and accepted by the Owner.
- 3) Contractor, at Contractor's expense, shall locate and repair leaks or other defects which may develop or become apparent during test. Contractor shall excavate, including removal of backfill already placed, and make all repairs necessary for required water tightness, and then replace all excavated material, after which Contractor shall retest repaired pipeline section. Pipeline sections shall be repeatedly repaired and tested until they meet requirements set forth herein.
- 4) Pipe manufacturer and fitting manufacturer shall have free access to the Work during testing. Any improper act on the part of Contractor which the pipe and fitting manufacturer may observe shall be reported to the Owner. Pipe and fitting manufacturer shall be free to observe and verify all tests.
- 5) After completed pipeline and appurtenances or test sections have successfully met test requirements to the satisfaction of the Owner, the entire pipeline or each test section shall be filled or shall remain filled with water until completion of the Work, unless otherwise ordered by the Owner.

3.13 *Miscellaneous Requirements*

A. Connections to Existing Water Mains:

The Contractor shall make all connections to existing water mains in the presence of Owner's inspector. Contractor shall obtain a water connection permit from the Owner prior to performing said connection work. Contractor shall provide all labor, equipment, and materials necessary to perform connection work, including but not limited to, isolation gate valve, fittings, and adapters.

Hydrostatic testing against isolation valves will not be allowed. Adjacent to the isolation valve, Contractor shall install a test plate for the aforementioned test and, after satisfactory test, remove said test plate and replace it with a 1/8 inch thick minimum ring gasket. The use of any other test appurtenances shall be as approved by the Owner.

B. Field Painting:

Contractor shall field paint all aboveground, bare, or exposed Piping and appurtenances in accordance with the applicable specifications and drawings.

END OF SECTION 33 11 00

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33 11 13.00 DUCTILE IRON WATER PIPE (ZINC COATED) AND FITTINGS

Part 1 General

Part 1 General

1.01 Requirement

It is required that the contractor shall furnish, unload and string along the trench site, all pipe and material as hereinafter described in these specifications. All fabrication, workmanship, material, and testing of pipe shall conform to the latest revision of the specifications.

1.02 Delivery

- A. Transport, deliver, unload, store and handle all materials in a manner to prevent damage to the materials or the work.
- B. All damaged, broken or otherwise defective materials will be rejected.
- C. Store all circular rubber gaskets and special lubricants in packaged materials with the manufacturer's name, brand and all other applicable data plainly marked thereon.

1.03 Quality Assurance

A. American Water Works Association (AWWA).

1. Ductile iron pipe centrifugally cast in metal molds or sand-lined molds for water or other liquids ANSI A21.51 (AWWA C151).
2. Cement mortar lining for ductile iron pipe and fittings for water ANSI A21.4 (AWWA C104).
3. Rubber gasket joints for ductile iron pressure pipe and fittings (ANSI A21.11 (AWWA C111).
4. Polyethylene Encasement for ductile iron pipe (ANSI/AWWA C105).
5. Standard for disinfecting water mains ANSI/AWWA C651.
6. Installation of ductile cast iron water mains and appurtenances ANSI/AWWA C600.
7. Thickness design of ductile iron pipe ANSI A21.50 (AWWA C150).

1.04 Measurement and Payment

Payment for pipe shall be made on a unit price basis per lineal foot of pipe.

Part 2 Product

2.01 Type of Pipe

Ductile iron pipe shall conform to ANSI A21.51 (AWWA C151) class to thickness designed per ANSI 21.50 (AWWA C150), Zinc coated and cement mortar lined per ANSI A21.4 (AWWA C104) unless otherwise specified, with bolted mechanical joints or push-on joints as indicated on the plans or special provisions. The minimum laying lengths for DIP shall be 18-feet. Cut sections of pipe (pups) shall not be less than 2 feet in length for pipe diameters 12 inches and smaller and not less than 3 feet for pipe diameters 18 inches and larger. Delivered pipe to include 5% +/- short joints.

2.02 Class of Pipe

Ductile iron pipe shall be minimum pressure class 350 for pipe diameters 12-inch and smaller, Class 250 for 18-inch and larger unless indicated differently on the plans.

2.03 Type of Fittings

Fittings shall be ductile iron and shall conform to ANSI A21.10 (AWWA C110) or A21.53 (AWWA C153), and ANSI A21.11 (AWWA C111). Fittings shall be bolted mechanical joints or push-on joints unless otherwise indicated on the plans, bid items, or the special provisions. All bends shall use mechanical joints for 18-inch and above. Fittings shall be tar (seal) coated and cement mortar lined per ANSI A21.4 (AWWA C104). Above grade fittings shall be flanged and from the Approved Materials List.

2.04 Service Connection Outlets

Service connection outlets shall be bronze service saddles with CS (Mueller) threads for receiving a bronze corporation stop in accordance with CVWD Standard Drawing W-6. Service Saddle shall be Mueller, Jones or approved equal, for piping up to 18-inch. Piping 24-inch and larger shall not be tapped for domestic services unless approved on the plans.

2.05 Polyethylene Encasement

All ductile iron pipe and fittings shall be encased with V-Bio enhanced polyethylene at the time of installation. Polyethylene encasement and installation shall be in accordance with ANSI/AWWA C105. Polyethylene encasement shall consist of three layers of co-extruded linear low density polyethylene, fused into a single thickness of not less than 8 mils. The inside surface of the polyethylene wrap to be in contact with the pipe exterior shall be infused with a blend of anti-microbial compound to mitigate microbiologically influenced corrosion and a volatile corrosion inhibitor to control galvanic corrosion.

2.06 Restrained Systems

Restrained systems for ductile iron pipe shall be installed in accordance with Section 33 11 13, Part 2 of CVWD Specifications.

2.07 Coating

The exterior of ductile iron pipe shall be coated with a layer of arc-sprayed zinc per ISO 8179. The mass of the zinc applied shall be 200 g/m² of pipe surface area. A finishing layer of asphaltic topcoat per AWWA Standard C151 shall be applied to the zinc. The mean dry thickness of the finishing layer shall not be less than 3 mils and shall not exceed 10 mils. The zinc coating system shall conform to ISO 8179-1 "Ductile Iron pipes – External zinc-based coating – Part 1: Metallic zinc with finishing layer." Most recent edition.

Minor scratches and larger areas shall be field repaired by a field application of a zinc-rich paint containing more than 85% zinc by mass in the dried film.

Part 3 Execution

3.01 Installation

Ductile iron pipe shall be installed in accordance with ANSI/AWWA C600 and Section 33 11 13 of these Specifications.

END OF SECTION 33 11 13.10

SECTION 33 11 13.10
DUCTILE IRON WATER PIPE AND FITTINGS

PART 1 General

1.01 *Requirements*

It is required that the contractor shall furnish, unload and string along the trench site, all pipe and material as hereinafter described in these specifications. All fabrication, workmanship, material, and testing of pipe shall conform to the latest revision of the Specifications.

1.02 *Delivery*

- A. Transport, deliver, unload, store and handle all materials in a manner to prevent damage to the materials or the work.
- B. All damaged, broken or otherwise defective materials will be rejected.
- C. Store all circular rubber gaskets and special lubricants in packaged materials with the manufacturer's name, brand and all other applicable data plainly marked thereon.

1.03 *Quality Assurance*

- A. American Water Works Association (AWWA).
 - 1. Ductile iron pipe centrifugally cast in metal molds or sand-lined molds for water or other liquids ANSI A21.51 (AWWA C151).
 - 2. Cement mortar lining for ductile iron pipe and fittings for water ANSI A21.4 (AWWA C104).
 - 3. Rubber gasket joints for ductile iron pressure pipe and fittings (ANSI A21.11 (AWWA C111)).
 - 4. Standard for disinfecting water mains ANSI/AWWA C651.
 - 5. Installation of ductile cast iron water mains and appurtenances ANSI/AWWA C600.
 - 6. Thickness design of ductile iron pipe ANSI A21.50 (AWWA C150).

1.04 *Measurement and Payment*

Payment for pipe shall be made on a unit price basis per lineal foot of pipe.

PART 2 Product

2.01 Type of Pipe

Ductile iron pipe shall conform to ANSI A21.51 (AWWA C151) class to thickness designed per ANSI 21.50 (AWWA C150), Tar (Seal) coated and cement mortar lined per ANSI A21.4 (AWWA C104) unless otherwise specified, with bolted mechanical joints or push-on joints as indicated on the plans or special provisions. The minimum laying lengths for DIP shall be 18 feet. Cut sections of pipe (pups) shall not be less than 2 feet in length for pipe diameters 12-inch and smaller and not less than 3 feet for pipe diameters 18-inch and larger. Delivered pipe to include 5% +/- short joints.

2.02 Class of Pipe

Ductile iron pipe shall be minimum pressure class 350 for pipe diameters 12-inch and smaller, Class 250 for 18-inch and larger unless indicated differently on the plans.

2.03 Type of Fittings

Fittings shall be ductile iron and shall conform to ANSI A21.10 (AWWA C110) or A21.53 (AWWA C153), and ANSI A21.11 (AWWA C111). Fittings shall be bolted mechanical joints or push-on joints unless otherwise indicated on the plans, bid items, or the special provisions. All bends shall use mechanical joints for 18-inch and above. Fittings shall be tar (seal) coated and cement mortar lined per ANSI A21.4 (AWWA C104). Above grade fittings shall be flanged and from the Approved Materials List.

2.04 Service Connection Outlets

Service connection outlets shall be bronze service saddles with CS (Mueller) threads for receiving a bronze corporation stop in accordance with CVWD Standard Drawings W-7, W-9, and W-11. Service Saddle shall be Mueller, Jones or approved equal, for piping up to 18-inch. Piping 24-inch and larger shall not be tapped for domestic services unless approved on the plans.

2.05 Polyethylene Encasement

All ductile iron pipe and fittings shall be polyethylene encased at the time of installation. Polyethylene encasement and installation shall be in accordance with ANSI/AWWA C105.

2.06 Restrained Systems

Restrained systems for ductile iron pipe shall be installed in accordance with Section 33 11 13, Part 2 of CVWD Specifications.

PART 3 Execution

3.01 *Installation*

Ductile iron pipe shall be installed in accordance with ANSI/AWWA C600 and Section 33 11 13 of these Specifications.

END OF SECTION 33 11 13.10

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SECTION 33 11 13.20
PVC PIPELINE SPECIFICATIONS

PART 1 General

1.01 *Description*

Contractor shall furnish all pipe, fittings, materials, equipment, and labor and perform all operations necessary to construct pipelines and appurtenances as shown on the Drawings. Drawings shall consist of construction drawings, installation drawings, laying drawings, standard drawings, detailed drawings, layout drawings, fabrication drawings, shop drawings, and clarifying diagrams or sketches.

The Work shall consist of all traffic control (including furnishing and installing all barricades, signs, delineators, arrow boards, and flagmen); verification of utilities (excavating, exposing, and verifying locations, depths, and dimensions of utility facilities); all pavement removal and disposal; all earthwork (including trenching, shoring, dewatering if required, blasting if required, bedding, backfilling, and compacting); furnishing and installing all pipe, fittings, appurtenances, and making all related connections; protecting in place or removing and replacing all existing utilities and public and private improvements; removing and replacing all asphalt and Portland cement concrete pavement; pavement striping and restriping as required; disinfecting and testing all pipelines; disposing of excess soil and rock material; and restoring all areas and improvements to pre-construction conditions.

Contractor shall, upon completion and successful testing of pipeline and appurtenances required herein, initially operate all components of the Work installed or furnished and make any additional adjustments, corrections, repairs, replacements, and reconstructions necessary to provide the Owner with complete and properly operating pipelines and appurtenances.

1.02 *Submittals*

Complete fabrication, assembly, and installation drawings, together with details and data governing materials used and other accessories furnished, shall be submitted for approval in accordance with Article 6 of Section 00 72 13. Data shall include, but not be limited to, the following:

A. Polyvinyl Chloride Pipe:

Contractor shall furnish an Affidavit of Compliance in accordance with Section 6.3, AWWA C900 and/or C905 (latest). Contractor shall also furnish certified copies of test reports containing results of all physical and chemical tests on pipe and coupling showing compliance with AWWA C900 and AWWA C905 (latest) as modified herein.

Unless specified otherwise, Contractor shall prepare detailed installation or laying drawings showing pipe, fittings, appurtenances, station and elevation for each fitting, and each approved change in alignment or slope. Contractor shall submit the detailed installation or laying drawings to Owner for approval in sufficient time to allow review and approval, and to accommodate the Contractor's construction schedule.

Revisions shown on the shop drawings shall be considered changes necessary to meet the requirements of these Specifications and shall not be taken as the basis of claims for extra charges. Contractor shall accept such revisions or submit others for acceptance. When delays are caused by resubmissions of shop drawings, Contractor shall not be entitled to any damages or extensions of time for such delays.

The Owner's acceptance of detailed layout and shop or fabrication drawings shall apply only to general arrangement and general compliance and not to specific details and dimensions and their correctness and compatibility. Contractor shall correct any misfits due to any errors in the detailed shop or fabrication drawings. Any fabrication in advance of receipt of detailed layout and shop or fabrication drawings marked "Accepted" or "Furnish as Corrected" shall be at Contractor's risk. Contractor shall furnish the Owner six sets of all accepted layout and shop or fabrication drawings.

PART 2 Products

2.01 General

A. Construction Materials:

Contractor shall furnish only approved materials as listed in the Owner's approved materials list. All materials shall be new and of the best quality for their intended use. All like materials shall be of one manufacturer for any particular project.

Contractor shall, in addition to furnishing other data herein required, submit three signed and dated copies of the list of materials to be used in pipeline construction.

2.02 Polyvinyl Chloride Pipe

A. Scope:

Polyvinyl chloride (PVC) pipe furnished and installed under these Specifications shall conform to applicable AWWA Standards (latest), as modified herein, by the Drawings, or by Owner.

All pipe furnished shall be manufactured by an organization which has had not less than 10 years successful experience in the manufacture of the type of pipe specified. Owner shall approve manufacturer's product before its use.

B. Pipe and Couplings:

All pipe and couplings furnished shall conform to AWWA C900 and C905 (latest) and the following additional requirements:

1. Unless otherwise specified or shown on the Drawings, AWWA C900 pipe and couplings shall be minimum Class 235 (4-inch through 12-inch diameter) (maximum dimension ratio of 18). Polyvinyl chloride pipe shall have the same outer dimensions as ductile iron pipe and pipe bell and pipe spigot shall have same thickness as pipe barrel.

Standard lengths of pipe shall have nominal length of 20 feet, 0 inches, plus or minus 1-inch. Standard lengths of pipe shall be furnished with integral bells and spigots and with rubber gaskets. Couplings may be used for closures and curved alignments where permitted by the Owner.

Pipe shall have sufficient strength to withstand an internal hydrostatic pressure of four times rated operating pressure for its class per AWWA C900 (latest).

2. Unless otherwise specified or shown on the Drawings, AWWA C905 pipe and couplings (14-inch through 36-inch diameter) shall have a maximum dimension ratio of 18 (Class 235). Polyvinyl chloride pipe shall have the same outer dimensions as ductile iron pipe and pipe bell and pipe spigot shall have same thickness as the pipe barrel.

Standard lengths of pipe shall have a nominal length of 20 feet, 0 inches, plus or minus 1-inch. Standard lengths of pipe shall be furnished with integral bells and spigots and with rubber gaskets. Couplings may be used for closures and curved alignments where permitted by the Owner.

Pipe shall have sufficient strength to withstand an internal hydrostatic pressure of two times the rated operating pressure for its class per AWWA C905 (latest).

3. Where restrained joints are required (specified or shown on the Drawings), the restraint system shall be a split ring installed on the spigot connected to a solid back-up ring seated behind the bell. Restraint system shall be Series 1350 Uni-Flange, Star Pipe Products Series 1100, EBBA Iron Megalug or equal. The solid back and split rings shall apply even pressure around the pipe and provide 360 degrees contact. Restraint device shall be ductile iron with 316 stainless steel rods and nuts. Restraint device shall be rated for full working pressure of the pipe with a 2:1 factor of safety.

C. Fittings:

All fittings shall be Class 150 ductile iron unless otherwise specified or shown on the Drawings.

Ductile iron fittings shall conform with AWWA C110, C111, and C153 (ANSI A21.10, A 21.11, and A21.53, respectively), latest. Unless specified otherwise, fittings shall be push-on joint and comply with AWWA C111 (ANSI A21.11). Fittings shall have an asphaltic outside coating in accordance with AWWA C110 or C 153 (ANSI A21.10 or A21.53), latest, and cement mortar lining in accordance with AWWA C104 (ANSI A21.4), latest. Fittings shall have standard lining thickness and shall be seal coated with asphaltic material or other approved material. The lining process must produce a dense, compacted lining that shall be bonded to the interior of the fitting and have a smooth surface.

Where PVC fittings are specified on the Drawings or permitted as an alternative as specified on the Drawings, fittings shall be in compliance with AWWA C907 (4-inch through 8-inch). Affidavits and testing results shall be submitted as required for PVC pipe.

Where a "special lining" is specified, it shall be provided in accordance with Part 2.08 herein.

Where restrained joints are required (specified or shown on the Drawings), the system shall be suitable for mechanical joint fittings or push-on fittings and be of split ring design providing even pressure around the pipe with 360 degrees contact. The rings shall be ductile iron and threaded rods shall be 316 stainless steel. System shall be Uni-Flange Series 1300 or equal.

D. Testing:

All pipe and couplings furnished shall be tested in the United States in accordance with Section 4, AWWA C900 and AWWA C905.

E. Manufacturing Inspection and Certification:

Owner shall at all times have the right to inspect all work and materials in the course of manufacture. Manufacturer shall furnish Owner reasonable facility for obtaining such information as Owner may desire regarding the progress and manner of the work and the character and quality of materials used.

F. Loading, Transporting, and Unloading:

After the pipe has been tested in accordance with Section 5 above, it shall be loaded on rubber-tired vehicles, adequately supported and chocked to prevent any damage during transportation, and delivered to the job site. All pipe and couplings (AWWA C900 and C905) shall be unloaded and stored in

accordance with AWWA manual M23 (latest). During the unloading and stringing operations, the pipe shall be moved in such a manner as to prevent injury to the pipe and/or couplings. Unloading shall be accomplished in a workmanlike manner as directed by the manufacturer. Under no circumstances are pipe sections to be dropped or bumped in handling.

G. Defective or Damaged Material:

The pipe and couplings shall be carefully inspected for defects. Any pipe, coupling, sleeve, or rubber ring found to be defective in workmanship or material or so damaged as to make repair and use impossible shall be rejected and removed from the job site.

In the event that pipe is damaged, the damaged portion may be removed, as approved by the Owner, and discarded. Remaining sound portions may be used with ductile iron fittings or with couplings. Contractor shall be responsible for any and all damage to material and shall stand expense of repairing or replacing same. Contractor shall take proper precautions to assure that the rubber gaskets are protected from oxidation or undue deterioration.

PART 3 Execution

3.01 Pipeline Construction

A. Pipelines and Appurtenances:

Pipelines and appurtenances shall be constructed in accordance with these Specifications and the Construction Drawings, and as specified by the Owner.

B. Valves and Appurtenances:

Pipeline valves at pipeline intersections shall be connected directly to pipeline intersection fittings (cross or tee) and, unless specified otherwise, all mainline or side outlet valves shall be located 3 feet minimum from any curb face. Pipeline valves shall not be placed under the curb or gutter or in a parkway unless approved by the Owner.

All appurtenances, including but not limited to air valve installations, blowoff installations, and related facilities, such as fire hydrants, fire services, and water services, shall not be installed within 5 feet of curb returns, curb depressions, and driveway approaches, or in inaccessible locations or locations where interferences may restrict facility operation, unless permitted otherwise by the Owner.

Unless specified otherwise, air valve installations shall be constructed at all pipeline high spots and blowoff installations shall be constructed at all pipeline low spots. Contractor shall construct, at Contractor's expense, air valve installations and blowoff installations in addition to those specified, if necessary, to accommodate Contractor's work and schedule.

C. Pipeline Length:

All pipeline lengths noted by the Construction Drawings or otherwise specified or referenced shall mean net horizontal constructed lengths and said lengths shall extend through all fittings and appurtenances including bends, outlets, tees, flanges, and valves. Contractor shall provide all pipe necessary to accommodate any vertical alignment of the pipeline and said pipe shall be represented by the net horizontal constructed length.

D. Pipeline Alignment:

All pipelines shall be constructed with no basic variation in horizontal alignment as shown by the Drawings or as specified by the Owner. Pipelines shall be constructed parallel with centerlines of streets or rights-of-way and appurtenances shall be constructed perpendicular thereto unless the construction drawings specify otherwise. Pipelines may be constructed by the use of pulled joints, short joints, bevels, bends, and elbows, provided pipelines are constructed as specified.

In all non-critical areas and subject to the Owner's approval, pipelines may be constructed at variance with vertical alignment as shown by the Drawings by the use of pulled joints, short joints, bevels, bends, and elbows provided pipelines are constructed as specified at pipeline connections and underground interferences, and where pipeline cover is limited. The Owner will not approve any variation in vertical alignment until it has determined that proposed alignment is proper and modifications are in order.

E. Pipeline Tolerances:

With regard to vertical alignment, pipelines shall be constructed so that actual flow line elevations, measured at pipe joints, are within 0.1 foot of design flow line elevations. Pipelines, when installed, shall have continuous slope upgrade or downgrade, corresponding with design slope, without any high spots.

With regard to horizontal alignment, pipelines shall be constructed so that actual pipeline centerlines, measured at pipe joints, are within 0.1 foot of design pipeline centerlines. Pipelines, when installed, shall closely follow specified horizontal alignment.

Pipeline construction shall conform to Construction Drawings and layout, shop, fabrication, installation, or laying drawings (design drawings which show flow line elevations and pipeline centerlines) in accordance with the above specified tolerances. Contractor shall make or assist the Owner in making all necessary measurements, as determined by the Owner, to confirm or verify compliance with construction tolerances.

F. Pipeline Cover:

Pipeline cover as shown by the Drawings is hereby defined as design cover over pipeline. If field conditions determined during construction staking show that pipe grade changes are required to provide design cover, Contractor shall, at Contractor's expense, make required changes in pipeline grade and construct pipeline accordingly based on the revised Drawings.

Pipeline cover from top of pipe to ground surface over pipeline shall not be less than 36-inch. Where future ground surface elevation over the pipeline has been established and where actual ground surface is greater, pipeline cover shall be referenced to future (established) ground surface elevation, not actual ground surface elevation.

3.02 *Survey Monuments and Staking*

Contractor shall not disturb or destroy any existing monuments or bench marks. If any survey monuments or bench marks need to be removed and replaced, Contractor shall have all necessary services performed by a registered civil engineer prior to 1982 or a licensed land surveyor. If Contractor fails to comply, the Owner's Representative will have said services performed at Contractor's expense.

Before removing any monuments in preparation for construction, Contractor shall have a registered civil engineer prior to 1982 or licensed land surveyor set at least four ties for each monument to be removed and replaced; after construction Contractor shall have the same registered civil engineer or licensed land surveyor replace each monument using the aforementioned ties and file a corner record with Riverside County and pay the appropriate fees for each replaced monument.

Unless specified otherwise, Contractor shall use construction stakes and cut sheets for pipeline construction and the Owner's Representative will use them for construction inspection. All construction stakes shall be set by a registered civil engineer prior to 1982 or licensed land surveyor. The Owner must approve cut sheets before actual construction. Contractor shall protect all construction stakes set for construction and Contractor shall restore any construction stakes destroyed or disturbed. If Contractor fails to comply, the Owner will have services performed at the Contractor's expense.

3.03 *Traffic Control*

Contractor shall prepare, submit, and provide traffic control drawings for construction. Said traffic control drawings shall be approved by the Owner and agencies having jurisdiction over highways, thoroughfares, and streets prior to starting construction.

Traffic control requirements may be modified by the Owner or said agencies as conditions warrant. Contractor shall modify traffic control as required by the Owner or said agencies at no additional cost. Throughout the Work, the Contractor shall inspect traffic control equipment (signs, barricades, arrowboards, and delineators) and shall maintain same in accordance with said traffic control drawings.

All construction signing, lighting, and barricading shall comply with the State of California, Department of Transportation "Manual of Traffic Controls, Warning Signs, Lights, and Devices for Use in Performance of Work Upon Highways", latest edition.

3.04 *Storage of Equipment and Materials*

Contractor shall not store equipment or materials on private or public property without written permission from property owner(s) approving such use. Said permission shall be submitted to and approved by the Owner before Contractor moves equipment or materials onto the Site.

Contractor shall not park equipment or store materials in the public right-of-way except while performing Work. Contractor shall remove equipment from public right-of-way and place it in Contractor's storage or construction yard by the end of each work day. Contractor shall keep materials in Contractor's storage or construction yard until they are needed for the Work.

Storage site or construction yard shall be completely fenced prior to moving any equipment or materials onto the site or into the yard. Contractor shall control dust in construction yard at all times, from establishing construction yard through construction, and until all Work has been completed and Contractor has moved all equipment, materials, and fencing from the site.

3.05 *PVC Pipe Installation*

Pipe manufacturer, fitting manufacturer, and material supplier, in addition to the Owner and the Owner's representative, shall have access to the Work during installation. Contractor shall use assistance provided by either the manufacturer or supplier where required for proper installation of pipe, fittings, or materials; however, Contractor shall limit the role of either manufacturer or supplier to advisory service.

All pipe shall be laid true to line and grade and at the locations as shown by the Drawings or as specified. Pipe shall be installed in accordance with AWWA C605 and Manual M23 (latest) (including AWWA C905 pipe and couplings), applicable provisions of the manufacturer's installation guides (latest) and manufacturer's directions. Owner shall approve manufacturer's product before its use. Contractor shall furnish Owner with two manufacturer's installation guides for use during construction. Bell ends shall be placed uphill unless otherwise specified.

Contractor shall install pipe in accordance with the trench details shown on the Drawings.

After the pipe has been set in trench, exterior of spigot and interior of bell shall be thoroughly cleaned. Lubricant recommended by pipe manufacturer and as approved by the Owner shall be applied to rubber gasket. Lubricant shall be water soluble, nontoxic, shall impart no objectionable taste or odor to the water, shall have no deteriorating effects on the rubber gaskets, and shall not support growth of bacteria. Excess lubricant shall be removed. Pipe ends shall be aligned, and spigot shall be pulled into bell with come-along devices, or hoists with chains and slings, unless permitted otherwise. If either the pry bar or the backhoe bucket method is permitted, a timber header shall be placed between the pipe and the pry bar or backhoe bucket before the spigot is pushed into the bell.

Curved alignment of AWWA C900 pipe shall be accomplished by longitudinal bending of the pipe. Minimum allowable bend radii shall be as specified by the pipe manufacturer. Unless otherwise allowed by the pipe manufacturer and approved by the Owner, axial deflection at the pipe joints of AWWA C900 pipe is prohibited. Where closing sections are required, Contractor shall make all necessary measurements to select appropriate pipe lengths and closure couplings for correct installation.

Curved alignment of AWWA C905 pipe by use of longitudinal bending is prohibited; however, curved alignment by use of pulled joints will be permitted. Unless otherwise allowed by the pipe manufacturer and approved by the Owner, maximum joint deflection shall be one (1) degree. For purposes of reducing angular deflections at pipe joints and for closure sections, Contractor may install pipe sections of less than standard length. Where closing sections are required, Contractor shall make all necessary measurements to select appropriate pipe lengths and closure couplings for correct installation.

Whenever cutting of pipe is required, it shall be done with a special cutting tool specifically made for cutting and machining PVC pipe. Cut ends and rough edges shall be ground smooth and beveled for push-on joints.

Pipe locator wire (No. 14 AWS insulated copper) shall be installed in trench with pipe where shown by the Standard Drawings unless it is specifically deleted by the Construction Drawings or by Owner. It shall be held in place by looping the pipe at 20 foot intervals maximum, or as specified.

As work progresses, a pipe cleaning tool as approved by the Owner shall be drawn through the pipe to remove dirt, rocks, or other foreign material. At the end of each day's work, all openings in the pipeline shall be plugged with watertight expandable plugs or Owner approved equal.

Unless specified otherwise, polyvinyl chloride pipe shall not be encased with concrete. If protection is necessary it shall be accomplished by the use of conductor casing(s) as approved by the Owner.

3.06 *Trench Backfill*

A. General:

In addition to meeting backfill requirements specified in Section 31-23-17 Trenching, Excavation, Backfill, and Compaction, Contractor shall also comply with backfill requirements established through permits issued by jurisdictions (State, County, City) having control over rights-of-way in which construction is taking place. Whenever the separate requirements conflict with one another, the more stringent shall apply. Backfill shall not commence without prior approval of the Owner.

Contractor shall assist, at no additional cost to the Owner, soils engineer in taking all compaction tests. Contractor shall furnish all equipment (including shoring), labor, and materials needed for such assistance. Compaction testing shall be completed and accepted by the Owner prior to hydrostatic and leakage testing of pipelines and appurtenances.

Within highways, thoroughfares, and streets, Contractor shall, at the end of each work day and by 5:00 PM, unless permitted otherwise, completely backfill trenches with material sufficiently compacted to support traffic. Contractor shall then place 2-inch minimum thickness temporary asphalt concrete pavement over trench; it shall be compacted, rolled smooth with a steel wheeled pavement roller and placed flush with adjacent pavement. Contractor shall maintain and repair backfilled and paved areas to prevent potholes or pavement failures. Highways, thoroughfares, and streets shall be completely open to traffic at night (after 5:00 PM), on weekends, on holidays whenever Contractor is not actively working in specific area, and the Contractor shall not excavate trenches or install pipe in highways, thoroughfares, and streets on weekends and holidays. Holidays include union holidays, Owner holidays, and County and municipal holidays. Contractor shall not leave any excavation open overnight or on weekends or holidays.

3.07 *Field Hydrostatic Test and Leak Test*

A. Hydrostatic and Leakage Test:

Hydrostatic and leakage testing shall be performed in accordance with Section 33 14 00.

B. General Requirements:

- 1) Required test pressures shall be applied by pump connected to pipeline sections being tested. The Owner shall approve pump connections to pipeline before testing begins. As part of the Work, and unless specified otherwise, Contractor shall install, at Contractor's expense, top outlets (service taps) required for testing. Contractor shall provide calibrated meters for measurement of leakage, and all pumps, piping, fittings, bulkheads, plugs, valves, gages, power equipment, and manpower necessary for conducting all tests required, all at Contractor's expense. Contractor shall furnish the Owner three copies of all records of all tests performed.
- 2) Unless specified otherwise, Contractor shall test against test plates for pipelines 12-inch and smaller. Contractor shall not remove said test plates until pipelines have been tested, disinfected, and accepted by the Owner.
- 3) Contractor, at Contractor's expense, shall locate and repair leaks or other defects which may develop or become apparent during the test. Contractor shall excavate, including removal of backfill already placed, and make all repairs necessary for required water tightness, and then replace all excavated material, after which the Contractor shall retest the repaired pipeline section. Pipeline sections shall be repeatedly repaired and tested until they meet requirements set forth herein.
- 4) Pipe manufacturer and fitting manufacturer shall have free access to the Work during testing. Any improper act on the part of the Contractor which the pipe and fitting manufacturer may observe shall be reported to the Owner. Pipe and fitting manufacturer shall be free to observe and verify all tests.
- 5) After completed pipeline and appurtenances or test sections have successfully met test requirements to the satisfaction of the Owner, the entire pipeline or each test section shall be filled or shall remain filled with water until completion of the Work, unless otherwise ordered by the Owner.

3.08 *Miscellaneous Requirements*

A. Connections to Existing Pipelines:

The Contractor shall make all connections to existing pipelines in the presence of the Owner's Representative. Contractor shall provide all labor, equipment, and materials necessary to perform connection work, including but not limited to, isolation gate valve, fittings, and adapters.

Hydrostatic testing against isolation valves will not be allowed. Adjacent to the isolation valve, Contractor shall install a test plate for the aforementioned test and, after satisfactory testing, remove said test plate and replace it with a 1/8 inch thick minimum ring gasket. The use of any other test appurtenances shall be as approved by the Owner.

B. Field Painting:

Contractor shall field paint all aboveground, bare, or exposed piping and appurtenances in accordance with the applicable specifications and drawings.

END OF SECTION 33 11 13.20

SECTION 33 11 13.30
FLEXIBLE PIPE COUPLINGS

PART 1 General

1.01 Description

As specified herein, the Contractor shall furnish all labor, materials, equipment and tools required for the complete installation and testing of the flexible pipe couplings as shown on the Drawings within the contract time allotted.

The details shown on the Drawings are intended to define the general layout, configuration, routing, method of support, pipe coupling size and type. The plans are not intended as flexible pipe coupling fabrication drawings. It is the Contractor's responsibility to develop the details necessary to construct all mechanical piping systems, measure and layout the flexible pipe coupling system, and to provide and install all spools, spacers, adapters, connectors, and other appurtenances in order to provide a complete and functional system.

The work includes, but is not limited to, all excavation, backfill, disposal, resurfacing of roads and driveways, verification of utilities, installation of all pipe and pipeline fittings/specials such as crosses, tees, elbows, bends, restrained joint systems, couplings, reducer, increasers, bolts, nuts, polyethylene encasement, and all necessary cuts and welds. All thrust forces in the pipe, such as at the ends of lines, closed valves, at crosses, tees, elbows, bends, reducers, etc., shall be restrained to withstand all unbalanced forces.

1.02 Quality Assurance

The Contractor shall be responsible for the quality of all work of his/her forces and that of his/her subcontractors, for adherence to all laws and regulations, for all public relations regarding the contract work and as set forth elsewhere in these Specifications.

1.03 Submittals

Submittals shall be submitted pursuant to the requirements of these Specifications and shall show the materials, dimensions, stations and relevant details.

1.04 Delivery, Storage, and Handling

All piping materials, fittings, valves, and appurtenances shall be delivered in clean and undamaged condition and shall be stored off the ground. All defective or damaged material shall be replaced with new materials by the Contractor at his/her expense.

PART 2 Products

2.01 Flexible Pipe Coupling

The flexible pipe couplings shall be sized based upon actual field measurements of the pipelines to be joined. The flexible pipe coupling shall be made from Ethylene Propylene Diene Monomer (EPDM) rubber, have a shear ring approximately 0.12-inches thick and 7.3 inches wide made from 300 series stainless steel. The t-bolt type clams are to be made from 316 series stainless steel and compression band are 0.75 inches wide. Product must meet ASTM 425, 1173, 923 and Greenbook standards.

Joints Calder Repair Coupling, Fernco Adapter or approved equal by the engineer of record may be used.

PART 3 Execution

3.01 Flexible Pipe Coupling

Install flexible pipe couplings by cleaning off all oil, scale, rust, and dirt from pipe ends. Clean the flexible coupling before installing. Install the coupling so that it does not roll or wrinkle up. Tighten the stainless steel bolts around the banding per manufacturer's specification.

3.02 Hydrostatic and Leak Testing

Hydrostatic and leakage testing shall be performed in accordance with Section 33 14 00. Repair, replace or retighten coupling if leaks are detected per manufacturer's specifications.

END OF SECTION 33 11 13

SECTION 33 11 13
PIPING SYSTEMS AND APPURTENANCES

PART 1 General

1.01 Description

As specified herein, the Contractor shall furnish all labor, materials, equipment and tools required for the complete installation and testing of the pipe system, appurtenances and structures as shown in the Bid Schedule Sheets, as shown on the Approved Plans and within the contract time allotted.

The piping shown on the Approved Plans is intended to define the general layout, configuration, routing, and method of support, pipe size and type. The plans are not intended as pipe fabrication drawings. It is the Contractor's responsibility to develop the details necessary to construct all mechanical piping systems, to accommodate the specific equipment provided and to provide and install all spools, spacers, adapters, connectors, and other appurtenances in order to provide a complete and functional system.

The work includes, but is not limited to, all excavation, backfill, disposal, resurfacing of roads and driveways, verification of utilities, installation of all pipe and pipeline fittings/specials such as crosses, tees, elbows, bends, restrained joint systems, couplings, reducer, increasers, bolts, nuts, polyethylene encasement, valve wells and extensions, meter boxes and all necessary cuts and welds. All thrust forces in the pipe, such as at the ends of lines, closed valves, at crosses, tees, elbows, bends, reducers, etc., shall be sufficiently restrained to withstand all unbalanced forces. Unless otherwise approved by the Owner's Representative, restrained fittings for ductile iron pipe shall be used as shown on the Approved plans, as indicated in these Specifications and as directed by the Owner's Representative. All pipe restraint systems shall be included in the bid price for the installation of pipe.

1.02 Quality Assurance

The Contractor shall be responsible for the quality of all work of his forces and that of his subcontractors, for adherence to all laws and regulations, for all public relations regarding the contract work and as set forth elsewhere in these Specifications.

1.03 Submittals

Submittals shall be submitted pursuant to the requirements of these Specifications and shall show the materials, dimensions, stations and relevant details.

1.04 *Delivery, Storage, and Handling*

All piping materials, fittings, valves and appurtenances shall be delivered in clean and undamaged condition and shall be stored off the ground. All defective or damaged material shall be replaced with new materials by the Contractor at Contractor's expense.

PART 2 Materials

2.01 *Restrained Joint System*

Restrained joint systems shall be designed for ductile-iron pipe and shall be selected from the Approved Materials List.

2.02 *Bolts and Nuts*

- A. Bolts and nuts shall be selected from the Approved Materials List.
- B. Cadmium/Zinc plated or fluoropolymer coated bolts and nuts shall be used for the installation of pipelines up to 18-inch diameter and shall be carbon steel conforming to ASTM A307, Grade A Bolts and A307 2H heavy hex nuts, unless otherwise indicated on the Approved Plans.
- C. Stainless steel bolts and nuts shall be used for the installation of pipelines 24-inch diameter and larger and for submerged flanges. Bolts and nuts shall be Type 316 stainless steel conforming to ASTM A193, Grade B8M for bolts and Grade 8M for nuts, unless otherwise indicated on the Approved Plans.
- D. All bolt heads shall be hexagonal conforming to ASME B18.2.1 and nuts shall be hexagonal conforming to ASME B18.2.2, except where special shapes are required. Bolts shall be of such length that a minimum of two threads shall protrude past the nut when fully tightened.

2.03 *Polyethylene Encasements*

Polyethylene encasement shall be as indicated below.

- A. Encasement material shall be V-Bio Enhanced Polyethylene with a minimum of 0.008 inch (8 mils) thickness from linear low-density polyethylene film (LLDPE) in accordance with ANSI/AWWA C105/A 21.5.
- B. Polyethylene encasement wrap or tubes shall be clear or white for potable water and purple for use with non-potable water.
- C. Polyethylene encasement material shall be clearly marked in accordance with AWWA/C105/A 21.5 with manufacturer's name, year manufactured, AWWA C105/A 21.5, film thickness and material type LLDPE.

- D. Polyethylene encasement wrap or tubes shall be secured with 2-inch wide polyethylene or vinyl adhesive tape.
- E. Polyethylene encasement shall be only tube type for pipe and shall be installed per methods A per AWWA C105/A 21.5.

2.04 *Valve Operator Wells*

- A. Valve operator wells shall consist of 8-inch polyvinyl chloride (PVC), AWWA C900-07 DR-18 pipe, concrete valve can, cast iron triangular cover and concrete collar selected from the Approved Materials List and as shown on the Approved Standard Drawings.
- B. Valve operator wells 8-inch PVC, AWWA C900-07 DR-18 for potable water system applications shall be white or blue.
- C. Valve operator well lids shall be triangular ductile iron selected from the Approved Materials List. Lids shall be cast as shown on the Approved Standard Drawings.

2.05 *Valve Operator Nut Extension*

Valve operator nut extensions shall be selected from the Approved Materials List.

2.06 *Meter Boxes*

- A. Meter boxes shall be selected from the Approved Materials List.
- B. Meter box lids for use for potable water systems shall be gray in color.
- C. Meter box lid for uses in non-potable systems shall be purple in color.

PART 3 Execution

3.01 *Restrained Joint System*

Restrained joint system shall be installed as shown on the Approved Plans and in accordance with the manufacturer's recommendations and as directed by the Owner's Representative.

3.02 *Bolts and Nuts*

- A. All bolts and nuts shall be new and unused. Bolts shall not be reused once tightened. All used bolts and nuts shall be discarded and removed from the job sites. Rusted or oxidized bolts and nuts shall not be used and are to be discarded.
- B. Bolts and nuts shall be clean and lubricated prior to assemble.

- C. Tighten bolts and nuts per the manufacture's recommended bolt tightening sequence and torque procedure.
- D. All stainless steel bolts shall be coated with anti-seize compound selected from the Approved Materials List.

3.03 *Polyethylene Encasement Installation*

Polyethylene encasement shall completely encase and cover all metal surfaces in accordance with AWWA C105.

A. Pipe:

All ductile-iron pipe shall be encased with polyethylene tubes in accordance with Method A as described in AWWA C105.

B. Pipe-Shaped Appurtenances:

All ductile-iron pipe-shaped appurtenances such as bends, reducers and offsets shall be encased with polyethylene tubes in accordance with Method A as described in AWWA C105.

C. Odd-Shaped Appurtenances:

Odd-Shaped Appurtenances such as tees and crosses shall be encased with polyethylene wrap in accordance with AWWA C105.

D. Valves:

Valves shall be encased with polyethylene wrap in accordance with AWWA C105. Valves shall be wrapped such that only the stem and operator nut are exposed and the wrap shall be attached so that the valve operation will not disturb or tear the polyethylene wrap sealing the valve. The exposed valve stem and operator nut above the polyethylene wrap shall be coated with NO-OX-ID protective grease selected from the Approved Materials List.

E. Securing Polyethylene Tubes:

Polyethylene sleeves shall be secured with polyethylene or vinyl adhesive tape at the ends and quarter points along the tube in such a manner that will hold the tube securely in place during backfill operation.

F. Securing Polyethylene Wrap:

Polyethylene wrap shall be secured with polyethylene or vinyl adhesive tape in such a manner that will hold the wrap securely in place during backfill operation.

- G. All holes, tears or abrasions to the polyethylene wrap shall be taped over or covered with a second layer of polyethylene wrap. The polyethylene surface shall be clean to allow full adhesion of the tape to the surface.

3.04 Valve Operator Wells

Valve operator wells shall be installed as shown on the Approved Standard Drawings and as described below.

- A. The valve operator well frame and lid shall be raised to final pavement grade.
- B. The valve operator well shall be centered over the valve operator nut. The valve operator well shall be free of all soil and debris for access to the valve operator nut prior to progressing the valve for service.
- C. The contractor shall make the final adjustment to caps as per the manufacturer's instruction and to the satisfaction of CVWD's representative. The cap shall not rock, shake or rattle when the roadway is open to vehicle traffic.
- D. The concrete collar shall be constructed of 560-C-3250 concrete with fiber reinforcing.
- E. Valve operator well caps shall be color-coded to identify the valves normal position of closed or open.

<u>Color</u>	<u>Valve Well Cap</u>
Red	Normally Closed System Valve
Yellow	Normally Open System Valve
Blue	Pressure Zone Split
Silver	Blow-off
Purple	Non-potable
Green	Sanitation

3.05 Valve Operator Nut Extension

All valve operator nut extensions shall be fabricated and installed in accordance with the Approved Standard Drawings when the operator nut is more than 4 feet below the roadway or finished grade. Valve operator nut extensions shall be installed where necessary to maintain the depth below finish grade to the operator nut to no more than four feet. The design of the valve operator nut extension shall be such to ensure the centering of the operator nut within the valve operator well. The stem extensions shall be complete with operator nut, location ring, and lower socket to fit valve operator nut. The configuration of the extension stem socket shall match that of the valve it operates.

3.06 *Meter Box Installation*

Meter boxes shall be installed at the elevations and locations as shown on the Approved Plans and in accordance with the Approved Standard Drawings. After sidewalk, curb and gutter have been installed a final meter box adjustment to finished grade may be required. Water meters shall not be installed until final adjustments are made to the meter box and are approved by the Owner's Representative.

3.07 *Installation of Water Pipeline*

Installation of pipeline shall be per the latest edition of the "Standard Specifications for Public Work Construction" (SSPWC) unless supplemented by this specification.

The pipe shall be accurately laid to the alignment and grade shown on the Approved Plans or as established by the Owner's Representative. Prior to placing the pipe in the trench, the contractor shall remove any material that may damage the pipe or the pipe polyethylene encasement including sharp rocks, lumber, nails, sheet metal or other sharp objects. The pipe ends shall be covered at the end of each day or when work activity has ceased on a particular section of pipe. The pipe is to remain free and clear of any dirt and foreign objects. The contractor shall be responsible for protecting the pipeline from mud and trench water during the construction of pipeline.

3.08 *Permanent Abandonment of Pipelines and Appurtenances*

When indicated on the Approved Plans or when directed by the Owner's Representative, existing pipelines to be abandoned shall be disconnected from all source pipelines in accordance with the modifications and instructions listed below:

- A. All above-ground appurtenances connected to pipelines to be abandoned shall be removed and disposed of or salvaged in accordance with this Section.
- B. All piping and appurtenances buried at a depth of 24-inch or less and connected to pipelines to be abandoned shall be removed and disposed of or salvaged in accordance with this Section. Remaining pipe ends, gate wells and other appurtenances cut at a depth of 24-inch shall be removed entirely or pressure grout or blown sand filled. Excavated areas shall be replaced with compacted backfill and surfaces shall be repaired in accordance with these Standard Specifications.
- C. All pipelines and appurtenances buried at a depth greater than 24-inch shall be pressure grout or blown sand filled or the pipeline crushed in place and appurtenances removed or as directed by the Owner's Representative.
- D. Abandoned pipe 16-inch and larger shall be entirely filled by pressure-grouting or by blown sand.

- E. All valves buried at a depth greater than 24-inch on pipelines to be abandoned and are not shown to be salvaged on the Approved Plans shall be turned to the closed position, the valve stem shall be severed and the operator nut removed. All valves to be abandoned regardless of depth shall have the valve can, concrete collar, lid and frame removed and the street repaired.
- F. Water services to be abandoned that are connected to pipelines that will remain in service shall be abandoned in-place and deactivated at the corporation. Water services connected to pipelines to be abandoned shall be abandoned in-place and cut ends shall be crimped.
- G. Sewer laterals connected to sewer mains to be abandoned or laterals to be abandoned shall be pressure grout or blown sand filled as directed by the Owner's Representative for the specific circumstance and material type identified.
- H. Sewer manholes shall have the cover and frame, concrete ring, grade rings and cone section removed to the depth indicated on the Approved Plans. Inlet and outlet piping shall be plugged with concrete, manhole void shall be filled with sand, and a 12-inch thick, reinforced concrete slab shall be poured over the top of remaining manhole. The Contractor shall backfill hole to ground surface with compacted select fill.
- I. Sewer and Storm Drain manhole covers and frames shall be salvaged and remain the property of CVWD in accordance with Section 3.11 Salvage.

3.09 *Removal of Pipelines and Appurtenances*

- A. Existing pipe and appurtenances shall be completely removed when indicated on the Approved Plans or as directed by the Owner's Representative. All materials removed during construction operations shall be salvaged or disposed of in accordance with this Section.
- B. When fittings, appurtenances, or pipe segments are removed from pipelines that are to remain in service, the removed portions shall be replaced with straight segments of pipe and appropriate couplings selected from the Approved Materials List.
- C. Contractor shall provide measures that allow for the removal of existing sewer mains and appurtenances with no leakage of raw sewage. Transportation of sewer mains and appurtenances removed from service shall be in waterproof trucks to prevent raw sewage from leaking on public streets.
- D. Removal of asbestos-cement pipe (ACP) and sewer mains and appurtenances shall be in accordance with all applicable State and Federal requirements, and disposal shall be in accordance with the requirements of this Section.

- E. Backfill, compaction, and surface repair of all excavations for removal of pipe and appurtenances shall be made in accordance with the Approved Plans, these Standard Specifications, or as directed by the Owner's Representative.

3.10 *Reconnections*

Existing water service lines or appurtenances shall be connected to new pipelines as shown on the Approved Plans or as directed by the Owner's Representative.

3.11 *Salvage*

When the Contractor is required to remove existing pipe and appurtenances, such materials may, when shown on the Approved Plans or directed by the Owner's Representative, be considered salvage. All materials identified as salvage are considered property of CVWD. The Contractor shall temporarily stockpile all material identified as salvage in a location that will not disrupt traffic or otherwise create an unsafe condition and shall deliver salvaged material to the CVWD's materials yard in Coachella. The Contractor shall provide all transportation and equipment to offload such materials as directed by the Owner's Representative.

3.12 *Disposal*

All materials removed during construction operations and not identified by the Owner's Representative as salvage shall be legally disposed of in accordance with all applicable Local, State, and Federal requirements.

Disposal of asbestos-cement pipe requires special handling and attention, including but not limited to, encapsulation within airtight packaging, submittal of certification letters and/or waste profile statements, and the use of a Cal-OSHA registered asbestos abatement contractor to transport and dispose of such wastes. The Owner's Representative shall be provided with copies of all applicable documentation regarding the transportation and disposal of asbestos-cement pipe. Contractor shall comply with all applicable regulations and all requirements of the disposal site. Contractor is responsible for all costs associated with disposal of materials, specifically including any materials that may contain asbestos.

END OF SECTION 33 11 13

SECTION 33 12 13
COPPER PIPE, TUBING, BRASS AND BRONZE PIPE FITTINGS

PART 1 General

1.01 *Description*

This section includes materials and installation of copper tubing, brass and bronze pipe fittings and appurtenances. All copper services and fittings shall conform to AWWA C800 and these Specifications.

1.02 *Service Lateral Hot/Wet Tap Connections*

CVWD will perform all hot/wet tap connections to existing pipelines in accordance with Section 33 11 13.

1.03 *Submittals*

If required by the Owner's Representative, the following items shall be submitted to CVWD for review and approval prior to ordering or delivery.

- A. The manufacture shall provide proof of compliance with NSF/ANSI 61 Annex G, NSF/ANSI 372 and conform with the lead content requirements for "lead-free" plumbing as defined by California's statute §116875.

PART 2 Materials

2.01 *Copper Pipe and Tubing*

Copper tubing shall conform to ASTM B 88 and shall be Type K soft (annealed). Copper tubing in 1-inch diameter and smaller may be delivered in coils. Copper 1 ½ inch and over shall be delivered in 20 foot straight lengths (not coils).

2.02 *Brass Pipe, Nipples, and Fittings*

Threaded nipples, brass pipe and fittings shall conform to ASTM B 43, regular wall thickness. Threads shall conform to ANSI B1.20.1. Fittings shall be compression type. Cast brass or bronze pipe fittings shall conform to ANSI / ASME B1.20.1 for thickness and pressure tests. Pipe threads for cast brass pipe fittings shall conform to ANSI / ASME B1.20.1.

2.03 *Bronze Appurtenances*

- A. Corporation stops, curb stops, meter and angle meter stops, meter flange adapters, and bronze-bodied service saddles shall be selected from the Approved Materials List in accordance with the Standard Drawings.
- B. Fittings intended to connect to copper tubing shall be compression type.
- C. All items specified herein shall be manufactured of bronze conforming to ASTM B 62.
- D. Service saddles for Ductile Iron Pipe (DIP) shall be the double strap type.

2.04 *Bolts and Nuts for Flanges*

Bolts and nuts shall be in accordance with Section 33 11 13 and the Approved Materials List.

PART 3 Execution

3.01 *Copper Tubing and Fittings*

- A. Trenching, bedding, backfilling and compacting shall be performed in accordance with Section 31 23 17 and the Standard Drawings. Provide a minimum cover of 30-inch below finished street grade.
- B. Cut tubing true and square and remove burrs.
- C. Bends in soft copper tubing shall be a long sweep. Shape bends with shaping tools. Form bends without flattening, buckling, or thinning the tubing wall at any point.
- D. Assemble copper tubing and fittings per the manufacturer's recommendation in accordance with the Approved Standard Drawings.

3.02 *Service Saddles*

- A. Service saddles shall be located a minimum of 24-inch from any pipe joint or fittings.
- B. Service saddles for connections shall be located a minimum of 24-inch from other saddles. Additionally, multiple service saddles for connections that are installed on the same side of a single pipe length shall be alternately staggered between 10 degrees and 30 degrees to prevent a weak plane in the pipe.

- C. The surface of the pipe shall be clean and all loose material shall be removed to provide a hard, clean surface.
- D. The service saddle shall be tightened in accordance with the manufacturer's recommendations to ensure a tight seal, using care to prevent damage or distortion of the service saddle or corporation stop due to over-tightening.
- E. The service saddle hole into the pipe shall be made in accordance with the pipe manufacturer's recommendation. Tools and/or shell cutters with internal teeth or double slots that will retain the coupon shall be used.

3.03 *Disinfection and Bacteriological Testing*

Disinfection, bacteriological testing, and flushing shall be performed in accordance with Section 33 13 00.

3.04 *Hydrostatic Testing*

Field hydrostatic testing shall be performed in accordance with Section 33 14 00.

END OF SECTION 33 12 13

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33 12 16.10

RESILIENT-SEATED GATE VALVES

PART 1 General

1.01 Description

This section includes materials, testing, and installation of manually-operated Resilient-Seated Gate Valves (RSGVs).

1.02 Service Application

- A. RSGVs shall be installed on potable and recycled water mains and appurtenances in accordance with the Approved Plans and the Approved Standard Drawings.
- B. RSGVs shall be used to isolate and depressurize pipeline segments for repairs, modifications, inspections or maintenance.
- C. In general, RSGVs shall be used when valves are required on pipelines and appurtenances sized 4-inch through 12-inch.
- D. Valves for pipelines sized 14-inch and larger generally require the use of butterfly valves (BFV's) in accordance with Section 33 12 16.20.
- E. Valves 3-inch and smaller shall be in accordance with Section 33 12 16.40.

1.03 Submittals

If required by the Owner's Representative, the following items shall be submitted to CVWD for review and approval prior to ordering or delivery of valves.

- A. RSGVs 12-inch and smaller shall be selected from the Approved Materials List.
- B. RSGVs 14-inch and larger require CVWD Approval. Submittals shall include catalog data showing conformance to AWWA C509, size(s) proposed for use, valve dimensions, pressure rating, and materials of construction, and such valves shall also conform to all other requirements specified herein.
- C. The manufacture shall provide proof of compliance with NSF/ANSI 61 Annex G, NSF/ANSI 372 and conform with the lead content requirements for "lead-free" plumbing as defined by California's statute §116875.

1.04 *Sizing of Valves*

Valves shall be the same size as the line in which they are installed unless otherwise noted on the Approved Plans.

1.05 *Valve Ends*

RSGVs shall be furnished with flanged ends. Ductile-iron flanges shall be in accordance with Section 33 11 13.10.

1.06 *Valve Testing*

RSGVs shall be hydrostatically leak tested and coatings shall be holiday detected prior to shipment to the field. Valves delivered to the site prior to successful hydrostatic testing and holiday detection shall be rejected.

1.07 *Delivery, Storage and Handling*

Valves shall be delivered and stored in accordance with AWWA C550. The port openings shall be covered with plastic, cardboard or wood while in transit and during storage in the field. These covers shall remain in place until valves are ready to be installed. Valves shall not be stored in contact with bare ground. Valves shall not be stacked.

1.08 *Polyethylene Wrap*

Polyethylene wrap shall be used for the buried installation of RSGVs in accordance with Section 33 11 13.

PART 2 Materials

2.01 *Resilient-Seated Gate Valves (RSGVs)*

- A. RSGVs shall be ductile-iron in accordance with AWWA C509 and C515 except as modified herein.
- B. RSGVs shall have smooth unobstructed waterways free from any sediment pockets.
- C. RSGVs shall be leak-tight at their rated pressure.
- D. RSGVs shall have a non-rising low-zinc bronze or stainless steel stem, opened by turning left (counterclockwise).
- E. Stem seals shall be the O-ring type incorporating a minimum of two rings as required by AWWA C509.

- F. Low-friction torque-reduction thrust washers or bearings shall be provided on the stem collar.
- G. Wedge (gate) shall be fully encapsulated with a bonded-in-place Ethylene Propylene Diene Monomer (EPDM) elastomeric covering. Minimum thickness of the rubber seating area shall be ¼ inch.
- H. Valves for buried applications shall be provided with a 2-inch square operating nut, and valves located above ground or in structures shall be equipped with a minimum 12-inch diameter hand wheel in accordance with AWWA C509 unless otherwise indicated on the Approved Plans or required by the Owner's Representative.
- I. RSGV interior and exterior surfaces (except for the encapsulated disc) shall be coated as described below.
- J. All bolts and nuts used in the construction of RSGVs shall be Type 316 stainless steel.

2.02 *Epoxy Lining and Coating*

Epoxy linings and coatings for valves shall be provided in accordance with AWWA C210, C213 and C550, with the following modifications:

- A. Epoxy lining and coating of valve surfaces shall be performed by the valve manufacturer by qualified personnel in a facility where the environment can be controlled. Epoxy lining and coating of valves in the field is prohibited.
 - 1. Surface preparation shall be as detailed in SSPC-SP5, White-Metal Blast Cleaning.
 - 2. The manufacture shall provide proof of compliance with NSF/ANSI 61 Annex G, NSF/ANSI 372 and conform with the lead content requirements for "lead-free" plumbing as defined by California's statute §116875.
 - 3. The minimum dry film thickness for epoxy linings shall be 0.008-inch or 8 mils. Liquid epoxy lining shall be applied in two (2) coats in accordance with AWWA C210 and application shall conform to the coating manufacturer's recommendations.
 - 4. Powder epoxy lining and coating materials shall contain one hundred percent (100%) solids in accordance with AWWA C213, shall be applied in one or more coats, and shall conform to the coating manufacturer's recommendations.

5. Repairs made to manufacturer's applied linings shall be performed by a company approved by the valve manufacturer, by qualified personnel, and in a facility where the environment can be controlled.

2.03 *Valve Wells and Extension Stems*

Valve wells and extension stems for buried valves shall be in accordance with Section 33 11 13 and selected from the Approved Materials List.

2.04 *Concrete*

Concrete used for thrust, anchor, and support blocks shall be in accordance with Section 03 30 00.

PART 3 Execution

3.01 *Installation*

- A. Install valves with the bolt holes straddling the vertical centerline of pipe and the operating nut in the vertical position unless otherwise noted on the Approved Plans.
- B. Valves shall be installed in accordance with the manufacturer's recommendations and the applicable section of these specifications for the piping material and joint type being used.

3.02 *Disinfection of Valves*

Disinfection and flushing shall be in accordance with Section 33 13 00, as part of the process of disinfecting the main pipeline. The valves shall be operated during the disinfection period to completely disinfect all internal parts.

3.03 *Hydrostatic Testing*

Valves shall be subject to pressure during the hydrostatic test of the pipelines in accordance with Section 33 14 00.

END OF SECTION 33 12 16.10

33 12 16.20
BUTTERFLY VALVES

PART 1 General

1.01 *Description*

This section includes materials, testing, and installation of manually operated butterfly valves (BFV).

1.02 *Service Application*

- A. Butterfly valves (BFV) shall be installed on potable and non-potable water mains and appurtenances where shown on the Approved Plans and in accordance with the Standard Drawings.
- B. Butterfly valves shall be used for open/closed operations.
- C. Valves discontinued by the manufacturer as of the bid opening date will not be accepted.
- D. In general butterfly valves shall be used when valves are required on pipelines 18-inch and larger and where the use of a motor-operated valve is required as shown on the Approved Plans. Butterfly valves smaller than 18-inch shall only be used as indicated on the Approved Plans or with the prior approval of the Owner's Representative.
- E. Valves for pipelines sized 12 inch and smaller generally require resilient wedge gate valves (RWGVs) in accordance with Section 33 12 16.10.
- F. Valves 3-inch and smaller shall be in accordance with Section 33 12 16.40.

1.03 *Submittals*

If required by the Owner's Representative, the following items shall be submitted to CVWD for review and approval prior to ordering or delivery of valves.

- A. An affidavit from the valve manufacturer shall be provided for the following:
 - 1. The valve manufacturer shall certify that all actuators were furnished and installed by the valve manufacturer.
 - 2. Submit all calculations for valve break and dynamic torque for butterfly valves operation from 0 to 90 degrees, at full open, the valves full rated pressure, and for bi-directional velocity. Pressure shall be 150 pounds per square inch (psi) at 16 feet per second (fps) unless otherwise noted. Where applicable, electric actuators shall be sized for a minimum safety

factor of 2.0 applied to the maximum dynamic torque for modulating valves or a safety factor of 1.5 applied to both break and dynamic torque for either open, closed or modulating valves. Calculations shall be provided for both methods in sizing electric actuators with the greater of the two methods governing.

3. Valves have successfully passed hydrostatic testing per AWWA C504 and coatings testing by the valve manufacturer.
 4. Provide copies of all test results certifying compliance with all applicable AWWA valve standards and as required in these specifications.
- B. The valve manufacturer's catalog data showing the size to be used, valve dimensions, pressure rating and materials of construction.
 - C. Upon the request of the Owner's Representative for butterfly valves 30-inch and larger, each valve body shall be pressure tested to the equal to twice the design water-working pressure, unless specified otherwise. Leak test each valve at 200 psi for class 150B valves and 250 psi for class 250B valves. Provide signed and dated certificates of conformance.
 - D. Actuator manufacturer's catalog data and detail construction sheets showing the dimensions, materials, number of turns, and required torque input of the actuator to be used.
 - E. The manufacture shall provide proof of compliance with NSF/ANSI 61 Annex G, NSF/ANSI 372 and conform with the lead content requirements for "lead-free" plumbing as defined by California's statute §116875.

1.04 *Sizing of Valves*

Valves shall be the same size as the line in which they are installed unless otherwise noted on the Approved Plans.

1.05 *Valve Ends*

Valve ends shall be flanged ductile-iron unless otherwise called for on the Approved Plans or as directed by the Owner's Representative.

Ductile-iron flanges shall generally be in accordance with AWWA C115, and rated at a working pressure of 250 psi. When Class 250 butterfly valves are shown on the Approved Plans or are otherwise required, ductile-iron flanges shall be compatible with AWWA C207, Class "F".

Maximum working pressure of the flange shall as specified in AWWA or ASME/ANSI. Flanges shall be integrally cast per AWWA C110.

1.06 *Valve Testing*

Each valve body shall be tested by the manufacturer under a test pressure equal to twice its design water working pressure, and shall be shop-operated three (3) times in accordance with the requirements of AWWA Standard C-504.

A. Butterfly Valves Larger Than 18-Inches

Butterfly Valve Testing. Butterfly valves with size greater than 18 inches shall be hydrostatically tested per AWWA C504 in both directions. This test shall be conducted within 50 miles of the CVWD office and shall be performed in the presence of CVWD Inspection. No valve shall be installed until this testing has been completed and approved by CVWD.

Each valve shall be tested as detailed in the CVWD Standard Specifications and as specified below:

1. Visually inspect each valve and its actuator for compliance with the submittal.
2. Visually inspect each valve for obvious damage or substandard construction.
3. The testing medium shall be water. Under no circumstances is air to be used as the test medium.
4. Each valves is to be tested at its rated pressure.
5. Both sides of each valve are to be tested.
6. The test duration on each side of the valve is 5 minutes. A passing test is one where there is no visible leakage and no decrease on the initial test pressure.
7. A valve which fails the pressure test shall be either repaired or replaced. Repaired valves shall be retested. Replacement valves shall be tested using this procedure.
8. Valves shall only be repaired by personnel authorized by the valve manufacturer to do the necessary repairs. Unless they have been authorized by the valve manufacturer, supplier or contractor shall not be permitted to perform repairs.

1.07 *Delivery, Storage and Handling*

Valves shall be delivered and stored in accordance with AWWA C504 and AWWA C550. The port openings shall be covered with plastic, cardboard or wood while in transit and during storage in the field. These covers shall remain in place until the valve

is ready to be installed. Valves shall not be stored in contact with bare ground. Valves shall not be stacked.

1.08 *Polyethylene Wrap*

Polyethylene wrap shall be used for buried installation of butterfly valves in accordance with Section 33 11 13.

PART 2 Materials

2.01 *Butterfly Valves (BFV)*

- A. Butterfly valves and appurtenant components and materials shall be selected from the Approved Materials List.
- B. Butterfly valves shall be short body, leak-tight closing, and rubber-seated in accordance with AWWA C504 except as modified herein.
- C. Butterfly valve bodies shall be ductile-iron as defined within AWWA C504.
- D. Except as modified below, BFVs shall be Class 150B in accordance with AWWA C504, rated for a flow velocity of 16 feet per second (fps).
- E. Where the static pressure of the pipeline in which the BFV is to be installed exceeds 150 psi, a Class 250B butterfly valve in general conformance with AWWA C504 shall be required. Class 250B butterfly valves shall be submitted to the Owner's Representative for approval prior to ordering or delivery.
- F. Butterfly valves shall open by turning left (counterclockwise). Valve disc shall rotate ninety degrees (90°) from the full open position to the tight shut position.
- G. Butterfly valve interior and exterior surfaces shall be coated as described below.

2.02 *Butterfly Valve Discs*

- A. The butterfly disc shall be ductile-iron as defined within AWWA C504.
- B. The butterfly disc shall be secured to shaft with Type 304 stainless steel, straight through taper pins and locking nuts.

2.03 *Rubber Seat*

- A. Butterfly valve shall be seat on body construction only.
- B. Seat material shall be peroxide cured EPDM. Buna-N and Sulfur cured EPDM seat material are not acceptable.
- C. The seat shall not be mechanically retained with bolts, clamps or rings.

2.04 *Butterfly Valve Disc Seating Edge*

The butterfly valve disc seating edge shall be stainless steel type 304 or 316, or nickel-chromium alloy and attached to the disc. Seat edge material shall completely cover the leading edge of disc and shall be installed prior to application of coating. Valves disc seating edge shall be free of paint, overspray or coating.

2.05 *Shaft Seal*

Shaft seals shall be of a standard split “V” design and shall be self-adjusting and wear compensating. Valves with manual packing glands are not acceptable.

2.06 *Manual Valve Actuators*

- A. General:
 - 1. Operators and component parts: AWWA C504, unless otherwise specified in these Specifications.
 - 2. All valve actuators shall be watertight, designed for buried or submerged uses. Actuators shall be fully gasketed, sealed, and factory packed with grease.
 - 3. As directed by the Owner’s Representative, actuators for valves located above ground or in vaults and structures may have hand wheels or chain wheels. Minimum hand wheel diameter shall be 12-inch. The actuator shall be equipped with a dial indicator, which shows the position of the valve disc. The Owner’s Representative may require the use of a 2-inch square-operating nut in some cases.

4. Actuators for valves shall be provided with a 2-inch square-operating nut when buried or when indicated on the Approved Plans.
5. Actuators shall have travel stops, which can be adjusted in the field without having to remove the actuator from the valve.
6. Actuators shall accept a minimum of 450 foot-pounds of input torque at the full open and full closed positions without damage to the actuator or the valve.
7. Actuators equipped with 2-inch operator nuts shall require a maximum input torque of 150 foot-pounds to operate the valve. A maximum input torque of 80 foot-pounds shall be required to operate valves with hand wheels.
8. Actuators shall be installed, adjusted, tested and certified by the valve manufacturer prior to shipping.
9. Actuators shall require a maximum of one hundred (100) input turns for the complete ninety-degree (90°) movement of the disc.
10. Actuators shall receive an epoxy coating on the exterior surface as described below.

B. Traveling Nut Actuators:

1. Actuators for butterfly valves sizes 18-inch through 24-inch may be the manual traveling nut type. Traveling nut actuators shall not be used on valves requiring motor driven actuators or where CVWD has specified a worm gear type actuator.

C. Worm Gear Type Actuators:

1. Actuators for butterfly valves 30-inch or larger shall be the worm gear type. In addition, worm gear type actuators shall be used on butterfly valves requiring motor driven actuators or where CVWD has specified a worm gear actuator.
2. Worm gear actuators shall be totally enclosed and self-locking.

2.07 *Epoxy Lining and Coating*

Epoxy linings and coatings for valves shall be provided in accordance with AWWA C213 and C550, with the following modifications:

- A. Epoxy lining and coating of valve surfaces shall be performed by the valve manufacturer by qualified personnel in a facility where the environment can be controlled. Epoxy lining and coating of valves in the field is prohibited.
 - 1. Epoxy lining materials shall be listed in the NSF Listing for Drinking Water Additives, Standard 61, and certified for use in contact for potable water.
 - 2. The minimum thickness for epoxy linings shall be 0.012-inch or 12 mils.
 - 3. Powder epoxy lining and coating materials shall contain one hundred percent (100%) solids in accordance with AWWA C213, shall be applied in three coats, and shall conform to the coating manufacturer's recommendations.
 - 4. Repairs made to manufacturer's applied linings shall be performed by a company approved by the valve manufacturer, by qualified personnel, and in a facility where the environment can be controlled.

2.08 *Valve Wells and Extension Stems*

Valve wells and extension stems for buried valves shall be in accordance with Section 33 11 13 and selected from the Approved Materials List.

2.09 *Concrete*

Concrete used for thrust, anchor, and support blocks shall be in accordance with Section 03 30 00.

PART 3 Execution

3.01 *Installation*

- A. Install valves with the bolt holes straddling the vertical centerline of pipe and the operating nut in the vertical position unless otherwise noted on the Approved Plans.
- B. Valves shall be installed in accordance with the manufacturer's recommendations and the applicable section of these specifications for the piping material and joint type being used.

C. Aboveground valves shall be rigidly held in place using supports and hangers in accordance with the Approved Plans and Standard Drawings. The stem orientation of valves in elevated piping shall be as approved by the Owner's Representative for accessibility, except that no valves shall be installed with stems aligned below horizontal. Saddle type valve supports shall be provided. Supports shall be of rugged construction providing at least one hundred twenty degrees (120°) under support for the valve body. Valve supports shall be constructed of steel, and shall be anchored to the foundations using stainless steel anchor bolts.

3.02 *Disinfection of Valves*

Disinfection and flushing shall be in accordance with Section 33 13 00, as part of the process of disinfecting the main pipeline. The valves shall be operated during the disinfection period to completely disinfect all internal parts.

3.03 *Hydrostatic Testing*

Valves shall be subject to pressure during the hydrostatic test of the pipelines in accordance with Section 33 14 00.

END OF SECTION 33 12 16.20

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SECTION 33 12 16.40
MISCELLANEOUS VALVES (3-inch and Smaller)

PART 1 General

1.01 *Description*

This section includes materials and installation of manually operated valves such as check valves, corporation stops, meter stops and ball valves.

1.02 *Submittals*

If required by the Owner's Representative, the following items shall be submitted to CVWD for review and approval prior to ordering or delivery of valves.

- A. The valve manufacturer's product data sheet showing the size to be used, valve dimensions, pressure rating and material construction.
- B. The manufacture shall provide proof of compliance with NSF/ANSI 61 Annex G, NSF/ANSI 372 and conform with the lead content requirements for "lead-free" plumbing as defined by California's statute §116875.
- C. Manufacturer's installation instructions or procedures including field adjustments as required.

1.03 *Sizing of Valves*

Valves shall be the same size as the appurtenance in which they are to be installed with unless otherwise called for on the Approved Plans or indicated on the Standard Drawings.

1.04 *Valve Ends*

Valve ends shall be compatible with the piping system or appurtenance in which they are to be installed or as called for on the Approved Plans or indicated on the Standard Drawings.

1.05 *Delivery, Storage and Handling*

Valves shall be delivered and stored in accordance with the manufacturer's recommendations. Valves shall remain in factory packaging until ready for installation. Valves shall not be stored in contact with bare ground.

1.06 *Polyethylene Wrap*

Polyethylene wrap shall be used for the buried installation of valves in accordance with Section 33 11 13.

PART 2 Materials

2.01 *Check Valve*

Water service straight single check valves shall be selected from the Approved Materials List.

2.02 *Corporation Stops*

Corporation stops shall be the ball type with a copper alloy body and T-Head operator. Valve ends shall be compatible with the piping system in which they are being installed or as called for on the Approved Plans or indicated on the Standard Drawings. Corporation stops shall be rated for a minimum pressure of 200 pound per square inch (psi). Corporation stops shall be selected from the Approved Materials List. A submittal will be required as described in this section.

2.03 *Angle Meter Stops*

Angle meter stops shall be the ball type with a copper alloy body and 90° lockwing. Valve ends shall be 110-style compression inlet and swivel meter nut for 1-inch and meter flange for 2-inch outlets. Angle meter stops shall be rated for a minimum pressure of 200 psi. Angle meter stops shall be selected from the Approved Materials List. A submittal will be required as described in this section.

2.04 *Ball Valve*

Ball valves 2-inch and smaller shall be of copper alloy construction conforming to ASTM B62 and equipped with a lever handle operator as required. Valve ends shall be compatible with the piping system in which they are being installed or as indicated on the Approved Plans or Standard Drawings. Ball valves shall be rated for a minimum pressure of 200 psi. Ball valves shall be selected from the Approved Materials List. A submittal will be required as described in this section.

PART 3 Execution

3.01 *Miscellaneous Valves*

- A. Valves shall be set in true alignment straddling the centerline of pipe with the valve operator in the vertical position unless otherwise noted on the Approved Plans or shown on the Standard Drawings.

- B. Valves shall be installed in accordance with the manufacturer's recommendations and the applicable section of these specifications for the piping material and joint type being used.
- C. Aboveground valves shall be rigidly held in place using supports and hangers in accordance with the Approved Plans and Standard Drawings. The stem orientation of valves in elevated piping shall be as approved by the Owner's Representative for accessibility, except that no valves shall be installed with stems aligned below horizontal. Saddle type valve supports shall be provided. Supports shall be of rugged construction providing at least one hundred twenty degrees (120°) under support for the valve body. Valve supports shall be constructed of steel, and shall be anchored to the foundations using stainless steel anchor bolts.

3.02 *Disinfection of Valves*

Disinfection and flushing shall be in accordance with Section 33 13 00 as part of the process of disinfecting the main pipeline. The valves shall be operated during the disinfection period to completely disinfect all internal parts.

3.03 *Hydrostatic Testing*

Valves shall be hydrostatically tested in conjunction with the pipelines in which they are installed in accordance with Section 33 14 00.

END OF SECTION 33 12 16.40

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SECTION 33 12 16.50
ECCENTRIC PLUG VALVES

PART 1 – General

1.01 *Description*

- A. This section covers furnishing all materials, supplies, tools, and equipment and performing all operations necessary to furnish, install, and test non-lubricated eccentric type plug valves (3-inch and larger), complete and operable, as shown and specified herein including operators, protective coatings, and appurtenant work, in accordance with the requirements of the Contract Documents.
- B. The Contractor shall also provide and install appurtenant equipment, sensors, switches, limit switches, and controls shown or specified elsewhere in the Contract Documents to make a complete and workable installation.
- C. Where buried valves are shown, the Contractor shall furnish and install valve boxes to grade, with covers, extensions, and position indicators per CVWD Standard Drawings.

1.02 *Related Work Specified Elsewhere*

- A. The requirements of the following sections and divisions apply to the Work of this section. Other sections and divisions of the Specifications, not referenced below, shall also apply to the extent required for proper performance of this Work.
 - 1. Section 09 90 00.10, Sewer Painting and Coating
 - 2. Section 10 10 10, Utility Marker Post
 - 3. Section 33 01 30.13, Sanitary Sewer System Testing
 - 4. Section 33 11 13, Piping Systems and Appurtenances
 - 5. Section 33 14 00, Hydrostatic Testing of Pressure Pipelines

1.03 *Reference Specifications, Codes and Standards*

- A. All Work specified herein shall conform to or exceed the applicable requirements of the referenced portions of the following publications to the extent that the provisions thereof are not in conflict with other provisions of these Specifications.
- B. Comply with the applicable editions of the following codes, regulations and standards.
 - 1. CVWD Detail Drawings for the Construction of Sanitary Sewer Systems

2. Industry Standards:

ANSI B16.1	Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250
ANSI B16.5	Pipe Flanges and Flanged Fittings
ANSI B16.42	Ductile Iron Pipe Flanges and Flanged Fittings
ASTM A126	Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings
ASTM A536	Standard Specification for Ductile Iron Castings
ASTM F593	Standard Specification for Stainless Steel Bolts, Hex Cap Screws and Studs
ASTM A743	Standard Specification for Castings, Iron- Chromium, Iron-Chromium-Nickel, Corrosion Resistant, for General
AWWA C116	AWWA Standard for Protective Fusion-Bonded Epoxy Coatings for the Interior and Exterior Surfaces of Ductile-Iron and Gray-Iron Fittings
AWWA C111/A21.11	Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
AWWA C517	Resilient-Seated Cast-Iron Eccentric Plug Valves
AWWA C550	Protective Epoxy Interior Coatings for Valves and Hydrants
ISO 9001	Quality Management Systems – Requirements

- C. Comply with the applicable reference Specifications as directed in the General Conditions, other applicable parts of the Contract Documents, and as specified herein.

1.04 *Submittals*

- A. Submittals shall be made in accordance with General Conditions, other applicable parts of the Contract Documents, and as specified herein. In addition to product information, the Contractor shall submit for acceptance layout drawings showing valve locations within the piping system, valve supports, and identification numbers.
- B. The following submittals and specific information shall be provided to CVWD for review and approval prior to ordering or delivery of valves.

1. Contractor shall submit complete information and technical data for all material and components, including, but not limited to, the following: fabrication, assembly, detailed specifications and data covering performance and materials of construction, parts, installation instructions, coatings, operators, valve boxes, extensions, and other pertinent data. Shop drawings shall clearly indicate size, end connections, and proposed service condition, as well as special features required for buried service.
2. Shop Drawings: Shop drawings of all valves and operators, including associated wiring diagrams and electrical data, shall be furnished.
3. Manufacturer's installation instructions or procedures including field adjustments as required.
4. Provide current certifications specified in the Article entitled "Quality Assurance" of this Specification.
 - a. When requested by CVWD, submit supporting documentation demonstrating effectiveness of the quality management system regarding valves specified herein.
5. Valve Schedule
 - a. List the use, size, type, and orientation of each valve by tag number or, if none, other valve identification as shown on the Drawings. In addition, the valve schedule shall include weight for each size, Kv, as well as orientation of each valve, including stem orientation, and location of operator, hand wheel, and chain. Note any exceptions taken to the installation requirements below. Identify valves not shown on the Drawings by a description of their use and location.
 - b. Show the orientation of each valve, including stem orientation, and location and orientation of operator or actuator, hand wheel, and chain as applicable. Indicate in the submittal each exception taken to the installation requirements specified in Part 3 of this Specification. The submittal shall also graphically depict available orientations for valves and operators as part of the general information submitted.
7. Manufacturer's certification that valves have been shop-tested shall be submitted at least thirty (30) days prior to scheduled shipment.
8. Operation and Maintenance Manual
 - a. Contractor shall submit for each valve a detailed operation and maintenance manual in accordance with the Contract Documents.

1.05 *Quality Assurance*

A. General

1. ISO quality management system: Manufacturer shall have an ISO 9001 quality management system, certified by an accredited certifying agency within the four (4) years prior to the Notice to Proceed.
2. All valves shall be tested in accordance with manufacturer's recommendation and applicable AWWA/ANSI specifications.
3. Proof Testing: Valves over 6-inches in diameter shall be proof-of-design tested by an independent North American testing laboratory per all applicable AWWA requirements.
4. Contractor shall coordinate valves furnished with connecting piping or equipment to ensure compatible end connections and proper valve operation.
5. All valves of a particular type shall be by one (1) manufacturer. In addition, valve operators for a particular type of valve shall be by one (1) manufacturer.

1.06 *Delivery, Storage and Handling*

- A. Valves shall be delivered and stored in accordance with the manufacturer's recommendations. Valves shall remain in factory packaging until ready for installation. Valves shall not be stored in contact with bare ground.

PART 2 – Products

2.01 *General*

- A. The Contractor shall furnish all valves, valve-operating units, stem extensions, and other accessories as shown or specified. All valves shall be new and of current manufacture.
- B. Valve pressure rating shall be as follows and shall be established by hydrostatic tests as specified by ANSI B16. Unless otherwise specified in the Contract Documents, pressure rating shall be 175 psi for valves through 12 inches, 150 psi for valves in sizes 14 through 72 inches. Valves shall provide a drip-tight shutoff up to the full pressure rating. Valves shall be capable of providing drip-tight shutoff up to the full valve with pressure in either direction.
- C. Buried Valves and Valve Boxes: Valve boxes shall be of the cast-iron sliding adjustable Buffalo type. The valve shall be provided with a 2-inch-square operating nut and an extension to within two (2) feet of the operating surface. The extensions shall be hot-dip galvanized after fabrication. One hot-dip galvanized operating tee wrench of approved size shall be furnished with each underground valve.

- D. Valve ends shall be compatible with the piping system or appurtenance in which they are to be installed or as called for on the Drawings or indicated on CVWD Standard Drawings.

2.02 Plug Valve

- A. All eccentric plug valves must be rugged and be of the non-lubricated cylindrical eccentric plug type with rectangular openings, designed, manufactured and tested in accordance with meet ANSI/AWWA C517 standard for use in water, wastewater, and irrigation water delivery as supplemented and modified by the following requirements.
- B. The plug shall be ASTM A126, Class B cast-iron or ASTM A536 Grade 65-45-12 ductile iron and shall have a cylindrical seating surface eccentrically offset from the center of the plug shaft that closes against a rectangular opening in the body.
- C. The plug for all services, except digester gas, shall be completely encased with Buna-N capable of withstanding 180 degrees Fahrenheit, vulcanized to the plug.
- D. The valve body shall be ASTM A126, Class B cast-iron or ASTM A536 Grade 65-45-12 ductile iron, with flanged ends.
- F. Valve flanges/ends shall be compatible (ANSI B16.1 125 lbs, ANSI B16.5 150 lbs, etc.), using appropriate adapters, with the piping system or appurtenance in which they are to be installed or as called for on the Drawings or indicated on CVWD Standard Drawings. Mechanical joint ends shall conform to AWWA/ANSI C111/A21.11.
- E. Valves shall be the same size as the piping in which they are to be installed unless otherwise called for on the Drawings or indicated on CVWD Standard Drawings. Port area shall be 100 percent of pipe area.
- F. Unless otherwise shown or specified in the Contract Documents, all valves for sizes larger than three (3) inches shall have worm gear operators with all gearing enclosed and seals on all shafts to prevent entry of dirt and water, Hand-operated valves shall have hand wheels, and, where located more than 6 feet about ground level, a chain drive. Chain operators shall have hot-dip galvanized chain extending to within 4 feet from the floor. The operator shall have a position indicator that visibly and clearly indicates valve position. Raised surfaces on a valve that clearly indicate position shall be painted a contrasting color. All quarter-turn operators shall be painted with contrasting markings to enhance the visibility of the valve position. Valves larger than three (3) inches shall have ANSI 125 or 150 psi flanged ends and shall be compatible with the piping system or appurtenance in which they are to be installed or as called for on the Drawings or indicated on CVWD Standard Drawings. Grooved ends shall not be acceptable.

- H. Valves of 3 inches and smaller shall have operating levers and flanged ends, unless otherwise shown on the Drawings.
- I. All internal metal parts, except the body and plug, shall be Type 316 stainless steel, Monel, or nickel. Bottom bearing and bearing housing shall be raised so that the top of the bearing is at least 1/4 inch above the bottom of the body.
- J. All bearings including stem bearing, bottom bearing and shaft bearings shall be sleeve type metal bearings and shall be of permanently lubricated Type 316 ASTM A743 Grade CF8M.
- K. Exposed nuts, bolts and washers on valve flanges and valve bodies shall be ASTM A593 Grade CF8M Type 316 stainless steel.
- L. The body seats in valves of 3-inches and smaller shall have a welded overlay of not less than 95 percent nickel on surfaces contacting the plug face.
- M. For valves over 3 inches, seats shall be welded overlay of not less than 95 percent pure nickel with the surface completely covered with weld and smoothly finished. Raised seat area shall be at least 1/2-inch wide 1/8-inch thick.
- N. All submerged and buried valves shall be equipped with worm-gear operators, lubricated and sealed to prevent entry of dirt and water into the operator. Provide Buna-N or PTFE grit excluders upper and lower journal bearings.
- O. Plug valves shall have a non-shock working pressure rating of not less than 150 psi, when tested and rated per ANSI B16.5 for cast iron and ANSI B16.42 for ductile iron valves.
- P. Shaft seals shall be of the multiple V-ring packing type with a minimum of four (4) sealing rings designed to seal tighter as pressure increases. Shaft seals shall be externally adjustable and replaceable under pressures up to 10 psig without removing the actuator or bonnet from the valve. Valves utilizing snap rings, O-ring seals or non-adjustable packing shall not be acceptable.
- Q. Unless otherwise required by the Contract Documents, all valves, actuators and accessories including solenoid valves, positioners, limit switches, manual overrides, mounting brackets, except local/remote/off switches that are ordinary mounted on the wall and generally provided by other manufacturers, shall be supplied by the valve manufacturer as a complete package and shall be assembled and tested as one unit in the United States.

2.03 *Manufacturers*

A. Manufacturers shall be the following, or approved equal:

1. DeZurik Series 100 PEC

2. Henry Pratt Company Ballcentric
3. Crispin K-flow
 - a. 800 Series for 2 ½" – 12"
 - b. 900 series for 14" – 18"

2.04 *Bolts, Nuts, and Washers for Flanged Valves*

- A. Bolts and nuts for flanged valves and flanges shall be Type 316 stainless steel conforming to ASTM A193, Grade B8M, for bolts and ASTM A194, Grade 8M, for nuts.
- B. 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.
- C. 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. All nuts, bolts, washers, external fasteners, mounting hardware, and brackets shall be 316 stainless steel.

2.05 *Gaskets for Valves*

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

2.06 *Protective Coatings*

- A. Interior:
 1. All interior non-working ferrous surfaces other than stainless steel shall be given an epoxy coating unless specified otherwise.
 2. All valves shall be fusion bonded epoxy lined (12 to 16 mils DFT) and holiday tested in accordance with AWWA C550 (latest). CVWD shall approve epoxy coating materials and methods before application. Completed coating shall be free from all defects and shall be inspected by use of low voltage holiday detecting and non-destructive thickness gauges.
 3. If small local repairs are necessary, they shall be made using a liquid epoxy recommended by the manufacturer of the epoxy with which the item was initially coated. The surface shall first be hand tool cleaned in accordance with SSPC-SP2. The repair epoxy material shall be applied in accordance with the manufacturer's instructions.
 4. Where factory hydrostatic testing of the valve is required the valve shall pass all tests prior to interior coating applications.

B. Exterior:

1. Valves: Buried, Submerged or in Contact with Process Fluid, and Located in Vaults
 - a. Exterior surfaces shall be coated with fusion bonded epoxy as specified in AWWA C116 with a DFT of 12 to 16 mils.
 - b. Except as otherwise provided herein, the material used shall be 100 percent powder epoxy, fusion bonded and shall be Scotchkote 206N, Valspar Pipe Clad 1500, AkzoNobel Resicoat Single Layer, or approved equal.
 - c. Finish coat shall match the color of the adjacent piping.
 - d. Exposed portions of the valve shaft shall not be coated.
2. Above Grade Valves (atmospheric weathering environment)
 - a. Unless otherwise required by the Contract Documents, all valves shall be coated with Service Condition A as specified in Section 09 90 00.10, Sewer Painting and Coating, or as shown on the Drawings
 - b. Finish coat shall match the color of the adjacent piping.
 - c. Exposed portions of the valve shaft shall not be coated.

C. Do not coat flange faces or other mating faces.

2.05 *Nameplates*

- A. Each and every valve shall be provided with a 14-gauge brass indexing tag, 1-1/2 inch diameter, bearing 3/16 inch die-stamped lettering with pipe duty designation and valve number. Exact lettering and numbering shall be as approved by CVWD. Each tag shall be securely attached to its valve with a #10 single-jack brass chain or with brass bolts or screws. Each tag shall be provided with two holes for securing tag with chain, bolts, or nails. Buried valves shall have tags attached to the valve box.

2.06 *Spare Parts*

- A. Contractor shall provide, as recommended by the valve manufacturer for two (2) years of operation and as applicable.

2.07 *Valve Orientation*

- A. Order valves with the opening direction and hand wheel or lever oriented so that they conform to the requirements specified in Part 3 of this Specification regarding valve orientation.

2.08 *Valve Operator Wells*

- A. Valve operator wells for valves shall consist of 8-inch diameter, C-900 PVC pipe as shown on Standard Drawing No. S-36.
- B. Valve operator wells shall be equipped with a cast iron frame with concrete and cast iron lid, marked, as shown on Standard Drawing No. S-37. The caps shall be painted OSHA green for sewer service.

2.09 *Extension Stems for Buried Valve Operators*

- A. Extension stems shall be solid Type 316 stainless steel, and shall be complete with 2-inch square operating nut.
- B. No pinned couplings are permitted.
- C. Extension stems shall conform to CVWD Standard Drawings.

2.10 *Polyethylene Wrap*

- A. Polyethylene wrap shall be used for the buried installation of valves in accordance with Section 33 11 13, Piping Systems and Appurtenances.

2.11 *Tracer Wire*

- A. Tracer wire material shall be as specified by the Contract Documents.

PART 3 – Execution

3.01 *General*

- A. All plug valves, operating units, stem extensions, valve boxes, and accessories shall be installed in strict accordance with this Specification section, the manufacturer's published recommendations. Valves shall be firmly supported to avoid undue stresses on the pipe.
- B. Valves shall be kept clean and free from dirt, earth, debris, and other deleterious materials prior to, during, and after installation and construction.
- C. Access: All valves shall be installed to provide easy access for operation without special tools or ladders, for removal and for maintenance, and to avoid conflicts between valve operators and structural members or handrails.
- D. Handles for all valves 6 inches and larger shall be malleable iron or steel.

3.02 *Installation - Aboveground Valves*

- A. Valves shall be installed so that when handles are moved from full open to full-closed position they shall clear all obstructions. If levers or handles impede access around valves, storage for removed levers or handles shall be provided on a nearby wall.

Location and orientation of all valve operators shall be subject to the Engineer's acceptance. Operators shall move through their entire range with no more than 40 pounds of applied force. For chain operators, mount cleats on walls as necessary to secure chain and to prevent interference in passageways or with equipment access. Arrangement shall be as indicated on the Contract Documents.

- B. Aboveground valves shall be rigidly held in place using supports and hangers in the Drawings and CVWD Standard Drawings. The stem orientation of valves in elevated piping shall be as approved by CVWD's Representative for accessibility, except that no valves shall be installed with stems aligned below horizontal. Saddle type valve supports shall be provided. Supports shall be of rugged construction providing at least one hundred twenty degrees (120°) under support for the valve body. Valve supports shall be constructed of steel, and shall be anchored to the foundations using stainless steel anchor bolts.
- C. Valves shall be installed to present minimum hazard to personnel. Hand wheels shall generally be between 24 and 54 inches above grade or floor. Horizontal, unguarded stems shall not be installed below 24 inches or between 54 and 75 inches above grade.

3.03 *Installation - Buried Valves*

- A. Valves shall be installed per CVWD Standard Drawings and as shown on the Drawings.
- B. Buried plug valves shall be provided with valve boxes and AWWA operating nuts. All underground valves shall be installed with cast-iron valve boxes set over the valve with no weight bearing on the valve or pipe.
- C. Buried valves shall be firmly supported in place by compacted backfill to preclude strain on the pipe connections. Valve boxes shall be checked for centering plumb over the wrench nut and ensure that the box cover is flush with the finish grade. Interior of valve box shall be cleaned of all foreign material before installation. The valve shall be inspected in the opened and closed positions to ensure all parts are in working condition. Valve shall be installed in accordance with CVWD Standard Drawings.
- D. Underground valves: Coating shall be protected from damage during installation and backfill. Coating shall be touched up as required before backfill.
- E. Polyethylene wrap shall be used for the buried installation of valves in accordance with Section 33 11 13, Piping Systems and Appurtenances.

3.04 *Thrust Restraint*

- A. Place concrete thrust blocks as indicated on the Drawings, CVWD's Detail Drawings for the Construction of Sanitary Sewer Systems, Section 33 11 13, Piping Systems and Appurtenances, and as directed by CVWD.
- D. Unless otherwise specified or indicated on the drawings, the depth of concrete thrust blocks below valves shall be placed in accordance with the following table and shall be full width of the trench.

<u>Size of Valve</u>	<u>Depth of Thrust Block Below Valve</u>
6-inch	6-inches
8-inch	8-inches
12-inch	12-inches
18-inch and up	As shown on the Drawings

- E. After completion of the installation of the thrust device and before acceptance thereof, the Contractor shall perform such tests as may be necessary to assure proper functioning of the thrust device. Defects disclosed by such testing shall be repaired to the satisfaction of CVWD.

3.05 *Installation - Valve Orientation*

- A. Unless otherwise directed, install eccentric plug valves according to the following rules.
 - 1. Position valves with the stem in the horizontal direction.
 - 2. Clean water: On lines conveying fluids without suspended solids, defined as fluids normally containing less than 15 mg/L total suspended solids, such as potable water or recycled water, install valves so that the normally higher pressure shall be through the valve when closed, to force the plug against the seat.
 - 3. Solids accumulation: On lines containing sewage, sludge, or any other liquid containing solids, including silt or fine sand, the orientation of the valve shall prevent the valve from accumulating solids behind the plug face when closed.
 - a. In vertical pipelines, the plug shall close with the plug at the top of the valve.
 - b. In horizontal pipelines, the plug shall swing upwards when opening, and close against the normal flow direction.
 - c. Pressure differential. Notwithstanding the rules above regarding solids accumulation, where the pressure differential through the valve can exceed 25 psi, and the valve does not have a worm gear, electric, or air

operator, the higher pressure shall be through the valve, to force the plug against the seat.

4. Hand wheel: Install the valve so that the hand wheel or lever operator is on the side of the pipe most accessible to an operator.
5. Consult with the manufacturer regarding valve orientation prior to installation.
6. Bring any conflicts and/or inconsistencies to CVWD's attention immediately.

3.06 *Valve Operator Wells*

- A. Valve operator wells shall be installed in accordance with Standard Drawing No. S-36. The caps and upper valve operator well sections shall be placed after the surrounding street surface has been laid.

3.07 *Valve Operator Nut Extensions*

- A. Valve operator nut extensions shall be installed where necessary to maintain the depth below finish grade to the operator nut to no more than three and one-half feet (3.5-ft). The design of the extension shall be such to ensure the centering of the operator nut within the valve operator well.

3.08 *Marker Posts*

- A. Locate and install marker posts in accordance with Section 10 10 10, Utility Marker Post and CVWD Standard Drawings W-27/S-38.

3.09 *Field-testing*

- A. Valves shall be hydrostatically tested in conjunction with the pipelines in which they are installed in accordance with Section 33 01 30.13, Sanitary Sewer System Testing and Section 33 14 00, Hydrostatic Testing of Pressure Pipelines.
- B. All concrete thrust/anchor blocks shall be allowed to cure a sufficient time to develop the designed minimum strength before field-testing activities and pressure tests on the pipelines.
- C. All valves shall be field tested following installation to demonstrate that the valve operates under field conditions in a manner consistent with the design of the system. Additionally, field-testing of valves shall be performed in accordance with manufacturer's recommendations. All field testing of valves shall be witnessed by CVWD's Representative and be subject to acceptance.
- D. All valves installed in a given pipe shall be designed to withstand the test pressure, at a minimum 1-1/2 times the working pressure for that particular pipe.

END OF SECTION 33 12 16.50

BLOWOFF ASSEMBLIES

PART 1 General

1.01 *Description*

This section includes materials, testing, and installation of blowoff assemblies.

1.02 *Service Application*

- A. Blowoff assemblies shall be installed on potable and recycled water mains.
- B. Blowoff assemblies shall be sized and located as shown on the Approved Plans. In general, blowoff assemblies will be installed at the ends and at low points of pipelines as shown below:
 - 1. 2-inch blowoff assemblies will be required on pipelines for temporary use or as otherwise directed by the Owner's Representative.
 - 2. 4-inch blowoff assemblies will be required on pipeline sizes 16-inch and smaller.
 - 3. 6-inch blowoff assembly will be required on pipeline sizes 18-inch and larger.

PART 2 Materials

2.01 *General*

Blowoff assemblies and appurtenant components and materials shall be selected from the Approved Materials List.

2.02 *Concrete*

Concrete used for thrust or anchor blocks shall be in accordance with Section 03 30 00.

2.03 *Polyethylene Wrap*

Polyethylene wrap shall be used for buried installation of blowoff piping and appurtenances in accordance with Section 33 11 13.

PART 3 Execution

3.01 Installation

- A. Blowoff assemblies shall be installed at locations shown on the Approved Plans or as directed by the Owner's Representative in accordance with the Standard Drawings.
- B. Blowoff assemblies shall be connected to water mains no closer than 24-inch to a bell, coupling, joint or fitting.
- C. Locations of blowoff assembly valve operator well shall be in accordance with the Approved Standard Drawings.
- D. If a blowoff is installed as a future point of connection (POC) the size of Blowoff control valve shall be equal to the size of the main if appurtenances are or will be installed between the blowoff and the nearest isolation valve.
- E. All blowoffs shall be restrained and all piping leading up to the assembly shall follow CVWD's restrained joint guidelines, see Appendix "A".

3.02 Concrete

Concrete thrust and restraint joints shall be installed in accordance with Section 03 30 00 and the Standard Drawings. Refer to Section 03 30 00 for the minimum concrete curing time required.

3.03 Disinfection of Blowoff Assemblies

Blowoff assemblies shall be disinfected in accordance with Section 33 13 00 in conjunction with disinfecting the main to which it is connected. Blowoff assembly valves shall be operated and the assembly shall be flushed to completely disinfect all internal parts.

3.04 Hydrostatic Testing

Blowoff assemblies shall be hydrostatically tested in accordance with Section 33 14 00 in conjunction with hydrostatically testing the pipeline to which it is connected.

END OF SECTION 33 12 17

SECTION 33 12 18
COMBINATION AIR/VACUUM VALVE ASSEMBLIES

PART 1 General

1.01 *Description*

This section includes materials, testing, and installation instructions for above ground combination air/vacuum valve assemblies (air/vac).

1.02 *Service Application*

- A. Combination air/vac valves are installed on all mains where shown on the Drawings and in accordance with the Standard Drawings and as directed by the Owner's Representative.
- B. Unless otherwise directed by the Owner's Representative, combination air valves will be required as shown below:
 - 1. 1-inch air/vac assemblies shall be installed on pipelines sizes 6-inch through 8-inch.
 - 2. 2-inch air/vac assemblies shall be installed on pipelines sizes 12-inch through 24-inch.
 - 3. 4-inch air/vac assemblies shall be installed on pipelines sizes 30-inch and larger.

1.03 *Submittals*

The manufacturer shall provide proof of compliance with California's lead free statute §116875 by providing certification from the independent American National Standards Institute (ANSI) or NSF International.

1.04 *Delivery, Storage and Handling*

Valves shall be delivered and stored in accordance with AWWA C550. The port openings shall be covered with plastic, cardboard or wood while in transit and during storage in the field. These covers shall remain in place until valves are ready to be installed. Valves shall not be stored in contact with bare ground. Valves shall not be stacked.

PART 2 Products

2.01 General

Combination air/vac valve assemblies shall comply with AWWA C512 except as modified herein. Combination air/vac valve assemblies and appurtenant components and materials suitable for the system pressure shall be selected from the Approved Materials List.

Combination air/vac valve assemblies shall conform to the following:

- A. Valves shall be of the sizes indicated on the Drawings, with flanged or threaded ends to match the adjacent piping.
- B. Seat washers and gaskets shall be of a material ensuring water tightness with a minimum of maintenance.

2.02 Epoxy Lining and Coating

Epoxy lining and coating for valves shall be provided in accordance with AWWA C550.

- A. Liquid epoxy lining materials shall be listed in the NSF Listing for Drinking Water Additives, Standard 61, certified for use in contact for potable water and shall also be in conformance with California's lead free statute § 116875.
- B. The minimum dry film thickness for epoxy linings shall be 0.008-inch or 8 mils. Liquid epoxy lining shall be applied in two (2) coats in accordance with AWWA C210.

2.03 Enclosures

Air/Vac enclosures shall be selected from the Approved Materials List.

2.04 Concrete

Concrete used for anchor or thrust blocks and equipment pads shall be in accordance with Section 03 30 00.

PART 3 Execution

3.01 Installation

- A. Air/Vac valve assemblies shall be installed in accordance with California Code of Regulations Title 22, Division 4, Chapter 16, Article 4, § 64576.
- B. Air/Vac valve assemblies shall be provided as shown on the Drawings. Additional air/vac valve assemblies may be required in areas of potential air entrapment, at the discretion of the Owner's Representative.

- C. Air/Vac valve assemblies shall be installed relative to street improvements in accordance with the Approved Standard Drawings.
- D. Connection for the air/vac valve assemblies shall be made within a section of the main line no closer than 24-inches of a bell, joint or fitting.
- E. The air/vac service line shall slope continuously upward from the main to the air/vac relief valve.
- F. The air/vac valves appurtenances shall be installed in accordance with the Approved Standard Drawing Nos. W-21A, 21B, 22A and 22B.
- G. Air/Vac valve assemblies 4-inch and larger shall not be hot taped or direct taped. The service line shall be connected to main with a tee, the tee and service line shall be equally sized to match the size of the air/vac valve in accordance with the Approved Standard Drawing.
- H. Air/Vac valve assemblies 4-inch and larger shall have a butterfly valve (BFV) to isolate the air/vac valve assemblies for repairs and maintenance. The minimum size BFV shall be equal to the size of air/vac or the next size larger as directed by the Owner's Representative.

3.03 *Disinfection*

Air/Vac valve assemblies shall be disinfected in accordance with Section 33 13 00 in conjunction with disinfecting the main to which it is connected. Air/Vac valve assembly shall be operated and the assembly shall be flushed to completely disinfect all internal parts.

3.04 *Hydrostatic Testing*

Air/Vac valve assemblies shall not be hydrostatically tested in conjunction with testing of the pipeline. The isolation valve shall be closed or the air/vac valve assemblies can be installed in the riser after the pipeline hydrostatic test is accepted.

3.05 *Field Tests*

After installation of air/vac valve assemblies and before acceptance thereof, the Contractor shall perform such tests as may be necessary to assure proper operation of all components. All defects disclosed by such testing shall be repaired to the satisfaction of the Owner's Representative.

END OF SECTION 33 12 18

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33 12 19
FIRE HYDRANTS

PART 1 General

1.01 *Description*

This section includes materials and installation of wet-barrel fire hydrant assemblies. All wet-barrel fire hydrants shall conform to AWWA C503 and these specifications.

1.02 *System Description*

Hydrants shall generally have the following number and size of outlets as follows:

1. One 6-inch bottom connection
2. Two 2 ½ inch hose connections
3. One 4-inch pumper connection

1.03 *Service Application*

- A. Fire hydrants shall be installed on potable water mains only.
- B. Wet-barrel hydrants shall generally be used for pressures up to 200 pounds per square inch (psi). System pressures up to and including 150 psi requires standard wet-barrel hydrants and pressures up to 200 psi shall require high-pressure wet-barrel hydrants in accordance with the Approved Materials List.
- C. Break-off check valve assemblies shall be installed on all wet-barrel hydrants.

1.04 *Submittals*

If required by the Owner's Representative, the following items shall be submitted to CVWD for review and approval prior to ordering or delivery of hydrants.

- A. Fire hydrant assemblies shall be selected from the Approved Materials List.
- B. Provide manufacturer's catalog data.
- C. The manufacture shall provide proof of compliance with NSF/ANSI 61 Annex G, NSF/ANSI 372 and conform with the lead content requirements for "lead-free" plumbing as defined by California's statute §116875.

1.05 *Fire Hydrant Assembly Joints and Fittings*

Fire hydrant assemblies shall be installed in accordance with the Approved Standard Drawing.

1.06 *Delivery, Storage and Handling*

Fire hydrants shall be delivered and stored in accordance with AWWA C210, AWWA C213, and AWWA C550. The port openings shall be covered with plastic, cardboard or wood while in transit and during storage in the field. These covers shall remain in place until the hydrant is ready to be installed. Fire hydrants shall not be stored in contact with bare ground. Fire hydrants shall not be stacked at the project site.

1.07 *Polyethylene Wrap*

Polyethylene wrap shall be used for all of buried fire hydrant assemble, hydrant pipe runs and valves in accordance with Section 33 11 13.

PART 2 Materials

2.01 *Fire Hydrant Assembly*

- A. Fire hydrants shall be selected from the Approved Materials List.
- B. Wet-barrel fire hydrants shall comply with AWWA C503 and these specifications unless otherwise indicated on the Approved Plans.
- C. The interior of ductile-iron hydrants and break-off check valve assembly shall be fusion-epoxy lined per C213 and C550.
- D. Epoxy lining materials shall be listed in the NSF Listing for Drinking Water Additives, Standard 61, certified for use in contact for potable water.
- E. All outlets shall be provided with National Standard Fire-Hose Threads. Outlets shall be provided and equipped with cast iron caps and metal chains.
- F. Wet-barrel fire hydrant flange, 90-degree bury ells and riser shall incorporate a six-hole bolt pattern to match the break-off riser and break-off check valve.
- G. Fire hydrants shall be opened by turning left (counterclockwise) unless otherwise indicated on the Approved Plans.
- H. Break-off check valves shall be selected from the Approved Materials List.

2.02 *Bolts and Nuts*

- A. Hydrant flange bolts and nuts shall be selected from the Approved Materials List.
- B. When indicated on the Approved Plans or with the prior approval of the Owner's Representative, wet barrel fire hydrants not equipped with break-off check valves shall be installed with break-away flange bolts selected from the Approved Materials List.

2.03 *Concrete*

Concrete used in the construction of the fire hydrant assembly for splash pads, thrust or anchor blocks shall be in accordance with Section 03 30 00.

2.04 *Field Painting and Coating*

Field painting and coating material shall be in accordance with the Approved Materials List.

The color scheme for fire hydrants shall follow AWWA C503 and NFPA 291, Chapter 3 and as modified herein.

Fire hydrant body shall be painted as follows:

<u>Supply</u>	<u>Body Color</u>
CVWD System:	Chrome Yellow
Private System:	Red

Fire hydrant bonnets shall be as follows:

<u>COLOR</u>	<u>CLASS</u>	<u>Available Flow @ 20 psi Residual</u>
GREEN	A	1,000 gallons per minute (gpm) or more
ORANGE	B	500 – 999 gpm
RED	C	Below 500 gpm

2.05 *Fire Hydrant Pavement Markers*

Fire hydrant pavement markers shall be blue and shall be selected from the Approved Materials List.

PART 3 Execution

3.01 Installation

- A. Fire hydrant assemblies shall be installed at locations shown on the Approved Plans and in accordance with the Approved Standard Drawings.
- B. The fire hydrant outlet ports shall be orientated as shown on the Approved Standard Plans.
- C. Fire hydrants depending on the location may require marker posts, protection posts or concrete retaining wall (if located in landscape slopes). When required by the Owner's Representative, or when shown on the Approved Plans the addition of marker posts, protection posts or retaining walls shall be installed in accordance with the Approved Standard Drawings.
- D. Trenching, bedding, backfilling and compacting shall be performed in accordance with Section 31 23 17, 33 11 13 and the Approved Standard Drawings.
- E. Blue hydrant reflective pavement markers shall be placed on all thoroughfares to mark fire hydrant locations. Markers shall be placed directly opposite each fire hydrant approximately three inches from the centerline of the street on the side of the street nearest the hydrant. Markers shall be selected from the Approved Materials List. Markers not listed on the Approved Materials List shall be approved by the Riverside County Fire Marshall.

3.02 Disinfection of Fire Hydrant Assembly

Disinfection and flushing shall be in accordance with Section 33 13 00 as part of the process of disinfecting the main pipeline. The fire hydrant shall be operated during the disinfection period to completely disinfect all internal parts.

3.03 Hydrostatic Testing

The fire hydrant assembly shall be subject to pressure during the hydrostatic test of the pipelines in accordance with Section 33 14 00.

END OF SECTION 33 12 19

33 13 00

DISINFECTION OF PIPING

PART 1 General

1.01 Description

This section describes the requirements for flushing and disinfection of potable water mains, services, pipe appurtenances and connections.

The Contractor shall flush and disinfect potable water mains and appurtenances, complete, including providing the water and the disposal thereof.

1.02 Service Application

- A. All existing water mains and appurtenances taken out of service for inspection, repairs or other construction activities that might lead to contamination shall be disinfected prior to connection to CVWD's existing system.
- B. All new water mains and appurtenances shall be disinfected prior to placing the facilities into CVWD's system.
- C. All components incorporated into a connection to CVWD's existing system shall be disinfected prior to installation.
- D. Disinfection of piping shall be done after passing hydrostatic testing of pipelines in accordance with Section 33 14 00.

1.03 Submittals

A written schedule shall include plans for water conveyance, control and disinfection shall be submitted in writing for approval a minimum of 7 days before commencing flushing and disinfection operations. The submittal shall also include the Contractor's plan for obtaining sufficient flow to flush disinfected water, neutralization of water from the pipeline, and release of water from pipelines after testing and disinfection has been completed.

PART 2 Materials

2.01 Material Requirements

- A. All test equipment, chemicals for chlorination, temporary valves, temporary blow-offs, or other water control equipment and materials shall be determined and furnished by the Contractor.
- B. Liquid chlorine for disinfection shall be used.

- C. Liquid chlorine shall be in accordance with the requirements of AWWA B301.
- D. The placing of HTH capsules, tablets or powder in pipe sections during the laying process is not acceptable.

PART 3 Execution

3.01 General

- A. The disinfection requirements under Title 17 and 22 of the California Code of Regulations, Article 5, §64580 Disinfection of New or Repaired Mains, shall be in accordance with AWWA C651.
- B. Disinfection of pipelines shall not proceed until all appurtenances and any necessary sampling ports have been installed and the Owner's Representative provides authorization.
- C. The Contractor shall make every effort to keep the water main and its appurtenances clean and dry during the construction installation process.
- D. All potable water pipelines, valves, fitting and appurtenances which become contaminated during installation shall be cleaned, rinsed with potable water, and then sprayed or swabbed with a 5 percent sodium hypochlorite chlorine disinfecting solution prior to installation.
- E. Water mains under construction that become flooded by storm water, runoff, or ground water shall be cleaned by draining and be flushed with metered potable water until clear water is evident. Upon completion, the entire main shall be disinfected using a method approved by the Owner's Representative.

3.02 Preliminary Flushing

Prior to disinfection, water mains 12-inches and smaller shall be flushed in accordance with AWWA C651. The flushing velocity in the main shall not be less than 2.5 feet per second (fps) for main sizes up to 16-inches in diameter. Flushing shall be sustained for a period of time not less than twice the minimum theoretical time necessary to flush the entire length of main. If so directed by the Owner's Representative, portions of certain appurtenances may be required to be temporarily reconfigured for flushing purposes. In the event of possible adverse effects of flushing on system operations, flushing shall be conducted during the hours of least demand or as directed by the Owner's Representative. CVWD shall not be responsible for loss or damage resulting from flushing operations.

For mains 18-inches and larger, an acceptable alternative to flushing shall be approved by the Owner's Representative.

3.03 *Disinfecting Potable Water Pipelines*

- A. All pumping equipment, piping, appurtenances and all other equipment in contact with the potable water shall be disinfected in accordance with the requirements of AWWA C651 using the Continuous-Feed Method as modified herein.
- B. The chlorine solution shall be introduced at one end of the pipeline through a tap in such a manner that as the pipeline is filled with water, the dosage applied to the water entering the pipe shall be a minimum 50 mg/l. Where pumping equipment is used with an injector, a backflow device shall be installed and connected to the potable water supply.
- C. The Owner's Representative will verify the presence of the chlorine disinfection solution throughout the system by sampling and testing for acceptable chlorine concentrations at various appurtenances and/or at test ports provide by the Contractor.
- D. The chlorinated water shall be retained in the system for a minimum of 24 hours. The Owner's Representative will test the total chlorine residual and will notify the Contractor of the test results. At the end of the 24 hour period the chlorine residual at the pipeline extremities and at other representative points shall be at least 25 mg/l.
- E. During the process of chlorinating the pipelines, all valves and other appurtenances shall be operated while the pipeline is filled with the heavy chlorinated water.
- F. If the initial test fails to produce satisfactory results the disinfection process shall be repeated. Two consecutive satisfactory test results shall be required after any unsatisfactory test results.
- G. Final flushing shall be done by the Contractor after being notified of a satisfactory chlorine residual test by the Owner's Representative. The chlorinated water shall be flushed from the pipeline until chlorine measurements show that the concentration in the water leaving the pipeline is no greater than what generally prevails in the system or is acceptable for its intended use.

3.04 *Disposal of Testing Water*

- A. All water used in testing and disinfecting the portions of pipeline or water system component, including that used for retesting, shall be disposed of following such testing, retesting, and disinfecting by the Contractor at Contractor's sole expense. The disposal of water shall, in all cases, be carried out in compliance with the water quality objectives and discharge permit restrictions established by the California Regional Water Quality Control Board.
- B. For contracts administered by CVWD, the Contractor will be authorized to discharge test water to the storm drain under the National Pollution Discharge Elimination System (NPDES) permit issued to CVWD if all requirements and procedures per such permit are followed. For all other projects, including Developer projects, Contractor or Developer shall obtain an NPDES permit and comply with that permit.
- C. Disposal of test water or chlorinated water used for disinfection will require the Contractor to apply a reducing agent (i.e. sodium thiosulfate, or ascorbic acid, etc.) to the test water in order to neutralize residual chlorine to meet the discharge limitation of "Non-Detect" (ND). Reducing agents used in neutralizing chlorinated water shall be in accordance with Appendix "C" of AWWA C651. Additionally, the flow of water from the portions of pipeline shall be controlled to prevent erosion of surrounding soil, damage to vegetation, and altering of ecological conditions in the area and shall not contribute to silt, mud, debris, or other contaminants entering storm drains or surface waters.

3.05 *Bacteriological Sampling Ports*

- A. Bacteriological sampling ports shall be installed in accordance with AWWA C651 and the Approved Standard Drawings.
- B. Bacteriological sampling ports shall be installed at intervals no greater than 1,200 feet on new water main, plus one port located at the end of the line and one port for each branch line. Under special conditions outlined under AWWA C651, the Owner's Representative may require additional bacteriological sample ports at no additional cost to CVWD.
- C. No hose or fire hydrant shall be used in the collection of samples.
- D. When approved by the Owner's Representative, Air/Vac's and Blow-off assemblies maybe modified to be used as a sampling port with a riser modification in accordance with AWWA C651 Figure 2. Upon the completion of collecting samples, all modified Air/Vac and Blow-off assemblies shall be returned to its previous condition and shall be in conformance with all sections of this specification and the Approved Standard Drawings.

- E. After samples have been collected, all temporary sampling port assemblies including the corporation stop at the main shall be removed and capped with a threaded plug of similar metal type (saddle or direct tap). Polyethylene encasement shall be repaired after the removal of sampling ports as per AWWA C105.

3.06 *Bacteriological Testing of Disinfected Potable Water Pipelines*

- A. After the chlorinated water has been flushed from the system, CVWD will perform bacterial analysis on the water samples from the disinfected system. The Contractor shall install necessary temporary bacterial sample risers in accordance with the Approved Standard Drawings. Only after successfully passing bacterial analysis shall temporary bacterial sample risers be removed and abandoned as directed by the Owner's Representative.
- B. Before the new water main is connected to the distribution system, two consecutive sets of acceptable samples, taken at least 24 hours apart, shall be collected from the new main. At least one set of samples shall be collected from every 1,200 feet of new water main, plus one set from the end of the line and at least one set from each branch line.
- C. If the initial disinfection fails to produce satisfactory bacteriological results or if other water quality is affected, the new main may be reflushed and shall be resampled. If check samples also fail to produce acceptable results, the main shall be re-chlorinated by the continuous-feed method until satisfactory results are obtained-that being two consecutive sets of acceptable samples taken 24 hours apart.
- D. The Contractor shall be responsible for all repeat flushing, disinfecting, disposal, dechlorination and bacteriological testing costs.

END OF SECTION 33 13 00

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SECTION 33 14 00
HYDROSTATIC TESTING OF PRESSURE PIPELINES

PART 1 General

1.01 *Description*

This section describes the requirements and procedures for pressure and leakage testing of all pressure mains. Hydrostatic testing shall conform to AWWA C600 and these specifications.

1.02 *Requirements Prior to Testing*

- A. All thrust blocks and anchor blocks shall be allowed to cure in accordance with Section 03 30 00.
- B. All piping, valves, fire hydrants, services, and related appurtenances shall be installed.
- C. Pressure tests on exposed, aboveground and vault installed piping shall be conducted only after the entire piping system has been installed and attached to pipe supports, hangers or anchors as shown on the Approved Plans.

1.03 *Hydrostatic Testing of Pipelines*

Hydrostatic testing of pipelines shall be performed prior to disinfection operations in accordance with Section 33 13 00. In the event repairs are necessary, as indicated by the hydrostatic test, the Owner's Representative may require additional flushing in accordance with Section 33 13 00.

1.04 *Connection to Existing Mains*

The Contractor shall install test plates at each valve that is connected to an active water main. Hydrostatic testing shall be performed prior to placing the facilities into service in CVWD's system. Test plates shall be removed by the Contractor after the pressure test has been accepted. CVWD authorization for connection to existing system shall be given only on the basis of acceptable hydrostatic testing, disinfection and bacteriological test results. Connection to existing mains shall be performed in accordance with Section 33 11 13, under direct CVWD inspection.

1.05 *Valve Locks*

The Contractor shall install valve-locking devices on all valves at stub-outs or where a valve connects directly to an active domestic water main. Locking devices shall also be installed on the control valves at newly constructed detector checks. The locking device shall be provided by the Contractor and the padlock provided by CVWD. At the time the new water system is progressed for service, locking devices will be removed by the Contractor under direct inspection by a CVWD inspector. Locking devices located on detector check valves shall be removed by CVWD's forces and returned to the Contractor or developer after the detector check has been installed.

PART 2 Products

2.01 *Water*

Potable water, supplied by a source approved by the Owner's Representative, shall be used for all hydrostatic testing of potable pipelines.

2.02 *Connections*

- A. Testing water shall be supplied through a metered connection equipped with a backflow prevention device in accordance with Section 33 13 00 at the point of connection to the potable water source used.
- B. The Contractor shall provide any temporary piping needed to deliver potable water to the piping that is to be tested. Temporary piping shall be in accordance with Section 33 11 13.

PART 3 Execution

3.01 *General*

- A. The Contractor shall provide CVWD with a minimum of 24 hours notice prior to the requested date and time for hydrostatic tests.
- B. The Contractor shall furnish all labor, materials, tools, and equipment for testing.
- C. Test pressure shall not exceed rated working pressure of gate or butterfly valves.
- D. Corporation stops shall be rated the same as the design pressure of the pipeline.
- E. Temporary blocking during the test will be permitted only at temporary plugs, caps or where otherwise directed by the Owner's Representative.

- F. The test pressure shall not exceed the thrust restraint design pressure or 1.5 times the pressure rating of the pipe or joint, whichever is less (as specified by the manufacture).
- G. While filling the pipeline, care shall be taken to release all air within the pipe and appurtenances to be tested. Air shall be released through services, fire hydrants, air release valves, or other approved locations. After filling the pipeline and before application of test pressure, test section shall be maintained at the working pressure for a minimum of one (1) hour to allow the pipeline to stabilize with respect to line movement under pressure, water absorption by the lining and for an initial leak inspection.
- H. The pressure shall be increased to 1.5 times the stated system pressure, or 150 pounds per square inch (psi), whichever is greater, to a maximum of 300 psi. Pressure shall be measured at, or corrected to, the lowest point in the portion of the pipeline being tested.

The test pressure for the entire section under test (if no leaks have been found, or if found, have been repaired and re-subjected to test pressure) shall be maintained for four (4) hours between ± 5 psi of the stated test pressure for the duration of the test. During the test time the amount of leakage shall be determined by measuring the quantity of water which must be added to maintain the test pressure. The maximum allowable leakage per 1,000 feet of pipe, in gallons per hour, shall conform to the hydrostatic testing table in the Approved Standard Drawings.

If the leakage exceeds the allowable loss, the leak points shall be located and repaired as required by the Owner's Representative. All defective pipes, fittings, valves and other appurtenances discovered shall be removed and replaced with sound material. The hydrostatic test shall be repeated until the leakage does not exceed the rate specified. All visible leaks shall be similarly repaired.

END OF SECTION 33 14 00

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33 21 00

WATER SUPPLY WELLS

PART 1 General

1.01 Introduction

Construction of domestic water pipelines, domestic water wells and appurtenances under the jurisdiction of the Coachella Valley Water District (CVWD) shall be in accordance with the requirements of the latest edition of the "Standard Specifications for Public Works Construction" (SSPWC), written and promulgated by the Southern California Chapter of American Public Works Association and the Southern California Districts of the Associated General Contractors of California Joint Cooperative Committee, complete with latest supplements thereto except as modified in this section.

1.02 Specific Site Data

- A. The existing on-site Well XXXX-X shall be protected in-place to allow for on-going water monitoring purposes. This well was drilled in XXXX to depth of X,XXX feet. OR.
- B. The Contractor shall destroy existing Well No. XXXX-X in accordance with California Water Well Standards 74-90, Section 23 including the removal of existing 5' X 5' concrete pump base and associated pipe and tubes.
- C. The existing facilities and appurtenances such as bypass structure, blow-off structure, underground valves, and other well site improvements shall be protected-in-place by the Contractor.
- D. Climatological data prepared by the U.S. Department of Commerce, National Weather Service, from 1927 to 1985 at the Palm Springs Airport, approximately 20 miles northwest of the site, shows temperatures ranging from an average minimum in January of 40.8°F to an average maximum in July of 109.2°F. Normally, there are only 10 days per year with temperatures of 32°F or lower, 184 days per year with readings of 90°F or higher, 10 days where temperatures exceed 115°F and 60 days where nighttime low temperatures are above 80°F. Estimated relative humidity ranges from 20 to 25 percent for summer afternoons to 35 to 45 percent for winter afternoons.
- E. Precipitation averages 5.2 inches per year, with December and January, the wettest months, averaging less than 1.0 inches each. There are normally only 11 days per year with a 0.1 inch or more of rain and only 20 days with any measurable precipitation.

- F. In addition to runoff from storms over the general area, the area is subject to summer flash floods. Wind direction is normally from the northwest at speeds of less than 13 miles per hour about 84 percent of the time. Winds of 25 miles per hour or more, occasionally resulting in blowing sand or dust, have been recorded only 2.4 percent of the time for the short period of wind records.

1.03 *Well Drilling Requirements*

- A. The well may be drilled by either the Conventional Rotary Method using circulating mud fluid, or by the Reverse Circulation Rotary Method.
- B. Work shall be done by equipment adequate to perform all phases of well construction.
- C. If, in the opinion of the Engineer, the Contractor's equipment is not capable of satisfactorily performing the work provided for in these specifications, the Contractor shall substitute equipment satisfactory to the Engineer.
- D. The Contractor's drilling rig and accessory equipment must be in good working condition so that the work can progress without interruption.
- E. The completed well shall be straight, plumb, and free of any obstructions to permit free and easy installation and operation of a deep well turbine type pump for the size and depth of setting required for maximum development and pumping of the well.
- F. CVWD reserves the right to go beyond the depth specified in Section 3.01, Bullet B, Sub-bullet 1 or to stop at a lesser depth, depending upon the formation encountered in the drilling of the pilot test hole.
- G. The Contractor shall perform its drilling operations, and other work incidental thereto with a minimum of noise.
- H. Sound curtains or an approved equal shall be used to mitigate construction noise throughout the Contract if determined by the Engineer.
- I. The Contractor shall remove drilling mud and cuttings from the construction sump, dispose of such material and backfill holes or depressions with clean earth and restore the ground surface, as reasonably as possible, to its original state.
- J. The Contractor shall, at its own expense, arrange for additional working space which may be required for its operation.
- K. If the well is not straight and plumb and free of any obstruction, as specified, the well shall be straightened, plumbed and freed of all obstructions or a new well shall be drilled at no additional cost to CVWD.

- L. In the event of the inability of the Contractor to complete the well due to faulty materials, workmanship, operations of the Contractor or a crooked hole, the Engineer may require a new well to be drilled immediately and no payment will be made for the depth to which the original well was drilled and abandoned.
- M. The new well shall be completed in accordance with all the terms and conditions stated herein.
- N. If, however, inability to complete the well was not due to any fault of the Contractor, the cost of the new well will be paid for by CVWD at the respective contract prices and the time for completion shall be extended proportionately. The abandoned hole shall be filled in accordance with the requirements of CVWD.
- O. In the event that additions to or deductions from the work shown on the drawings or described in the specifications are made, and they are covered by the items listed in the bid forms, the Contractor agrees that the unit prices stated in the Schedule of Pay Items for such items shall be used in making additions to or deductions from the contract price.

1.04 *Well Development Requirements*

- A. After the well has been constructed in accordance with the contract documents, the Contractor shall notify the Engineer and shall make the necessary arrangements for conducting the development and testing portion of the project.
- B. The Contractor shall be responsible for the discharge of development and test water. Mud, sand, and debris pumped from the wells during development and testing shall be removed and disposed of by the Contractor as part of this contract in such a manner as not to damage property or create a nuisance.
- C. [CVWD has made arrangements with XXXXX, the owners of a retention basin located XXXXXXXXXX. See attached Aerial Photo as shown in PART VIII DRAWINGS AND PERMITS for the exact location.]
- D. It is the Contractor's responsibility to discharge water into the retention basin in such a manner as to not damage the properties or create a nuisance. The Contractor, together with a CVWD Project Engineer and Inspector will ensure that the water being released onto this retention basin property will be clean and clear.
- E. The Contractor shall contain the water within the retention basin and shall not discharge water to nearby streets.

- F. The Contractor shall indemnify the retention basin property owners (XXXXXXXXXX) of any damages associated with the water discharge and shall make reasonable provisions to protect the public from any water hazards created by its work.
- G. The Contractor shall restore all areas affected by water discharge to preconstruction conditions acceptable to property owners, CVWD Inspector and Project Engineer. A Damage Release from XXXXX will be required as specified in SC-3.3, Status of Project Area and Right-of-Way. A Damage Release Form can be found in Appendix C.
- H. The Contractor shall perform development operations during daylight hours only.
- I. Following completion of airlift development, the top of the well casing shall be provided with a metal cap securely welded to the casing to cover and protect the well and to guard against entrance by foreign objects or materials, until the test pump is installed.
- J. Immediately following removal of the test pump, plumbness and alignment testing and final disinfection, the top of the well casing shall be secured with a metal cap securely welded to the casing.
- K. The metal cap shall cover and protect the well, and will guard against entrance by foreign objects or materials, until the permanent pump is installed.

1.05 *Existing Well*

The contractor shall protect in place existing Well No. XXXX-X. The water well drillers report is included in part VIII, DRAWINGS AND PERMITS.

OR

The Contractor shall destroy existing Well No. XXXX-X in accordance with California Water Well Standards 74-90, Section 23, including the removal of existing 5' X 5' concrete pump base and associated pipe and tubes. The Water Well Drillers Report is included in PART VIII, DRAWINGS AND PERMITS.

PART 2 Materials

ARTICLE 2

2.01 Well Casing Specifications

- A. The carbon steel conductor casing shall be manufactured in accordance with ASTM A 139 Grade B, latest. The diameter shall be 36 inches outside diameter. The wall thickness shall be 5/16 inch. Casing shall be factory assembled in sections not less than 20 feet in length having not more than one longitudinal seam nor more than one circumferential seam in 10 feet.
- B. All material shall be new.
- C. The carbon steel blank casing shall be manufactured in accordance with ASTM A 53, Grade B, latest. The diameter shall be 16-inches O.D. The wall thickness shall be 5/16 inch.
 - 1. The casing shall be factory assembled in not less than 20 foot lengths and shall contain one longitudinal seam parallel to the axis of the casing and not more than one circumferential seam in 10 feet.
 - 2. All longitudinal and circumferential seams shall be butt welded from the exterior against copper faced mandrels with shield or electrodes to protect the weld metal from air while cooling, and to assure full fusion with the parent metal and complete penetration.
 - 3. The ends of each joint shall be machine beveled perpendicular to the axis of the casing to insure the straightness of each assembled section. One end of each assembled section shall be swaged to permit a bell and spigot joint, or approved equal, to be assembled by welding in the field with a continuous weld with not less than 1/4 inch fillet.
 - 4. Spiral welded casing manufactured in accordance with ASTM A-139-61 Grade B may be substituted for the butt-welded casing.
 - 5. All field welding shall be performed by welders certified in accordance with Appendix 11 of the American Standard Code for Pressure Piping, ASA B31-1, or other approved standard.
 - 6. Different diameter casing shall be joined by a tapered cone reducing section 4 feet long and fabricated from 5/16 inch thick steel plate of the same physical and chemical properties as called for in Section 2.01, Bullet B.

2.02 *Well Screen Specifications*

- A. The screen material is expected to be carbon steel and to have Ful-Flo horizontal shutters as manufactured by Roscoe Moss Company or approved equal; however, the Engineer may change the material based on information from the pilot bore.
- B. The alternative screen material is expected to be 316L Stainless Steel (SS) and to have Ful-Flo horizontal shutters as manufactured by Roscoe Moss Company or approved equal; however, the Engineer may change the material based on information from the pilot bore. Contractor shall include two (2) dielectric couplings per section of screen installed.
- C. No additional compensation will be made to the Contractor for delays resulting from a change in the screen material.
- D. The screen shall be of high strength construction for setting to the final well depth.
- E. The screens shall be 20 feet in length where permissible and equipped with welding rings ends.
- F. The expected slot size is approximately 0.060-inch (No. 60 Slot).
- G. The Engineer shall determine the exact slot size after the completion of the pilot bore. The actual slot size shall not vary from the specified slot size by more than ± 10 percent, as measured by wire gauges.

2.03 *Screened and Inverted Casing Vent*

The screened and inverted casing vent shall be Schedule 40 mild steel and manufactured in accordance with ASTM A-53, Grade B, latest.

2.04 *Sounding Tube*

The sounding tube shall be Schedule 40 mild steel and manufactured in accordance with ASTM A-53, Grade B, latest.

2.05 *Camera Access Pipe*

The camera access pipe shall be Schedule 40 mild steel and manufactured in accordance with ASTM A-53, Grade B, latest.

2.06 *Gravel Feed Pipe*

The gravel feed pipe shall be Schedule 40 mild steel and manufactured in accordance with ASTM 53, Grade B, latest.

2.07 Gravel Material

- A. The gravel shall be composed of sound, durable well rounded articles, containing no silt, clay, organic matter, or deleterious materials.
- B. The gradation of the gravel shall be determined by the Engineer after analysis of the samples from the pilot bore.
- C. Crushed rock shall not be installed in the well. A representative sample of the gravel to be used shall be submitted to the Engineer. Gravel shall not be delivered to the job site prior to obtaining approval of the gravel from the Engineer.
- D. Weight slips for gravel delivered shall be supplied to the Engineer's inspector.
- E. The filter gravel to be installed in the screen area and to a depth of 100 feet above the top of the screen area shall be produced by Colorado Silica Sand, Inc. Colorado Springs, Colorado, or Tacna Sand and Gravel LLC, Yuma, Arizona.
 - 1. The following expected gravel gradation is provided for the Contractor's information; however, the gradation may be changed by the Engineer based on results of the pilot bore sample analysis.
 - 2. The filter pack shall be non-uniform and have a uniformity coefficient of approximately 2.
 - 3. The Contractor shall furnish gravel of the gradation specified by the Engineer at the unit price stated in the Schedule of Pay Items.
- F. The gravel shall be composed of sound, durable well rounded articles, containing no silt, clay, organic matter, or deleterious materials. The gradation of the gravel shall be determined by the Engineer after analysis of the samples from the pilot bore.

Percentages Passed

<u>Screen</u>	<u>Percentages Passing</u>
¼ Inch	100
No. 4	95
No. 6	87
No. 8	70
No. 10	58
No. 14	27
No. 16	18
No. 20	10
No. 30	6
No. 40	2

2.08 *Drilling Fluid*

- A. Conventional Rotary Method: Only high grade approved clays in common usage in the Southern California area for oil field drilling shall be used in the make-up of the drilling fluid.
- B. Drilling with a mixture of water and unprocessed mud, clay or other material will not be permitted.
- C. Portland Cement will not be permitted.
- D. The drilling fluid shall possess such characteristics as are required to adequately condition the walls of the hole to prevent caving of the walls as drilling progresses and to permit recovery of representative samples of cuttings.
 - 1. An approved shale shaker designed to remove all but the finest of drill cuttings from the drilling fluid shall be installed between the drilling rig and mud pit.
 - 2. If found necessary, centrifugal de-sanding equipment shall be furnished and installed by the Contractor in the hydraulic system to remove excessive quantities of sand that may accumulate in the drilling fluid.
 - 3. During the drilling, the sand content of the mud entering the hole must not be in excess of 4 percent of volume.
 - 4. The maximum mud properties must be met: Filter cake 3/32-inch; water loss-15 cubic centimeters; funnel viscosity-38 seconds; mud weight-78 pounds per cubic foot; sand content-4 percent.
 - 5. Immediately before the well casing is installed in the hole, the following mud properties must be met: Sand content must not be in excess of 2 percent of volume; funnel viscosity must not exceed 30 seconds; and mud weight must not exceed 68 pounds per cubic foot.
 - 6. Contractor shall furnish sand content measuring set with 200 mesh screen as detailed in API Code No. 29 and shall make periodic measurements.
 - 7. The Contractor shall also provide and make available all test equipment to test the properties of the drilling fluid.
- E. Reverse Circulation Rotary Method: The drilling fluid shall be water with minimal additives permitted.

2.09 *Well Development Equipment and Testing*

- A. The Contractor shall furnish all materials, equipment, and labor necessary to conduct development operations and test pumping in accordance with these specification and directions of the Engineer.
- B. The pump furnished shall be of the deep well turbine type capable of pumping not less than the capacity specified in Section 3.01, Bullet B, and Sub-bullet 10.
- C. The pump shall be powered by a variable speed type prime mover of adequate capacity for development.
- D. A satisfactory throttling device shall be provided so that the discharge flow rate may be reduced to 20 percent of the test pumping capacity specified.
- E. During development and testing operations, the Contractor shall provide metering facilities to accurately measure the rate of flow.
- F. No equipment or materials for the disposal of water will be supplied by CVWD.

2.10 *Pump Assembly*

- A. The Contractor shall furnish in accordance with these specifications a vertical deep well turbine pump, complete with column piping, shafting, bearings and fabricated steel surface discharge head, nominal 1,760 rpm, and all necessary appurtenances.
- B. The pump shall be of the open line shaft, water lubricated type. Bearings shall be provided to prevent the occurrence of shaft critical speed vibration at normal operating speeds.
- C. The pump shall have the design points specified in Table No. 1 of the Technical Conditions.
- D. CVWD reserves the right to modify these design points within the design range of the specified pump, prior to delivery, at no additional cost to CVWD. At least two points shall be verified on the pump curve.
- E. All equipment shall be new and of current manufacture. No equipment shall be furnished until the review and return of submittals to the Contractor without rejection or revisions.
- F. The service of factory representatives to check installation and operation of the pump and motor assembly and appurtenances after installation, shall be furnished at no additional cost to CVWD.

- G. A Goulds performance curve is given to establish minimum efficiency requirements but any equal curve may be submitted, except for Peerless. The pump curve is in Appendix C of these Specifications.
- H. The pump operation shall conform with the following design characteristics with no excessive vibration, cavitation and no continuous upward thrust forces which could cause excessive noise or harmful operation to the pump, motor and piping, and meet Hydraulic Institute Standards.
- I. The pump shall be capable of operating along the pump curve to meet the design conditions as identified herein. All materials furnished and installed by the Contractor shall be compatible for these purposes.
- J. The design operation points on the curve shall be capable of meeting minimum efficiencies, design flow, horsepower and other criteria established herein, at the design head listed in the conditions summary.
- K. At no point on the pump curve shall the required motor horsepower exceed the horsepower of the supplied motor.
- L. Pumping equipment shall be the product of a manufacturer having at least ten years' experience in manufacturing and selling of such equipment.
- M. The minimum pump efficiency specified is the minimum efficiency for a completely staged unit. Certified factory un-witnessed test shall be performed on the pump assembly.
- N. The factory test pump curve shall be submitted and approved prior to delivery.
- O. It is required that the pump manufacturer list the guaranteed efficiencies for its pump at the specified design head and submit a curve showing the performance characteristics of the pump.
- P. In the event of the failure of the pump to meet the guaranteed efficiencies, the Contractor shall make such modifications and repairs as needed to make the unit conform to specification requirements and shall receive no additional compensation.

Technical Conditions
Table No. 1

Lower Design Point					Upper Design Point			
Pump No.	Well Site No.	T.D. H* (ft)	Flow (gpm)	Bowl Eff (%)*	T.D. H* (ft)	Flow (gpm)	Bowl Eff (%)*	No. of Stages
1	5640-2	550	1725	84.2	530	1876	84.6	7

Table No. 2
Gould's

Pump No.	Delivery Tag to Read	No. of Stages**	Bowl Size	Curve No.	Impeller Dia. (in)**	Quantity 10-ft. Column pipes	Overall Length of Column Pipes
1	Well 5640-2	7	14RJMC	E6614RGPC3	9.6875	34	350

*If a pump curve other than Gould's or Ingersoll-Dresser is used, the given design points should fall to the right of peak efficiency of the curve. This allows for any future increase in drawdown the well may experience.

**Final impeller size to be trimmed to match final design point and stages may be added or reduced after the pump test has been completed for the well.

2.11 Motor Assembly

- A. The motor shall be constructed in accordance with the latest applicable UL, NEMA, EASA, IEEE and ASA Standards and shall be designed and selected for the specific purpose, application and load requirements and shall be squirrel-cage induction type.
- B. The motor is to be provided by the supplier of the driven equipment and is to be compatible with the electrical characteristics as follows and physical location as shown on the plans. The supplier shall furnish two copies of a parts list and a maintenance manual for the motor furnished.
- C. The motor shall be manufactured by General Electric, U.S. Motors or Newman.
- D. The Contractor shall fill out and submit the motor data sheet, CVWD-890 in Appendix-D, as part of the pump motor shop drawing submittal.
- E. The power circuits shall supply alternating current, 60 hertz part wound starting and at the voltage as specified. Motor service leads shall be provided with stranded wire leads with crimped on solderless lugs. The wiring shall be complete, and include all motor connections. The motor shall be supplied with a connection point suitable for a grounding lug.
- F. The motor shall be equipped with oversized terminal boxes for all conduit and wire connections as required. Boxes shall be properly sized, diagonally split, and rotatable in 90-degree steps. Provide a gasket between the box and motor frame, and attach the box to the motor frame with high strength zinc plated and chromate steel bolts and cap screws.
- G. The castings shall be coated with a red-oxide zinc-chromate primer and finished with a corrosion resistant epoxy coating. Submit details of manufacturer's primers and coatings and furnish a gallon of each for touch-up after the one-year warranty.
- H. Provide stainless steel nameplates of ample size with clear numerals and letters.
- I. Nameplates shall indicate the manufacturer, serial number, model number, type, horsepower, phase, hertz, volts, design, full load amperes, locked rotor code letter, service factor, speed, insulation class, certified IEEE-112B tested efficiency, power factor, ambient and rise temperature rating and other essential data.
- J. Nameplate data shall be complete in English.

- K. Nameplates shall be secured to the motor frame with corrosion resisting pins in accessible locations.
- L. The motor frame (enclosure) for the induction motor shall be approved for the installation as indicated. The equipment shall have the manufacturer's corrosion resistant finish and job site painting per specifications.
- M. The enclosure for the motor shall be of cast iron or aluminum. The enclosure shall be suitably treated to inhibit corrosion and adequately braced to resist distortion and vibration.
- N. Enclosures manufactured from synthetic materials are not acceptable.
- O. A drain shall be provided in the lowest location of the motor to prohibit the accumulation of fluids.
- P. The motor shall be a weather protected Type I (WPI) high thrust, vertical hollow-shaft machine with non-reversing ratchet as specified and required. The motor shall operate continuously and satisfactorily in ambient temperatures from zero degrees C to plus 50 degrees C and Class B rise with maximum elevations of 1,000 feet. Motor insulation shall be Class F or better.
- Q. The motor shall be sized for proper operation of the driven equipment without exceeding nameplate horsepower rating for continuous operation. Torque and slip characteristics shall be as recommended by the manufacturer of the driven equipment and as specified. The head shaft shall be 2-piece.
- R. The motor shall be designed for premium efficiency and power factor per Table 3, Design Parameters.
- S. The motor must be 480 volts, 3-phase and 60 hertz unless otherwise indicated. The motor shall have leads extended from the starter with crimped compression, single-eye lugs. Motor leads shall be field connectable for part wound starting.
- T. The pump motor shall be 3-phase, 60-hertz, 4-pole induction operating approximately 1,780 rpm under load with vertical thrust as required by the pump operation, on vertical hollow shaft. High efficiency shall be certified by IEEE-11, and tested to be equal to or greater than the given design parameters in Table 3. Test Method B, as specified in NEMA Standard MG1-12.53a using segregated loss determination, shall be used.

- U. The actual motor efficiency shall be labeled on the motor per NEMA Standard MG1-12.53b. These requirements shall apply even when the NEMA Standards are written for polyphase squirrel-cage motor of 1 to 125 horsepower. The pump motor shall be rated with a service factor of 1.15. The motor service factor shall not be used to obtain the necessary horsepower to drive the pump.
1. Alternating current motors shall have a service factor of 1.15.
 2. The motor shall have torques in conformance with NEMA MG-1, section 20.41. If special torque values are required, they shall be listed by the motor manufacturer.
 3. The motor must be able to accelerate the driven machine from zero to top speed at 90 percent of rated voltage without overheating when repeated 6 times at 15-minute intervals.
 4. Maximum locked rotor current shall not exceed 650 percent of full load current.
 5. The motor shall be capable of operating at the variations of voltage and frequency as specified in NEMA Standard MG1.
- V. Provide bearings that are designed to give 5 years B-10 life for the conditions specified in continuous operation, proportions, mountings, and adjustments consistent with best modern practices for all applied radial and thrust loads at specified speeds. Design thrust bearings to carry up or down thrust that pump may impose during starting or operation at any capacity including shutdown.
1. Oil lubricated bearing housings shall be equipped with a reservoir of depth to provide space for settling of foreign matter. A drain plug and a visual oil level indicator shall be accessible from motor exterior.
 2. Sleeve bearings are not acceptable.
 3. Motors requiring a forced-fed lubrication system are not acceptable.
 4. When required by the manufacturer, bearings shall be insulated from the housing to eliminate passage of shaft currents to the bearings. If the bearings are interchangeable, both bearings shall be insulated.

5. The thrust bearings for 15 horsepower and larger vertical motors shall be oil lubricated. The bearings shall be capable of carrying the weight of all the rotating parts plus the thrust of the driven equipment at rated load with five-year B-10 life. In addition, the motor must be capable of withstanding any momentary thrust which may be specified on the motor data sheet. All hollow shaft motors shall be supplied with steady bushings.

W. The motor shall be dynamically balanced.

1. The use of solder or similar deposits is not acceptable. Any parent metal removed to achieve dynamic or static balance shall be removed in a manner which will maintain the structural integrity of the rotor.
2. The motor shall be tested with seismic-type vibration sensors by the manufacturer at the factory under no load conditions at rated voltage and frequency.
3. The motor shall have maximum peak-to-peak amplitude of vibrations on the bearing chambers of 0.0010 inches.

X. The motor shall have the following insulation system:

1. The motor shall have copper stator windings.
2. Random wound stator windings shall have a moisture resistant insulation system including two dips and bakes of polyester varnish and two dips and bakes of epoxy resin.
3. All motors 100 horsepower and above shall have random wound stator coils. The complete stator shall receive at least one complete vacuum impregnation process cycle of 100 percent solids epoxy resin.

Y. Pump Motor Accessories:

1. The pump motor shall be furnished with an anti-reverse assembly to prevent backspin of the motor in case of a reverse flow of water through the pump.
2. The J-box on the motor shall be one size larger than standard size.
3. The motor shall be provided with winding remote thermal devices (RTD), 3 per motor. RTD shall be 2-wire, 100-ohms, ± 0.5 percent, at 0°C.

Z. The sound pressure level measured at three feet from the motor shall not exceed 90 dB(a) reference 0.0002 microbars, for drip-proof and weather protected motors and 95 dB(a) for totally enclosed motors.

AA. Certified test reports shall be supplied for the motor at time of shipment. The test requirements for the motor are as follows (send copy of factory test results with motor). Routine test results shall provide the following data:

1. No load running current.
2. Locked rotor current.
3. High potential test.
4. Winding resistance.
5. No load vibration check.

BB. The motor shall be supplied with a detailed outline drawing which includes:

1. Motor dimensions,
2. Wiring diagram,
3. Accessory descriptions,
4. Performance data of electrically similar motor at no load,
5. Nameplate data, per MG1-12.53b,
6. Motor serial number,
7. Purchase order number,
8. Application,
9. Job site.

CC. The motor shall be per the table below, vertical, hollow shaft, high thrust, non-reverse ratchet, P Base type (20 inches), rated at 480 volts, three phase. The 100 percent full load rating of the motor shall be as follows:

Table 3						
Delivery Tag to Read		VFD Duty Rated	Drive Coupling Size (inches)		Name-Plate Horsepower (Hp)	
Well No. 5640-2		No	1/15/2016		300	
RPM	LRA	FLA	Volts	Eff. (%)	PF (%)	HP
1780	2100	333	480	95	89	300

DD. Contractor shall submit for Engineer's review shop drawings, typical performance factory data, operation and installation data, and technical data for the pump and motor equipment.

EE. The equipment shop drawings shall be complete and include the following:

1. Plans shall show the equipment assembly, space requirements, clearances and locations for conduits and anchor bolts.
2. Elevations shall show the component arrangements of the equipment.
3. Details shall show the required enlarged small parts.

PART 3 Execution

3.01 Rotary Drilled Well

- A. This article covers furnishing all labor, supervision, material and equipment and performing all operations necessary to drill, enlarge, bore and place gravel envelope for one domestic water well to the depth and dimensions stated hereinafter.
- B. The well shall have the following configuration and capacity:
 1. The pilot bore and final well depth shall be approximately 1,300 feet below ground surface.
 2. The length of the well screen shall be approximately 400 feet.
 3. The outside diameter of the well screen and blank casing shall be 16-inches.
 4. The blank casing shall extend from the top of the well screen to a minimum of 1 foot above the ground surface.
 5. The final borehole diameters shall consist of the following:

- a. From approximately 0 to 50 feet the borehole diameter shall be 42-inches,
 - b. From approximately 50-500 feet the borehole diameter shall be 32-inches,
 - c. From approximately 500-1,300 feet the borehole diameter shall be 26-inches.
6. The inside diameter of the sounding tube shall be 3-inches, and the length shall be approximately 450 feet.
 7. The inside diameter of the screened and inverted casing vent shall be 3-inches.
 8. The inside diameter of the camera access pipe shall be 3-inches, and the length shall be approximately 500 feet.
 9. The inside diameter of the gravel feed pipe shall be 3-inches, and the length shall be approximately 600 feet.
 10. The well shall be test pumped at approximately 3,000 gallons per minute or to the satisfaction of the Engineer.
 11. Final well efficiency as determined by the continuous drawdown test in Section 3.17, Bullet E, Sub-Bullets 1-6, shall not be less than 75 percent.

3.02 Conductor Casing Placement

- A. The use of a conductor casing is required for all wells. The conductor casing shall be installed by the Contractor prior to drilling the pilot bore.
- B. The conductor casing bore shall have a minimum diameter of 42 inches and depth of 50 feet to provide for installation of a conductor casing, and grout for sealing.
- C. Joints in the conductor casing shall be securely welded and shall be watertight. The casing shall be furnished with collars or welding lugs for field welded joints.
- D. Casing guides shall be welded to the conductor casing in accordance with the casing guide detail on the plans.

- E. A cement grout seal, approximately 3 inches thick, shall be provided between the casing and the bore for a tight seal. The cement grout shall be mixed in the following proportions by volume: 1-part cement; 1 ½ parts sharp, clean sand; and 6/10-part water. The water shall be potable and the sand free from clay, earth, or other deleterious matter.
- F. The sealant shall be carefully placed from the bottom of the annular space to the top in one continuous operation so that the grout will be placed before the occurrence of the initial set, thus forming a complete and continuous seal. After cementing operations are completed, the cement shall be left undisturbed for a period of not less than 12 hours.
- G. A 3-inch Schedule 40 gravel feed pipe shall be welded to the outer casing in accordance with the plans. Prior to completion of placing the gravel envelope, a 3-inch pipe cap with standard thread shall be installed on the upper end of the gravel feed pipe. A stream of clear water shall be run into the gravel feed pipe at all times during development or shall be cleaned out and refilled until it does take water.

3.03 *Pilot Bore*

- A. A pilot bore having a diameter of 17½ inches shall be drilled to an approximate depth as specified in Section 3.01, Bullet B, and Sub-Bullet 1 to provide an indication and classification of geological formations encountered.
- B. The exact depth will be determined by the Engineer, with contract price adjustments for any added or deducted footage made in accordance with the unit prices on the Schedule of Pay Items.
- C. The Contractor shall take all measures necessary to protect the top portion of the pilot bore from caving or raveling. The Contractor shall not remove his pilot bore drilling equipment from the well until directed to do so by the Engineer.
- D. When drilling using a conventional or direct (mud) rotary system, at each change of formation, and at 10-foot intervals between changes in formation using a 5-gallon bucket, formation samples shall be collected from the trough that conveys the discharged fluid from the borehole to the fluid reservoir, before it enters the fluid cleaning system.
- E. The inspector shall take a large, representative sample of the formation, and label and preserve a portion of each sample in a 1-gallon size plastic zip-lock bag or container as approved by the Engineer.

- F. The Contractor shall be held responsible for assuring that samples are representative of the formation, so that a sound well design can be derived from the "E" log and the samples taken from the pilot bore.
- G. Because the drilling fluid has a higher viscosity than does the clear water, formation samples shall be collected by diverting a portion of the discharged fluid into an approved sampling or collection device. It is the Contractor's responsibility to provide the means for the collection of an acceptable representative sample.
- H. When drilling using a reverse circulation rotary method, formation samples shall be collected from the entire stream of discharged fluid by passing it through a sample collection box. The sample collection box shall be flushed clear of any remaining drill cuttings after each sample has been collected.
- I. Should the sample collection box completely fill before each 10-foot section of pilot borehole has been drilled, shorter sampling intervals shall be used. It is the Contractor's responsibility to provide the means for the collection of an acceptable representative sample.
- J. A complete shift drilling log and record shall be furnished daily to the Engineer. Upon completion of the log, four copies shall be furnished to CVWD.
- K. If the Contractor elects to drill a pilot bore larger than the minimum diameter specified, the Contractor shall be paid only the pilot bore unit price for drilling depths not cased.
- L. The Contractor shall provide an electric log ("E" log) upon the completion of the pilot hole. The "E" log shall consist of one spontaneous potential curve and three resistivity curves.
- M. The Contractor shall furnish the original and not less than four copies of the log. An interpretation of the "E" log, together with recommendations for location of screen casing, shall also be furnished.

3.04 *Aquifer Zone Sampling*

- A. In order to determine estimates of yield and water quality, it is necessary to determine the vertical variation of water quality within the zone of saturation. This will be accomplished by a technique known as aquifer zone testing.
- B. Aquifer zone testing consists of isolating a specific aquifer zone after drilling the pilot borehole and testing the zone for yield and water quality. Three zones are expected to be tested. The procedure which shall be used is as follows:

1. Based on analysis of the formation samples collected during drilling and the geophysical borehole logs, the Engineer will select the prescribed number of zones within the saturated interval for isolated zone testing.
 2. Backfill material shall be placed in the pilot borehole to a depth of approximately 10 feet below the first (or deepest) zone to be tested. The top of the backfill material shall be “tagged” to verify its depth. The depth measurement shall be recorded in the Driller’s Daily Report.
 3. A 10-foot seal consisting of Baroid or MI bentonite products (or as otherwise approved by the Engineer) shall be placed on the top of the backfill material. This seal is necessary to isolate aquifers occurring below the zone selected for testing. The top of the seal shall be tagged and recorded.
 4. Isolated zone testing shall be accomplished by attaching an 8-inch diameter by 20-foot long piece of mill-slotted pipe, to the bottom of the 7-inch I.D. threaded drill pipe. This 20-foot length of slotted pipe will be placed opposite the zone selected for testing.
 5. The annular space between the 8-inch slotted pipe and the 17½ inch pilot borehole shall then be backfilled using filter pack material. The filter pack material shall be brought to a minimum of 10 feet above the top of the slotted screen section. The top of the filter pack material shall be tagged and recorded.
 6. A second 10-foot seal, consisting of Baroid or MI bentonite products (or as otherwise approved by the Engineer), shall be placed on top of the filter pack material.
 7. The bentonite seal shall be allowed to hydrate for at least 1 hour. The top of the upper seal shall be tagged and recorded.
 8. The isolated zone shall be initially developed by airlifting until the water produced from the zone is clean and clear, and the integrity of the seal has been verified by the Engineer.
 9. A high capacity submersible pump capable of producing a minimum of 200 gpm from 360 feet shall be placed within the 7-inch ID drill pipe.
- C. A calibrated flow meter with a totalizer and a gate valve shall be installed in the discharge line for accurate measurement and control of flow rate. In addition, a sampling port shall be installed (at an easily accessible location) on the discharge line to obtain the water quality sample(s).

- D. The location of the sampling port shall be easily accessible and promote a representative sample. The sampling port shall be inspected by CVWD before any samples are collected.
- E. The integrity of the seal shall again be determined to the satisfaction of the Engineer. The isolated zone shall be pumped at its maximum capacity until the discharge has reached a maximum turbidity of 10 NTU.
- F. Once the discharge turbidity has reached 10 NTU or less as determined by the Engineer, the isolated zone shall be pumped for a total of 2 hours, without interruption. During this time, water quality samples will be collected at the end of the 2 hours of continuous pumping by CVWD for analysis.
- G. Once zone testing has been completed on the selected zone, the test screen shall be removed from the borehole and cleaned.
- H. The Engineer may require inspection of the zone testing tools before they are installed to test the next selected zone.
- I. No payment shall be made for any aquifer zone test in which a water quality sample is not obtained as a result of the Contractor's failure to provide an acceptable seal as determined by the Engineer.

3.05 *Aquifer Zone Sampling Collection and Analysis*

- A. If aquifer zone sampling is required, CVWD will collect and analyze aquifer samples between 7:00 a.m. on Monday and 6:00 a.m. on Friday excluding CVWD observed holidays with no cost to the Contractor.
- B. All aquifer zone sampling and sample delivery to a CVWD-approved laboratory will be performed by CVWD.

3.06 *Reaming*

- A. The pilot bore shall be carefully reamed to the final borehole diameters specified in Section 3.01, Bullet B, Sub-Bullet 5.
- B. The depth of reaming and associated final borehole diameters shall be determined by the Engineer after the pilot bore is completed.

3.07 *Caliper and Alignment Surveys*

- A. The Contractor shall provide a caliper and an alignment survey immediately upon completion of reaming to the final well diameter. The alignment survey shall be measured at twenty-five foot intervals, and the Contractor shall provide both a plan and profile plot of plumbness and alignment.

- B. The Contractor shall furnish the original and four copies of each survey. An interpretation of each survey, together with recommendations, shall also be furnished. Horizontal deviation from plumb shall not exceed 6 inches per each 100 feet.

3.08 *Placement of Casing and Gravel Pack*

- A. The placement of the casing, gravel pack, fine sand layer, and 10-sack slurry shall begin immediately upon completion of the caliper and alignment surveys. The casing, gravel pack, fine sand layer, and 10-sack slurry shall be installed in a nonstop operation and placement shall be complete within 36 hours.
- B. A casing schedule, including the location and length of the screen sections in the casing string, shall be determined by the Engineer after a study of the driller's log, formation samples, and "E" log. CVWD will provide the casing schedule no more than seven (7) working days after the last aquifer zone sample is collected. If no aquifer zone samples are required, CVWD will provide the casing schedule to the Contractor no more than four (4) full working days after delivery of the "E" log to CVWD.
- C. Blank casing and screen shall be installed in the center of the final well hole, and in accordance with applicable welding procedures. The well shall be cased at the top with blank casing, and the bottom portion of the well, as determined by the Engineer, shall be cased with screen.
- D. Screen shall be installed with three centering guides as shown on the plans and placed at no greater than 120-foot intervals throughout the entire length of casing and screen, starting from the bottom of the screened interval, to insure concentric placement of the casing in the reamed hole.
- E. The centering guides shall consist of three 5/16-inch by 2-inch by 3-foot long, shaped steel straps. These straps, or centralizer, shall be welded at 120 degrees to the casing in the field.
- F. The casing shall extend 1-foot above ground surface. The bottom of the screen shall be fitted with a 10-foot length of equal diameter blank casing and a plug.

3.09 *Gravel Envelope Placement and Cleaning*

- A. The gravel envelope shall extend from the bottom of the well casing to a depth of 100 feet above the top of the screen area and shall be placed and cleaned using the following technique.

- B. After the casing and screen is centered in the borehole, circulation shall be established in the annulus through the tremie pipe. Granular chlorine shall be added at a rate of ½ pound of granular chlorine per cubic yard of the filter pack material.
- C. During placement of the filter pack, water shall be pumped with the gravel through the tremie pipe into the annular space. The top of the well casing and sounding tube shall be temporarily covered during gravel packing with welded on, watertight caps. As the gravel and water mixture exits the end of the tremie and “builds up” around the screen, the end of the tremie will become plugged, causing circulation to stop. When this occurs, a maximum of 62 feet of tremie pipe may be removed at any one time until the top of the filter pack material in the annulus reaches the desired level (or as otherwise instructed) below the ground surface.
- D. The top of the filter pack material shall be tagged periodically to verify the level of the material in the annular space. At no time shall the Contractor allow the filter pack material to fall more than 62 feet below the bottom of the tremie. This method will ensure the proper placement of the filter pack material, while simultaneously washing sand, silt and drilling mud from the filter pack material being placed in the annulus.
- E. The Contractor shall guarantee that the gravel pack is a continuous unbroken column surrounding the casing from the bottom to the top, completely filling the annular space between the casing and the bore. The quantity of gravel required to form the envelope must equal or exceed the volume of the annular space to insure against voids or bridging of the gravel pack.

3.10 *Placement of Fine Sand Layer*

- A. Following placement of the filter pack material, a 5-foot layer of fine sand shall be placed. This fine sand layer shall consist of five feet of uniformly graded, fine to medium “construction” sand.
- B. The fine sand layer shall be placed on top of the filter pack material through a tremie pipe. The top of the fine sand layer shall be tagged and recorded. The purpose of the fine sand is to prevent the infiltration of the cement slurry into the upper portion of the filter pack.
- C. The top of the fine sand layer shall be tagged after one hour following placement to verify its level.

3.11 *Annular Seal*

- A. Upon completion of the installation of the filter pack material and fine sand layer, the annular space between the 16-inch O.D. casing and the 26-inch borehole shall be filled with a 10-sack sand cement slurry. The cement shall be of Type II cement (ASTM C150-95 Standard Specification for Portland Cement). The 10-sack sand cement mixture shall consist of approximately 2,208 pounds of washed sand, 940 pounds of Type II cement and 525 pounds (63 gallons) of water.
- B. A maximum of 66 gallons per cubic yard is allowed, if necessary, to make the mixture more fluid for pumping. Care must be taken to avoid segregation of the grout mix by the addition of excessive quantities of water. The weight of the mixture shall be approximately 136 pounds per cubic feet.
- C. A maximum of 2 percent by weight of bentonite, and 2 percent by weight of calcium chloride may be added to condition the slurry for a fluid mix, and to accelerate the set-up time for the cement. The addition of bentonite will reduce shrinkage and cracking of the cement. However, if used, it shall be added to the water first and shall be allowed to hydrate a minimum of 10 minutes prior to the introduction of cement to the mixture.
- D. In no case shall more than two hours lapse from the time of addition of water to the mixture at the ready mix plant, to time of pumping down the hole.
- E. All cementing equipment and specialized tools shall be operated by personnel thoroughly trained in the operation and application of their equipment. The placing of the cement shall be done in a manner such that the casing is entirely sealed against infiltration by water. Grouting of the blank casing shall be carried out in one continuous operation through a tremie, being forced by pressure, into the annular space to the depth directed by the engineer.
- F. The Contractor should be aware of and protect himself against any large hydrostatic forces which may be involved, and if necessary, stage the cementing operation and allow sufficient time after each interval has been cemented, to allow for hydration and consolidation of the cement.
- G. The 10-sack sand-cement slurry shall then be pumped into the annulus (through the tremie pipe) from the top of the fine sand layer to top of the well. Upon completion of grouting, cement shall be visible from the surface of the ground between the conductor casing and the well casing.
- H. The cement seal in the annulus shall remain undisturbed for a minimum of 24 hours before further work is performed in the well. Should the top of the cement seal drop, it shall be topped off with additional cement.

- I. The sounding tube(s) shall be flushed clear of any debris that accumulates during casing installation, gravel packing, installation of the fine sand layer and installation of the annular seal.

3.12 *Sounding Tube*

- A. Installation of the 2-inch inside diameter sounding tube will ensure accurate and reliable water level measurements by electric water level indicators or transducers, without the danger of being caught between the pump column assembly and the casing.
- B. The Contractor shall furnish a 2-inch I.D. sounding tube as shown on the plans. The top of the sounding tube shall be fitted with a threaded cap. The sounding tube material shall be ASTM A53, Grade B.
- C. All material used in the well shall be new.
- D. Unless specified otherwise, the sounding tube connections shall be threaded and coupled except that they shall be welded to casings as shown by the aforementioned details.
- E. Connections between tubes and casings shall be watertight and all burrs, slag and sharp edges shall be removed from the inside thereof. The tube passages must be clean and unrestricted enough to permit short cylinders (dummies), slightly smaller than the inside diameters of the tubes, to pass through them entirely.
- F. Failure of Contractor to demonstrate compliance with the above shall be considered due cause for replacement of the sounding tube at no cost to CVWD.

3.13 *Camera Access Pipe*

- A. The Contractor shall furnish a 4-inch I.D. camera access pipe as shown on the plans. The top of the camera access pipe shall be fitted with a threaded cap.
- B. The camera access pipe material shall be ASTM 53, Grade B. All the material used in the well shall be new.

3.14 *Gravel Tube*

- A. A 3-inch Schedule 40 gravel feed pipe shall be welded to the outer casing in accordance with the plans. Prior to completion of placing the gravel envelope, a 3-inch pipe cap with standard thread shall be installed on the upper end of the gravel feed pipe.
- B. A stream of clear water shall be run into the gravel feed pipe at all times during development or shall be cleaned out and refilled until it does take water.

3.15 *Plumbness and Alignment*

- A. The Contractor shall guarantee that the well, when completed, shall be sufficiently straight and plumb for the free installation and operation of a turbine pump regularly built for a 16-inch O.D. casing with bowls set approximately 350 feet below ground surface.
- B. To demonstrate compliance with this requirement the Contractor shall furnish all labor, tools, and equipment, and make a caging test to the satisfaction of the Engineer. The test shall be performed after completion of the well construction and before its acceptance.
- C. The completed well shall be drilled in such vertical alignment that a line drawn from the center of the well casing at ground surface to the center of the well casing 400 feet below the ground surface shall not deviate from the vertical more than 6 inches in 100 feet of length, and shall be no closer to the inside wall of the casing than 5 inches.

3.16 *Well Log and Drilling Records*

- A. The Contractor shall keep records providing the following information for the well log:
 - 1. A log of the formation drilled from surface to total depth showing each change in formation.
 - 2. A collection of samples from surface to total depth placed in separate containers for each interval, plainly marked with the depth. Samples shall be taken each 10 feet and at each change of formation.
 - 3. The Contractor shall provide an approved sample collection device as specified in Section 3.03, Bullet D which has been approved by the Engineer for taking samples. The method of taking samples shall also be approved by the Engineer.
 - 4. The final well log shall show: diameter, wall thickness, depths, and quantities of casings and screens installed; details of reducing sections; type, aperture size and pattern of perforation; borehole diameters; cemented sections; gradation of gravel envelope; quantity of gravel initially installed and quantity of gravel added during development operations, quantity of material removed during development operation; and other pertinent details.
- B. The Contractor shall keep and provide the following drilling records:
 - 1. A record of mud properties at each 4-hour interval shall show weight, funnel viscosity, 30-minute water loss, cake thickness, and sand content.

2. Records shall also be made prior to commencing the drilling operations each morning and before terminating the drilling each evening.

3.17 *Well Development and Testing*

- A. Within 4 calendar days after completing the placement of the gravel pack, fine sand layer, and annular seal, the Contractor shall commence developing the well by a combination of swabbing and air lift pumping.
- B. The combination of swabbing and air lift pumping shall continue for a minimum of 24 hours, exclusive of time required for equipment set up or adjustment.
- C. Well Development by air lifting:
 1. Initial development and clearing of the filter pack and aquifer shall be accomplished by first running into the well with the drill string open-ended to remove any remaining heavy drilling fluid and fill material that accumulated during gravel packing.
 2. The drill string shall be removed and the swabbing tool shall be installed on the drill string.
 3. The Contractor shall provide a combination swabbing and airlifting tool which has two rubber discs spaced 10 feet apart and designed such that it will allow simultaneous pumping (by airlifting) and swabbing to occur.
 4. The rubber discs shall have no more than ½ inch clearance within the well screen and shall be replaced if clearance exceeds this value.
 5. The swabbing and airlifting tool shall be attached to the end of the drill pipe and the air compressor used shall be capable of producing a minimum of 300 gpm from the well.
 6. The use of PVC materials for the swabbing and airlifting procedure will not be accepted.
 7. Development and cleaning of the filter pack and aquifer shall be accomplished by airlift pumping and swabbing in stages opposite the entire screened interval until the filter pack is clean and consolidated.
 8. If heavy amounts of sand are produced from a given interval, the Contractor shall continue to work on that interval until it is determined that it has been stabilized against the migration of sand from the formation.
 9. Initial airlift development shall begin at the top of the screened Interval and shall proceed downward in the well before continuing from the bottom of the screened interval to the top.

10. Swabbing and airlifting operations shall be conducted simultaneously, over no more than one length of drill pipe (40 feet), until each 10-foot section within the 40 feet is adequately cleaned and developed, as directed by the Engineer.
11. Sand in the discharge shall be continuously monitored by the Contractor in 15-minute time intervals during airlifting. The time of day, sand content and depth interval shall be recorded by the inspector and Contractor.
12. In no case shall development proceed for less than 24 hours exclusive of the time required for equipment set up or adjustment.
13. The Contractor shall bail the well as required to remove any sand and debris drawn into the casing by the development procedure.
14. Once development by airlifting and swabbing is determined to be acceptable and complete as determined by the Engineer, the test pump shall be installed in the well, and development by pumping shall commence.

D. Well Development by Pumping:

1. The Contractor shall furnish and install pump discharge piping of sufficient size and length to conduct the water with acceptable orifices, meters, or other approved devices which will accurately measure the flow rate.
2. An electric sounder or an airline with properly calibrated gauge and air pressure shall be provided to measure the elevation of water in the well.
3. The initial pumping rate shall be restricted and as the water clears shall be gradually increased until the maximum rate is reached. The desired maximum rate is specified in Section 3.01, Bullet B, and Sub-Bullet 10; however, the rate will be determined by the Engineer's inspector after consideration of the well's drawdown and discharge characteristics.
4. At intervals to be determined by the Engineer's inspector, the pump shall be stopped and the water in the pump column shall be allowed to surge back through the pump bowls and through the perforated area. While pumping and surging, a continuous stream of water shall be added to the top of the gravel envelope, unless the well has been sanitary sealed.
5. The Contractor shall bail the well as required to remove any sand and debris drawn into the casing by the development procedure.

6. The cycle of pumping and surging shall continue until the discharged water is clear of sand, silt, and mud and until there is no increase in specific capacity during at least 6 continuous hours of pumping and surging. In no case shall the pumping time be less than 24 hours.
7. The following conditions must be achieved by the end of the development period in the opinion of the Engineer:
 - a. A maximum sand production of 5 parts per million (ppm).
 - b. Well efficiency as specified in Section 3.01, Bullet B, and Sub-Bullet 11.
 - c. A maximum turbidity of 5 nephelometric turbidity units (NTU).
 - d. The quantity of filter pack material placed in the annulus shall be at least as great as the calculated volume of the annulus.
 - e. There shall be no increase in the specific capacity with further pumping or development.
 - f. There is no further settlement of the filter gravel envelope.
8. Sand production shall be measured in accordance with AWWA A100-97, most current edition. Turbidity shall be measured in NTU's as described in Standard Methods, 20th Edition, 1998. Both sand production and turbidity measurements will be accomplished by the CVWD laboratory.

E. Test Pumping:

1. Upon the completion of the development operations, and no sooner than 12 hours thereafter, the Contractor shall perform with the aid of the Engineer a continuous drawdown test of not less than 200 minutes duration to establish the efficiency of the well.
2. The test-pumping rate shall not be less than 2,000 gpm and must be precisely maintained throughout the duration of the test. An electric sounder shall be used for the performance of this test.
3. At the completion of the test pumping, all sand and debris shall be removed from the bottom of the well.
4. After the continuous drawdown test, the Contractor shall perform "step" pumping tests of the well. Contractor shall make a test of the well pumping at a minimum of 6 definite rates to determine the shape of the drawdown curve from zero gallons per minute to the maximum designated gallons per minute or the maximum capacity of the well, whichever is less.

5. Pumping shall continue at each rate for a sufficient length of time to bring about a stable water level in the well. The minimum time at any pumping rate shall be 15 minutes.
6. See Section G for final water chemistry sample requirements during the step-pumping test.

F. Flow Meter Survey:

1. Near the end of the continuous drawdown test and before the final pumping water level reading, the Contractor shall provide a vertical spinner flow meter survey.
2. Access to the well can be obtained via either the 4-inch camera access tube or the water level sounding tube. The survey shall be performed during a constant discharge rate between 1,500 and 3,000 gpm as determined by the Engineer.
3. The dynamic tests shall be made in a downward direction from the top of the first screened interval to the bottom of the well.
4. Three separate downrun tests shall be made at corresponding line speeds. Speeds shall be 30, 45, and 60 feet per minute or as otherwise approved by the Engineer.
5. Each test will incorporate 2-minute stop counts at 20-foot intervals. The record for each test shall indicate either meter speed or percentage of total meter speed with depth.
6. The meter used for the survey shall be calibrated within the uppermost and lowermost blank sections of the casing and utilize centralizers to ensure stability and accurate readings.
7. The flow meter survey shall be performed in the presence of CVWD inspection and shall become the property of CVWD at the time of completion.
8. The Contractor shall provide 3 field copies of the survey to CVWD's Inspector immediately upon completion and 3 final copies, including 1 reproducible original, within 1 week of the survey at no additional cost to CVWD.
9. The Contractor shall provide whatever assistance that may be required to accomplish the flow meter survey.

G. Final Water Chemistry Samples:

1. The final water chemistry sample shall be collected only between Monday and Thursday between the hours of 7:00 a.m. and 3:00 p.m.
2. The sample shall be collected during the step-pumping test at the representative flow rate for the well as determined by the Engineer.
3. If the sample is not collected during the step-pumping test, then the pumping equipment shall be left on the project site until a final water chemistry sample is collected, and the sample shall be collected after running the well for two (2) hours at the representative flow rate for the well as determined by the Engineer.
4. Compensation for additional hours of pumping will be paid at the unit price stated in the Schedule of Pay Items per Item X-XX and/or X-XX.

H. Aquifer Zone Sampling:

1. CVWD reserves the right to delete any portion of the aquifer zone sampling from the Contract. See Sections 3.04 and 3.05 in this document for further information regarding aquifer zone sampling.

3.18 *Well Development Testing Records*

- A. Development and test records shall be maintained on a 30-minute basis, showing production rate, static water level, pumping level, drawdown, production of sand, and all other pertinent information concerning method of development.
- B. The Contractor will, upon completion of the testing, deliver a certified copy of the development and test records to the Engineer.

3.19 *Pump Construction*

- A. The pump bowls shall be cast iron, Class 30 or better, and lined with baked vitreous porcelain enamel or equal. Material tensile strength shall be a minimum of 30,000 psi. Maximum bowl size shall be 13-5/8 inch.
- B. The impellers shall be constructed of SAE 40 or 64 bronze. Impeller lock collets shall be A1S1B-1113 steel or stainless steel. Pump bearings shall be constructed of SAE bronze. The suction pipe shall be of the same material and diameter as the column pipe and 10 feet in length. The cone-type strainer shall be galvanized steel or bronze.

- C. The bearing retainer assemblies shall be constructed of ASTM B62 bronze. The rubber bearing shall be Standard No. 80 shore or better. The bearing retainer shall be "drop-in" and shall be installed under direct CVWD inspection. The bronze used in the impellers and bearings shall meet the requirements of the "Specifications for Composition Bronze or Ounce Metal Castings" (ASTM Designation B62).
- D. The length of the bearings shall be at least 1½ times the diameter of the shaft. The pump shaft shall be of Type 416 stainless steel, 1-15/16-inch diameter. The head shaft shall be 2-piece. All screws, bolts and nuts shall be of Type 316 stainless steel.
- E. The steel column assembly shall be 12 inches in diameter with a minimum thickness of .33 inch. The column shaft shall be 1-15/16-inch diameter. The line shaft shall be constructed of Type 416 stainless steel.
- F. The overall column length shall be made up as follows: One top column pipe 5 feet long; 10-foot long column pipe sections, the quantities of which are specified in Table No. 2; and one bottom column pipe 5 feet long; bowl assembly; one suction pipe 10 feet long, and one cone-type strainer.
- G. The discharge head outlet shall be fabricated of steel. The discharge outlet shall have a 12-inch diameter with a Class 125 flange. The head to motor interface shall be 20-inch. The base to motor dimension shall be 39 inches. The centerline of discharge to base dimension shall be 12 inches. The centerline of head to discharge flange face shall be 15 inches.
- H. The base shall be a 7/8-inch thick by 25-inch square steel plate with rounded corners. The discharge head shall have two ½-inch diameter ports for the lube and drain line.
- I. The packing container shall be Class B long bronze bushing to steady at least five rings of non-asbestos packing. Container shall be capable of being repacked without disassembly. The discharge head shall be bolted to the pump pad as shown on the plans.
- J. The pump shall be installed in accordance with the manufacturer's recommendations, and the plans, if applicable.
- K. All pump material and appurtenances to be installed in the well shall be chlorinated just prior to installation in accordance with AWWA Standard for Disinfection of Wells, Section C654 (latest edition). All exposed areas shall be dusted with calcium hypochlorite powder or by spraying such areas with a solution having a chlorine residual of not less than 200 mg/L.

- L. The bidder shall submit with each proposal complete dimensional prints, descriptive material and performance information. Installation and operation instructions shall be furnished with the pump assembly.

3.20 *Existing Well*

Existing Well No. XXXX-X shall be protected in place for the entire duration of this project.

OR

Existing Well No. XXXX-X shall be destroyed prior to the start of drilling Well No. 5640-2. Concrete shall be used for the entire length of the well.]

PART 4 Measurement and Payment

4.01 *Rotary Drilled Well*

- A. The conductor casing will be measured for payment as a lump sum.
- B. The pilot bore will be measured for direct payment as the number of lineal feet of bore satisfactorily drilled
- C. Aquifer sampling will be measured for payment as a lump sum for each respective depth.
- D. Reaming will be measured for direct payment as the number of lineal feet of well casing satisfactorily installed.
- E. The blank casing will be measured for direct payment as the number of lineal feet of casing satisfactorily furnished and installed
- F. The screen will be measured for direct payment as the number of lineal feet of screen satisfactorily furnished and installed.
- G. Gravel will be measured for payment as the number of tons of gravel satisfactorily furnished, placed, and cleaned.
- H. The 2-inch I.D. sounding tube will be measured for direct payment as the number of lineal feet of sounding tube satisfactorily furnished and installed.
- I. The 3-inch I.D. screened and inverted casing vent will not be measured for payment. Payment for the screened and inverted casing vent will be included in the price for pay items as associated Work.
- J. The 4-inch I.D. camera access pipe will be measured for direct payment as the number of lineal feet of camera access pipe satisfactorily furnished and installed.

- K. The 3-inch I.D. gravel feed pipe will be measured for direct payment as the number of lineal feet of gravel feed pipe satisfactorily furnished and installed.
- L. The records will not be measured for payment. Payment for the records will be included in the price for pay items of associated Work.
- M. The 10-sack slurry annular seal above the fine sand layer will be measured for payment as the number of cubic yards of slurry satisfactorily furnished and installed.
- N. The fine sand layer will be measured for payment as the number of tons of fine sand satisfactorily furnished and installed.
- O. Payment shall constitute full compensation for all materials, equipment and incidentals to satisfactorily drill the well.
- P. The rotary drilled well will be paid at the contract unit price stated in the Schedule of Pay Items for the items listed below:
 - 1. Item 4-1 Conductor Casing/Reaming to 42-inch diameter
 - 2. Item 4-2 Pilot Bore
 - 3. Item 4-3 Aquifer Zone Sampling at approximately 1,150-foot depth
 - 4. Item 4-4 Aquifer Zone Sampling at approximately 850-foot depth
 - 5. Item 4-5 Aquifer Zone Sampling at approximately 550-foot depth
 - 6. Item 4-6 Reaming to 32-inch diameter
 - 7. Item 4-7 Reaming to 26-inch diameter
 - 8. Item 4-8 Blank Casing
 - 9. Item 4-9 Well Screen
 - 10. Item 4-10 Sounding Tube
 - 11. Item 4-11 Camera Access Pipe
 - 12. Item 4-12 Gravel Feed Pipe
 - 13. Item 4-13 Filter Gravel
 - 14. Item 4-14 Fine Sand Layer
 - 15. Item 4-15 Annular Seal

Q. The items listed below will not be paid separately. Payment for these items will be included in the price for pay items of associated work.

1. "E" Log
2. Caliper and Alignment Surveys
3. Caging Test
4. Records
5. Screened and Inverted Casing Vent

4.02 *Development and Testing*

A. Development by air lifting for a minimum period of 24 hours will be measured for payment as a lump sum item. Development in excess of 24 hours will be measured for payment as the total number of hours that such development is satisfactorily performed to the nearest hour. Time spent for set up or adjustment of equipment shall not be included in the measurement.

1. Item 4-16: Development by air lifting for a minimum period of 24 hours will be paid at the contract lump sum price.
2. Item 4-17: Development in excess of 24 hours will be paid at the contract unit price.
3. Payment shall constitute full compensation for all materials, equipment, and incidentals to satisfactorily develop the well.

B. Development by pumping for a minimum period of 24 hours will be measured for payment as a lump sum item. Development in excess of 24 hours will be measured for payment as the total number of hours that such development is satisfactorily performed to the nearest hour.

1. Item 4-18: Development by pumping for a minimum period of 24 hours will be paid at the contract lump sum price.
2. Item 4-19: Development by pumping in excess of 24 hours will be paid at the contract unit price.
3. Payment shall constitute full compensation for all materials, equipment and incidentals to satisfactorily develop the well.

- C. Test pumping will be paid at the Contract lump sum price:
 - 1. Item 4-20: Test pump for yield and drawdown. Payment shall constitute full compensation for all materials, equipment and incidentals to satisfactorily chlorinate and test pump the well.
- D. Payment for the flow meter survey will be made at the Contract lump sum price:
 - 1. Item 4-21: Perform flow meter survey. Payment shall constitute full compensation for all materials, equipment, labor and incidentals to satisfactorily perform a flow meter survey of the well while in production.
- E. Discharge of water will be paid at the contract lump sum price stated in the Schedule of Pay Items for the item listed below at the time the properties are returned to preconstruction conditions and damage release waivers are returned to CVWD.
 - 1. Item 4-22: Discharge of water during air lifting, aquifer zone testing and development by pumping.
- F. Records will not be paid separately. Payment for records will be included in the price for pay items of associated work.

4.03 *Pump and Motor Assembly*

- A. Each item will be measured for payment at the Contract unit price.
- B. Payment will be paid at the Contract price stated in the Schedule of Pay Items for the items listed below. Payment shall constitute full compensation for all materials, equipment and incidentals to satisfactorily provide and install the pump and motor.
 - 1. Item 4-23: Furnish and install pump and vertical hollow-shaft electric motor with 300 horsepower nameplate rating for completed Well No. 5640-2 including discharge head and related appurtenances (Tables 2 and 3).
 - 2. Item 4-24: Trim pump impellers, if required. Includes disassembly and reassembly of pump.
- C. The Contractor shall perform vibration and efficiency testing of the pumping unit (pump and motor) after installation. All final tests shall be performed under normal operating conditions, and therefore, will be contingent upon the completion of the well's pumping plant, i.e., electrical panel, manifold, etc. This work will take place approximately 6 months to 1 year after completion of the Contractor's work.

- D. A test shall be conducted in the field, after the pump is on-line, in accordance with the requirements of the "Test Code for Centrifugal Pumps" of the Standards of the Hydraulic Institute, Incorporated. The cost of conducting such a test shall be borne entirely by the Contractor. Certified copies of the performance test conducted at the site shall be furnished to the Engineer. Failure to comply with the operational requirements shall require repair or adjustment to the pump, to the satisfaction of CVWD's inspector, at no additional cost to CVWD.
- E. The completed pumping unit (pump and motor) shall receive a final field trim balance, as may be required, and vibration of unit shall not exceed 0.0025 inches, peak to peak amplitude when operating. Contractor shall field measure vibration when pump is on line with a suitable calibrated instrument and all measurements shall be witnessed by a CVWD Inspector.
- F. Vibration shall be measured at motor thrust bearing housing, and at any other locations on pumping unit as directed by a CVWD Inspector. Results of vibration tests shall be provided to a CVWD Inspector.
- G. If minimum vibration requirements are not met as called out above, the Contractor and pump manufacturer shall be responsible for all costs associated with the balancing of the pumping unit.
- H. Testing of the final pumping unit will be measured for payment as a lump sum item.
 - 1. Item 4-25: Perform vibration and efficiency tests of the final pumping plant, if required. Payment shall constitute full compensation for all materials, equipment and incidentals to satisfactorily test the final pumping unit.

4.04 *Existing Well*

Efforts to protect the existing well in place will not be paid separately. Payment for these efforts will be included in the price for pay items of associated work.

|OR

- A. Item 4-26: The destruction of existing **Well No. XXXX-X** will be measured for payment as a lump sum price.
- B. Payment shall constitute full compensation for all materials, equipment and incidentals to satisfactorily destroy existing Well No. XXXX-X. |

END OF SECTION 33 21 00

SECTION 33 23 19.10
SEWER BYPASS SYSTEM

PART 1 - General

1.01 *Description*

- A. This article covers furnishing all labor, supervision, materials and equipment and performing all operations necessary to installing and maintaining sewer bypass systems.
- B. This item shall include all equipment, maintenance and operations necessary to bypass the sewer for the construction of the sanitary sewer gravity main and force main relocation and replacement as shown on the project plans.
- C. The provisions of Section 7-8.5 "Sanitary Sewers" and Section 306-5 "Dewatering" of the Standard Specifications for Public Works Construction (SSPWC) and all other applicable provisions of these specifications shall apply except as modified and supplemented below.
- D. The Contractor shall construct, operate, maintain and remove, without damage to existing structures, all temporary sewage handling facilities. The Contractor shall supply the pumps, conduits, power, labor and other equipment to divert the flow of sewage around the areas where work is to be performed. The bypass system shall be of sufficient capacity to handle existing flow and, if required by the Contract Documents, additional flow during a rainstorm. The Contractor shall have on-site a 100% backup of the by-pass systems and capable of pumping 150% of the existing flow. The design, installation and operation of the temporary pumping system shall be the Contractor's responsibility through the duration of the project. This section includes materials, installation, and testing of polyvinyl chloride (PVC) pipe for 4-inch through 36-inch diameter sewer force mains, in accordance with the applicable provisions of AWWA C900.

1.02 *Related Work Specified Elsewhere*

- A. The requirements of the following sections and divisions apply to the Work of this section. Other sections and divisions of the Specifications, not referenced below, shall also apply to the extent required for proper performance of this Work.

- 1. Section 33 11 13, Piping Systems and Appurtenances

1.03 *Reference Specifications, Codes, and Standards*

- A. All Work specified herein shall conform to or exceed the applicable requirements of the referenced portions of the following publications to the extent that the provisions thereof are not in conflict with other provisions of these Specifications.
- B. Comply with the applicable editions of the following codes, regulations and standards.
 - 1. CVWD Detail Drawings for the Construction of Sanitary Sewer Systems
 - 2. Industry Standards:
 - SSPWC "Green Book", Standard Specifications for Public Works
Construction (2015 Edition).
- C. Comply with the applicable reference Specifications as directed in the General Conditions, other applicable parts of the Contract Documents, and specified herein.

1.04 *Submittals*

- A. Complete fabrication, assembly, and installation drawings, together with details and data governing materials used and other accessories furnished, shall be submitted for approval in accordance with General Conditions, other applicable parts of the Contract Documents, and as specified herein. Data shall include, but not be limited to, the following items.
 - 1. The Contractor shall submit four copies of the drawings of material and equipment; it may be the brochures of catalog sheets of manufacturer, showing in sufficient details the dimensions and manufacturer's tolerances. In addition, Contractor shall submit a complete bypass plan that includes scheduling.
 - B. Qualifications of the person preparing the plan.
 - C. Flow Monitoring Plan.
 - D. Bypass plan per requirements of this section. Specify when the plan is required to be submitted. Allow time, at least 30 days, for review and approval. CVWD must receive notification one week in advance before bypassing starts and bypass plan must be approved at the time notification of bypass activities is sent.
 - E. Written Spill prevention and emergency response plan. The plan shall identify waterways, channels, stormwater drains to be protected, emergency contacts, notification procedures.
 - F. Traffic Control Specification – include reference to that section if applicable.

1.05 *Quality Assurance*

A. [Note to Specifier: Include require contractor/preparer qualifications]

PART 2 – Products

2.01 *General*

A. The bypass system shall meet the requirements of all codes and regulatory agencies having jurisdiction. The bypass system shall, at a minimum, meet the requirements and include the equipment as specified herein.

2.02 *Anticipated Flows*

A. Pump and motor system rated at a capacity sufficient to convey the upstream peak flows as required by the Contract Documents. Provide all temporary high lines, line stops, thrust restraints, etc. as required.

2.03 *General System Requirements*

[Note to Specifier: Include qualifications required for the person that prepares the plan: Certification (PE, wastewater operator), Minimum experience, etc.]

A. The bypass systems are to be monitored 24-hours a day, 7 days a week for the entire duration of work by personnel on-site duly qualified to maintain and operate the sewer bypass system.

B. Pump starter and control panel which includes the following:

1. Hand-off-auto selector
2. Run indication light
3. Fail indication light
4. High level indication light

C. Float control system which includes the following:

1. Low level float (pump stop)
2. High level float (pump start)
3. High level float (high level alarm)

D. An alarm system which will notify Contractor personnel in the event of an alarm (pump fail and high level).

E. Sound attenuated enclosure for all engine drivers and/or power generating equipment.

- F. 100% standby capacity shall be installed as part of any bypass system such that, in the event of a failure of the primary bypass equipment, stand-by equipment may immediately be placed into service.
- G. Backup power.
- H. Flow monitoring of upstream and downstream flows.

2.04 *Pumps*

- A. All pump(s) drivers shall have noise suppresser exhaust systems to mitigate the noise levels to less than 50 dB or 10 dB above ambient noise level when measured at the property lines closest to the noise source.
- B. The Contractor shall be responsible for furnishing the necessary pump(s) and back-up pumps to adequately convey 150% of the stated flows in Article entitled “Anticipated Flows” of this Specification.
- C. Contractor shall account for the suction lift and the pressures at the force mains and shall provide for all requirements, equipment, etc. to accommodate these hydrological parameters.

PART 3 – Execution

3.01 *Bypass Pumping*

- A. All pump(s) drivers shall have noise suppresser exhaust systems to mitigate the noise levels to less than 50 dB or 10 dB above ambient noise levels when measured at the property lines closest to the noise source.
- B. Under no circumstances shall sewage or solids be deposited onto the ground surface, or into ditches, catch basins or storm drains or natural drainage ways. Sewage shall be handled in a manner so as not to create a public nuisance of health hazard.
- C. The Contractor shall be responsible for any waste solids and shall properly handle, transport, and dispose of said solids in accordance with the requirements of all codes and regulatory agencies having jurisdiction. Contractor shall be responsible for preventing, containing, recovery, and legal disposal of sewer overflows and spills. Contractor shall be responsible for handling penalties, liability, and claims for causing or allowing wastewater spills.
- D. The sewage flow from the sewer main(s) shall be maintained during construction and handled in a manner so as not to create a public nuisance or health hazard during the execution of the work to be performed under this Contract. In the event that sewage backup occurs and enters dwellings or other structures the Contractor shall

be responsible for cleanup, repair property damage costs and all claims arising therefrom. All spills shall be contained and returned to the sanitary sewer system.

- E. The Contractor shall be responsible for furnishing the necessary labor and supervision to set up and operate the pumping and bypassing systems. The bypass systems are to be monitored 24-hours a day, 7 days a week for the entire duration of work by personnel on-site duly qualified **[Note to Specifier: list relevant required experience]** to maintain and operate the sewer bypass system.
- F. The Contractor shall provide reliable sewer service to the users of the sanitary sewer at all times, so as to prevent backup and/or overflow into adjacent streets, ditches, storm sewers and waterways during construction of the sewer pipes and to allow for manhole connections, construction and reconstruction.

3.02 *Design Requirements*

- A. The Contractor shall have adequate standby equipment with 100% standby capacity available and ready for immediate operation and use in the event of an emergency or breakdown. One standby pump for each size pump utilized shall be installed at the mainline flow bypassing locations, ready for use in the event of primary pump failure.
- B. Bypass pumping system shall be capable of bypassing the flow around the work area without interrupting, causing operational issues, or sewer overflows in CVWD's sanitary sewer system and of releasing any amount of flow up to full available flow in the work area as necessary for satisfactory performance of work.

3.03 *Performance Requirements*

- A. It is essential to the operation of the existing sewage system that there is no interruption in the flow of sewage throughout the duration of the project. To this end, the Contractor shall provide, maintain and operate all temporary facilities such as dams, plugs, pumping equipment (both primary and back-up units as required), conduits, all necessary power, and all other labor, tools and equipment necessary to intercept the sewage flow before it reaches the point where it would interfere with his work, carry it past his work and return it to the existing sewer downstream of his work.
- B. The design, installation and operation of the temporary pumping system shall be the Contractor's responsibility. The bypass system shall meet the requirements of all codes and regulatory agencies having jurisdiction.
- C. The Contractor shall provide all necessary means to safely convey the sewage past the work area. The Contractor will not be permitted to stop or impede the main flows under any circumstances.

- D. The Contractor shall maintain sewer flow around the work area in a manner that will not cause surcharging of sewers, damage to sewers and that will protect public and private property from damage and flooding.
- E. The Contractor shall protect water resources, wetlands and other natural resources.

3.04 *Bypass Pumping and Flow Control Plan*

- A. The Contractor shall be responsible to prepare and submit a bypass pumping and flow control plan in conformance with the requirements of Section 306-6 of the Public Works Specifications, and these Specifications. A bypass pumping and flow control plan is to be submitted [X days] after Notice to Proceed (allow 30 days for review). Contractor shall notify CVWD in writing 2 weeks in advance before bypassing activities. Notice to start any bypassing activities shall be given only after the bypass plan has been approved.
- B. The Contractor shall submit detailed plans and descriptions outlining all provisions and precautions to be taken by the Contractor regarding the handling of existing wastewater flows. This plan must be specific and complete, including such items as schedules, interception of sewer/discharge locations, elevations (water levels, street, sewer line, bypass line, point of discharge), capacities of equipment, materials and all other incidental items necessary and/or required to insure proper protection of the facilities, including protection of the access and bypass pumping locations from damage due to the discharge flows, and compliance with the requirements and permit conditions specified in these Contract Documents. No construction shall begin until all provisions and requirements have been reviewed by the District.
- C. The plans shall include but not be limited to details of the following:
 - 1. Bypass start and end dates;
 - 2. Name and phone of who is responsible for daily operation;
 - 3. 24-hour contact information in case of operational emergency;
 - 4. A Spill Response Plan Should be included as part of this bypass pumping plan;
 - 5. A flow monitoring plan (to verify bypassing system can handle the flows) should be included as part of this bypass pumping plan.
 - 6. Staging area for pumps;
 - 7. Traffic control measures to accommodate bypass equipment and staging area;
 - 8. Sewer plugging method and types of plugs;

9. Number, size, material, location and method of installation of suction piping; and
10. Number, size, material method of installation and location of installation of discharge piping;
11. Bypass pump sizes, capacity, number of each size to be on site and power requirements;
12. Calculations of static lift, friction losses, and flow velocity (pump curves showing pump operating range shall be submitted);
13. Standby power generator size, location;
14. Downstream discharge plan specifying how bypassing sewer will be handled or directed.
15. Method of protecting discharge manholes or structures from erosion and damage;
16. Thrust and restrain block sizes and locations;
17. Sections showing suction and discharge pipe depth, embedment, select fill and special backfill;
18. Method of noise control for each pump and/or power generator;
19. Any temporary pipe supports and anchoring required;
20. Design plans and computation for access to bypass pumping locations indicated on the drawings;
21. Calculations for selection of bypass pumping pipe size;
22. Schedule for installation of and maintenance of bypass pumping lines;
23. Plan indicating selection location of bypass pumping line locations;
24. Sequence for bypass removal and sewer main system cleaning.

3.05 *Service Interruption*

- A. The Contractor shall maintain sewer service to all upstream users. Any service interruption will require prior District approval and coordination with District staff.

3.06 Measurement and Payment

- A. Measurement

1. The sewer bypass system shall not be measured for payment.

B. Payment

1. Payment for the sewer bypass system shall be paid at the Lump Sum Contract Unit Price stated in the appropriate Bid Item(s). Payment shall constitute full compensation for furnishing the installing of material, labors, pumps, construction staking and surveying, traffic controls, continual monitoring, back-up systems, system removal, pipeline jetting, surface restoration (including pavement replacement), sound attenuation, permitting, and all other incidentals necessary to complete the work per the satisfaction of the District. Payment will occur upon satisfactory completion of the task. No additional compensation will be allowed thereof.

END OF SECTION 33 23 19.10

SECTION 33 31 11

PVC PIPE FOR SANITARY SEWER

PART 1 – General

1.01 *Description*

- A. The Work of this Section includes providing underground PVC non-pressure pipe for gravity sewer flow and all appurtenant work, complete in place.
- B. It shall be the responsibility of the Contractor to furnish and install all plastic piping systems specified herein and as shown on the Contract Drawings. Each system shall be installed complete with all required fittings, supports, anchors, expansion joints, flexible connections, valves, wall castings, sleeves, and accessories to provide a functional system as specified.
- C. The Contractor shall be responsible for all piping identification, testing, cleaning, disinfecting, excavation, backfill and/or encasement specified herein or shown on the Contract Drawings.
- D. PVC pipe shall be used in sanitary sewer systems and/or when necessary for sewer and water pipeline separation requirements as specified on Standard Drawing Nos. S-3 and S-4 or as specified on the Drawings.

1.02 *Related Work Specified Elsewhere*

- A. The requirements of the following sections and divisions apply to the Work of this section. Other sections and divisions of the Specifications, not referenced below, shall also apply to the extent required for proper performance of this Work.
 - 1. Section 31 23 17, Trenching, Excavation, Backfill and Compaction
 - 2. Section 31 23 19, Dewatering
 - 3. Section 31 23 19.10, Sewer Bypass System
 - 4. Section 33 01 30.13, Sanitary Sewer System Testing
 - 5. Section 33 01 30.16, TV Inspection of Sewer Pipelines
 - 6. Section 33 05 15, Manholes and Precast Vaults
 - 7. Section 33 08 30, Connection to Sanitary System
 - 8. Section 33 39 33, House Laterals
 - 9. Section 33 39 23, Sanitary Utility Sewer Cleanouts

1.04 *Reference Specifications, Codes, and Standards*

A. All Work specified herein shall conform to or exceed the applicable requirements of the referenced portions of the following publications to the extent that the provisions thereof are not in conflict with other provisions of these Specifications.

B. Comply with the applicable editions of the following codes, regulations and standards.

1. CVWD Detail Drawings for the Construction of Sanitary Sewer Systems

2. Industry Standards:

a. Materials and Testing:

ASTM D 1784 Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds.

ASTM D 2122 Test method for Determining Dimensions of Thermoplastic Pipe and Fittings.

ASTM D 2241 Standard Specification for Poly (Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series).

ASTM D 2412 Determination of External Loading Characteristics of Plastic Pipe by Parallel Plate Loading.

ASTM D 3034 Standard Specification for Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings.

ASTM D 3212 Standard Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals.

ASTM F 477 Elastomeric Seals (Gaskets) for Joining Plastic Pipe.

ASTM F 593 Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs.

ASTM F 679 Standard Specification for Poly (Vinyl Chloride) (PVC) Large-Diameter Plastic Gravity Sewer Pipe and Fittings.

ASTM F 1336 Standard Specification for Poly (Vinyl Chloride) (PVC) Gasketed Sewer Fittings.

b. Installation:

ASTM F 1668 Standard Guide for Construction Procedures for Buried Plastic Pipe.

ASTM D 2321 Standard Practice for Underground Installation of Flexible Thermoplastic Sewer Pipe.

AWWA M-23 PVC Pipe - Design and Installation.

c. Other:

AWWA American Water Works Association.

SSPWC Standard Specifications for Public Works Construction.

ISO 9001 Quality Management Systems – Requirements.

C. Comply with the applicable reference specifications listed in the General Conditions, other applicable parts of the Contract Documents, and as specified herein.

1.05 *Submittals*

A. Shop Drawings: The Contractor shall submit shop drawings and engineering data on all pipe, joints, special fittings, and piping appurtenances in accordance with the General Conditions, other applicable parts of the Contract Documents, and as specified herein.

B. Certificates: The Contractor shall provide manufacturer's certificates for all materials indicating conformance to the Contract Documents.

C. Shoring and bracing drawings in accordance with the requirements of Section 31 23 17, Trenching, Excavation, Backfill and Compaction.

D. Testing and inspection results in accordance with Section 33 01 30.13, Sanitary Sewer System Testing for deflection, air pressure, and CCTV.

1.06 *Quality Assurance*

A. Testing

1. ISO quality management system: Manufacturer shall have an ISO 9001 quality management system, certified by an accredited certifying agency within the four (4) years prior to the Notice to Proceed.

2. All materials testing shall be based upon applicable ASTM Test Methods and AWWA Standards referenced herein for the materials specified. All costs of such inspection and tests shall be borne by the Contractor.

3. The manufacturer shall perform all tests and submit the test results data and certification in compliance with SSPWC Subsection 207-17.4.

1.07 *Delivery, Handling, and Storage*

A. Pipe shall be stored at the jobsite in unit packages provided by the manufacturer.

Caution shall be exercised to avoid compression, damage or deformation to bell ends of the pipe.

- B. If pipe is to be exposed to direct sunlight for any length of time it must be covered with an opaque material while permitting adequate air circulation above and around the pipe to prevent excessive heat accumulation.
- C. If pipe is strung along trench prior to installation, string only pipe to be used within a 24-hour period; all pipe is to be laid on a flat surface.
- D. The interior as well as all sealing surfaces of pipe, fittings, and other accessories shall be kept free from dirt and foreign matter.
- E. Gaskets shall be protected from excessive exposure to heat, direct sunlight, ozone, oil and grease.

PART 2 – Products

2.01 General

- A. All PVC pipe, fittings, couplings and appurtenances shall comply with SSPWC Subsection 207-17.
- B. All PVC pipe shall be continuously and permanently marked with the manufacturer's name and code, pipe size, PVC minimum cell classification, pipe stiffness designation, and the designation ASTM D 3034 or F 679.
- B. The manufacturer's code shall include the year, month, day, shift, plant and extruder of manufacture. This coding shall be done in conjunction with records to be held by the manufacturer for 2 years, covering quality control tests, raw material batch number, and other information deemed necessary by the manufacturer.
- C. The pipe and fittings shall be homogenous throughout and free from visible cracks, holes, foreign inclusions and other injurious defects. The pipe shall be as uniform as commercially practical in color, opacity, density and other physical properties.

2.02 Pipe

- A. All PVC pipe shall be joined by compression joints unless otherwise shown or specified, and shall conform to the following requirements:
 - 1. Unless otherwise shown on the Drawings PVC pipe shall be SDR 35.
 - 2. Pipe and fittings 4-inch through 15-inches in diameter shall conform to ASTM D 3034.
 - 3. Pipe and fittings 18-inches in diameter and larger shall conform to ASTM F 679.
 - 4. The pipe shall be joined with an integral bell and spigot type rubber gasketed

joints. Each integral bell joint shall consist of a formed bell with a rubber gasket. Flexible gasketed joints shall be elastomeric compression types conforming to ASTM F 477. Joints shall be tested in accordance with ASTM D 3212.

5. Pipe shall be made of PVC plastic having a cell classification of 12454 or 12364 as defined in ASTM D 1784. Maximum filler content shall be 10 percent.
6. All pipe, fittings, gaskets, and joint lubricants shall be supplied by the manufacturer, or per manufacturer's specifications.
7. Pipe shall be furnished in standard laying lengths not exceeding 20 feet and shall be colored green in accordance with the Utility Location and Coordination Council Uniform Color Guide.

2.03 *Fittings*

- A. All fittings for PVC pipe shall conform to the requirements of ASTM D 3034 or F 679, as applicable, and have a cell classification of 12454. The ring groove and gasket ring shall be compatible with PVC pipe ends.
- B. The minimum wall thickness of the fittings shall be not less than the minimum wall thickness of the equivalent size of pipe.

2.04 *Caps*

- A. Pipe caps shall be Mission Rubber Company Bands Seal End Caps, or equal.

2.05 *Manufacturers*

- A. PVC gravity sewer pipe shall be as manufactured by Diamond Plastics Corporation JM Eagle, North American Pipe Corporation, or approved equal.
- B. PVC gravity sewer pipe fittings shall be as manufactured by HARCO Fittings, or approved equal.

2.06 *Identification and Locator Tape*

- A. Identification and locator tape materials shall be as required by the Contract Documents.

PART 3 – Execution

3.01 *General*

- A. All laying, jointing, and testing for defects and for leakage shall be performed in the presence of the Engineer, and shall be subject to their acceptance. All material found during the progress to have defects will be rejected and the Contractor shall promptly remove such defective materials from the site of the Work.
- B. Installation shall conform to the requirements of ASTM D 2321, SSPWC Section 306, and to the supplementary requirements or modifications specified herein. Wherever

the provisions of this Section and the requirements of ASTM D 2321 and SSPWC Section 306 are in conflict, the more stringent provision shall apply.

3.02 *Trenching, Bedding, and Backfill*

- A. Trench excavation, bedding, and backfill shall conform to the requirements of Section 31 23 17, Trenching, Excavation, Backfill, and Compaction.
- B. Contractor shall be responsible for keeping the trench in a dewatered condition during pipe installation. Removal of water shall be in conformance with Section 31 23 19, Dewatering.
- C. The minimum depth of cover over the top of the pipe shall be 7 feet unless otherwise shown on the Drawings. The width of the trenches shall be as indicated on the Drawings, but not less than required per ASTM D 2321.

3.03 *Laying Pipe*

- A. The pipe shall be installed in accordance with the requirements of ASTM D 2321 and as specified herein and shown and the sections shall be closely jointed to form a smooth flow line. Immediately before placing each section of pipe in final position for jointing, the bedding for the pipe shall be checked for firmness and uniformity of surface.
- B. Proper implements, tools, and facilities as recommended by the pipe manufacturer's standard printed installation instructions shall be provided and used by the Contractor for safe and efficient execution of the Work. All pipe, fittings, valves, and accessories shall be carefully lowered into the trench by means of derrick, ropes, or other suitable equipment in such a manner as to prevent damage to pipe and fittings. Under no circumstances shall pipe or accessories be dropped or dumped into the trench.
- C. Cutting and machining of the pipe shall be accomplished in accordance with the pipe manufacturer's standard procedures for this operation. Pipe shall not be cut with a cold chisel, standard iron pipe cutter, nor any other method that may fracture the pipe or will produce ragged, uneven edges.
- D. The pipe and accessories shall be inspected for defects prior to lowering into the trench. Any defective, damaged or unsound pipe shall be repaired or replaced. All foreign matter or dirt shall be removed from the interior of the pipe before lowering into position in the trench. Pipe shall be kept clean during and after laying. All openings in the pipe line shall be closed with water tight expandable type sewer plugs or PVC test plugs at the end of each day's operation or whenever the pipe openings are left unattended. The use of burlap, wood, or other similar temporary plugs will not be permitted.

3.04 *Buried Piping ID Tape, Locator Tape, and Tracer Wire*

- A. Identification tape, locator tape, and tracer wire shall be installed in accordance with

Section 33 11 00, Basic Pipeline Specifications.

3.05 *Handling*

- A. Handling of the PVC pipe shall be done with care to insure that the pipe is not damaged in any manner during storage, transit, loading, unloading, and installation.
- B. Pipe shall be inspected both prior to and after installation in the ditch and all defective lengths shall be rejected and immediately removed from the working area.

3.06 *Field Jointing*

- A. Each pipe compression type joint shall be joined with a lock-in rubber ring and a ring groove that is designed to resist displacement during pipe insertion.
- B. The ring and the ring seat inside the bell shall be wiped clean before the gasket is inserted. At this time a thin film of lubricant shall be applied to the exposed surface of the ring and to the outside of the clean pipe end. Lubricant other than that furnished with the pipe shall not be used. The end of the pipe shall be then forced into the ring to complete the joint so that the second home mark is just visible adjacent to the bell entry point.
- C. The pipe shall not be deflected either vertically or horizontally in excess of 75% of the manufacturer's recommendations for joint deflection.
- D. When pipe laying is not in progress, the open ends of the pipe shall be closed to prevent trench water from entering pipe. Adequate backfill shall be deposited on pipe to prevent floating of pipe. Any pipe which has floated shall be removed from the trench, cleaned, and re-laid in an acceptable manner. No pipe shall be laid when, in the opinion of the Engineer, the trench conditions or weather are unsuitable for such Work.

3.07 *Installation of Bends, Tees, and Reducers*

- A. Fittings shall be installed utilizing standard installation procedures. Fittings shall be lowered into trench by means of rope, cable, chain, or other acceptable means without damage to the fittings. Cable, rope, or other devices used for lowering fitting into trench, shall be attached around exterior of fitting for handling. Under no circumstances shall the cable, rope or other device be attached through the fitting's interior for handling. Fittings shall be carefully connected to pipe or other facility, and joint shall be checked to insure a sound and proper joint.

3.08 *Haunching*

- A. Once the pipe is joined together, pipe bedding material shall be placed in the haunching per the trench details shown on the Drawings and Section 31 23 17, Trenching, Excavation, Backfill, and Compaction. The haunching area extends from the bottom of the pipe to the springline of the pipe. Bedding shall be as shown on the Drawings.

3.09 *Identification and Locator Tape*

- A. Identification and locator tape shall be placed as required by the Contract Documents.

3.10 *Sewer Laterals*

- A. Sewer laterals shall be installed in accordance with Section 33 39 33, House Laterals.

3.11 *Sewage Bypass*

- A. The Contractor shall prepare a bypass plan and control the flow in accordance with Section 31 23 19.10, Sewer Bypass System and as required by the Contract Documents. A sewage bypass plan shall be submitted to CVWD for approval prior to construction. The Contractor shall at all times, be responsible for the operations of this bypass system, including furnishing all the necessary equipment and making arrangements to obtain power as required. The Contractor shall not be permitted to trench public or private streets for bypass purposes without the approval of the entity (State, County, City, etc.) having jurisdiction.

3.12 *Shoring Removal*

- A. Any bedding, pipe zone or backfill voids created by moving or removing shoring shall be left in place or filled per the trench details shown on the Drawings and Section 31 23 17, Trenching, Excavation, Backfill, and Compaction.

3.13 *Connections to Manholes*

- A. Pipelines shall be connected to manholes as indicated on the Drawings and Section 33 08 30, Connection to Sanitary System. Each connection shall be made at a time and in a manner that will result in the least interruption of service.
- B. Pipe connections to new or existing manholes shall be done under the direction of the Engineer and other applicable requirements specified for new manholes, including all necessary concrete work, coring, and shaping of channel.
- C. All PVC pipe entering or leaving a manhole shall have a rubber sealing gasket in accordance with Section 33 08 30, Connection to Sanitary System, firmly seated perpendicular to the pipe axis, around the pipe exterior and cast into the structure base or near the wall center as a water stop. Water stop may also consist of a manhole coupling with rubber sealing rings cast into the structure base.
- D. Sanitary sewer connections to existing manholes shall be core-drilled and made using a flexible rubber seal/water stop.

3.14 *Connections to Existing Pipe*

- A. The Contractor shall provide fittings or adapters required to connect new pipe to existing pipe. Detail drawings of such fittings or adapters and the method of

connection shall be submitted to CVWD for approval. Each connection shall be made at a time and in a manner that will result in the least interruption of service.

- B. Pipelines shall be connected to existing gravity sewer mains as indicated on the Drawings and Section 33 08 30, Connection to Sanitary System.
- C. Lateral connections to gravity PVC sewer mains shall be made using a CVWD approved saddle tee or saddle wye in accordance with Section 33 39 33, House Laterals.

3.15 *Testing and Acceptance*

A. General

1. It is the intent of the Contract Documents that the completed sewer pipe of all types, along with manholes and other appurtenances, shall be watertight.
2. Unless otherwise indicated on the Drawings, air testing, infiltration testing, deflection testing, sag measurements, and video inspection shall be performed in accordance with Section 33 01 30.13, Sanitary Sewer System Testing and this specification section.
3. The Contractor shall furnish all labor and materials for making the tests required at no additional cost to CVWD. All tests shall be completed before the street and/or trench is resurfaced, unless otherwise directed by CVWD.
4. Tests shall be made in the presence of CVWD's Representative.

B. Air Testing

1. Contractor shall perform field air testing in accordance with Section 33 01 30.13, Sanitary Sewer System Testing.
2. If, in the opinion of CVWD, excessive groundwater is encountered during construction of a section of sewer, the air pressure test for leakage shall not be used. An infiltration test shall be performed instead.

C. Sag Measurement

1. Contractor shall perform sag measurements in accordance with Section 33 01 30.13, Sanitary Sewer System Testing.

D. CCTV Inspection

1. Contractor shall perform CCTV inspection in accordance with Section 33 01 30.13, Sanitary Sewer System Testing and Section 33 01 30.16, TV Inspection of Sewer Pipelines.
2. Sags, or standing water in pipe, shall meet the following criteria:

E. Deflection Testing

1. Deflection measurements shall be performed on all gravity sewer pipe per Section 33 01 30.13, Sanitary Sewer System Testing. If the mandrel sticks in the pipe at any point the pipe shall be repaired and retested. Pipe sections not meeting the deflection requirements shall be excavated, re-installed, and subject to an additional 30-day deflection test at no additional cost to CVWD. The cost for the deflection test shall be included in the unit price bid for the sanitary sewer pipe.

Complies with Specification	Unacceptable: Replace Pipe
Sag: 1/2" or less	Sag: greater than 1/2"

F. Acceptance

1. Even though a section of sewer may have previously passed the leakage or infiltration test, each section of pipe shall be tested subsequent to the last backfill compacting operation thereon. If, in the opinion of CVWD, heavy compaction equipment or any of the operations of the Contractor may have affected the required watertight integrity of the pipe, structure, or appurtenances, additional leak testing shall be required.
2. If the pressure drop, leakage and/or infiltration rate, sag, or deflection measurements are greater than specified herein or in the Section 33 01 30.13, Sanitary Sewer System Testing, the sewer shall be repaired, or, if necessary, the pipe shall be removed and re-laid at no additional cost to CVWD.
3. The sewer will not be considered acceptable until the pressure drop, leakage and/or infiltration rate, as determined by the appropriate test, meets the allowable limit. Even when infiltration is less than the specified amount, the Contractor shall stop any observed individual leaks when detected by the Contractor and/or ordered to do so by CVWD.
4. For pipe not meeting the sag requirements:
 - a. If the sag exceeds the allowable value, then work will not be accepted and payment won't be released until the installation is corrected to satisfy the minimum sag required in this specification.
 - b. Due to unacceptably high operation and maintenance costs and poor system reliability, pipelines with sag depths exceeding allowed amount will be rejected. Replacement of pipe includes all construction costs including, but not limited to, sewer bypassing, excavation, pipe installation, backfilling, resurfacing, tunneling, etc., for the length of pipe that exceeds the sag amount specified, plus 20 linear feet of pipe in

each direction. Damaged pipe shall be removed and disposed of in a legal manner, and new pipe shall be installed and retested at no additional cost to CVWD.

5. For pipe not meeting the deflection test requirements:
 - a. Contractor shall make the necessary repairs or replacements at the Contractor's expense by a method acceptable to CVWD's Representative at no additional cost to CVWD.
 - b. Pipe shall be subject to an additional 30-day deflection test at no additional cost to CVWD.

END OF SECTION 33 31 11

SECTION 33 31 13.13

DUCTILE IRON PIPE

PART 1 – General

1.01 *Description*

- A. This section describes materials, installation, and testing of ductile iron pipe and fittings for pressurized sewer pipelines (force mains, etc.).
- B. Ductile iron pipe for pressurized sewer pipelines shall be furnished in the sizes, classes, grades, or nominal thickness and joint types as specified herein or indicated on the Drawings.
- C. It shall be the responsibility of the Contractor to furnish and install all ductile iron piping systems specified herein and as shown on the Drawings. Each system shall be installed complete with all required fittings, hangers, supports, anchors, expansion joints, flexible connections, valves, wall castings, sleeves, and accessories to provide a functional system as specified.
- D. The Contractor shall be responsible for all insulation, lining and coating, piping identification, testing, cleaning, disinfecting, excavation, backfill and/or encasement specified herein or shown on the Drawings.
- E. The Contractor shall furnish all tools, equipment, materials, and supplies and shall perform all labor necessary to provide a complete installation of ductile iron pipe as shown on the Drawings and specified herein.

1.02 *Related Work Specified Elsewhere*

- A. The requirements of the following sections and divisions apply to the Work of this section. Other sections and divisions of the Specifications, not referenced below, shall also apply to the extent required for proper performance of this Work.
 - 1. Section 09 90 00.10, Sewer Painting and Coating.
 - 2. Section 10 10 10, Utility Marker Post.
 - 3. Section 31 23 17, Trenching, Excavation, Backfill and Compaction.
 - 4. Section 33 01 30.13, Sanitary Sewer System Testing.
 - 5. Section 33 11 00, Basic Pipeline Specifications.
 - 6. Section 33 11 13, Piping Systems and Appurtenances.

7. Section 40 05 78.23, Sewer Air Valve Assemblies.

1.03 *Reference Specifications, Codes, and Standards*

A. All Work specified herein shall conform to or exceed the applicable requirements of the referenced portions of the following publications to the extent that the provisions thereof are not in conflict with other provisions of these Specifications.

B. Comply with the applicable editions of the following codes, regulations and standards.

1. CVWD Detail Drawings for the Construction of Sanitary Sewer Systems

2. Industry Standards

ASME B16.1	Gray Iron Pipe Flanges and Flanged Fittings (Classes 25, 125, and 250)
ASME B16.42	Ductile Iron Pipe Flanges and Flanged Fittings Classes 150 and 300
ASTM A 47	Standard Specification for Ferritic Malleable Iron Castings
ASTM A 48	Standard Specification for Gray Iron Castings
ASTM A 183	Standard Specification for Carbon Steel Track Bolts and Nuts
ASTM A 194	Standard Specification for Carbon and Alloy Steel Nuts for Bolts for High Pressure or High Temperature Service, or Both
ASTM A 536	Standard Specification for Ductile Iron Castings
ASTM G 62	Standard Test Methods for Holiday Detection in Pipeline Coatings
AWWA C104	Cement-Mortar Lining for Ductile-Iron Pipe and Fittings
AWWA C105	Polyethylene Encasement for Ductile-Iron Pipe Systems
AWWA C110	Ductile-Iron and Gray-Iron Fittings for Water
AWWA C111	Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
AWWA C115	Flanged Ductile-Iron Pipe with Ductile-Iron or Gray-Iron Threaded Flanges

AWWA C116	Protective Fusion-Bonded Epoxy Coatings for the Interior and Exterior Surfaces of Ductile-Iron and Gray-Iron Fittings
AWWA C150	Thickness Design of Ductile-Iron Pipe
AWWA C151	Ductile-Iron Pipe, Centrifugally Cast, for Water
AWWA C600	Installation of Ductile-Iron Water Mains and Their Appurtenances
AWWA C606	Grooved and Shouldered Joints

2. Other Standards

SSPC	Society for Protective Coatings (formerly Steel Structures Painting Council)
SSPWC	“Green Book”, Standard Specifications for Public Works Construction

- C. Comply with the applicable reference Specifications as specified in the General Conditions and other applicable parts of the Contract Documents.

1.04 *Submittals*

- A. The Contractor shall submit complete shop drawings for acceptance in accordance with the General Conditions, other applicable parts of the Contract Documents, and as specified herein.
- B. Shop drawings shall include all ductile iron pipe, fittings, gaskets, couplers, hangers, supports, wall castings, sleeves, and all required appurtenances indicated on the Drawings or as specified herein necessary to provide a complete, operable piping system as specified.
- C. The Contractor shall submit for review and acceptance complete piping lay-out drawings showing piping, fittings, couplers, hangers, supports, wall castings, sleeves, and all required appurtenances. Layout drawings shall indicate any and all interfaces with other systems being installed.
- D. Lining, coating and wall thickness for all piping shall be provided.
- E. It is the responsibility of the Contractor to coordinate all Work being performed and review all shop drawings to ensure that no unnecessary interference exist.
- F. The Contractor shall submit as part of the shop drawings for ductile iron piping affidavits of compliance with the standards referenced (e.g. AWWA C151, etc.)

- G. If required by the Contract Documents, cathodic protection system and testing results.

1.05 *Quality Assurance*

A. General

1. Affidavits of compliance with standards referenced in this specification, e.g., AWWA C151, shall be provided.
2. Inspection of ductile iron pipe manufacturing, grooving, lining and coating shall be at the discretion of CVWD.
3. Manufacturer shall perform hydrostatic testing on pipe in conformance with AWWA C151.
4. Each pipe shall have clearly marked on each piece the words "DUCTILE IRON", the weight, thickness or pressure class and the casting date.
5. Each piece of grooved end pipe and fitting shall have the groove type (flexible or rigid) clearly marked on each end of the pipe.

B. American Water Works Association (AWWA).

1. Ductile iron pipe centrifugally cast in metal molds or sand-lined molds for water or other liquids (AWWA C151).
2. Rubber gasket joints for ductile iron pressure pipe and fittings (AWWA C111).
3. Fusion bonded epoxy coating Protective Fusion-Bonded Epoxy Coatings for the Interior and Exterior Surfaces of Ductile-Iron and Gray-Iron Fittings (AWWA C116)
4. Installation of ductile cast iron water mains and appurtenances ANSI/AWWA C600.
5. Thickness design of ductile iron pipe (AWWA C150).

C. Ceramic Epoxy Lining

1. Lining shall be applied and tested in accordance with Part 2 of this Specification.

D. Contractor Qualifications

1. Comply with the requirements for the certifications, licenses, training, skills, experience, and other qualifications specified herein.

2. Comply with the requirements for the certifications, licenses, training, skills, experience, and other qualifications specified in Part 2 of this Specification.

1.06 *Warranty*

- A. Guarantees shall be furnished in accordance with Contractor's Guarantee of the General Conditions and other applicable parts of the Contract Documents.

1.07 *Transport, Delivery, and Storage*

- A. Transport, deliver, unload, store and handle all materials in a manner to prevent damage to the materials or the work and per AWWA C600.
- B. All damaged, broken or otherwise defective materials will be rejected.
- C. Store all circular rubber gaskets and special lubricants in packaged materials with the manufacturer's name, brand and all other applicable data plainly marked thereon.
- D. Lined pipe and fittings shall be handled only from the outside of the pipe and fittings. No forks, chains, straps, hooks, etc. shall be placed inside the pipe and fittings for lifting, positioning, or laying. The pipe shall not be dropped or unloaded by rolling.
- E. Care should be taken not to let the pipe strike sharp objects while swinging or being off loaded. Ductile iron pipe shall not be placed on grade by use of hydraulic pressure from an excavator bucket or by banging with heavy hammers.

PART 2 – Products

2.01 *General Requirements*

- A. All pipe and fittings shall be carefully examined for cracks and other defects prior to shipment. All defective pipe and fittings shall be rejected and replaced.
- B. All pipe and equipment shall be supported in accordance with the Contract Documents.
- C. Compact fittings are not acceptable.

2.02 *Ductile Iron Pipe*

- A. General
 1. Ductile iron pipe shall be manufactured in accordance with AWWA C151.
 2. Cut sections of pipe (pups) shall not be less than 2 feet in length for pipe diameters 12-inch and smaller and not less than 3 feet for pipe diameters 18-inch and larger. Delivered pipe to include 5% +/- short joints.
- B. Thickness

1. Ductile iron pipe shall be minimum pressure class 350 for pipe diameters 12-inch and smaller, Class 250 for 14-inch and larger unless otherwise shown on the Drawings.

C. Joints

1. Unless otherwise called out on the Drawings or Contract Documents, push-on type joints shall be used. The joint dimension and gasket shall be as specified in ANSI A-21.11/AWWA C111.
2. Unless otherwise shown on the Drawings, all pipe joints shall be bonded to provide electrical continuity for corrosion monitoring and future cathodic protection. For joint-bonding details and requirements refer to CVWD Standard Drawings and to Cathodic Protection and Joint Bonding Specifications if part of the Contract Documents *[Specifier to delete or add section if applicable].*

D. Manufacturers shall be the following, or equal:

1. U.S. Pipe
2. McWane Ductile
3. American Cast Iron Pipe Company

E. Restrained Joints

1. Where called for on the Drawings, pipe and fittings shall be restrained. Restrained joints shall be as specified in this Section and shall be one of the following types:
 - a. Flanged fittings.
 - b. Manufactured locking restraint pipe with fittings.
 - i. Acceptable products and manufacturers include:
 - (1) Flex Ring by American Cast Iron Pipe
 - (2) TR-Flex by U.S. Pipe or McWane Ductile
 - ii. Field welding of ductile iron restrained joint or ductile iron components is not acceptable.
 - c. Mechanical Joints with Mechanical Joint Restraints.
 - d. Push-on joint pipe with restrained harness assembly. Restraint of push-on joints shall only be used where specifically called for on the Drawings. Shop drawings reflecting every part, material and dimension of the restraint assembly shall be submitted to CVWD for approval.

- i. Restraint systems using lugs integral to the pipe shall be cast with the pipe or fitting by the pipe manufacturer. Attachment of angle iron; angle-clips; harness-lugs or tabs by field welding to the ductile iron pipe or fitting is strictly prohibited.
 - (a.) All threaded harness parts shall be manufactured of type 316 stainless steel.
 - ii. Restraint of push-on joints shall be of the type utilizing cast lugs, or retainer rings bearing against the pipe shoulders at the bell or fitting.
- e. Grooved pipe and fittings (for above grade or in vaults).

2.03 Ductile-Iron Fittings

A. Ductile iron fittings shall be manufactured in accordance with AWWA C110

B Push-on Joints

1. All pipe fittings shall be made with push-on joints designed for use with the type of pipe to be joined unless noted otherwise on the Drawings.

C. Restrained Joints

1. Restrained joints shall be as called for on the Drawings. Joint restraint type shall be as specified in this Section for ductile iron pipe, and shall be as specified in Article entitled "Ductile Iron Pipe" of this Specification.

D. Bell Ends

1. Bell ends shall be compatible with the pipe ends so as to provide confinement of the rubber rings and prevent damage to the ends of the pipe. Ring grooves and interior surfaces of the bell shall be smooth and free from ridges, notches, or uneven surfaces.

E. Mechanical Joints

1. Mechanical joint fittings will be allowed only in areas specifically called for on the project Drawings or as approved by CVWD as a substitute for other types of fittings. Mechanical joint fittings will be used in areas where there is limited room for a thrust block or in cases where the pipeline needs to be activated in a short period of time. These ductile iron fittings shall comply with ANSI / AWWA C111/A-21.11, with a pressure rating of 250 psi and an ANSI Class 125 and Class 150 bolt pattern. Tee-bolts for mechanical joint fittings shall be Type 316 stainless steel.

2. Field applications where speed of construction to facilitate tie-ins and where there is limited space available for concrete thrust blocks, are examples of where mechanical joint fittings with retainer glands are appropriate.

F. Mechanical Joint Restraint Systems

1. Mechanical joints with retainer gland fittings will only be allowed in areas specifically called for on the project Drawings or as approved by CVWD as a substitute for other types of fittings. Mechanical joint fittings shall meet or exceed the ASTM A536 requirements. Torque off bolts shall be tightened per manufacturer's recommendations and shall be inspected by CVWD prior to backfill.
2. Manufacturers and associated product shall be one of the following, or equal:
 - a. Ebba Iron – Megalug
 - b. Ford – Uniflange
 - c. Star – Stargrip and 3000 series for DIP and 4000 series for PVC
 - d. Romac – Romagrip
 - e. Sigma – Onelok
 - f. Tyler Union – TUF Grip Series 1500
 - g. SIP Industries – EZ Grip

7. Flanged Fittings

1. Unless otherwise indicated on the drawings, all fittings with flanged ends shall comply with ANSI/AWWA C110/A21.10, with a pressure rating of 250 psi and a Class 125 ASME/ANSI B-16.1 flange or an ANSI/AWWA C115/A-21.15 Class 125 flange. The gasket surface shall have a serrated finish of approximately 16 serrations per inch, approximately 1/32-inch deep, with serrations in either a concentric or spiral pattern.
2. In addition, all flanges shall meet the following tolerances:

Description	Tolerance (inches)
Bolt circle drilling	± 1/16
Bolt hole spacing	± 1 /32
Eccentricity of bolt-circle & facing with respect to bore center	± 1/32

3. Manufacturers

- a. Fittings shall be manufactured by American Cast Iron Pipe, McWane Ductile, Sigma, SIP Industries, Star Pipe Products, Tyler, or U.S. Pipe.

2.04 Gaskets

A. Gaskets for Flanged Joints

1. Gaskets for flanged joints shall be 1/8-inch thick and be made of Ethylene Propylene Diene Monomer (EPDM), or synthetic fiber suitable for use in wastewater and raw sewage. Gaskets shall be suitable for a water pressure of 350 psi at a minimum temperature of 180°F. For non-potable water applications, gaskets shall be compatible with water that may have a chlorine residual of 25 mg/L.

B. Full Face Type Gaskets or Ring Gaskets for Flanged Joints

1. Full face type gaskets with pre-punched holes shall be used where both flanges are flat face. Ring gaskets extending to the inner edge of the bolts may be used where a raised face flange is present.

C. Gaskets for Push-on, Mechanical, and Restrained Joints

1. Gaskets for push-on, mechanical, and restrained joints shall be synthetic or natural rubber in accordance with AWWA C111.

D. Manufacturers

1. Gaskets shall be one of the following or equal:
 - a. Garlock, Klinger, Teadit, Cranite, or U.S. Pipe.

2.05 Bolts, Nuts, and Washers

- A. Bolts and nuts for flanged valves and flanges shall be Type 316 stainless steel conforming to ASTM A193, Grade B8M, for bolts and ASTM A194, Grade 8M, for nuts. For grooved-end fittings, bolts shall be Type 316 stainless steel and conform to ASTM F593 or ASTM A183 and have a minimum tensile strength of 100,000 psi.
- B. 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.
- C. 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.

2.06 Grooved-end Fittings and Couplings

- A. Fittings for use with grooved-end ductile iron pipe shall be cast iron conforming to AWWA C606, ASTM A 48, Class 30-A, or ductile iron conforming to ASTM A 536,

Grade 65-45-12 unless otherwise specified. Fittings shall conform to the dimensional requirements of AWWA C110 except for end preparation.

- B. Grooves in pipe and fittings shall be cut in accordance with the coupling manufacturer's recommendations. Field grooving is not permitted except as stated in Part 3 of this Specification. Pipe up to size 16 inches to be grooved by cutting shall have a wall thickness not less than thickness Class 53 and not less than the minimum recommended by the coupling manufacturer for cut grooving.
- C. Couplings shall be self-centering and shall engage and lock the grooved pipe and pipe fitting ends in place in a positive watertight couple. Coupling housing clamps shall be fabricated in two or more parts of malleable iron castings conforming to ASTM A 47, Grade 32510, or ductile iron castings conforming to ASTM A 536, Grade 60-45-10. Coupling assemblies shall be securely held together by two or more stainless steel bolts and nuts. Bolts and nuts shall be as specified herein.
- D. Couplings shall hold in place a gasket designed so that internal pressure serves to increase the seal's watertightness. Unless otherwise specified, gaskets shall be made of chlorinated butyl in accordance with ASTM D 2000, Grade No. M3BA615A14B13 with special heat-resistance test of 16 hours at 350 degrees F and maximum elongation change of minus 30 percent.
- E. Connections to valves and flanged-end pipe shall be by grooved-end to flanged pipe adapter or flanged adapter nipple.
- F. All of the threaded parts shall be Type 316 stainless steel and shall be lubricated with anti-seize compound.
- G. Where the restrained joint is of the grooved type, the wall thickness beneath the groove shall be equal to or greater than the minimum specified wall thickness and shall be sufficient to meet the maximum pressure.
- H. All grooved-end fittings, gaskets, and couplings shall be the product of the same manufacturer.
- I. Each fitting and coupling shall have clearly marked on each piece the name of the manufacturer, the country of manufacture, the thickness or pressure class, the size, and the casting date.
- J. Manufacturers shall be the following, or approved equal:
 - 1. Victaulic Company of America;
 - 2. Mueller/Anvil, Gruvlok brand;
 - 3. TYCO Grinnell.

2.07 Connection Outlets

- A. Service, gauge, and other connection outlets shall be as shown on the Drawings and Part 3 of this Specification.

2.08 Lining and Coating

A. General

1. All ductile iron pipe and fittings shall be lined with ceramic epoxy or fusion bonded epoxy as specified herein, unless otherwise indicated on the Drawings.
2. All ductile iron pipe shall be coated as indicated on the Drawings and in accordance with Section 09 90 00.10, Sewer Painting and Coating for the appropriate condition.
3. CVWD shall approve coating materials and methods prior to application.
4. Fittings shall be lined with the same coating system as the attached piping. Coating shall be as specified herein or as indicated on the Drawings.
5. Factory hydrostatic testing of the fitting shall pass all tests prior to interior coating and lining applications.
6. The pipe or fitting manufacturer shall supply a certificate attesting to the fact that the applicator met the requirements of this Specification, and that the material used was as specified, and that the material was applied and tested as required by the Specification.

B. Pipe

1. Buried Pipe
 - a. Buried ductile iron pipe and fittings shall be shop coated on the outside with a one mil thick asphaltic coating per AWWA C151/A21.51 for ductile iron pipe, AWWA C115/A21.15 for flanged pipe and AWWA C110/A21.10 and AWWA C153/A21.53 for fittings.
 - b. Pipe shall be polyethylene encased in accordance with Section 33 11 13, Piping Systems and Appurtenances.
2. Exposed, Inside Structures, Aboveground, and Submerged Ductile Iron Fittings
 - a. Unless otherwise specified or indicated on the Drawings, the exterior surfaces of fittings that will be located in underground vaults, exposed to the atmosphere, inside structures, above ground, or submerged shall be thoroughly cleaned, and given the appropriate protective coating per

Section 09 90 00.10, Sewer Painting and Coating, and shall not be coated with asphaltic coating.

C. Ceramic Epoxy Lining

1. General

- a. This Specification includes the requirements for plant application of Protecto 401 Ceramic Epoxy Liner, or equal.
- b. Coating materials shall be handled, stored and applied in accordance with the manufacturer's specifications, or as directed by an authorized representative of the coating manufacturer.
- c. The material used for lining the pipe and fittings shall have a successful history of protecting pipe lines in sewer service. The material shall be a high build multi-component Amine cured Novalac Epoxy lining. Any request for substitution shall meet the following criteria and be accompanied by:
 - i. The permeability rating when tested according to Method A of ASTM E-96, Procedure A, with a test duration of 42 days as reported by an independent laboratory.
 - ii. A statement from the manufacturer of the submitted material attesting to the fact that at least 20 percent of the volume of the lining contains ceramic quartz pigment.
 - iii. A laboratory report containing test data for Immersion in acids, bases, and deionized water at elevated temperatures using ASTM D 714 for the rating method. The report should also contain data on ASTM D 2794 direct impact, and ASTM G 154 moisture and ultraviolet light exposure.
 - iv. A statement concerning recoatability and repair to the lining.

2. Surface Preparation

- a. All ductile iron pipe and fittings shall have a high build protective lining on the interior and a bituminous coating on the exterior except for 6 inches back from the spigot end. The bituminous coating shall not be applied to the first 6 inches of the exterior of the spigot ends. All ductile pipe and fittings shall be delivered to the application facility without asphalt, cement lining, or any other lining on the interior surface. Because removal of old linings may not be possible, the intent of this Specification is that the entire interior of the ductile iron pipe and fittings shall not have been lined with any substance prior to the application of the specified lining.

- b. Prior to abrasive blasting, the entire area that will receive the protective compound shall be inspected for oil, grease, etc. Any areas where oil, grease, or any substance that can be removed by solvent is present shall be solvent cleaned using the guidelines outlined in SSPC-1 Solvent Cleaning. After the surface has been made free of grease, oil or other substances, all areas to receive the protective compounds shall be abrasive blasted using compressed air nozzles with sand or grit abrasive media. The entire surface to be lined shall be struck with the blast media so that all rust, loose oxides, etc., are removed from the surface. Only slight stains and tightly adhering annealing oxide may be left on the surface. Any area where rust reappears before coating shall be reblasted to remove all rust.

3. Application

- a. The lining shall be applied by a competent firm with a successful history of applying linings to the interior of ductile iron pipes and fittings.
- b. After the surface preparation and within 8 hours of surface preparation, the interior pipe shall receive 40 mils dry film thickness of the protective lining. No lining shall take place when the substrate or ambient temperature is below 40 degrees Fahrenheit. The surface shall also be dry and dust free. If flanged fittings of pipe are included in the project, the linings shall not be used on the face of the flange; however, full face gaskets shall be used to protect the ends of the pipe. All fittings shall be lined with 40 mils of the protective lining. The 40 mils system shall not be applied in the gasket grooves.
- c. Due to the tolerances involved, the gasket area and spigot end up to 6 inches back from the end of the spigot end shall be coated with 6 mils nominal, 10 mils maximum joint compound that shall be joint compound approved by the lining manufacturer. This coating shall be applied by brush to ensure coverage. Care should be taken that the coating is smooth without excess buildup in the gasket groove or on the spigot end. All materials for the gasket groove and spigot end shall be applied after the application of the lining.
- d. The number of coats of lining material applied shall be as recommended by the lining manufacturer. However, in no case shall this material be applied above the dry thickness per coat recommended by the lining manufacturer in printed literature. The time between coats shall never exceed that time recommended by the lining material manufacturer. No material shall be used for lining that is not indefinitely recoatable with itself without roughening of the surface.

- e. Utilize joint compound approved by the lining manufacturer for touch-up or repair. Procedures shall be in accordance with manufacturer's recommendations.

4. Inspection

- a. All ductile iron pipe and fitting linings shall be checked for thickness using a magnetic film thickness gage. The thickness testing shall be done using the method outlined in SSPC-PA-2 Film Thickness Rating.
- b. The interior lining of all pipe and fittings shall be tested for pinholes, holidays and discontinuities in accordance with ASTM G 62, Method B. All holidays shall be properly repaired and the pipe retested.
- c. Each pipe joint and fitting shall be marked with the date of application of the lining system and with its numerical sequence of application on that date.

5. Lining Repair

- a. All coating damaged or removed by impact, cutting, or any other means shall be repaired and sealed prior to the installation.
- b. Repairs and touch-up shall be performed in accordance with the manufacturer's recommended repair and touch-up materials and procedures.

D. Fusion-Bonded Epoxy Lining and Coating

1. Material

- a. Fusion-bonded epoxy lining and coating shall be in accordance with AWWA C116 as if the requirements were for pipe, and as amended below.
- b. Except as otherwise provided herein, the material used shall be 100 percent powder epoxy, fusion bonded and shall be Scotchkote 206N, Valspar Pipe Clad 1500, Akzo Nobel Resicoat Single Layer, or approved equal.
- c. Where, in CVWD's opinion, because of the nature of the item being coated and lined, it would be impossible to use fusion-bonded powder epoxy method without causing damage to the item, the use of a liquid epoxy factory applied by the manufacturer of the item being coated will be permitted in not less than three coats to provide a DFT of 16 mils. Said liquid epoxy shall be 3-M Company "Scotchkote" 309 or Koppers 294 Epoxy Primer and No. 200 HB Epoxy System. The use of liquid epoxy

other than those specified, including the equipment manufacturer's proprietary coating system, must be reviewed and approved by CVWD prior to use.

3. Surface Preparation

- a. The surface shall be blast-cleaned in accordance with Steel Structures Painting Council (SSPC) SP-5 (White Metal Blast Cleaning). The grit size used shall be as recommended by the epoxy manufacturer.

4. Application

- a. Application of the epoxy coating and lining shall be in accordance with the manufacturer's instructions; provided that, if liquid epoxy is permitted, it shall be applied in not less than 3 spray coats to give the required total thickness.

5. Thickness

- a. The minimum dry coating and lining thickness for epoxy shall be 16 mils, provided, however that the thickness of coating in the grooves for valves or fittings designed to receive a rubber gasket shall be approximately 5 mils.

6. Inspection and Repair

- a. Coating and lining thickness shall be checked with a nondestructive magnetic type thickness gage. Coating integrity shall be tested in accordance with AWWA C116 and ASTM G62. All pinholes shall be marked, repaired and retested. No pinholes or other irregularities will be permitted in the final coating and lining.
- b. If small local repairs are necessary, they shall be made using a liquid epoxy recommended by the manufacturer of the epoxy with which the item was initially coated. The surface must first be hand tool cleaned in accordance with SSPC-SP-2 (Hand Tool Cleaning). The repair epoxy material shall be applied in strict accordance with the manufacturer's instruction.
- c. Exothermic weld connections required for the installation of bond cables across joints of the pipeline for cathodic protection shall be repaired and touched-up as specified herein and in accordance with the coating manufacturer's instruction.

E. Inspection

1. Inspection

- a. All ductile iron pipe and fitting linings shall be checked for thickness using a magnetic film thickness gage. The thickness testing shall be done using the method outlined in SSPC-PA-2 Film Thickness Rating.
- b. The interior lining of all pipe and fittings shall be tested for pinholes, holidays and discontinuities in accordance with ASTM G 62, Method B. All holidays shall be properly repaired and the pipe retested.
- c. Each pipe joint and fitting shall be marked with the date of application of the lining system and with its numerical sequence of application on that date.

3. Lining and Coating Repair

- a. All coating damaged or removed by impact, cutting, or any other means shall be repaired and sealed prior to the installation.
- b. Repairs and touch-up shall be performed in accordance with the manufacturer's recommended repair and touch-up materials and procedures.

2.09 Polyethylene Encasement

- A. All ductile iron pipe and fittings shall be polyethylene encased at the time of installation. Polyethylene encasement and installation shall be in accordance with ANSI/AWWA C105 per Section 33 11 13, Piping Systems and Appurtenances.
- B. Unless otherwise required by the Contract Documents, polyethylene encasement shall not be used where pipe joints are NOT electrically bonded.

2.10 Cathodic Protection

- A. Where so specified, shown on the Drawings, or required by the Contract Documents, buried piping shall be cathodically protected as required in accordance with the Drawings and CVWD Standard Drawing Nos. W-36A, W-36B, W-36C, and W-36D. All equipment and materials provided shall meet qualities of satisfactory service.
- B. The cathodic protection system shall be designed by a corrosion engineer and shall be a specialist in this field, who is a registered corrosion engineer in the State of California and/or a Certified Corrosion Specialist by the National Association of Corrosion Engineers and is regularly engaged in designing cathodic protection facilities.
- C. Corrosion control system includes providing a complete system as indicated including electrical connections, installation of anodes, and all accessories required for a complete operable system, including testing the system after installation.

PART 3 – Execution

3.01 General

- A. All ductile iron pipe and fittings shall be delivered, handled, and installed in accordance with the applicable provisions of AWWA C600, latest, applicable provisions of Ductile Iron Pipe Research Association "Guide for the Installation of Ductile Iron Pipe", latest, Section 33 11 13, Piping Systems and Appurtenances, and SSPWC Section 306, latest, and manufacturer's directions. Bell ends shall be placed uphill unless otherwise permitted.
- B. Excavation and backfilling shall be in accordance with Section 31 23 17, Trenching, Excavation, Backfill and Compaction.
- C. Pipe shall not be stacked higher than the limits shown in Table 5 of AWWA C600. The bottom tier shall be kept off the ground on timbers, rails, or concrete.
- D. Pipe manufacturer, fitting manufacturer, and material supplier, in addition to CVWD and CVWD's representative, shall have access to the Work during installation. Contractor shall use assistance provided by either manufacturer or supplier where required for proper installation of pipe, fittings, or materials; however, Contractor shall limit role of either manufacturer or supplier to advisory service.

3.02 Traffic Control

- A. The Contractor is responsible for traffic control and it shall include all material, labor and equipment to provide safe and effective work areas to warn, control, protect and expedite vehicular, bicycle and pedestrian traffic. Unless otherwise required by the Contract Documents, all work and material provided under this section shall be performed or furnished in accordance with SSPWC Part 6 Temporary Traffic Control and the entity (City, County, State, etc.) having jurisdiction. Traffic control shall also be in accordance with Section 33 11 00, Basic Pipeline Specifications.

3.03 Lining and Coating Repair

- A. General
 - 1. All lining and coating damaged or removed by impact, cutting, or any other means shall be repaired and sealed prior to the installation.
 - 2. Repairs and touch-ups shall be performed in accordance with the manufacturer's recommended repair and touch-up materials and procedures.
- B. Ceramic Epoxy and Fusion bonded Epoxy Coating and Lining
 - 1. Coating Repair

- a. Repairs and touch-ups shall be performed in accordance with the manufacturer's recommended repair and touch-up procedures.
- b. All field cut ends shall be repaired and sealed prior to the installation.

3.04 *Alignment*

- A. All pipe shall be laid true to line and grade and at the locations shown by the construction drawings or as specified.
- B. Deflections for full-length pipe from a straight line or grade shall not exceed the values stipulated in Tables 2 and 3 of AWWA C600 for push-on and mechanical joints, respectively, unless specially designed approved bells and spigots are provided.
- C. Curved alignment by use of pulled joints will be permitted. Maximum joint deflection shall be 3 degrees. For purposes of reducing angular deflections at pipe joints, Contractor may install pipe sections of less than standard length.

3.05 *Laying Pipe*

- A. All lumps, blisters, and excess coating shall be removed from the socket and plain ends of each pipe, and the outside of the plain end and the inside of the bell shall be wiped clean and dry and be free from dirt, sand, grit, or any foreign materials before the pipe is laid.
- B. Joints shall be clean. If any lubricated part touches soil or is otherwise contaminated, completely clean and re-lubricate the joint before making it. Bells may face either direction.
- C. At times when pipe laying is not in progress, the open ends of pipe shall be closed by a watertight plug or other means accepted by the Engineer. The plug shall be fitted with a means for venting. Prior to removal of the plug, care shall be taken to prevent pipe flotation should the trench fill with water.
- D. A flexible coupling shall be installed where ductile iron pipe penetrates an outer wall of a structure, and at the edge of the structure excavation where the pipe trench leaves undisturbed ground. Pipes through fill areas shall be supported at intervals of not over 10 feet.
- E. All subgrade pipe shall have compaction tests taken and be subject to Engineer's acceptance prior to pipe installation.
- F. Remove soil around joint locations to allow for tape wrap joint coating and taping of polyethylene encasement.

- G. Following installation and before backfilling, completely encase all buried pipe, fittings, and appurtenances with polyethylene wrap per Part 2 of this Specification.

3.06 *Polyethylene Encasement*

- A. All metal surfaces, ductile-iron pipe fittings, and buried valves shall be polyethylene encased at the time of installation. Polyethylene encasement and installation shall be in accordance with ANSI/AWWA C105 per Section 33 11 13, Piping Systems and Appurtenances.

3.07 *Grooved End Joints*

- A. Grooved-end pipe and fittings shall not be used underground or underwater unless indicated otherwise on the Contract Documents. Grooved-end pipe shall not be used for systems that may be steamed, nor for any piping systems at temperatures above 100 degrees F. All grooved-end fittings and couplings used shall be the product of the same manufacturer.
- B. Grooved end fittings and couplings shall be installed in accordance with AWWA C606 and the manufacturer's recommendations and instructions.
- C. Unless otherwise shown on the Drawings, completed joints in piping above grade and within tunnels, galleries or buildings shall be rigid and shall not allow angular deflection or longitudinal movement.
- D. Except for closure pieces accepted by CVWD, field grooving of pipe will not be permitted.
 - 1. All field grooving allowed will be in strict accordance with AWWA C606.
 - 2. Only grooving tools designed for cut-grooving of ductile iron pipe will be allowed for field grooving. Roll-grooving of field grooved pipe will not be allowed.
 - 3. Cut-grooving tools shall be designed to be driven around a stationary pipe, shall have integral pipe stop to provide proper groove depth, and stops in the tool to provide proper dimension from the pipe end to the groove.
 - 4. Prior to beginning field grooving operations, the Contractor shall submit for acceptance of the grooving tools intended for use.
 - 5. All field grooving shall be done in the presence of CVWD and be subject to Engineer's acceptance.
- E. The outside surface of the pipe between the groove and the pipe end shall be smooth and free from deep pits or swells.

- F. All rust, loose scale, oil, grease, and dirt shall be removed prior to installation of the coupler.
- G. Grooved pipe and fitting ends shall be lightly coated with lubricant approved by the coupling manufacturer prior to placing the gasket.
- H. Grooved-end pipe shall be supported in accordance with manufacturer's recommendations. In addition, the pipe shall be supported between any two couplings.
- I. Buried pipe joints shall be wrapped with a minimum of 40 mils of approved pipe tape wrap per Section 09 90 00.10, Sewer Painting and Coating.

3.08 *Mechanical Joints*

- A. When specified or indicated on the Drawings, mechanical joints shall be carefully assembled in accordance with AWWA C110 and AWWA C111, manufacturer's recommendations, and as follows:
 - 1. Wipe clean the socket and the plain end. Lubrication and additional cleaning shall be provided by brushing both the gasket and plain end with soapy water or an approved pipe lubricant, just prior to slipping the gasket onto the plain end for joint assembly. Place the gland on the plain end with the lip extension toward the plain end, followed by the gasket with the narrow edge of the gasket toward the plain end.
 - 2. Insert the pipe into the socket and press the gasket firmly and evenly into the gasket recess. Keep the joint straight during assembly.
 - 3. Push the gland toward the socket and center it around the pipe with the gland lip against the gasket. Insert bolts and hand tighten nuts. Make deflection after joint assembly but before tightening bolts.
 - 4. Tighten the bolts to the normal range of bolt torque as required by the manufacturer while at all times maintaining approximately the same distance between the gland and the face of the flange at all points around the socket. This can be accomplished by partially tightening the bottom bolt first, then the top bolt, next the bolts at either side, finally the remaining bolts. Repeat the process until all bolts are within the appropriate range of torque. In large sizes (30 inches through 48 inches), five or more repetitions may be required.
 - 5. If effective seating is not obtained, the joint shall be disassembled, thoroughly cleaned, and reassembled.
 - 6. Over tightening of bolts to compensate for poor installation will not be permitted.

- B. Holes in mechanical joints with tie rods shall be carefully aligned to permit installation of the tie rods.
- C. In flange and mechanical joint pieces, holes in the mechanical joint bells and the flanges shall straddle the top (or side for vertical piping) centerline. The top centerline shall be marked on each flange and mechanical joint piece at the foundry.
- D. Minimum number of tie rods shall be dependent on pipe size, operating pressure, and manufacturer.

3.09 *Push-on Joints*

- A. When specified or indicated on the Drawings, joints shall be installed in conformance with AWWA C111 and the pipe manufacturer's instructions and recommendations for proper jointing operations.
- B. Cut ends and rough edges shall be ground smooth, and for push-on joint connections, the cut end shall be beveled by methods recommended by the manufacturer and be subject to Engineer's acceptance.
- C. Thoroughly clean the groove and the bell socket of the pipe or fitting; also clean the plain end of the mating pipe. Make sure the gasket faces the correct direction and that it is properly seated.
- D. All joint surfaces shall be properly lubricated with approved heavy vegetable soap solution in accordance with the pipe manufacturer's recommendations, immediately before the joint is completed.
- E. Lubricant shall be suitable for use in potable water, shall be stored in closed containers, and shall be kept clean at all times.
- F. Push the plain end into the bell socket of the mating pipe. Keep the joint straight while pushing. Make deflection after the joint is assembled.

3.10 *Flanged Joints*

- A. When specified or indicated on the Drawings, flanges shall conform to ASME B16.1 and/or B16.42.
- B. Bolts shall be tightened gradually and at a uniform rate to facilitate uniform gasket compression.
- C. Care shall be taken when connecting to pumping equipment to insure that pipe stresses are not transmitted to the pump flanges.
- D. All flanged piping connecting to pumping equipment shall be permanently supported so that accurate matching of bolt holes and uniform contact over the entire surface of

abutting pump and piping flanges are obtained before the installation of any bolts in these flanges.

- E. Pump connection piping shall be free to move parallel to its longitudinal centerline while the bolts are being tightened.
- F. Each pump shall be leveled, aligned, and placed into position, but shall not be grouted until the initial fit-up and alignment of the pipe is completed.
- G. Each pump shall be grouted before final bolting of the connecting piping.

3.11 *Flanged Coupling Adapters*

- A. When specified or indicated on the Drawings, flanged coupling adapters shall be installed in strict accordance with manufacturer's recommendations and instructions.

3.12 *Sleeve-Type Couplings*

- A. When specified or indicated on the Drawings, mechanical couplings shall be installed in accordance with the manufacturer's recommendations and instructions.
- B. A space of at least a 1/4 inch, and not more than 1 inch, shall be left between the pipe ends.
- C. All assembly bolts shall be uniformly tightened so that the coupling is free from leaks and all parts of the coupling are square and symmetrical with the pipe.
- D. Following installation of the coupling, damaged areas of shop coatings of the pipe and coupling shall be repaired. The repair shall be subject to acceptance by the Engineer.

3.13 *Wall Castings*

- A. Unless otherwise specified or indicated on the Drawings, wall castings shall be provided where ductile iron pipe passes through concrete walls.
- B. A flexible coupling shall be installed close to the wall outside a structure.
- C. Where a flange and mechanical joint piece is to connect to a mechanical joint wall casting, the bolt holes in the bell of the wall casting shall straddle the top (or side for vertical piping) center line of the casting and shall align with the bolt holes in the flange and mechanical joint piece. The top centerline shall be marked on the wall casting at the foundry.
- D. When specified or indicated on the Drawings, all wall castings other than flush mounted castings and wall sleeves shall be standard mechanical joint flanged joints as indicated.

- E. When specified or indicated on the Drawings, bells on flush mounted wall castings and wall sleeves shall be mechanical joint type with tapped holes for tie rods or stud bolts.

3.14 Reducers

- A. Reducers, adjacent to flowmeters and pumps or in other locations as specified or indicated on the Drawings, shall be eccentric pattern, installed with the straight side on top so that air traps are not formed. All other reducers shall be concentric pattern unless otherwise shown on the Drawings.

3.15 Outlets

- A. Where a 12-inch or smaller branch outlet is specified or indicated on the Drawings, and the diameter of the line pipe is at least twice the diameter of the branch, either a tee or factory welded-on boss shall be used.
- B. Connections of gages to 6-inch and smaller pipe shall be made using a tee complete with blind flange drilled and tapped to accept the gage piping specified.
- C. Connections of gages to 8-inch and larger piping shall be made by means of a factory welded-on boss.
- D. Tapping saddles shall be used for "hot taps," and only in specified instances or when shown on the Drawings. Use of tapping saddles shall be subject to a written acceptance by the Engineer prior to use in every instance.
- E. Service line connections for air valves shall be in accordance with Section 40 05 78.23, Sewer Air Valve Assemblies.

3.16 Connections to Existing Piping

- A. Where new pipelines are to be connected to existing lines of CVWD, the Contractor shall verify in the field the location, elevation, pipe material, pipe outside diameter, and any other characteristics of the existing line before proceeding with the pipe installation. This field verification shall be performed in the presence of CVWD Engineer.
- B. Prior to construction, the Contractor shall submit for review and acceptance detailed procedures for pressure testing and the making of final connections to existing lines.
- C. Connections between new work and existing piping shall be made using fittings submitted and be subject to Engineer's acceptance for each separate condition encountered.
- D. Each connection to existing pipe shall be made at a time and under conditions that will least impact normal operations, and as authorized in writing by the Engineer.

- E. The Contractor is responsible for making provisions for cutting of existing pipe when necessary, using approved mechanical means. Flame cutting of pipe will not be allowed.
- F. The Contractor is responsible for making provisions for dewatering existing lines and for disposal of water from the dewatering operation.
- G. The Contractor shall make all connections to existing pipelines in the presence of CVWD's Representative. Contractor shall provide all labor, equipment, and materials necessary to perform connection work, including but not limited to, isolation plug valve, fittings, and adapters.

3.17 *Thrust Blocks*

- A. Place concrete thrust blocks as indicated on the Drawings, CVWD's Detail Drawings for the Construction of Sanitary Sewer Systems, Section 33 11 13, Piping Systems and Appurtenances, and as directed by CVWD.

3.18 *Corrosion Control*

- A. Joint Bonding/Electrolysis Test Stations: Except where otherwise indicated, all joints shall be bonded in accordance with the details indicated. The pipe shall be cleaned to bare bright metal at the point where the bond is installed. The pipe manufacturer shall be responsible for determining and implementing a suitable procedure and schedule for installation of bonding—field versus factory versus combination—in such a manner that the corrosion resistance of the lining and coating is not degraded by the bonding process. It may involve welding joint bonding pads, or welding the bonding wires in the factory before applying the lining and coating specified and/or may involve patching impaired areas in the factory or the field.
- B. Bonding and Electrical Continuity: All unwelded pipe joints shall be bonded for electrical conductivity in accordance with the details indicated. The Contractor shall furnish all materials required for joint bonding and test station installations. Following welding of the bonding wires to the pipe, the exterior coating shall be repaired per the coating manufacturer's instructions and applicable AWWA Standards.
- C. Cathodic Protection: Corrosion mitigation and testing materials, such as an impressed current cathodic protection system, magnesium anodes, reference electrodes, and test lead wires shall be provided where indicated.
- D. All system components shall be inspected by a qualified corrosion engineer prior to backfill and compaction. All tests and repairs shall be per the Engineer.
- E. Upon completion of the installation, the Contractor shall furnish testing of the system by a qualified corrosion engineer. The testing shall be conducted in the presence of the Engineer. The testing shall include measurement of all anode currents and

potentials, potentials of metallic pipelines and casings with anodes connected. Measurements shall be made at all test stations and anode junction box locations. All system checkout test results shall be recorded as the "Acceptance Test Results" in the test log form furnished below. Any deficiencies of systems tested shall be reported to the Engineer and repairs to the systems and retesting of systems shall be at no additional cost to CVWD.

1. Manufacturer's operation and maintenance instructions.
2. List of spare parts recommended for 2 years' successful operation.
3. Anode wire resistance test records.
4. Log of "Holiday" testing.
5. Factory test results for rectifiers.
6. Testing schedule and log form.
7. Diagram indicating locations of system tests.

F. Record drawings shall reflect accurate record of actual locations of cathodic protection equipment, devices, outlets, and appurtenances.

3.19 *Marker Posts*

A. Locate and install marker posts in accordance with Section 10 10 10, Utility Marker Post and CVWD Standard Drawing S-38.

3.20 *Testing and Acceptance*

A. Hydrostatic and Leakage Test:

1. Hydrostatic and leakage testing shall be performed in accordance with Section 33 01 30.13, Sanitary Sewer System Testing.

B. General Testing Requirements:

1. Required test pressures shall be applied by pump connected to pipeline sections being tested. CVWD shall approve pump connections to pipeline before testing begins. As part of the Work, and unless specified otherwise, Contractor shall install, at Contractor's expense, top outlets (service taps) required for testing. Contractor shall provide calibrated meters for measurement of leakage, and all pumps, piping, fittings, bulkheads, plugs, valves, gages, power equipment, and manpower necessary for conducting all tests required, all at Contractor's expense. Contractor shall furnish CVWD three copies of all records of all tests performed.

2. Unless specified otherwise, Contractor shall test against test plates for pipelines 12-inch and smaller. Contractor shall not remove said test plates until pipelines have been tested, disinfected, and accepted by CVWD.
3. Contractor, at Contractor's expense, shall locate and repair leaks or other defects which may develop or become apparent during the test. Contractor shall excavate, including removal of backfill already placed, and make all repairs necessary for required water tightness, and then replace all excavated material, after which the Contractor shall retest the repaired pipeline section. Pipeline sections shall be repeatedly repaired and tested until they meet requirements set forth herein.
4. Pipe manufacturer and fitting manufacturer shall have free access to the Work during testing. Any improper act on the part of the Contractor which the pipe and fitting manufacturer may observe shall be reported to CVWD. Pipe and fitting manufacturer shall be free to observe and verify all tests.
5. After completed pipeline and appurtenances or test sections have successfully met test requirements to the satisfaction of CVWD, the entire pipeline or each test section shall be filled or shall remain filled with water until completion of the Work, unless otherwise ordered by CVWD.

3.21 *Coating Requirements*

A. Field Painting:

1. Contractor shall field paint all aboveground, bare, or exposed piping and appurtenances in accordance with Section 09 90 00.10, Sewer Painting and Coating, as indicated on the Drawings, and as specified herein.

END OF SECTION 33 11 13.13

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SECTION 33 31 14

VITRIFIED CLAY PIPE FOR SANITARY SEWER

PART 1 – General

1.01 *Description*

- A. This section covers the furnishing and installation of vitrified clay pipe and fittings for sanitary sewers, as specified and shown, complete, in accordance with the requirements of the Contract Documents.
- B. The Contractor shall furnish all tools, equipment, materials, and supplies and shall perform all labor required to complete the Work as indicated in the Contract Documents.

1.02 *Related Work Specified Elsewhere*

- A. The requirements of the following sections and divisions apply to the Work of this section. Other sections and divisions of the Specifications, not referenced below, shall also apply to the extent required for proper performance of this Work.
 - 1. Section 31 23 17, Trenching, Excavation, Backfill and Compaction
 - 2. Section 31 23 19, Dewatering
 - 3. Section 31 23 19.10, Sewer Bypass System
 - 4. Section 33 01 30.13, Sanitary Sewer System Testing
 - 5. Section 33 01 30.16, TV Inspection of Sewer Pipelines
 - 6. Section 33 08 30, Connection to Sanitary System
 - 7. Section 33 39 33, House Laterals

1.03 *Reference Specifications, Codes, and Standards*

- A. All Work specified herein shall conform to or exceed the applicable requirements of the referenced portions of the following publications to the extent that the provisions thereof are not in conflict with other provisions of these Specifications.
- B. Comply with the applicable editions of the following codes, regulations and standards.
 - 1. CVWD Detail Drawings for the construction of Sanitary Sewer Systems

2. Industry Standards:

ASTM C 12	Standard Practice for Installing Vitrified Clay Pipe Lines
ASTM C 301	Standard Test Methods for Vitrified Clay Pipe
ASTM C 425	Standard Specification for Compression Joints for Vitrified Clay Pipe and Fittings
ASTM C 700	Standard Specification for Vitrified Clay Pipe, Extra Strength, Standard Strength, and Perforated
ASTM C 828	Standard Test Method for Low-Pressure Air Test of Vitrified Clay Pipe Lines
SSPWC	“Green Book”, Standard Specifications for Public Works Construction

- C. Comply with the applicable reference Specifications as directed in the General Conditions, other applicable parts of the Contract Documents, and as specified herein.

1.04 *Contractor Submittals*

- A. Submittals shall be made in accordance with the General Conditions, other applicable parts of the Contract Documents, and as specified herein.
- B. Certifications: The Contractor shall furnish a certified affidavit of compliance for all pipe and other products or materials furnished under this section, as specified in the referenced standards and the following supplemental requirements:
1. Product drawings and data for pipe, joints, and gaskets.
 2. Hydrostatic test reports.
 3. Three-edge bearing strength test reports.
- C. Testing results in accordance with Section 33 01 30.13, Sanitary Sewer System Testing for deflection, air pressure, and CCTV.
- D. The Contractor is responsible for traffic control and it shall include all material, labor and equipment to provide safe and effective work areas to warn, control, protect and expedite vehicular, bicycle and pedestrian traffic. Unless otherwise required by the Contract Documents, all work and material provided under this section shall be performed or furnished in accordance

with SSPWC Part 6 Temporary Traffic Control and the entity (City, County, State, etc.) having jurisdiction. Traffic control shall also be in accordance with Section 33 11 00, Basic Pipeline Specifications.

1.05 *Quality Assurance*

A. General

1. Quality assurance shall conform to SSPWC Sections 207-8.2 and 207-8.5 requirements.
2. Imperfections
 - a. Imperfections in pipe and fittings containing blisters, cracks, and chips in excess of the limitations herein will be rejected; however, certain cracks and chips meeting the requirements of SSPWC Section 207-8.2.4 may be repaired in accordance with SSPWC Section 207-8.6.
3. Clay Pipe Repair
 - a. Clay pipe with imperfections meeting the requirements of SSPWC Section 207-8.2.4 may be repaired in accordance with SSPWC Section 207-8.6.
4. Inspection of Repairs
 - a. All pipe to be repaired shall be inspected by CVWD's Representative after preparation for repair, and again after repair has been made. Repairs made without prior inspection shall be rejected. The Engineer may require retesting of any repaired pipe to demonstrate its soundness. CVWD shall be reimbursed for all costs incurred for inspection and testing of repaired pipe.
5. Factory Testing Requirements
 - a. All pipe shall meet the testing requirements of SSPWC Section 207-8.5
6. Contractor shall coordinate with the related general requirements common to all Specification sections of the Project as addressed in General Conditions, other applicable parts of the Contract Documents, and as specified herein.

1.06 *Warranty*

- A. Contractor shall comply with all warranty requirements as specified in the Contract Documents.

PART 2 – Products

2.01 *Vitrified Clay Pipe*

- A. All pipe and fittings shall conform to SSPWC Section 207-8.1 requirements.
- B. Except as otherwise indicated, vitrified clay pipe and fittings, including perforated pipe, shall be extra-strength manufactured in accordance with ASTM C 700.
- C. Vitrified clay pipe shall be of the best quality, vitrified, homogeneous in structure, thoroughly burned throughout the entire thickness, free from cracks or other imperfections and must give a clear metallic ring when struck with a hammer.
- D. All pipe and fittings shall be clearly marked with the name or trademark of the manufacturer, the location of the manufacturing plant and extra strength designation.
- D. Dimensions and Tolerances
 - 1. Limits for dimensional variation shall be according to Table 2 of ASTM C 700.
 - 2. The pipe diameter shall not vary from a true circle by more than 2.5 percent of nominal diameter. The maximum bevel of the ends of the pipe to be laid on a curve is 4 degrees. Plain-end pipe shall not be beveled.
 - 3. Except for special purposes, the minimum standard length of straight pipe, exclusive of socket depth, shall be 40 inches. Pipe shall not deviate from straight by more than 1/16 inch per foot of length measured from the concave side of the pipe.

2.02 *Fittings and Stoppers*

- A. All fittings and stoppers shall conform to the requirements of SSPWC Section 207-8.3.
- B. The stoppers for all pipe 8-inches in diameter and smaller, in which a sealing component for a flexible compression-type joint is cast, shall be neoprene, polyethylene, or polyurethane. Stoppers in all other cases shall be discs of the same material as the pipe, equal in diameter to the outside of the pipe barrel, and made and installed as approved by CVWD representative.
- C. Neoprene stoppers shall be manufactured from a compound containing not less than 50 percent neoprene by volume, which shall be the sole elastomer.

Stoppers shall not be adversely affected when exposed to the chemical and bacteriological environments normally found in wastewater sewers.

- E. All joints for stoppers shall be adequate to withstand the internal pressure of the leakage and infiltration test.

2.03 *Joints*

- A. Joints shall be in accordance with SSPWC Subsections 207-8.4 and 208-2 requirements.
- B. Joints in vitrified clay pipe shall be made using a factory-made mechanical compression joint, consisting of a plastic material (Polyurethane), and shall be "Wedgelock" or "Speed-Seal," or approved equal, and shall conform to the requirements of SSPWC Subsection 208-2.3, Type "G" Joints.
- C. All pipe shall have Type "G" (polyurethane) joints, except that 4-inch through 12-inch pipe sizes may have one (1) Type "D" or Type "Z" rubber coupling joint to connect with an existing sewer lateral.

2.04 *Manufacturers*

- A. Vitrified clay pipe shall be as manufactured by Gladding McBean, Pacific Clay, Mission Clay Products, or approved equal.

2.05 *Epoxy Resin*

- A. All approved saddle connections to CVWD VCP sewer mains shall be accomplished with an approved epoxy resin. Epoxy resin shall be Epibond 157 as manufactured by Furane Plastics, Inc., WR633 A&B as manufactured by Wyndham Chemicals, Inc., EPON 828 as manufactured by Shell Chemical Corporation, or approved equal. The epoxy resin shall be used in strict accordance with the manufacturer's specifications.

2.06 *Bedding and Encasement Materials*

- A. All bedding and encasement materials shall be as shown on the Drawings and Section 31 23 17, Trenching, Excavation, Backfill, and Compaction.

2.07 *Factory Inspection*

- A. CVWD shall have free access to that part of the manufacturer's plant involved in work performed to meet requirements of this specification. The manufacturer shall afford CVWD, at no charge, reasonable facilities needed to determine if the pipe meets the requirements of this specification.

2.08 *Identification and Locator Tape*

- A. Identification and locator tape materials shall be as required by the Contract Documents.

PART 3 – Execution

3.01 General

- A. Pipe shall be installed in accordance with SSPWC 306.
- B. Trench excavation, bracing methods, foundation preparation, pipe bedding, trench backfill, and related operations shall be in accordance with the requirements of Section 31 23 17, Trenching, Excavation, Backfill, and Compaction.
- C. The sewer shall be constructed to the alignment and grade shown. The grade line shown on the profile is the invert or interior bottom of the pipe. The excavation shall be made a sufficient distance below the grade line to allow for the placing of the sewer pipe and the supporting bedding if such bedding is shown. Should the trench be excavated to a depth greater than required, the Contractor shall refill such excess excavation with the same fill material as specified for the overlying fill or bedding and compacted as required for such overlying fill or bedding.
- D. Sewer pipelines shall never be used as drains for removing water that has infiltrated into the trenches.
- E. The Contractor shall not store pipe upon the roadway or parkway of residential streets for more than or upon commercial streets for more than.
- F. Where any portion of the sewer is located within ten feet of any tree (measured horizontally from the center line of the sewer to the center of the tree), the removal of which is not included in the Contract for the sewer improvements, the joints of the pipe shall be wrapped with Bio-Barrier® or a root herbicide product to prevent root intrusion.
- G. Sanitary sewer lines, house laterals and domestic water supply mains separated by less than 10 feet horizontally, measured from outside of pipes, shall be installed in accordance with CVWD Standard Drawing Nos. S-3 and S-4.
- H. Sanitary sewer lines and house laterals that cross domestic water supply mains shall be installed in accordance with CVWD Standard Drawing Nos. S-3 and S-4.

3.02 Installation of Vitrified Clay Pipe

- A. Installation of pipe shall be in accordance with SSPWC Section 306-1 as modified herein. Pipe laying shall proceed upgrade with spigot ends pointing

in direction of flow. After a section of pipe has been lowered into the prepared trench and immediately before joining the pipe, the ends of the pipe to be joined shall be cleaned, and the rubber gasket lubricated, all in accordance with the pipe manufacturer's written instructions. Assembly of the pipe length shall be in accordance with the recommendations of the manufacturer of the type of joint used. All special tools and appliances required for joining the pipe shall be provided by the Contractor. When cutting or machining of the pipe is necessary, only tools and methods recommended in writing by the pipe manufacturer and accepted by the Engineer shall be employed.

B. Field jointing of clay pipe shall be in accordance with SSPWC Section 306-1.2.3.

C. Laying Vitrified Clay Pipe

1. All pipe shall be laid without break, upgrade from structure to structure, with the socket ends of the pipe upgrade. Pipe shall be laid to the line and grade shown on the Drawings and in such a manner as to form a close concentric joint with the adjoining pipe and prevent sudden offsets of the flow line. Mating surfaces shall be cleaned and lubricated prior to jointing as recommended by the manufacturer. The interior of the sewer pipe shall be cleaned of all dirt and superfluous materials as the Work progresses.
2. The trench and other excavation shall be kept entirely free of water while concrete or pipe is being placed and until all concrete or mortar has set hard. Refer to Section 31 23 17, Trenching, Excavation, Backfill, and Compaction and Section 31 23 19, Dewatering of these Specifications for additional requirements including pipe bedding construction and dewatering.
2. The Contractor shall take all necessary precautions to prevent excavated or other foreign material from getting into the pipe during the laying operations. At all times, when laying operations are not in progress and at the close of the day's work, the ends of the pipe in the trench shall be closed with a tight-fitting cap or stopper to prevent animals and foreign materials from entering.

D. Installation of Clay Pipe Branches and Fittings

1. Wyes of the sizes specified on the Contract Documents shall be installed for all sewer house connections and for future sewer house connections as shown on the Contract Documents. Tees shall be installed for chimneys as shown. The main barrel of branch fittings placed in line and grade with the vitrified clay pipe sewer shall be of the same construction as said sewer. Installation, earthwork, and bedding

for branches shall conform to the applicable provisions set forth for vitrified clay sewer pipe. Unless otherwise specified, the branch of wye fittings shall be included upward at an angle not greater than 45 degrees from horizontal. No wye or tee for a sewer house connection branch shall be located closer than 5 feet downstream from the outside of any structure.

2. The Contractor shall place pipe-bedding material per Section 31 23 17 - Trenching, Excavation, Backfill, and Compaction, of these Specifications, at least eight (8) inches deep under every non-vertical branch when installed.
3. Stoppers and caps shall be installed in such a manner that they may be removed without damage to the pipe or joint sealing component.

E. Vitrified Clay Pipe at Manholes or Structures

1. Two (2) 2-foot sections of vitrified clay pipe with the same inside diameter as the adjoining pipe shall be placed at the inlet and outlet to each manhole, structure, casing pipe, concrete encasement, deep lateral connection, and as required by CVWD. Pipe shall be installed into manholes or structures as shown on Standard Drawing No. S-5.

- F. All necessary precautions shall be taken to prevent uplift or floating of the pipe prior to the completion of the backfilling operation. The Contractor shall assume full responsibility for any damage due to this cause and shall, at its own expense, restore and replace the pipe to its specified condition and grade if it is displaced due to floating.

3.03 *Identification and Locator Tape*

- A. Identification and locator tape shall be placed as required by the Contract Documents.

3.04 *Sewer Laterals*

- A. Sewer laterals shall be installed in accordance with Section 33 39 33, House Laterals.

3.05 *Connections to Manholes and Pipe*

- A. Pipelines shall be connected to manholes as indicated on the Drawings and Section 33 08 30, Connection to Sanitary System. Each connection shall be made at a time and in a manner that will result in the least interruption of service.

- B. The Contractor shall provide fittings or adapters required to connect new pipe to existing pipe. Detail drawings of such fittings or adapters and the method of connection shall be submitted for approval.
- C. Pipe connections to new or existing manholes shall be done under the direction of the Engineer and other applicable requirements specified for new manholes, including all necessary concrete work, coring, and shaping of channel.
- D. Sanitary sewer connections to existing manholes shall be core-drilled and grouted (non-shrink type) in accordance with Section 33 08 30, Connection to Sanitary System.
- E. Existing flow shall be maintained through a bypass as specified herein. A bypass plan shall be submitted and the Contractor shall be solely responsible for maintaining the bypass and shall be liable for any fines levied by any agency as a result of any spill or overflow.
- F. Lateral connections to gravity VCP mains shall be made using a CVWD approved saddle tee or saddle wye in accordance with Section 33 39 33, House Laterals.

3.06 *Sewage Bypass*

- A. The Contractor shall prepare a bypass plan and control the flow in accordance with Section 31 23 19.10, Sewer Bypass System and as required by the Contract Documents. A sewage bypass plan shall be submitted to CVWD for approval prior to construction. The Contractor shall at all times, be responsible for the operations of this bypass system, including furnishing all the necessary equipment and making arrangements to obtain power as required. The Contractor shall not be permitted to trench public or private streets for bypass purposes without the approval of the entity (State, County, City, etc.) having jurisdiction.

3.07 *Shoring Removal*

- A. Any bedding, pipe zone or backfill voids created by moving or removing shoring shall be left in place or filled per the trench details shown on the Drawings and Section 31 23 17, Trenching, Excavation, Backfill, and Compaction.

3.08 *Testing and Acceptance*

A. General

1. It is the intent of the Contract Documents that the completed sewer pipe of all types, along with manholes and other appurtenances, shall be watertight.

2. Unless otherwise indicated on the Drawings, air testing, infiltration testing, deflection testing, sag measurements, and video inspection shall be performed in accordance with Section 33 01 30.13, Sanitary Sewer System Testing and this specification section.
3. The Contractor shall furnish all labor and materials for making the tests required at no additional cost to CVWD. All tests shall be completed before the street and/or trench is resurfaced, unless otherwise directed by CVWD.
4. Tests shall be made in the presence of CVWD's Representative.

B. Air Testing

1. Contractor shall perform field air testing in accordance with Section 33 01 30.13, Sanitary Sewer System Testing.
2. If, in the opinion of CVWD, excessive groundwater is encountered during construction of a section of sewer, the air pressure test for leakage shall not be used. An infiltration test shall be performed instead.

C. Sag Measurement

1. Contractor shall perform sag measurements in accordance with Section 33 01 30.13, Sanitary Sewer System Testing.

D. CCTV Inspection

1. Contractor shall perform CCTV inspection in accordance with Section 33 01 30.13, Sanitary Sewer System Testing and Section 33 01 30.16, TV Inspection of Sewer Pipelines.
2. Sags, or standing water in pipe, shall meet the following criteria:

Complies with Specification	Unacceptable: Replace Pipe
Sag: 1/2" or less	Sag: greater than 1/2"

E. Deflection Testing

1. Deflection measurements shall be performed on all gravity sewer pipe per Section 33 01 30.13, Sanitary Sewer System Testing. If the mandrel sticks in the pipe at any point the pipe shall be repaired and retested. Pipe sections not meeting the deflection requirements shall be excavated, re-installed, and subject to an additional 30-day deflection test at no additional cost to CVWD. The cost for the deflection test shall be included in the unit price bid for the sanitary sewer pipe.

F. Acceptance

1. Even though a section of sewer may have previously passed the leakage or infiltration test, each section of pipe shall be tested subsequent to the last backfill compacting operation thereon. If, in the opinion of CVWD, heavy compaction equipment or any of the operations of the Contractor may have affected the required watertight integrity of the pipe, structure, or appurtenances, additional leak testing shall be required.
2. If the pressure drop, leakage and/or infiltration rate, sag, or deflection measurements are greater than specified herein or in the Section 33 01 30.13, Sanitary Sewer System Testing, the sewer shall be repaired, or, if necessary, the pipe shall be removed and re-laid at no additional cost to CVWD.
3. The sewer will not be considered acceptable until the pressure drop, leakage and/or infiltration rate, as determined by the appropriate test, meets the allowable limit. Even when infiltration is less than the specified amount, the Contractor shall stop any observed individual leak when detected by the Contractor and/or ordered to do so by CVWD.
4. For pipe not meeting the sag requirements:
 - a. If the sag exceeds the allowable value, then work will not be accepted and payment won't be released until the installation is corrected to satisfy the minimum sag required in this specification.
 - b. Due to unacceptably high operation and maintenance costs and poor system reliability, pipelines with sag depths exceeding allowed amount will be rejected. Replacement of pipe includes all construction costs including, but not limited to, sewer bypassing, excavation, pipe installation, backfilling, resurfacing, tunneling, etc., for the length of pipe that exceeds the sag amount specified, plus 20 linear feet of pipe in each direction. Damaged pipe shall be removed and disposed of in a legal manner, and new pipe shall be installed and retested at no additional cost to CVWD.
5. For pipe not meeting the deflection test requirements:
 - a. Contractor shall make the necessary repairs or replacements at the Contractor's expense by a method acceptable to CVWD's Representative at no additional cost to CVWD.
 - b. Pipe shall be subject to an additional 30-day deflection test at no

additional cost to CVWD.

END OF SECTION 33 31 14

SECTION 33 31 15

FIBERGLASS REINFORCED SEWER PIPE

Part 1 – General

1.01 *Description*

- A. The work of this section includes the requirements for materials, excavation, installation, backfill, and testing of centrifugally cast and filament wound fiberglass reinforced polymer mortar pipe and fittings for gravity sewers, as specified and shown, and all appurtenant work complete in place in accordance with the requirements of the Contract Documents.
- B. The Contractor shall provide all tools, supplies, materials, equipment, and all labor necessary to complete the Work of this section in accordance with the requirements of the Contract Documents.
- C. The Contractor shall furnish, install, and test fiberglass reinforced pipe, fittings, and appurtenances of the dimensions and to the lines and grades shown on the Contract Documents.
- D. This specification section applies to open trench installed gravity sewer pipe.

1.02 *Related Work Specified Elsewhere*

- A. The requirements of the following sections and divisions apply to the Work of this section. Other sections and divisions of the Specifications, not referenced below, shall also apply to the extent required for proper performance of this Work.
 - 1. Section 31 23 19.10, Sewer Bypass System
 - 2. Section 33 01 30.13, Sanitary Sewer System Testing
 - 3. Section 33 01 30.16, TV Inspection of Sewer Pipelines
 - 4. Section 33 05 15, Manholes and Precast Vaults
 - 5. Section 33 31 11, PVC Pipe for Sanitary Sewer
 - 6. Section 33 31 14, Vitrified Clay Pipe for Sanitary Sewer
 - 7. Section 33 39 XX, Connection to Sanitary System
 - 8. Section 33 39 XX, House Laterals

1.03 *Reference Specifications, Codes, and Standards*

- A. All Work specified herein shall conform to or exceed the applicable requirements of the referenced portions of the following publications to the extent that the provisions thereof are not in conflict with other provisions of these Specifications.
- B. Comply with the applicable editions of the following codes, regulations and standards.
 - 1. CVWD Detail Drawings for the Construction of Sanitary Sewer Systems.
 - 2. Industrial Standards:
 - a. ASTM D638, Standard Test Method for Tensile Properties of Plastics
 - b. ASTM D695, Standard Test Method for Compressive Properties of Rigid Plastics
 - c. ASTM D2412, Standard Test Method for Determination of External Loading Characteristics of Plastic Pipe by Parallel-Plate Loading
 - d. ASTM D3262, Standard Specification for "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Sewer Pipe
 - e. ASTM D3567, Standard Practice for Determining Dimensions of "Fiberglass" (Glass-Fiber-Reinforced Thermosetting Resin) Pipe and Fittings
 - f. ASTM D3681, Standard Test Method for Chemical Resistance of "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe in a Deflected Condition
 - g. ASTM D3839, Standard Guide for Underground Installation of "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe
 - h. ASTM D4161, Standard Specification for "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe Joints Using Flexible Elastomeric Seals
 - i. ASTM F477, Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe
 - j. SSPWC, "Green Book", Standard Specifications for Public Works Construction
 - k. AWWA Manual M-45, Fiberglass Pipe Design

- C. Comply with the applicable reference Specifications as directed in the General Conditions, other applicable parts of the Contract Documents, and as specified herein.

1.04 *Contractor Submittals*

- A. Submittals shall be made in accordance with the General Conditions, other applicable parts of the Contract Documents, and as specified herein.
- B. Shop drawing submittals shall be made in accordance with SSPWC Subsection 2-5.3. Shop drawing submittals shall contain all required information.
- C. Submittals shall include detailed drawings of the pipe, gaskets, joints, pipe special sections, pipe-laying diagrams and/or schedule per CVWD test reports in accordance with ASTM D3262, ASTM D3681, and ASTM D4161, and test reports on the properties of the gasket material.
- D. Provide pipe-laying diagrams and/or schedule as required by CVWD showing the location, length, strength designation, and number designation of each pipe section and special pipe section to be furnished. The station and elevation of the pipe invert at all changes in grade and all data on curves and bends for both horizontal and vertical alignment shall also be shown.
- E. Submittals shall include complete design calculations for each pipe size and pipe stiffness to be prepared and sealed by a California Registered Civil Engineer.
- F. Provide manufacturer's technical data showing complete information on material composition, physical properties and dimensions of the fiberglass reinforced pipe and fittings. Provide the following, among other items:
 - 1. Coupling and gasket design, material, and technical data.
 - 2. Qualifications of gasket manufacturer.
 - 3. Polymer resin system information demonstrating compliance with the Article entitled "Materials" of this Specification and the requirements of SSPWC Subsection 207-20.
 - 4. Glass reinforcement chemical composition, source, and class.
 - 5. Pipe wall structural design including location of reinforcement.
- G. Provide references documenting history of satisfactory pipe performance conveying municipal sewage for the pipe submitted for this Project. References shall be for pipe that was manufactured using the composite composition of the pipe submitted for this Project, including resin, fillers,

pigment, and glass. References shall include the following, among other items:

1. Installation year, size, stiffness class, agency or CVWD, length installed, and design engineer. Agency and engineer information shall include name and phone number of an individual familiar with the installation.
 2. Certify that listed projects used the resins and fillers intended for this Project as well. Include all such projects installed in North America in the last five years.
- H. Provide manufacturer's recommendations for transport, handling, storage, installation, and repair of pipe and fittings.
- I. Installation Certification:
1. Provide certification from pipe manufacturer that the Contractor is qualified to join, lay and handle pipe.
 2. Alternatively, submit evidence of Contractor's satisfactory experience (including references and contact information) with qualifying installations of fiberglass pipe per ASTM D3262 or AWWA C950. "Satisfactory experience" means, among other things, that CVWD of the qualifying pipe installation confirms that the pipe was installed and continues to be leak free, laid on line and grade, and was completed and accepted without lawsuits being filed or change orders in excess of ten (10) percent of the pipe Work. Such qualifying installations shall comprise at least three (3) projects totaling at least 10,000 feet of pipe, installed within the last five (5) years, utilizing the personnel that will be utilized for this Project as well.
 3. If neither of the above requirements are met to the satisfaction of CVWD provide a manufacturer's representative resident on site providing full time observation of the installation of the pipeline, and certifying the installation work complies with the manufacturer's recommendations.
- J. Certifications and test reports demonstrating that pipe manufactured under the current ownership, and at the facility from which the pipe will be manufactured and shipped, complies with SSPWC Subsection 207-20.5 and the qualification requirements of ASTM D3262.
- K. Provide proof of qualification testing as specified in the Article entitled "Quality Assurance" of this Specification.
- L. All other submittals as described in the Article entitled "Factory Witnessed Testing" in Part 3 of this Specification.

1.05 *Quality Assurance*

- A. Comply with the requirements specified herein, the applicable reference Specifications, General Conditions, and other applicable parts of the Contract Documents. Also, comply with applicable requirements of the SSPWC.
- B. All pipe and fittings shall be from a single manufacturer. The supplier shall be responsible for the provisions of all test requirements specified in AWWA C950 and ASTM D3262 as applicable.
- B. Contractor Qualifications: Installation certifications shall be as specified in the Article entitled "Contractor Submittals" of this Specification.
- C. Factory Qualifications:
 - 1. The factory producing the pipe shall each have at least two (2) years of experience producing pipe of at least 36 inches in nominal size with a stiffness class of at least SN46, under the current ownership. The pipe shall be produced under the supervision of a factory manager and quality control supervisor with a tenure at the factory of at least two (2) years when pipe production begins.
 - 2. The factory producing the provided pipe shall each have produced at least 40,000 lineal feet of pipe of at least 36 inches in nominal size with a stiffness class of at least SN36, under the current ownership, factory manager, and quality control supervisor.
 - 3. Perform and provide proof of qualification testing of the pipe per ASTM D3262 and of laboratory testing of the joint per ASTM D4161. This shall also include the strain corrosion requirements specified in the Article entitled "Manufacturer's Testing and Examinations" in Part 3 of this Specification. Qualification testing done on pipe without vinyl ester lining shall be acceptable.
 - 4. Submit design calculations that verify pipe stiffness in accordance with in the Article entitled "Manufacturer's Testing and Examinations" in Part 3 of this Specification.

1.06 *Delivery, Handling, and Storage*

- A. Delivery, storage, and handling of pipe shall be per the pipe manufacturer's recommendations.
- B. Damaged pipe shall be defined as pipe with any kinks or with gouges exceeding ten (10) percent of pipe wall thickness.
- C. Pipe shall be stored at the jobsite in unit packages provided by the manufacturer.

- D. If, at any time since manufacture, the pipe has been exposed to direct sunlight for more than three (3) months cumulative, the pipe shall be shaded thereafter with an opaque material. Such provisions for shading shall permit ambient air circulation above and around the pipe while blocking all direct sunlight.
- E. Limit stacking of pipe to a height that will not cause significant deformation of bottom layers of pipes under foreseeable temperature conditions. Significant deformation is defined as more than two (2) percent of the nominal diameter.
- F. When stored outdoors, store pipe on wooden dunnage, spaced and of such widths as not to allow significant deformation of pipe under the point of contact with dunnage or elsewhere.
- G. If pipe is strung along trench prior to installation, string only pipe to be used within a twenty-four (24) hour period; all pipe is to be laid on a flat surface. The interior as well as sealing surfaces of pipe, fittings, and other accessories shall be kept free from dirt and foreign matter.

1.07 *Service Conditions*

A. Comply with the following:

- | | |
|--------------------------------------|--|
| 1. Conveyed Fluid: | Raw sewage (i.e. pipe and liner shall be highly resistant to exposure to sulfuric acid as produced by biological activity from hydrogen sulfide gases) |
| 2. Chemical Resistance Requirements: | Pipe shall exceed the long-term chemical resistance requirements of ASTM D3681, ASTM D3262, and SSPWC Subsection 207-20.5 |
| 3. pH Range: | Between 2 and 11 |
| 4. Fluid Temperature Range: | 12 degrees C to 35 degrees C |
| 5. Flow Range: | See the Drawings |
| 6. Pipe Cover: | See the Drawings |
| 7. Soil Conditions: | See the Geotechnical Report and Drawings |

Part 2 - Products

2.01 *General*

- A. Both centrifugally cast and filament wound pipe and fittings shall conform to SSPWC Subsection 207-20 requirements, except tables 207-20.3.2 and

207-20.4 and as modified herein. Except when in conflict with the forgoing, pipe shall also comply with ASTM D3262 and pipe joints shall comply with ASTM D4161.

2.02 *Materials*

A. Conform to SSPWC Subsection 207-20 and the following:

1. Composite System: Data showing a proven history of satisfactory performance conveying municipal sewage shall have been acquired from a composite material with the same structural design, reinforcement and matrix as the submitted product.
2. Resin Systems: The manufacturer shall comply with requirements in the latest edition of the SSPWC, including providing a vinyl ester liner.
3. Glass Reinforcement: The reinforcing glass fibers used to manufacture the components shall be of highest quality commercial grade E-glass filaments with finish, binder and sizing compatible with impregnating resins used.
4. Silica Sand: Sand shall be kiln dried silica with a maximum moisture content of 0.2 percent and a minimum silica content of 98 percent.
5. Additives: Resin additives, such as curing agents, pigments, dyes, fillers, thixotropic agents, and the like, shall not detrimentally affect the performance of the product. "Detrimentially affect" means that the performance of the product in the application would be improved if the additive were to be removed.
6. Gaskets shall meet the following requirements:
 - a. Ethylene Propylene Diene Monomer (EPDM) meeting the requirements of ASTM D4161 and ASTM F477 shall be supplied by a qualified gasket manufacturer and be suitable for the service intended.

2.03 *Marking*

A. Marking shall be performed as specified in SSPWC Subsection 207-2.10, 207-20.6, and shall also comply with the following:

1. Each pipe shall be uniquely marked with a manufacturer's quality control number on the inside at both the bell and spigot ends.
2. Each pipe shall also have the pipe number designation referenced on the laying diagram marked on the inside at both the bell and spigot ends.

3. Marking shall include the following:
 - a. Nominal diameter
 - b. Manufacturer's name
 - c. ASTM D3262.
 - d. Type, Liner, and Grade
 - g. Stiffness number (SN)
 - h. Date of manufacture and/or acceptance
4. All mitered pipe shall be marked with the degree of miter
5. All markings shall be legible and indelible

2.04 *Manufacture and Construction*

A. Pipe

1. Manufacture pipe by the centrifugal casting or filament wound process to result in a dense, nonporous, corrosion-resistant, consistent composite structure based on interior and exterior fiberglass reinforcement in a polymer resin matrix.
2. A less heavily reinforced polyester/sand mortar layer may be used near the neutral axis in the center of the structural section of the wall to separate the heavily reinforced layers and provide increased stiffness.
3. If called for by the Drawings, or to meet chemical resistance requirements listed in Article entitled "Service Conditions" of this Specification, the resin of the interior liner shall be one hundred (100) percent vinyl ester to protect the reinforcement and the polyester resin from attack by the carried liquid, and to provide chemical, crack and abrasion resistance.
4. The exterior surface layer shall be polyester resin based, and be sufficiently thick and continuous to provide scratch and abrasion protection, and to protect the underlying reinforcement from exposure to groundwater. The surface layer shall also contain sufficient UV inhibitor and/or other constituents such as sand or pigment to protect the underlying resin from UV degradation.
5. Types
 - a. Centrifugally cast pipe shall be ASTM D3262 Type 1, Liner 2, and Surface Grade 3 meeting the following requirements: The interior

surface liner shall consist of at least 40 mils (0.040 inch) of non-reinforced thermosetting polyester (vinyl ester if called for on the Drawings or to meet chemical resistance requirements in Article entitled "Service Conditions" of this Specification) resin, and the exterior surface layer shall consist of silica sand and resin, with at least 20 mils (0.020 inch) of cover over all fiber reinforcement.

- b. Filament wound pipe shall be ASTM D3262 Type 1, Liner 1, and Surface Grade 1 meeting the following requirements: The interior surface liner shall include at least 60 mils (0.060 inch) of reinforced thermosetting polyester (vinyl ester if called for on the Drawings or to meet chemical resistance requirements specified herein) resin. The exterior surface shall be smooth and provide UV protection.

B. Cut Ends

1. Factory cut ends, and other cut or otherwise uncoated surfaces shall be sealed with multiple coats of liner resin to yield a minimum 20 mils (0.020 inch) DFT.

C. Joints

1. Unless otherwise specified, the pipe shall be field connected with fiberglass sleeve couplings with two gaskets; or integral coupling and spigot or integral bell and spigot joints with one gasket.
2. Gaskets shall be neoprene or EPDM and shall be the sole means to maintain joint water tightness.
3. The joints shall meet the requirements of ASTM D4161. Joints at tie-ins, when needed, may utilize gasket-sealed closure couplings.

D. Fittings

1. Flanges, elbows, reducers, tees, wyes, laterals and other fittings shall be capable of withstanding all operating conditions when installed. They may be contact molded or manufactured from mitered sections of pipe joined by glass-fiber-reinforced overlays.
2. If accepted by CVWD, properly protected ductile iron, fusion-bonded epoxy-coated steel or Type 316 stainless steel fittings may also be used.

E. Installation

1. Changes in pipe stiffness (and thickness) shall only take place at manholes. All pipe segments between manholes shall have the same stiffness dictated by the highest stiffness required in that pipe segment.

2.05 *Dimensions*

A. Wall Thickness

1. Wall thickness shall be measured in accordance with ASTM D3567. The minimum wall thickness at any point in the pipe wall shall not be less than 95.0 percent of the nominal wall thickness for the required stiffness, published in the manufacturer's literature current at the time of purchase. The outside diameter shall be in accordance with ASTM D3262 with the necessary wall thickness to exhibit a pipe stiffness (SN) of 46 and 72 PSI.

B. Internal Diameter

1. The minimum internal diameter shall not be less than the design nominal pipe size as called out on the Drawings, or, if not shown on the Drawings, as specified elsewhere in the Contract Documents. The internal diameter of any portion of each piece of pipe shall not vary more than plus or minus 1 percent.

- C. Pipe shall be round and straight. Out-of-roundness shall be less than 1 percent when measured per ASTM D3567. Straightness shall be within 1/8 inch when measured per ASTM D3567, except measured on the inside of the pipe.

D. Lengths

1. Pipe shall be supplied in nominal lengths of 20, 40 or 60 feet. Actual laying length shall be nominal length plus 1, minus 4 inches. At least 90 percent of the total footage of each size and class of pipe, excluding special order lengths and pipe shown to be laid on a curve in the Drawings, shall be furnished in nominal length sections.

- E. Unless shown otherwise on the Drawings or specified in the Contract Documents the Contractor shall provide pipe meeting at least the following wall thickness/pipe stiffness requirements:

Depth of Cover (feet)	Nominal Stiffness Class
0-10	SN46
10-20	SN46
20-30	SN72

Depth of Cover (feet)	Nominal Stiffness Class
30-40	SN72

- F. End Squareness: Provide pipe ends square to pipe axis in accordance with ASTM D 3262 subsection 6.2.4.

2.06 *Manhole Connections*

- A. Provide a waterstop flexible flange boot or gasket for connection to cast-in-place or precast manholes, structures, or existing manholes, in accordance with Section 33 05 15, Manholes and Precast Vaults and Section 33 39 XX, Connection to Sanitary System.
- B. Pipe connections and stubs for all structures and manhole connections shall not exceed 2-ft in length. Caps/plugs shall be furnished where required.
- C. Submit a shop drawing detailing the method of connecting the proposed pipe to the manhole for review and approval.

2.07 *Manufacturers*

- A. If otherwise meeting the requirements of this Specification section, the manufacturer and pipe shall be one of the following, or approved equal:
1. Centrifugally cast pipe by HOBAS Pipe USA
 2. Filament wound pipe by Thompson Pipe Group – Flowtite

2.08 *Identification and Locator Tape*

- A. Identification and locator tape materials shall be as required by the Contract Documents.

Part 3 - Execution

3.01 *General*

- A. Trench excavation, bracing methods, foundation preparation, pipe bedding, trench backfill, and related operations shall be in accordance with the requirements of Section 31 21 17, Trenching, Excavation, Backfill, and Compaction and the installation instructions of the pipe manufacturer.
- B. The sewer shall be constructed to the alignment and grade shown on the Drawings. The grade line shown on the profile is the invert or interior bottom of the pipe. The excavation shall be made a sufficient distance below the grade line to allow for the placing of the sewer pipe and the supporting

bedding if such bedding is shown on the Drawings. Should the trench be excavated to a depth greater than required, the Contractor shall refill such excess excavation with the same fill material as specified for the overlying fill or bedding and compacted as required for such overlying fill or bedding.

- C. Sewer pipelines shall never be used as drains for removing water that has infiltrated into the trenches.

3.02 *Manufacturer's Testing and Examination*

A. Pipes

- 1. Pipes shall be manufactured and tested in accordance with ASTM D3262.

B. Joints

- 1. Joints and gaskets shall meet the requirements of ASTM D4161.

C. Stiffness

- 1. Minimum pipe stiffness when tested in accordance with ASTM D2412 shall be at least 46 psi with design calculations performed to verify pipe stiffness, based on five (5) percent long-term deflection per ASTM D3262.

D. Strain Corrosion

- 1. Pipe shall meet or exceed the 50-year strain corrosion requirements of ASTM D3262, Table 4, when tested in accordance with ASTM D3681 using pH 1 sulfuric acid.

E. Long Term Deflection

- 1. Maximum allowable long-term pipe ring deflection, as determined per ASTM D3262, shall be five (5) percent of the initial diameter.

F. Additional Chemical Resistance and Physical Testing

- 1. Shall meet the requirements of SSPWC Subsection 207-20.5.

3.03 *Factory Witnessed Testing*

- A. Contractor shall notify CVWD of start date and location of pipe manufacture at least 30 days prior to commencing pipe production. Should CVWD elect to witness the manufacture of specific pipes during any phase of the manufacturing process, the manufacturer shall provide CVWD with at least a 30-day advance notice of when and where the production of those pipes will take place.

- B. Factory Test Data: Signed, dated, and certified third-party factory test data for each pipe segment shall be submitted before shipment of materials. No materials shall be shipped until the test data have been accepted by CVWD.

3.04 *Installation*

A. Burial

1. Unless otherwise shown on the Drawings, the bedding and burial of pipe and fittings shall be in accordance with the Contract Documents, the manufacturer's requirements, SSPWC 306, ASTM D3839, and Section 31 21 17, Trenching, Excavation, Backfill, and Compaction.

- B. Pipe shall be installed by factory lot, with pieces placed in a sequential order as much as possible.

- C. Pipe Handling: Use textile slings, other suitable and approved materials and equipment, or a forklift. Use of chains or cables shall not be acceptable.

D. Jointing:

1. Clean ends of pipe and coupling components.
2. Apply joint lubricant to pipe ends and elastomeric seals of coupling. Use only lubricants approved by the pipe manufacturer.
3. Use suitable equipment and end protection, acceptable to CVWD, to push or pull the pipes together.
4. Do not exceed forces recommended by the manufacturer for coupling pipe.
5. Join pipes in straight alignment and then deflect to required angle. Do not allow the deflection angle to exceed 75 percent of the maximum deflection permitted by the manufacturer, or the requirements of SSPWC 207-20, whichever is less.
6. Where double-mitered pipe joint sections are used to angle the pipe alignment, the section shall be completely factory-manufactured and not constructed in the field.
7. Where the pipe cross-section is exposed to flow, for example at cuts and uncoated pipe ends, Contractor shall radius sharp edges and seal with multiple coats of approved inner liner resin to yield a minimum 20 mils (0.020 inch) dry film thickness.

3.05 *Services of the Manufacturer's Representative*

- A. The manufacturer shall supply a qualified field service representative to be present, at a minimum, for the entire duration of the first three (3) days of pipe installation. If no length of pipe is installed on a given day, that day will not be counted towards the three (3) required days of service. Additional service will be required at no cost to CVWD if, in the opinion of CVWD, there is any evidence of improper installation by the Contractor.

3.06 *Haunching*

- A. Once the pipe is joined together, pipe bedding material shall be placed in the haunching per the trench details shown on the Drawings and Section 31 23 17, Trenching, Excavation, Backfill, and Compaction. The haunching area extends from the bottom of the pipe to the springline of the pipe. Bedding shall be as shown on the Drawings.

3.07 *Identification and Locator Tape*

- A. Identification and locator tape shall be placed as required by the Contract Documents.

3.08 *Sewer Laterals*

- A. Sewer laterals shall be installed in accordance with Section 33 39 XX, House Laterals.

3.09 *Connections To Manholes*

- A. Pipelines shall be connected to manholes as indicated on the Drawings and Section 33 39 XX, Connection to Sanitary System. Each connection shall be made at a time and in a manner that will result in the least interruption of service.
- B. Pipe connections to new or existing manholes shall be done in the presence of CVWD's Representative, including all necessary concrete work, coring, and shaping of channel.
- D. Sanitary sewer connections to existing manholes shall be core-drilled and made using a flexible rubber seal/waterstop.
- E. Existing flow shall be maintained through a bypass. A bypass plan shall be submitted and the Contractor shall be solely responsible for maintaining the bypass and shall be liable for any fines levied by any agency as a result of any spill or overflow.

3.10 *Connections To Existing Pipe*

- A. The Contractor shall provide fittings or adapters required to connect new pipe to existing pipe. Detail drawings of such fittings or adapters and the method of connection shall be submitted by the Contractor to CVWD for approval.
- B. Pipelines shall be connected to existing mains as indicated on the Drawings and Section 33 39 XX, Connection to Sanitary System. Each connection shall be made at a time and in a manner that will result in the least interruption of service.
- C. Lateral connections to FRP mains shall be made using a CVWD approved saddle tee or saddle wye in accordance with Section 33 39 XX, House Laterals.

3.11 *Sewage Bypass*

- A. The Contractor shall prepare a bypass plan and control the flow in accordance with Section 31 23 19.10, Sewer Bypass System and as required by the Contract Documents. A sewage bypass plan shall be submitted to CVWD for approval prior to construction. The Contractor shall at all times, be responsible for the operations of this bypass system, including furnishing all the necessary equipment and making arrangements to obtain power as required. The Contractor shall not be permitted to trench public or private streets for bypass purposes without the approval of the entity (State, County, City, etc.) having jurisdiction.

3.12 *Shoring Removal*

- A. Any bedding, pipe zone or backfill voids created by moving or removing shoring shall be left in place or filled per the per the trench details shown on the Drawings and Section 31 23 17, Trenching, Excavation, Backfill, and Compaction.

3.13 *Testing and Acceptance*

A. General

- 1. It is the intent of the Contract Documents that the completed sewer pipe of all types, along with manholes and other appurtenances, shall be watertight.
- 2. Unless otherwise indicated on the Drawings, air testing, infiltration testing, deflection testing, sag measurements, and video inspection shall be performed in accordance with Section 33 01 30.13, Sanitary Sewer System Testing and this specification section.

3. The Contractor shall furnish all labor and materials for making the tests required at no additional cost to CVWD. All tests shall be completed before the street and/or trench is resurfaced, unless otherwise directed by CVWD.
4. Tests shall be made in the presence of CVWD's Representative.

B. Low Pressure Air Joint Test

1. Each joint shall be tested with air pressure (max four (4) psi) in accordance with Section 33 01 30.13, Sanitary Sewer System Testing. The system passes the test if the pressure drop due to leakage through the pipe or pipe joints is less than or equal to the one (1) psi over sixty (60) seconds.

C. Infiltration Test

1. Infiltration test shall be in accordance with in accordance with Section 33 01 30.13, Sanitary Sewer System Testing.
2. If, in the opinion of CVWD, excessive groundwater is encountered during construction of a section of sewer, the air pressure test for leakage shall not be used. An infiltration test shall be performed instead

D. Sag Measurement

1. Sags shall be measured in accordance with Section 33 01 30.13, Sanitary Sewer System Testing.
2. Sags, or standing water in pipe, shall meet the following criteria:

Complies with Specification	Unacceptable: Replace Pipe
Sag: 1/2" or less	Sag: greater than 1/2"

E. Deflection Test

1. Deflection test shall be in accordance with Section 33 01 30.13, Sanitary Sewer System Testing.
2. Ring deflection shall meet the requirements specified in the table below. Percent deflection is defined as measured deflection divided by nominal diameter.

Nominal Diameter		Maximum Deflection
From:	To:	
12 inch	30 inch	3.0 percent
31 inch	60 inch	2.5 percent
61 inch	90 inch	2.0 percent
91 inch	120 inch	1.5 percent

F. Acceptance

1. Even though a section of sewer may have previously passed the leakage or infiltration test, each section of pipe shall be tested subsequent to the last backfill compacting operation thereon. If, in the opinion of CVWD, heavy compaction equipment or any of the operations of the Contractor may have affected the required watertight integrity of the pipe, structure, or appurtenances, additional leak testing shall be required.
2. If the pressure drop, leakage and/or infiltration rate, sag, or deflection measurements are greater than specified herein or in the Section 33 01 30.13, Sanitary Sewer System Testing, the sewer shall be repaired, or, if necessary, the pipe shall be removed and re-laid at no additional cost to CVWD.
3. The sewer will not be considered acceptable until the pressure drop, leakage and/or infiltration rate, as determined by the appropriate test, meets the allowable limit. Even when infiltration is less than the specified amount, the Contractor shall stop any observed individual leaks when detected by the Contractor and/or ordered to do so by CVWD.
4. For pipe not meeting the sag requirements:
 - a. If the sag exceeds the allowable value, then work will not be accepted and payment won't be released until the installation is corrected to satisfy the minimum sag required in this specification.
 - b. Due to unacceptably high operation and maintenance costs and poor system reliability, pipelines with sag depths exceeding allowed amount will be rejected. Replacement of pipe includes all construction costs including, but not limited to, sewer bypassing, excavation, pipe installation, backfilling, resurfacing, tunneling, etc., for the length of pipe that exceeds the sag amount specified, plus 20 linear feet of pipe in each direction.

Damaged pipe shall be removed and disposed of in a legal manner, and new pipe shall be installed and retested at no additional cost to CVWD.

5. For pipe not meeting the deflection test requirements:
 - a. Contractor shall make the necessary repairs or replacements at the Contractor's expense by a method acceptable to CVWD's Representative at no additional cost to CVWD.
 - b. Pipe shall be subject to an additional 30-day deflection test at no additional cost to CVWD.

END OF SECTION 33 31 XX

SECTION 33 34 11

PVC SEWER FORCE MAIN

PART 1 – General

1.01 *Description*

- A. This section includes materials, installation, and testing of polyvinyl chloride (PVC) pipe for 4-inch through 36-inch diameter sewer force mains, in accordance with the applicable provisions of AWWA C900.
- B. Contractor shall furnish all pipe, fittings, materials, equipment, and labor and perform all operations necessary to construct pipelines and appurtenances as shown on the Drawings.
- C. Contractor shall, upon completion and successful testing of pipeline and appurtenances required herein, be available during the initial operating period to make any additional adjustments, corrections, repairs, replacements, and reconstructions necessary to provide CVWD with complete and properly operating pipelines and appurtenances.

1.02 *Related Work Specified Elsewhere*

- A. The requirements of the following sections and divisions apply to the Work of this section. Other sections and divisions of the Specifications, not referenced below, shall also apply to the extent required for proper performance of this Work.
 - 1. Section 10 10 10, Utility Marker Post
 - 2. Section 31 23 17, Trenching, Excavation, Backfill and Compaction
 - 3. Section 31 23 19, Dewatering
 - 4. Section 33 01 30.13, Sanitary Sewer System Testing
 - 5. Section 33 11 13.10, Ductile Iron Pipe
 - 6. Section 33 11 00, Basic Pipeline Specifications
 - 7. Section 33 11 13, Piping Systems and Appurtenances
 - 8. Section 40 05 78.23, Sewer Air Valve Assemblies

1.03 *Reference Specifications, Codes, and Standards*

A. All Work specified herein shall conform to or exceed the applicable requirements of the referenced portions of the following publications to the extent that the provisions thereof are not in conflict with other provisions of these Specifications.

B. Comply with the applicable editions of the following codes, regulations and standards.

1. CVWD Detail Drawings for the Construction of Sanitary Sewer Systems

2. Industrial Standards:

AWWA C104	Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water
AWWA C105	Polyethylene Encasement for Ductile-Iron Pipe Systems
AWWA C110	Ductile-Iron and Gray-Iron Fittings 3-in Through 48-in for Water and Other Liquids
AWWA C111	Rubber-Gasket Joints for Ductile-Iron and Gray-Iron Pressure Pipe and Fittings
AWWA C116	Protective Fusion-Bonded Epoxy Coatings for the Interior and Exterior Surfaces of Ductile-Iron and Gray-Iron Fittings
AWWA C600	Installation of Ductile-Iron Water Mains and Appurtenances
AWWA C605	Underground Installation of Polyvinyl Chloride (PVC) and Molecularly Oriented Polyvinyl Chloride (PVCO) Pressure Pipe and Fittings
AWWA C900	Polyvinyl Chloride (PVC) Pressure Pipe 4-in Through 12-in for Water Distribution
AWWA C905	Polyvinyl Chloride (PVC) Water Transmission Pipe, Nominal Diameters 14-inch through 36-inch
AWWA C907	Injection-Molded Polyvinyl Chloride (PVC) Pressure Fittings, 4 In. Through 12 In. (100 mm Through 300 mm), for Water, Wastewater, and Reclaimed Water Service

ASTM D1784	Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds
ASTM F477	Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe
ASTM D2241	Standard Specification for Poly (Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series)
ASTM D2584	Test Method for Ignition Loss of Cured Reinforced Resins
ASTM D3139	Standard Specification for Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals
PPI Technical Report TR 3/4	Policies and Procedures for Developing Recommended Hydrostatic Design Stresses for Thermoplastic Pipe Materials
SSPWC	“Green Book”, Standard Specifications for Public Works Construction

AWWA Manual M23 PVC Pipe - Design and Installation

ISO 9001

Quality Management Systems – Requirements

- C. Comply with the applicable reference Specifications as directed in the General Conditions, other applicable parts of the Contract Documents, and specified herein.

1.04 Submittals

- A. Complete fabrication, assembly, and installation drawings, together with details and data governing materials used and other accessories furnished, shall be submitted for approval in accordance with General Conditions, other applicable parts of the Contract Documents, and as specified herein. Data shall include, but not be limited to, the following items.

1. Polyvinyl Chloride Pipe

- a. Contractor shall furnish an Affidavit of Compliance in accordance with Section 6.3, AWWA C900 and/or C905 (latest). Contractor shall also furnish certified copies of test reports containing results of all physical and

chemical tests on pipe and coupling showing compliance with AWWA C900 and AWWA C905 (latest) as modified herein.

- b. Unless specified otherwise, Contractor shall prepare detailed installation or laying drawings showing pipe, fittings, appurtenances, station and elevation for each fitting, and each approved change in alignment or slope. Contractor shall submit the detailed installation or laying drawings to CVWD for approval in sufficient time to allow review and approval, and to accommodate the Contractor's construction schedule.

- 2. Detailed drawings and procedures for connections to existing lines.
- 3. Manufacturer's literature on ductile iron fittings conforming to AWWA C110, C111, and C115 including dimensions, thickness, weight, coating, lining, and a statement of inspection and compliance with the acceptance tests of AWWA C110.
- 4. Manufacture's catalog data and descriptive literature for Electronic Marker System (EMS), tracer wire, marking tape, and utility marker posts.
- 5. Field Test Reports
 - a. Hydrostatic testing

- B. Revisions shown on the shop drawings shall be considered changes necessary to meet the requirements of these Specifications and shall not be taken as the basis of claims for extra charges.

1.05 *Quality Assurance*

- A. Inspection and Testing: All PVC materials, pipe and fittings shall be inspected and tested in accordance with the requirements of AWWA C900, C905, and C605.
- B. Pipe shall be installed within 90 days from the date of manufacture.
- C. Affidavit of Compliance: The manufacturer shall furnish an affidavit of compliance affirming that the piping components comply with the requirements of AWWA C900 and C905 and this Section. The affidavit shall be signed under penalty of perjury by an officer of the pipe manufacturer's company.
- D. The pipe manufacturer shall have manufacturing and quality control facilities that are capable of producing and assuring the quality of the pipe and fittings required by these Specifications. The Manufacturer's production facilities shall be open for inspection by the Customer or his Authorized Representative. The pipe and fitting manufacturer shall be ISO Certified in accordance with the current edition of ISO 9001 and a documented quality management system that defines product

specifications and manufacturing and quality assurance procedures that assure conformance with customer and applicable regulatory requirements. Upon request, the manufacturer shall provide a current Certificate of Compliance form and independent ISO 9000 Registrar.

1.06 *Warranty*

- A. Guarantees shall be furnished in accordance with Contractor's Guarantee of the General Conditions, other applicable parts of the Contract Documents, and as specified herein.

1.07 *Delivery, Handling, and Storage*

- A. Delivery, storage, and handling of pipe shall be per the pipe manufacturer's recommendations and AWWA C605.
- C. Pipe shall be stored at the jobsite in unit packages provided by the manufacturer.
- D. If, at any time since manufacture, the pipe has been exposed to direct sunlight for more than three (3) months cumulative, the pipe shall be shaded thereafter with an opaque material. Such provisions for shading shall permit ambient air circulation above and around the pipe while blocking all direct sunlight.
- E. Limit stacking of pipe to a height that will not cause significant deformation of bottom layers of pipes under foreseeable temperature conditions. Significant deformation is defined as more than two (2) percent of the nominal diameter.
- F. When stored outdoors, store pipe on wooden dunnage, spaced and of such widths as not to allow significant deformation of pipe under the point of contact with dunnage or elsewhere.
- G. If pipe is strung along trench prior to installation, string only pipe to be used within a twenty-four (24) hour period; all pipe is to be laid on a flat surface. The interior as well as sealing surfaces of pipe, fittings, and other accessories shall be kept free from dirt and foreign matter.

PART 2 – Products

2.01 *General*

- A. Construction Materials:
 - 1. Contractor shall furnish only approved materials as listed in CVWD's approved materials list. All materials shall be new and of the best quality for their intended use. All like materials shall be of one manufacturer for any particular project.

2. Contractor shall, in addition to furnishing other data herein required, submit three signed and dated copies of the list of materials to be used in pipeline construction.

2.02 *Polyvinyl Chloride Pipe*

A. General

1. PVC pipe shall be manufactured in accordance with AWWA C900, and shall be of the sizes and pressure classes shown on the Drawings. The dimension ratio (DR) for C900 PVC pressure pipe shall be DR-14 or thicker walled (lower DR). The pipe shall have gasketed bell end or plain end with elastomeric gasketed coupling.

B. Material

1. Material used to produce the pipe and couplings shall be made from Class 12454-A or B virgin compounds as defined in ASTM D1785, with an established hydrostatic design basis rating of 4,000 psi for water at 73.4°F (23°C).

C. Pipe Lengths

1. Laying lengths shall be 20 feet with the manufacturer's option to supply up to 15% random lengths (minimum length 10 feet).

D. Pipe Marking

1. Each pipe length shall be marked showing the date of manufacture, nominal pipe size and O.D. base, the AWWA DR, and the AWWA specification designation (AWWA C900). For potable water application, the seal of the testing agency that verified the suitability of the material for such service shall be included.

E. Manufacturers

1. All pipe furnished shall be manufactured by an organization which has had not less than ten (10) years successful experience in the manufacture of the type of pipe specified.
2. PVC pressure pipe shall be the product of one of the following manufacturers or equal.
 - a. CertainTeed Corporation, Diamond Plastics Corporation, Ipex, Inc., North American, or Vinyltech Corporation.

C. Joints

1. As indicated, all joints for the pipe shall be either an integral bell manufactured on the pipe or a restrained joint employing a harness, coupling, or gland type restraint. The bell and coupling shall be the same thickness as the pipe barrel, or greater thickness. The sealing ring groove in the coupling shall be of the same design as the groove in cast iron fittings and valves available from local water works supply distributors.

D. Joint Deflection

1. Deflection at the joint shall not exceed 1.5 degrees or one-half the maximum deflection recommended by the manufacturer, whichever is less. No deflection of the joint shall be allowed for joints which are over-belled or not belled to the stop mark.

C. Pipe and Couplings

1. General: All pipe and couplings furnished shall conform to AWWA C900 and C905 (latest) and the following additional requirements specified herein.
2. Unless otherwise specified or shown on the Drawings, AWWA C900 pipe and couplings shall be minimum Class 235 (4-inch through 12-inch diameter) (maximum dimension ratio of 18). Polyvinyl chloride pipe shall have the same outer dimensions as ductile iron pipe and pipe bell and pipe spigot shall have same thickness as pipe barrel.

Standard lengths of pipe shall have nominal length of 20 feet, 0 inches, plus or minus 1-inch. Standard lengths of pipe shall be furnished with integral bells and spigots and with rubber gaskets. Couplings may be used for closures and curved alignments where permitted by CVWD.

Pipe shall have sufficient strength to withstand an internal hydrostatic pressure of four (4) times rated operating pressure for its class per AWWA C900 (latest).

3. Unless otherwise specified or shown on the Drawings, AWWA C905 pipe and couplings (14-inch through 36-inch diameter) shall have a maximum dimension ratio of 18 (Class 235). Polyvinyl chloride pipe shall have the same outer dimensions as ductile iron pipe and pipe bell and pipe spigot shall have same thickness as the pipe barrel.

Standard lengths of pipe shall have a nominal length of 20 feet, 0 inches, plus or minus 1-inch. Standard lengths of pipe shall be furnished with integral bells and spigots and with rubber gaskets. Couplings may be used for closures and curved alignments where permitted by CVWD.

Pipe shall have sufficient strength to withstand an internal hydrostatic pressure of two times the rated operating pressure for its class per AWWA C905 (latest).

4. Where restrained joints are required (specified or shown on the Drawings), the restraint system shall be a split ring installed on the spigot connected to a solid back-up ring seated behind the bell. The solid back and split rings shall apply even pressure around the pipe and provide 360 degrees contact. Restraint device shall be ductile iron with 316 stainless steel rods and nuts. Restraint device shall be rated for full working pressure of the pipe with a 2:1 factor of safety.
 - a. Restraint system shall be one of the following or equal:
 - (1) Series 1350 Uni-Flange
 - (2) Star Pipe Products Series 1100
 - (3) EBBA Iron Megalug

2.03 *Fittings*

A. Materials

1. All fittings shall be Class 150 ductile iron in accordance with Section 33 31 13.13, Ductile Iron Sewer Pipe unless otherwise specified or shown on the Drawings.
2. Exposed or aboveground fittings shall be flanged and buried fittings shall be push-on joint or mechanical joint unless otherwise specified or shown on the Drawings.
3. All ductile iron fittings shall be lined and coated in accordance with Section 33 31 13.13, Ductile Iron Sewer Pipe.

B. Bell Sizes

2. Bell size shall be for Class 235 (DR 18) and Class 305 (DR 14) iron pipe-size equivalent PVC pipe, including the rubber-ring retaining groove.

C. Where restrained joints are required (specified or shown on the Drawings), the system shall be suitable for mechanical joint fittings or push-on fittings and be of split ring design providing even pressure around the pipe with 360 degrees contact. The rings shall be ductile iron and threaded rods shall be 316 stainless steel.

1. Restraint system shall be one of the following or equal:
 - a. Uni-Flange Series 1300

2.04 *Rubber Rings*

- A. Rubber rings for use in couplings and fittings shall conform to the requirements of ASTM F477. Rubber rings shall be stored out of direct sun light, clearly labeled with the material type, and protected in a manner to prevent deterioration.

2.05 Service Saddles

- A. Service saddles for 1-inch and 2-inch diameter outlets shall be designed for use on C900 PVC pipe and shall conform to the requirements shown on the Drawings.
- B. The allowable upper pipeline diameter limit for use of service saddles shall be pipe nominally sized 12-inches in diameter.
- C. For outlets of larger than 2-inch diameter and for all outlets on larger diameter pipelines, ductile iron tees with flanged outlets shall be used.

2.06 Protective Coatings

A. General

CVWD shall approve coating materials and methods prior to application.

- 2. Factory hydrostatic testing of the fitting shall pass all tests prior to interior coating and lining applications.
- 3. The exterior surfaces of ductile iron fittings that will be located in underground vaults, exposed to the atmosphere, inside structures, above ground, or submerged shall be thoroughly cleaned, and given the appropriate protective coating Painting and Coating in accordance with Section 33 31 13.13, Ductile Iron Sewer Pipe.

B. Buried Fittings

- 1. Ductile iron fittings shall be lined and coated in accordance with Section 33 31 13.13, Ductile Iron Sewer Pipe.

C. Fittings Located in Vaults

- 1. Ductile iron fittings shall be lined in accordance with Section 33 31 13.13, Ductile Iron Sewer Pipe.
- 2. Unless otherwise required by the Contract Documents, ductile iron fittings shall be coated in accordance with Service Condition A defined in Section 09 90 00.10, Sewer Painting and Coating.

D. Exposed PVC Pipe and Fittings

1. Unless otherwise required by the Contract Documents, exposed PVC pipe shall be coated in accordance with Service Condition O defined Section 09 90 00.10, Sewer Painting and Coating.

E. Exposed Ductile Iron Fittings

1. Unless otherwise required by the Contract Documents, exposed ductile iron fittings shall be coated accordance with Service Condition A defined in Section 09 90 00.10, Sewer Painting and Coating.

2.07 *Polyethylene Encasement*

- A. All metal surfaces, ductile-iron pipe fittings, and buried valves shall be polyethylene encased at the time of installation in accordance with ANSI/AWWA C105 per Section 33 11 13, Piping Systems and Appurtenances.

2.08 *Factory Testing*

- A. All pipe and couplings furnished shall be tested in the United States in accordance with AWWA C900 and AWWA C905.
- B. Manufacturing Inspection and Certification:
 1. CVWD shall at all times have the right to inspect all work and materials in the course of manufacture at no additional cost.
 2. Manufacturer shall furnish CVWD reasonable facility for obtaining such information as CVWD may desire regarding the progress and manner of the work and the character and quality of materials used.
 3. Notify CVWD of date and location of pipe manufacture at least thirty (30) days prior to commencing pipe production. Should CVWD elect to witness the manufacture of specific pipes during any phase of the manufacturing process, the manufacturer shall provide CVWD with at least a 30-day advance notice of when and where the production of those pipes will take place. If CVWD elects to witness pipe production or testing, provide CVWD with the following at the factory:
 - a. A work desk including telephone and computer with internet access near the manufacturing line;
 - b. Free access to the manufacturing line to witness production, and the testing facilities to witness testing;
 - c. Free access to witness manufacturing controls and instrumentation;
 - d. Free access to and testing of tools and instrumentation;

- e. A work desk or area with cellular and internet access;
 - f. Access to take random samples for testing by an independent testing laboratory.
4. At CVWD's request, provide certified laboratory data to verify the physical properties of the pipe witnessed.

2.09 *Tracer Wire*

- A. Tracer wire material shall be as specified by the Contract Documents.

2.10 *Identification and Locator Tape*

- A. Identification and locator tape shall be as required by the Contract Documents.

2.11 *Electronic Marking*

- A. All PVC force mains shall utilize an Electronic Marker System (EMS). Mid-range pipe locator markers manufactured by 3M Electrical Products Division, Scotchmark Market Locator (EMS) Model No. 1258, or approved equal.

PART 3 – Execution

3.01 *General*

- A. PVC pipe shall be installed in conformance with Section 31 23 17, Trenching, Excavation, Backfill and Compaction, manufacturer's recommendations, AWWA M23, instructions, ASTM D 2321, SSPWC Section 306 and Supplement Amendments, to the supplementary requirements or modifications specified herein, and shall comply with the alignment and profile indicated on the Drawings. Wherever the requirements of this Section and the aforementioned requirements are in conflict, the more stringent provision shall apply.

3.02 *Loading, Transporting, and Unloading*

- A. After the pipe has been tested in accordance with AWWA Standards, it shall be loaded on rubber-tired vehicles, adequately supported and chocked to prevent any damage during transportation, and delivered to the job site.
- B. All pipe and couplings (AWWA C900 and C905) shall be unloaded and stored in accordance with AWWA manual M23 (latest). During the unloading and stringing operations, the pipe shall be moved in such a manner as to prevent injury to the pipe and/or couplings. Unloading shall be accomplished in a workmanlike manner as directed by the manufacturer. Under no circumstances are pipe sections to be dropped or bumped in handling.

- C. Ship, store, and place pipe at the storage yard or installation site by supporting the pipe uniformly. Avoid scratching the pipe surface. Do not stack higher than four (4) feet nor stack with weight on bells. Cover to protect from sunlight while permitting adequate air circulation above and around the pipe. Gaskets should be stored in a cool, dark place out of the direct rays of the sun, preferably in original cartons. Do not install pipe that is gouged or scratched forming a clear depression. Do not install pipe contaminated with a petroleum product (inside or outside). Do not install any pipe that shows evidence of exposure to sunlight, age, surface deterioration, or other physical damage. The decision of CVWD shall be final as to the acceptability of the pipe to be installed.

3.03 *Defective or Damaged Material*

- A. The pipe and couplings shall be carefully inspected for defects. Any pipe, coupling, sleeve, or rubber ring found to be defective in workmanship or material or so damaged as to make repair and use impossible shall be rejected and removed from the job site.
- B. In the event that pipe is damaged, the damaged portion may be removed, as approved by CVWD, and discarded. Remaining sound portions may be used with ductile iron fittings or with couplings. Contractor shall be responsible for any and all damage to material and shall stand expense of repairing or replacing same. Contractor shall take proper precautions to assure that the rubber gaskets are protected from oxidation or undue deterioration.

3.04 *Storage of Equipment and Materials*

- A. Contractor shall not store equipment or materials on private or public property without written permission from property and CVWD(s) approving such use. Said permission shall be submitted to and approved by CVWD before Contractor moves equipment or materials onto the Site.
- B. Contractor shall not park equipment or store materials in the public right-of-way except while performing Work. Contractor shall remove equipment from public right-of-way and place it in Contractor's storage or construction yard by the end of each work day. Contractor shall keep materials in Contractor's storage or construction yard until they are needed for the Work.
- C. Storage site or construction yard shall be completely fenced prior to moving any equipment or materials onto the site or into the yard. Contractor shall control dust in construction yard at all times, from establishing construction yard through construction, and until all Work has been completed and Contractor has moved all equipment, materials, and fencing from the site.

3.05 *Pipeline Construction*

A. Pipelines and Appurtenances

1. Pipelines and appurtenances shall be constructed in accordance with these Specifications and the Construction Drawings, and as specified by CVWD.
2. At all times when pipe laying is not in progress, the open end of the pipe shall be closed with a tightfitting cap or plug to prevent the entrance of foreign matter into the pipe. These provisions shall apply during the noon hour as well as overnight. In no event shall the pipeline be used as a drain for removing water which has infiltrated into the trench. The Contractor shall maintain the inside of the pipe free from foreign materials and in a clean and sanitary condition until its acceptance by CVWD.

B. Valves and Appurtenances

1. Pipeline valves at pipeline intersections shall be connected directly to pipeline intersection fittings (cross or tee) and, unless specified otherwise, all mainline or side outlet valves shall be located 3 feet minimum from any curb face. Pipeline valves shall not be placed under the curb or gutter or in a parkway unless approved by CVWD.
2. All appurtenances, including but not limited to air valve installations, blow-off installations, and related facilities, such as fire hydrants, fire services, and water services, shall not be installed within five (5) feet of curb returns, curb depressions, and driveway approaches, or in inaccessible locations or locations where interferences may restrict facility operation, unless permitted otherwise by CVWD.
3. Unless specified otherwise, air valve installations shall be constructed at all pipeline high spots and blow-off installations shall be constructed at all pipeline low spots. Contractor shall construct, at Contractor's expense, air valve installations and blow-off installations in addition to those specified, if necessary, to accommodate Contractor's work and schedule.

C. Pipeline Length

1. All pipeline lengths noted by the Construction Drawings or otherwise specified or referenced shall mean net horizontal constructed lengths and said lengths shall extend through all fittings and appurtenances including bends, outlets, tees, flanges, and valves. Contractor shall provide all pipe necessary to accommodate any vertical alignment of the pipeline and said pipe shall be represented by the net horizontal constructed length.

D. Pipeline Alignment

1. All pipelines shall be constructed with no basic variation in horizontal alignment as shown by the Drawings or as specified by CVWD. Pipelines shall be constructed parallel with centerlines of streets or rights-of-way and appurtenances shall be constructed perpendicular thereto unless the construction drawings specify otherwise. Pipelines may be constructed by the use of pulled joints, short joints, bevels, bends, and elbows, provided pipelines are constructed as specified.
2. In all non-critical areas and subject to CVWD's approval, pipelines may be constructed at variance with vertical alignment as shown by the Drawings by the use of pulled joints, short joints, bevels, bends, and elbows provided pipelines are constructed as specified at pipeline connections and underground interferences, and where pipeline cover is limited. CVWD will not approve any variation in vertical alignment until it has determined that proposed alignment is proper and modifications are in order.

E. Pipeline Tolerances

1. With regard to vertical alignment, pipelines shall be constructed so that actual flow line elevations, measured at pipe joints, are within 0.1 foot of design flow line elevations. Pipelines, when installed, shall have continuous slope upgrade or downgrade, corresponding with design slope, without any high spots.
2. With regard to horizontal alignment, pipelines shall be constructed so that actual pipeline centerlines, measured at pipe joints, are within 0.1 foot of design pipeline centerlines. Pipelines, when installed, shall closely follow specified horizontal alignment.
3. Pipeline construction shall conform to Construction Drawings and layout, shop, fabrication, installation, or laying drawings (design drawings which show flow line elevations and pipeline centerlines) in accordance with the above specified tolerances. Contractor shall make or assist CVWD in making all necessary measurements, as determined by CVWD, to confirm or verify compliance with construction tolerances.

F. Pipeline Cover

1. Pipeline cover as shown by the Drawings is hereby defined as design cover over pipeline. If field conditions determined during construction staking show that pipe grade changes are required to provide design cover, Contractor shall, at Contractor's expense, make required changes in pipeline grade and construct pipeline accordingly based on the revised Drawings.
2. Pipeline cover from top of pipe to ground surface over pipeline shall not be less than 48-inches to maximum of 12-feet. Where future ground surface elevation

over the pipeline has been established and where actual ground surface is greater, pipeline cover shall be referenced to future (established) ground surface elevation, not actual ground surface elevation.

G. Pipeline air valves and low points

1. Where required, Wastewater air valve assemblies shall be furnished and installed in accordance with Section 40 05 78.23, Sewer Air Valve Assemblies.
2. Where shown on the Drawings, at major low-points a manually controlled drain valve shall be installed in a manhole to allow for cleaning or draining.

3.06 *Traffic Control*

- A. The Contractor is responsible for traffic control and it shall include all material, labor and equipment to provide safe and effective work areas to warn, control, protect and expedite vehicular, bicycle and pedestrian traffic. Unless otherwise required by the Contract Documents, all work and material provided under this section shall be performed or furnished in accordance with SSPWC Part 6 Temporary Traffic Control and the entity (City, County, State, etc.) having jurisdiction. Traffic control shall also be in accordance with Section 33 11 00, Basic Pipeline Specifications.

3.07 *PVC Pipe Installation*

- A. Pipe manufacturer, fitting manufacturer, and material supplier, in addition to CVWD and CVWD's representative, shall have access to the Work during installation. Contractor shall use assistance provided by either the manufacturer or supplier where required for proper installation of pipe, fittings, or materials; however, Contractor shall limit the role of either manufacturer or supplier to advisory service.
- B. All pipe shall be laid true to line and grade and at the locations as shown by the Drawings or as specified. Pipe shall be installed in accordance with AWWA C605 and Manual M23 (latest) (including AWWA C905 pipe and couplings), applicable provisions of the manufacturer's installation guides (latest) and manufacturer's directions. CVWD shall approve manufacturer's product before its use. Contractor shall furnish CVWD with two manufacturer's installation guides for use during construction. Bell ends shall be placed uphill unless otherwise specified.
- C. Contractor shall install pipe in accordance with the trench details shown on the Drawings.
- D. Inspect each pipe and fitting before lowering into the trench. Clean ends of pipe thoroughly. Remove foreign matter and dirt from inside of pipe and keep clean during and after laying.

- E. Handle pipe in a manner to avoid any damage to the pipe. Lift pipes with mechanical equipment using wide belt slings. Do not use cable slings or chains. Do not drag pipe over the ground, drop it onto the ground, or drop objects on it. Do not drop or allow pipe to fall into trenches.
- F. After the pipe has been set in trench, exterior of spigot and interior of bell shall be thoroughly cleaned. Lubricant recommended by pipe manufacturer and as approved by CVWD shall be applied to rubber gasket. Lubricant shall be water soluble, nontoxic, shall impart no objectionable taste or odor to the water, shall have no deteriorating effects on the rubber gaskets, and shall not support growth of bacteria. Excess lubricant shall be removed. Pipe ends shall be aligned, and spigot shall be pulled into bell with come-along devices, or hoists with chains and slings, unless permitted otherwise. If either the pry bar or the backhoe bucket method is permitted, a timber header shall be placed between the pipe and the pry bar or backhoe bucket before the spigot is pushed into the bell.
- G. Curved alignment of AWWA C900 pipe shall be accomplished by longitudinal bending of the pipe. Minimum allowable bend radii shall be as specified by the pipe manufacturer. Unless otherwise allowed by the pipe manufacturer and approved by CVWD, axial deflection at the pipe joints of AWWA C900 pipe is prohibited. Where closing sections are required, Contractor shall make all necessary measurements to select appropriate pipe lengths and closure couplings for correct installation.
- H. Curved alignment of AWWA C905 pipe by use of longitudinal bending is prohibited; however, curved alignment by use of pulled joints will be permitted. Unless otherwise allowed by the pipe manufacturer and approved by CVWD, maximum joint deflection shall be one (1) degree. For purposes of reducing angular deflections at pipe joints and for closure sections, Contractor may install pipe sections of less than standard length. Where closing sections are required, Contractor shall make all necessary measurements to select appropriate pipe lengths and closure couplings for correct installation.
- I. At the location of each joint, dig bell holes in the bottom of the trench and at the sides to permit visual inspection of the entire joint and to prevent the pipe from being supported by the bell end or fitting.
- J. Whenever cutting of pipe is required, it shall be done with a special cutting tool specifically made for cutting and machining PVC pipe. Cut ends and rough edges shall be ground smooth and beveled for push-on joints.
- K. As work progresses, a pipe cleaning tool as approved by CVWD shall be drawn through the pipe to remove dirt, rocks, or other foreign material. At the end of each day's work, all openings in the pipeline shall be plugged with watertight expandable plugs or CVWD approved equal.

- L. Keep the trench in a dewatered condition during pipe installation. Removal of water shall be in conformance with Section 31 23 19, Dewatering.
- M. Unless specified otherwise, polyvinyl chloride pipe shall not be encased with concrete. If protection is necessary, it shall be accomplished by the use of conductor casing(s) as approved by CVWD.

3.08 *Buried Fittings*

- A. Force main alignment shall use 45-degree elbow fittings to reduce the potential for stoppages where a 90-degree change of direction in the force main is required. When require the Contractor shall obtain CVWD prior to using two 45-degree elbows.
- B. Ductile iron fittings shall be installed utilizing standard installation procedures. Fittings shall be lowered into the trench by means of rope, cable, chain, or other acceptable means without damage to the fittings or linings or coating. Cable, rope, or other devices used for lowering fittings into the trench shall be attached around the exterior of fitting for handling. Under no circumstances shall the cable, rope or other device be attached through the interior for handling. Fittings shall be carefully connected to the pipe or other facility, and joints shall be checked to insure a sound and proper joint.
- C. CVWD's Representative will inspect all fittings prior to installation for damage to the interior protective coatings. Patch damaged areas in the field with material similar to the original.
- D. For mechanical joint fittings, clean the bell socket and the plain end of the pipe of all foreign material and dirt. Place the gland on the pipe spigot with the lip extension toward the plain end. Lubricate the pipe spigot and gasket. Use the same lubricant as supplied by the pipe manufacturer. Install the gasket on the pipe spigot with the narrow edge of the gasket toward the plain end. Insert the pipe into the bell socket and press the gasket firmly into the gasket recess. Keep the joint straight during assembly. Push the gland towards the socket and center it on the pipe with the gland lip against the gasket. Insert bolts and hand tighten nuts.
- E. Make joint deflection after assembly but before tightening bolts. Uniformly tighten bolts and nuts in a progressive diametrically opposite sequence, and torque nuts to 75 to 90-foot-pound with a calibrated torque wrench.
- F. For push-on joint fittings, clean the bell ends of the fitting of all foreign material and dirt. Insert the gasket in the groove of the bell and make sure the gasket faces the correct direction. Feel that the gasket is completely and evenly seated in the groove. When pipe is cut in the field, bevel the plain end prior to installation. Lubricate the exposed gasket surface and the beveled pipe spigot with the same lubricant supplied

by the pipe manufacturer. Insert the spigot into the bell and force it slowly into position. Keep the joint straight while pushing. Make joint deflection after the joint is assembled.

- G. Inspect and repair epoxy coating per Section 09 90 00.10, Sewer Painting and Coating and per Part 2 of this Specification.

3.09 *Polyethylene Encasement*

- A. All metal surfaces, ductile-iron pipe fittings, and buried valves shall be polyethylene encased at the time of installation. Polyethylene encasement and installation shall be in accordance with ANSI/AWWA C105 per Section 33 11 13, Piping Systems and Appurtenances.

3.10 *Thrust Blocks*

- A. Place concrete thrust blocks as indicated on the Drawings and CVWD's Detail Drawings for the Construction of Sanitary Sewer Systems.

3.11 *Tracer Wire*

- A. Tracer wire installation, testing, and acceptance requirements shall be as specified by the Contract Documents.

3.12 *Identification and Locator Tape*

- A. Identification and locator tape placement shall be as required by the Contract Documents.

3.13 *Electronic Marking*

- A. All PVC force mains shall utilize an Electronic Marker System. Mid-range pipe locators shall be placed 3-feet below grade on the force main at 500 foot intervals, at all horizontal changes in alignment, and as directed by CVWD.

3.14 *Marker Posts*

- A. Locate and install marker posts in accordance with Section 10 10 10, Utility Marker Post and CVWD Standard Drawings W-27/S-38.

3.15 *Connections to Existing Piping*

- A. Where new pipelines are to be connected to existing lines of CVWD, the Contractor shall verify in the field the location, elevation, pipe material, pipe outside diameter, and any other characteristics of the existing line before proceeding with the pipe installation. This field verification shall be performed in the presence of CVWD's Representative.

- B. Prior to construction, the Contractor shall submit for review and acceptance detailed procedures for pressure testing and the making of final connections to existing lines.
- C. Connections between new work and existing piping shall be made using fittings submitted and be subject to CVWD's acceptance for each separate condition encountered.
- D. Each connection to existing pipe shall be made at a time and under conditions that will least impact normal operations, and as authorized in writing by CVWD.
- E. The Contractor is responsible for making provisions for cutting of existing pipe when necessary, using approved mechanical means. Flame cutting of pipe will not be allowed.
- F. The Contractor is responsible for making provisions for dewatering existing lines and for disposal of water from the dewatering operation.
- G. The Contractor shall make all connections to existing pipelines in the presence of CVWD's Representative. Contractor shall provide all labor, equipment, and materials necessary to perform connection work, including but not limited to, isolation plug valve, fittings, and adapters.

3.16 *Field Hydrostatic Test and Leak Test*

A. Hydrostatic and Leakage Test:

1. Hydrostatic and leakage testing shall be performed in accordance with Section 33 01 30.13, Sanitary Sewer System Testing.
2. Hydrostatic testing against isolation valves shall not be allowed. Adjacent to the isolation valve, Contractor shall install a test plate for the aforementioned test and, after satisfactory testing, remove said test plate and replace it with a 1/8-inch thick minimum ring gasket. The use of any other test appurtenances shall be as approved by CVWD.

B. General Testing Requirements:

1. Required test pressures shall be applied by a pump connected to pipeline sections being tested. CVWD shall approve pump connections to pipeline before testing begins. As part of the Work, and unless specified otherwise, Contractor shall install, at Contractor's expense, top outlets (service taps) required for testing. Contractor shall provide calibrated meters for measurement of leakage, and all pumps, piping, fittings, bulkheads, plugs, valves, gages, power equipment, and manpower necessary for conducting all tests required, all at Contractor's expense. Contractor shall furnish CVWD three copies of all records of all tests performed.

2. Unless specified otherwise, Contractor shall test against test plates for pipelines 12-inch and smaller. Contractor shall not remove said test plates until pipelines have been tested and accepted by CVWD.
3. Contractor, at Contractor's expense, shall locate and repair leaks or other defects which may develop or become apparent during the test. Contractor shall excavate, including removal of backfill already placed, and make all repairs necessary for required water tightness, and then replace all excavated material, after which the Contractor shall retest the repaired pipeline section. Pipeline sections shall be repeatedly repaired and tested until they meet requirements set forth herein.
4. Pipe manufacturer and fitting manufacturer shall have free access to the Work during testing. Any improper act on the part of the Contractor which the pipe and fitting manufacturer may observe shall be reported to CVWD. Pipe and fitting manufacturer shall be free to observe and verify all tests.
5. After completed pipeline and appurtenances or test sections have successfully met test requirements to the satisfaction of CVWD, the entire pipeline or each test section shall be filled or shall remain filled with water until completion of the Work, unless otherwise ordered by CVWD.

3.17 *Coating Requirements*

A. Field Painting:

1. Contractor shall field paint all aboveground, bare, or exposed piping and appurtenances in accordance with Section 09 90 00.10, Sewer Painting and Coating, Section 33 31 13.13, Ductile Iron Sewer Pipe, as required by the Drawings, and as specified herein.

END OF SECTION 33 34 11

SECTION 33 34 12

HDPE PIPE FOR SEWER FORCE MAINS

Part 1 – General

1.01 *Description*

- A. This Specification section provides requirements for solid-wall high-density polyethylene (HDPE) pressure pipe (4-inch through 63-inch in diameter), HDPE pipe accessories, including fittings, and piping appurtenances. The Contractor shall furnish all material, tools, and equipment and shall perform all labor required to complete the Work as indicated in the Contract Documents.
- B. HDPE pressure pipe shall comply fully with AWWA C906 and ASTM D3350. HDPE pipe shall be outside diameter controlled and have either iron pipe size (IPS) or ductile iron pipe size (DIPS) nominal diameters, except as noted otherwise in the Contract Documents. HDPE pipe joints shall be fused, except where explicitly detailed otherwise on the Contract Documents.

1.02 *Related Work Elsewhere*

- A. The requirements of the following sections and divisions apply to the Work of this section. Other sections and divisions of the Specifications, not referenced below, shall also apply to the extent required for proper performance of this Work.
 - 1. Section 10 10 10, Utility Marker Post
 - 2. Section 31 23 17, Trenching, Excavation, Backfill and Compaction
 - 3. Section 33 01 30.13, Sanitary Sewer System Testing
 - 4. Section 33 01 30.16, TV Inspection of Sewer Pipelines
 - 5. Section 33 11 00, Basic Pipeline Specifications
 - 6. Section 33 11 13, Piping Systems and Appurtenances

1.03 *Reference Specifications, Codes, and Standards*

- A. All Work specified herein shall conform to or exceed the applicable requirements of the referenced portions of the following publications to the extent that the provisions thereof are not in conflict with other provisions of these Specifications.

B. Comply with the applicable editions of the following codes, regulations and standards.

1. CVWD Detail Drawings for the Construction of Sanitary Sewer Systems

2. Industry Standards:

ASME B16.1	Gray Iron Pipe Flanges and Flanged Fittings Classes 25, 125, and 250
ASME B16.21	Nonmetallic Flat Gaskets for Pipe Flanges
ASTM D2321	Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications
ASTM D2657	Standard Practice for Heat Fusion Joining of Polyolefin Pipe and Fittings
ASTM D2774	Standard Practice for Underground Installation of Thermoplastic Pressure Piping
ASTM D2837	Standard Test Method for Obtaining Hydrostatic Design Basis for Thermoplastic Pipe Materials or Pressure Design Basis for Thermoplastic Pipe Products
ASTM D3261	Standard Specification for Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing
ASTM D3350	Standard Specification for Polyethylene Plastics Pipe and Fittings Materials
ASTM F714	Standard Specification for Polyethylene (PE) Plastic Pipe (DR-PR) Based on Outside Diameter
ASTM F1759	Standard Practice for Design of High- Density Polyethylene (HDPE) Manholes for Subsurface Applications
ASTM F2206	Standard Specification for Fabricated Fittings of Butt-Fused Polyethylene (PE) Plastic Pipe, Fittings, Sheet Stock, Plate Stock, or Block Stock

AWWA C110	Ductile-Iron and Gray-Iron Fittings
AWWA C906	Polyethylene (PE) Pressure Pipe and Fittings, 4 in. (100 mm) Through 63 in. (1,600 mm), for Water Distribution and Transmission
AWWA M55	PE Pipe - Design and Installation
PPI	Material Handling Guide
PPI	Handbook of Polyethylene Pipe
PPI TR-4	PPI Listing of Hydrostatic Design Basis (HDB), Hydrostatic Design Stress (HDS), Strength Design Basis (SDB), Pressure Design Basis (PDB) and Minimum Required Strength (MRS) Ratings for Thermoplastic Piping Materials or Pipe
SSPWC	"Green Book", Standard Specifications for Public Works Construction
ISO 9001	Quality Management Systems – Requirements

- C. Comply with the applicable reference specifications listed in the General Conditions, other applicable parts of the Contract Documents, and as specified herein.

1.04 *Contractor Submittals*

- A. Submittals shall be made in accordance with the General Conditions, other applicable parts of the Contract Documents, and as specified herein.
- B. Pipe, fittings and accessories: Submit the following:
1. Specifications and data sheets;
 2. Dimensions, dimension ratio and pressure rating;
 3. Material manufacturer, composition, and physical properties;
 4. Certification from the Plastic Pipe Institute that the pipe manufacturer meets recipe and mixing requirements for resin used to manufacture the pipe for this Project;
 5. Manufacturer's affidavit of compliance with AWWA C906;

6. Manufacturer's recommendations for transport, handling, storage, and repair;
7. Submittal for mechanical joint adapters, including hardware and backer rings shall include manufacturer's written installation directions including alignment and bolt tightening recommendations.

C. Joining and Fusion Welds: Submit the following:

1. Pipe manufacturer's joint assembly procedure including cool down time and recommended datalogger equipment;
2. Pipe manufacturer-recommended fusion equipment, fusing procedure and restrictions;
3. Specifications and cutsheets for joint fusion machine(s), and for fusing machine data logger including temperature, date, time, and pressure recording elements;
4. Contractor's field welding quality control plan including equipment to be used, methods and procedures, and documentation plan.

D. Qualifications: Submit the following:

1. Proof and detailed documentation of the firms' and technician's experience, certifications, training and other qualifications as specified in the Article entitled "Quality Assurance" and in Part 2 of this Specification section.

E. Installation: Submit the following:

1. The manufacturer-recommended installation manual including instructions, recommendations and guidelines for handling, joining, installing, embedding and testing of polyethylene pipeline;
2. Detailed drawings of the pipe, gaskets, joints, and pipe special sections.
3. Pipe-laying diagrams.

F. Measurements and quality control documentation: Provide the Engineer with access to observe measurement and logger data as specified in the Article entitled "Quality Assurance" of this Specification section. Submit fusion quality control documentation as specified in the Article entitled "Quality Assurance" of this Specification section.

G. Field testing plan and drawings.

1.05 *Quality Assurance*

- A. Comply with the requirements specified herein and the applicable reference specifications of the General Conditions and other applicable parts of the Contract Documents.
- B. Inspection and Testing: All HDPE materials, pipe and fittings shall be inspected and tested in accordance with the requirements of AWWA C906.
- C. Affidavit of Compliance: Manufacturers of pipe and fittings shall furnish an affidavit of compliance conforming to the requirements of AWWA C906, Section 1.5, affirming that the piping components comply with the requirements of AWWA C906 and this Section. The affidavit for both pipe and fittings shall be signed under penalty of perjury by an officer of the manufacturer's company.
- D. The pipe manufacturer shall have manufacturing and quality control facilities that are capable of producing and assuring the quality of the pipe and fittings required by these Specifications. The Manufacturer's production facilities shall be open for inspection by the Customer or his Authorized Representative. The pipe and fitting manufacturer shall be ISO Certified in accordance with the current edition of ISO 9001 and a documented quality management system that defines product specifications and manufacturing and quality assurance procedures that assure conformance with customer and applicable regulatory requirements. Upon request, the manufacturer shall provide a current Certificate of Compliance form and independent ISO 9000 Registrar.
- E. Contractor Qualifications
 - 1. General
 - a. HDPE pipe jointing shall be performed by personnel trained in the use of butt-fusion equipment and the recommended methods for new pipe connections.
 - b. Personnel directly involved with installing the new pipe shall receive training in the proper methods for handling and installing HDPE pipe. Such training shall be conducted by a qualified representative of the fusion equipment manufacturer.
 - c. The Contractor shall maintain records of trained personnel, and shall certify that all the training was received not more than twelve (12) months before commencing the construction.
 - 2. HDPE fusion
 - a. Each HDPE fusion technician making the heat fusion joints shall have received training specific to the fusion equipment to be used

and shall be certified by the fusion equipment manufacturer or another certifying party acceptable to the Engineer, that the technician is qualified to join, lay and handle pipe;

- b. Each HDPE fusion technician making the heat fusion joints shall be certified by the HDPE pipe fusion equipment supplier that the technician has received training in the proper use of the proposed fusion equipment.
- c. Personnel fusion bonding HDPE pipe and/or fittings shall have the following minimum experience:
 - (1) The technician performed fusion bonding on at least three (3) previous projects;
 - (2) The technician performed fusion bonding on at least 20,000 feet of largest pipe diameter specified on the Drawings HDPE pipe;
 - (3) No HDPE fusion technician shall perform fusion bonding until after written acceptance of meeting the minimum experience requirements by CVWD's Representative.

3. HDPE fabricated fittings

- a. The fitting fabricator shall have at least five (5) years of experience in the fabrication of pressure-rated HDPE fittings of similar size and complexity as this project.
- b. The technician fabricating the HDPE fabricated fittings shall have the following minimum experience:
 - (1) The technician has at least two (2) years of experience fabricating HDPE fittings.
 - (2) The technician fabricated at least forty (40) fittings that are DR17 or thicker and 24-inch diameter or larger.

E. Factory testing

- 1. Refer to Part 2 of this Specification section.

F. HDPE fusion measurements and quality control

- 1. General: Contractor shall be responsible for employing a rigorous quality control procedure for quality control and documentation. All fusion shall be accomplished with equipment reviewed by and accepted by the Engineer.

2. Data collector and recording device: Contractor shall utilize data collection and recording equipment to verify proper fusion procedures have been followed prior to installation. The data collector shall consist of a rugged computer to record and report key weld parameters including the fusion machine heater plate surface temperature and hydraulic cylinder interface pressure profile over time during butt-fusion joining operations.
 - a. Measurements shall be permanently recorded utilizing a data collector and recording device that shall be Datalogger as manufactured by McElroy or equal.
 - b. CVWD shall have access to observe logger data at any time.
 - c. Recorded fusion data and reports shall be submitted within two (2) days following the completion of any joint. Failure to submit this information may be cause for rejection of the joint by CVWD.
 - d. The reports shall provide the following information, at a minimum:
 - (1) Date, time, and ambient temperature;
 - (2) Joint Number that correlates to Project pipeline stationing;
 - (3) Name of fusion technician;
 - (4) Equipment identification and specifications including piston area;
 - (5) Pipe data including material, size, and dimension ratio;
 - (6) Interfacial pressures in pounds per square inch (psi) including heat, soak, fuse, and cool;
 - (7) Recommended gauge pressures in pounds per square inch (psi) including heat soak, fuse, and cool;
 - (8) Recorded data including drag pressure, weld temperature;
 - (9) Graphs of pressure and temperature over time. Provide one (1) graph for the first five (5) minutes of weld procedure and a summary plot of the entire weld and cool-down process.
 3. Fusion failure definition shall be as specified in Part 3 of this Specification section.
- G. Damaged pipe sections shall be removed and replaced as specified in Part 3 of this Specification section.

Part 2 - Products

2.01 *Size and Dimensional Tolerances*

- A. **Diameters:** The outside diameter, wall thicknesses, and tolerances of the pipes shall be in accordance with AWWA C906 and ASTM F714.
- B. Pipe shall be round and true.
- C. **Lengths:** Pipe shall be supplied in nominal lengths of 20, 40, or 60 feet. Actual laying length shall be nominal length plus 1, or minus 4 inches. Alternate lengths for shipping purposes will be submitted to CVWD for approval. At least 90 percent of the total footage of each size and class of pipe, excluding special order lengths, shall be furnished in nominal length sections.
- D. **Pipe Size:** HDPE pressure pipe shall have a nominal diameter indicated on the Drawings with outside dimension (OD) corresponding to standard iron pipe sizes (IPS), ductile iron pipe sizes (DIPS), or as specified on the Drawings.
- E. **Wall Thickness:** Minimum Pipe Class shall be DR 13.5, or as specified on the Drawings.
- F. **Minimum Working Pressure Rating:** 160 psi, or as specified on the Drawings.

2.02 *HDPE Pipe Materials*

- A. **Pipe and fittings:** The pipe and fittings shall be a high-performance, high molecular weight, PE 4710 per PPI TR4, high-density polyethylene pipe, black in color with a green stripe indicating wastewater service, and contain a UV stabilizer. Minimum cell classification value shall be 445574 for PE4710 as referenced in ASTM D3350. Material shall have a minimum hydrostatic design basis (HDB) of 1,600 psi at 73 degrees F when tested in accordance with ASTM D2837 and shall be listed in PPI TR-4 by name of the pipe and fitting manufacturer. The fittings shall be molded from a polyethylene compound having a cell classification equal to or exceeding the compound used in the pipe or shall be manufactured using the polyethylene compound having a cell qualification equal to or exceeding the cell classification of the pipe supplied. To ensure compatibility of polyethylene resin, all fittings shall be of the same manufacturer as the pipe being supplied.
- B. Bolts and nuts for buried mechanical joining components such as flanges shall be made of 316 Stainless Steel.
- C. **Manufacturers:**

1. Manufacturers shall have at least five (5) years of experience producing pipe and fittings, as applicable, in the sizes specified for the Project.
2. HDPE pressure pipe shall be the product of one of the following manufacturers or approved equal:
 - a. JM Eagle;
 - b. Performance Pipe.
3. HDPE fittings shall be the product of one of the following manufacturers or equal:
 - a. ISCO Industries;
 - b. Performance Pipe;
 - c. Plasson USA.

D. Factory Testing

1. CVWD shall at all times have the right to inspect all work and materials in the course of manufacture.
2. Manufacturer shall furnish CVWD reasonable facility for obtaining such information as CVWD may desire regarding the progress and manner of the work and the character and quality of materials used.
3. Notify the Engineer of date and location of pipe manufacture at least thirty (30) days prior to commencing pipe production. Should CVWD elect to witness the manufacture of specific pipes during any phase of the manufacturing process, the manufacturer shall provide the Engineer with at least a 30-day advance notice of when and where the production of those pipes will take place. If CVWD elects to witness pipe production or testing, provide the Engineer with the following at the factory:
 - a. A work desk including telephone and computer with internet access near the manufacturing line.
 - b. Free access to the manufacturing line to witness production, and the testing facilities to witness testing;
 - c. Free access to witness manufacturing controls and instrumentation;
 - d. Free access to and testing of tools and instrumentation;
 - e. A work desk or area with cellular and internet access;

- f. Access to take random samples for testing by an independent testing laboratory.
4. Factory Test Data: Signed, dated, and certified third-party factory test data for each pipe segment shall be submitted before shipment of materials. No materials shall be shipped until the test data have been accepted by the Engineer.

D. Marking

1. Marking shall be legible and indelible, performed as specified in AWWA C906, and shall also include the following:
 - a. Pipe number designation referenced on the laying diagram;
 - b. Pipe actual internal diameter;
 - c. Pipe DR;
 - d. ASTM D3350 cell classification and PPI TR4 PE material designation;
 - e. The AWWA or ASTM designation(s) of the standard(s) to which the pipe was manufactured; and
 - f. Name of manufacturer and manufacturing date code.

E. Joints

1. General
 - a. HDPE pipe joints shall be butt-fused, except where otherwise indicated on the Drawings or specified herein.
 - b. Electro-fusion joints may be used only by written acceptance and only where butt fusion cannot be practically performed.
 - c. Friction and/or pressure couplings are not acceptable and shall not be allowed, except where explicitly shown on the Drawings.
2. Butt fusion joints butt fusion techniques shall meet all requirements of ASTM D2657, PPI TR33, and AWWA M55.
3. Flanged joints
 - a. Flanged joints shall consist of HDPE flange adapters and flange backing ring, unless otherwise shown on the Drawings.

- b. Full-face flat ring gaskets of 1/8-inch black reinforced rubber conforming to ASME B16.21 shall be installed between the flange adapter and opposing flange. Gaskets shall be full-faced with bolt holes and be held in position by the through-bolts.
 - c. Flanged backing rings (flanges) shall be ductile iron with polypropylene coating or ductile iron.
 - d. Flange backing rings shall be compatible with AWWA C110 flanges with ASME B16.1, class 125 flange bolting.
 - e. Flanged backing rings pressure ratings shall meet or exceed the pressure class of the pipe.
 - f. Flanged Joints shall have a Type 316 stainless steel bolt sets (bolt, nut, and washers) or Tripac 2000 Blue coated bolts and nuts. Diameter, number and length of the bolts shall be as determined by the flange adapter manufacturer. Stainless steel hardware shall be installed with anti-seize lubricant.
4. Electro-fusion Joints: Use only with prior written acceptance by CVWD's Representative.
- a. Electro-fusion joints shall have a five (5) year history of successful performance as acceptable to the Engineer based on information submitted by Contractor for each size and dimension ratio of coupling.
 - b. Joints shall meet ASTM 1290, AWWA M55, and AWWA C906 requirements.
 - c. Joint pressure ratings shall meet or exceed the pipe pressure rating of the adjoining pipe.
 - d. The inside diameter of an electro-fusion coupling shall match the outside diameter of the adjoining pipe.

F. Fittings

1. HDPE fittings: Fittings shall be made from material meeting the same requirements as the pipe. All HDPE fittings shall be molded, turned or otherwise fabricated by the same manufacturer. All fittings shall be marked with size, dimension ratio, pressure rating, and appropriate ASTM specification number.
- a. All fittings shall be pressure-tested to four (4) times working pressure of pipe for five (5) seconds or alternative back-bend test as provided for in AWWA C906.

2. Fabricated fittings: Fabricated fittings shall meet the requirements of AWWA C906 and ASTM F2206.
 - a. All fittings shall have the same pressure rating as the adjoining pipe. If required by CVWD, when of a thicker SDR, the fitting shall be planed in accordance with the manufacturer's recommendations to match adjacent pipe interior and external diameters.
 - b. Field-fabricated fittings do not comply with AWWA C906 or ASTM F2206 and shall not be allowed.
 3. Molded fittings shall be butt-fusion type manufactured in accordance with ASTM D3261 and shall have the same pressure rating as the adjacent pipe.
 4. Flange Adapters: Polyethylene flange adapters shall be made with sufficient through-bore length to be clamped in a butt-fusion machine without the use of a stub-end holder. The sealing surface of the flange adapter shall be machined with a series of small v-shaped grooves to provide gasketless sealing to prevent gasket blow-out.
- G. Where indicated on the Drawings, structure and manhole connections shall be done using HDPE flange with Type 316 stainless steel back-up ring and HDPE wall spool with wall anchor cast into the structure or manhole base. In lieu of the wall anchor and anchor bolts, the Contractor can submit for Engineer's acceptance an alternative method recommended by the HDPE pipe manufacturer to resist pullout.

2.02 *Tracer Wire*

- A. Tracer wire material shall be as specified by the Contract Documents.

2.03 *Identification and Locator Tape*

- A. Identification and locator tape materials shall be as required by the Contract Documents.

2.04 *Electronic Marking*

- A. All HDPE force mains shall utilize an Electronic Marker System (EMS). Mid-range pipe locator markers manufactured by 3M Electrical Products Division, Scotchmark Market Locator (EMS) Model No. 1258, or approved equal.

Part 3 - Execution

3.01 *General*

- A. General: HDPE pipe shall be installed in conformance with the manufacturer's recommendations, and shall comply with the alignment and profile indicated on the Drawings.
- B. HDPE pipe shall be installed in conformance with Section 31 23 17 Trenching, Excavation, Backfill and Compaction, manufacturer's recommendations, AWWA M55, instructions, ASTM D 2774, SSPWC Section 306 and Supplement Amendments, to the supplementary requirements or modifications specified herein, and shall comply with the alignment and profile indicated on the Drawings. Wherever the requirements of this Section and the aforementioned requirements are in conflict, the more stringent provision shall apply.
- C. The Contractor is responsible for traffic control and it shall include all material, labor and equipment to provide safe and effective work areas to warn, control, protect and expedite vehicular, bicycle and pedestrian traffic. Unless otherwise required by the Contract Documents, all work and material provided under this section shall be performed or furnished in accordance with SSPWC Part 6 Temporary Traffic Control and the entity (City, County, State, etc.) having jurisdiction. Traffic control shall also be in accordance with Section 33 11 00, Basic Pipeline Specifications.

3.02 *Shipping Storage and Handling*

- A. HDPE pressure pipe shall be shipped and stored with the pipe supported uniformly. Pipe shall be shipped and stored in the unit packages provided by the manufacturer.
- B. Pipe shall be stored at the Work site in unit packages provided by the manufacturer. Delivery, storage, and handling of pipe shall be per the pipe manufacturer's recommendations, SSPWC, PPI Material Handling Guide, and the additional requirements of this Specification section.
- C. Except for black HDPE pipe, when pipe is exposed to direct sunlight for more than 60 days, the pipe shall be covered with an opaque material while permitting adequate air circulation above and around the pipe to prevent excessive heat accumulation.
- D. Limit stacking of pipe to a height that will not cause circular deformation of bottom layers of pipes of more than five (5) percent of interior diameter under anticipated temperature conditions.

3.03 *Installation of Pipe*

- A. In the event that a specific issue is not addressed in the Contract Documents, the issue shall be governed by the respective requirements of the next

preferred document listed below in the order of descending preference from “1” (one) being the most preferred to “6” (six) being the least preferred:

1. Contract Documents
 2. Manufacturer’s recommendations;
 3. SSPWC 306-8.6;
 4. ASTM D2321;
 5. ASTM D2774;
 6. PPI Handbook of Polyethylene Pipe.
- C. All pipes shall be laid to line and grade with a true and firm bearing for the pipe throughout its entire length. Adjustment of pipes to lines and grade shall be made by scraping away or filling in and tamping material under the body of the pipe throughout its entire length, and not by blocking or wedging. All bedding materials shall be mechanically compacted / consolidated to a minimum of ninety (90) percent of maximum density unless otherwise required by the Contract Documents.
- D. If pipe is strung along trench prior to installation, string only pipe to be used within a 24-hour period. All pipe shall be laid on a flat surface. The interior as well as sealing surfaces of pipe, fittings, and other accessories shall be kept free from dirt and foreign matter.
- E. Before each new length of pipe is placed, the interior of the preceding pipe shall be carefully cleaned of all dirt and debris. At all times when the work of installing pipe is not in progress, all openings into the pipe and the ends of the pipe in the trench shall be tightly closed to prevent entrance of animals or foreign materials.
- F. Joints: Joints between plain ends of polyethylene pipe shall be made by butt fusion when possible. The recommendations of the fusion machine manufacturer and pipe manufacturer’s fusion procedures shall be followed at all times. The wall thicknesses of the adjoining pipes and fittings shall have the same dimension ratio.
- G. Fusion beads: Butt-fused welds will result in a weld bead on the inside and outside surface of the fused joint. Unless called for on the Drawings, the Contractor shall not be responsible for removing the weld bead on the inside or outside of the pipe. If required, removal shall take place immediately after welding is complete. Contractor shall exercise caution to avoid damage to the joint and pipe while removing the bead and shall be responsible for repairs and/or replacement of any damaged joint and/or pipe.

- H. Mechanical fittings: If mechanical fittings (which are designed for or tested and found acceptable for use with polyethylene pipe) are utilized for transitions between pipe materials, repairs, joining pipe sections, saddle connections, or at other locations, follow the recommendations of the mechanical fitting manufacturer. These procedures may differ from those for other pipe materials. All connections to HDPE pipe shall be restrained by an Engineer approved and appropriate method.
- I. Butt fused joints bend back testing:
1. A bend back test shall be performed at the beginning of the Work; for every 50 fusions or 3,000 ft. of pipe thereafter, whichever is more frequent; when directed by CVWD's Representative. An initial bend back test shall also be performed when a new fusion operator is brought on.
 2. The trial fusion shall be allowed to cool completely, and then fusion test straps shall be cut out. The test strap length shall be a minimum of twelve (12) inches or 30 times the wall thickness, whichever is longer. The test strap width shall be a minimum of one (1) inch or 1.5 times the wall thickness, whichever is wider. Bend the test strap until the ends of the strap touch. If the fusion fails at the joint, a new trial fusion shall be made, cooled completely, and tested. Butt fusion of pipe to be installed shall not commence until a trial fusion has passed the bent strap test.
 3. All testing shall be at the Contractor's expense. If the bent strap test of the trial fusion fails, the field fusions represented by the trial fusion shall be rejected. The Contractor at his expense shall make all necessary corrections to equipment, set-up, operation and fusion procedure, and shall re-make the rejected fusions.
 4. Fusion failure shall be defined as either of the following defects:
 - a. Cracking: a split or separation of material;
 - b. Crazing: visible fine cracks at or under the surface, which may be exhibited by visible fine white lines.

3.04 *Joining of Pipe*

- A. Heat fusion joining: Join pipe in conformance with ASTM D3261, PPI Handbook of Polyethylene Pipe, and the following requirements.
- B. Joints between plain end pipes shall be made by the butt fusion method. The butt fusion procedures used shall be procedures that are recommended by the pipe manufacturer. External beads do not need to be removed. Unless called for on the Drawings, internal beads from invert to spring line do not

need to be removed. If required, the bead shall be removed down to, or just above the pipe's surface, but never below it. The joint shall be completely cooled to ambient temperature before bead removal.

- C. HDPE pipe shall not be joined to existing pipe or adjacent segments until a minimum of 12 hours has elapsed to allow for temperature equalization and stress relief. HDPE pipe stretched beyond its elastic limit and/or damaged in any way shall be rejected.
- D. For each setup, conduct a sample weld and test for complete fusion.
- E. For pipe sizes larger than 36 inches in diameter, struts shall be provided and installed per the manufacturer's recommendations. However, the struts shall not cause more than twelve (12) percent vertical elongation; in no case shall horizontal elongation be acceptable.
- F. Before each new length of pipe is fused, the interior of the preceding pipe shall be carefully cleaned of all dirt and debris.

3.05 *Damaged Pipe*

- A. Do not use pipe sections with a kink, gouge, cut, gash, blister, abrasion, nick, scar, scratch, crack, and/or other deleterious fault that is greater in depth than ten (10) percent of the wall thickness or 1/4 inch, whichever is less. Such pipe sections shall not be removed from the Work site and replaced at no additional cost to CVWD. However, a defective area of the pipe may be cut out and the undamaged pipe portions may be rejoined using butt-fusion joining methods in accordance with the manufacturer's recommendations.
- B. Pipe sections having other defects such as concentrated ridges, discoloration, excessive spot roughness, pitting, variable wall thickness and/or any other defect of manufacturing, handling and/or installation as determined by CVWD's Representative shall be discarded, removed from the Work site and replaced at no additional cost to CVWD.

3.06 *Flange and MJ Adapter Installation*

- A. Flanges/MJ adapters shall be attached to pipe and fittings using butt fusion. The flanges/MJ adapters shall be aligned and centered relative to the pipe. Flanges/MJ adapters shall be square with the valve and/or other flange before tightening of bolts. Bolts shall not be used to draw flanges into alignment. Bolt threads shall be lubricated, and flat washers shall be used under flange nuts. Bolts shall be tightened using a star tightening pattern per manufacturer's recommendations. Twenty four (24) hours after first tightening the flange bolts, they shall be re-tightened using the same star tightening pattern used above. The final tightening torque shall be as indicated by the manufacturer.

3.07 *Buried Fittings*

- A. Force main alignment shall use two 45-degree elbow fittings to reduce the potential for stoppages where a 90-degree change of direction in the force main is required.
- B. Ductile iron fittings shall be installed utilizing standard installation procedures. Fittings shall be lowered into the trench by means of rope, cable, chain, or other acceptable means without damage to the fittings or linings or coating. Cable, rope, or other devices used for lowering fittings into trench shall be attached around the exterior of fitting for handling. Under no circumstances shall the cable, rope or other device be attached through the interior for handling. Fittings shall be carefully connected to the pipe or other facility, and joints shall be checked to insure a sound and proper joint.
- C. All fittings will be inspected by CVWD's Representative prior to installation for damage to the interior protective coatings. Patch damaged areas in the field with material similar to the original.
- D. For mechanical joint fittings, clean the bell socket and the plain end of the pipe of all foreign material and dirt. Place the gland on the pipe spigot with the lip extension toward the plain end. Lubricate the pipe spigot and gasket. Use the same lubricant as supplied by the pipe manufacturer. Install the gasket on the pipe spigot with the narrow edge of the gasket toward the plain end. Insert the pipe into the bell socket and press the gasket firmly into the gasket recess. Keep the joint straight during assembly. Push the gland towards the socket and center it around the pipe with the gland lip against the gasket. Insert bolts and hand tighten nuts.
- E. Make joint deflection after assembly but before tightening bolts. Uniformly tighten bolts and nuts in a progressive diametrically opposite sequence, and torque nuts to 75 to 90-foot-pound with a calibrated torque wrench.
- F. For push-on joint fittings, clean the bell ends of the fitting of all foreign material and dirt. Insert the gasket in the groove of the bell and make sure the gasket faces the correct direction. Feel that the gasket is completely and evenly seated in the groove. When pipe is cut in the field, bevel the plain end prior to installation. Lubricate the exposed gasket surface and the beveled pipe spigot with the same lubricant supplied by the pipe manufacturer. Insert the spigot into the bell and force it slowly into position. Keep the joint straight while pushing. Make joint deflection after the joint is assembled.

3.08 *Valves and Appurtenances*

- A. Pipeline valves at pipeline intersections shall be connected directly to pipeline intersection fittings (cross or tee) and, unless specified otherwise, all mainline

or side outlet valves shall be located 3 feet minimum from any curb face. Pipeline valves shall not be placed under the curb or gutter or in a parkway unless approved by CVWD.

- B. All appurtenances, including but not limited to air valve installations, blowoff installations, and related facilities, such as fire hydrants, fire services, and water services, shall not be installed within five (5) feet of curb returns, curb depressions, and driveway approaches, or in inaccessible locations or locations where interferences may restrict facility operation, unless permitted otherwise by CVWD.
- C. Air valve installations and blowoff installations shall be constructed at all locations indicated in the Drawings.

3.09 *Polyethylene Encasement*

- A. All metal surfaces, ductile-iron pipe fittings, and buried valves shall be polyethylene encased at the time of installation. Polyethylene encasement and installation shall be in accordance with ANSI/AWWA C105 per Section 33 11 13, Piping Systems and Appurtenances.

3.10 *Tracer Wire*

- A. Tracer wire installation, testing, and acceptance requirements shall be as specified by the Contract Documents.

3.11 *Identification and Locator Tape*

- A. Identification and locator tape placement shall be as required by the Contract Documents.

3.12 *Electronic Marking*

- A. HDPE force mains shall utilize an Electronic Marker System. Mid-range pipe locators shall be placed 3-feet below grade on the force main at 500 foot intervals, at all horizontal changes in alignment, and as directed by CVWD.

3.13 *Marker Posts*

- A. Locate and install marker posts in accordance with Section 10 10 10, Utility Marker Post and CVWD Standard Drawings W-27/S-38.

3.14 *Connections to Existing Piping*

- A. Where new pipelines are to be connected to existing lines of CVWD, the Contractor shall verify in the field the location, elevation, pipe material, pipe outside diameter, and any other characteristics of the existing line before

proceeding with the pipe installation. This field verification shall be performed in the presence of CVWDs' Representative.

- B. Prior to construction, the Contractor shall submit for review and acceptance detailed procedures for pressure testing and the making of final connections to existing lines.
- C. Connections between new work and existing piping shall be made using fittings submitted and be subject to CVWD's acceptance for each separate condition encountered.
- D. Each connection to existing pipe shall be made at a time and under conditions that will least impact normal operations.
- E. The Contractor is responsible for making provisions for cutting of existing pipe when necessary, using approved mechanical means. Flame cutting of pipe shall not be allowed.
- F. The Contractor is responsible for making provisions for dewatering existing lines and for disposal of water from the dewatering operation.
- G. The Contractor shall make all connections to existing pipelines in the presence of CVWD's Representative. Contractor shall provide all labor, equipment, and materials necessary to perform connection work, including but not limited to, isolation plug valve, fittings, and adapters.

3.15 *Testing and Acceptance.*

- A. Hydrostatic and Leakage Test
 - 1. Hydrostatic and leakage testing shall be performed in accordance with Section 33 01 30.13, Sanitary Sewer System Testing.
- B. Deflection Test
 - 1. Deflection test shall only be performed if called for on the Drawings. If required, the deflection testing shall be performed as specified in the Specification Section 33 01 30.13, Sanitary Sewer System Testing.
- C. CCTV Inspection
 - 1. If called for on the Drawings, the completed pipeline shall be CCTV inspected as specified in the Specification Section 33 01 30.13, Sanitary Sewer System Testing.
- D. General Pressure Testing Requirements
 - 1. Required test pressures shall be applied by pump connected to pipeline sections being tested. CVWD shall approve pump connections to

pipeline before testing begins. As part of the Work, and unless specified otherwise, Contractor shall install, at Contractor's expense, top outlets (service taps) required for testing. Contractor shall provide calibrated meters for measurement of leakage, and all pumps, piping, fittings, bulkheads, plugs, valves, gages, power equipment, and manpower necessary for conducting all tests required, all at Contractor's expense. Contractor shall furnish CVWD three copies of all records of all tests performed.

2. Unless specified otherwise, Contractor shall test against test plates for pipelines 12-inch and smaller. Contractor shall not remove said test plates until pipelines have been tested and accepted by CVWD.
3. Contractor, at Contractor's expense, shall locate and repair leaks or other defects which may develop or become apparent during the test. Contractor shall excavate, including removal of backfill already placed, and make all repairs necessary for required water tightness, and then replace all excavated material, after which the Contractor shall retest the repaired pipeline section. Pipeline sections shall be repeatedly repaired and tested until they meet requirements set forth herein.
4. Pipe manufacturer and fitting manufacturer shall have free access to the Work during testing. Any improper act on the part of the Contractor which the pipe and fitting manufacturer may observe shall be reported to CVWD. Pipe and fitting manufacturer shall be free to observe and verify all tests.
5. Hydrostatic testing against isolation valves shall not be allowed. Adjacent to the isolation valve, Contractor shall install a test plate for the aforementioned test and, after satisfactory testing, remove said test plate and replace it with a 1/8-inch thick minimum ring gasket. The use of any other test appurtenances shall be as approved by CVWD.
6. After completed pipeline and appurtenances or test sections have successfully met test requirements to the satisfaction of CVWD, the entire pipeline or each test section shall be filled or shall remain filled with water until completion of the Work, unless otherwise ordered by CVWD.

END OF SECTION 33 34 12

SECTION 33 39 23
SEWER CLEAN-OUTS

PART 1 – GENERAL

1.01 *Description*

- A. This section describes the material and installation requirements for clean-outs connected to new or existing gravity sewers and new or existing house laterals.
- B. The Contractor shall furnish all tools, equipment, materials, and supplies and shall perform all labor required to complete the Work as indicated in the Contract Documents and as necessary to complete the work of this section.
- C. Each clean-out shall be stationed by the Contractor on the Record Drawings.

1.02 *Related Work Specified Elsewhere*

- A. The requirements of the following sections and divisions apply to the Work of this section. Other sections and divisions of the Specifications, not referenced below, shall also apply to the extent required for proper performance of this Work.
 - 1. Section 31 23 17, Trenching, Excavation, Backfill and Compaction
 - 2. Section 33 01 30.13, Sanitary Sewer System Testing
 - 3. Section 33 01 30.16, TV Inspection of Sewer Pipelines
 - 4. Section 33 31 15, Fiberglass Reinforced Pipe for Sanitary Sewer
 - 5. Section 33 31 11, PVC Pipe for Sanitary Sewer
 - 6. Section 33 31 14, Vitrified Clay Pipe for Sanitary Sewer
 - 7. Section 33 08 30, Connection to Sanitary System
 - 8. Section 33 39 33, House Laterals

1.03 *Reference Specifications, Codes, and Standards*

- A. Comply with the applicable editions of the following codes, regulations and standards.
 - 1. CVWD Detail Drawings for the Construction of Sanitary Sewer Systems
 - 2. Industry Standards:

SSPWC "Green Book", Standard Specifications for Public Works Construction

- B. Comply with the applicable reference Specifications as directed in the General Conditions, other applicable parts of the Contract Documents, and as specified herein.

1.04 *Submittals*

- A. Submittals shall be made in accordance with the General Conditions, other applicable parts of the Contract Documents, and as specified herein.
- B. Certifications: The Contractor shall furnish a certified affidavit of compliance for all pipe and other products or materials furnished under this section, as specified in the referenced standards and the following supplemental requirements:
 - 1. Product drawings and data for pipe, pipe locator markers, fittings, stoppers, joints, gaskets, and couplings.
 - 2. Pipe manufacturer recommended tools for cutting new and existing pipe.
 - 3. Three-edge bearing strength test reports.
 - 4. Frames and covers.
 - 5. Concrete collar mix design.
 - 6. Adjustable clean-out.
 - 7. Tags.
- C Location of cleanouts per Article entitled "Record Drawings" of this Specification.

1.05 *Quality Assurance*

- A. General
 - 1. Quality assurance shall conform to Section 33 31 14, Vitrified Clay Pipe for Sanitary Sewer.
 - 2. Contractor shall coordinate with the related general requirements common to all Specification sections of the Project as addressed in General Conditions, other applicable parts of the Contract Documents, and as specified herein.

1.06 *Warranty*

- A. Contractor shall comply with all warranty requirements as specified in the Contract Documents.

PART 2 – Products

2.01 Pipe and Fittings

- A. Terminal clean-out pipe and fittings materials shall match the sewer main material, where feasible, and be in accordance with SSPWC 207-8 and Section 33 31 14, Vitrified Clay Pipe for Sanitary Sewer or PVC pipe, Section 33 31 11, PVC Non-Pressure Pipe for Sanitary Sewer, and with Section 33 31 15, Fiberglass Reinforced Sewer Pipe. Alternate pipe materials shall be subject to prior CVWD approval.
- B. Clean-out pipe and fittings (bell and spigot and banded) connected to new laterals shall be vitrified clay pipe in accordance with SSPWC 207-8 and Section 33 31 14, Vitrified Clay Pipe for Sanitary Sewer. Alternate pipe materials shall be subject to prior CVWD approval.
- C. Clean-out connection to existing laterals shall be as specified in Section 33 39 33, House Laterals.
- D. Clean-out pipe and fittings connected to existing laterals shall be vitrified clay pipe in accordance with SSPWC 207-8 and Section 33 31 14, Vitrified Clay Pipe for Sanitary Sewer. Alternate pipe materials shall be subject to prior CVWD approval.

2.02 Plugs/Stoppers

- A. Pipe plugs and stoppers shall conform to the requirements of Section 33 31 14, Vitrified Clay Pipe, Section 33 31 11, PVC Non-Pressure Pipe for Sanitary Sewer, and CVWD Standard Drawing Nos. S-6, S-44, S-44A, and S-45.
- B. An approved clean-out rubber stopper shall be connected to the VCP or PVC pipe riser with an approved band seal compression coupling or threaded fitting for PVC pipe.

2.03 Frame and Cover

- A. Clean-out frame and cover shall be Alhambra A-1240 as manufactured by Alhambra Foundry Company, Ltd., Alhambra, California, or approved equal.
- B. The word “SEWER” or the letters “C.O.” shall be imprinted on the cover.
- C. Frame and cover shall be in accordance with CVWD Standard Drawing No. S-6.

2.04 Adjustable Clean-Out

- A. Adjustable clean-out shall be Finish Line 834 Series, or approved equal.

- B. The word "SEWER" or the letters "C.O." shall be imprinted on the cover.
- C. Adjustable Clean-Out be in accordance with Standard Drawing No. S-44A.

2.05 *Mid-Range Pipe Locators*

- A. Mid-range pipe locator markers manufactured by 3M Electrical Products Division, Scotchmark Market Locator (EMS) Model No. 1258, or approved equal.

2.06 *Other Materials*

- A. Other materials shall be in accordance with these Specifications and CVWD Standard Drawings Nos. S-6, S-44, S-44A, and S-45.

PART 3 – Execution

3.01 *Construction*

- A. Clean-outs shall be installed where indicated on the Drawings or as directed by CVWD.
- B. Unless otherwise noted on the Drawings, all sanitary sewer laterals shall terminate in a clean-out constructed to the form and dimensions shown and detailed on CVWD Standard Drawings.
- C. Terminal clean-outs shall match the size of the sewer main.
- D. Clean-outs shall be at the termination of a sewer line, where there is no termination manhole. There shall be a maximum of 200 feet from a clean-out to the nearest manhole.
- E. Sewer laterals require a clean-out at the property line or point of termination.
- F. Trench excavation, bracing methods, foundation preparation, pipe bedding, trench backfill, and related operations shall be in accordance with the requirements of Section 31 23 17, Trenching, Excavation, Backfill, and Compaction.
- G. Unless otherwise shown on the Drawings:
 - 1. Terminal clean-outs and fittings shall be of the material, diameter, and of the form of the sewer main and as specified herein.
 - 2. Lateral clean-outs and fitting shall be VCP and match the diameter of the lateral.

Clean-out wye branch fitting shall have a barrel diameter equal to the diameter of the sanitary sewer main or lateral diameter indicated on the

Contract Documents. All wye branch fittings that are to be left unconnected shall be plugged with a stopper as specified in Section 33 31 14, Vitrified Clay Pipe for Sanitary Sewer, Section 33 31 11, PVC Non-Pressure Pipe for Sanitary Sewer, and marked as specified herein.

- H. All clean-outs shall be plugged with a stopper and band seal compression coupling. The stopper and coupling along with wye branch plug shall withstand the internal pressure generated during the test for leakage and shall be installed in such a manner that it may be removed without damage to the socket.
- I. Resurfacing of excavations for house laterals shall conform to the provisions of Section 31 23 17, Trenching, Excavation, Backfill, and Compaction and other applicable portions of the Contract Documents.
- J. Where any portion of the sewer is located within ten feet of any tree (measured horizontally from the center line of the sewer to the center of the tree), the removal of which is not included in the Contract for the sewer improvements, the joints of the pipe shall be wrapped with "Bio-Barrier" or a CVWD approved root herbicide product to prevent root intrusion.
- K. Sanitary sewer lines, house laterals and domestic water supply mains separated by less than ten (10) feet horizontally, measured from outside of pipes, shall be installed in accordance with CVWD Standard Drawing Nos. S-3 and S-4.
- L. Sanitary sewer lines and house laterals that cross domestic water supply mains shall be installed in accordance with CVWD Standard Drawing Nos. S-3 and S-4.

3.02 *Standard Drawings*

- A. Unless otherwise shown on the Drawings, install laterals in accordance with the following CVWD Standard Drawings:
 - 1. S-6 – Standard Clean-Out
 - 2. S-44 – Standard Offset Clean-Out Detail for Lateral under Driveway with No Sidewalk
 - 3. S-44A – Standard Clean-Out in Driveway
 - 4. S-45 – Standard Offset Clean-Out Detail for Lateral under Driveway with Sidewalk

3.03 *Location and Marking*

- A. Location of Clean-outs: The exact location and stationing of clean-outs are not shown on the Drawings. The Contractor shall either protect in place or replace appropriate sections of each clean-out. Branch fittings for future clean-outs shall be treated similarly.
- B. The location of clean-outs shall be marked as follows:
1. Standard clean-out for new construction:
 - a. Lid shall be marked per Part 2 of this specification.
 - b. A one (1) inch diameter brass or SS tag connected to the stopper with a SS chain or cable. "C.O." shall be imprinted on the tag.
 2. Clean-out for an existing lateral located under driveway without or without a sidewalk:
 - a. Lid shall be marked per Part 2 of this specification.
 - b. A one (1) inch diameter brass or SS tag connected to the stopper with a SS chain or cable. "OFFSET C.O." shall be imprinted on the tag.
 - b. A "CO" 2 inches high shall be chiseled or permanently marked on the curb at the location of the clean-out.
 - c. An appropriate mid-range or full range magnetic marker, per Part 2 of this specification, shall be placed three (3) feet below the finished ground surface directly above the Wye fitting of the clean-out as shown on CVWD Standard Drawings.

3.04 *Clean-Out Connections*

A. General

1. Lateral connections to an existing sewer main shall be performed in a manner so as to minimize any potential damage to the existing sewers and in accordance with Section 33 08 30, Connection to Sanitary System and Section 33 39 33, House Laterals.
2. The continuous operation of CVWD sewers during connection of laterals shall be maintained at the Contractor's expense in accordance with Section 33 08 30, Connection to Sanitary System.
3. Unless otherwise shown on the Drawings, the clean-out shall be constructed to CVWD Standard Drawing Nos. S-6, S-44, S44A, and S-45.

4. For offset clean-outs, wye fitting branches may be rotated upward from the horizontal to any angle between 15 and 45 degrees.
5. CVWD will be the sole judge regarding the slope and minimum cover necessary at each clean-out location.

B. Connections at the termination of new or existing sewers

1. End of Sewer – Vitrified Clay Pipe
 - a. An approved VCP wye fitting per Section 33 31 14, Vitrified Clay Pipe for Sanitary Sewer shall be installed to the sewer main.
2. End of Sewer – PVC and Fiberglass Reinforced Pipe
 - a. Prior to installing an approved VCP/PVC/FRP wye fitting in the receiving sewer main, the sewer main shall be cut with a pipe manufacturer recommended device for the type of sewer pipe over its entire circumference.
 - b. An approved VCP/PVC/FRP wye fitting in accordance with Section 33 31 14, Vitrified Clay Pipe for Sanitary Sewer, Section 33 31 11, PVC Non-Pressure Pipe for Sanitary Sewer, and with Section 33 31 15, Fiberglass Reinforced Sewer Pipe with shall be installed to the sewer main for the clean-out connection.
3. The subgrade immediately below the wye fitting shall obtain a 90 percent compaction or be bedded with 3/4-inch gravel.
4. Under no circumstances shall debris from the work enter the sewer.

B. Connections to new or existing house laterals

1. Existing house lateral: Prior to installing an approved wye fitting in the receiving sewer lateral, the sewer main shall be cut with a pipe manufacturer recommended device suitable for the type of sewer pipe. An approved wye fitting shall then be installed in the sewer lateral.
2. New house lateral: An approved wye fitting shall be installed to the sewer lateral.
3. The subgrade immediately below the wye fitting shall obtain a 90 percent compaction or be bedded with 3/4-inch gravel.
4. Under no circumstances shall debris from the Work enter the sewer.

3.05 *Inspection and Testing*

A. General

1. Clean-out markings shall be verified for accuracy by appropriate CVWD personnel. The installation of clean-outs and the placement of locators shall be witnessed by appropriate CVWD personnel.

B. Television Inspection

1. Clean-outs shall be videoed upon completion of installation. Video shall include the vertical portion of the clean-out. CCTV inspection shall be in accordance with Section 33 01 30.16, TV Inspection of Sewer Pipelines.

C. Testing

1. Sewer clean-outs shall be tested with the sewer main or new sewer service lateral in accordance with Section 33 01 30.13, Sanitary Sewer System Testing.
2. If required by the Contract Documents, new sewer cleanouts added to existing mains and laterals shall be tested independently of the existing sewer system in accordance with Section 33 01 30.13, Sanitary Sewer System Testing by isolating (using acceptable means to conduct the test) the new segment.

3.06 *Preservation of Property*

- A. Any and all damage to improvements, whether in private property or in public right-of-way, which occurs as a result of the Contractor's operation in connection with the installation of clean-outs, shall be repaired and restored to the original condition at the Contractor's sole expense. The repair and/or restoration shall be subject to acceptance by CVWD. Improvements shall include but not be limited to curbs, gutters, paving, driveways, lawns, shrubs, fences, and retaining walls. This provision shall apply whether such improvements are shown on the Contract Documents or not.

3.07 *Record Drawings*

- A. The Contractor shall furnish drawings showing the location of branch fittings and clean-outs with dimensions to buildings, curbs, trees, or tie points.

END OF SECTION 33 39 23

SECTION 33 39 33

HOUSE LATERALS

PART 1 – GENERAL

1.01 *Description*

- A. This section covers the materials and installation requirements for house laterals connected to new or existing gravity sewers. Unless otherwise specified, only a single dwelling unit per lateral will be permitted.
- B. The Contractor shall furnish all tools, equipment, materials, and supplies and shall perform all labor required to complete the Work as indicated in the Contract Documents and as necessary to complete the work of this section.
- C. House laterals shall be constructed of the type, location, and size shown on the Drawings in conformance with the Contract Documents. The term "house lateral" is used in the Contract Documents to designate a branch sewer laid from a sanitary sewer main to points at a curb or property line, or where shown on the Drawings from which sewer service can be obtained through a proper sewer extension by the property owner.
- D. Each lateral shall be stationed by the Contractor on the Record Drawings.

1.02 *Related Work Specified Elsewhere*

- A. The requirements of the following sections and divisions apply to the Work of this section. Other sections and divisions of the Specifications, not referenced below, shall also apply to the extent required for proper performance of this Work.
 - 1. Section 10 10 10, Utility Marker Post
 - 2. Section 31 23 17, Trenching, Excavation, Backfill and Compaction
 - 3. Section 33 01 30.13, Sanitary Sewer System Testing
 - 4. Section 33 01 30.16, TV Inspection of Sewer Pipelines
 - 5. Section 33 31 15, Fiberglass Reinforced Sewer Pipe
 - 6. Section 33 31 11, PVC Pipe for Sanitary Sewer
 - 7. Section 33 31 14, Vitrified Clay Pipe
 - 8. Section 33 39 23, Sewer Cleanouts

1.03 *Reference Specifications, Codes, and Standards*

- A. All Work specified herein shall conform to or exceed the applicable requirements of the referenced portions of the following publications to the extent that the provisions thereof are not in conflict with other provisions of these Specifications.
- B. Comply with the applicable editions of the following codes, regulations and standards.
 - 1. CVWD Detail Drawings for the Construction of Sanitary Sewer Systems
 - 2. Industry Standards:
 - SSPWC “Green Book”, Standard Specifications for Public Works Construction
- C. Comply with the applicable reference Specifications as directed in the General Conditions, other applicable parts of the Contract Documents, and as specified herein.

1.04 *Submittals*

- A. Submittals shall be made in accordance with the General Conditions, other applicable parts of the Contract Documents, and as specified herein.
- B. Certifications: The Contractor shall furnish a certified affidavit of compliance for all pipe and other products or materials furnished under this section, as specified in the referenced standards and the following supplemental requirements:
 - 1. Product drawings and data for pipe, stoppers, joints, gaskets, and couplings.
 - 2. Hydrostatic test reports.
 - 3. Three-edge bearing strength test reports.
 - 4. Mid-range or full range magnetic marker.
- C. Record drawings for each completed house lateral showing staked location and elevations at sewer center and property lines in accordance with Part 3 Article entitled “Record Drawings (As-Builts)” of this Specification.

1.05 *Quality Assurance*

- A. General

1. Quality assurance shall conform to Section 33 31 14, Vitrified Clay Pipe Section 33 31 11, PVC Pipe for Sanitary Sewer, and Section 33 31 15, Fiberglass Reinforced Sewer Pipe.
2. Contractor shall coordinate with the related general requirements common to all Specification sections of the Project as addressed in General Conditions, other applicable parts of the Contract Documents, and as specified herein.

B. Connections shall be made in the presence of CVWD's Representative.

1.06 *Warranty*

- A. Contractor shall comply with all warranty requirements as specified in the Contract Documents.

PART 2 – Products

2.01 *General*

- A. Unless otherwise shown or specified, house lateral pipe and fittings shall be vitrified clay pipe in accordance with Section 33 31 14, Vitrified Clay Pipe for Sanitary Sewer and SSPWC 207-8. Alternate pipe materials shall be subject to CVWD approval.

2.02 *Connections to Sewer Mains*

- A. Bell and spigot VCP wye fitting for new sewer mains shall be in accordance with Section 33 31 14, Vitrified Clay Pipe for Sanitary Sewer. Fittings with banded couplings shall not be allowed for new sewer pipe unless specifically approved by CVWD on a case-by-case basis.
- B. PVC wye fitting for new PVC mains shall be in accordance with Section 33 31 11, PVC Pipe for Sanitary Sewer. SDR of fitting shall match sewer main. PVC gasketed fittings shall be by HARCO Fittings, or equal.
- C. FRP wye fitting for new FRP mains shall be provided by the FRP pipe manufacturer in accordance with Section 33 31 15, Fiberglass Reinforced Sewer Pipe.
- D. Banded VCP wye fitting for existing sewer mains shall be in accordance with Section 33 31 14, Vitrified Clay Pipe for Sanitary Sewer.
- D. Inserta Wye
 1. Inserta Wye, specifically configured for the lateral and main sizes and materials, shall be by Inserta Tee, or equal.

E. Saddle Wye

1. Flexible saddle wye shall be a high durometer PVC meeting ASTM D 5926 with stainless steel straps. Ferguson flexible tap saddles or equal.
2. PVC saddle wye per ASTM D 3034 with stainless steel straps shall be by HARCO Fittings, or equal.
3. FRP saddle wye shall be provided by the FRP pipe manufacturer in accordance with Section 33 31 15, Fiberglass Reinforced Sewer Pipe.

2.03 *Plugs/Stoppers*

- A. Unless otherwise shown or specified, house lateral plugs and stoppers shall be constructed of vitrified clay pipe or neoprene in accordance with Section 33 31 14, Vitrified Clay Pipe and as specified herein.
- B. Testing plugs shall be as recommended by the pipe manufacturer for the selected test method.
- C. Laterals to be left unconnected shall include a VCP or neoprene stopper at the point of termination.

2.04 *Cleanouts*

- A. Cleanout materials shall be in accordance with Section 33 39 23, Sewer Clean-Outs.

2.05 *Carsonite Utility Marker (for laterals left unconnected to dwelling units)*

- A. Carsonite utility marker shall be in accordance with CVWD Detail Drawing No. S-39 and Section 10 10 10, Utility Marker Post.

2.06 *Mid-Range Pipe Locators*

- A. Mid-range pipe locator markers manufactured by 3M Electrical Products Division, Scotchmark Market Locator (EMS) Model No. 1258, or equivalent.

2.07 *Other Materials*

- A. Other materials shall be in accordance with these Specifications and CVWD Standard Drawings Nos. S-9A, S-9B, S-9C, and S-24.

PART 3 – Execution

3.01 *Construction*

- A. Laterals shall be installed in accordance with SSPWC Section 306 and Section 33 31 14, Vitrified Clay Pipe.
- B. The Contractor shall be responsible for notification of the local residents a minimum of seven (7) days prior to the commencement of any work in the

immediate area. Notices to the local residents will be supplied by CVWD. The Contractor shall be required to complete the notice as to the date the work will be performed and deliver a copy to each residence within the affected area. All costs associated with the notification of the residents shall be borne by the Contractor.

- C. Existing sewer laterals shall not be out of service for more than 4-hours.
- D. Unless otherwise specified, sewer house laterals shall be minimum of 4-inches and commercial laterals shall be a minimum of 6-inches. No 4-inch diameter house laterals shall be constructed into a manhole.
- E. Sewer laterals shall not be installed in driveways.
- F. Unless otherwise specified or shown on the Drawings, the depth of house laterals shall be sufficient to provide service to the lowest or most distant point to be served on each lot at a minimum grade of two and one-tenth (2.1) percent with not less than one (1) foot of cover over the top of the pipe.
- G. Trench excavation, bracing methods, foundation preparation, pipe bedding, trench backfill, and related operations shall be in accordance with the requirements of Section 31 23 17, Trenching, Excavation, Backfill, and Compaction.
- H. Unless otherwise shown, single family residences shall have 4-inch diameter VCP sewer laterals and all others (apartments, commercial, etc.) shall be 6-inches or greater. Each wye branch fitting shall have a barrel diameter equal to the diameter of the sanitary sewer main and the spur (or branch) diameter indicated on the Contract Documents. Wye branch fittings shall be set at an angle of 45 degrees from horizontal and shall be supported by pipe bedding material in accordance with the details shown on the Contract Documents. No wye branch shall be placed closer than 5 feet downstream from the outside of any structure. All wye branch fittings that are to be left unconnected shall be plugged with a stopper and marked as specified herein.
- I. All costs of furnishing, installing, and supporting wye branch fittings for house laterals shall be included in the Contract Price that is paid per linear foot for the sewer main complete in place; the cost of such fittings shall not be included in the unit price of house laterals. Tee branches shall be installed only where specifically indicated by the Contract Documents.
- J. House laterals shall be joined to wye branch fittings at the sanitary sewer main with a combination of straight sections and/or eighth (1/8) and sixteenth (1/16) bends. All eighth (1/8) and sixteenth (1/16) bends are a part of house lateral sewer line. Bends greater than one-eighth (1/8) are not allowed.

- K. All house laterals shall be plugged with a stopper in the last joint of each tributary house lateral and shall be securely sealed in place as specified in Section 33 31 14, Vitriified Clay Pipe. The stopper shall withstand the internal pressure generated during the test for leakage and shall be installed in such a manner that it may be removed without damage to the socket.
- L. 6-inch laterals required as clean-out at the property line or point of termination per Section 33 39 23, Sewer Cleanouts and CVWD Standard Drawings.
- M. Resurfacing of excavations for house laterals shall conform to the provisions of Section 31 23 17, Trenching, Excavation, Backfill, and Compaction, and other applicable portions of the Contract Documents.
- N. Where any portion of the sewer is located within ten feet of any tree (measured horizontally from the center line of the sewer to the center of the tree), the removal of which is not included in the Contract for the sewer improvements, the joints of the pipe shall be wrapped with Bio-Barrier, or a CVWD approved root herbicide product to prevent root intrusion.
- O. Sanitary sewer lines, house laterals and domestic water supply mains separated by less than ten (10) feet horizontally, measured from outside of pipes, shall be installed in accordance with CVWD Standard Drawing Nos. S-3 and S-4.
- P. Sanitary sewer lines and house laterals that cross domestic water supply mains shall be installed in accordance with CVWD Standard Drawing Nos. S-3 and S-4.

3.02 *Standard Drawings*

- A. Unless otherwise shown on the Drawings, install laterals in accordance with the following CVWD Standard Drawings:
 1. S-3 – Separation and Construction Requirements for Sewer and Water Lines (Parallel Construction)
 2. S-4 – Separation and Construction Requirements for Sewer and Water Lines (Crossings)
 3. S-9A – Standard House Lateral Type "A"
 4. S-9B – Standard House Lateral Type "B"
 5. S-9C – Standard House Lateral Type "C"
 6. S-24 – Chimney Pipe and Base

7. W-5A - General Location of Sewer Lateral and Water Meter/Water Service Installation
8. W-5B – General Location of Sewer Lateral and Water Meter/Water Service Installation
9. S-44 – Standard Offset Clean-Out Detail for Lateral under Driveway with No Sidewalk
10. S-45 – Standard Offset Clean-Out Detail for Lateral under Driveway with Sidewalk
11. S-46 – Construction Detail for Structural Encasement of Sewer

3.03 *Location and Marking*

A. Location of House Laterals: The exact location and stationing of house laterals are not shown on the Drawings. The Contractor shall either protect in place or replace appropriate sections of each house lateral. Branch fittings for future house laterals shall be treated similarly.

B. The location of house laterals shall be marked as follows:

1. Streets with curbs: An "S" 2 inches high shall be chiseled or permanently marked on the curb at the location of the house laterals; and an appropriate mid-range or full range magnetic marker, per Part 2 of this Specification, shall be placed two (2) feet below the finished ground surface directly above the terminus of the lateral.
2. Streets without curbs: A magnetic marker as described in "Streets with curbs" above shall be placed one foot below the finished ground surface directly above the terminus of the lateral. In areas where the finished ground surface is unknown the marker shall be installed two feet below the assumed finished ground surface.

A Carsonite Utility Markers shall be installed in accordance with Detail Drawing No. S-39. Carsonite Utility Markers shall be located inside the public right-of-way in such a position as to minimize the probability of damage from vehicular impact. Unless otherwise specified, Carsonite Utility Markers shall be located at the point two (2) feet inside the public right-of-way. The offset to the pipe centerline or center of manhole shall be recorded on a brass tag and affixed to the Carsonite Utility Marker. The tag shall face the pipe. If the distance to the edge of right-of-way is excessive, the marker post shall be installed as directed by CVWD's Representative.

3. Easements: A magnetic marker as described in "Streets with curbs" above shall be placed at wye connection fittings in the sewer main

where a lateral is or will be extended. The markers shall be placed two (2) feet below the finished ground surface unless the easement area is paved in which case the marker shall be placed in the paving subgrade at a depth of two (2) feet or less.

3.04 *House Connections*

- A. Unless otherwise shown on the Drawings, the invert of the upper end of the house connection sewer shall be constructed to the elevation shown on the profile, or if no such elevation is shown, to a depth five (5) feet below the top of the existing curb, or where there is no curb, five (5) feet below the grade at the property line.
- B. Branches may be rotated upward from the horizontal to any angle between 30 and 45 degrees in order to meet the slope of the house connection sewer. When the branch rotation does not conform to the slope of the house connection sewer, short lengths of beveled pipe may be used for adjustment.
- C. CVWD will be the sole judge regarding the slope and minimum cover necessary at each lateral location.

3.05 *Lateral Connections*

A. General

- 1. Lateral connections to an existing sewer main shall be performed in a manner so as to minimize any potential damage to the existing sewers.
- 2. The continuous operation of CVWD sewers during connection of laterals shall be maintained at the Contractor's expense.
- 3. Under no circumstances shall debris from the work enter the sewer.

B. New Sewer

1. VCP Main

- a. CVWD approved bell and spigot VCP wye fitting and appurtenances shall be installed in the sewer main as specified herein. The subgrade immediately below the wye fitting shall obtain a 90 percent compaction or be bedded with 3/4-inch gravel.

2. PVC and FRP Main

- a. Install CVWD approved PVC/FRP wye fitting in the sewer main in strict accordance with the manufacturer's instructions. Install CVWD approved banded coupling for connection to the VCP house lateral.

C. Existing Sewer

1. VCP Main

- a. Wye saddle: Prior to installing an approved "Inserta Wye" or wye saddle and gasket to the receiving sewer, the sewer shall be cored using an approved VCP coring tool. The saddle connection shall be approved for VCP and installed in accordance with the manufacturer's instruction.
- b. Wye Connections: Prior to installing a wye fitting in the receiving sewer main, the sewer main shall be cut with an abrasive saw or chain breaker over its entire circumference. The subgrade immediately below the wye fitting shall obtain a 90 percent compaction or be bedded with 3/4-inch gravel. An approved wye fitting with approved bandseals in accordance with ASTM C425 with stainless steel shear rings or equal shall be installed in the sewer main.

2. PVC and FRP Main

- a. Core a neat trim opening with pipe and/or fitting manufacturer approved tool in the upper portion of the PVC or FRP main sewer. Install CVWD approved "Inserta Wye" or saddle wye and gasket in strict accordance with the manufacturer's instructions. Install CVWD approved stainless steel banded flexible coupling for connection to the new or existing VCP house lateral.

3.06 *Abandonment of Laterals*

- A. Some existing houses and buildings use common or shared laterals. The Contractor shall determine if the lateral is common/shared prior to abandonment. If the lateral serves one building and is **NOT** part of a common/shared lateral:
 1. The downstream end of the lateral shall be sealed with a manufactured watertight cap/stopper made specifically for the purpose of sealing/capping the end of a sanitary sewer. The cap/stopper shall be installed per manufacturer's recommendation and in such a way to prevent any source of water from entering the sanitary sewer system. Any device or material that may slide into the lateral and potentially cause a blockage or obstruction in the mainline sewer will not be allowed. The cap/stopper shall be installed on a defect free portion of the lateral immediately before the wye connection to the city main. If defects are found in the wye connection, the Contractor shall excavate toward the main and the wye shall be removed and replaced with a new portion of equally sized pipe.

2. The remaining portion of the lateral from the point of termination to structure shall be sealed at both ends with a manufactured watertight cap/stopper made specifically for the purpose of sealing/capping the end of a sanitary sewer. The cap/stopper shall be installed on a defect free portion of the lateral. If defects are found, then the Contractor shall excavate the lateral until a defect free portion of the lateral is located.
3. If at least one service from the common lateral is intended to remain, the connecting fitting for the laterals shall be removed and replaced with a new section of straight pipe or an elbow of sufficient angle to provide a smooth transition between the existing portions of the lateral. Elbow shall be a manufactured fitting and shall be installed per manufacturer's recommendation to assure a watertight seal.

3.07 *Cleanouts*

- A. Cleanout connection shall be in accordance with Section 33 39 23, Sewer Clean-Outs.

3.08 *Inspection*

A. General

1. New sewer lateral connections and replacement of existing house laterals and reconnections to a new or existing mains shall be made in the presence of CVWD's Representative.
2. The Contractor shall provide a state of CA registered land surveyor to stake sewer center and property lines.
3. House lateral markings shall be verified for accuracy by appropriate CVWD personnel. The termination of laterals and the placement of locators shall be witnessed by appropriate CVWD personnel.

B. Television Inspection

1. CCTV inspection shall be in accordance with Section 33 01 30.16, TV Inspection of Sewer Pipelines.
2. Unless otherwise indicated on the Drawings, new sewer laterals 6-inches and greater shall be videoed upon completion of installation.
3. Unless otherwise indicated on the Drawings, sewer laterals connected to new and existing sewer mains shall be videoed upon completion of installation. At all service connections, the camera shall be stopped and the pan and tilt features shall be used to obtain a clear picture. Where possible, the camera shall be panned to view up each lateral or point of connection.

3.09 *Testing and Acceptance*

A. General

1. It is the intent of the Contract Documents that the completed house laterals of all types shall be watertight.

B. Existing House Laterals

1. Unless otherwise required by the Contract Documents, existing house laterals that are reconnected (including portion replaced between main and trench wall or other specified point shown on the Drawings) to a new sewer main do not require testing.

C. New House Laterals

1. Unless otherwise required by the Contract Documents, new house laterals shall be tested in accordance with Section 33 01 30.13, Sanitary Sewer System Testing.

3.10 *Preservation of Property*

- A. Any and all damage to improvements, whether in private property or in public right-of-way, which occurs as a result of the Contractor's operation in connection with the installation of house laterals, shall be repaired and restored to the original condition at the Contractor's sole expense. Improvements shall include but not be limited to curbs, gutters, paving, driveways, lawns, shrubs, fences, and retaining walls.

3.11 *Record Drawings (As-Builts)*

- A. The Contractor shall furnish drawings showing the survey stake information, location of branch fittings, and the upper end of all house laterals with dimensions to buildings, curbs, trees, or tie points.

END OF SECTION 33 39 33