

B. STANDARD SPECIFICATIONS FOR WATER MAINS AND SERVICES

SECTION W

W1. GENERAL

W1.01 Scope of Work: The work shall include the furnishing of all materials, labor, tools, implements, and equipment necessary to construct and test the water mains with all appurtenances, complete and ready to operate, including final cleanup of job site; all construction to be in accordance with the details shown on the plans, the standard drawings of the City of Milpitas and with the provisions of these specifications.

W1.02 Definitions:

- W1.02.01 Phrase "or approved equal" shall mean only that which has been approved as equal in writing by the City Engineer in response to a written request to consider an alternate as being equal. Such a request shall be made by the Contractor when the City is the contracting agency, or by the Owner when the City is not the contracting agency.
- W1.02.02 "ASTMASTM" refers to ASTM International, the successor organization of the American Society for Testing and Materials.
- W1.02.03 "AWWA" refers to the American Water Works Association, and it is intended that the current requirements of their standards shall govern throughout, unless otherwise herein specified. Such AWWA requirements shall be used in their entirety unless otherwise noted.
- W1.02.04 "Contractor" shall mean the party entering into contract for the performance of the work (construction) covered by this contract and his authorized agents or legal representatives.
- W1.02.05 "Engineer" shall mean the party entering into contract for the performance of the work (design) covered by this contract and his authorized agents or legal representatives.
- W1.02.06 "Inspector" shall mean the engineering or technical inspector or inspectors duly authorized and appointed by the City Engineer, limited to the particular duties entrusted to them.
- W1.02.07 "Owner" shall mean the party entering into the contract, for whom the performance of the work covered by this contract is being done, when the City is not the contracting agency.
- W1.02.08 "Owner s Engineer" shall mean the Engineer engaged by the Owner, acting within the scope of the particular duties assigned by the Owner.

W1.02.09 “State Specifications” refers to the most current edition of the Standard Specifications, State of California, Business and Transportation Agency, Department of Transportation.

W1.02.10 “CDPH” shall mean the California Department of Public Health and its requirements shall be complied with. CDPH is the successor regulatory agency to the California Department of Health Services (DOHS).

W1.03 Safety Provisions: The Contractor shall conform to the rules and regulations pertaining to safety established by the California Division of Industrial Safety.

W1.04 Special Conditions: Special Engineering consideration shall be given to, and special specifications written for, any water main construction with a cover less than 42 inches in the street and 48 inches in the easement (unpaved).

Where water mains cross or approach any other underground utility or structure with less than 1-foot clearance, special encasement of the water line is required and details of such crossing and approach shall be according to DPHS standards and must be approved by the City Engineer.

W1.05 Inspection: As the work progresses, each phase of the work must be inspected and approved before the next phase of construction is started. This condition is not meant to restrict the Contractor from carrying on simultaneous operations of several phases of construction in different areas of locations within the project. The Contractor will notify the City Engineer at least 24 hours in advance when inspection will be needed and shall keep the City Engineer informed of the schedule of work.

W1.06 Construction Staking: The contractor will notify the City Engineer (or the Owner's Engineer when the City is not the contracting agency) at least 48 hours in advance of needing construction stakes. A copy of the cut sheets shall be supplied to the City's Engineer 24 hours prior to excavation.

W1.07 Material Guarantee: Before any contract is awarded, the bidder may be required to furnish a complete statement of the origin, composition, and manufacture of the work, together with samples, which may be subjected to the test provided for in these specifications to determine their quality and fitness of the material.

W1.08 Interpretation: The general plans, standard drawings, details and specifications are intended to depict, without requiring interpretations, the work and working conditions of the contract. Should interpretation be required, such interpretation shall be made by the City Engineer as provided for in the General Conditions.

W1.09 Authority of City Engineer: The City Engineer, or his/her designee, shall decide all questions which may arise as to the quality of acceptability of materials furnished and work performed and as to the manner of performance and rate of progress of work; all

questions which may arise as to interpretation of plans and specifications; all questions as to the acceptable fulfillment of the contract on the part of the Contractor; and, when the City is the contracting agency, all questions as to the compensation. His/her decision shall be final and he/she shall have authority to enforce and make effective such decisions and order which the Contractor fails to carry out promptly.

- W1.10 Superintendent: The Contractor shall keep at this site, during its progress, a competent superintendent and any necessary assistants all satisfactory to the City Engineer. The Superintendent shall not be changed except with the City Engineer's consent, unless the Superintendent proves to be unsatisfactory to the Contractor and ceases to be in his employ. The Superintendent shall represent the Contractor in his absence and all directions given to him shall be as binding as if given to the Contractor. The Contractor shall furnish the City Engineer with the names and phone numbers of two responsible men, one of whom may be reached at all times that the work is not in progress, to be called in case of any emergency on the work.
- W1.11 Connection to System: All connections to existing water mains are to be made under the direction of the City and only after the Contractor has properly prepared the site for work, and is approved by the City Engineer after all tests have passed. A detail of each connection shall be shown on the plans for the work and a schedule of the work shall be approved by the City Engineer.
- W1.12 Changes in Work: If, in the "pinion of the City Engineer, the strict application of these specifications is impractical and will not provide the results desired, then the City Engineer may prescribe such alternate methods as deemed necessary.
- W1.13 Abandoned Pipes, Wells, Etc.: When, in the course of the work, a Contractor encounters or discovers in the work area any abandoned pipes, conduits, pumps, septic tanks, wells, or any other condition that could be detrimental to any part of the work or constitute a threat to the public health or safety, that condition shall be rendered harmless by the Contractor to the satisfaction of the City Engineer.

W2. MATERIALS

The Contractor shall furnish all materials required to complete the work. The materials furnished and used shall be new. The materials shall be manufactured, stored, handled, and used in a workmanlike manner to insure complete work in accordance with the plans and specifications. All damaged or defective materials shall be removed from the work or job site. Materials shall be inspected by the City Engineer or his/her representative prior to use.

- W2.01 Portland Cement Concrete: Portland Cement Concrete shall conform to all applicable provisions of State Specifications, Section 90.

- W2.01.01 Class of Concrete: The class of concrete shall be as designated in the City's Standard Drawings or as approved by the City Engineer.
- W2.02 Reinforcing Steel: Reinforcing steel shall be deformed billet steel bars, Grade 60 and shall conform to the specifications of ASTM Designation A-615-76a.
- W2.03 Polyvinyl Chloride (PVC) Pipe: PVC pipe shall conform to the requirements of the "Standard Specifications for PVC Pipe" (AWWA C900).
- Ductile Iron (DI) Pipe: DI pipe shall conform to the requirements of the "Standard Specifications for DI pipe" (AWWA C100).
- Steel Cylinder (SC) Pipe: SC pipe shall conform to the requirements of the "Standard Specifications for SC Pipe" (AWWA C200).
- Concrete Pipe: Concrete pipe shall conform to the requirements of the "Standard Specifications for Concrete Pipe" (AWWA C300).
- W2.03.01 The nominal inside diameter of the water main shall be that shown on the plans.
- W2.03.02 Pipes shall conform to the following requirements:
1. Minimum pressure Class 150 and dimension ratio of 18 for PVC pipe.
 2. Minimum thickness Class 50 for ductile iron pipe.
 3. Minimum wall thickness and strength as stated in the project's special conditions and plans for steel pipe.
- W2.03.03 The length of each size required, as indicated on the proposal sheet, is the total length of water main, including all valves and fittings. The laying length of pipe shall be determined in the field.
- W2.03.04 Short lengths are to be used wherever the pipe passes through a rigid structure. The total number and lengths of short sections required for making connections to valves, fittings, and for making closures, shall be determined in the field.
- W2.03.05 The Contractor shall furnish and install couplings of the size and class required. Couplings to be used shall meet with the approval of the Engineer.
- W2.03.06 Trace wire is required with the installation of PVC pipe.
- W2.04 Fittings: Fittings shall conform to the main's wall thickness, manufacturing process and water pressure requirements of AWWA Specifications.

W2.05 Valves: Valves shall be Mueller gate valve #A2370-24 or #A2370-34 with operating nut, or approved equal. Hydrant valves shall be Mueller #A2370-26, or approved equal.

- Valves shall be of the size indicated on the plans.
- The position of the valves shall be vertical.
- The direction for opening of valves shall be counterclockwise.

Butterfly Valves: Manufacturers specifications shall be submitted to the City Engineer for approval prior to ordering.

W2.06 Valve Boxes: An adjustable valve box of the type shown on Standard Drawing 702 shall be installed for each valve. The word "water" shall be marked on the cover. All valve boxes shall have full 8-inch inside diameter.

W2.07 Marker Post for Valves: When valves and valve boxes are installed in an easement or unimproved areas, a marker post shall be installed in compliance with Standard Drawing 204.

W2.08 Air Release Valves: Appropriate air release valves, in accordance with Standard Drawing 740, shall be installed at all high points of mains that could trap air. Fire hydrants may not be used in lieu of air release valves at high points.

W2.09 Fire Hydrants: Fire hydrants shall be Rich No. 75 or 76 (150 psi working pressure) or approved-equal per Standard Drawing No. 742.

The two and one-half inch (2-1/2") outlet shall have National Standard Hose Threads. The steamer outlet shall be four inches (4") and shall have California Standard Hose Threads.

Fire hydrants shall be given three (3) coats of yellow enamel, in compliance with Federal Color Specification TT-C-595, Color No. 1305. Paint shall be heavy duty synthetic plastic industrial enamel.

W2.10 Dead-End Assemblies shall be installed in accordance with the standard drawings #706 at locations shown on the plans. End lines with a valve, air and vacuum valve and plugged end assembly.

W3. CONSTRUCTION PROCEDURE

W3.01 Excavation: Trenches shall be excavated, either by hand or by machine. All trenches shall be excavated vertically and shall be of open construction. Tunneling will not be permitted, except where permission is given by the City Engineer and the dimensions and methods of construction and backfilling have been definitely approved by the City Engineer.

All trenches shall be of sufficient width to provide free working space on each side of the pipe, but in no case shall it be wider than 1-1/2 times diameter + 12", except that 6-inch pipe may be laid in a 2-foot trench. Where bracing and shoring is necessary, an additional width, as directed by the City Engineer, will be allowed. In all cases, there shall be a 6" space between pipe and the sides of the trench to allow for backfill and compaction around the pipe.

The Contractor shall undercut the trench to a depth of at least two inches (2") below the final position of the coupling. The trench shall be backfilled to a depth of two inches (2") above grade with sand or granular material of the quality herein specified as encasement material for water pipe and sanitary sewer pipe. The pipe bed shall then be formed by hand to final grade; or during installation, each length of pipe shall be supported at two points, each one-fifth (1/5) the length of the pipe from its ends. The method of support shall be by sand mounds high enough to provide a clearance of two inches (2") below the couplings.

If any trench is excavated below the bottom grade as required by the plans, it shall be refilled to grade, at the Contractor's expense for all labor and material, with approved bedding material.

Material excavated in streets or roadways shall be laid along side of the trench and kept trimmed up so as to cause as little inconvenience as possible to public travel.

At street crossings, or where existing driveways occur on a street, the Contractor shall make provisions for ditch crossings at these points, either by means of backfill or temporary bridges as the City Engineer may direct.

Free access must be provided to all fire hydrants, water gate valves, and private drives and means shall be provided whereby all storm and waste water can flow uninterrupted.

W3.02 Bracing and Shoring: The Contractor shall, at all times, furnish, install and maintain sufficient bracing and shoring in trenches in conformity with requirements of the California Division of Industrial Safety to insure the safety of workmen and to protect and facilitate the work. All such bracing and shoring shall be removed from the trench as the backfilling proceeds unless otherwise approved by the City Engineer. The cost for shoring shall be included in the bid prices.

W3.03 Removal of Water and/or Unstable Material from Trenches: The Contractor shall furnish and install all sheet piling required and shall furnish, install and operate such pumps or other devices as may be necessary for removing water from trenches during construction of the water lines. Ground water shall be removed by laying drain rock or gravel on the bottom of the trench or by other means which will prevent ground water from softening the bottom of the trench. If unstable material is encountered at the excavation grade, such unstable material shall be removed to the depth directed by the City Engineer. The cost for dewatering and/or stabilizing the trench bottom shall be

considered to be included in the bid price for the work, unless specifically provided for otherwise.

Water shall be disposed of in accordance with an approved construction water management plan in such a manner as not to cause injury to private property, cause violation of the City's Municipal Regional Stormwater Permit, nor be a menace to public health.

W3.04 Pipeline Laying: All pipe shall be laid true to line and grade as specified on the plans, or as directed by the City Engineer to pass existing obstructions. Before any length of pipe is laid, it shall be carefully inspected for damage or defects. No pipe, or other material, which shows damage or defects shall be placed.

Pipes, valves and fittings must be carefully wiped out and cleaned, as they are being laid so that no earth or rubbish may become lodged inside. All ends, fittings or other openings shall be plugged to prevent entry of any foreign matter or water during construction. No deflection will be permitted at joints where water pipe is joined to cast iron fittings or valves. Deflections will be permitted up to the maximum allowed by the manufacturer's recommendation.

Rubber ring joints shall be installed in complete compliance with the recommendations of the manufacturer.

W3.05 Blocking: Thrust blocks and anchor blocks shall conform to Standard Drawings 702, 704, 706 and 742 or as directed by the City Engineer.

W3.06 Trench Construction: All trench construction and backfill shall conform to the requirements of Standard Drawing No. 220 and 222.

W3.07 Services: Water services (domestic, irrigation and fire) including meter box shall be installed to each lot in accordance with Standard Drawing No. 722, 723, 724, or 726. Water services greater than 2" diameter shall be installed in accordance with Standard Drawing No. 729.

The letter "W" shall be stamped or chiseled on the face of curb directly over the point where the service crosses the curb line.

W3.08 Meters: Water meters shall be furnished by the City at the expense of the customer, owner or developer. Water meters up to 2" in size will be set by the City. Water meters greater than 2" will be installed by the owner. Each meter and backflow preventer in a bank of meters and backflow preventers shall be identified to indicate which, i.e., addresses, buildings, tenant spaces that each meter and backflow preventer serves.

W3.09 Water pressure testing of the complete pipe lines, including services, shall be performed at the Contractor's expense as each section of line is completed from valve to valve. Test pressure to be 225 pounds per square inch, measured at the lowest point in the

section of pipe line undergoing test. The Contractor shall furnish all labor and equipment required for the test.

The completed section of the line shall be slowly filled with water with adequate provision for the release of air in the test section. When the line has been completely filled with water, a test pump of adequate capacity shall be attached to the line and operated to provide the specified test pressure. Water from a container of known capacity shall then be supplied to the line through the test pump to maintain this pressure during the test period. All joints shall be exposed for visual inspection. The test period shall be for one hour, or enough time to adequately check the entire line, whichever time is the greater. Leakage shall be considered to be the quantity of water which is added to the line during the test period in order to maintain the specified pressure. It shall not exceed 20 gallons per mile per 24 hours per inch of nominal diameter of PVC, ductile iron or steel water main or manufacturer's recommendation, whichever loss is the lesser.

During the test period, all joints shall be inspected. If leakage exceeds the permissible maximum, the Contractor shall at his own expense take whatever steps are necessary to reduce the leakage, after which the test shall be repeated as often as necessary until acceptable results are obtained.

It is required that all joints shall be left uncovered for observation and inspection while the pipeline is under hydrostatic pressure test. The Contractor shall be particularly careful to place sufficient trench backfill over the pipe to prevent movement under the test pressure.

W3.10

Sterilizing and Flushing Water Lines: Sterilizing of the completed work, including pipelines, valves, and fittings, shall be performed by the Contractor, who will supply all materials, equipment, supplies and labor required by the operation. All sterilization shall be performed under the supervision of the City Engineer.

After completion of hydrostatic testing, the pipelines and appurtenances shall be thoroughly flushed until, in the opinion of the Engineer, all dirt and foreign matter have been removed from the system. The system shall then be disinfected with a hypochlorite solution containing a residual chlorine content of one hundred (100) parts per million. The solution shall be allowed to remain in the pipe for at least 24 hours. A chlorine residual of at least 10 ppm must remain in all parts of the line after 24 hours. The lines shall then be thoroughly flushed until a maximum residual chlorine content of 0.2 ppm is obtained in all parts of the system.

All chlorination shall be in accordance with AWWA Standards for "Disinfecting Water Mains," AWWA C651-86. Extreme care shall be exercised to prevent backflow water from an unsterilized or super-chlorinated system into existing mains.

Disinfectant may be made by the use of calcium hypochlorite tablets attached by means of gasket cement to the inside top of the lengths of pipe at they are being laid. The

amount of adhesive shall be limited to the smallest practicable amount applied to one side of the tablet only. The tablets shall have an average weight of 0.009 of a pound each and shall contain not less than seventy percent (70%) of available chlorine.

Chlorination and pressure tests may be accomplished concurrently, unless inability to pass the pressure test makes it necessary to repair the line and to disinfect it at a later date.

The following table shows the number of tablets to be used per one hundred linear feet of pipe of various sizes:

<u>Inside Diameter of Pipe</u>	<u>Number of Hypochlorite Tablets per 100 Feet</u>
4"	8
6"	20
8"	36
10"	54
12"	78
16"	138

Total coliform test shall be performed by City-approved laboratory upon completion of sterilization of the water line. If test fails, water line shall be resterilized until the total coliform test successfully passes.

Flushing at 2.5 feet per second (fps) velocity will be required. Hydrants and/or blowoffs will be available to develop adequate velocity. The Contractor shall provide the adapters, hoses and other items needed for flushing. The length and size of hose and the location of disposal of water from the flushing operation will be as directed by the Engineer.

Disinfect potable water lines using general procedures and material conforming to AWWA C651 and the directions listed below.

1. Notify the City's representative a minimum of 24 hours before beginning any chlorination operation. Contractor must submit a disinfection plan to the City for approval.
2. Before starting chlorination operations, open the blow off valve at the discharge point and verify the test mains are not under pressure. The City's representative shall be present during this verification.
3. Verify that all cross-connection valves are closed. Verification shall be made with the City's representative present.

4. Adequate person-to-person communications shall be maintained between the contractor's personnel during chlorination operations, so that the operation can be immediately shut down at the sign of a problem anywhere along the test main.
5. Before operations begin, any additional valves shall be closed at the direction of the Engineer.
6. Under the direction of the Engineer, fire hydrants shall be monitored continuously during the operation for possible chlorine contamination.

W3.11 Connections to Existing Pipelines

General: The new pipeline shall be connected to existing pipelines as indicated on the drawings. Connections shall be made by the Contractor only after inspector's approval of complete and satisfactory preparation for such work. The water released by cutting or opening existing pipelines shall be removed and the excavation kept dry at all times.

Where existing mains are provided with fittings for the purpose of connecting to the new main, the Contractor shall remove the plugs or bulkheads, clean the ends, prepare them for connection to the new main, and make the new joints. Where existing mains are not provided with fittings for the purpose of connecting to the existing main which is to be abandoned, the Contractor shall remove the required amount of existing main and make the connection by means of fittings and sections of pipe, as shown on the drawings or as directed by the Engineer.

Shutdowns of existing in-service pipelines will be made as required to complete pipeline connections. A shutdown shall be for as short a period as possible and will be scheduled at such a time during a regular working day that interference with the use of water by the City's customers will be minimized, except as provided below. While an existing pipeline is shut down, the connection work shall be performed without interruption, continuing after regular working hours if necessary, until completed. All costs of making connections to existing pipelines at the time specified shall be included in the bid prices for installing pipe and appurtenances.

W3.12 Prevention of Contamination: All waterline components, including stubs, shall be provided with a permanent capped-physical separation. Specifically, all water main stubs shall be capped per Standard Drawing No. 706. Water services shall be installed with appropriate backflow devices per Standard Drawings #730, 732 and 734.

Control of Shutdowns: In all cases, shutdowns will be made in cooperation with and under the direction of the Engineer. The City will close all valves in making a shutdown and open all valves in restoring pressure to an existing main. All valves required for initiating pressure in the new installation shall be under the direct supervision of the Engineer.

Schedule: The schedule of shutdown and connection operations shall be agreed to jointly between the Contractor and the Engineer. The schedule shall be subject to adjustment by the Engineer as necessary to maintain water service to the customers of the City.

Advance Notice: The Contractor shall give the Engineer two working days written notice before any connection operations are to be performed so that advance preparation on the part of the City can be made.

W4. PROTECTION FROM CORROSION

Corrosion protection shall meet the requirements of these specifications and the special provisions and/or drawings. Where corrosion protection requirements for ferrous metal directly buried has not been specifically required on the plans or specified in detail, a mastic or tape coating shall be applied per manufacturer's recommendation. The determination of the type of coating to be applied in each instance shall be made by the City Engineer. Ferrous metal items to be protected shall include, but not be limited to, valves, fittings, service lines, reinforcing steel anchor rods, flexible couplings, bolts, and nuts, flanges, saddles, tapping sleeves, hydrant buries, and plugged end and blowoff assemblies. Mastic and tape coated ferrous metal shall also be protected with polywrap. All copper and brass parts (for example: water service lines) shall be isolated from contact with steel and cast iron mains by installation of an insulating bushing, coupling, union or flange. Copper piping or any copper or brass part shall not be permitted to contact steel or cast iron pipe at any point. If contact is unavoidable, the copper or brass part shall be mastic or tape coated. All cast iron, steel or other ferrous metal shall be insulated from any concrete structure, such as footings, anchor blocks, encasements or structure walls using mastic, tape coating or other specified coating system extending 6 inches beyond the concrete. All coatings shall be continuous and unbroken, pinhole and holiday free (continuous internal lining through the joint). Apply protective coatings over a properly prepared surface.

W4.1 Plastic Coating: This protective coating is a coal tar synthetic resin solvent release, cold applied coating. The mastic coating may be applied with spray equipment or by hand with brush or rubber gloves. A two coat system shall be applied. The metal surfaces shall first be cleaned of all loose scale, dirt and other foreign matter. No primer is required before application. Each coat shall be applied to produce a minimum wet film thickness of 15 millimeter. with a minimum of two hours allowed between application of coatings. The second coat shall be allowed to dry a minimum of three hours before the backfilling operation begins.

W4.2 Tape Coating: Apply tape coating over a clean surface (no loose rust, scale, dirt, oil or grease). Apply two layers, each layer lapped 1/2 inch, or half lapped if the tape is less than one inch wide. Apply the tape immediately on the wet primer and pull tight enough to conform to the surface being coated. Tape coating shall be Protecto Wrap No. 200, 46 millimeter thickness applied with Protecto Wrap No. 1170 primer, or approved equal.

- W4.3 Polywrap: Polyethylene protective wrapping shall be 8 millimeter thick sheets. The material shall be wrapped completely and the edges shall extend 6" beyond area to be protected. The edges shall be secured with 8 mil. thick, one inch wide Scotchwrap as manufactured by Minnesota Mining and Manufacturing Co., or approved equal.
- W4.4 Modified Resin Protective Coating System: This protective coating shall be either a combination of phenolic resins modified with a small quantity of liquid alkaline cured epoxy resin or an amine cured epoxy resin both containing the proper amounts of plasticizers, solvents and inert pigments. Coating shall be a high build type such as Plasite #7122 as manufactured by Wisconsin Protective Coating Company, Green Bay, Wisconsin; Amercoat #64/1603 as manufactured by Amercoat Corp., South Gate, California; Macor 447 M High Build, manufactured by Magna Corp., Santa Fe Springs, California; Scotchkote No. 302 as manufactured by Minnesota Mining & Manufacturing Co., or approved equal. Application methods shall be as recommended by manufacturer.
- Certification of applicator: The contractor shall submit proof to the City Engineer that the applicator is currently certified by the coating manufacturer to be competent and proficient in the preparation and application of the coating to be used.
- W4.5 Coal Tar Epoxy Coating System: This coating system is a cold-applied catalyzed-epoxy coating modified by combining coal tar pitch with the epoxy resin, plus solvents and pigments.
- The coating material shall be "Target" (manufactured by Pittsburgh Coke and Chemical Company) or approved equal. Application and testing methods shall be as recommended by manufacturer.
- W4.6 Fusion Epoxy Coating System: This lining and coating material shall be 100% dry powder epoxy resin as manufactured by Minnesota Mining & Manufacturing Co., "Scotchkote #103, #105, or #202"; Michigan Chrome and Chemical Co., "Micron #651"; or approved equal. Application and testing methods shall be as recommended by manufacturer.
- W4.7 Electrolysis Control: Standard Electrolysis Test Stations shall be installed in accordance with City of Milpitas Standard Drawing No. 750. Test stations shall be installed at locations shown on the drawings or as directed by the Engineer. The color coding of the wires and the method to be used to terminate the test leads above ground shall be as shown on the Standard Drawing. The distance between the points of connection shall be measured to the nearest one foot and recorded.
- Insulating couplings shall be installed as detailed on the drawings. The preparation of the pipe, and of the replacement coating shall be as herein before specified. The insulating coupling shall be completely and thoroughly coated with the same coating system as the pipe.

Bonding of joints shall be as shown on the drawings. Electrical continuity tests shall be made between each standard electrolysis test station installation. Should the test indicate an open circuit or an unusually high resistance, the Contractor shall rebond the necessary joints until the circuit is continuous and the high resistance is lowered to acceptable values and approved by the Engineer.

Coating Repair: Removal and replacement of the coating shall be done so as to leave the pipe after restoration of the coating in the same condition as before the removal of the coating. The coating will be removed in sufficient quantity to permit the attachment of the wire from the test or anode station. After the test lead is bonded to the cylinder, the void remaining after the coating removal shall be restored to the satisfaction of the Engineer.

Anode stations shall be completely furnished and installed at the locations and in the manner shown on the drawings. The Contractor shall submit to the Engineer for approval details of the terminal installation. Magnesium anodes shall be of the size and type indicated on the drawings. Care shall be taken during backfilling operations to protect anode and pipe terminal cables from damage and breakage.