Los Angeles Department of Water & Power

CUSTOMERS FIRST

April 14, 2020

Mr. Marques Tamanaha
State Water Resources Control Board
Division of Financial Assistance
1001 I Street, 17th Floor
Sacramento, California 95814

Dear Mr. Tamanaha:

Subject: American Iron and Steel Waiver Request
City Trunk Line North Unit 1
Drinking Water State Revolving Fund Application PIN Number 44475
City of Los Angeles, California

Dear Mr. Tamanaha:

The City of Los Angeles (City), acting by and through the Department of Water and Power (LADWP), is requesting a waiver from the American Iron and Steel (AIS) requirement for the purchase of earthquake resistant ductile iron pipe (ERDIP) for the City Trunk Line North Unit 1 (Project). The request is based on LADWP's determination that "iron and steel are products are not produced in the United States in sufficient and reasonably available quantities and of satisfactory quality."

LADWP's City Trunk Line North Project (CTLN) will replace the northern extent of the existing Los Angeles City Trunk Line (LACTL) with approximately 33,400 feet of 54-inch diameter trunk line (Attachment 1). LACTL was installed in 1914 to serve the City with water delivered by the Los Angeles Aqueduct to what is now known as the Van Norman Complex, which houses the Los Angeles Reservoir, LADWP's largest surface storage facility. LACTL traverses the eastern San Fernando Valley (Valley) from the Van Norman Complex to the Santa Monica Mountains, providing direct supply to areas of the eastern Valley as well as serving as a primary transmission conduit for water for central areas of the City through connections to the Franklin Reservoir Tunnel and North Hollywood Pump Station.

The portion of the LACTL that will be replaced by CTLN is a 72-inch diameter riveted steel pipeline, which has severely corroded over the last 105 years. In 2016, LADWP's Asset Management Group developed the Trunk Line Priority Grading System (TPG) to reassess the condition of all of the trunk lines in the LADWP Water System. The TPG is

based on factors that would affect the likelihood of failure and consequences of failure to create a business risk exposure (BRE) score. The BRE score takes into account the following factors:

BRE Factors	
Leaks	Pressure
Soil Resistivity	Life safety risk
Stray currents	Damage potential
Cement lined	Socio-economic costs to businesses due to traffic in event of a pipe break
Temperature	Property damage
Ground movement	

Based on the BRE score, trunk lines were graded on their risk of failure. LACTL is ranked within the top 32 percent of the highest risk trunk lines. The most problematic portion of LACTL is located within the Van Norman Complex, where severe corrosion has been noted. Several pipe segment joints have calcium segments, weeping leaks, and extensive corrosion including rivet heads corroded down to small cones. Spot thickness measurements showed readings of 0.16 inches, compared to the original 0.25 inches.

Since 2000, it has experienced numerous leaks and ruptures, including:

- January 2001: Hydrostatic testing of LACTL resulted in a break at the Pacoima Spreading Grounds
- October 2002: A rupture occurred at the Pacoima Spreading Grounds. Subsequent efforts to shut down the flow resulted in a collapse of 400 feet of the LACTL in the Van Norman Complex; 230 feet of damaged pipe were replaced.
- 2014-2016: LACTL experienced 10 leaks within the Van Norman Complex.
- June 2016: A break occurred north of the venturi meter located just south of the closed 72-inch butterfly valve connection to the Bypass Reservoir Outlet Line. This break resulted in the venturi meter being removed and the trunk line being bulkheaded at both ends
- December 2019: An existing 72-inch pipe suffered a large leak to a corrosion pipe break. Due the leak, the pipe also collapsed about 2 miles north of the break due to the vacuum effect. LADWP ultimately repaired and replaced 600 feet of pipe in order to put the pipe back in service in January 2020.

CTLN will replace an aging and deteriorating trunk line; increase service reliability to the Los Angeles Reservoir service area; and enhance resiliency of LADWP's water distribution system.

CTLN will be constructed in two units, based on the type of material to be used.

- Unit 1, the Project, starts within LADWP's Van Norman Complex, continues along Stranwood Avenue, San Fernando Mission Boulevard, Arleta Avenue, and terminates at the intersection of Arleta Avenue and Terra Bella Street. Total alignment length is approximately 19,900 feet with 3,580 feet being sliplined, and 16,320 feet installed using open trench construction. Because this alignment crosses through several active faults, 54-inch ERDIP will be utilized for the Project. LADWP is in the process of seeking construction financing from the California Safe Drinking Water State Revolving Fund (DWSRF) for the Project (PIN No. 44475).

- Unit 2 starts at the intersection of Arleta Avenue and Terra Bella Street, continues along Arleta Avenue, Branford Street, Canterbury Avenue, and connects to CTLS Unit 1. Total alignment length is approximately 12,200 feet with 2,350 feet being sliplined, and 9,850 feet installed using open trench construction. Unit 2's alignment does not cross any active faults. As such, it will consist of 54-inch welded steel pipe. LADWP has submitted an application for DWSRF construction financing for CTLN Unit 2 (PIN No. 29734).

A fault displacement characterization study commissioned by LADWP (Attachment 2) has shown that the Project crosses the active San Fernando, Mission Hills, and Northridge fault zones. The study discusses the methodology used, the geology of the Project area, and potential geologic hazards, including projected net displacement of faults crossing the Project alignment. As a result of these findings, LADWP has determined that the Project will be comprised of ERDIP, consistent with the goals of the City of Los Angeles' Resilience by Design report and Sustainability pLAn, as well as LADWP's Requirements for the Water System's Seismic Resilient Pipe Network (Attachment 3).

ERDIP functions to maintain greater flexibility at the joints between pipe segments such that segments of the pipeline can expand, contract, and move laterally in response earth movement resulting from a seismic event, thus minimizing failures. These seismically restrained joints have proven to be effective. ERDIP did not suffer any damage in the 1995 Kobe (6.9 magnitude) and 2011 Tohoku (9.0 magnitude) earthquakes in Japan, even in areas where the land subsided or was displaced.

Project construction is scheduled to begin in October 2021. Because fabrication, delivery, and testing of the required pipeline is anticipated to take a minimum of 9 months following actual purchase, LADWP is initiating procurement of ERDIP. The draft specifications are provided as Attachment 4; seismic design requirements are defined in Section 1.06. LADWP anticipates the Invitation for Bid will be advertised in summer 2020.

In order to facilitate material procurement and ensure timely Project delivery, LADWP has conducted extensive market research to determine the availability of domestically produced materials that meet its technical specifications and AIS requirements. LADWP has contacted the following manufacturers:

MANUFACTURER	HEADQUARTERS	RESPONSE
[redacted]	[redacted]	Supplier unable to meet Project technical requirements.
[redacted]	[redacted]	Supplier does not produce 54 inch diameter pipe.
[redacted]	[redacted]	Supplier unable to meet Project technical requirements.

Correspondence received from the suppliers is provided as Attachment 5.

[redacted]

DESCRIPTION	QUANTITY	MANUFACTURER	UNIT PRICE
[redacted]	[redacted]	[redacted]	[redacted]

[redacted]

LADWP respectfully requests permission to purchase and install the above product in the Project.

If you have any questions or need additional information, please contact Samantha Yu, Loans & Grants Manager of the Water System, at (213) 367-3781.

Sincerely,

David Christensen
Manager of Project & Construction Management
Water Engineering & Technical Services Division

DC/SY:sy
Attachments

c: Uyen Trinh-Le, State Water Resources Control Board
Susan Avila Suarez, LADWP
Samantha Yu, LADWP

This waiver request was submitted to the EPA by the state of California. All supporting correspondence and/or documentation from contractors, suppliers or manufacturers included as part if this waiver request was done so by the recipient to provide an appropriate level of detail and context for the submission. Some referenced attachments with project diagrams, schedules, and supplier correspondence are in formats that do not meet the Federal accessibility requirements for publication on the Agency's website. Hence, these exhibits have been omitted from this waiver publication. They are available upon request by emaling DWSRFWaiver@epa.gov.

Los Angeles Department of Water & Power

REQUIREMENT FOR THE WATER SYSTEM'S SEISMIC RESILIENT PIPE NETWORK

The City of Los Angeles (City), along with the entire State of California, is in a high-risk-seismic zone with essential infrastructure assets subject to catastrophic damage from major seismic events. The Los Angeles Department of Water and Power (LADWP) is committed to work towards a goal in which all residents, visitors, businesses, emergency responders, and other public agencies will have continuous water service or limited disruption to water service after seismic events. LADWP will plan for, design, construct, and maintain a seismic resilient pipeline network (SRPN) appropriate for a resilient, reliable, and sustainable water distribution and transmission system consisting of more than 7,300 miles of pipeline.

The requisite for developing an SRPN is supported by several LADWP documents including:

- 2014 *Water System Seismic Resilience and Sustainability Program* report
- *Preliminary Plan to Improve the Water System for Managing the Fire Following Earthquake Risks*
- *Initial Plan for Developing a Resilient Water System Network*
- *Performance Based Seismic Design for LADWP Water System*

These LADWP documents align with the goals described for the Los Angeles Water System in the City's *Resilience by Design* report, *Los Angeles Sustainability Plan,* and the *Resilient Los Angeles* report. These reports were developed with guidance, oversight, and approval from the City of Los Angeles and the Mayor's office.

All new construction, reconstruction, and rehabilitation projects shall be viewed as an opportunity to develop and enhance the SRPN. LADWP will coordinate with other City departments, utilities, customers, and developers to ensure that the principles and practices of an SRPN are incorporated within their planning, design, construction, and maintenance activities. LADWP has developed performance-based seismic design procedures that are being used to establish and maintain design criteria, standards, and guidelines for the SRPN. All projects requiring replacement, modifications, additions to, and/or introducing surcharge or deformation to LADWP water pipelines will require a preliminary assessment by LADWP during the pre-planning phase. LADWP will provide the SRPN requirements for each project.

The development of the SRPN will be achieved over a long period of time as the installation of the new and the replacement of the aging distribution and transmission systems is completed.

Richard F. Harasick
Senior Assistant General Manager – Water System

1.25.2019
Date

David H. Wright
General Manager
Los Angeles Department of Water and Power

1-30-19
Date

PART F - DETAILED SPECIFICATIONS
DIVISION F2 - SITE CONSTRUCTION

SECTION F02563 – FABRICATION OF EARTHQUAKE RESISTANT DUCTILE IRON PIPE 24 INCHES IN DIAMETER AND LARGER

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. For an understanding of the complete contract, reference is made to a statement of the Contract Documents in Division D1.

1.02 SUMMARY

A. Fabrication of earthquake resistant ductile iron pipe.

B. Flanges, gaskets, bolts, and nuts.

C. Inspection and testing.

1.03 RELATED SECTIONS

A. Section F01330 - Submittals.

B. Section F01430 – Inspection.

1.04 REFERENCES

A. ANSI B16.1, Gray Iron Pipe Flanges and Flanged Fittings.

B. ANSI B16.5, Pipe Flanges and Flanged Fittings.

C. ANSI/AWWA C104/A21.4, Standard for Cement-Mortar Lining for Ductile Iron Pipe and Fittings for Water or JWWA A113, Standard for Mortar lining of ductile iron pipes for water supply.

D. ANSI/AWWA C110/A21.10, Standard for Ductile-Iron and Gray Iron Fittings, 3 in, Through 48 in. for Water or JWWA G114, Standard for Ductile iron fittings for water supply, 75mm (3 in), Through 2600mm (104 in.).

E. ANSI/AWWA C 111/A21.11, Standard for Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings or JWWA K156, Standard for Rubber materials for water supply.

F. ANSI/AWWA C 115/A21.15, Standard for Flanged Ductile-Iron Pipe with Ductile-Iron or Gray-Iron Threaded Flanges or JWWA G114, Standard for Ductile iron fittings for water supply, 75mm (3 in), Through 2600mm (104 in.).

G. ANSI/AWWA C 150/A21.50, Standard for Thickness Design of Ductile-Iron Pipe or Design Criteria for Waterworks Facilities published by JWWA, Criteria for Thickness Design of Ductile-Iron Pipe.

H. ANSI/AWWA C 151/A21.51, Standard for Ductile-Iron Pipe, Centrifugally Cast, for Water or JWWA G113, Standard for Ductile iron pipes for water supply, 75mm (3 in), Through 2600mm (104 in.).

I. ASTM A 536, Specification for Ductile-Iron Castings or Japanese Industrial Standard (JIS) G 5526 Standard for Ductile iron pipes or JIS G 5527 Standard for Ductile iron fittings.

J. ASTM C 150 or JIS R 5210 , Standard Specification for Portland Cement or JIS R5213, Standard Specification for Portland fly-ash cement.

K. AWWA C116/A21.16-09 Protective Fusion-Bonded Epoxy Coatings for the interior and Exterior Surfaces of Ductile-Iron and Gary-Iron Fittings or JWWA G112 Epoxy-Powder Coating for Interior of Ductile-Iron Pipes for Waterworks, and JWWA Liquid Epoxy Resin Paints for Waterworks and Method of Coating.

L. JWWA K139 Synthetic Resin Paints for Ductile Iron Pipes for Waterworks.

M. ASME Boiler and Pressure Vessel Code, Section VIII, Division 1.

N. NSF/ANSI 61-2005/Addendum 1.0-2005, Drinking Water System Components – Health Effects.

O. ISO 8179-1 Ductile Iron Pipes, Fittings, Accessories and their Joints – External Zinc-Based Coating.

1.05 SUBMITTALS

A. Submit the following in accordance with Section F01330:

1. Purchase Order: Within 7 days of Notice to Proceed, submit a copy of the Purchase Order for the manufacturing of ductile iron pipe.

2. Fabrication Schedule: Within 7 days of Notice to Proceed, submit a schedule showing start dates, durations, and end dates for the following activities and milestones: purchase order issued, submittal preparation, submittal review and approval, fabrication of straight pipe, fabrication of special sections, cement mortar lining, coating, hydrostatic testing, and pipe delivery.

3. Delivery Schedule: Within 30 days of Notice to Proceed, submit a schedule showing delivery by pipe stations and piece mark numbers.

4. Design Calculations: Design calculations for blind flanges shall be signed and stamped by a licensed civil, mechanical, or structural engineer registered in the State of California.

    a. Blind Flange Design: Use ASME Boiler and Pressure Vessel Code Section VIII, Pressure Vessels, Division 1.

5. Shop Drawings in separate submittal packages not less than 21 days apart unless otherwise required by Engineer, in the following order:

    a. Shop Drawings Package 1: Cylinder Fabrication.

        1) Ductile iron cylinder details including approximate footage, approximate number of pieces, cylinder length, thickness, inside diameter (ID), shop hydrostatic test pressure, roundness tolerance, joint tolerance (maximum and minimum), type and thickness of coating, thickness of cement mortar lining, maximum design deflection of standard joint length (in degrees and inches).

        2) Shipping stull and brace block details.

    b. Shop Drawings Package 2: Detail Drawings and Lay Diagram. Separate Package 2 into individual segments in accordance with Work Areas shown on the drawings.

        1) Special Section details including location of outlets and details for joints, couplings, flanges, blind flanges outlets, tees, wyes, and other special sections.

2) Lay diagram plan and profile showing direction, stations, elevations, piece numbers, joint type, outlets, blind flanges, valves, vaults, and appurtenant piping. Stations shall increase from left to right on shop drawings. Lay diagram shall show the lap of bell and spigot.

6. **Mix design** for each shop and field type of cement-mortar lining, and where each type of mix shall be used.

7. Manufacturer's certification that the following materials have been tested in accordance with the material specified and meets the requirements of these specifications.

   a. Cement.

   b. Sand.

   c. Epoxy.

8. Manufacturer's specifications for gaskets.

9. Certified copies of mill-test reports, including the physical and chemical properties of pipe.

10. Material specifications and material safety data sheets for all shop and field-applied materials.

11. Welding Procedures.

12. Inspection and Testing practices to ensure compliance with these specifications. These practices shall be defined in detail in a written Quality Control (QC) Plan.

13. QC Inspection and Tests Records: Upon the Inspectors request, daily records of QC inspection and tests and a summary report thereof for a requested series of production dates.

14. Certified Test Reports: Five copies of certified reports of all tests.

15. NSF 61 certification for all materials in contact with potable water.

16. Certified tests that pipe joints meet specified deflection, expansion, contraction, and axial force resistance.

17. Finite Element Method Analysis.

18. Finite Element Method Analysis validation.

19. Spacer shop drawings and calculations.

1.06 SEISMIC DESIGN

A. Design in accordance with design parameters provided below. Verified design by performing a Finite Element Method Analysis for both crossing angles between pipe and fault.

Design fault displacement: 4.26 meters (14.0 feet) across a single plane

Sense of fault movement: Oblique reverse left-lateral

Crossing angles between pipe and faults: 33 degrees, 36 degrees, 49 degrees, and 88 degrees

Width of potential fault rupture zone: 100 feet

The number of fault crossings: 5

Pipe burial depth: 5 feet from surface to top of pipe

Trench backfill material: cement slurry, concrete class 100-E-100

Natural soil material: Sandy soil

Safety Factor for seismic loads: 1.1

The finite element analysis shall be validated against laboratory test results simulating fault rupture. Validation evaluations shall be undertaken by the same person who performs the finite element analysis for the 54" ERDIP. The pipe system shall be analyzed for fault rupturing at any joint and mid-way between any two joints. The fault rupture shall be assumed to occur anywhere within the entire alignment of the trunk line. Results shall confirm all joints are able to rotate and slip without exceeding their certified design capacity. Joints shall move the maximum certified movement and rotate the maximum certified rotation accommodating the maximum certified axial force without leakage. The stresses in each pipe segment shall remain within the elastic range. Results shall be presented in a written report which shall include the following information:

1. Figures to describe the methodology.

2. Describe finite element computer program.

3. Describe how soil-pipe interaction is handled.

4. State assumptions used in the analysis.

5. State parameters used for input, displacement, rotation, and stresses calculated for each case analyzed.

Validate results including the testing program for which the analysis is validated against, and differences between the validation test analysis and the analysis for the proposed pipe installation shall be included in the report. The validation shall show the finite element analysis program is able to capture the main specified features of the piping system with 15 percent accuracy. Any outlying results shall be described. The reported information shall meet common engineering standard of practice and be sufficient to allow for independent reproduction of the work. The results shall be justified and presented to the LADWP upon request.

1.06 DEFINITIONS

A. Joint: Two pipe segments joined together by a bell and spigot, mechanical joint, push-on joint, or ball and socket joint.

B. Lining: An application of cement-mortar or other specified product to the interior surface of steel pipe.

C. Coating: A specified coating product applied directly to the exterior surface of steel pipe.

D. Stull: Post used to maintain the pipe's shape during shipping and storage and to elongate the vertical diameter of the pipe prior to bedding consolidation operations. Each end of the stull shall be attached to the center of a brace block.

E. Brace Blocks: Beams attached perpendicular to a stull.

1.07 NOTIFICATION OF ENGINEER

A. Notify the Engineer in accordance with the provisions of Section F01430 prior to the start of pipe fabrication.

B. Conduct all phases of pipe manufacturing and testing in the Engineer's presence.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Stull and brace block the pipe for shipping.

B. Do not use chains for lifting pipe.

C. Deliver all pipe and fittings to 13001 Sepulveda Boulevard, Sylmar California 91342.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Ductile Iron Pipe: Material properties shall comply with the requirements described in ASTM A 536 Grade 60-42-10 or JWWA G113 and G114.

B. Ductile Iron Fittings: Material properties shall comply with the requirements described in ASTM A 536, Grade 70-50-05 or JWWA G113 and G114.

C. Bolts:

1. Bolts for flanges shall meet the requirements of ANSI B 16.5, Section 6.9.1 or JWWA G113 and G114.

2. Nut and bolt head shapes shall be furnished in the American National Standard heavy hexagonal dimensions or T-head bolt and Nut in JWWA G113 and G114.

3. Machine bolt material for flanges under 16 inches shall meet the requirements of ASTM A 307, Grade B or the requirements of JWWA G113 and G114.

4. Machine bolt and stud bolt material for flanges 16 inches in diameter or larger shall meet the requirements of ASTM A 193, Grade B7, and ASTM A 194, Grade 2H or the requirements of JWWA G113 and G114.

D. Rubber Gasket Joints:

1. Gaskets for mechanical, push-on and flanged joints shall be manufactured in accordance with ANSI/AWWA C 111/A21.11 or JWWA K156. Gaskets shall be of such size and cross section as to completely fill the groove and provide a watertight seal under all conditions of design pressure and allowing join deflection.

E. Polyethylene Tubing:

1. Polyethylene Tubing shall be 8-mil thick low density polyethylene manufactured in accordance with ANSI/AWWA C 105/A21.5-10. Encasement shall be clear or black tube, and shall be micro-perforated. Polyethylene Adhesive Tape shall be 10-mil thick, as specified in AWWA C105.

2.02 CEMENT-MORTAR

A. Base mix design on the following:

1. A minimum compressive strength of 2,600 psi in 7 days.

2. A minimum compressive strength of 4,500 psi in 28 days.

3. Materials shall comply with AWWA C104/A21.4-13.

4. Cement shall be low-alkali Portland cement meeting the requirements of ASTM C150, Type II or Type V or JIS R 5210.

5. Sand shall meet the mortar requirements of the SSPWC, Subsection 200-1.5.3, and the additional impurity and gradation requirements of AWWA C104, Section 5.1 for mortar.

6. Water shall contain no more than 1,000 ppm of chlorides calculated as Cl, nor more than 1,000 ppm of sulfates calculated as SO4. Water shall be clean, colorless, and free of any materials that may reduce the strength or durability of the cement-mortar.

2.03 ACCESSORIES

A. Mechanical Joints: Glands shall be of ductile iron and coated with the same material as that used for the external coating of pipes and fittings. Locking rings and connecting

piece shall be ductile iron conforming to 80-60-03 of ASTM A536 or the requirement of JWWA G113 and G114, and coated with synthetic resin (epoxy) paint. Tee-head bolts shall be stainless steel 304 or equivalent. Back-up rings shall be of polyamide resin.

B. Spigot Ring for Cut Pipe: Spigot ring shall be of ductile iron coated with synthetic resin (epoxy) paint.

C. Design spacers to prevent pipe in the steel casing from moving from set position. Spacers shall be designed to withstand pulling or pushing loads on the pipe. Spacers shall be removed after pipe installation.

PART 3 - EXECUTION

3.01 FABRICATION

A. General: Ductile iron pipe shall be furnished with bell and spigot, mechanical joint or push-on with integral restrained joint or ball socket (push-on bell and spigot with integral restrained) with rubber gaskets. All pipes, fittings, and gaskets shall be certified as meeting the specifications of NSF/ANSI 61-2005/Addendum 1.0-2005. Pipes shall be furnished with cement mortar interior lining and asphaltic exterior coating or synthetic resin.

B. Ductile Iron Pipe: Fabricate in accordance with the requirements described in ANSI/AWWA C 150/A 21.50 or JWWA G114, and ANSI/AWWA C 151/A21.51 or JWWA G113 or JWWA G120. Push-on joints shall be rated to 350-psi in accordance with ANSI/AWWA C111/A21.11

1. The wall thickness of pipe shall be as shown in Table No. 1.

Table No. 1 – Minimum Pipe Thicknesses (Dimensions in inches)

Nominal Diameter	Thickness
54	0.85

2. Pipes shall have a minimum nominal laying length of 16 feet unless pipes have been pre-cut at the manufacturing facility.

3. Pipes and fittings with 54-inch diameter shall have a minimum rated working water pressure of 150 psi

4. Hydrostatic Test: Maintain the test pressure as indicated on Table No. 2.

Table No. 2 – Hydrostatic Test Pressure

Nominal Diameter (inches)	Hydrostatic test pressure (psi)	
	Pipe	Fittings
54	200 (not less than 10 seconds)	150 (not less than 60 seconds)

5. Joint Performance: ERDIP joints shall be mechanical type or ball and socket type. The ERDIP joint performance shall be as shown on Table No. 3.

Table No. 3 – ERDIP Joint Performance

Diameter, inches	Pull-Out Resistance	Expansion and Contraction	Maximum Deflection Angle
54 Pipe	17,000 x D^1 (lbf)	1% of pipe length, respectively	7°
All Fittings*	17,000 x D^1 (lbf)	N/A	N/A

1. D = Nominal Diameter in inches

* The joint performance of collar/telescoping sleeve shall be same as pipe joint.

C. Ductile Iron Fittings: All fittings shall be ductile iron, fabricated in accordance with ANSI/AWWA C 110/A21.10 or ANSI/AWWA C 153/A21.53 or JWWA G114 or JWWA G121. All fittings shall be furnished with bell and spigot, mechanical joint or push-on joint or ball and socket joint with rubber gaskets. The fittings shall be cement-mortar lined or fusion-bonded epoxy coating or synthetic resin coating in accordance with Article 3.02 of this Section.

D. Ductile Iron Flanged Fittings:

1. All flanged ductile iron fittings shall be fabricated in accordance with ANSI/AWWA **C 110/A21.10 or** C 153/A21.53-11, unless otherwise specified herein or shown on the drawings.

2. Bolt circles, number of bolts and bolt holes of flanges shall match Class 125, ANSI B16.1. Use 250 psi to determine flange thickness using ASME Boiler and Pressure Vessel Code, Section VIII, Division 1, and shall not be less than flange thickness per ANSI/AWWA **C 110/A21.10 or** C 153/A21.53-11.

3. Flange facings shall be smooth when mating with flanges having O-ring gaskets. All other flange facings shall be finished with shallow serrations, unless otherwise shown on the drawings.

4. All flanged ductile iron pipes shall be furnished with double thick cement mortar lining without asphaltic coating.

E. Collar or telescoping sleeve: Collar or telescoping sleeve shall conform to AWWA C 110/A21.10 or JWWA G114. Maintain the test pressure as indicated on Table No. 4 for collar and telescoping sleeve.

Table No. 4 - Hydrostatic test Pressure

Pipe Size inch	(Collar and Telescoping Sleeve)	
	Test Pressure psi	Duration Sec.
54	150	200

1. Collar and telescoping sleeve shall be coated with synthetic resin paint in accordance with JWWA G114. The synthetic resin paint shall conform to JWWA K139. Apply a coat at a DFT of 4 mils. Epoxy color shall be black.

2. Collar, long-body collar and telescoping sleeve shall be lined with fusion-bonded epoxy in accordance with JWWA G112 or liquid epoxy in accordance with JWWA K135 or solvent-free epoxy in accordance with JWWA K157. Apply 2 coats for a minimum DFT of 11.8 mils and an average DFT of 20 mils. Epoxy color shall be gray.

F. Pipe Identification: In addition to the markings on pipes and fittings required in the AWWA Standards or JWWA standard, the following shall be integrally cast onto each pipe and fitting.

1. A code identifying the melting unit and batch number from which the pipe and fitting were poured.

G. Welding: When welding is allowed by the drawings for ductile iron pipe, restrained joints, thrust collars, or outlets 8 inches in diameter or less, all welding procedures shall be submitted to the Engineer for review. Furnish production weld samples upon request.

3.02 CEMENT-MORTAR LINING

A. General:

1. The interior surfaces of each piece of ductile iron pipe shall be cement-mortar lined in accordance with the requirements described in ANSI/AWWA C 104/A21.4 or JWWA A113, and fittings shall be cement-mortar lined in accordance with the requirements described in ANSI/AWWA C 104/A21.4 or fusion-bonded epoxy coating in accordance with the requirements described in JWWA G112. The cement-mortar lining shall be double thickness, have a smooth finish and thoroughly bonded to the interior pipe wall. The cement mortar lining shall be applied so that the method insures a dense mortar lining.

2. The cement-mortar lining shall not be seal coated.

B. Preparation: Prior to lining, the surfaces shall be thoroughly cleaned and free of blacking, graphite, grease, dirt, loose sand, rust, slag, flux, and any other foreign materials.

C. Curing: Immediately after lining each pipe section and fitting, the ends shall be sealed with plastic sheeting having a minimum thickness of 4 mils and remain in place during the period of storage in the plant and during delivery to the jobsite. Curing shall commence after the mortar has set but not later than 12 hours after the application of the lining. Cure the lining in accordance with one of the following methods:

1. The steam curing shall not begin sooner than 4 hours after application of the lining. Steam for curing shall be moist. The lining shall be cured not less than 16 hours prior to moving from the curing area. Steam temperatures shall not be

less than 120F nor more than 150F. The interior lining shall be water cured for an additional 5 days after the initial steam cure, prior to shipping to the jobsite.

2. The water curing method shall keep the entire surface of the lining wet throughout the entire curing period. The interior lining shall be water cured for 7 days before shipping to the jobsite. Upon removal from the curing areas, the interior lining of the pipe shall be kept moist until the pipe is delivered to the jobsite.

D. After the pipe has been cement-mortar lined, inside of the bells shall be cleaned and then lightly sprayed or brushed with an asphaltic paint or synthetic resin or other Engineer approved coating, to a thickness of one-mil in accordance with the procedures described in ANSI/AWWA C 151/A21.51 or JWWA G113 and JWWA G114 for belled ductile iron pipe, to the procedures described in ANSI/AWWA C 115/A21.15 for flanged pipe, and to the procedures described in ANSI/AWWA C 110/A21.10 for fittings.

3.03 COATING

A. General

1. The exterior of all pipes shall have a standard asphaltic coating in accordance with ANSI/AWWA C151/A21.51 or zinc rich paint in accordance ISO 8179-1 or JWWA K139.

2. The exterior of all fittings shall have standard asphaltic, zinc-rich paint, synthetic resin paint in accordance with ANSI/AWWA C110/A21.10 or C153/A21.53-11 Section 51-8-1 or JWWA K139. The minimum application mass of the zinc rich paint will be 0.66 oz. / square ft [200g/square meter]. The synthetic resin paint used for second coat will conform to JWWA K139 and the minimum mean dry film thickness of the coating will be 3.1mil [0.08 mm].

3. Pipes and fittings will be coated with zinc rich paint as first coat and followed by synthetic resin coating as second coat.

The minimum application mass of the zinc rich paint will be 0.49 oz./ft2 [150 g/m2]. The synthetic resin paint used for second coat will conform to JWWA K 139 and the minimum mean dry film thickness of the coating will be 3.1 mil [0.08 mm].

3.04 SOURCE QUALITY CONTROL

A. The Contractor shall implement approved inspection and testing procedures.

1. Chemical analysis of not less than one sample taken during every ladle for Fe, Iron; C, Carbon; Si, Silicon; Mn, Manganese; S, Sulfur; P, Phosphorous; Cu, Copper; Cr, Chromium; Sn, Tin; Mg, Magnesium; Mo, Molybdenum; Ce, Cerium; Ni, Nickel; Pb, Lead; Al, Aluminum, As, Arsenic; B, Boron; Ti, Titanium; V, Vanadium.

2. Certification: All pipes and fittings shall be furnished with a sworn statement by the contractor that all specified testing and inspection was completed and the results thereof comply with the specifications.

3.05 QUALITY ASSURANCE INSPECTION AND TESTS

A. As a means of Quality Assurance (QA), inspection will be made and tests shall be performed by the Inspector in the Contractor's mill, factory, yard, or warehouse in accordance approved Quality Assurance and Quality Control Programs:

1. QA Inspection: The Inspector will have the right to inspect the Contractor's and the subcontractor's work in the course of production or fabrication and will witness tests, provided such tests will cause no delay in the production of acceptable materials or equipment. However, final inspection will be made upon receipt at the jobsite. If any material does not meet the requirements of these specifications, the lot or any faulty portion thereof may be rejected.

The Contractor shall furnish, at no additional cost to the Department, reasonable facilities, including tools and instruments, for so doing and for obtaining such information as the Inspector desires, respecting the progress and the manner of the work and the character of the materials used.

2. Surface Pitting: Any pipe having excessive pitting on the exterior surface will be rejected. Pitting will be measured by a pit depth gauge. Pitting will be considered excessive when it exceeds 20 percent of the wall thickness of the pipe or when the pitting exceeds 10 pits over a one square inch area. A pit is defined as a surface void caused by any foreign material or gas on the interior of the mold that displaces the molten iron during casting process that exceeds 10 percent of wall thickness in depth.

3. Witness Tests: Mill or factory witness tests shall be made in the presence of the Inspector. The Contractor shall bear all costs of such tests.

3.06 HANDLING

A. Care shall be taken during all stages of manufacturing, packaging and delivery to prevent damage to the pipe and fittings. At no time shall material be placed inside of the pipe or fittings.

3.07 PACKAGING

A. Large diameter ductile iron pipe shall be delivered in bare.

B. Large diameter fittings and joint accessories shall be packed in wooden case and/or crate.

3.08 HANDLING and STORAGE

A. Unload ductile iron pipe and handle in bare. Do not used chains, steel cables, wire ropes and hooks to lift pipe. When lifting a pipe, wide nylon band sling or a forklift to protect the surface of pipe. When storing pipes in a stock yard, pipes shall be stacked up to a single tier. The stock yard shall be situated at flat ground. Place two 6" by 6" timbers under the bottom of pipes and secure them with wooden cramped chocks. Make sure that socket ends do not rest on spigot ends, and spigot and spigot ends shall alternate at each tier. The size of timber shall be at least 6 inches by 6 inches square cross-sectional.

When lifting a case or crate, use of nylon sling or a forklift. Rubber gasket shall be stored in a cool, dry place (e.g. warehouse) to avoid direct sunlight.

END OF SECTION