INFRASTRUCTURE DESIGN STANDARDS

SPECIFICATIONS FOR TRUNK MAIN WORK

March 2012

THE CITY OF NEW YORK
BUREAU OF WATER AND SEWER OPERATIONS
DEPARTMENT OF ENVIRONMENTAL OPERATIONS

SPECIFICATIONS

FOR

TRUNK MAIN WORK

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DIVISION 1

SPECIAL PROVISIONS FOR TRUNK MAIN WORK

(1) **Specifications:** (This shall apply for all steel water main work.)

(A) Material, fabrication, delivery, installation and construction of steel pipe for water main work shall be in accordance with "**Specification For Furnishing, Delivering And Laying Steel Pipe And Appurtenances - March 1999**", included herein.

(B) Material, fabrication and delivery of flow meters for water main work and bolted split sleeve type restrained coupling for water main work shall be in accordance with material specifications "**Standard Specifications For Bi-Directional Ductile-Iron Venturi Flow Meters**", and/or, "**Standard Specifications For Uni-Directional Ductile Iron Venturi Flow Meters**", and "**Standard Split-Sleeve Restrained And Non-Restrained Couplings For Plain-End Pipe**". The Contractor must acquire these water main work specifications (latest revisions) for this contract from the Department of Environmental Protection, Bureau of Water and Sewer Operations, Office of the Chief of Water Main Failure Analysis, 59-17 Junction Boulevard, 3rd Floor-Low Rise, Flushing, NY 11373:

(2) **Schedule Of Shop Drawing Submittals And Approvals:** (This shall apply only to water mains twenty four (24) inches (600 mm.) and larger.)

(A) Within thirty (30) calendar days after the date specified in a written notice signed by the Commissioner, and as further described in **Article 8** of the Contract, the Contractor shall prepare and submit complete geometry drawings as described in **paragraph (3)** below ("Geometry For Water Mains Twenty-Four (24) Inches (600 mm.) And Larger") as well as shop drawings, which are based on the pipe geometry for the first two thousand (2,000) feet (609.6 m.) of pipe scheduled for this contract.

(B) The Engineer will examine the geometry and shop drawings and return them to the Contractor within ten (10) calendar days after receipt of them.

(C) The Contractor shall resubmit all corrected geometry and shop drawings within ten (10) calendar days after the Engineer returns them for corrections.

(D) The Engineer will examine the resubmitted geometry and shop drawings and return them to the Contractor within ten (10) calendar days following receipt of them.

(E) Based on the approved geometry drawings, pipe laying schedule(s), shall be submitted by the Contractor within ten (10) calendar days following the return of the geometry drawings by the Engineer.

(F) The Engineer will examine the submitted pipe laying schedule(s) and return them to the Contractor within ten (10) calendar days following receipt of them.

(G) Within ten (10) calendar days after receipt of the approved pipe laying schedule(s), the Contractor shall submit pipe fabrication drawings.

(H) The Engineer will examine the pipe fabrication drawings and return them to the Contractor within ten (10) calendar days following receipt of them.

(I) The installation of the new trunk main in the field shall start within twenty (20) calendar days after the drawings for installation of the first two thousand (2,000) feet (609.6 m.) of pipe have been approved.

(3) **Geometry For Water Mains Twenty-Four (24) Inches (600 mm.) And Larger:** The Contractor shall excavate test pits and take all necessary field measurements to prepare a trunk main geometry indicating horizontal and vertical alignment and appurtenance locations that conform to the contract specifications, requirements of the contract drawings and to field conditions. Alignment and appurtenance locations shall be indicated by stationing, elevations (datum: mean sea level at Sandy Hook) and deflection angles. Legal and existing street widths, street alignment, grades and all

topographical and subsurface information from property line to property line identified and located shall be shown on the geometry drawing. In addition, the relationship of the trunk main to significant field features (e.g., curbs, cross street centerline, subsurface structures, buildings lines, etc.) shall be indicated by stationing and/or dimensioning. All reference points shall be clearly documented so that they may be reestablished at any time.

The geometry shall be submitted on 22" x 36" (559-mm. x 914-mm.) sheets with a vertical scale of 1"=5' (1:60) and a horizontal scale of 1"=30' (1:360). Each sheet must be stamped by a NYS Licensed Land Surveyor and/or Professional Engineer and submitted for approval to the Engineer.

The Contractor shall also submit for approval a pipe-laying schedule based on the approved geometry. After approval of the pipe-laying schedule, pipe fabrication drawings shall be submitted for approval to the Engineer.

Payment for preparation of the geometry (including field measurements and test pits within the contract specified trench limits), the pipe-laying schedule and the fabrication drawings shall be deemed included in the various contract items. However, additional test pits, if ordered by the Engineer, shall be paid for under item labeled "ADDITIONAL EARTH EXCAVATION INCLUDING TEST PITS".

(4) **Drawings Furnished By The Contractor:** The Contractor shall furnish whenever required, drawings showing in detail the materials and construction of any part of the mains and appurtenances for which the Engineer does not issue detail drawings. No time will be allowed for delays caused by the Contractor submitting drawings that are not in accordance with the specifications. The Contractor shall check all dimensions and quantities on the drawings or schedule given to the Contractor by the Engineer, and shall notify the Engineer of all errors therein which the Contractor may discover.

(5) **As-Built Drawings for Contracts Involving Water Mains Twenty Four (24)-Inches (600 mm.) and Above:** Upon completion of the work and as a condition precedent to obtaining the certificate for Substantial Completion under **Article 44** of the Contract, the Contractor shall furnish to the City one (1) complete set of reproducible ink, record contract drawings on mylar. All drawings shall conform to the standard size of 22" x 36" (559-mm. x 914-mm.) using a 1"=30' (1:360) horizontal and 1"=10' (1:120) vertical scale. All such record or as-built work shall be as directed by the Engineer, and such drawings shall become the property of the City. No direct payment will be made for this work, compensation for such work shall be deemed included in other items.

(6) **Additional Provisions For Adjustment In Payment:**

(A) PARTIAL PAYMENTS: As the basis for estimating the allowances for steel pipes and appurtenances prior to their installation, and for the purpose of making partial payments, the Contractor shall submit to the Engineer material supplier's bills certified by the material supplier as to the amounts and quantities the Contractor charged. These certified amounts will be assumed as the latest prices.

If material for which partial payments are made are not at the site or in the storage yard, on land owned by the City, the lease or leases to the land where such material is stored shall be assigned by the Contractor to the City before partial payments will be made for such material.

The area of the storage yard shall be sufficient to store the pipes without piling, and the yard shall be of acceptable configuration, suitable for the storage and handling of pipe. The yard shall be enclosed with an approved security fence with suitable hinges or rolling gates for trucks and, if ordered, separate hinged gates for persons shall be provided at approved locations. All gates shall have locks sufficient to protect the stored material and the Engineer shall be provided with keys. The Contractor shall continuously provide the services of a security watchman, and the storage yard shall be maintained in a neat and serviceable condition until permission is given for its discontinued use.

(B) LENGTH OF STEEL MAINS FOR FINAL PAYMENT: For the purpose of payment, the length of steel mains furnished, delivered and laid will be taken as measured along the axis of the pipe in place from the end of the existing pipe, irrespective of the number of joints, outlets or closure pieces, but excluding the lengths of valves or other appurtenances for which separate payment is provided.

The length of each reducer will be taken as the centerline length of the reducer portion of the pipe section with the larger diameter taken as the diameter of the reducer.

The length of each shop fabricated bend for steel pipe, for which payment will be made, shall be determined from the true angle of the bend and a radius of bend two and one-half (2-1/2) times the nominal diameter of the pipe, or a radius allowed by the Engineer to make the proper fittings.

No extra payment will be made for corporation stop connections, sampling outlet connections, and miter cuts on steel pipe made up in the shop, but payment therefore will be included in the unit price per linear foot of steel pipe.

Tangent pieces adjacent to bends will not be included in figuring the length of bends, but payment thereof will be made at the unit price for linear foot as straight pipe.

No extra payment will be made for pipe cut in the field, and unused because of necessity to make bevel field joints to provide for unexpected conditions required through no fault or omission on the part of the Contractor and shall become the property of the Contractor and shall be hauled away from the field.

The caulking bands and sleeve closure pieces used to connect the new pipe to the existing pipe shall be included for the purpose of payment in the price bid for item labeled "FURNISHING, DELIVERING AND INSTALLING PLATE STEEL OUTLETS ON STEEL PIPE, INCLUDING STEEL PIPE CLOSURE SLEEVE, CAULKING BANDS AND ACCESS MANHOLE OUTLET WITH COVER, NUTS AND BOLTS COMPLETE".

(C) NO EXTRA PAYMENT FOR FLANGES: No extra payment will be made for flanges including bolts and all accessories on straight pipe, reducers, bends, special castings, spool pieces or piping adjacent to expansion joints, but payment thereof will be included in the unit price bid per linear foot as straight pipe or bends, if flanges are part of the straight pipe or bends.

No extra payment will be made for insulated flange joints indicated on the standard and contract drawings, but payment thereof will be deemed to be included in other items.

(D) FURNISHING, DELIVERING AND INSTALLING BUTTERFLY VALVES

(a) Description: These specifications are applicable for installing butterfly valves with its appurtenances.

(b) Materials: Butterfly valves shall be in compliance with **Section 2.03 - Standard Specifications For Butterfly Valves 24-inch To 72-Inch With Manual Actuators.**

(c) Construction Methods: The Contractor shall furnish, test, deliver and install butterfly valves and actuators complete and ready for operation as specified herein, to the sizes and at the locations shown on the contract drawing and as directed by the Engineer.

The butterfly valves together with all adjacent appurtenances (bypass, expansion joint or coupling) shall be housed in chambers which shall be constructed by the Contractor in accordance with the following:

(1) For 24-Inch Thru 48-Inch Butterfly Valves - Applicable Standard Drawing.
(2) For 60-Inch And 72-Inch Butterfly Valves - Applicable Contract Drawing.

(d) Expansion Joints: Expansion joints will be installed at each 48" (1200-mm.), 36" (900-mm.), and 30" (750-mm.) line and connection valve as per Department **Standard Drawing No. 48829-Z.** Payment will be made at the unit price bid in the Schedule of Bid Prices for appropriate item labeled "FURNISHING, DELIVERING AND INSTALLING 48" (1200-MM.), 36" (900-MM.), OR 30" (750-MM.) EXPANSION JOINT FOR BUTTERFLY VALVES INCLUDING 6-INCH BY-PASS OUTLET", and shall include the pipe with the six (6) inch (150-mm.) bypass outlet between the expansion joint and valve. Expansion joints will be of the slip type with limiting rods, Dresser Style 63, Type III or Baker Expansion Joint, Type 3, Series 403 or approved equal. Slip pipe shall be stainless steel. Contractor is to submit detailed shop drawings to the Engineer for approval.

All internal and external steel surfaces of each expansion joint, except the slip pipe, shall be cleaned and sand blasted in full accordance with Steel Structures Painting Council Specifications SSPC-SP5, White Metal Blast Cleaning. Since these surfaces will be required to function satisfactorily in submerged service, the Contractor is specifically advised that Commercial or Near-White blast cleaning is not acceptable.

Immediately after cleaning, such surfaces will be primed and later finished with two coats of a National Sanitation Foundation (NSF) approved material specifically formulated for potable water usage and applied in accordance with the manufacturer's instructions. After assembly, defects in coating shall be rectified.

(e) Bolted, Split Sleeve Type Restrained Coupling: Where shown on the contract drawing or directed by the Engineer, the Contractor shall furnish, deliver and install Victaulic Depend-O-Lok, Fixed x Fixed, Type 2RC Restrained Coupling, 250-psi minimum, or approved equal, in lieu of an expansion joint. The coupling shall be installed as per manufacturer's recommendations and as directed by the Engineer.

(f) By-Pass For Butterfly Valve: The Contractor shall install the external by-pass as indicated on the Standard Drawing for the valve chamber for 30-inch (0.76-m.), 36-inch (0.91-m.), 48-inch (1.22-m.), 60-inch (1.52-m) and 72-inch (1.83-m) diameter Butterfly Valves.

Provision for Payment: There will be no direct payment for various components, including six (6) inch (150-mm.) outlet and six (6) inch (150-mm.) flanged valve for installing complete by-pass valve arrangement, but payment for these components will be included in the unit price bid in the Schedule of Bid Prices for appropriate item labeled "FURNISHING, DELIVERING AND INSTALLING EXPANSION JOINT FOR BUTTERFLY VALVES INCLUDING 6-INCH BY-PASS OUTLET", or, for appropriate item labeled "FURNISHING, DELIVERING AND INSTALLING COUPLING".

(g) Measurement: The quantity of butterfly valves measured for payment shall be the number of butterfly valves of each size actually furnished, delivered and installed by the Contractor and approved by the Engineer.

(h) Price To Cover:

(1) The contract price for FURNISHING, DELIVERING AND INSTALLING BUTTERFLY VALVE WITH BY-PASS ARRANGEMENT AND OUTLET, COMPLETE shall be the unit price bid for each size of butterfly valve furnished, delivered and installed and shall cover the cost of all labor, equipment, materials, plant, samples, tests and insurance required and necessary to furnish, deliver and install butterfly valves in the manner specified herein. No separate or additional payment will be made for any costs associated with the work of furnishing, delivering and installing butterfly valves.

(2) Payment for the chamber (concrete, reinforcing steel, structural steel, miscellaneous steel, manhole steps, castings and pipe-to-wall penetration seals) shall be made to the Contractor under the appropriate bid items.

(3) Payment for expansion joint or coupling shall be made to the Contractor under the appropriate bid items.

(E) FURNISHING, DELIVERING AND INSTALLING FLOW METERS

(a) Description: These specifications are applicable for installing flow meters with its appurtenances.

(b) Materials: Flow Meters shall be in compliance with "**Standard Specifications For Bi-Directional Ductile-Iron Venturi Flow Meters**", and/or, "**Standard Specifications For Uni-Directional Ductile Iron Venturi Flow Meters**".

(c) Construction Methods: The Contractor shall furnish, test, deliver and install flow meters complete with all instrumentation, recorders and appurtenances to the sizes and at the locations shown on the contract drawing and as directed by the Engineer.

The flow meters together with all required appurtenances shall be housed in chambers which shall be constructed by the Contractor in accordance with the following:

(1) For 12-Inch Thru 48-Inch Flow Meters - Applicable Standard Drawing.
(2) For 60-Inch And 72-Inch Flow Meters - Applicable Contract Drawing.

(d) Bolted, Split Sleeve Type Restrained Coupling: Where shown on the contract drawing or directed by the Engineer, the Contractor shall furnish, deliver and install Victaulic Depend-O-Lok, Fixed x Fixed, Type 2RC Restrained Coupling, 250-psi minimum, or approved equal, in lieu of a bolted, sleeve-type coupling with external restraint system. The coupling shall be installed as per manufacturer's recommendations and as directed by the Engineer.

(e) Measurement: The quantity of flow meters measured for payment shall be the number of flow meters of each size actually furnished, delivered and installed by the Contractor and approved by the Engineer.

(f) Price To Cover:

(1) The contract price for FURNISHING, DELIVERING AND INSTALLING FLOW METER TUBE AND APPURTENANCES, COMPLETE shall be the unit price bid for each size of flow meter furnished, delivered and installed and shall cover the cost of all labor, equipment, materials, plant, samples, tests and insurance required and necessary to furnish, deliver and install flow meters in the manner specified herein. No separate or additional payment will be made for any costs associated with the work of furnishing, delivering and installing flow meters.

(2) Payment for the chamber (concrete, reinforcing steel, structural steel, miscellaneous steel, manhole steps and pipe-to-wall penetration seals), coupling, piping and castings shall be made to the Contractor under the appropriate bid items.

(7) Sequence Of Work: The sequence of work and shut-down periods shall be determined by the Department of Environmental Protection, Agency Borough Distribution Engineer.

(8) Furnishing, Installing And Testing Corrosion Control System For Water Mains Twenty-Four (24) Inches (600 mm.) And Above:

(A) IF A CORROSION CONTROL SYSTEM DESIGN IS NOT FURNISHED WITH THIS CONTRACT: The Contractor shall furnish all labor, equipment and materials to study, design, install and test a Department approved complete corrosion control system for the protection of water mains and appurtenances installed under this contract. The Contractor shall under this article employ the services of a Corrosion Specialist, as accredited by Nace International, and as approved by DEP, having proven expertise in designing, installing and testing or supervising the installation and testing of the DEP approved corrosion control system.

Survey and Design of the corrosion control system shall, at a minimum, address the following considerations:

(a) A survey and engineering study shall be conducted for determining the cause or causes of probable future corrosion problems and the type and extent of the required control system; and,

(b) The study shall analyze the soil samples taken and the applicability of various corrosion control methods providing adequate protection against corrosion. In addition to the protection as provided by the insulating joints, the study shall offer conclusive recommendations and the proposed system shall address those recommendations which is to consist of one method or a combination of methods such as electrical isolation of vulnerable elements of the installation, properly selected coatings, and galvanic anode cathodic protection. Where galvanic anodes are recommended, they shall be designed and sized to last and provide the required protection for at least twenty (20) years. The recommendations shall cover the number and location of proposed corrosion control test stations required. Insulating coating, if required, shall be applied in addition to the standard pipe coating; and,

(c) The study shall also analyze the effects of the proposed corrosion control system upon neighboring underground pipelines, utilities and other installations. Special care shall be taken to avoid any harm or damage to the said installations due to the installation and function of the corrosion control system to be installed under this contract; and,

(d) Design documents, based on approved recommendations of the engineering study, shall be prepared and submitted for approval to the Bureau; and,

Suitable drawings shall be prepared to designate the overall layout of the piping and appurtenances to be protected and the location of significant items of structure hardware, corrosion control test stations, electrical bonds, insulators, and neighboring buried or submerged metallic structures.

Locations of proposed galvanic anode installations shall be recorded on the drawings or in tabular form with appropriate notes as to anode type, weight, spacing, depth, and backfill; and,

(e) Specifications shall be prepared for all materials and installation methods incorporated in the construction of the corrosion protection system.

The corrosion control system shall be installed in strict conformance with the requirements shown on the approved design drawings and specifications.

To verify that the installation is made in strict accord with the drawings and specifications, all work in connection with the installation of the corrosion control system shall be done under the surveillance and direct supervision of trained and qualified personnel referred to in **paragraph (8)(A)** above.

All deviations from construction specifications shall be noted on as-built drawings.

After the corrosion control system is energized, a survey by electrical measurements and inspections shall be conducted to determine that protection has been established in accordance with applicable criteria and that each part of the system is operating properly and efficiently.

As part of preparing the design documents, a complete Operation and Maintenance Manual shall be prepared, five (5) copies of which shall be submitted to the Department. The manuals shall include but not be limited to the following information:

(1) Frequency and conduct of periodic surveys.

(2) Inspection test methods, testing equipment and instruments to be used.

(3) Remedial measures to be taken when periodic surveys and inspections indicate that protection is no longer adequate.

(4) Corrosion control records to be established and maintained.

(B) IF A COMPLETE CORROSION CONTROL SYSTEM DESIGN IS FURNISHED WITH THIS CONTRACT: The Contractor shall employ the services of a Corrosion Specialist, as accredited by Nace International, and as approved by DEP. The Contractor shall furnish all labor, equipment and materials and install approved complete corrosion control system for the protection of water mains and appurtenances installed under this contract and as specified in **Part IV of "Specification for Furnishing, Delivering and Laying Steel Pipes and Appurtenances"** latest revision, on file at the office of the Department of Design and Construction, located at 30-30 Thomson Avenue L.I.C., N.Y. 11101 and as shown on the contract drawings.

The Corrosion Specialist hired by the Contractor shall be responsible for all testing, installation and survey work done regarding the cathodic protection system and notifying the Engineer of any inaccuracies, errors of omission or inconsistencies in the design drawings for corrosion control.

The corrosion control system shall be installed in strict conformance with the requirements shown on the design drawings and specifications. All deviations from construction specifications shall be noted on as-built drawings.

After the corrosion control system is energized, a survey by electrical measurements and inspections shall be conducted to determine that protection has been established in accordance with applicable criteria and that each part of the system is operating properly and efficiently.

Before commencing any construction activity pertaining to the installation of a corrosion control system, regardless of whether the corrosion control system design was furnished by the Contractor or the City, the Contractor shall notify the Engineer. To verify that the installation is made in strict accord with the drawings and specifications, all work in connection with the installation of the corrosion control system shall be done under the surveillance and direct supervision of the Engineer.

For all labor, equipment, materials, expenses and costs necessary to perform completely the work to be done under this article for either case as specified above, the Contractor shall receive the lump sum bid for this Item. No additional payment will be made under any other items for labor, material, equipment, expenses and costs furnished under this Item.

(9) Flange Bolts, Nuts And Washers:

All flange bolts, nuts, and washers for insulated flange joints for valves, outlets, and tie-ins shall be stainless steel as per Section 15 of the "**Specification For Furnishing, Delivering And Laying Steel Pipe And Appurtenances - March 1999**".

In addition, carbon steel flange bolts, nuts, and washers for all non-insulated flange joints shall be as per Section 15 of the aforementioned specification and shall be coated with a fluoropolymer coating meeting the 1,000-hour salt spray requirements of ASTM B117. The fluoropolymer coating shall be Tripac as manufactured by Tripac Fasteners, 475 Klug Circle, Corona, CA 92880, or approved equal.

(10) Existing Sampling Stations:

Any existing sampling station shall be reconnected to the new water main to the satisfaction of the Engineer. There shall be no extra payment to the Contractor for this work, including removal, temporary storage, and re-installation of the sampling station and appurtenances, as required. If any damage occurs, the Contractor shall repair such damage at own expense to the satisfaction of the Engineer. The Contractor shall submit shop drawings showing details of the sampling station connection to the new water main for review and approval by the Engineer prior to construction.

(11) Standard Valve Chambers:

The Contractor is advised that the dimensions and layouts of the various components within the standard chambers may differ from those shown on the standard drawings. The Contractor shall verify all dimensions and accordingly alter roof slabs and/or chamber dimensions for operational access to the valves. Shop drawings detailing all alteration work to the roof slabs and/or chamber shall be submitted to the Engineer for review and approval prior to chamber construction. The cost for this alteration work shall be deemed included in the appropriate bid items provided in the contract. No additional or separate payment will be made for this alteration work.

For regulator valve chambers, the opening for the manway access (casting where the steps are located) shall be on the side (determined by pipe centerline) of the chamber where the regulator control components and sump pit are located. Regulator valve chambers must be located completely within a sidewalk or mall area and not within roadway areas.

Any relocation of chambers due to field conditions must be approved by the Engineer.

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CITY OF NEW YORK

DEPARTMENT OF ENVIRONMENTAL PROTECTION

BUREAU OF WATER SUPPLY AND WASTEWATER COLLECTION

SPECIFICATION FOR

FURNISHING, DELIVERING, AND LAYING

STEEL PIPE AND APPURTENANCES

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Specification for Furnishing, Delivering and Laying Steel Pipe and Appurtenances

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PART I

FURNISHING AND DELIVERING STEEL PIPES AND APPURTENANCES 30 INCHES IN DIAMETER AND LARGER

I. INTENT OF SPECIFICATIONS:

It is the intention of this part of the specifications to describe the materials and workmanship entering into the fabrication, shop testing and delivery of the items for an electrically welded steel pressure main, 30" in diameter and larger, with all necessary appurtenances. Wherever Standard Specifications and Standard Drawings are listed in these Specifications, it shall mean the latest revisions in effect on the date of the Bid.

2. WORK INCLUDED:

The Contractor shall furnish and deliver the steel pipe and appurtenances indicated on the drawings. Steel pipe and plate steel specials, 30" and larger in diameter, shall comply with the requirements of these specifications and the American Water Works Association Standard for Steel Water Pipe 6 Inches and Larger, ANSI/AWWA C200-97; where there may be a conflict between the AWWA Standard and these specifications, the latter shall prevail. Wherever the drawings include steel pipe and specials 24" in diameter and smaller, they shall conform with the requirements of the "Specifications for Furnishing and Delivering Steel Pipe Up to and Including 24-inch Diameter" as given in Part V of this Specification. On all Bureau of Water Supply and Wastewater Collection Drawings, for trunk mains 30-inch in diameter and larger the inside diameter of the pipe is the nominal diameter.

3. GEOMETRY OF PIPE:

To determine the definite horizontal and vertical alignment of the pipeline, the Contractor shall excavate test pits along the line of the work and prepare a pipe geometry as described in Article 33 of the General Conditions. Based on field survey data and pipe geometry, the Contractor shall prepare the shop drawings and the schedule(s) of straight pipe, including random lengths and closure pieces, and of all bends and fittings, required to complete the work, and submit them to the Engineer for approval.

4. CHANGES IN ALIGNMENT AND GRADE:

The contract drawings give the alignment and grades of the pipes based upon the existing substructures as shown on these drawings, and the work will be laid out approximately as shown thereon. Corrections in alignment and grades may be necessary as the trench is excavated. Test pits shall be done to minimize these corrections. Changes in the alignment or grades, from those shown on the contract drawings, and alterations of pipes, either in the shop or in the field, due to such changes in alignment or grade shall be made by the Contractor at his own expense, except that additional compensation will be made for bends other than those shown on the drawings, required to deflect the pipe line over, under or around the City owned structures, as provided in the "Proposal for Bids".

5. CURVES AND OTHER SPECIALS:

Wherever changes in line or grade of the pipes make angles necessary, they shall be formed by cutting and beveling the ends of a sufficient number of courses to produce the desired total deflection or curvature. All bends less than 2-1/2 degrees shall be made up of straight pipe with mitre cuts at the ends, these cuts being made in the shop. As an alternate to the foregoing, and where appropriate, pipe may be deflected within bell end in accordance with Standard Drawing No. 35310-C-Y. Closure or filler pieces of odd lengths shall be furnished and delivered by the Contractor as required and approved. The Contractor shall take careful measurements to determine the dimensions and curvature of all bends, closure pieces and other specials required, and shall be responsible for the accurate detailing and fabrication of same so that they will fit in the work. The shop drawings for all pipes, reducers, bends and other specials shall be submitted for approval of the Engineer before fabrication.

6. RESERVE CLOSURE PIECES AND BENDS:

If called for by a note on the contract drawings, the Contractor shall furnish, deliver and have in reserve, in advance of the delivery of the other pipe, certain random lengths or closure pieces and bends to be used at locations where unexpected obstructions or other difficulties may arise, requiring their immediate use to avoid leaving the trench open at such locations for long periods, or otherwise delaying the completion of the pipe line. The number and dimensions of such closure pieces and bends to be furnished shall be as given on the drawings.

Any pipe, bend or special which is not called for in the schedules or on the contract drawings, or which is not required in the finished work, but which may have been delivered, shall at the finish of the contract, remain the property of the Contractor, or revert to him, and shall be promptly removed by him from the site of the work.

Where apiece of pipe has been cut, the remaining section may be incorporated in the work by the Contractor, provided the length is not less than 7-1/2 feet.

Sections less than 7-1/2 feet in length may be used, with the approval of the Engineer.

7. COATING AND LINING:

All steel pipe, specials, and fittings, fabricated of steel and lining plate, shall be lined on the interior and coated on the exterior as hereinafter described in Part III, "Lining and Coating of Steel Pipe and Appurtenances in the Shop and in the Field".

8. MATERIALS:

Steel for plates of welded pipe shall be manufactured by one or more of the following processes: open hearth, basic-oxygen or electric furnace and shall fulfill the requirements of a carbon steel from the following table:

TYPE OF STEEL*	GRADE	YIELD POINT P.S.I., MIN.	TENSILE STRENGTH P.S.I.
A 36	---	36,000	58,000 to 80,000
A 135	B	35,000	60,000 min.
A 139	B C D	35,000 42,000 46,000	60,000 min. 60,000 min. 60,000 min.
A 283	C D	30,000 33,000	55,000 to 70,000 60,000 to 75,000
A 572	42 50 60	42,000 50,000 60,000	60,000 min. 65,000 min. 75,000 min.
A 570	33 36 40 45 50	33,000 36,000 40,000 45,000 50,000	52,000 min. 53,000 min. 55,000 min. 60,000 min. 65,000 min.

* The type of steel chosen by the Contractor to be used on this contract shall conform to the minimum yield strength(s) and pipe wall thickness(es) as designated on the contract drawings. Unusual field conditions may require special designs in these cases pertinent calculations shall be submitted by the Contractor to the Engineer for approval before commencing fabrications.

Pipe shall be furnished to meet the requirements of the Standard Specification for Pipe, Steel, Electric-Fusion (ARC)-Welded (Sizes NPS 16 and Over), ASTM Designation A134-85, or the Standard Specification for Electric-Resistance Welded Steel Pipe, ASTM Designation A135-88, or the Standard Specification for Electric-Fusion (ARC)-Welded Steel Pipe (NPS 4 and Over), ASTM Designation A139-88 as longitudinal straight seam, circumferential girth seam or spiral seam manufactured electric-fusion arc welded product.

All specimens and records shall be furnished and analyses and tests made, as provided in the above specifications. The Contractor shall notify the Engineer in writing at least five (5) days in advance of the date of rolling, sampling and testing of the plate. The Engineer will then determine whether the Department will be represented by an inspector during the fabrication and test, or will, in lieu thereof, accept certified copies of the mill tests and analyses. Duplicate samples shall be furnished to the Engineer whenever required. Two copies of mill test reports of all materials shall be submitted to the Department Inspector.

9. THICKNESS:

Unless otherwise noted on the contract drawings, the thickness of steel plates for pipe and fittings which may be ordered by weight, shall be as follows:

Nominal Size of Pipe	Thickness	Nominal Weight
30" and 36"	3/8"	15.3 Lb. per Sq. Ft.
48" to 72"	1/2"	20.4 Lb. per Sq. Ft.
"	5/8"	25.5 Lb. per Sq. Ft.
"	3/4"	30.6 Lb. per Sq. Ft.
"	7/8"	35.7 Lb. per Sq. Ft.

30-inch and 36-inch diameter Electric-Fusion (ARC)-Welded Steel Pipe, 3/8" wall thickness, ASTM Designation A139, Grade B, will be accepted under these specifications, as a substitute for pipe fabricated from carbon steel plate manufactured to meet Standard Specification Tensile ASTM Designation A283-88, Grade D requirements.

10. DIMENSIONS:

Pipe fabricated for lap fillet welded field joints shall be made with alternate inside and outside courses without reduction in the thickness or in the nominal diameter which is the inside diameter of the inside course; with a clearance between the laps of the pipe of 1/8" maximum and 1/16" minimum, measured on the diameter, and similar to that shown on Drawing No. 35310-C-Y unless otherwise indicated on the contract drawings or specified.

Pipe for lap fillet welded field joints may also be fabricated by cold expanding one end to form a bell or by shop welding a steel sleeve on one end, the inside and remaining outside joints being made in the field as shown on Standard Drawing No. 35310-C-Y.

Pipe shall be not less than 30 ft. long except where shorter lengths are required and be manufactured by either spiral weld process using the double submerged arc welding method from steel coil, or the electric-fusion (arc)-welded straight-seam welding method using rolled plates. All longitudinal seams, splice seams, spiral seams and shop girth seams shall be butt-welded. The welding procedure chosen must be approved by the Engineer before any production starts. When the straight-seam manufacturing method is chosen, pipe 30" in diameter shall be made with one longitudinal seam. Pipe 36" to 48" in diameter may be made with two longitudinal seams. Pipe 60" and larger may be made with three longitudinal seams. On 36" to 48" diameter pipes, the plate shall subtend a minimum arc of 150 degrees. On pipe 60" in diameter and larger, the minimum arc shall be 100 degrees.

11. FABRICATION:

All shearing, rolling, punching, fitting, welding and other shop operations shall be done in a shop having adequate facilities to produce sufficient pipe per daytime shift to enable the Contractor to fulfill the time requirements of this contract. Spiral welded pipe shall be fabricated from coiled steel stock, purchased to the appropriate ASTM standard in automatic equipment that is capable of forming the proper thickness and strength pipe required by Contract requirements. Pipe fabricated from plate shall be cold rolled to the proper curvature for its entire length. The variation of the radius of curvature from the specified radius shall be held within the generally accepted limits of good workmanship.

There shall be no flat area along the longitudinal seams; the plate shall be crimped in a suitable press before rolling, or other special forming shall be employed to meet this requirement.

All surfaces to be welded shall be thoroughly freed from rust, scale and dirt before welding. Joint edges shall be smooth, uniform and free from defects that adversely affects proper welding. Surfaces and edges that are torch cut or air-arc gouged shall be ground to remove slag and oxidation and be of the proper shape and contour for welding.

Longitudinal, spiral, splice and circumferential shop joints shall be double butt welded, with complete penetration by a method subject to the approval of the Engineer. Peripheral joints of pipe and special fittings shall be accurately aligned and retained in position so that edges meet and surfaces coincide within 1/8". The welds shall be central to the seam with complete penetration and, with automatic welding; the weld reinforcement shall not extend more than 1/8" above the plate surface. The weld bead lying within the area of the contract surfaces of the field joint shall be ground flush with the plate.

Circumferential (girth) seams shall not be less than 7-1/2 feet apart for straight pipe, unless otherwise approved or directed by the Engineer. The butt welding joints used in the shop for these seams shall have the outside surface of the pipe coincide within one-sixteenth (1/16) of an inch, and the adjoining plates within one-eighth (1/8) of an inch, at the closest points.

The straightness of a 40-foot length of pipe shall not deviate more than plus or minus one-half (1/2) of an inch from a straight line.

The roundness tolerances shall be as follows: The circumference shall not be smaller than one-sixteenth (1/16) of an inch or greater than one-eighth (1/8) of an inch from the true circumference. Each of the diameters when measured on the zero, 120, and 240 degrees axes shall not vary more than 3/16" from the true diameter.

The inside of the pipe shall be prepared for the lining process, with cleaning of welds and weld spatter.

12. WELDING RODS, ELECTRODES, AND FILLER METALS:

All welding materials shall comply with the ASME Boiler and Pressure Vessel Code, Section II Material Specifications, Part C - Welding Rods, Electrodes, and Filler Metals. Materials and procedures shall be such quality as will insure thorough full penetration and sound weldments. Any welding rod, electrode, flux, filler metal that shows undesirable properties during welding shall be rejected.

Welding rods for manual welding shall be of the low hydrogen type, conforming to AWS/ASME Designations E7018, E6018, E7016, or E6016 or as required for the particular steel being used. Provision shall be made to store these electrodes in a dry place at the job or field site and to keep them free from moisture at all times until used.

The welding procedure specification (WPS), the procedure qualification record (PQR), and the welder/welding operator performance qualification tests (WPQ) in the shop or field shall be indicated on the shop drawings as part of the general notes and must be approved by the Engineer before any production can proceed.

The welding procedures shall be qualified in accordance with the American Welding Society standard qualification procedures as given in: AWS B2.1, Welding Procedure and Performance Qualification, and AWS D10.9, Specification for Qualification of Welding Procedures and Welders for Piping and Tubing

(available from American Welding Society, 50 NW LeJeune Rd., Miami, FL 33125) or ASME Section IX of the Boiler and Pressure Vessel Code (available from The American Society of Mechanical Engineers, 345 East 47 Street, New York, New York 10017). ASTM standards are available from ASTM, 1916 Race Street, Philadelphia, PA 19103-1187.

13. SPECIAL FITTINGS:

The design of bends and special fittings shall be subject to the approval of the Engineer before fabrication. The term, special fittings, as used in this paragraph shall mean any bend or fitting of plate steel of which one or more peripheral joints are made in the shop, or any plate steel reducer. In general, the angle subtended by any one segment of a bend shall not exceed 15 degrees, and no circumferential (girth) seam shall intersect another. The radius of any bend, unless otherwise required and approved, shall be not less than two and a half (2-1/2) times the nominal diameter of the pipe. One out of every 10 bends or specials shall have a specimen cut out of each weld and tested, as per the requirements of Paragraph 17.

Fittings shall have dimensions as given in Standard AWWA C208 (R89) except where such dimensions conflict with these specifications or applicable Bureau Contractor Standard Drawings.

Two mitre cuts (i.e. one shop welded joint) is permissible for a maximum deflection of 15 degrees.

Two shop-welded joints, (i.e., one intermediate segment) are required for angles greater than 15 degrees, but not exceeding 30 degrees.

Three shop-welded joints (i.e. two intermediate segments) are required for angles greater than 30 degrees, but not exceeding 45 degrees.

Four shop welded joints (i.e. three intermediated segments) required for angles greater than 45 degrees, but not exceeding 60 degrees.

Payment for bends will be made by computing the length along the centerline of pipe from "point of curvature" to "point of tangency", using the radius of the bend and the true deflection central angle.

From the above, mitre cuts for shop welded joints shall not exceed 7-1/2 degrees.

14. FIELD JOINTS:

Field joints, unless otherwise indicated on contract drawings, shall be lap fillet welded as shown on Standard Drawing No. 35310-C-Y. A 15/16 inch diameter bolting up hole on the field top center line, 1/4 inch from each end of pipe or special, shall be provided at each joint. For field-testing, a 1/4 inch N.P.T. tapped hole shall be provided. This hole shall be located on the outside of the pipe, in the center of the lap, and approximately six (6) inches away from the bolting up hole. The tapped hole shall be plugged before shipping.

Surfaces and edges to be welded shall be free from scale, rust and other foreign material. Edges that have been torch cut or air-arc gouged shall be ground to remove slag and oxidation. All edges must have the proper bevel and miter configuration as given by the Engineer, approved welding procedures and as per AWWA Standard for Field Welding of Steel Water Pipe, ANSI/AWWA C206-91.

I5. FLANGED JOINTS:

Flanges for flanged joints, where called for or as indicated on the contract, shall be standard steel hub or ring slip-on flanges in accordance with AWWA C207-94 (or latest revision thereof) Class E. Flanges shall be made from seamless forgings which meet the requirements of the Standard Specification for Forgings, Carbon Steel, for General-Purpose Piping, ASTM Designation A181-87, Class 70 or the Standard Specification for Forgings, Carbon Steel, for Piping Components, ASTM Designation A105- 87. Flanges may also be cut as a single piece from steel plate conforming to the requirements of AWWA Standard for Steel Pipe Flanges for Waterworks Service - sizes 4 in. through 144 in., ANSI/AWWA C207-94.

Flanges shall be flat faced: that is, without projection or raised face and shall be welded front and back with continuous fillet weld size equal to the pipe wall thickness. Flanges shall be spot faced or back faced at the rear; such facing shall not reduce the minimum flange thickness by more than 1/16-inch. The spot or back facing shall be in accordance with MSS Standard Practice SP-6-1985, Standard Finishes for Contact Faces of Pipe Flanges and Connecting-End Flanges of Valves and Fittings and MSS Standard Practice SP-9-1987, Spot Facing for Bronze, Iron and Steel Flanges (available from Manufacturers Standardization Society of the Valve and Fittings Industry, Inc. 127 Park St., NE, Vienna, VA 22180).

Dimensions of flanges shall conform to Class E hub-type or ring-type slip on flanges in accordance with ANSI/AWWA C207-94 except for the bolt holes on insulated flanged joints. For insulated flange joints the bolt hole diameters shall be 1/16-inch larger than the table values for flanges of pipes 16-inches diameter and less and 1/8-inch larger than the table values for flanges of pipes greater than 16-inches diameter. For flanges for outlet connections see Standard Drawing No. 38226-Y, latest revision; for flanges for insulated flanged joints see Standard Drawing No. 46104-W, latest revision, "Insulated Flange Joints for Reduction of Electrolysis in Trunk Mains".

Blind flanges shall be as per AWWA C207-94, Class E, ring slip on type. Blind flanges shall be flat-faced.

Each flanged joint shall be drilled and tapped with a 1/4 inch hole for subsequent air testing as shown on Standard Drawing No. 35310-C-Y, Joints for Steel Water Mains.

Center gaskets shall be full-faced rubber with cotton cloth insertor epoxy/glass, 1/8 inch thick, with bolt holes and bolt circle to match the AWWA Standard Class E Type flanges for pipe 30-inches and larger in diameter. Material for gaskets shall be; (a) cotton cloth-reinforced SBR rubber, Style 159, as manufactured by Garlock, Inc., Mechanical Packing Division, Palmyra, NY, 14522-9355, or (b) Model No.1175 as manufactured by Allstate Gasket and Packing, Inc., Hicksville, NY or approved equal.

Bolts, nuts and washers for un-insulated joints shall be carbon steel to meet the requirements of the Standard Specification for Carbon Steel Bolts and Studs, 60000 PSI Tensile Strength, ASTM Designation A307-90, Grade B for bolts; ASTM A563-90, Grade A for nuts; and ASTM F844-90 for washers. The bolt head and nut shall be of the heavy hex series in accordance with the dimensions shown in ANSI B18.2.1 for heavy hex bolts; ANSI B18.2.2 for heavy hex nuts. Two washers per bolt (one on the inside head and the other on the nut) will be required. The washers shall be in accordance with ANSI B18.22.1, Type A, Table 1B (wide). All bolts and nuts shall be threaded in accordance with ASME B1.1-1989 (Revision of ANSI B1.1-1982) Unified Inch Screw Threads, Course Thread Series (UNC), Class 2A and 2B fit respectively and all surfaces shall be free of mill scale.

For insulated joints, bolts and studs shall be stainless steel Type 304 and meet the requirements of the Standard Specification for Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service, ASTM Designation A193/A193M-90, Grade B8A. Class 1a: with a Class 2A thread fit. The thread bolt shall be the heavy hex type in accordance with the dimensions of ANSI B18.2.1-1981 and the Heavy Hex Screws Series. All bolts and studs up to 1-inch diameter shall be threaded with the coarse thread series (UNC) and with the 8-pitch thread series (8UN) when 1-1/8 inch and larger in diameter, except where tapped holes for flanged butterfly valves have UNC threads.

Nuts, for insulated joints, shall be Type 303 stainless steel and meet the requirements of the Standard Specification for Carbon and Alloy Steel Nuts and Bolts for High-Pressure and High Temperature Service, ASTM Designation A194/A194M-90, Grade 8FA, Class 1A, with a thread fit of Class 2B and with a machined washer face. The nuts shall also be the heavy hex head series in accordance with the dimensions of ANSI B18.2.2 and shall have thread pitch compatible to the mating bolt or stud. The threads shall be cleaned and lubricated with a thread lubricant such as Molykote before packaging the nuts for shipment by the manufacturer.

Washers, for insulated joints, shall be Type 304 stainless steel and comply with the chemical and physical requirements of ASTM Designation A193/A193M-90, Grade B8A, Class 1A material. The required washer diameter that matches a particular size bolt shall be as shown in Drawing No. 46104-W, Insulated Flange Joints for Reduction of Electrolysis in Trunk Mains.

All stainless steel threaded fasteners and washers shall be cleaned free of all scale and shall have a bright finish, and be passivated in accordance with approved procedures as given in the Standard Practice for Cleaning and Descaling Stainless Steel Parts, Equipment, and Systems, ASTM Designation A380-88. All stainless steel fasteners shall be made up, during both shop and field assembly, with a thread lubricant. The thread lubricant shall have properties that will prevent seizing and galling between the male and the female threads, reduce the torque required to tighten the fasteners, permit ready disassembly after many years of service in damp locations, and prevent contamination at the bearing surface of heads, nuts, and flanges. The thread lubricant shall be readily applied by brushing or dipping, have no detrimental effect on the gaskets used, and shall be Molycote, Type G-N paste, as manufactured by the Dow Corning Corporation, Midland, Michigan or approved equal.

All bolts, carbon steel and stainless steel shall have a sufficient machined chamfer to ensure a sound starting thread. The BWSWC Quality Assurance Section shall be notified in sufficient time prior to all tension tests and heat treatments so that arrangements can be made for Q/A personnel to witness the tests and heat treatments. If proper notification is not given, the tests and heat treatments may be disapproved. One test shall be made for each diameter of each heat. Steps shall be taken to ensure that heats are traceable.

Certified test reports and mill certificates are required for each material heat incorporated under this work. One chemical check is required for each heat of steel and two percent (2%) of the nuts; washers and bolts shall be checked for dimensional compliance in the presence of the Bureau of Water Supply & Wastewater Collection Quality Assurance Section Inspector.

For all threaded fasteners the Contractor shall furnish a complete chemical analysis of each heat, made and certified by an approved laboratory, and shall furnish a certified statement of the heat treatment procedure.

16. FLANGE JOINT HYDROSTATIC TEST IN SHOP:

Before being coated, each flanged lap fillet welded joint on the inside and outside of the pipe shall be painted with soap suds and tested with air at a pressure of 40 psi applied through the 1/4" tapped hole inside the pipe.

Any defect in the weld, indicated by air leak forming bubbles, shall be repaired by chipping out a section of weld not less than one inch either side of the defect and replacing the removed section. If, in the opinion of the Engineer, the number of defects disclosed by the test are such as to indicate that the entire circumferential weld is defective, the entire weld shall be chipped out and replaced. Caulking of welds will not be permitted. All joints, in which welding repairs have been made, shall be retested. After testing, the 1/4" hole shall be welded shut. After satisfactory completion and acceptance of each welded joint, the coating, electrical testing and wrapping of the joints may be completed. Similarly, outlet connections and manholes welded in the field shall be air tested.

17. TEST FOR APPROVAL OF PIPE:

Qualification tests shall be conducted prior to approval of the welding, coating and wrapping processes. For the purpose of these tests, all equipment required for rolling, welding, testing, cleaning, coating and wrapping pipe shall be installed and ready for operation in the shop or shops where the pipe is fabricated and coating applied.

Charpy V-Notch Impact Tests shall be performed on every heat of pipe coil. The samples shall be removed from the spiral-welded pipe when the weld test samples are removed as described hereinafter. The samples shall be machined in a set of three transverse specimens in accordance with ASTM A370 and tested at the temperatures shown and meet the following minimum requirements:

Test Temperature	Ft-lbs.
30° F	25
0° F	15

When using sub size samples (i.e. pipe thickness of less than one half inch) as specified in ASTM A673, the following minimum requirements shall be met:

Test Temperature	Ft-lbs.
30° F	19
0° F	11

Should the average ft-lbs of the three samples not meet the above requirements when tested at both temperatures, all the pipes manufactured from that heat shall be rejected.

A specimen of weld shall be cut from each of three pipes fabricated for approval of the welding process. One specimen shall be cut from each longitudinal seam or spiral seam, and one from each circumferential butt-welded seam, with the opening left with rounded corners. All splice welds used in fabrication lengths of spiral-welded pipe must be qualified.

Each specimen shall be large enough to furnish four companion test pieces, two for bending and two for tension. Each of these test pieces shall be at least 14" long, with weld running crosswise at its center, and shall be machined to a width of 1-1/2". The weld reinforcement may be removed from each bending specimen. The welding process shall be approved if--

(a) The base metal tensile strength reached at failure shall meet the minimum requirements of Section 8 for the carbon steel material used to fabricate the pipe.

(b) The tensile stress at failures that occur in the welds or heat-affected zones shall exceed 75,000 psi.

(c) To determine tensile strength, the ultimate load in pounds us divided by the cross section of the test piece, measured adjacent to the weld.

(d) Two test pieces are bent cold 180 degrees around a 2-1/2" diameter pin, with the weld in the center of the bend. The bend-test pieces shall be considered as having passed if no cracks or other open defects exceeding 1/8" measured in any direction is present in the weld metal or between the weld and base material after the bending. The direction of bending of one piece shall be towards the center of the pipe and the other piece bent away from the center of the pipe.

If any of the pieces fails in its respective test, whether tensile or bending, approval of the welding process will be withheld and the pipe will not be accepted.

If the welding process is approved, patch plates of the same material shall be lap fillet welded inside and outside over the openings and the three lengths of pipe shall be tested in the hydrostatic press, as provided in Section 19 of these specifications. Patch plates shall lap openings by at least two inches and welds tested by air pressure and soap solution. Welds shall be 5/16" minimum. Flush patches, double butt-welded, may be used, provided the pipe or special fitting is hydrostatically tested thereafter in conformance with Section 19.

Complete records of the results of the bending and tensile tests shall be available at all times to the Engineer at the point of fabrication.

These three lengths of pipe shall be then sandblasted, lined, coated, and wrapped by the mechanical means outlined in these specifications. The lining, coating, and wrapping process shall be approved if the requirements of the specifications are met.

The preliminary tests may be omitted with the approval of the Engineer, where the process has been previously approved and not changed in any respect in the interim.

One length chosen at random out of every 20 lengths of straight pipe shall have a specimen of each welded seam cut out and tested. The specimen shall pass the tests outlined above, and patch plates installed as outlined above. Straight pipe shall vary from 30 ft. to 40 ft. in length.

The fabricator's attention is called to the inspection provisions in the lining and coating specifications, when the lining and coating is done in a plant other than that in which fabrication and testing take place.

18. WELDERS TO BE QUALIFIED:

Welders and welding operators shall have at least six (6) years experience in welding ferrous metals. In addition, all assigned welders shall be qualified by the Department or by an approved laboratory prior to welding.

The Welder/Welding Operator Performance Qualification Test (WPQ) for field joint welding shall be performed as described below after the proposed welding procedures are approved by the Department. The qualifying test can be done on a test plate or on a pipe in accordance to ASME Boiler and Pressure Vessel Section IX, governing pressure pipe welding as specified in QW-461.9 (Performance Qualification - Position and Diameter Limitations) and QW-202.1 (Type of Tests Required). The welding qualifications shall be based on the type and position(s) of welds to be performed and sizes of pipe on the project and shall be according to QW-461.9 and QW-202.1. The minimum qualifying weld position on plate is 4G and on pipe is 5G. The welding procedures will be qualified only if two tensile and four guided-bend test specimens are prepared and tested as specified in QW-150 and QW-160, and are accepted as specified in QW-153 and QW-163. The welder will be qualified if the test required as mentioned in QW-302 meets the requirements prescribed in QW-160. Alternately, welders may elect to be qualified for the combination of 2G, 3G and 4G on a test plate and 6G on a test pipe which will not restrict welders to the type of welding, welding position or size of pipe.

The performance qualifications of a welder or welding operator shall expire after 18 months unless affected by on of the following conditions:

(a) when he has not welded with a process during a period of 3 months or more, his qualifications for the process shall be expired; except if he is welding with another process, the period may be extended to 6 months.

(b) when he has not welded with any process during a period of 3 months, all his qualifications shall be expired including any which may extend beyond 3 months by virtue of (a) above.

(c) when there is a specific reason to question his ability to make welds that meet the specification, his qualifications, which support the welding which he is doing, shall be revoked.

The tests shall be made by the Department or a Department approved testing laboratory and a written report of each test specimen shall be furnished to the Engineer. The cost of equipment, materials and labor for all tests shall be entirely borne by the Contractor.

The Welder/Welding Operator Performance Qualification Test (WPQ) for shop welding shall be a vertical (3G) uphill groove weld in accordance with the Welding Procedure Specification (WPS) as specified in Section IX, 1989 ASME Boiler and Pressure Vessel Code in fabricating the carbon steel pipe. This WPS shall reference the supporting Procedure Qualification Record (PQR) which is the complete record of the welding data used to weld the test coupon and pipe. The format of the PQR, the WPS, and the WPQ are shown in Section IX of the Code. The test coupon shall be large enough for two tension specimens and four guided bend test specimens and the welder shall be qualified if the tests are positive as for field joint welding. A chemical analysis of the weld filler metal shall also be included for carbon, silicon, and manganese. There shall be at least one set of weld-test specimens taken of each size, grade, and wall thickness from work performed by each welding machine and each operator.

All qualifying weld procedures and tests for both the field and shop shall be witnessed by a Department inspector or a Department approved representative or laboratory. When a laboratory is performing this function they shall witness the weld procedures and perform the tests.

19. HYDROSTATIC TEST IN SHOP:

Before being coated, each completed straight pipe shall be tested and made tight at the shop under a hydrostatic pressure not less than that determined by the following formula:

$$P = \frac{2ST}{D}$$

Where:

P = minimum hydrostatic test pressure (psi)
NOTE: When the diameter and the wall thickness of the pipe are such that the capacity of the testing equipment is exceeded by these requirements, the test pressures may be reduced as approved by the Bureau.
S = stress in pipe wall during hydrostatic test (psi), which shall be 0.75 times the specified minimum yield point of the steel used.
T = wall thickness (in.)
D = outside diameter (in.)

The test pressure shall be held for sufficient time to observe the weld seams. There shall be no leaks. Plate and/or welds shall be struck with a sledge of the weight specified in the ASTM Specification applicable for the material being used.

Special fittings shall be tested and made tight under a hydrostatic pressure of 150 lbs. per square inch, unless otherwise directed by the Engineer.

Cracks in the weld not more than three inches in length may be repaired by welding, provided all the weld metal is removed at the sides of the crack and far enough beyond the end of the crack to insure that sound metal has been reached. If any pipe under hydrostatic test develops more than one crack or a single crack more than three inches in length, the entire weld will be rejected.

All repaired pipe shall be subjected to the hydrostatic test specified above, and any completed pipe failing to meet the requirements on the third test will be rejected.

A general sweating of the weld under the hydrostatic test shall cause rejection of the complete pipe; peening with hammer or other tool will not be permitted. Hammer or similar marks on a weld, other than that authorized by the Engineer, will be sufficient ground for rejection.

20. GAUGING:

The ends of all pipe shall be measured with a circular gauge before leaving the shop, to insure a proper fit and roundness at the joint, in accordance with Section 11.

21. OUTLET CONNECTIONS:

Outlet connections shall be fabricated from carbon steel conforming to the latest revision of Drawing No. 38226-Y, "Standard Fabricated Connections For Steel Mains". Plate steel for the outlet saddle may be Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates, ASTM Designation A283-88, Grade C or Grade D. Pipe outlets, from 6" to 24" in diameter inclusive, shall be fabricated from pipe produced in a pipe mill according to the Standard specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless, ASTM Designation A53-88a, Type S Seamless, Grade B. Pipe outlets 30" and larger shall be of the same material as the main pipe section. Flanges shall conform to requirements of Section 15.

Before being coated, each flange, reinforcement collar and manhole saddle shall be hydrostatically air tested in accordance with Section 16.

Payment for these fittings will be on the weights indicated on latest revision of Drawing No. 38226-Y, "Standard Fabricated Connections for Steel Mains".

22. CONNECTIONS, MANHOLES, REINFORCING RINGS:

Manhole, blowoffs, hydrants, and lateral connection fittings (of the designs and materials specified and shown on the contract drawings) shall be attached to the pipe at the general locations shown on the drawings and as shown on additional working drawings which may be furnished. Unless otherwise ordered or permitted, the jointing and the cutting of outlets in the steel pipe for all connections for branches, blowoffs and hydrants shall be done in the field after the pipes are in place in the trench. The Contractor, if he so desires for construction purposes, may increase the number of manholes beyond those shown on the drawings or ordered, but no additional payment will be allowed for such extra manholes. He shall place additional temporary manholes and operate portable blowers through such manholes or pass holes as may be necessary to secure adequate ventilation within the pipeline and safeguard persons working therein. Additional manholes may be made by cutting an opening of approved size in the pipe, which is to be enclosed and made watertight by welding a steel plate, not less than 1/2" thick, to the pipe. The details of all such additional manholes shall be submitted for the approval of the Engineer before they are made. Reinforcing rings, bead bands, lugging bands, collars and flanges shall be provided and attached in an approved manner on all reducers and on all-steel pipe where connections are made to cast iron pipe.

Steel Specials shall be firmly jointed to the pipe by welding, and required apertures through the pipe plates shall be cut out neatly. While work is being done inside the pipe, the flanges of all manhole frames shall be protected by a heavy disc of durable wood securely bolted in position. Between the flange and the wood disc, there shall be a double layer of burlap saturated with heavy mineral grease.

23. DROP HOLES, SMALL PIPE CONNECTIONS AND CORPORATION STOPS:

Two-inch (2") N.P.S. drop holes shall be provided in each outside pipe section and special and in alternate sections where "bell and spigot" welded joints are used. These drop holes shall be located on the field top center line, approximately 6 inches to 13 inches from one end of the pipe. These openings shall be provided with forged steel saddles properly welded to the pipe, inside and outside. Openings in the saddles shall be properly tapped and closed by solid forged steel plugs of approved design. Corporation stops installed for temporary connections shall be removed and replaced with solid cast or forged steel or solid bronze plugs. Corporation stops, which will be furnished by the City, shall be inserted in the steel pipe or in access manhole covers, as indicated on the contract drawings.

24. STAMPING, MARKING AND SHIPPING OF PIPE:

Before starting shop welding, each pipe and special shall be given a running number stamped clearly on the inside of each end, approximately 6 inches from each end and 6 inches from the longitudinal seam. Where "bell and spigot" pipe is used, the running number shall be stamped at the spigot end only.

Before leaving the shop, each length of pipe and special that conforms with the above specifications shall be plainly marked in paint on the inside and near the end of the pipe and special, with the identifying piece number corresponding to that shown on the geometry drawing.

On the top center line of pipe, at the bolting up hole, an arrow shall be painted on the outside of the pipe to indicate the direction of field assembly. Any curve or special, which cannot be completely fabricated in the shop, shall be match marked to facilitate assembling in the field.

A detailed schedule in quadruplicate, on forms furnished by the Department, shall be given to the " Inspector for each shipment of pipe, specials and appurtenances. These forms, numbered consecutively, shall indicate each day's total shipment.

To assure roundness of pipe at joints, all pipe and fittings shall be braced horizontally and vertically at both ends during storage and shipping. All pipe is to be rounded before bracing is installed.

Heat numbers on the steel plate used for fabrication shall be painted on the plate in a position to be visible at the inside of the spigot end of the pipe after rolling.

Stamped-on running numbers shall be encircled with a paint to spot location of the number.

The New York City Inspector shall be furnished a report, daily giving:

(A) Heat numbers of plates used that day for making pipe or specials.

(B) Running numbers of all rolled pipe or specials:

(1) fabricated on that day,
(2) rounded and ring tested on that day,
(3) belled on that day,
(4) hydrostatically tested on that day, and
(5) lined, coated and wrapped in that day.

(C) Running numbers of all straight pipe taken for making specials on that day.

25. HANDLING OF FABRICATED PIPE:

During handling, loading, transportation and unloading, more than ordinary care shall be taken to prevent injury to the pipe. Loading and unloading shall be done carefully, with each pipe at all times under perfect control. Under no condition shall a pipe be dropped. All dunnage, skids, and blocks must be padded with a layer of carpet and shall be placed under each pipe in the shop, storage yard and during transportation. The pipe shall be securely wedged during transportation and elsewhere, as required. Stulling of the pipe ends is required with 4" x 4" wooden cross braces during transportation to the installation site. The braces shall be so placed that they do not encroach or mar the coal tar coated internal surface of the pipe. Pipe must be carried or lifted by the use of nylon slings or carpet padded forks to protect all exterior coating from damage. Coated pipe shall be shipped with nylon tie-down straps located approximately over the stulling as required to maintain roundness of pipe to 3/16 inch. In case any pipe is indented or deformed, it shall be resumed to the proper shape if such repairs can be made acceptable; otherwise, it will be rejected and shall be replaced with a new pipe. Wire rope slings and chain slings, padded or otherwise, shall not be used to lift coated pipe.

26. APPURTENANCES:

Metropolitan gate valves to be furnished under this contract shall comply with NYC Standard Specifications, except that, as shown on the drawings or as indicated in the schedule, the connections may be either flange ends, or hub and flange ends.

Butterfly valves to be furnished under this contract shall comply with Standard Specifications for Rubber Seated Butterfly Valves 24", 30", 36", and 48" Class 150B with Square Nut Drive.

Pressure regulator valves to be furnished under this contract shall comply with Standard Specifications for Pressure Regulator Valves and Appurtenances Sized 8", 12", 20", 24", and 30".

Flanges on all appurtenances shall be in accordance with the design on Drawing 46104-W, Insulated Flange Joints for Reduction or Electrolysis in Trunk Mains. Flanges shall be full flat faced and drilled in accordance with ANSI B16.1-1975 Class 125 Cast Iron Flanges, except where necessary to be drilled 1/8-inch larger to accept Mylar insulating sleeves, and either faced or spot faced at the rear, unless otherwise noted. Flanges shall be protected from corrosion by one smooth coat of Tnemec Series 139. Pota-Pox II, with a maximum thickness of 8 mils, as manufactured by the TNEMEC Company. Inc., Kansas City, Missouri, or approved equal. For flange fasteners see Section 15 of these specifications.

Cast Iron Pipe and Special Castings shall comply with Standard Specification No. 32-P-6b, attached hereto, except that, as shown on the drawings or as indicated in the schedule, the connections may be flanged.

Gaskets shall be full-faced rubber with cotton cloth insert, 1/8" thickness as specified in Section 15 of this specification.

27. INSPECTION FACILITIES:

The fabricator of the pipe shall have available for the City Inspector a desk and a locker for clothes for his exclusive use; and clean toilet and wash-up facilities shall also be available.

28. SAFETY EQUIPMENT FOR INSPECTOR:

The fabricator shall furnish the City Inspector, a "hard" hat, safety goggles and such other safety equipment as may be necessary to protect him from injury while he is performing his inspection functions on the premises.

28a. INSPECTION OF PIPE FABRICATION:

Not more than one (1) City Inspector will be assigned to the pipe fabrication for this Contract. Under no conditions, e.g., if a portion of pipe fabrication is subcontracted resulting in two (2) or more pipe fabricators, will more than one (1) Inspector be assigned to pipe fabrication for this contract.

The pipe fabrication shall be done in a shop having adequate facilities to produce sufficient pipe per normal eight (8) hour daytime shift to enable the Contractor to fulfill the time requirement of this contract.

Pipe fabrication on Saturdays, Sundays, Holidays or during overtime periods on weekdays is prohibited, unless specifically permitted by the Engineer.

The Contractor's attention is also hereby directed to Section 51C of Part III, "Lining and Coating of Steel Pipe and Appurtenances in the Shop and in the Field".

The pipe fabricator shall schedule all work in accordance with the above conditions.

PART II

LAYING STEEL PIPES AND APPURTENANCES

29. INTENT OF SPECIFICATIONS:

It is the intention of this part of the specification to describe the installation of a steel pressure water main complete with all necessary fittings and appurtenances. Wherever Standard Specifications and Standard Drawings are listed in these specifications, it shall mean the latest revision in effect on the date of the Bid.

30. STANDARD SPECIFICATIONS TO APPLY:

The provisions of the "Standard Water Main Specifications" attached to, and made a part of, this contract shall apply to all the work of installing the steel pipe and appurtenances, except in so far as they are modified or amended by these Specifications, in which case the latter shall apply.

31. WORK INCLUDED:

The Contractor shall lay, test and make tight the line of steel pipe indicated on the drawings. The work of laying the steel pipe also includes the air test of pipe joints, the cleaning of the line in preparation for coating or covering, the final cleaning of the inside of the steel pipe, and the disinfection and filling of the line with clean water in preparation for placing it in service.

Any pipe, bends, or specials, which are not called for in the schedules or on the contract drawings or which are not required in the finished work but which may have been delivered, shall, at the finish of the contract, remain the property of the Contractor or revert to him and shall be promptly removed by him from the site of the work.

32. HANDLING PIPE AND SPECIALS:

During loading, transportation, unloading, and lowering into the trench, more than ordinary care shall be taken to prevent injury to the pipe or the wrapping. Pipe and specials shall be suspended on at least two (2) slings of fabric, nylon or leather, each not less than six inches in width, of ample strength to support the weight of the pipe or special, with each pipe or special under perfect control at all times. Additional slings shall be used to suspend pipe longer than 40', subject to approval. Chain slings and wire rope slings regardless of padding are specifically prohibited for use in lifting coated pipe. Under no condition shall material be dropped. Rolling of pipe on the ground or on skids will not be permitted. In case any pipe is indented or deformed, it shall be returned to the proper shape if such repairs can be made acceptably, otherwise it will be rejected and shall be replaced with a new pipe.

Pipe stored on the ground, awaiting installation in the trench, shall be placed on burlap bags filled with sand to prevent damage to pipe coatings.

33. TRENCH EXCAVATION:

The pipe shall be laid to accurate line and grade and the excavation and backfill so performed that the pipe will be firmly imbedded. No timber blocking will be permitted for the purpose of maintaining line and grade; sand bags or other approved means may be used for this purpose. There shall be at least a 12" clear distance between the pipe and the sides of the trench.

Where the trench is in rock, no rock shall project nearer than 6" to the bottom or 12" to the side of the pipe, and before laying, the bottom of the trench shall be filled with clean earth thoroughly compacted to the level of the underside of the pipe.

Where the trench is in fresh fill or in soil of low bearing power, the pipe, where and as directed, shall be laid on concrete cradles, supported on a continuous reinforced concrete mat or on a concrete pile caps which in turn shall be supported on approved piles, where and as ordered by the Engineer.

Where the trench is in a material which, in the opinion of the Engineer, is not suitable to give a proper bed or support for the pipe, the Contractor shall, where directed, excavate 6" below subgrade and fill to grade with clean earth or sand thoroughly compacted to the underside of the pipe.

Unless otherwise indicated on the plans or in the specifications, the length of trench which may be opened between the point where backfilling is completed and the point where excavation of the trench is commenced shall, in general, not exceed 500'; this length, however, may be increased or reduced with the approval of the Engineer and in accordance with his direction, depending upon the density of the population and the degree of the traffic congestion along the route of the pipe line, and the requirements of other City departments having jurisdiction of street permits, traffic, etc.

The lane adjacent to the trench shall be used for trucks and equipment. The excavated material shall not be placed on the streets except when permitted by the Engineer. No pipe or appurtenances shall be left in the street over night.

34. BRIDGING TRENCH:

All street intersections are to be kept clear of excavated or other material and ample width of roadway left thereat for traffic.

At street intersection or across lines of traffic, and where ordered by the Engineer, the Contractor shall construct temporary bridges across the trench, of adequate strength to carry 20-ton trucks. The bridges shall consist of steel and/or timber, and detail drawings shall be submitted to the Engineer for approval, before starting construction.

Where bridging is required for the full width of the street, the Contractor is to excavate approximately the full depth of trench for one-half of the street without interfering with traffic on the remaining half of the street. This work is to be done as expeditiously as possible, and the bridging is to be so placed that it will not be necessary to later interfere with the bridging supports in laying the pipe. Where only a portion of the width of the street is to be bridged, the Contractor is to carry on his work in such a manner as may be directed by the Engineer, with a view of minimizing the interference with traffic on such street.

If the field conditions are such as, in the opinion of the Engineer, will justify the excavation of the trench across the full width of the street before any bridging is placed, such excavation may be made, provided the Contractor carries on the work of excavation continuously throughout the twenty-four hours until the excavation has been completed and at least one-half of street has been bridged.

When the pipe is being placed under the bridged roadway and the full width of the roadway is bridged, the Contractor may remove the bridging for one-half of the width of the roadway for the purpose of facilitating the placing of the pipe.

He shall replace the bridging so removed before the bridging on the remaining half of the roadway is disturbed, and shall replace any disturbed bridging immediately after the work under it has been completed.

35. LAYING PIPES:

Inspection While Laying-Field Jointing: After the trench has been excavated as required, the pipe, specials, gate valves and other appurtenances shall be delivered on the street and placed at once in the trench. Unless otherwise permitted, no pipe or appurtenances shall be left on the street over night and none more than six hours before laying. When the pipe is on the filled sandbags, it shall be thoroughly cleaned, inspected and the coating, if applied, shall be removed from the surfaces that are to be in contact at the joints. This requirement, however, is not to be taken to apply to the priming solution used to protect the contact surfaces. When suspended above the trench, all abrasions of the coating and wrapping which will be inaccessible after laying, shall be satisfactorily repaired as approved by the Engineer. The patch wrapping shall be securely bonded and shall lap the damaged portion at least 4 inches. The pipe shall then be lowered into place upon the subgrade excavated accurately to the desired elevation of the pipe and laid to the required line and grade without blocking. Pipe shall not be dragged on the trench bottom in making joints. Wire rope slings and chain slings, regardless of padding, shall not

be used. After placing the pipe in the trench, special effort shall be given to make up each field joint promptly and the Contractor shall provide an adequate force of men and appliances to meet this stipulation. Every effort, including use of interior jacks and braces, shall be made to keep the pipe round within limits set in Section 11.

36. WELDED JOINTS:

Welded field joints shall be lap fillet welded and in accordance with Drawing 35310-C-Y, "Joints for Steel Water Mains", unless otherwise indicated on the Contract drawings or specified.

Surfaces and edges to be welded shall be free from scale, rust and other foreign material. Edges that have been torch cut or air-arc gouged shall be ground to remove slag and oxidation. All edges must have proper bevel and miter configuration as given by welding procedures approved by the Engineer and AWWA Standard for Field Welding of Steel Water Pipe, ASNI/AWWA C206-88 except that the requirements of these specifications and applicable Bureau Contract and Standard Drawings shall prevail in cases of conflict.

All manual and field welding shall be done by the Shielded Metal Arc Welding (SMAW) method. The electrodes shall conform with the requirements of the Specification for Covered Carbon Steel Arc Welding Electrodes, SFA-5.1, ASME Boiler and Pressure Vessel Code, Section II, Material Specifications, Part C - Welding Rods, Electrodes, and Filler Metals, classification number E7016, E7018, E6016, or E6018, or as required for the particular steel being used. Welding Electrodes shall be the same as those used for welding procedure qualification. A copy of the engineer approved Welding Procedure Specification shall be kept at the field-welding site to allow the Bureau of Water Supply Inspector to monitor the field welding parameters and methods. The welding current shall be within the range recommended by the manufacturer of the electrodes used and the Engineer approved welding procedure specification (WPS). The Contractor shall control the storage and handling of the electrodes to maintain their low-hydrogen (moisture) characteristics as recommended by the electrode manufacturer.

The electrodes shall be kept in cans covered and stored in a dry place, and kept dry until used. A portable holding oven shall be at the field-welding site to facilitate keeping the low-hydrogen electrodes dry. Electrodes not used after a days production shall be stored in a hermetically sealed container.

Reconditioning and drying or electrodes that have absorbed excess moisture shall not be allowed and those electrodes so exposed shall be rejected.

Refer to Section 18 for field welding/welder qualification requirements.

37. FILLET WELDED LAP JOINTS:

Shall be made with a double, continuous 5/16" minimum fillet weld, with full penetration into the base metal. Each joint shall be properly prepared and cleaned for welding. Welding shall be in accordance with the Welding Procedure Specification WPS approved by the Engineer and a copy shall be at the work site during welding. Welds up to 3/8" may be made in a single pass. If made in more than one pass, all slag or flux remaining on any bead of welding shall be removed before laying down the next successive bead. Any cracks or blowholes that appear on the surface of any bead of weld shall be removed by chipping, grinding or gouging before depositing the next successive bead. There shall be no under cutting of the base metal. All slag shall be removed from finished welds and the welds shall show workmanlike appearance, uniform section, and freedom from porosity and trapped slag.

All outlet connections and manholes shall be welded with continuous, double lap, fillet weld, as shown on Drawing 38226-Y-A, "Standard Fabricated Connections for Steel Mains".

The holes used in aligning the pipe shall be satisfactorily plug welded after the completion of each joint, or closed by the insertion of a 7/8" diameter cold panhead rivet, 7/8" long, and welded inside and outside.

38. TEST OF FILET WELDED LAP JOINTS:

After the welding of a circumferential field joint is completed, the inside and outside of the joint shall be painted with soap suds and tested with air at a pressure of 40 psi applied through the 1/4" hole at the top

of the pipe. Any defect in the weld, indicated by air leak forming bubbles, shall be repaired by chipping out a section of weld not less than one inch either side of the defect and replacing the removed section. If, in the opinion of the Engineer, the number of defects disclosed by the test are such as to indicate that the entire circumferential weld is defective, the entire weld shall be chipped out and replaced. Caulking of welds will not be permitted. All joints, in which welding repairs have been made, shall be retested. After field-testing, the 1/4" hole shall be welded shut. After satisfactory completion and acceptance of each welded joint, the coating, electrical testing and wrapping of the joints may be completed. Similarly, outlet connections and manholes welded in the field shall be air tested.

39. FIELD JOINTING TO KEEP UP WITH PIPE LAYING:

The work of making the field joints and outlet connections, etc., shall keep up as closely as possible to that of the pipe laying gang so that, except where otherwise permitted, not more than five joints shall intervene between the last joint that is made and the pipe that is being laid.

If, at any time the Engineer is of the opinion that the Contractor is not advancing the various portions of the work at a satisfactory rate, then the Contractor shall, under the direction of the Engineer, temporarily suspend the pipe laying or any other portion of the work, to permit the other portions of the work to be advanced sufficiently to justify the resumption of the work suspended.

To minimize the effect of ambient temperature affects on expansion joints valve chambers during construction, joints immediately outside the chambers shall be welded last before final backfilling. A "make-up" sleeved and welded joint may be introduced by the Contractor for this purpose at his option.

40. PROTECTION OF PIPE COATING:

The Contractor shall at all times take every precaution to prevent injury to the coating and wrapping of the pipe and appurtenances by workmen or trespassers. During the laying and jointing of the pipe, or at any other time while it is exposed, no person shall be permitted to walk on or in the pipe wearing boots or shoes with hobnails or other attachments that will injure the coating. Dropping of tools and other materials on the pipe, dragging of heavy objects over them, and other acts that would mar the coating and wrapping, shall be prevented. The ends of completely coated pipes in the storage yard, unless otherwise permitted, shall be stopped by an approved head or barrier of wood or metal with apertures not more than 4" wide. Unless pipes delivered on the street from the storage yard are to be immediately placed in the trench, the ends shall be similarly protected, and the heads or barriers shall not be removed until the pipes are about to be laid. Each day at the close of work, and when laying is not in progress, the exposed ends of the pipe in the trench shall also be protected in this way. Ends of pipe, if any, when it becomes necessary to cover with earth before making connection to adjacent piping, shall be closed by suitable timber bulkheads before the trench is backfilled.

41. FLOATING:

The Contractor shall take every precaution against the floating of the pipe due to water flowing into the trench, or through flushing or puddling. In case of such floating, he shall replace the pipe at his own expense, making wholly good any injury or damage which may result. The responsibility for the movement of the pipe, due to water flowing into the trench, shall rest entirely upon the contractor and no claim shall be made by or will be allowed to him for the expense of repairing the damage resulting therefrom, due to the deficiency, or alleged deficiency, in the capacity of the sewers or drains in the vicinity to carry off storm water flow, or for any other reason.

42. COMPLETION OF LINING AND COATING:

After satisfactory completion and acceptance of the field test, the Contractor shall remove any water from the section and shall clean all of the interior surface. All abrasions and other damage to interior lining shall be cleaned, dried and repaired. The coating and wrapping shall then be completed at all field joints and at all jointed appurtenances shall be primed and coated on the exterior and the interior, as hereafter specified, except that the coating and wrapping may be applied by hand. Wrapping shall be bonded firmly and smoothly, to lap adjacent layers by at least one inch (1").

After completion of wrapping, the section of trench over the field joint shall be backfilled as hereafter specified.

43. ELECTRICAL TEST OF INTEGRITY OF COATING:

Following the repair and completion of coating, all of the interior lining and exterior coating shall be again tested electrically for flaws, such as cracks, pin holes, holidays and thin spots. All imperfections revealed by the inspection and test shall be immediately covered by an additional full thickness of hot enamel as has been used or as approved by the Engineer for other coating systems.

44. MAINTAINING PIPE UNDER PRESSURE:

In addition to the requirements for field testing stipulated above, the Contractor shall fill with water and maintain, under hydrostatic pressure any portion or portions or the whole of the pipe line as frequently, and for such lengths of time, as may be directed by the Engineer, in order to keep the pipe as closely as practicable to a circular cross-section and unchangeable in shape when concrete is being placed about the steel pipe, when backfilling is being rammed or puddled and until it is acceptably consolidated, and when loads, other than from backfilling could, in the opinion of the Engineer, unduly distort the pipe; and he shall likewise required shall be that of the available service pressure from water mains adjacent to the length to be filled, and the pressure shall be maintained for the required time with only such slight fluctuations as may be approved. Any flanged joint which shows evidence of leakage after the introduction of hydrostatic pressure shall be completely disassembled and reassembled at the contractor's own cost and expense.

45. CONCRETE BACKING AND VAULTS:

The Contractor shall place a suitable backing of concrete, reinforced, if and as directed, of such dimensions as may be ordered or shown on working plans to be furnished, at all bends and other locations in the pipe line, where, in the opinion of the Engineer, unbalanced pressures may exist or develop which will tend to cause movement in the pipe line, while the pipe is under normal or test pressure.

Vaults, manholes and footings shall be constructed around and under valves in accordance with the standard drawings, as specified, and "Standard Water Main Specifications" attached hereto, and the special designs shown on the contract drawings or as may be otherwise required.

46. BACKFILLING TRENCH:

Where there is a deficiency of good clean earth to fill the trench and/or where the excavated material consists of cinders or other deleterious material not suitable for backfill, the Contractor shall obtain and use as backfill, clean fill, and will be paid for as indicated in Article 28 of Standard Water Main Specifications General Conditions, "Additional Provisions for Adjustment in Payment". The satisfactory backfill shall be placed as follows: not less than one (1) foot on either side of the pipe; not less than six (6) inches above the top of the barrel of the pipe; and to the bottom of the base of the existing or proposed pavement.

The Contractor shall take such borings or excavate such test pits as he may deem necessary to schedule his operation, consistent with the need of having an adequate supply of satisfactory backfill material available along the line of the street so that he may proceed with undue interruptions, and no payment, other than hereinbefore provided, will be allowed the Contractor for delays or other expenses incurred because the satisfactory backfill is not available at the proper time and place; and no other allowance will be made to the Contractor for disposing of the unsatisfactory excavated material.

The satisfactory backfill material shall be placed in layers not more than 8 - 12 inches in thickness and thoroughly compacted by mechanical tamping or other approved means, with particular attention paid to placing and compacting under the pipes.

Where a backfilling machine is employed, the trench shall be backfilled by hand and mechanically tamped for the first foot of cover to prevent injury to pipe from stones in the backfill. No material used for backfill

shall contain any stone for fill up to at least one foot over the pipe. Above that point, no stones larger than three (3) inches will be permitted, and no stone shall come within six inches of the pipe.

If so noted on the drawings, the trench may be refilled with the excavated material, irrespective of its nature.

The backfilling shall be thoroughly consolidated by flushing, using a hose at least 1-1/2" in diameter, to which shall be attached a flushing pipe at least one inch in diameter, to which shall be inserted into the backfill to approximately the depth of the center line of the pipe. The flushing pipe shall be inserted in the backfill at such points and for such time as in the opinion of the Engineer will result in a satisfactory consolidation of the backfilling. This flushing shall be carried on either during or after the completion of the backfilling, or at both times, as may be directed by the Engineer. For the period following the flushing, during which, in the opinion of the Engineer, the backfilling is too soft to safely permit vehicles passing over it, the Contractor shall barricade the trench in a manner satisfactory to the Engineer. Where either the nature of the material to be used in the backfilling or the subsurface condition is such as, in the opinion of the Engineer, to make it inadvisable to use the flushing method of consolidating the backfill, the backfill shall be consolidated by mechanical tamping. In unpaved streets, the Contractor shall use such material for surfacing the trench as will result in the restored surface being equal to the original surface for the purpose of carrying vehicular traffic.

Any rock that is excavated from the trench, that is of a size in excess of that allowed to be placed in the backfilling, shall be immediately separated from the material that is to be used for backfilling the trench, and shall be promptly removed from the work.

If the pavement along the sides of the trench is or becomes undermined, the Contractor shall break down and remove such pavement, together with the pavement foundation, loose earth and rock, before placing the temporary pavement, and he shall place and compact the necessary backfilling and relay the pavement so undermined.

Where the roadway or sidewalk in which the trench is excavated is surfaced with cinders, such cinder surfacing shall be restored by the Contractor to the satisfaction of the Department of Highways.

47. PROTECTION OF TREES:

All work shall be carried on so as not to disturb the soil in the vicinity of trees, and the latter shall be protected from damage in a manner satisfactory to the Engineer and to the Department of Parks.

48. TEMPORARY PAVING:

Except as herein provided, in all roadway areas having an improved pavement, as soon as the trench has been backfilled, the contractor shall place temporary pavement over the trench. The temporary pavement shall be of the following type:

> Plant mixed hot binder mixture, four (4) inches minimum thickness after compression, one layer, as designated in Section 3.01, Asphalt Paving Mixtures of the Standard Specifications of the Department of Highways.
>
> The material and workmanship shall comply with the requirements of the Department or Bureau having jurisdiction.

The area of temporary pavement, for which payment will be made, will be as stipulated in Form 17 of Standard Water Main Specification "For Replacing Pavement and Foundations".

Temporary pavement in roadway and/or sidewalk areas shall be maintained by the Contractor until replaced by the permanent pavement, permanent pavement base, and permanent sidewalk.

Should a settlement occur or other defect develop in temporary pavement during these periods, which in the opinion of the Engineer may cause hazards or undue inconvenience to pedestrian or vehicular traffic, the Contractor shall immediately restore such pavement to proper grade or otherwise repair the defects.

Where stone paving blocks are removed by the Contractor during pipe laying operations, such blocks shall remain the property of the City and shall either be removed by the Contractor to a corporation yard under the control of the Department of Highways or, when indicated by the Department to be left at the site of the work, shall be placed at a location and in the manner, as directed by the Engineer.

49. CUTS MADE IN STREETS:

Cuts made in streets that have recently constructed pavements and which are still under guarantee by the City contractor, shall be backfilled with clean sand or run-of-bank gravel, in order to minimize future settlement, except as determined by the Engineer, where subsurface conditions preclude granular backfill. All unsuitable excavated material must be removed from the site.

50. DISINFECTION:

When all construction work on a section has been completed, including all connections and appurtenances, cleaning, testing and completing all necessary repairs to the coating, the Contractor, when and as directed, shall disinfect the section as stated hereinafter and as described in Section 6.7 of the Standard Water Main Specifications. The water main section shall be filled with water from a nearby water main and, when filled, bled from the opposite end. While water is flowing the Contractor shall pump into the section, through a corporation stop or an appurtenant structure installed at the upstream end, an aqueous solution of chlorine to obtain a concentration of twenty-five (25) parts per million in the water main section. The solution shall be prepared, in a separate container, by dissolving hypochlorite (65%), hypochloride of lime (25%) or chlorine laundry bleach (10%) in water. The pumping of the chlorine solution shall be continued until it is distributed uniformly throughout the section. Pumping shall then be stopped, the water supply shut off and the bleed closed. This chlorine solution is to remain in the section for not less than twenty-four (24) hours. After this time interval, tests shall be taken to ensure a chlorine residual of no less than ten (10) parts per million remains. If the chlorine residual is less than ten (10) PPM, the above procedure must be repeated. Once an acceptable chlorine residual is obtained, the water in the section shall then be blown off and the main shall be flushed with fresh water until all excess chlorine has been removed. Samples of the water flowing in the section will then be taken and analyzed by the Engineer. If the sanitary condition of the new main is found by the Engineer to be unsatisfactory, it shall be presumed that it is due entirely to failure on the part of the Contractor to clean the main satisfactorily and exercise sufficient care to prevent the entrance of foreign matter. The Contractor shall then repeat the process of disinfection and take such other steps as may be required to clean the interior of the main until its sanitary condition is satisfactory to the Engineer. The new main or section of main will not be accepted until the sanitary condition of the interior of the main is satisfactory to the Engineer.

PART III

LINING AND COATING OF STEEL PIPE AND APPURTENANCES IN THE SHOP AND IN THE FIELD

51. GENERAL:

A. All steel pipe and fittings furnished for use in the distribution system shall be lined and coated unless specifically noted otherwise. The term lining in these specifications shall mean the application of cement mortar, or primed liquid epoxy conforming to the requirements of NSF Standard #61 and approved for potable water line use by NSF, to be either a high solids polyamine epoxy or 100% solids polyurethane to the interior of the pipe, fittings, special sections, connections or appurtenances, and the term coating in these specifications shall be understood to mean the wrapping and coating of the exterior of the pipe, fittings, special sections, connections or appurtenances with the materials herein specified as follows:

1. The interior shall be lined with cement-mortar or epoxy NSF #61 approved or polyurethane NSF #61 approved as per coating specifications of manufacturer, and unless specifically noted otherwise, the exterior shall be coated with primed hot coal-tar enamel and shall be wrapped with glass-fiber felt reinforced tape in accordance with the American Water Works Association Standards for Coal-Tar Protective Coatings and Linings for Steel Water Pipelines--Enamel and Tape--Hot-Applied, ANSI/AWWA C203-91, as hereinafter described; or

2. The exterior shall be coated and/or the interior shall be lined in accordance with the American Water Works Association Standard for "Liquid Epoxy Coating Systems for the Interior and Exterior of Steel Water Pipelines, AWWA C210-84", as hereinafter described; the interior shall be lined with cement-mortar or epoxy NSF #61 approved or polyurethane NSF #61 approved as per manufacturers specifications.

3. The exterior shall be coated and wrapped with fabricated multilayer cold applied polyethylene tape in accordance with the American Water Works Association Standard for "Tape Coating Systems for the Exterior of Steel Water Pipelines, ANSI/AWWA C214-89", as hereinafter described; or

4. The exterior shall be coated and wrapped with cold applied primer and prefabricated tape in accordance with the American Water Works Association Standard for Cold-Applied Tape Coatings for the Exterior of Special Sections, Connections, and Fittings for Steel Water Pipelines, ANSI/AWWA C209-84, as hereinafter described; or

5. The interior shall be lined with cement-mortar in accordance with the American Water Works Association Standard for "Cement-Mortar Protective Lining and Coating for Steel Water Pipe--4 In. and Larger--Shop Applied, ANSI/AWWA C205-89", and the American Water Works Association Standard for "Cement-Mortar Lining or Water Pipelines--4 In. (I00mm) and Larger--In Place, ANSI/AWWA C602-89".

6. All materials used for lining the interior of pipe, fittings, special sections, connections and appurtenances shall have been approved for use in contact with potable drinking water by Underwriter's Laboratories under the ANSI/National Sanitation Foundation Specification Standard ANSI/NSF 61-1992 or as further revised.

B. Whenever in the opinion of the Engineer, the quality of the lining and coating operations has deteriorated so as to require excessive inspection and repairs, not-withstanding any other statement in these specifications, the applicator will be required to employ a qualified representative of the material manufacturer to supervise his operations.

C. Coating of pipe and specials in a plant other than that in which fabrication and testing take place, will be permitted under the following conditions:

1. No fabrication or testing of pipe under this contract is to be done unless an Inspector is at the fabricating plant.

2. No coating of pipe under this contract is to be done unless an Inspector is at the coating plant.

D. Pipe lying in storage after final inspection for a period of more than three (3) months before installation in the ground shall be subject to reinspection, including the use of the holiday detector for determining any defects. Such pipe shall be repaired, if required, as directed by the Engineer.

52. QUALIFICATIONS OF COAL TAR ENAMEL APPLICATOR:

A. The coating applicator will be considered as qualified to perform work in the shop on straight pipe after he has complied with the following:

1. He shall have under suitable cover a manufacturer's plant approved by the Engineer capable of coating steel water pipe in accordance with the American Water Works Association Standard for "Coal Tar Protective Coatings and Linings for Steel Water Pipelines--Enamel and Tape--Hot-Applied, ANSI/AWWA C203-91" for the sizes called for in this contract.

2. He shall have been continuously engaged in this business for a period of not less than 5 years during which time he shall have successfully lined, coated and wrapped the following lengths of pipe to demonstrate his abilities for qualification:

   a. a minimum of 15,000 lin. ft. of 72" pipe or;
   b. a total of 30,000 lin. ft. of mixed sized 8" - 84" in diameter.
   c. In the event the coating applicator cannot comply with the foregoing, he may also qualify by agreeing to employ a representative of the material manufacturer until such time as he has completed the required quantities necessary for qualification.
   d. There shall be available for the exclusive use of the City Inspector, a desk and locker for clothes. Clean toilet and wash-up facilities shall also be available.

B. The coating applicator will be considered as qualified to perform work in the shop on specials and fittings after he has complied with the following:

1. He shall have a physical plant under suitable cover.

2. He shall have been engaged in this type of work either as the head of his own business, or in a supervisory capacity with a concern doing this type of work for a period of at least five (5) years.

3. He shall take a qualification test to be given by the Department. This test shall consist of coating a section of steel pipe in accordance with Department specifications. This section will be inspected and tested by the Department and, if found satisfactory, the applicator will be declared qualified.

4. He shall employ experienced help for this work if the applicator is acting in the supervisory capacity and not doing the work himself.

5. Should subsequent inspections reveal that the applicator is consistently doing work of an inferior nature, he will be disqualified from all Department work.

C. The coating applicator will be considered as qualified to perform work in the field on joints and touching-up of defective areas after he has qualified with the following:

1. He shall have been engaged in this type of work either as the head of his own business, or in a supervisory capacity with a concern doing this type of work, for a period of at least five (5) years.

2. He shall take the qualification test described in Section 52-B-3.

3. He shall employ experienced help for this work if the applicator is acting in a supervisory capacity and not doing the work himself.

4. Should subsequent inspections reveal that the applicator is consistently doing work of an inferior nature, he will be disqualified from all Department work.

D. The applicator for coating specials, and for work in the field on joints and "touch-up" should have the following equipment:

1. Tar kettle with metal paddle agitators.
2. Thermometer.
3. Thickness gauge.
4. Hand daubers.
5. Approved electrical testing equipment for holiday detection.
6. Penetrometer testing equipment available for sample testing by the Contractor, if required in the opinion of the Inspector.
7. Heating torches.
8. Grinders.
9. Paint Sprayers.
10. Paint brushes and rollers.
11. Sand paper.
12. Mixing equipment.

53. MATERIALS FOR PRIMER. COAL-TAR ENAMEL. GLASS-FIBER FELT, AND WHITEWASH:

A. Primer: The primer shall be of the fast-drying synthetic type complying with the following:

Fast-drying synthetic primer shall consist of chlorinated rubber, synthetic plasticizer, and solvents, suitably compounded to produce a liquid coating which can be readily applied cold by brushing or spraying and which will produce a suitable and effective bond between the metal and subsequent coating of coal-tar enamel.

The primer shall have good spraying and brushing properties and a minimum tendency to produce bubbles during application. The primer shall dry hard to the touch when applied as recommended.

B. Coal Tar Enamel: This enamel shall be composed of a specially processed coal-tar pitch combined with an inert mineral filler. No asphalt of either petroleum or natural base shall be acceptable as part of the ingredients. The enamel shall have the characteristics of Type II shown in Table I.

TABLE I

Characteristics of Coal-Tar Enamel Type II

Test	Minimum	Maximum
Softening point, ASTM D36	220°F (104°C)	250°F (116°C)
Filler (ash), ASTM D2415, % by weight	25	35
Fineness filler, through 200 mesh, ASTM D546, % by weight	90	----
Specific gravity at 77°F (25°C), ASTM D71	1.4	1.6

*Penetration-AWWA C203, Sec. 2.8.1		
At 77°F (25°C), 100-g weight, 5 sec.	10	20
At 115°F (46.1°C), 50-g weight, 5 sec.	15	55
High-temperature test at 160°F (72°C) (sag), AWWA C203, Sec. 2.8.9	----	1/16 in. (1.6 mm)
Low-temperature test at -10°F (-23.3°C) (cracking), AWWA C203, Sec. 2.8.10	N/A	N/A
Low-temperature test at -20°F (-28.9°C) (cracking), AWWA C203, Sec. 2.8.10	----	None
Impact test at 77°F (25°C) 650-g ball, 8-ft. drop, AWWA C203, Sec. 2.8.12		
Direct impact, disbonded area	----	10 in^2 (6452 mm^2)
Indirect impact, disbonded area	----	2 in^2 (1290 mm^2)
Peel test, AWWA C203, Sec. 2.8.11	No peeling	

* For static conditions above 5°F (-15°C), use enamel with 5-10 penetration at 77°F (25°C); below 5°F (-15°C) and above -10°F (-23°C), use 10-15 penetration; and below -10°F (-23°C) and above -20°F (-29°C), use 15-20 penetration enamel. (Static conditions are those conditions under which the pipe is not being handled).

Sampling and test procedures shall be in accordance with Sections 2.6, 2.7, 2.8 and 2.9 of the American Water Works Standard for Coal-Tar Protective Coatings for Steel Water Pipelines--Enamel and Tape--Hot-Applied, ANSI/AWWA, C203-86 or latest revision, except that all tests will be at the expense of the Contractor in laboratories approved by the Engineer.

In addition, and witnessed by the New York City Bureau of Water Supply Inspector, samples shall be taken from the kettles during the coating operations according to the following schedule:

1. From each kettle, one sample shall be taken prior to commencing work; one at mid-day, and one at the end of the working day.

2. No recharging of the kettles will be allowed until the samples are taken.

3. The samples taken shall be tested by the coater and shall not have a loss of penetration at 77°F - 100 gram, 5 seconds, exceeding seven (7) points from the material certified by the manufacturer as supplied in the drum.

4. Except that, during the coating operation, the penetration of the enamel applied to the pipe shall not be less than ten (10) during the period of October through April, and eight (8) during the period of May through September.

5. At the end of each working day, the kettles shall be drained of the enamel; and such drained enamel shall not thereafter be used for coating pipe for this Department.

C. Whitewash Formula: All whitewash to be used shall be mixed as follows:

1. Ingredients:

50 gal. water
1 gal. boiled linseed oil
150 lb. processed quicklime
10 lb. salt

2. Mixture: Lime and oil shall be slowly added simultaneously to the water and mixed thoroughly. The mixture shall be allowed to stand for not less than 3 days before it is used.

D. Glass-Fiber Coal-Tar Saturated Felt: The wrapper shall be composed of a glass-fiber felt with suitable binder, the whole saturated with a distilled coal-tar to produce the following characteristics in the finished felt:

1. Appearance: The finished tar-saturated glass-fiber felt shall have a smooth, uniform surface, free from visible defects. When unrolled at temperatures of 32°-100°F, it shall not stick to such an extent as to cause tearing.

2. Weight per 100 sq. ft.: Exclusive of all comminuted surfacing or sand which has been added to prevent sticking in the rolls, the weight shall be not less than 12 lb/l00 sq. ft. nor more than 15 lb/l00 sq. ft. The weight of the base glass-fiber mat, before coating, shall not be less than 1.7 lb/l00 sq. ft.

Test Method: In accordance with the requirements of the Standard Methods of Sampling and Testing Bitumen-Saturated Felts and Woven Fabrics for Roofing and Waterproofing, ASTM Designation D146-78a (Reapproved 1986).

3. Breaking Strength: Average after test samples from the inside of the roll have been aged in free air for at least 2 hrs. at 77° ± 2°F (25°C ± 1°C):

3a. With fiber grain (longitudinal), not less than 35 lbf/in. (6130 N/m) of width.
3b. Across fiber grain (transverse), not less than 27 lbf/in. (4730 N/m) of width.

Test Method: In accordance with the requirements of the Standard Test Methods for Tensile Properties of Thin Plastic Sheeting, ASTM Designation D882-88.

4. Pliability: Average after test samples from the inside of the roll have been aged in free air for at least 2 hrs. at a temperature of 77 ± 2°F (25°C ± 1°C): No cracking of felt when bent over a 1-in. mandrel at 77°F.

Test Method: Five 6-in. strips shall be cut with the fiber grain as shown at D-l to D-5 (Fig. 1 of the ASTM specification D146- 78a (Reapproved 1986) and immersed in water at 77°F (25°C) for 10-15 mins. These strips shall be bent through 130° at a uniform speed, in approximately 2 sec., around a mandrel with a diameter of 1 in.

5. Saturation: Average after test samples from the inside of the roll have been aged in free air for 2 hrs. at a temperature of 77 ± 2°F (25°C ± 1°C): The saturation by extraction shall be not less than 22 percent nor more than 32 percent of the weight of the extracted felt.

Test Method: ASTM D146-78a (Reapproved 1986) Sec. 16, omitting correction for entrained carbonaceous materials, calculated as follows:

$$\frac{\text{wt. of extracted saturant x 100}}{\text{wt. of extracted felt (as defined)}} = \% \text{ saturation}$$

6. Loss on Heating: The loss on heating shall be not more than 10 percent according to the following test method:

Test Method: Cut two samples, 6 in. wide by 12 in. long, of saturated felt, weighing each strip and suspend by wire hooks for 2 hrs. in an oven maintained at 200°F ±5°F. Care shall be taken to see that the felt does not touch the oven side or other samples of felt and that localized overheating of the samples does not take place. Remove from the oven, cool in a desiccator, and weigh. Compute the percentage of toss in weight based upon the original weight of the sample, minus the weight of surfacing. The average of the result on the two samples shall be reported as the loss on heating.

54. SHOP APPLICATION OF EPOXY PRIMERS AND COAL-TAR ENAMELS:

A. GENERAL:

The Contractor shall furnish all labor, equipment and material required, shall prepare all surfaces to be coated, and shall apply the primer and coal-tar enamel to all exterior surfaces to be coated.

B. PREPARATION OF SURFACES:

1. Before blasting, all oil and grease on the surfaces of the metal shall be removed thoroughly by flushing and wiping, using "Xylol," or other suitable solvents and clean rags. The use of dirty or oily rags or solvent will not be permitted. All other foreign matter not removable by blasting shall be removed by suitable means. All metal surfaces shall be thoroughly cleaned by blasting. Blast-cleaning operations shall remove all rust, scale, and other impurities from the surface, exposing base metal over all, presenting a grayish matte appearance, in accordance with the requirements of the Steel Structures Painting Council, Surface Preparation Specification No.10, Near-White Blast Cleaning, SSPC-SP10. (Available from Steel Structures Painting Council, 4400 Fifth Avenue, Pittsburgh, PA 15213). Blasted surfaces that rust before a priming coat has been applied shall be cleaned of all rust by buffing or wire brushing or, at the discretion of the Engineer, shall be reblasted. Adequate air separators shall be used to remove effectively all oil and free moisture from the air-supply to the blaster.

2. After cleaning, the pipe shall be protected from and maintained free of all oil, grease, and dirt that might fall upon the pipe from whatever source until it has received its final enamel coat. Any pipe showing pits after beginning of blasting shall be set aside immediately, pending examination by the Inspector for approval, reconditioning or rejection.

C. PRIMING:

The primer shall be as specified in Section 53 of these specifications, and the application shall be as follows:

1. All blasted steel surfaces shall be cleaned of dust and grit and shall be primed immediately following blasting and cleaning. The surfaces shall be dry at the time the primer is applied, and no primer shall be applied during rain or fog unless protected from the weather by suitable housing.

2. At the option of the Contractor, the application of the primer shall be by hand brushing, air gun spraying, or spraying-and-brushing, and shall be in accordance with instructions for application as supplied by the manufacturer of the primer. The apparatus to be used shall be approved by the Engineer. Spray gun apparatus to be used shall include a mechanically agitated pressure pot and an air separator that will remove all oil and free moisture from the air supply.

3. The use of coal-tar primer that becomes fouled with foreign substances or has thickened through evaporation of the solvent oils will not be permitted.

4. After application, the priming coat shall be uniform and free from floods, runs, sags, drips, holidays, or bare spots. Any bare spots or holidays shall be recoated with an additional application of primer. All runs, sags, floods, or drips shall be removed by scraping and cleaning and the cleaned area retouched, or, at the discretion of the Inspector, all such defects shall be remedied by reblasting and repriming. Suitable measures shall be taken to protect wet primer from contact with rain, fog, mist, spray, dust, or other foreign matter until completely hardened and enamel applied.

5. In cold weather when the temperature of the steel is below 45°F, or at any time when moisture collects on the steel, the steel shall be warmed to a temperature of approximately 85°-100°F for sufficient time to dry the pipe prior to priming. To facilitate spraying and spreading, the primer may be heated and maintained during the application at a temperature of not more than 120°F.

6. The minimum and maximum allowable drying time of the primer between application of primer and application of coal-tar enamel shall be in accordance with instructions issued by the manufacturer of the primer unless otherwise directed by the Engineer. If the enamel is not applied within the maximum time after priming, as required by the manufacturer or as directed by the Engineer, the pipe shall be reprimed with an additional light coat of primer, or, at the discretion of the Engineer, the entire prime coat shall be removed by reblasting and the pipe reprimed.

D. PREHEATING OF PRIMED PIPE:

1. At all times during cold weather when pipe temperature is below 45°F, or during rainy or foggy weather when moisture tends to collect on cold pipe, enameling shall be preceded by warming the pipe.

2. Warming shall be done by any method which will heat pipe uniformly to recommended temperature without injury to primer. Steel temperature of pipe shall not exceed 160°F.

3. After heating and while pipe is at its highest temperature, inside lining enamel shall be applied. Coating of the outside of the pipe with coal-tar enamel shall proceed immediately after the spinning operation is completed, while the pipe is still warm from preheating and centrifugal casting.

E. COAL-TAR ENAMEL APPLICATION:

Coal-tar enamel coating to be used for the exterior coating shall be in accordance with Section 53 of these specifications. The application shall be as follows:

1. The coal-tar enamel shall be heated in approved heating kettles equipped with accurate and easily readable thermometers. In addition, the purchaser reserves the right to require recording thermometers; such thermometers shall be installed on the heating kettles as directed by the Engineer and at the expense of the Contractor. Such thermometers will be checked and adjusted by the Engineer whenever necessary. The charts therefrom shall constitute a basis for acceptance or rejection of any enamel because of improper heating and/or handling.

2. The operating and/or supply kettles shall be provided in sufficient numbers so that the coal-tar enamel may be heated and coordinated with the application procedure. No enamel shall be held in the operation kettles at application temperatures for a longer period than recommended by the manufacturer or stated in his instructions. The enamel heated in supply kettles shall not exceed the temperatures and melting periods recommended by the coating manufacturer. Operating kettles shall not be used as a continuous source of supply by adding unmelted enamel during the time they are in use but shall be completely emptied of one charge and cleaned, if necessary, before the next charge of unmelted enamel is added; except when mechanically agitated kettles are used. In the practice of field patching, the Engineer may permit continuous use of a heating kettle not exceeding 50-gal. capacity. Kettles shall be covered with hinged lids

which may be securely fastened down and shall be tightly closed during the heating and application of enamel except for necessary loading and stirring.

3. The coal-tar enamel shall be maintained moisture and dirt free at all times prior to, and at the time of, heating and application.

4. In loading the kettles, the enamel shall be broken into pieces suitable for the heating equipment used.

5. In heating the coal-tar enamel, the charge shall be melted and brought up to application temperature as rapidly as possible without injury to the enamel. The temperature at which the enamel will be applied shall be in accordance with the recommendation furnished by the manufacturer. The hot enamel shall be thoroughly stirred at intervals not exceeding 15 min. regardless of whether the enamel is being used from kettles or is being held ready for use. Iron paddles shall be used for stirring; wooden paddles will not be permitted.

6. The maximum allowable temperature to which enamel may be heated and the maximum allowable time that the enamel may be held in the kettles an application temperature shall be in accordance with the instructions supplied by the manufacturer.

7. Coal-tar Enamel that has been heated in excess of the maximum allowable temperature, or that has been held at application temperature for a period in excess of that specified, shall be condemned and rejected. Fluxing the enamel will not be permitted.

8. Excess enamel remaining in a kettle at the end of any heat shall not be included in a fresh batch in an amount greater than 10 percent of the batch. Kettles shall be emptied and cleaned frequently as required. The material removed in cleaning the kettles shall be dumped and wasted.

F. APPLICATION OF COAL-TAR ENAMEL TO EXTERIOR SURFACES:

1. The primed steel surface to be enameled shall be dry and clean at the time the enamel is applied. Any damage occurring to the primer coat shall be repaired by retouching before application of the enamel.

2. External enamel shall be applied by pouring on the revolving pipe and spreading to the specified thickness. Enamel shall be applied so the each spiral resulting from the spreading operations shall overlap the preceding spiral, producing a continuous coat free from defects. The thickness of coating shall be 3/32 in., and the allowable variation in thickness shall not exceed ±1/32 in.

3. The enameled pipe shall not be rolled or supported on its enameled surface until thoroughly cooled and hardened.

4. For application to specials and other shapes, see Section 54 of these specifications.

5. Exterior enamel coating shall be electrically tested as per Section 53K, before wrapping is applied.

G. APPLICATION OF COAL-TAR ENAMEL AT END OF PIPE SECTIONS:

1. When pipe sections are to be joined together by field welding, the protective materials shall be left off the outside surfaces at the ends a distance of 4 inches for the primer and of 9 inches for the final coating and wrapping, to permit the making of field joints without injury to the lining and coating.

2. When pipe sections are to be joined together with mechanical couplings, the enamel shall be left off the exterior of the pipe a distance back from the ends of 1 in. more than one-half the overall length of the assembled coupling. The interior lining shall extend to the pipe end.

3. For joints other than specified herein, the length of pipe to be left bare at ends shall be in accordance with instructions supplied by the Engineer.

H. SPECIALS--CLEANING, AND COATING:

The results of cleaning, and coating of specials shall be equivalent to the results of similar work on straight pipe sections. Methods deviating from the prescribed procedure shall require approval by the Engineer. If the shape precludes spinning, the exterior coating shall be applied by hand daubers as follows:

1. All surfaces shall be double coated by applying the enamel with hand daubers. The brush strokes of enamel shall be made in the direction of flow. All brush strokes of enamel shall overlap and form a continuous coating. The daubing may be done by the double-lap or "shingling" method. The work shall be done in a workmanlike manner, and no indiscriminate smearing of the enamel will be permitted. On all welds the strokes of the first coat of enamel shall be applied along the weld.

2. Enameling buckets shall be filled from the heating kettles with ladles or from spigots attached to the kettles and shall not be dipped for filling. Buckets shall be kept clean and free of dirt at all times and shall not be set directly upon the ground or on enameled surfaces but shall be set upon suitable pads or blocks. Buckets shall not be allowed to accumulate excess chilled enamel but shall be kept clean.

3. Enamel shall not be used from the enameling buckets below the minimum temperature specified by the manufacturer.

4. All drips and splashes of enamel on primed surfaces shall be carefully scraped off before the hand brushed coat of enamel is applied. This pertains particularly where overhead hand enameling is necessary inside of pipe or specials.

5. Hand-enameling daubers or mops shall be of the size best adapted for the work and shall be subject to the approval of the Engineer. Daubers shall be made of the best grade of Tampico Fibre set in solid hardwood handles. Sweeps, or knot daubers shall not be used. Long hand horseshoe daubers will be acceptable for large areas and flat work. Mops shall be made of top quality waterproofer's yarn looped, with strand lengths of 6" to 8".

I. FITTINGS:

All fittings such as manholes, service connections, air valves, and blowoff connections shall be protected with primer and coal-tar enamel, and the same application procedure shall be employed as specified under Section 54H of these specifications.

J. APPLICATION OF GLASS-FIBER COAL-TAR SATURATED FELT:

Fiberglass felt shall be mechanically applied in a continuous end-feed machine or in a lathe-type machine or by approved field felt application equipment.

1. External enamel and glass-fiber felt wrapper shall be applied to the revolving pipe so as to produce a coal-tar enamel coating to a thickness of 3/32 in., and the allowable variation in the enamel thickness shall not exceed ±1/32 in. The fiberglass felt shall be definitely and positively bonded to the enamel. The enamel coating shall be continuous and free from defects, skips, or holidays.

2. The glass-fiber felt as specified in Section 53D shall be of suitable width for smooth, spiral application and shall be of approximately uniform width. The overlap of the felt shall be not less than 1/2 in. The glass-fiber felt shall be applied neatly and smoothly and shall be free of wrinkles and buckles. The second layer (when required) of coal-tar enamel and glass-fiber coal-tar saturated felt shall overlap the first layer by 50% producing a continuous coat free from defects, skips or holes. The thickness of this layer shall be 3/32 in., and the allowable variation in thickness shall not exceed ±1/32 in. The second glass-fiber coal-tar saturated felt layer shall have a 1/32 in. minimum cover of hot coal-tar.

3. Over the bonded glass-fiber felt wrapper shall be applied a coating of whitewash following final inspection as specified in Section 54L of this specification.

K. ELECTRICAL INSPECTION:

The Contractor shall conduct electrical inspection of all of the coating by means of an approved electrical flaw detector delivering approximately 10,000 V at low amperage. Before final shop acceptance of coal-tar enamel coating, the entire interior and exterior surfaces of all coated pipe shall be tested, and all defects found shall be satisfactorily repaired by and at the expense of the Contractor.

L. USE OF WHITEWASH ON EXTERIOR:

Outside surfaces of all pipe and specials shall be given a coat of water-resistant whitewash immediately following final inspection. Before whitewashing coated and wrapped pipe, it shall have completely cooled. Kraft paper may be used in lieu of a whitewash coating on the outside surface of the pipe in accordance with AWWA Standard for Coal-Tar Protective Coatings and Linings for Steel Water Pipelines--Enamel and Tape--Hot-Applied, ANSI/AWWA C203-91 Section 2.5.

55. FIELD PROCEDURE AND ENAMELING:

A. TRANSPORTING AND HANDLING ENAMELED PIPE:

1. Protected pipe at all times shall be handled with equipment such as stout, wide belt slings and wide padded skids designed to prevent damage to the coating. Bare cables, chains, hooks, metal bars, or narrow skids shall not be permitted to come in contact with the coating. All handling and hauling equipment shall be approved by the Engineer before use.

2. When shipped by rail, all pipe shall be carefully loaded on properly padded saddles or bolsters. All bearing surfaces and loading stakes shall be properly padded with approved padding materials. Pipe sections shall be separated so that they do not bear against each other, and the whole load must be securely fastened together to prevent movement in transit. When applicable to this type of pipe, the pipe shall be loaded and tied into a unit load in strict accordance with the current loading rules of the American Railway Association.

3. In truck shipments, the pipe shall be supported in wide cradles of suitable padded timbers hollowed out on the supporting surface to fit the curvature of pipe, and all chains, cables, or other equipment used for fastening the load shall be carefully padded. For smaller diameter pipe, sand or sawdust filled bags may be used instead of hollowed out timbers.

4. The purchaser shall inspect the pipe and pipe protection on cars or trucks at destination, and if the pipe or pipe protection is found damaged, claim shall be made against the carrier.

B. HANDLING ENAMELED PIPE IN FIELD OR AT TRENCH:

1. Pipe shall be stored along the trench side, supported on wooden timbers placed under the uncoated ends to hold the pipe off the ground.

2. Pipe shall be hoisted from the trench side to the trench by means of a wide belt sling. Chains or cables, no matter how well padded, tongs, or other equipment likely to cause damage to the enamel coating will be not be permitted. Dragging or skidding the pipe will not be permitted. The Contractor shall allow inspection of the coating on the under side of the pipe while suspended from the sling. Any damage shall be repaired before lowering the pipe into the trench.

3. Where the trench traverses rocky ground or ground containing hard objects that would penetrate the protective coating, a layer of screened earth or sand not less than 3 in. in thickness shall be placed in the bottom of the trench prior to installation of pipe, or as otherwise specified or directed by the Engineer.

4. At all times during erection of the pipeline the Contractor shall use every precaution to prevent damage to protective coating on the pipe. No metal tools or heavy objects shall be unnecessarily permitted to come in contact with the finished coating. Workmen will be permitted to walk upon the coating only when necessary, and in case of such necessity the workmen shall wear shoes with rubber or composition soles and heels. This shall apply to all surfaces, whether bare, primed, or enameled. Any damage to the pipe or the protective coating from any cause during the installation of the pipeline and before final acceptance by the purchaser shall be repaired as directed by the Engineer, and at the expense of the Contractor.

C. WELDED FIELD JOINTS--COAL-TAR ENAMEL COATING:

1. The primer and coal-tar enamel used shall be the same material as used for coating the pipe.

2. Interior: After field pressure testing, exterior surface of welds of field joints shall be cleaned. Primer shall then be applied and allowed to dry according to the coating manufacturer's instructions. Completion of lining of field joints shall be compatible with the lining used and accepted Standard Practice. (The requirements of this paragraph are applicable only to those sizes of pipe 30 in. and larger, into which it is possible to enter for cleaning and applying primer).

3. Exterior: After field pressure tests have been completed, joints shall be cleaned and primed. When the primer is dry, the field joints shall be manually coated and wrapped to the specified thickness. Enamel shall overlap the coating on each side of the field joint to form a continuous external coating free from defects.

4. All hand enameling shall be done in accordance with the procedure outlined in paragraphs under Section 54H of these specifications, and heating of enamel for field application shall be done in accordance with the procedure outlined in paragraphs under Section 54E of these specifications.

5. All field coating work shall be thoroughly inspected in the presence of the Engineer by the Contractor, using an electrical flaw detector, and any flaws or holidays found shall be repaired by the Contractor.

6. Once each day a standard peel test shall be taken by the Engineer from the outside of one field joint before wrapping. The joint selected shall be one done during that day.

The test procedure shall be as follows:

With a knife-edge, cut two parallel lines through the enamel to the steel approximately 3/4 inch apart and approximately 4 inches in length. With the edge of the knife blade, cut under the enamel strip at one narrow end and loosen the enamel from the plate the full width and back about 1/2 inch. Place the blade under the loosened end and with a firm grip on the enamel between the blade and a finger, apply a slow upward pull on the strip.

(a) If the strip peels only 1/8 inch, the test shall be recorded "no peel" and the coating made that day are acceptable.

(b) If the strip peels more than 1/8 inch, the test shall be recorded "unacceptable peel".

If (b) occurs, all other coated joints made during the working day represented by the tested coated joint shall be similarly tested. Any joint showing the same condition shall have the coating removed, and a new coating reapplied, all at the expense of the Contractor.

D. MECHANICAL COUPLINGS—CLEANING, PRIMING, AND COATING:

At the point of manufacture, all couplings shall be cleaned, then primed with the primer specified by the manufacturer of the coating used on the pipe. The couplings and the exposed pipe ends shall be reprimed in the field. When the primer is dry, these exterior surfaces shall be coated with the AWWA coal-tar enamel coating recommended by the manufacturer of the coating used on the pipe. The coating shall be capable of conforming to the normal movement of the buried pipe without cracking.

E. TRUNK MAIN BULKHEADS:

The Contractor shall be aware that trunk main bulkheads shall be lined and coated as herein specified for the interior and exterior surfaces of the trunk main pipe section.

F. FINAL INSPECTION BEFORE BACKFILLING:

All phases of the installation work shall be done in such a manner so as to prevent any damage to the trunk main lining and coating. Prior to backfilling any section of the trunk main, these surfaces shall receive a final visual inspection, and an overall electrical flaw inspection using an approved "holiday detector". Any defects noted shall be repaired and the surfaces retested until satisfactory results are obtained. The holiday detector shall deliver 10.000 V to 12,000 V at low amperage.

G. BACKFILLING:

Backfilling shall be conducted at all times in such a manner as to prevent damage and abrasion to coal-tar enamel exterior protection of pipe.

56. EXTERIOR TAPE COATING FOR STEEL PIPE:

A. DESCRIPTION:

1. All steel pipe fittings and field joints of this contract shall have exterior corrosion protection coating consisting of prefabricated cold-applied tapes placed by mechanical methods. The tape coating system shall be applied as a three-layer system consisting of a primer, an innerwrap tape (corrosion preventive) and a double layer of outerwrap tapes (mechanical protective). The tape coating system shall be applied to the thoroughly cleaned and blasted exterior pipe surface.

2. The tape coating system primary material components shall be a cross-linked butyl rubber adhesive mass bonded to polyethylene backings. The coating system shall be YG-111 system as manufactured by Polyken Pipeline Coatings, Murrysville, PA 15668, or approved equivalent. The materials manufacturer shall furnish all components required for the system including all priming materials, the proper taping materials, and all related incidental items. The manufacturer shall furnish complete instructions for the application of the tape system. The manufacturer's representative shall make a field visit to the application plant at the beginning of the tape application work for this contract. He shall also make a field visit to the site when the taping of field welded joints begins. During these visits the manufacturer's representative shall inspect the pipe preparation and tape coating work to insure that the application work is proceeding properly. The manufacturer's representative shall make additional visits to the application plant and to the construction site when requested by the City Inspector.

B. REFERENCE STANDARDS:

1. The primary reference standards for the exterior tape coating work of this contract shall be the American Water Works Association Standard for Tape Coating Systems for the Exterior of Steel Water Pipelines, ANSI/AWWA C214-89 and the American Water Works Association Standard for Cold-Applied Tape Coatings for Exterior of Special Sections, Connections, and Fittings for Steel Water Pipelines, ANSI/AWWA C209-90. All requirements of these standards including the General Requirements, the Coating System Minimum Physical Standards, the Coating Application Methods, and the Inspection, Testing and Rejection Requirements, shall be applicable, except as modified herein.

2. Other standards which apply to the exterior tape coating work of this contract shall include those of the Steel Structures Painting Council (SSPC), the National Association of Corrosion Engineers (NACE), and the American Society for Testing and Materials (ASTM). The pertinent standards of these associations are given in the primary reference standards listed above.

3. Wherever the requirements of these Contract specifications exceed those of the reference standards, the contract Specification requirements shall govern, and shall be the minimum requirements for acceptance of the work.

57. QUALIFICATION OF TAPE COATING APPLICATOR:

A. The applicator for the exterior tape coating system will be considered qualified to perform the work in the shop and in the field if he complies with following:

1. He shall have under suitable cover a physical plant approved by the Engineer capable of mechanically coating steel water pipe and fittings as per AWWA C214-89 (pipe) and C209-92 (fittings) for the sizes called for under this contract. The physical plant shall include efficient cleaning and blasting equipment, hydraulic tape tensioning and dispensing machinery, pipe rotating and traveling equipment and adequate storage and handling facilities.

2. The applicator shall have been continuously engaged in the pipe tape coating business and shall have at least five years experience in the application of the tape coating system specified herein. He shall be approved and certified as a qualified applicator by the manufacturer of the system components.

3. The applicator shall have experienced and qualified personnel to perform the field application work required for tape coating field welded joints and for making any field repairs which may be required.

4. The applicator shall have experienced and qualified personnel to perform final tests of the coated pipe both in the shop and in the field.

5. The applicator shall certify that he will carefully follow the instructions of the manufacturer and the reference standards in the application of the tape coating system. Furthermore, that he will make arrangements with the manufacturer's representative for inspection visits during the application work as described hereinbefore.

6. The applicator shall make available for the exclusive use of the City Inspector a desk, and locker for clothes. Clean toilet and wash-up facilities shall also be available.

58. MATERIALS FOR TAPE COATING SYSTEM:

A. PRIMER:

1. The primer shall be supplied by the tape system manufacturer and shall consist of a butyl rubber matrix in a solvent which will produce, without heat application, an effective bond between the pipe surface to be protected and the innerwrap tape. Primer shall comply with all code and regulatory requirements regarding safety and environmental protection in effect at the location of use.

B. COATING TAPES:

1. Innerwrap tape shall be 20 mils thick, having a ratio of 11 mils of cross-linked butyl rubber adhesive mass bonded to a 9 mil blend of high and low density polyethylene backing.

2. Outerwrap tapes (2 required) shall each be 30 mils thick, having a ratio of 5 mils of pressure sensitive cross-linked butyl rubber adhesive mass bonded to 25 mils of high-density polyethylene backing. The first outerwrap shall be colored black. The second outerwrap shall be colored white.

3. Strip tape for longitudinal welds shall be 25 to 35 mils thick consisting of cross-linked butyl rubber adhesive mass bonded to a pliable low-density polyethylene backing.

4. Hand-wrapped tape for coating of fittings and field welds shall be 35 mils thick, consisting of a soft cross-linked butyl rubber mass of high adhesive quality bonded to a blend of medium and low density polyethylene backing.

C. PHYSICAL PROPERTIES:

1. The overall impact resistance for the pipe coating system shall have a minimum average value of 89 in.-lbs. in accordance with the Standard Test Method for Impact Resistance of Pipeline Coatings (Falling Weight Test), ASTM Designation G14-88. The total tape coating thickness for pipe sections shall be 80 mils, and the total tape coating thickness for pipe fittings and field joints shall be 70 mils. Other physical requirements of the tape coating system shall equal or exceed the minimum physical property requirements tabulated in Reference Standards AWWA C214 and C209.

D. TESTS OF MATERIALS:

1. The batch sampling and testing procedure, and basis of rejection for the tape coating system materials shall be in accordance with Section 4 of Reference Standard AWWA C214, except that all tests will be at the expense of the Contractor, in laboratories approved by the Engineer. The sampling selection will be done at the application plant as the tape coating materials are received. The number of samples taken shall be based on the material quantities required determined as follows:

   a. One batch sample and test series of primer, innerwrap and outerwrap tapes from the material required for tape coating 500 linear feet of straight pipe.

   b. One batch sample and test series of handwrapped tape from the material required for tape coating 50 field joints or pipe fittings.

59. APPLICATION OF TAPE COATING SYSTEM:

A. PIPE COATING:

1. The pipe coating system shall consist of: pipe cleaning; surface blasting; primer application; strip taping longitudinal welded joints; and application of inner and outerwrap tapes.

2. The application procedure for the pipe coating shall comply with the requirements of Section 3 of Reference Standard AWWA C214, except that an additional outerwrap shall be applied to provide the required double wrap outer mechanical protective coating.

3. The primer shall be applied in a uniform thin film at an approximate coverage rate of 400 to 600 square ft. per gallon in accordance with the manufacturer's instructions. The primer should be thoroughly mixed and agitated as needed during application to prevent settling of solid material. The primer may be applied by spray or rug type action. The primer must coat the entire exterior pipe surface. The primer coat on the pipe should be uniform and free of floods, runs, sags and drips. The primed surface should be free of any foreign substances such as sand, grease, oil, grit, and rust particles. The primer should be tacky to dry prior to the application of the innerwrap tape.

4. In the mechanical application of the coating tapes, the tensioning and dispensing machine shall apply the inner and outerwraps to the rotating pipe in a spiral manner with a minimum one-inch overlap. The minimum tape tension during application shall be 8-10 pounds per inch of tape width for the innerwrap, and 13-15 pounds per inch of tape width for the outerwrap. The maximum tension during application shall not cause a narrowing of more than 0.0625 inches in the tape width.

B. TAPE COATING FOR FITTINGS, FIELD JOINTS AND REPAIRS:

1. Surface preparation, priming and wrapping procedures for tape coating application of fittings, field joints and repairs shall comply with the applicable requirements of Reference Standards AWWA C214, AWWA C209, and the manufacturer's instructions. Pipe preparation shall include blasting of fittings, and machine wire brushing of field joints and repairs. Following the cleaning and priming of these surfaces, they shall be double-wrapped with hand-wrap tape applied with a "Handwrapster" machine approved by the manufacturer.

C. TESTS OF COATED PIPE:

1. After coating, each pipe section and fitting shall be tested for thickness and for flaws in the coating system in accordance with the requirements of Section 4 of Reference Standards AWWA C214 and C209. After coating of welded joints in the field and the completion of any field repair work, these coated surfaces shall also be tested for coating flaws as required in the Reference Standards. Any defects noted from the testing procedures shall be repaired and the coating retested until satisfactory results are obtained.

60. FIELD PROCEDURE:

A. TRANSPORTING AND HANDLING LINED AND COATED PIPE:

1. Lined and coated pipe shall at all times be handled with equipment such as stout, wide belt slings and wide padded skids designed to prevent damage to the coating. Bare cables, chains, hooks, metal bars, or narrow skids shall not be permitted to come in contact with the coating. All handling and hauling equipment shall be approved by the Engineer before use.

2. When shipped by rail, all pipe shall be carefully loaded on properly padded saddles or bolsters. All bearing surfaces and loading stakes shall be properly padded with approved padding materials. Pipe sections shall be separated so that they do not bear against each other, and the whole load must be securely fastened together to prevent movement in transit. When applicable to this type of pipe, the pipe shall be loaded and tied into a unit load in strict accordance with the current loading rules of the American Railway Association.

3. In truck shipments, the pipe shall be supported in wide cradles of suitable padded timbers hollowed out on the supporting surface to fit the curvature of pipe, and all chains, cables, or other equipment used for fastening the load shall be carefully padded. For smaller-diameter pipe, sand or saw-dust-filled bags may be used instead of hollowed-out timbers.

4. The purchaser shall inspect the pipe and pipe protection on cars or trucks at destination, and if the pipe or pipe protection is found damaged, claim shall be made against the carrier.

B. HANDLING LINED AND COATED PIPE IN FIELD OR AT TRENCH:

1. Pipe shall be stored along the trench side, supported on wooden timbers placed under the uncoated ends to hold the pipe off the ground.

2. Pipe shall be hoisted from the trench side to the trench by means of a wide belt sling. Chains or cables, no matter how well padded, tongs, or other equipment likely to cause damage to the coating will not be permitted. Dragging or skidding the pipe will not be permitted. The Contractor shall allow inspection of the coating on the under side of the pipe while suspended from the sling. Any damage shall be repaired before lowering the pipe into the trench.

3. Where the trench traverses rocky ground or ground containing hard objects that would penetrate the protective coating, a layer of screened earth or sand not less than 3 in. in thickness shall be placed in the bottom of the trench prior to installation of pipe, or as otherwise specified or directed by the Engineer.

4. At all times during erection of the pipeline, the Contractor shall use every precaution to prevent damage to protective coating on the pipe. No metal tools or heavy objects shall be unnecessarily permitted to come in contact with the finished coating. Workmen will be permitted to walk upon the coating only when necessary, and in case of such necessity the workman shall wear shoes with rubber or composition soles and heels. This shall apply to all surfaces, whether bare, primed, or coated. Any damage to the pipe or the protective coating from any cause during the installation of the pipeline and before final acceptance by purchaser shall be repaired as directed by the Engineer, by and at the expense of the contractor.

C. WELDED FIELD JOINTS--EPOXY POLYURETHANE LINING AND TAPE COATING:

1. The epoxy primer and polyurethane used shall be the same material as used for the pipe lining and the coal-tar enamel shall be the same as applied to the exterior of the pipe.

2. Interior: After field pressure testing, welds of field joints shall be cleaned. NSF #61 approved primer shall then be applied and allowed to dry according to the coating manufacturer's instructions. Completion of lining of field joints shall be compatible with the lining used and accepted Standard Practice. (The requirements of this paragraph are applicable only to those sizes of pipe 30 in. and larger--into which it is possible to enter for cleaning and applying primer.

3. Exterior: After field pressure tests have been completed, joints shall be cleaned and primed. When the primer is dry, the field joints shall be double-wrapped to the specified thickness. Tape shall overlap the coating on each side of the field joint to form a continuous external coating free from defects.

4. All hand lining shall be done in accordance with the procedure outlined in paragraphs under Section 54H of these specifications; and heating of enamel for field application shall be done in accordance with the procedure outlined in paragraphs under Section 54E of these specifications.

5. All field coating work shall be thoroughly inspected in the presence of the Engineer by the Contractor, using an electrical flaw detector, and any flaws or holidays found shall be repaired by the Contractor.

D. MECHANICAL COUPLINGS--CLEANING, PRIMING, AND COATING:

At the point of manufacture, all couplings shall be cleaned, then primed with the primer specified by the manufacturer of the coating used on the pipe. The couplings and the exposed pipe ends shall be reprimed in the field.

E. FINAL INSPECTION BEFORE BACKFILLING:

All phases of the installation work shall be done in such manner so as to prevent any damage to the trunk main lining and coating. Prior to backfilling any section of the trunk main, these surfaces shall receive a final visual inspection, and an overall electrical flaw inspection using an approved "holiday detector". Any defects noted shall be repaired and the surfaces retested until satisfactory results are obtained.

F. TRUNK MAIN BULKHEADS:

The Contractor shall be aware that trunk main bulkheads shall be lined and coated as herein specified for the interior and exterior surfaces of the trunk main pipe section.

61. INTERIOR LINING AND EXTERIOR COATING WITH NSF APPROVED EPOXY AND POLYURETHANE COATINGS:

The interior lining and the exterior coating shall be in accordance with the American Water Works Association Standard for Liquid Epoxy and Polyurethane Coating System for the Interior and Exterior of Steel Water Pipelines, AWWA C210-84. This standard covers the material and application requirements of a liquid epoxy coating system that will provide long term protection from corrosion to both interior and exterior of steel water pipe, special sections, welded joints, and connections installed underground under normal conditions. The lining system must also have been approved for use in contact with potable drinking water in accordance with the ANSI/National Sanitation Foundation Specification Standard ANSI/NSF 61-1992. This lining system shall consist of a liquid two-part chemically cured rust-inhibitive epoxy primer and one or more coats of a liquid two-part epoxy finish coat such as TNEMEC Series 139 Potapox II or Madison Chemical Polyurethane Coating or equal. The coating system may alternatively consist of two or more coats of the same epoxy coating without the use of a separate primer. The first coat of this alternate system shall be considered as the primer.

62. QUALIFICATIONS OF NSF APPROVED EPOXY AND POLYURETHANE APPLICATOR:

A. The Coating and lining applicator will be considered as qualified to perform work in the shop or in the field on straight pipe, special sections, welded joints, couplings, venturi tubes, regulators, valves, expansion joints, fittings and connections after he has complied with the following:

1. He shall have under suitable cover a manufacturer's plant approved by the Engineer capable of cleaning, blasting, lining and coating steel pipe and appurtenances in accordance with American Water Works Association Standards, Steel Structures Painting Council Specifications, and National Association of Corrosion Engineers Standards.

2. He shall have been engaged in this type of work either as the head of his own business, or in a supervisory capacity with a concern doing this type of work for a period of at least five (5) years.

3. He shall take a qualification test to be given by the Department. This test shall consist of lining and coating a section of steel pipe in accordance with Department specifications. This section will be inspected and tested by the Department and, if found satisfactory, the applicator will be declared qualified.

4. He shall employ experienced help for this work if the applicator is acting in the supervisory capacity and not doing the work himself.

5. Should subsequent inspections reveal that the applicator is consistently doing work of an inferior nature, he will be disqualified from all Department work.

B. The applicator for coating pipe and appurtenances, and for work in the field on joints and "touch-up" should have the following equipment:

1. Sufficient epoxy components that have not exceeded shelf life.
2. Mixing kettle with metal paddle agitators.
3. Thermometer and timer.
4. Thickness gauge, both wet and dry.
5. Hand daubers and spray equipment.
6. Approved electrical testing equipment for holiday detection.
7. Approved cleaning materials and sand blast cleaning equipment.
8. Exhaust fans for adequate health and safety precautions.

63. MATERIALS FOR PRIMER, EPOXY AND POLYURETHANE:

A. PRIMER:

1. The primer shall be supplied by the epoxy manufacturer approved by NSF for use in potable water mains and shall consist of a two component epoxy system of bisphenol, an epoxy resin and a polyamide resin catalyst, in a solvent which will produce, without heat application, an effective bond between the metal steel surface to be protected and the next coat to be applied. The primer shall comply with all code and regulatory requirements regarding safety and environmental protection in effect at the location of use.

B. EPOXY FINISH COATS:

1. The topcoat shall consist of a two-part liquid epoxy to be used over the epoxy primer. The mixing ratio of the two components shall be as specified by the manufacturer. The characteristics and performance properties of the topcoat shall conform to the requirements stated in Table I.

TABLE I

Characteristic and Performance Properties

Primer	Minimum	Maximum	Method
1. Sag of wet film		None	Sec.5.3.2.1*
Top coat	Minimum	Maximum	Method
1. Sag of wet film		None	Sec.5.3.2.1

Coating system	Minimum	Maximum	Method
1. Penetration at 140°F (60°C)		0.001 in. (0.025 mm)	Sec.5.3.2.2
2. Impact resistance at 75°F ±2°F (24°C ±l°C)		Pass	Sec.5.3.2.3
3. Cathodic disbondment		1.5 in.^{2} (967.5 mm^2)	Sec.5.3.2.4
4. Hot water resistance 24 h at 208°F ±4°F (98°C ±2°C)	Pass		Sec. 5.3.2.5
5. Water extractables		0.5 mg/in.^{2} (0.00078mg/mm^2)	Sec. 5.3.2.6
6. Taste and odor	Pass		Sec. 5.3.2.7
7. Immersion	Pass		Sec. 5.3.2.8
8. Adhesion	Pass		Sec.5.3.2.9

* In accordance with the American Water Works Association Standard for Liquid Epoxy Coating Systems for the Interior and Exterior of Steel Water Pipelines, AWWA C210-84.

2. Pipe, appurtenances, mechanical couplings, flanges, and expansion joints shall be coated externally with the epoxy primer and liquid epoxy finish coat system. Both primer and finish coat(s) shall be spray-applied in accordance with the manufacturer's recommendations. Application by airless spray is the preferred method.

C. SPECIFICATION OF 100% POLYURETHANE COATINGS AND LININGS FOR STEEL PIPE:

1. SCOPE: This specification covers a plural component 100% solids polyurethane coating system for use as an internal lining or external coating for steel pipe.

2. MATERIAL: The coating/lining material shall consist of a 100% solids polyIsocyanate resin and polyol resin that meets the performance requirements AWWA standard C210-84 as described in Section 2.2 that has the following properties:

PROPERTY	REQUIREMENT
% Solids	100%
Dry-to-touch time	60 seconds @ 70°F
Mix Ratio	1:1

3. SURFACE PREPARATION: All surfaces to be coated or lined should be cleaned to a near white metal finish (SSPC-SP10) with an angular profile of at least 2.5 mils. All surfaces to be coated shall be completely dry, free of moisture, dust, grease or any other deleterious substances at the time the coating or lining is applied.

4. THICKNESS: The required thicknesses are as follows for the respective applications:

APPLICATION	MINIMUM FILM THICKNESS	NOMINAL FILM THICKNESS
Internal Potable Water	15 mils (375 microns)	18 mils (450 microns)
Line Pipe	15 mils (375 microns)	18 mils (450 microns)
Field Joints	15 mils (375 microns)	18 mils (450 microns)
Valves	20 mils (500 microns)	25 mils (625 microns)
Fittings	20 mils (500 microns)	25 mils (625 microns)
Slip Bore	50 mils (1250 microns)	-
Stock Pipe	25 mils (625 microns)	-
Other Internal	depends on chemical and abrasive content and floor rates	

5. COATING APPLICATION: A heated, plural component airless spray pump (1:1 ratio) is to be used to apply the coating in one coat, multi-pass operation. No primers are to be used with this coating system.

6. REPAIR AND FIELD TOUCH-UP: Repair and touch-up materials should be compatible with the main coating system and applied according to the manufacturers recommendations.

7. INSPECTION: Holiday inspection shall be conducted as described in AWWA C210, Section 5.3.3.1. The testing may be conducted any time after the coating has reached sufficient cure.

64. SHOP AND FIELD APPLICATION OF PRIMER AND EPOXY SYSTEM:

A. GENERAL:

The Contractor shall furnish all labor, equipment and material required, shall prepare all surfaces to be coated, and shall apply the NSF approved primer and either epoxy and polyurethane exterior surfaces to be coated.

B. PREPARATION OF SURFACES:

1. Before blasting, all oil and grease on the surfaces of the metal shall be removed thoroughly by flushing and wiping, using "Xylol," or other suitable solvents, and clean rags. The use of dirty or oily rags or solvent will not be permitted. All other foreign matter not removable by blasting shall be removed by suitable means. All metal surfaces shall be thoroughly cleaned by blasting. Blasting-cleaning operations shall remove all rust, scale, and other impurities from the surface, exposing base metal over all, presenting a grayish matte appearance, in accordance with the requirements of the Steel Structures Painting Council, Surface Preparation Specification No.10, Near-White Blast Cleaning, SSPC-SP10. (Available from Steel Structures Painting Council, 4400 Fifth Avenue, Pittsburgh, PA 15213). Blasted surfaces that rust before a priming coat has been applied shall be cleaned of all rust by buffing or wire brushing or, at the discretion of the Engineer, shall be reblasted. Adequate air separators shall be used to remove effectively all oil and free moisture from the air-supply to the blaster.

2. After cleaning, the surfaces shall be protected from and maintained free of all oil, grease, and dirt that might fall upon it from whatever source until it has received its final epoxy coat. Any surface showing pits or cracks after beginning of blasting shall be set aside immediately, pending examination by the Inspector for approval, reconditioning or rejection.

3. The use of epoxy or polyurethane epoxy that becomes fouled with foreign substances or has thickened through evaporation of the solvent oils or began to harden will not be permitted.

4. After application, the coatings shall be uniform and free from floods, runs, sags, drips, holidays, or bare spots. Any bare spots or holidays shall be recoated with an additional application of primer. All runs, sags, floods, or drips shall be removed by scraping and cleaning and the cleaned area retouched, or, at the discretion of the Inspector, all such defects shall be remedied by reblasting and repriming. Suitable measures shall be taken to protect wet coatings from contact with rain, fog, mist, spray, dust, or other foreign matter until completely hardened.

5. In cold weather when the temperature of the steel is below 55°F, or at any time when moisture collects on steel, the steel shall be warmed to a temperature of approximately 85°-120°F for sufficient time to dry the surface prior to priming or coating. To facilitate spraying and spreading, the mixed epoxy may be heated and maintained during the application at a temperature of not more than 75°F. The temperature of the mixed epoxy and the steel surfaces at the time of application shall not be lower than 55°F (13°C).

C. END PREPARATION OF PIPE, SPECIAL CONNECTIONS AND APPURTENANCES:

1. Pipe section with butt or lapped joints to be joined by field welding shall not be coated within 2-1/2in. ±1/2in. (64 mm ±13 mm) of the area to be welded. This requirement applies to both the inside and outside surfaces of the pipe. Coating material on the holdback, bevel, or band is not acceptable. When rubber gasketed joints or mechanical couplings are used, the coating may extend to the ends of the pipe; but the coating thickness on the pipe surfaces that receive rubber-sealing gaskets shall not exceed what is recommended by the manufacturer of the coupling.

2. Nuts, bolts, and other items of mechanically threaded system parts used in conjunction with connections, couplings and attachments that must be assembled and operated in the field shall be left uncoated, except as shown on the approved drawings or specifications.

3. Flange faces, spot faces on flanges and bolt holes shall be coated with one smooth coat of epoxy with a dry film thickness of approximately three (3) mils.

D. ELECTRICAL AND THICKNESS INSPECTION:

The Contractor shall conduct electrical inspection of all of the coating by means of an approved electrical flaw detector. Either wet sponge or high-voltage equipment shall be used and the voltage settings and procedures must be in strict accordance with National Association of Corrosion Engineers Standard Recommended Practice for Discontinuity (Holiday) Testing of Protective Coatings, NACE RPO 188-88.

After coating each pipe section and fitting shall also be tested for thickness in accordance with the epoxy or polyurethane manufacturers recommendation with an approved thickness gauge. The total system coating shall provide in two or more coats a total dry film thickness of not less than 14 mils nor more than 25 mils. Any defects noted from the testing procedures shall be repaired and the coatings retested until satisfactory results are obtained.

65. FIELD PROCEDURE:

A. TRANSPORTING AND HANDLING COATED PIPE AND APPURTENANCE:

Similar to Section 55.A.I, .2, .3, and .4 and Section 60.A.I, .2, .3, and .4.

B. HANDLING EPOXY AND POLYURETHANE LINED AND COATED PIPE IN FIELD OR TRENCH:

Similar to Section 55.B.I, .2, .3 and .4 and Section 60.B.I, .2, .3 and .4.

C. WELDING FIELD JOINTS - EPOXY AND POLYURETHANE LINED AND COATED:

See Section 64.C.I.

D. MECHANICAL COUPLINGS:

See Section 64.C.I.

E. TRUNK MAIN BULKHEADS:

See Section 55.E and Section 60.F.

F. FINAL INSPECTION BEFORE BACKFILLING:

Similar to Section 55.F and 60.E.

G. BACKFILLING:

Backfilling shall be conducted at all times and in such a manner as to prevent damage and abrasion to the exterior coating of the pipe.

66. ENGINEER APPROVED EPOXY AND POLYURETHANE COATING SYSTEM:

A. The Bureau of Water Supply and Wastewater Collection has qualified the epoxy coating Series 139 Pota-Pox II manufactured by the TNEMEC Company Inc., Kansas City, Missouri, or other manufacturers subsequently approved by the N.S.F. as meeting the aforementioned specifications when the steel is coated with two coats as a dry film minimum thickness of 8 mils per coat. The Polyurethane Coating that is approved is manufactured by Madison Chemical Industries of Ontario Canada, or other manufacturers subsequently approved by the N.S.F. The coating has been specified on the following Bureau articles:

1. Rubber seated butterfly valves.
2. Expansion joints in standard chambers (except slip pipe portion).
3. Venturi flowmeters and appurtenances.
4. Pressure regulator valves.
5. Sleeve-type couplings.

There shall be strict adherence to the manufacturer's directions for preparation and application of this epoxy coating system. The coated film shall not contain any blisters or cracks and shall be uniform without runs or sags. The coating shall be worked into angles and crevices formed by joining members. After coring it shall not be easily chipped or peeled by penetration with a knee joint.

67. INTERIOR LINING WITH CEMENT-MORTAR:

A. DESCRIPTION:

All steel pipe, fittings and field joints of this contract shall have interior corrosion protection lining consisting of shop and field applied cement-mortar. The cement-mortar protective lining shall be applied by centrifugally spinning the pipe or by a method known to provide equivalent results. Mitres, angles, bends, reducers and other specials shall be lined with cement-mortar by a hand troweling, mechanical placement, pneumatic placement, or a method known to provide equivalent results. The manufacturer's representative shall field visit to the Contractor's installation site to verify proper workmanship and technique and shall furnish reasonable assistance in carrying out inspection duties, character of materials to be used and the proper manner of doing the work.

B. REFERENCE STANDARDS:

1. The primary reference standards for the interior lining work of this contract shall be the American Water Works Association Standard for Cement-Mortar Lining and coating for Steel Water Pipe--4In. (100mm) and Larger--In Place, ANSI/AWWA C602-89, for the sizes called for in this contract.

2. He shall have been continuously engaged in this business for a period of not less than 5 years during which time he shall have successfully lined, coated and wrapped the following lengths of pipe to demonstrate his abilities for qualification:

   a. A minimum of 15;000 lin. ft. of 72" pipe or

   b. a total of 30,000 lin. ft. of mixed sizes 8"-84" in diameter.

   c. In the event the coating and lining applicator cannot comply with the foregoing, he may also qualify by agreeing to employ a representative of the material manufacturer until such time as he has completed the required quantities necessary for qualification.

d. There shall be available for the exclusive use of the City Inspector, a desk and locker for clothes. Clean toilet and wash-up facilities shall also be available.

C. The lining applicator will be considered as qualified to perform work in the shop on specials and fittings after he has complied with the following:

1. He shall have a physical plant under suitable cover.

2. He shall have been engaged in this type of work either as the head of his own business, or in a supervisory capacity with a concern doing this type of work for a period of at least five (5) years.

3. He shall take a qualification test to be given by the Department. This test shall consist of lining and coating a section of steel pipe in accordance with Department specifications. This section will be inspected and tested by the Department and, if found satisfactory, the applicator will be declared qualified.

4. He shall employ experienced help for this work if the applicator is acting in the supervisory capacity and not doing the work himself.

5. Should subsequent inspections reveal that the applicator is consistently doing work of an inferior nature, he will be disqualified from all Department work.

D. The lining applicator will be considered as qualified to perform work in the field on joints and touching-up of defective areas after he has qualified with the following:

1. He shall have been engaged in this type of work either as the head of his own business, or in a supervisory capacity with a concern doing this type of work, for a period of at least five (5) years.

2. He shall take the qualification test similar to that described in Section 2-B-3 for coatings.

3. He shall employ experienced help for this work if the applicator is acting in a supervisory capacity and not doing the work himself.

4. Should subsequent inspections reveal that the applicator is consistently doing work of an inferior nature, he will be disqualified from all Department work.

E. Whenever in the opinion of the Engineer, the quality of the lining operator has deteriorated so as to require excessive inspection and repairs, notwithstanding any other statement in these specifications, the applicator will be required to employ a qualified representative of the material manufacturer to supervise his operations.

Lining of pipe and specials in a plant other than that in which fabrication and testing take place, will be permitted under the following conditions:

1. No fabrication or testing of pipe under this contract is to be done unless an Inspector is at the fabricating plant.

2. No coating of pipe under this contract is to be done unless an Inspector is at the coating plant.

3. Pipe lying in storage after final inspection for a period of more than three (3) months before installation in the ground shall be subject to reinspection, including the use of the holiday detector for determining any defects. Such pipe shall be repaired, if required, as directed by the Engineer.

69. LINING MATERIAL:

A. PORTLAND CEMENT:

Portland cement shall conform to the requirements of the Standard Specification for Portland Cement, ASTM Designation C150-86 of Type I or Type II cement, or as otherwise specified by the Engineer.

B. SAND:

Sand shall consist of inert materials having hard, strong, durable, uncoated grains conforming to the requirements of Standard Specification for Concrete Aggregates ASTM Designation C33-86.

C. MIXING WATER:

Water shall be clean, colorless, and free from injurious quantities of organic matter, alkali, salt, or other impurities that might reduce the strength, durability, or other desirable qualities of the mortar.

D. CURING COMPOUND:

Curing compound for curing cement-mortar linings shall comply with the requirements of Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete, ASTM Designation C309-89.

E. PAINT:

The paint or other materials used to prevent the rusting of steel surfaces at hold backs of mortar lining or coating before pipe installation shall be a quick-drying, corrosion resistant material with good bonding properties to steel and shall dry tack-free and smooth within 4 hours after application. The paint shall be applied, without sags or runs, to a thickness that will not impair the clearances required for proper welding and installation of the joint. The paint material applied to the interior of pipe or fittings shall be free from contaminants that may be harmful to the end user of the potable water.

F. INSPECTION:

All materials furnished and work done shall be subject to inspection. The contractor shall furnish, without additional cost to the purchased, reasonable assistance for the inspection of materials and workmanship. The Engineer or Inspector shall, at all times, have access to all parts of the shop and works where such material is being manufactured or such work is being performed.

G. REINFORCEMENT:

Wire-fabric reinforcement for lining of specials, shall be 2 x 4 WO.5 x WO.5 welded wire fabric. The wire shall conform to the requirements of the Standard Specification for Steel Welded Wire, Fabric, Plain, for Concrete Reinforcement, ASTM Designation A185-85, or the Standard Specification for Steel Welded Wire Fabric, Deformed, for Concrete Reinforcement, ASTM Designation A497-86. Unless otherwise specified by the purchaser, wire fabric reinforcement may be either crimped or uncrimped.

H. CLEANING SURFACES:

All surfaces to be mortar lined shall be cleaned to remove loose or other foreign matter that could interfere with the adherence of the cement mortar.

I. CEMENT MORTAR:

Cement mortar shall be composed of cement, sand, and water, well mixed and of proper consistency to obtain a dense, homogeneous lining that will adhere firmly to the pipe surface. If an admixture is to be used by the contractor, it shall be subject to review and acceptance by the Engineer. Proportions of sand to cement shall be not more than 3 parts sand to 1 part cement, by weight. The soluble chloride-ion (Cl-) content of the cement-mortar mix shall not exceed 0.15 percent, expressed as a percentage of cement weight.

J. THICKNESS:

Cement-mortar lining shall be uniform in thickness, except at joints or other discontinuities in the pipe wall. Lining thickness shall be as listed in Table 3 or as specified by the Engineer. Ends of lining shall be left square and uniform with regard to the longitudinal axis of the pipe, and the lining holdback shall be as specified by the Engineer for the type of joint required.

Table 3 - Cement-Mortar Lining Thickness

Nominal Pipe Size in.	Lining Thickness In.	Tolerance in.
4-10	1/4	-1/16 + 1/8
11-23	5/16	-1/16 + 1/8
24-36	3/8	-1/16 + 1/8
greater than 36	1/2	-1/16 + 1/8

K. EQUIPMENT:

1. LINING: Straight sections of pipe shall be lined by use of a spinning machine specifically designed and built for the purpose of rotating the pipe section and centrifugally applying cement-mortar linings to the interior of steel pipe or by a method known to provide equivalent results

2. MIXING: The mortar shall be mixed in batches. The amount of cement and sand entering into each batch shall be measured by weight. The quantity of water entering the mixer shall be measured automatically by an adjustable device, or it shall be otherwise measured to ensure that the correct quantity of water is being added.

L. MACHINE LINING:

1. BRACING: When required to prevent distortion or vibration during the spinning, each section of pipe shall be suitably braced with external or internal supports appropriate to the equipment.

2. PLACEMENT: In application of lining by a spinning machine, the entire quantity or mortar required for completion of the lining of the section of pipe shall be placed without interruption.

3. FINISH: After the mortar has been distributed to a uniform thickness, the rotation speed shall be increased to produce a dense mortar with a smooth surface.

4. SURPLUS WATER: Provision shall be made for removal of surplus water by air blowing, tilting of the pipe, or other methods approved by the Engineer.

M. LINING OF SPECIALS:

1. GENERAL: The application of cement-mortar lining to miters, angles, bends, reducers, and other special sections, the shape of which precludes application by the spinning process, shall be accomplished by mechanical placement, pneumatic placement, or hand application and finished to produce a smooth, dense surface.

2. REINFORCEMENT: Wire-fabric reinforcement or ribbon-mesh reinforcement shall be applied to the interior of fittings larger than 24 in. and shall be secured at frequent intervals by tack welding to the pipe, by clips, or by wire. The wires on 2-in. spacing on the 2-in. x 4-in. fabric shall extend circumferentially around the fitting. Repaired areas of machine-applied linings at miters, pipe ends, outlets, and other cuts made in the lining for fabrication of the fitting need not be reinforced if the width of the repair area does not exceed 12 in. Repairs for widths exceeding 6 in. shall be bonded to the steel and adjacent faces of the lining with a bond agent.

3. THICKNESS: Thickness shall be as required for spun lining of straight sections, except that it may be varied by feathering or filleting to a smooth transition with adjoining sections of pipe.

4. HANDWORK: Cement mortar for handwork shall be of the same materials and in the same sand-cement proportions as the mortar for machine lining except that plaster sand conforming to the Standard Specification for Inorganic Aggregates for Use in Gypsum Plaster, ASTM Designation C35-89 may be used in place of sand conforming to ASTM C33-86. Areas shall be cleaned to remove loose or other foreign matter that would interfere with the adherence of the cement mortar and, if necessary, shall be moistened with water just before the placing of the mortar.

N. DEFECTIVE LINING:

1. GENERAL: All defects, including but not restricted to sand pockets, voids, oversanded areas, blisters, and cracking as a result of impacts, shall be cut out and replaced by hand or pneumatic placement to the same the thickness as required or the mortar lining.

2. LINING CRACKS: Temperature and shrinkage cracks in the mortar lining less than 1/16 in. in width need not be repaired. Cracks wider than 1/16 in. need not be repaired if it can be demonstrated to the satisfaction of the purchaser that the cracks will heal autogenously under continuous soaking in water. The autogenous healing process may be demonstrated by any procedure that keeps the lining of the pipe continually wet or moist. Pipe used in the demonstration shall be representative of the pipe to be supplied, and water for the moistening of the pipe shall be chemically similar to the water to be carried in the pipeline.

0. CURING OF LINING:

1. GENERAL: Immediately after completion of the spinning, the pipe sections may be moved to a curing area. Care shall be exercised at all times to prevent damage to the lining. At the option of the contractor, linings shall be accelerated cured or moist cured. Accelerated curing or moist curing may be used interchangeably on a time-ratio basis of 5-1/2 h of moist curing to 1 h of accelerated curing, except that moist curing may be used only if the minimum ambient temperature exceeds 40°F (5°C) continuously during the required minimum curing period. In any case, linings shall be kept continually moist until the completion of the minimum specified curing period.

2. MOIST CURING: On arrival at the curing area, but not later than 30 min after completion of the lining operation, pipe ends shall be covered with plastic or wet burlap for a minimum period of 24 hours before applying the exterior coating, if such coating is specified. No credit shall be allowed for any time during which the temperature drops below 50°F (10°C). If a cement-mortar exterior coating is not specified, the lining shall be kept moist for four days before shipment. In either case, the lining shall be cured for a total period of four days before shipment. The ends of the pipe sections shall be kept closed during the curing period, with plastic end caps except sprinkling heads are used, the reinforcement and outside coatings are being applied, or accelerated curing is being substituted. If the plastic end caps are installed at that time, they can be used for shipping to the job site as indicated in Section 70.D. The contractor shall exercise care and diligence to avoid drying out or cracking of the lining.

3. ACCELERATED CURING: Accelerated curing may begin immediately on arrival of the pipe at the curing area, but the temperature of the Pipe shall not exceed 90°F (32°C) for 3 hrs. or until the mortar has taken its initial set, whichever occurs first. The ambient vapor shall then be maintained at a temperature between 110°F and 150°F (43°C and 66°C) at a relative humidity of not less than 85 percent for a minimum curing period of 6 hrs. after which the exterior coating may be applied, if such coating is specified.

   The lining shall be cured for 18 hrs. before shipment. In either case, the lining shall be cured for a total period of 18 hrs. before shipment.

4. ALTERNATE CURING METHODS: When approved by the Engineer, alternate curing methods may be substituted providing the method used by the contractor produces a cured lining equivalent to that set forth in Section 69.O.

P. MORTAR LINING TEST CYLINDERS:

1. MORTAR TEST CYLINDERS: A set of at least two standard test cylinders, 6 in. in diameter by 12 in. in length, shall be made each day from the mortar lining for each shift to satisfy the 7-day and 28-day strength quality control requirements of Section 69.P.4. The mortar shall be removed from the mix in accordance with the Standard Method of Sampling Freshly Mixed Concrete, ASTM Designation C172-82, or samples may be prepared by omitting sufficient water from the production mix to obtain a 1-in. to 3-in. slump. Test cylinders shall be made in conformance with the Standard Practice for Making and Curing Concrete Test Specimens in the Field, ASTM Designation C31-88. The test cylinders shall be cured with the pipe at the same temperature and for the same total length of time. Other sized cylinders, such as 2 in. x 4 in. (50 mm x 100 mm), may be used to test compressive strength. If the 7-day test attains 28-day test requirements, then the 28-day test need not be completed.

2. CENTRIFUGAL TEST CYLINDERS: Centrifugally spun test cylinders may be substituted for mortar test cylinders, at the option of the contractor. Test cylinders shall be spun about their longitudinal axes in 6-in. diameter by 12-in long steel molds at a speed that will simulate the compaction of mortar in the lining to produce a spun cylinder wall thickness of at least 1-1/2 in. Then the cross-sectional area of the hollow cylinder shall be used to determine its compressive strength. Damaged cylinders shall not be tested.

3. TEST CYLINDERS: All test cylinders shall be tested in accordance with the Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens, ASTM Designation C39-86, by an approved testing laboratory unless the contractor has approved testing facilities at the work site. In such an event, the tests shall be made by the contractor. All cylinder tests shall be made by the contractor. All cylinder tests shall be made at the expense of the contractor. Certified test reports shall be submitted by the contractor to the Engineer. Re-tests are the contractor's responsibility.

4. STRENGTH OF MORTAR LINING: Mortar test cylinders shall attain a minimum compressive strength of 2600 psi in 7 days and 4500 psi in 28 days. Pipe made with mortar lining that does not meet the strength requirements set forth herein shall be subject to rejection. The average of any 10 consecutive strength tests of cylinders representing each mortar mix shall be equal to or greater than the specified strength, and not more than 20 percent of the strength tests shall have values less than the specified strength. No cylinder test result shall be less than 80 percent of the specified strength.

70. INSIDE LINED FIELD JOINTS:

A. MATERIAL:

This paragraph covers material requirements and application procedures recommended for the application of cement-mortar field joints.

Cement mortar used for the joints shall be composed of a minimum of 1 part cement to not more than 2 parts sand, by weight, dry mixed, and moistened with sufficient water to permit packing and troweling without crumbling. Sand shall be graded within the limits for plaster sand conforming to ASTM C35-89. Water shall be clean and free from injurious quantities of organic matter, alkali, salts, and other impurities. If permitted by the purchaser, workability of the mortar may be improved by replacing not more than 7 percent, by weight, of the cement with hydrated lime, or by replacing not more than 20 percent, by weight, of the cement with pozzolan, in accordance with the Standard Specification for Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Portland Cement Concrete, ASTM Designation C618-88.

B. APPLICATION:

Inside joints of mortar-lined pipe shall be filled with cement mortar and finished off smooth and flush with the inside surface of the pipe by troweling or by equivalent means. Before placing the joint mortar material against the surfaces of the lining, the surfaces shall be carefully cleaned, have all soap removed, and then be wetted to ensure a good bond between the lining and the joint mortar. The pipeline shall not be put into service until the mortar has cured for a minimum of 24 hours.

1. FOR PIPE DIAMETERS 22 IN. AND LARGER: When pipe is 22 inches in diameter and larger, the joints shall be finished smooth with the inside surface of the lining by troweling.

2. FOR PIPE DIAMETERS LESS THAN 22 IN.: When the pipe is smaller than 22 inches, the joint shall be finished by placing a sufficient amount of the joint mortar in the bell end of the section against the shoulder of the lining, just before installing it in the line. When the section has been laid in place, the pipe joint shall be finished by pulling a rubber ball or the equivalent through the joint to finish it off smooth with the inside surface of the lining.

C. MANUFACTURE AND HANDLING:

During the entire period of the application of the lining and the curing thereof, the section shall be carefully supported and handled to avoid damage to the mortar. If a pipe section must be moved, such operation shall be done with every reasonable precaution to protect against damage. Any damaged portion of the lining shall be cut out and replaced.

D. DELIVERY:

Care shall be exercised during loading, hauling, and unloading to prevent damage to any of the components of the completed pipe. Pipe and specials shall be suitably braced, supported to provide sufficient bearing area to prevent damage to the coating, and tied to prevent shifting or distortion of the pipe during transportation.

PLASTIC END CAPS: Plastic end caps shall be securely fastened to pipe ends of completed pipe for protection of the cement-mortar lining. End caps shall be maintained in place until time of installation.

PART IV

CORROSION CONTROL
CATHODIC PROTECTION

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CORROSION CONTROL - CATHODIC PROTECTION

71. INTRODUCTION:

The following specification is a general guideline to be followed for the design, installation and testing of cathodic protection systems. Corrosion control is often site specific and several of the guidelines listed here may not apply in every case. There may be occasion when the contractor will be directed to perform a task not listed in this specification, or omit a specified task. Amendment to this specification will be done in writing on an individual contract basis, with the full agreement of the consultant, the Water Main Design and Quality Assurance and Corrosion Control Sections, of the Bureau's Design Division.

A. Scope of Work:

The Contractor shall furnish all labor, equipment and materials, and install and test the system as required in accordance with the contract specifications, ordered or approved. A complete corrosion control system for the water main(s) shall be installed under this contract. The corrosion control system shall be designed to assure protection, based on prevailing conditions for a minimum of 50 years. The contractor shall also provide all labor necessary to test the corrosion control system, in part or as a whole.

The Contractor shall employ the services of a Corrosion Specialist certified by the National Association of Corrosion Engineers (N.A.C.E.), and approved by this Bureau. The specialist shall design the cathodic protection system in accordance with the requirements of this specification, amended as required. The specialist or an approved N.A.C.E. technologist in the employ of the specialist shall supervise the installation and testing of the system.

All cathodic protection work shall be done under the surveillance of a representative of the Bureau's Quality Assurance and Corrosion Control Section (the Engineer). NO work shall be performed without a minimum of three days prior notification to the Engineer. Failure to provide this notice before any testing, surveying or installation work may cause the rejection of all work performed, or may result in denial of approval to work on future contracts.

The Contractor shall be responsible for notifying the corrosion specialist of all changes in geometry, design and materials made by the Bureau or caused by field conditions.

Any apparent conflict between the terms of this contract, this specification, manufacturer's recommendations or the specifications listed in Section 77, and normal construction practices shall be reported in writing for resolution to the Engineer.

B. Corrosion Specialist's Responsibilities:

The corrosion specialist recommended by the contractor and approved by the Bureau shall supply the following information:

1. Certification as an N.A.C.E. Corrosion Specialist.

2. Certification for supervisors as N.A.C.E. Corrosion Technologists or higher.

3. Evidence of responsible design for at least two projects of equivalent size and conditions.

4. References from clients serviced within the past five years.

5. In addition, the corrosion specialist/corrosion engineering firm must meet all other requirements for a subcontractor as set forth in the general specifications.

The corrosion specialist (or designee) shall be responsible for all testing, installation and survey work done regarding the cathodic protection system. A system shall be established to record <u>all</u> work done relating to this system. This includes, but is not limited to:

1. All preliminary work, such as soil surveys, P/S surveys of existing structures, stray current surveys and any other work needed to compile information for the proposed cathodic protection system;

2. All anode ground bed installations, lead wire connections, and test box assemblies;

3. Interim and final testing of the system or completed sections. This includes, but is not limited to testing of insulating joints, on and off P/S potentials and stray current effects;

4. Stray current surveys performed during and after installation;

5. Electrical continuity of the installed pipeline;

6. Damage to or conditions surrounding the pipeline affecting cathodic protection and remedial measures taken;

7. Isolation of the pipeline from other existing metallic structures, within the contract limits;

8. As-built sketches, showing anode and test station locations. There shall be a maximum of two test station details per 8-1/2 by 11 inch sketch. Locations shall be given by distances from permanent structures and by street address if applicable.

The corrosion specialist shall be responsible for reviewing all data collected in the field and forwarding signed copies of the information to the Bureau's Engineer.

The corrosion specialist shall serve as a coordinator with existing utilities and services with influence within the limits of the contract, or whose facilities may be affected by the Bureau's installation. These include, but are not limited to National Grid (formerly Keyspan Energy Delivery), Consolidated Edison of N.Y., Verizon, N.Y.C. Transit Authority, etc.

The corrosion specialist shall give the Contractor three days advance notification of all planned activity regarding the cathodic protection system. Cancellation notice of any work scheduled shall be given by 4:00pm on the previous business day. Costs incurred by the City as a result of a no-show by the consultant should be charged to the consultant.

72. MATERIALS:

A. NO TEXT

B. To Be Furnished by the Contractor:

The Contractor shall furnish hydrant valve boxes, Bureau of Water and Sewer Operations Drawing 10241-A-Z, to be used as cathodic protection test stations. Only the top half of the valve box shall be used for the test station assembly.

The Contractor shall furnish all other material as approved by the City and required for the corrosion control work under this contract. This includes, but is not limited to anodes, wiring, connections, thermite welding materials, coating repair materials, PVC conduit and splicing materials. The materials furnished shall meet the requirements listed in this specification.

1. Anodes: The net nominal weight of each anode shall be as determined by the corrosion specialist and noted on the cathodic protection (C.P.) design drawings. Anodes shall be high potential magnesium alloy as manufactured by Dow Chemical Company, or approved equal. Magnesium ribbon anodes shall not be used unless the corrosion specialist sufficiently demonstrates the need for, and the advantages of ribbon anodes for the project. The use of ribbon anodes must be approved by the Engineer.

Anodes shall be packaged in a permeable cloth bag or porous paper box with a backfill that shall consist of (by weight) 75 percent hydrated gypsum, 20 percent bentonite and 5 percent anhydrous sodium sulfate. Grain size of the backfill shall be such that 100 percent will pass through a 20 mesh screen and 50 percent will be retained on a 100 mesh screen.

Each anode will have a 10 foot long factory applied number 12 AWG solid copper lead wire with TW insulation.

The Contractor shall supply material certification from each heat of anodes used on the project.

The Contractor shall furnish adequate storage facilities on the jobsite to protect the cathodic protection materials from the weather as per Section 75.C.1 of this specification.

2. Wiring: Anode header wiring shall be number 8 AWG stranded copper wire with high molecular weight polyethylene (HMWPE) seven strand single conductor insulated cable suitable for direct burial.

   Pipe lead wires for insulation testing and anode connections shall be number 10 AWG copper wire with TW insulation. Color codes shall be as specified in Section 73.C. Any other wires shall be installed as shown on the design drawings.

3. Splices: Splices shall be made with Burndy KS-17 mechanical type connectors or approved equal.

   Splices shall be insulated with two layers of self-vulcanizing rubber tape, "Tac-Tape" or approved equal, and coated with two layers of plastic tape.

4. Pipe Connections: Connections to the pipe shall be made by an exothermic weld process, such as CADWELD, by Erico Products, Solon, Ohio. The procedure shall be performed by qualified personnel and according to manufacturer's instructions.

   Lead wire shall be wrapped around the diameter of the pipe and be tied to itself, so as to take tension off of the thermite weld.

   Each pipe connection shall be coated in a manner compatible with the pipe coating. Mastic or a weld cap shall be used on enamel-coated pipe. A double wrapping of hand repair tape shall be used on tape-coated pipe. Refer to pipe coating field repair specification for procedure.

5. Conduit for Roadway Crossing: Conduit for roadway crossings shall be heavy wall Schedule 40 PVC conduit. The conduit shall have bushings at each end to prevent wire abrasion during pulling.

6. Flange Insulation Kits: Insulation kits shall be as manufactured by Central Plastics Co., Shawnee, Oklahoma; PSI, Inc., Houston, Texas, or approved equal.

7. Permanent Reference Cells: Permanent reference cells may be used where deemed necessary by the consultant.

73. REQUIRED DESIGN PARAMETERS:

The corrosion specialist shall design the system to function effectively under existing conditions for a minimum of 50 years, incorporating the parameters outlined in this section of this specification, and N.A.C.E. Recommended Practice RP01-69, latest revision.

The cathodic protection system shall employ the use of magnesium anodes, installed along the water main as shown on the approved design drawings. The system shall include associated test stations, insulating joints and all wiring and connections.

A. Electrical Isolation:

1. Insulated Joints for Line Valves and Contract Limits: All sections of the trunk main installed under this contract shall be isolated from the remainder of the distribution system at the contract limits by insulating joints or couplings.

   The water main being installed shall be divided into isolated sections by installing insulated flanges at all line valve and connection valve locations.

   Test stations to monitor the effectiveness of insulated joints and couplings shall be installed according to Section 75.B of this specification.

2. Insulating Joints for Blowoffs and Aircocks: Insulating joints shall be installed at blowoff and aircock connections.

3. Foreign Structures: The new water main shall be isolated from sleeves, conduits, reinforcing rods, casings and all other structures by physical means, or by the use of high strength dielectric materials. Test stations shall be placed at pipeline crossings as required or approved by the Engineer.

4. Casings: Under NO circumstances shall the water main be shorted to a casing.

   At locations where casings are required, the pipeline shall be isolated from the casing by installing approved insulating devices.

B. Test Stations:

1. Design: Test stations shall be designed to minimize or prevent damage of components from construction during installation, or at a later date.

   Test stations shall be designed so damage to the anode header cable shall not affect the functioning of the cathodic protection system.

   Test stations may be designed to be able to measure more than one function, such as insulation and anode current output. Wiring of test stations shall be limited to a maximum of six wires per station.

2. Assembly: Test stations shall be assembled as described in Section 75.G of this specification.

C. Wiring:

Wiring shall conform to specifications noted in this document.

1. Number 10 white wire shall denote an unprotected structure at an insulating joint.

2. Number 10 red wire or number 10 blue wire shall denote a protected structure at a potential test station, and anode test station or at an insulating test station.

3. Number 10 green wire shall denote a connection to a casing.

4. Number 8 black wire shall denote an anode groundbed.

5. Number 10 black wire shall denote a permanent reference cell.

Additional conventions shall be added on a contract specific basis.

Test station wiring shall be placed in PVC conduit mentioned in Section 72.B.5, at all roadway crossings. Buried headers and/or conduit shall be clearly marked with yellow warning tape buried one foot above the conduit.

74. SUBMITTAL PROCEDURE:

A. Materials and Equipment:

The Contractor shall submit a complete list of materials and equipment to be incorporated into the cathodic protection installation. This submittal shall include descriptive data and catalog numbers allowing ready and complete item identification.

All materials are subject to approval of the Bureau. Additional information or samples of any material used, including anodes, shall be available for submittal upon request by the Bureau.

B. Design Drawings:

The contractor shall submit shop drawings for approval, showing the complete cathodic protection system. No work shall begin without drawings approved by the Quality Assurance and Corrosion Control Section of the Design Division.

All design drawings shall be submitted as a single submittal. These drawings shall include material requirements, groundbed layout, test station locations, test station details and any other information necessary for the proper installation and operation of a cathodic protection corrosion control system.

The submittal shall also include calculations, and all assumptions made during the design phase.

At the discretion of the Bureau, advance copies of all submittals may be sent directly to the Design Division, while formal submittals are processed through proper channels.

75. INSTALLATION:

All material and equipment shall be installed according to the recommendations of the manufacturer, and shall conform to the requirements of the contract documents and the reference standards.

A. Trench Work:

The contractor and the consultant shall install the cathodic protection system in tandem with the water main. Unless retrofitting or troubleshooting a cathodic protection system, the contractor shall not re-excavate the water main to install anodes or any other part of the cathodic protection system.

Anodes shall be placed as shown on the approved design drawings. Reasonable offset is allowable to clear rocky formations, concrete structures or other immovable objects. All changes are subject to the approval of the Quality Assurance and Corrosion Control Section. All changes shall be noted on the as-built drawings.

B. Test Stations:

Test stations shall be installed according to the design submitted and approved under Section 74.B of this specification. There shall be a minimum of one test station for each anode groundbed, insulating joint (except blowoffs and aircocks), casing, contract limits, and wherever deemed necessary by the engineer.

Test stations shall be assembled and mounted as shown on the Standard Drawings for cathodic protection. Burndy KS-17 split bolt connectors or approved equal shall be used to connect the header to the pipe lead as shown.

Eighteen inches of slack shall be left on each wire in each test station. In the event that a wire (including wire for a permanent reference cell) is too short to reach the test station, one splice per wire may be made to provide sufficient length. The additional wire must be of the same size or larger, and be the same color as the original wire.

All test stations shall be located in the adjacent mall or sidewalk in heavy traffic areas. Reasonable offset is permitted to clear prevailing conditions. Location and traffic considerations will determine test station location on an individual contract basis. All changes are subject to the approval of the Bureau. All changes shall be noted on the as-built drawings.

Those test stations located in grassy or undeveloped areas shall be mounted in a two foot by two foot by six inch deep concrete slab.

C. Anodes:

Where multiple anodes are to be installed on a header cable, the anode lead wires shall be carefully spliced to the header cable as shown on the standard drawings and according to Section 75.D of this specification.

1. Storage: Anodes shall be stored in a building or covered shed until ready for installation. Any anodes which are damaged or exposed to water shall be either repacked if permitted by the Engineer, or they shall be removed from the jobsite.

2. Location: Anodes shall be installed at the locations shown on the approved design drawings, outside the limits of any concrete work being performed, and with minor adjustments made to clear obstructions. Any changes in vertical or horizontal distances from the main must be approved by the corrosion specialist and the Bureau's Engineer.

3. Handling: Packaged anodes shall be lowered into holes by rope sling or by grasping the cloth gather. Anodes shall not be handled by the lead wire. Anodes with damaged lead wires will not be used.

4. Backfill: The anodes shall be backfilled with approved soil on all sides. Under no circumstances shall the anode be backfilled with sand. A minimum of 5 (five) gallons of water shall be poured over the anode package immediately before backfilling.

D. Splices:

Anode header cable shall be number 8 AWG HMWPE wire as described in Section 72.B.2. Splices shall be made by stripping the casing off the anode header cable a maximum of two inches, without scoring the copper strands, and connecting the anode lead wire securely with a Burndy KS-17 connector or approved equal.

The connection shall be coated with two layers of "Tac-Tape," or approved equal, and two layers of plastic tape for mechanical protection.

E. Test Lead Connections:

Test lead connections shall be permanently made to the pipe at all test station locations. Test lead connection shall conform to details shown on the standard drawings. Location shall be as shown on the approved design drawings.

1. Preparation: To connect the lead wire to the pipe, a three inch by three inch, window must be removed from the pipeline coating. The substrate metal must be cleaned to a bright finish with a file or wire brush.

2. Weld Procedure: Test lead connections shall be made using the Cadweld exothermic weld process or approved equal. Each test lead wire shall be connected to the pipe using the appropriate size charge and remain mechanically secure and electrically conductive.

3. Safety: All safety procedures recommended by the manufacturer shall be observed. Only those persons familiar with the process and qualified should do the actual welding.

4. Testing Welds: All welds shall be tested by striking the molten weld deposit with a hammer or a file. If the weld becomes loose, a second weld shall be performed not less than six inches from the first. The second weld shall be prepared and tested in the same manner as the first. Clean wire conductor shall be used.

5. Miscellaneous: Nominal distance between welds shall be twelve inches. On wires to be welded which are number 10 gauge or smaller, copper sleeves shall be used.

F. Coating Repair:

All cuts and holidays in the water main coating shall be repaired and tested according to BWSWC specifications and manufacturer's recommendations, prior to backfilling.

All repairs shall be made with approved materials compatible with the shop applied coating and the insulation on the wire.

G. Test Station Assembly:

Test stations shall be assembled according to specific purpose as noted on the approved design drawings.

The anode header cable shall be connected to the water main through a connection in the test station, as shown on the standard drawings. Connections in the test stations may be made with a resistive shunt or other device to control the flow of current. Installation of these devices shall be agreed upon by the consultant and the Engineer.

The contractor shall leave all anodes connected so the cathodic protection system is operating after construction is complete.

Assembled test station shall be filled with native soil as shown in the standard drawings, to provide contact for the copper-copper sulfate half cell.

76. TESTING:

To insure that the cathodic protection system is functioning properly, and that the criteria for protection as stated in N.A.C.E. Recommended Practice RP01-69 (latest revision) are met, field tests shall be performed under the supervision of the Corrosion Specialist. All testing shall be witnessed by the Quality Assurance and Corrosion Control Section.

A. Frequency of Testing:

During installation, testing shall be performed on each isolated section or group of sections of completed pipe over 2000 feet in length. An interim report for each section shall be submitted to the Bureau.

Complete testing of the system shall be performed before final restoration and pipe to soil potential testing shall be repeated following final restoration.

B. Tests to be Performed:

Field tests shall be conducted using a copper-copper sulfate reference cell and a high impedance voltmeter, having an internal resistance of at least 100,000 ohms per volt and a full scale reading of two volts. Measurement and control of anode current at the anode test station shall be done using a low resistance milliammeter or other suitable test meter. Components of the system to be tested, confirmed and reported include, but are not limited to the following:

1. Insulating Joints: All insulated joints and couplings shall be tested for satisfactory performance. They shall be tested according to N.A.C.E. Recommended Practice RP02-86-86, Section 7. Any insulating joint which shows evidence of current leakage shall be repaired to the satisfaction of the engineer, at no cost to the City. All insulated flanged joints shall, immediately following acceptance, be primed and coated according to the notes shown on Standard Drawing 46104-W.

2. Cathodic Protection System: Testing of the cathodic protection system shall be as described in section 71.B. On new pipeline installations, the -0.85 volt criteria shall be the standard for acceptance. Additional tests listed in N.A.C.E. RP01-69 (latest revision), Section 10, shall be performed at the request of the Bureau. Any faulty or suspect readings shall be investigated and corrected.

3. Stray Currents: The consultant shall conduct tests to determine the continued influence of stray currents on the water main, when necessary. These tests shall employ the use of a recording voltmeter to measure the effects over an extended period. Additional tests as per N.A.C.E. RP01-69 Section 9 shall be performed at the direction of the Engineer.

77. REFERENCE STANDARDS:

A. Primary Standard:

The primary reference standard for this work is National Association of Corrosion Engineers (N.A.C.E.) RP01-69 (latest revision), "Recommended Practice - Control of External Corrosion on Underground or Submerged Metallic Piping Systems".

B. Supplementary Standards:

Additional standards which apply to the materials and procedures which are required for the satisfactory completion of this work include the following:

1. N.A.C.E. RP02-74, High Voltage Electrical Inspection of Pipeline Coatings Prior to Installation;

2. N.A.C.E. RP02-86-86, Recommended Practice for the Electrical Isolation of Cathodically Protected Pipelines;

3. AWWA C203-86, Standard for Coal Tar Protective Coatings and Linings for Steel Water Pipelines--Enamel and Tape--Hot Applied;

4. AWWA C209-84, Standard for Cold Applied Tape Coatings for the Exterior of Special Sections, Connections and Fittings for Steel Water Pipeline;

5. AWWA C210-78, Standard for Coal Tar Epoxy Coating System for the Interior and Exterior of Steel Water Pipes;

6. AWWA C214-83, Standard for Tape Coating Systems for the Exterior of Steel Water Pipelines;

7. SSPC-SP 2-82, Hand Tool Cleaning; and

8. SSPC-SP 3-82, Power Tool Cleaning.

All work performed under this specification shall be done according to all applicable standards, codes and regulations. Refer to Section 71.A of this specification in the event of a conflict.

78. FINAL SUBMITTAL:

The cathodic protection system shall not be considered complete until a final report has been submitted and accepted by the Bureau. The report shall be organized in an orderly chronological fashion.

A. Final Report:

The information included in the final report shall contain, but not be limited to the following:

1. Data Summaries for all testing sessions conducted during the installation of the water main. This includes highlights and pertinent information gathered during interim testing.

2. As-Built Drawings shall be prepared by the consultant, with the aid of the Contractor. These drawings shall show reasonably accurate locations of foreign structures as well as groundbeds, test stations, bonds, and wiring arrangements. All deviations from this or any other specification shall be noted on these drawings. The basis for these drawings may be the contract drawings, however, the as-built drawing must be clean and readable.

   These as-built drawings shall be submitted as part of the cathodic protection submittal and are separate from as-built drawings required under Article 13 of the General Conditions of the Water Main Specifications.

3. Performance evaluations shall be included with the final report. The evaluation shall include, but is not limited to cautions that should be taken with the system and any peculiarity that should be noted for future reference.

PART V

FURNISHING AND DELIVERING STEEL PIPE UP TO AND INCLUDING 24-INCH DIAMETER

79. TYPE OF PIPE:

The pipe to be furnished under this specification shall be the standard mill product carbon steel pipe and shall conform with Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless ASTM Designation A53-90a or Standard Specification for Electric-Fusion (ARC)-Welded Steel Pipe (NPS 4 and over) ASTM Designation A139-89b, Grade B. The pipe shall be new and unused. Unless otherwise required, pipe may be random lengths.

The wall thickness of pipe to be furnished under these specifications shall conform to the following table:

Nominal Size	Weight Class	Thickness	Schedule No.
6"	STD	0.280"	40
8"	STD	0.322"	40
12"	STD	0.375"	---
12"	---	0.406"	40 (optional)
16"	STD	0.375"	30
20"	STD	0.375"	20
24"	STD	0.375"	20

80. WELDERS:

Welding operators shall have had at least six (6) years experience in welding ferrous metals. In addition, all assigned welders shall be qualified by the Department.

The Performance Qualification Test shall be as described in Section 36 of these Specifications.

81. TYPE OF FIELD JOINTS:

Unless otherwise required, field joints of pipe shall be made with either Forged Steel Slip-on Flanges in accordance with Section 15 of these specifications or with Forged Steel Welding Neck Flanges as approved upon submittal to the Bureau.

Slip-on flanges may be cocked a maximum of two (2) degrees in order to make up slight deflections in the pipe alignment, under which condition the top centerline shall be indicated by punching into the edge of the cocked flange.

Each pair of flanges and each single flange on the end of the run, included on the pipe, shall be furnished complete with carbon steel bolts and nuts and rubber, cloth-inserted full-face gasket. Where stainless steel bolts are required (insulated flanged joints) the bolts shall conform to the requirements of ASTM Designation A193-90, Grade B8, Class 1. The nuts shall conform to the requirements of ASTM A194-90, Grade 8F. Bolts and Nuts shall have a thread fit of class 2A/2B. Threads of stainless steel nuts shall be prelubricated with a thread lubricant such as Molykote before packaging for shipment.

82. CAULKING BANDS:

Where required, caulking bands, of the size specified, shall be attached to the end of the pipe. These bands shall be fabricated as shown on Drawing No. 20731-Z-C, "Standard Method of Connections Between Steel and C.I. Pipe," or latest revision thereof. The steel bands shall extend 3/8" beyond the end of the pipe and shall be beveled at the back on the inside face; the bands shall be welded with a 5/16" (min.) fillet weld at the front and a 5/16" (min.) bevel weld at the back. At the back the weld shall be ground square with the pipe.

83. BENDS:

Bends may be made either with welding seamless steel, standard weight long radius elbows; with welded pipe segments; or by bending steel pipe. The angle subtended by any one segment shall not exceed 15 degree Fahrenheit and the radius of the bend, for other than seamless steel elbows, shall be not less than five times the nominal diameter of the pipe.

The length of symmetrical bend sections, as measured along the axis, shall not exceed 6 ft. for 6" and 8" pipe, 8 ft. for 12" pipe, and 10 ft. for 16" pipe and larger. In nonsymmetrical bends, the distance from the end to the center of the bend shall not exceed one-half the stated length. Required intermediate joints of bend sections shall be made with flanges, as herein specified, unless otherwise required. Each offset bend shall be considered as two bends.

84. BRANCH CONNECTIONS:

Where required, branch connections shall be made with forged steel tees of the same schedule number as the pipe. The length of tees fabricated with straight pipe shall not exceed the length given for bends.

85. BOSSES:

Wherever Corporation Stops are required on the pipe, a plate 4" x 4" x 3/8" and curved to match the pipe outside diameter shall be continuously welded to the pipe, as a boss. Drilling and tapping of specified size shall be done in the shop and closed with a screw plug before lining, coating, and wrapping.

86. WELDING:

Circumferential shop joints shall be welded. The circumferential joints shall be electric full butt welded, and the pipe shall be so rotated that the weld shall be formed directly underneath the welding arc.

87. HYDROSTATIC TEST:

Before lining and coating, all sections of pipe fabricated with welded joints or bends, shall be tested in the shop under a hydrostatic pressure of 250 psi. It shall be held at this pressure for at least three minutes and the pipe shall be perfectly tight under the test.

88. CLEANING:

All pipe shall be cleaned inside and outside by sand, grit or shot blasting. All mill scale, weld spatters, fins, burrs, grease and foreign matter shall be removed, if necessary, by power-driven brushes and gasoline.

89. LINING AND COATING:

All pipe, bends, etc. furnished under this specification shall be lined, wrapped and coated in accordance with Part III, "Lining and Coating of Steel Pipe and Appurtenances In the Shop and In The Field" of these specifications.

90. INSPECTION:

All pipe furnished under this specification shall be subject to inspection, in the shop, by a representative of the City of New York. The manufacturer shall notify the Department at least five days in advance of the date when fabrication will start, so that an inspector may be assigned to witness fabrication and tests.

Charpy V-Notch Impact Tests shall be performed on every heat of pipe coil. The samples shall be removed from the spiral-welded pipe when the weld test samples are removed as described hereinafter. The samples shall be machined in a set of three in accordance with ASTM A370 and tested at the temperatures shown and meet the following minimum requirements:

Test Temperature	Ft-Lbs
30°F	25
0°F	15

When using subsize samples (i.e. pipe thickness of less than one half inch) as specified in ASTM A673, the following minimum requirements shall be met:

Test Temperature	Ft-Lbs
30°F	19
0°F	11

Should the average ft-lbs of the three samples not meet the above requirements when tested at both temperatures, all the pipes manufactured from that heat shall be rejected.

The inspector shall have free entry at all times to all parts of the shop where pipe is fabricated, lined and coated. The manufacturer shall afford the inspector all reasonable facilities, without charge, to satisfy him that the pipe is fabricated in accordance with the requirements of the specifications and the order. The manufacturer shall furnish all materials, gages and apparatus required in making all essential tests. Pipe shall be placed in such position as the inspector may require and shall be moved, when required, for the convenience of inspection.

When required, the manufacturer shall submit certificates certifying that the pipe complies with the requirements of the specifications and has satisfactorily passed the required tests.

91. MARKINGS:

All pipe shall be marked by the fabricator for identification in the fabricating shop and the lining and coating plant.

The following information shall be given, using Steel Lettering Punches with letters at least 3/8 inch high, on the edge of the flange or on the caulking band:

Name of the Fabricator or his code mark.

Identification Number of the piece.

Fabricator's Shop order number.

92. FIELD HYDROSTATIC TEST:

After installation, the run of pipe furnished under these specifications, shall be subjected to a hydrostatic test pressure of 150 psi. The pressure shall be raised to 150 psi and it shall be so maintained for a period not less than one hour. All visible leaks shall be repaired and the run of pipe made watertight. If, during the test, leakage may occur into the distribution system, the run of pipe shall be disinfected before the test.

PART VI

FURNISHING AND DELIVERING CAST STEEL

93. MATERIAL:

Steel castings shall be made by the open-hearth or electric process, and the chemical and physical properties, inspection and testing shall conform to the Standard Specification for Steel Castings, Carbon, For General Application, A27-87 Gr. 65-35, full annealed. At least two specimens each for bending and for tension from each melt shall be furnished and tested by the Contractor under the supervision of the Engineer and at the cost and expense of the Contractor. Should any test piece fail to come up to the required standards, two other test pieces from the same melt may be tried, and if these fail to comply with these specifications, the entire melt will be rejected. Where it is not practicable to have the tests of cast steel made at or near the point of manufacture, the Contractor shall have the specimens tested at a recognized laboratory to be approved by the Engineer, and shall furnish the Engineer with duplicate certified copies of the results of the tests. The tests shall be made at the expense of the Contractor.

94. MANUFACTURE:

The weights and details of the castings shall be as given on approved drawings. The thickness of the metal will be tested by calipers after the castings have been freed from sand and cleaned. No steel casting will be accepted if the thickness of the metal is less than the thickness required by the drawings by more than one-eighth (1/8) of an inch. Flanges shall be faced and accurately drilled and either faced or spot faced at the rear, unless otherwise shown on the drawing. Finished surfaces shall be coated at the shop with tallow and white lead.

95. CASTINGS TO BE MARKED:

Steel castings shall have the year in which they are cast, the running number of the castings of the same size and form and the letters D.W.S. cast on the outer surface in the raised letters of not less than two (2) inches in length and one-eighth (1/8) inch in relief, in such manner as length and one-eighth (1/8) inch in relief, in such manner as the Engineer may direct. Castings too small to carry lettering of this size shall be marked or stamped with letters of a size as directed by the Engineer. In case any casting is condemned, the letters, D.W.S., shall be erased by the Contractor under the direction of the Inspector.

The castings shall not be stripped or taken from the molds while showing color of heat, but shall be left in the flasks or molds for a sufficient length of time, in the opinion of the Engineer, to prevent damage by handling or unequal contraction by subsequent exposure.

96. ANNEALING:

All steel castings shall be thoroughly annealed. The treatment shall be such as to free the castings from all strains, and result in uniform strength and ductility of the metal in all cross sections.

97. CLEANING:

Steel castings shall be cleaned after an annealing by sand blasting. Fins and other irregularities shall be removed by chipping. No acid or other liquid shall be used in cleaning castings.

98. HAMMER INSPECTION:

All castings, after being thoroughly cleaned, shall be subjected to a careful hammer inspection by the Engineer or his authorized inspector or representative.

99. QUALITY OF CASTINGS:

All Castings shall be true to pattern, sound and smooth and free from injurious cold shuts, swells, lumps, scabs, scoria, sandholes and other defects or imperfections.

100. WELDING:

Plugging or filing of castings, will be in general not allowed. Isolated blowholes or small checks may be filled with a soft steel filler, properly welded into the shell of the castings, if such filling and welding will, in the judgement of the inspector, make the casting entirely satisfactory for the purpose for which it is intended. The filling and welding shall be done to the satisfaction of the Inspector.

101. CASTINGS TO BE MOVED FOR INSPECTION:

The Contractor shall place the castings in such a position as the Inspector may require and shall move them when required for the convenience of the Inspector.

102. COATING:

Steel castings shall be coated and lined as specified for steel pipe, except that the coating may be applied by hand. Wrapping will not be required.

Machine-finished surfaces shall not be coated.

103. PROOF UNDER HYDROSTATIC PRESSURE:

The castings shall, before the coating is applied, be tested at the foundry to a hydrostatic pressure of 250 pounds per square inch. The pressure shall be maintained on all castings for a period of not less than one-half minute. While under this hydrostatic test the castings may be subjected to a hammer test. Any casting which shows any defect by leaking, sweating, or otherwise, will be rejected. The test shall be made at the foundry at the expense of the Contractor and in the presence of the Inspector.

104. FINAL INSPECTION:

The approval of any castings by the Inspector shall not prevent its rejection for any defects which may be discovered at any time before the final inspection and acceptance thereof upon the completion of the contract.

105. WEIGHTS TO BE MARKED:

After being coated, each casting shall be weighed at the foundry in the presence of the Engineer, or his authorized representative and the weight in pounds and the running number of the casting shall be distinctly marked on the casting in white paint. The Contractor shall provide at the point of manufacture proper sealed scales and weights for weighing the castings. The weighing shall be done at the expense of the Contractor and he shall keep all scales properly balanced and shall from time to time, prove to the satisfaction of the Engineer or Inspector, that the scales are accurate, a sufficient number of standard test (dead) weights being provided for each scale.

106. VARIATION IN WEIGHT OF CAST STEEL SPECIAL CASTINGS:

Any cast steel casting the weight of which when compared with its standard weight is deficient by more than ten percent (10%) will be rejected. No allowance will be made for weight of steel castings in excess of the standard weight.