SECTION 33 05 01.01
WELDED STEEL PIPE AND FITTINGS

PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. American Society of Mechanical Engineers (ASME):
    a. B16.9, Factory-Made Wrought Buttwelding Fittings.
    b. B36.10M, Welded and Seamless Wrought Steel Pipe.
    c. BPVC SEC VIII, Div. 1, Rules for Construction of Pressure Vessels.
    d. BPVC SEC IX, Welding and Brazing Qualifications.
2. American Society for Nondestructive Testing Inc. (ASNT):
    SNT-TC-1A, Recommended Practice for Personnel Qualification and Certification in Nondestructive Testing.
3. American Water Works Association (AWWA):
    a. C200, Steel Water Pipe - 6 In. (150 mm) and Larger.
    b. C205, Cement-Mortar Protective Lining and Coating for Steel Water Pipe - 4 In. (100 mm) and Larger - Shop Applied.
    c. C206, Field Welding of Steel Water Pipe.
    d. C207, Steel Pipe Flanges for Waterworks Service - Sizes 4 In. Through 144 In. (100 mm Through 3,600 mm.
    e. C208, Dimensions for Fabricated Steel Water Pipe Fittings.
    f. C602, Cement-Mortar Lining of Water Pipelines in Place - 4 In. (100 mm) and Larger.
    g. M11, Steel Pipe - A Guide for Design and Installation.
4. American Welding Society (AWS):
    a. A2.4, Standard Symbols for Welding, Brazing, and Nondestructive Examination.
    b. A3.0M/A3.0, Standard Welding Terms and Definitions Including Terms for Adhesive Bonding, Brazing, Soldering, Thermal Cutting, and Thermal Spraying.
    c. D1.1/D1.1M, Structural Welding Code - Steel.
    d. QC 1, Standard for AWS Certification of Welding Inspectors.
5. ASTM International (ASTM):
    a. A20/A20M, Standard Specification for General Requirements for Steel Plates for Pressure Vessels.
    b. A53/A53M, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
    c. A106/A106M, Standard Specification for Seamless Carbon Steel Pipe for High-Temperature Service.

d. A234/A234M, Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service.
e. A370, Standard Test Methods and Definitions for Mechanical Testing of Steel Products.
f. A435/A435M, Standard Specification for Straight-Beam Ultrasonic Examination of Steel Plates.
g. A516/A516M, Standard Specification for Pressure Vessel Plates, Carbon Steel, for Moderate- and Lower-Temperature Service.
h. A770/A770M, Standard Specification for Through-Thickness Tension Testing of Steel Plates for Special Applications.
i. A1018/A1018M, Standard Specification for Steel, Sheet and Strip, Heavy-Thickness Coils, Hot-Rolled, Carbon, Commercial, Drawing, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength.
j. E329, Standard Specification for Agencies Engaged in Construction Inspection, Testing, or Special Inspection.
k. E1255, Standard Practice for Radioscopy.

6. International Organization for Standardization (ISO): 9001:2000, Quality Management Systems - Requirements.
7. Lloyd's Registry.
8. NSF International (NSF): 61, Drinking Water System Components - Health Effects.
9. Steel Pipe Fabricators Association (SFPA).

1.02 DEFINITIONS

A. Fittings: Including, but not limited to fittings, closure pieces, bends, reducers, tees, wyes, bifurcations, crosses, outlets, manifolds, nozzles, wall sleeves, bulkheads, and other piping and appurtenances fabricated from steel plate, sheet, or coils as required to provide the Work, complete. Fittings shall include piping above ground or inside structures.

B. Acronyms:

1. CJP: Complete Joint Penetration.
2. CWI: Certified Welding Inspector.
3. MT: Magnetic Particle Testing.
4. NDE: Nondestructive Examination.
5. NDT: Nondestructive Testing.
6. PJP: Partial Joint Penetration.
7. PQR: Procedure Qualification Record.
8. PT: Liquid Penetrant Testing.
9. RT: Radiographic Testing.
10. UT: Ultrasonic Testing.
11. VT: Visual Testing.

12. WPQ: Welder/Welding Operator Performance Qualification.
13. WPS: Welding Procedure Specification.

1.03 DESIGN REQUIREMENTS

A. Fittings:

1. Design reinforcement, unless otherwise shown.
2. Design in accordance with AWWA M11, AWWA C200, and AWWA C208 as modified herein, and this specification.

B. Pipe Layout:

1. Design in accordance with AWWA M11:
   a. General:
      1) Base stationing and elevation convention as shown on Drawings.
      2) Maximum Laying Lengths:
         a) Not limited, unless specifically shown on Drawings.
         b) Select lengths to accommodate installation operation.
   b. Include, as minimum:
      1) Specific number, location, and direction of each pipe, joint, and fitting. Number each pipe in installation sequence.
      2) Station and centerline elevation at changes in grade or horizontal alignment.
      3) Station and centerline elevation to which bell end of each pipe will be laid.
      4) Elements of curves and bends, both in horizontal and vertical alignment.
      5) Location of mitered pipe sections, beveled ends for alignment conformance, butt straps, and deep bell lap joints for temperature stress control.
      6) Location of closures, cutoff sections for length adjustment, temporary access manways, vents, and weld lead outlets for construction convenience.
         a) Provide for adjustment in pipe laying headings and to conform to indicated stationing.
         b) Changes in location or number will require Engineer approval.
      7) Location of bulkheads, both those shown and as required, for hydrostatic testing of pipeline.

C. Welding Procedure Specification (WPS):

1. Qualified by testing in accordance with ASME BPVC SEC IX for shop welds and AWS D1.1/D1.1M for field welds.

2. PQRs conducted on unlisted base metal (most coil products are unlisted base metals) to be production welded as required in the referenced welding Code shall be traceable to heat lots.
3. Written WPS required for welds, both shop and field.
4. Notch-tough welding procedures that require heat input control shall be required:
   a. AWS D1.1/D1.1.M prequalified welding procedures are not allowed.
   b. WPS used to shop fabricate pipe shall be qualified in accordance with ASME BPVC SEC IX and shall include Supplementary Essential Variables.
   c. PQRs shall be qualified for notch tough welding with consideration for thickness of steel, test temperature, and Charpy V-notch CVN values. Refer to AWS D1.1/D1.1M, Table 4.6 PQR Supplementary Essential Variable Changes for CVN Testing Applications Requiring WPS Requalification for SMAW, SAW, GMAW, FCAW, and GTAW and Section 4, Part D Requirements for CVN Testing, Option A (three specimens). CVN test temperature and acceptance shall be same as pipe base metal specified herein.

D. Stulling (Strutting): Design for pipe and fittings such that over-deflection and damage is avoided during handling, storage, and installation, including backfill and compaction.

1.04 SUBMITTALS

A. Action Submittals:

1. Shop Drawings showing pipe layout.
2. Material list and steel reinforcement schedules for materials specified.
3. Fabrication Information:
   a. Pipe and fitting details for temporary and permanent facilities indicating:
      1) Cylinder thickness.
      2) Manufacturing tolerances.
      3) Maximum angular deflection limitations of field joints.
      4) Closure sections and cutoffs for field length adjustment.
      5) Bulkheads, including details for removal of test bulkheads and repair of lining.
      6) Weld lead outlets and plugs.
      7) Stulling size, spacing, and layout.
   b. Welded joint details including:
      1) Butt joints.

2) Miter-cut ends for alignment conformance.
3) Lap joints.
4) Special thermal control joints required for control of temperature stresses.
5) Butt strap joints.

4. Welding Data (Shop and Field Welding):
   a. Show on a weld map, complete information regarding base metal specification designation location, type, size, and extent of welds with reference called out for WPS and NDE numbers in tail of welding symbol.
   b. Distinguish between shop and field welds.
   c. Indicate, by welding symbols or sketches, details of welded joints and preparation of base metal. Provide complete joint welding details showing bevels, groove angles, and root openings for all welds.
   d. Welding and NDE symbols shall be in accordance with AWS A2.4.
   e. Welding terms and definitions shall be in accordance with AWS A3.0M/A3.0.
   f. Submit welding data together with Shop Drawings as a complete package.
   g. Fittings: Provide a joint weld beveling diagram. Refer to AWS D1.1/D1.1M, Annex P Local Dihedral Angle that can be used to calculate bevels for weld joint details of intersecting pipes.
5. Product data for the following:
   a. Welded Steel Pipe and Fittings:
      1) Material data.
      2) Chemical and physical test reports showing data consistent with specified requirements for each heat of steel proposed for use.

B. Informational Submittals:

1. Certificates:
   a. Manufacturer’s Certificate of Compliance.
   b. Lining Materials: Certificate that lining system is currently approved for potable water contact in accordance with NSF 61 and satisfies current applicable governmental health and safety requirements for use in potable water.

2. Pipe Manufacturer's written Quality Assurance/Control Plan.
3. Statements of Qualification:
    a. Pipe manufacturer.
    b. Fittings fabricator.
    c. Contractor's Shop Inspector.
    d. Contractor's Field Inspector.
    e. NDT Quality Control Personnel.
4. Procedures:
    a. Shop and field welding information; at a minimum include complete welding code paper trail with linkage to Shop Drawings.
    b. Welder Qualifications and Welding Procedure Specifications as specified below:
        1) Provide complete joint dimensions and details showing bevels, groove angles, root face, and root openings for all welds.
        2) Notch-tough welding procedures required. For shop welding, address supplementary essential variables in addition to essential variables as indicated in ASME Section IX, QW-251.2. For field welding, heat-input, control PQR essential variables as indicated in AWS D1.1/D1.1M, Table 4.6 shall be included. For shop and field welding, provide heat-input table on WPSs for welder guidance.
        3) PQRs for notch-tough welding shall document heat- input control by monitoring volts, amps, and travel speed or time-rate of change of weld metal volume as calculated by measuring change in electrode length over a period of time. Charpy V-notch tests shall be conducted on weld metal and heat affected zone. Test coupons shall be oriented transverse to final direction of rolling. Full size Charpy specimen test acceptance shall be same as base metal specified herein.
        4) Written NDT procedures.
        5) Written description of proposed sequencing of events or special techniques such as:
            a) Controlling pipe wall temperature stress during installation.
            b) Minimizing distortion of steel.
            c) Shop-Applied Cement-Mortar Lining: Include description of machine to be used and list of similar projects where machine was used. Identify pipe size and total footage.
            d) Monitoring pipeline temperatures during installation.
    c. Written weld repair procedures for the Work.
    d. Field coating application and repair.

e. Field lining application and repair.

5. Reports:
   a. Source Quality Control Test Reports:
      1) Nondestructive weld testing.
      2) Steel impact testing using Charpy V-notch method.
      3) Letter from independent testing agency certifying pipe furnished meets requirements of this specification.
   b. Cement-mortar lining compressive strength tests in accordance with AWWA C205.
6. Design calculations prepared by a licensed professional engineer in the state of the Work for fittings, including opening reinforcement details of collars, wrappers, crotch plates; and harnessed joint assemblies.
7. Pipe manufacturer's design engineer's certification of training of Contractor's pipe installation crews.

1.05 QUALITY ASSURANCE

A. Qualifications:

1. Pipe Manufacturer:
   a. Experienced in fabricating pipe of similar diameters, lengths, and wall thickness required for the Work.
   b. Steel Pipe Fabricators Association (SPFA), Lloyd's Registry Certification, or ISO 9001:2000 Certification.
   c. Demonstrate current production capability for volume of work required for Project.
   d. Experience shall include successful fabrication to AWWA C200 standards of at least 25,000 linear feet of 36-inch diameter or larger pipe, with wall thickness of 0.2 inches or greater, within past 5-year period.
   e. Experience shall be applicable to fabrication plant facilities and personnel, not company or corporation that currently owns fabrication facility or employs personnel.
2. Fittings Fabricator:
   a. Experienced in fabricating fittings of similar diameters and wall thickness required for the Work.
   b. Steel Pipe Fabricators Association (SPFA), Lloyd's Registry Certification, or ISO 9001:2000 Certification.
   c. Demonstrate current production capability for volume of work required for this Project.
   d. Experience shall include successful fabrication to AWWA C200 and AWWA C208 standards of at least 25 fittings of 36-inch or larger pipe, with wall thickness 0.2 inch or greater, within past 5-year period.
   e. Experience shall include successful fabrication of at least five crotch plate fittings requiring post weld heat treatment within past 5-year period.

f. Experience shall be applicable to fabrication shop facilities and personnel, not company or corporation that currently owns fabrication facility or employs personnel.

3. Welders and Welding Operators:
   a. Shop Welders: In accordance with ASME BPVC SEC IX.
4. Inspector for Shop Welding:
   a. In accordance with AWS QC 1, with knowledge of welding code for the Work.

      After receiving CWI qualification, at least one Shop CWI shall have 5 years' minimum professional experience related to welding inspection similar to the Work. Other CWIs may work under the supervision of 5-year CWI, provided they have 1 year of related professional experience after receiving CWI qualification.
5. NDT Quality Control Personnel:
   a. In accordance with requirements of ASNT SNT-TC-1A, NDT Level II.
   b. After receiving NDT qualification, at least one NDT person shall have 5 years minimum professional experience related to NDT inspection similar to the Work. Other NDT personnel may work under the supervision of 5-year NDT, provided they have 1 year of related professional experience after receiving NDT qualification.

B. Shop Inspector:

1. In accordance with AWWA C200.
2. Responsibilities:
   a. Verify conformance to use of specified materials and their proper storage.
   b. Monitor conformance to approved WPS.
   c. Monitor conformance to approved NDT procedure specifications.
   d. Monitor conformance of WPQ.
   e. Provide 100 percent visual inspection before, during, and after shop welding.
   f. Coordinate NDT work and review test results.
   g. Maintain records and prepare report confirming results of inspection and testing.

C. Prefabrication Meeting:

1. Hold prior to fabrication of pipe and fittings between representatives of Thornton, Construction Manager, Contractor, Engineer, and pipe fabricator to review following:

a. Project scope.
b. Submittal requirements.
c. Testing.
d. Inspection responsibilities.
e. Shop welding requirements.
f. Field welding requirements.
g. Shop and field coating and lining requirements.
h. Production and delivery schedule.
i. Other issues pertinent to the Work.

D. Inspection of Coating and Lining Application: Qualified manufacturer's technical representative shall visit pipe coating and lining shop and Site at beginning of application process to verify proper workmanship associated with coating and lining application and as may be required to resolve shop or field problems. Submit written report of visit to Engineer.

1.06 DELIVERY, HANDLING, AND STORAGE

A. Pipe Marking:

1. Legibly mark installation sequence number on pipe and fittings in accordance with piping layout. Standard pipe sections do not need sequence number labeled provided wall thickness is clearly marked.
2. Fittings shall be marked at each end with notation "TOP FIELD CENTERLINE".
3. The word "TOP" shall be painted or marked on outside top spigot of each fitting.
4. Mark "TOP MATCH POINT" for compound bends per AWWA C208 so end rotations can be easily oriented in field.

B. Delivery:

1. Securely bulkhead or otherwise seal ends of pipe and fittings prior to loading at manufacturing site.
2. Pipe ends shall remain sealed until installation.
3. Damage to pipe and fittings, including linings and coatings, found upon delivery to Site shall be repaired to Engineer's satisfaction or removed from Site and replaced.

C. Storage:

1. Support pipe securely to prevent accidental rolling and to avoid contact with mud, water, or other deleterious materials.
2. Support on sand or earth berms free of rock exceeding 3 inches in diameter.

D. Acceptance at Site: Contractor shall inspect all deliveries for acceptance of material on site.

1.07 SEQUENCING AND SCHEDULING

A. Notify Engineer in writing of the following:

1. Pipe Manufacturing: Not less than 14 days prior to starting.
2. Not less than 5 days prior to start of each of the following:
   a. Welding.
   b. Coating application.
   c. Lining application.
   d. Shop hydrostatic testing.

PART 2 PRODUCTS

2.01 GENERAL

A. Pipe Manufacturer:

1. Pipe and fabricated fittings shall be responsibility of one main Supplier.
2. If pipe and fabricated fittings are manufactured by separate Suppliers, one main Supplier shall be responsible for formally managing other Supplier. The one main Supplier is responsible for coordination and management of production of all pipe and fittings work of both Suppliers, including, but not limited to:
   a. Qualifications.
   b. Submittals.
   c. Dimensional consistency between pipe and fittings.
   d. Fabrication.
   e. Quality assurance.
   f. Quality control.
   g. Reporting.
   h. Shop lining.
   i. Shop coating.
   j. Shop testing.
   k. Field services.
   l. Delivery schedule.
   m. Warranties or guarantees.

B.Pipe Size:

1. Unless shown otherwise for pipe over 30 inches in diameter, diameter shown shall be considered finished inside diameter after lining.
2. For pipe 30 inches in diameter and less, diameter shown shall be per ASME B36.10M.

a. Pipe size shall be nominal outside diameter for 14-inch diameter pipe and larger.
b. Pipe size shall be nominal inside diameter for 12-inch diameter pipe and smaller.

C. Steel pipe and fittings shall be manufactured, tested, inspected, and marked to comply with AWWA C200 and additional requirements of these Contract Documents.

D. In lieu of collar reinforcement, pipe or fittings with outlets may be fabricated in their entirety of steel plate having thickness equal to sum of pipe wall plus required reinforcement.

E. Materials furnished shall be NSF 61 approved for use with potable water.

2.02 PIPE BARREL

A. Steel: Provide steel coils for spiral welded steel pipe or steel plate for straight seam welded steel pipe per AWWA C200 and as follows:

1. Specified Minimum Yield Strength: 42,000 psi.
2. Specified Minimum Tensile Strength: 53,000 psi.
3. Minimum Elongation in 2-inch Gauge Length: 21 percent.
4. Steel Quality as follows:
   a. Coils:
      1) Continuous cast process, fully-killed, fine grained practice conforming to physical, manufacturing and testing requirements of ASTM A1018/A1018M, SS Grade 36, Type 1.
      2) Continuous cast process, fully-killed, fine grained practice conforming to physical, manufacturing and testing requirements of ASTM A1018/A1018M, HSLAS Grade 50, Class 2 (modified). Measured yield strength shall not exceed 85 percent of measured tensile strength.
   b. Plate:
      1) Fully-killed, conforming to ASTM A20/A20M, fine grained practice conforming to physical, manufacturing and testing requirements of ASTM A516/A516M, Grade 70.
      2) Steel Chemistry: Conform to ASTM A516/A516M, Grade 70. Steel plates that are 3/4-inch thick or greater shall be normalized.
   c. Toughness:

1) Charpy V-notch Acceptance Criteria: Transverse specimen orientation, full size specimens, 25 foot-pounds energy at test temperature of 30 degrees F.
2) Frequency: See Paragraph Steel Toughness Testing for Thickness Equal to or Greater than 7/16 Inches.

5. Minimum nominal wall thickness as shown on Drawings. Maximum allowable thickness variation for plate, sheet, or coil shall be 0.010 inch less than ordered thickness.

2.03 FITTINGS

A. Fabrication:

1. Shop fabricate. No field fabrication will be allowed, unless approved by Engineer.
2. Fabricate from materials or straight pipe in conformance with specified requirements and dimensions of AWWA C208, unless otherwise indicated.

B. Crotch Plate: Fabricate from fully-killed, fine grain, pressure vessel steel conforming to ASTM A516/A516M, Grade 70, and as follows:

1. Plates shall be normalized.
2. Perform through-thickness tension testing of plates in accordance with ASTM A770/A770M.
3. Charpy V-notch tests in direction transverse to final rolling shall be performed per ASTM A370 on full size specimens of coupons taken from each plate. Acceptance shall be 25 foot-pounds at 30 degrees F.

C. Wall Thickness:

1. General:
   a. Refer to ASME B36.10M for definitions of wall thickness for standard weight pipe and nominal pipe size (NPS).
   b. Reinforce to withstand either internal pressures, both circumferential and longitudinal, or external loading conditions, whichever is greater.
   c. Minimum Plate Thickness: The greater of adjacent mainline pipe, thickness shown, thickness calculated as hereinafter specified, or as shown in Table 1.

Table 1		
Nominal Pipe Diameter (inches)	**Pipe Manifolds Piping Above Ground Piping in Structures**	**Bends Reducers**
24 and Under	Standard Weight	Standard Weight
Over 24	Adjacent Pipe Thickness	Adjacent Pipe Thickness

D. Bends, Unless Otherwise Indicated:

1. Minimum Radius: 2.5 times pipe diameter or as indicated on Drawings.
2. Minimum Bend Wall Thickness: Greater of Table 1 above or, if radius is less than 2.5 time pipe diameter, as calculated using equation in Chapter 7 of AWWA M11.
3. Maximum Miter Angle: 11-1/4 degrees on each section resulting in a maximum deflection angle of 22.5 degrees per miter weld as recommended in AWWA C208.
4. Bevels: Vary bevels on miters to provide a constant weld groove angle. For 11-1/4-degree miter, (22.5-degree miter weld) bevels must vary from 18.75 degrees on OD of bend to 41.25 degrees on ID of bend to provide a constant 60-degree groove angle for CJP welding.
5. Complete joint penetration (CJP) welds on miter welds.

E. Outlets:

1. 24 Inches and Smaller: Fabricate from ASTM A53/A53M, Type E or S, Grade B, standard weight steel pipe.
2. Larger than 24 Inches: Fabricate from ASTM A106/A106M, Grade B, standard weight pipe.

3. Fabricate collar or wrapper reinforcement using same steel as specified for main pipe barrel.

F. Steel Butt-Weld Fittings:

1. 24 Inches and Smaller: In accordance with ASME B16.9 conforming to ASTM A234/A234M.
2. Standard weight.
3. Taper pipe wall at welds at 4:1 for connection to pipe of different wall thickness.
4. Coordinate difference in diameter convention between fittings and AWWA C200 and AWWA C208 pipe and fittings to provide complete piping system as shown.

2.04 JOINTS

A. Shop Welded:

1. Fabricate in accordance with AWWA C200 as modified herein.
2. Complete joint penetration (CJP) butt joints shall be used for longitudinal, girth, and spiral welds, unless otherwise indicated.
3. Lengths of pipe shall not be shop-joined using lap joints.

B. Preparation of Joints for Field Welding:

1. Butt Joint Welded:
   a. Plain ends beveled as required by AWWA C200 and Contractor's field WPS.
   b. Provide protection for factory beveled pipe ends so ends are not damaged during transport.
2. Lap Joint Welded:
   a. [A: Double fillet] [B: Single fillet] lap joints in preparation for field welding shall be in accordance with AWWA C200.
   b. For pipe 30 inches in diameter and larger, provide one of the following:
      1) Tack weld four metal tabs at equal intervals around inside circumference of bell ends to indicate location at which spigot end has reached maximum penetration into bell. Remove stops after welding of joint.
      2) Paint a 3/4-inch wide white stripe on outside circumference of spigot end of pipe. Side of stripe furthest from pipe end shall indicate location at which spigot end has reached maximum penetration into bell. Side of stripe closest to end of pipe will indicate limit of maximum joint pull.
   c. Double welded lap joints and butt-strap joints shall be tapped and drilled for testing in accordance with AWWA C206.

C. Miter-End Cuts:

1. Lap Joints:
   a. As shown on Drawings.
   b. Moderate deflections and long radius curves may be made using miter-end cuts.
   c. Use only with lap welded joints, unless specifically approved in writing by Engineer.
   d. Maximum Total Allowable Angle: 3 degrees per pipe joint.
   e. Provide miter-cut that is cold expanded square with face of miter-cut on bell ends only.
   f. Mitering of spigot ends will not be permitted.
2. Welded Butt Joints:
   a. Maximum Total Allowable Angle: 2.5 degrees per pipe joint.
   b. Minimum Pipe Wall Thickness: 3/8 inch.
   c. Welded Butt joints shall be CJP.

D. Special Temperature Control Joint:

1. Provide a special longer bell end (Special Temperature Control Joint) at a maximum spacing as indicated herein to account for movement on installed pipe as a result of temperature changes.
2. Pipe manufacturer shall determine length required for the longer bell.
3. Minimum Special Temperature Control Joint length is: as shown on Drawings.

2.05 FLANGES

A. In accordance with AWWA C207.

2.06 STULLING (STRUTTING)

A. Materials:

1. Shop-Lined Pipe: Wood stulls and wedges.
2. Unlined Pipe: Steel or wood.

B. Install stulling for pipe and fittings in accordance with approved submittal and as soon as practical after pipe is fabricated or, for shop-lined pipe, after lining has been applied.

C. Install stulling in manner that will not harm lining.

2.07 COATING

A. General:

1. Notify Engineer at least 3 days prior to application of coating

products.

2. Holdback of and coating from field-welded shall be as determined by designer for coating system specified.
3. Unless otherwise indicated, coat exterior surfaces of pipe and fittings passing through structure walls from center of wall or from wall flange to end of underground portion.

B. Shop-Applied:

1. As determined by Engineer for requirements of coating specified.

2.08 CEMENT-MORTAR LINING

A. General:

1. Notify Engineer at least 3 days prior to application of lining products.
2. Holdback of lining from field-welded joints shall be as follows:
   a. For lap-welded joints and flex couplings, 8 inches.
   b. For butt-weld and butt-strap joints, 6 inches.

B. Shop-Applied:

1. Applied centrifugally in conformance with AWWA C205. Thickness shall be in accordance with AWWA C205.
2. Lining machine type that has been used successfully for similar work and approved by Engineer.
3. Maintain pipe in round condition during lining operation and thereafter by suitable bracing or strutting.
4. Provide polyethylene or other suitable bulkhead on ends of pipe and on special openings to prevent drying out of lining. Bulkheads shall be substantial enough to remain intact during shipping and storage until pipe is installed.
5. Pipe shall be left bare where field joints occur.
6. Ends of lining shall be left square and uniform. Feathered or uneven edges will not be permitted.

2.10 SOURCE QUALITY CONTROL

A. Steel Toughness Testing for Thickness Equal to or Greater than 7/16 Inches:

1. Include three impact specimens; conduct test in direction transverse to final direction of the coil rolling.
2. Coils:
   a. Conduct Charpy Testing per ASTM A370 on an initial coil of each heat to establish uniformity of steel.
   b. Take test coupons from an initial coil of each heat at locations of outer and inner wrap of coil.

c. For each coil that fails to meet acceptance criteria, conduct Charpy Testing on next two coils in that heat.
d. Do not use coils that do not qualify in production of pipe.

3. Plate:
   a. Conduct Charpy Tests on each plate in accordance with ASTM A20/A20M.
   b. Conduct on full-size (10 mm by 10 mm) specimens from each plate in accordance with ASTM A20/A20M.
   c. Do not use plates that do not qualify in production of pipe.

B. Crotch Plate:

1. Perform through-thickness tension testing with acceptance criteria per Article 5 of ASTM A770/A770M on each plate.
2. Conduct straight-beam ultrasonic examination with acceptance criteria per Article 6 of ASTM A435/A435M on each plate.
3. Plates that do not qualify shall not be used.

C. Shop Hydrostatic Pressure Test: In accordance with AWWA C200 Section 5.2, except as follows:

1. General: Unless specified otherwise, testing of pipe and fittings shall be performed before lining and coating is applied.
2. Pipe: Maintain test pressure for minimum of 5 minutes.
3. Fittings:
   a. Except as otherwise specified herein, no additional shop hydrostatic test will be required on fittings fabricated from successfully tested straight pipe.
   b. Test with crotch plates, regardless of whether or not straight pipe sections used were previously tested.
   c. Test Pressure: Design Pressure of fitting.
   d. Maintain test pressure for a length of time as required to perform a visual inspection of welds.
   e. No leakage is allowed.

D. Shop Nondestructive Testing:

1. Welds: 100 percent visually examined by Shop Inspector to criteria in ASME BPVC SEC VIII, Division 1.
2. CJP Welds: Spot radiographically or radioscopically examine pipe in accordance with ASME BPVC SEC VIII, Div. 1, Paragraph UW-52. Welds that, in opinion of Engineer, cannot readily be radiographed, shall be 100 percent ultrasonically examined in accordance with paragraph UW-53.
3. Fillet Welds: 100 percent examine using magnetic particle inspection method in accordance with ASME BPVC SEC VIII, Division 1, Appendix 6.
4. Air test collars and wrappers in accordance with AWWA C206.

PART 3 EXECUTION

3.01 MANUFACTURER'S SERVICES

A. Manufacturer's representative available at Site for installation assistance and training of pipe installation crews.

1. Coordinate pipe manufacturer's representative services.
2. Pipe manufacturer's representative shall visit Site and instruct, guide, and provide procedures for pipe handling, laying, and jointing at start of pipe installation by each crew.

END OF SECTION