JEA Northside Generation Station

Limestone Piping Replacement

General Construction

418228.70.1000

Client Review Issue
Rev B

23 May 2024

Black & Veatch Corporation

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01100 – General Requirements and Scope of Work

01100.1 Project Description

The Northside Generating Station (NGS) is replacing its limestone piping due to piping failures and frequency of repairs due to internal erosion. Limestone is transported from the crusher building to Units 1 & 2 (N01 & N02) day bins. On each Unit, there are three lines, lines A, B, C, which transport limestone from the day bins to the furnace where there are twelve (12) injection ports.

The Contractor is responsible for replacing the existing limestone piping from the crusher building to the day bins, and from the day bins to the injection ports. The Contractor is also responsible for reconnecting interconnecting piping, instrumentation, auxiliary systems connections, and wiring once the new piping has been erected. Three (3) diverter valves and the twenty-four (24) 8” isolation valves at injection ports will be reused, and all other valves will be replaced. Piping, fittings, pipe supports, and auxiliary steel will be supplied by United Conveyor Corporation (UCC), and all other materials must be supplied by the Contractor..

The new piping will mostly follow the existing routing, with all alternate routing design occurring in the 8” piping going to injection ports. Auxiliary steel for new pipe supports will be required to support new routing design.

The project will be completed in three construction phases:

- Phase 1 – N02 day bin to furnace injection points
  - Replace limestone lines (A, B, and C) coming from N02 day bin to the furnace
  - Install piping and associated components as shown on the design drawings and in accordance with all welding specifications.
  - Complete post installation testing per documents and specifications.
  - Remove lockouts and clearances and return system to service.
- Phase 2 – N01 day bin to furnace injection points
  - Replace limestone lines (A, B, and C) coming from N01 day bin to the furnace
  - Install piping and associated components as shown on the design drawings and in accordance with all welding specifications.
  - Complete post installation testing per documents and specifications.
  - Remove lockouts and clearances and return system to service.
- Phase 3 – Crusher building to N01 & N02 day bins
  - Replace three (3) limestone lines coming from the crusher building to the day bins, three (3) diverter valves shall be reused
  - Install piping and associated components as shown on the design drawings and in accordance with all welding specifications.
  - Complete post installation testing per documents and specifications.
  - Remove lockouts and clearances and return system to service.

01100.2 Scope of Work

All work necessary to furnish, fabricate and erect equipment, piping, valves, pipe supports, as indicated on the Contract Drawings and as specified herein shall be provided by the Contractor. This consists of, but not limited to, the following.

- Remove and dispose of current piping and equipment as required
- Remove, store, and reinstall existing valves and actuators
  - Twelve (12), 8” knife valves at furnace injection for Unit 1 will be reused
  - Twelve (12), 8” knife valves at furnace injection for Unit 2 will be reused
  - Three (3), diverter valves for common piping will be reused
- Install new valves and actuators to replace existing valves furnished by JEA
  - Six (6), 10” knife gate valves for Unit 1
  - Six (6), 12” knife gate valves for Unit 1

    - Six (6), 10” knife gate valves for Unit 2
    - Six (6), 12” knife gate valves for Unit 2
- Furnish and install four (4) 10” Sch80 45 degree elbows to tie into existing lateral for bed ash injection
    - One (1) 10” Sch80 45 degree elbow on Line A Unit 1
    - One (1) 10” Sch80 45 degree elbow on Line B Unit 1
    - One (1) 10” Sch80 45 degree elbow on Line A Unit 2
    - One (1) 10” Sch80 45 degree elbow on Line B Unit 2
- Furnish and install twenty-four (24) limestone injection sleeves with mold insert and refractory into Intrex piping
    - Design per original Foster Wheeler Intrex Section & Details drawing 43-7587-5-387 (Refer to view A1-A1)
    - Four (4) new injection sleeve on Line A Unit 1
    - Four (4) new injection sleeve on Line B Unit 1
    - Four (4) new injection sleeve on Line C Unit 1
    - Four (4) new injection sleeve on Line A Unit 2
    - Four (4) new injection sleeve on Line B Unit 2
    - Four (4) new injection sleeve on Line C Unit 2
- Demolish and dispose twenty-four (24) existing limestone injection sleeves with mold insert and refractory into Intrex piping
    - Four (4) existing injection sleeve on Line A Unit 1
    - Four (4) existing injection sleeve on Line B Unit 1
    - Four (4) existing injection sleeve on Line C Unit 1
    - Four (4) existing injection sleeve on Line A Unit 2
    - Four (4) existing injection sleeve on Line B Unit 2
    - Four (4) existing injection sleeve on Line C Unit 2
- Receive and install new limestone piping and pipe supports per the UCC design drawings
    - Phases 1 & 2 will reuse most existing supports, with new supports required based on the new pipe routing
    - Phase 3 piping will resuse most existing supports, with new supports required based on the new pipe routing.
- Structural steel modifications for installation of new pipe supports
- Reconnect all auxiliary system connections to pre-construction locations in the limestone piping
- Pre-operational 100% leak test of all joints (must not be by visual methods), with test reports
    - Contractor to clarify testing method with bid.
-
- As-built drawing markups

The above materials will be installed in accordance with United Conveyor Corporation (UCC) design drawings for piping and pipe supports.

All piping will be shipped in random lengths and will require field cutting to suit. Straight sections are to be butt-welded in the field. Fittings, expansion joints, and wear sections will be shipped to the field loose. Flanges will be furnished loose and will be used at fittings and expansion joints. The connections and gaskets will ship with all of the required connection hardware and require field assembly.

Pipe supports and hardware will be shipped loose and will require field assembly.

Field fabrication, and installation of all necessary piping, fittings, valves, and piping supports for the system as shown on the Contract Drawings.

Contractor shall supply all equipment and consumables necessary to fabricate piping and pipe supports as detailed on the Contract Drawings.

Contractor shall provide all craft labor, tools, special tools, machine work, equipment, and vehicles to perform all phases of the Work.

All piping shall be per ASME B31.1. All welds shall be inspected per ASME B31.1 Table 136.4.

It shall be the responsibility of Contractor to disconnect/reinstall/replace any piping, structure, wiring, conduit, instrumentation, insulation, lagging, or related items which were removed by Contractor to aid them in their work; however, Contractor shall not de-energize/energize any station electrical or mechanical system. This shall be done in accordance with Owner Lockout/Tagout procedures and coordinated through the Owner Operations personnel.

The Contractor shall provide all materials and services to furnish and erect a complete system, unless noted otherwise. Omission by Engineer of specific equipment and services shall not relieve the Contractor of his responsibility to provide all materials and services to furnish and erect a complete and operational system as specified herein.

Where provision of specific equipment, materials, and services are specified herein, the Contractor shall provide the equipment, materials and services as specified unless otherwise noted or approved by the Owner.

Contractor understands that the work will be performed in an operating power plant. Work shall be performed in required sequence coordinated with plant operations to minimize operational impact.

Where the term “Contractor” is used herein, it shall refer to the Prime Contractor and/or the Prime Contractor’s sub-Contractor(s) and/or the Prime Contractor’s Contractor(s). Where the term “Owner” or “Owner” is used herein, it shall refer to the Owner (JEA) and the Owner’s representative(s).

In the event of technical conflicts, errors, or discrepancies, the detailed technical specifications, including this Section 01100 and all higher numbered sections, take precedence over Section 21000, Technical Supplemental Specifications.

01100.2.2 Project Schedule

The materials furnished by UCC will arrive onsite at the following dates.

Phase 1 – N02 day bin to furnace injection points:

- Piping, fittings, and associated hardware – August 9th, 2024
- Piping supports, auxiliary steel, and associated hardware - August 28th, 2024

Phase 2 – N01 day bin to furnace injection points:

- Piping, fittings, and associated hardware – December 20th, 2024
- Piping supports, auxiliary steel, and associated hardware - December 20th, 2024

Phase 3 – Crusher building to N01 & N02 day bins:

- Piping, fittings, and associated hardware – November 4th, 2024

The installation schedule is dependent on the arrival of the materials from UCC. Due to the shipping schedule mentioned above, the piping systems will be installed in three phases. Phase 1 includes piping from the N02 day bin to the furnace injection points, Phase 2 includes piping from N01 day bin to the furnace injection points, and Phase 3 crusher building to N01 & N02 day bins.

Phase 1 shall be constructed, tested, and commissioned during the Fall 2024 outage, and Phases 2 & 3 will be constructed, tested, and commissioned during the Spring 2025 outage. The outage dates are as follows.

- N02 Fall 2024 Outage – September 30th, 2024 through November 1st, 2024
- N01 Spring 2025 Outage – March 28th, 2025 through April 30th, 2025

01100.2.3 Substantial Completion

01100.2.3.1 Preliminary Procedures

Before requesting inspection for certification of Substantial Completion, complete the following and list exceptions in the request: In the Application for Payment that coincides with, or first follows, the date Substantial Completion is claimed, show 100% completion for the Work.

- Include supporting documentation for completion as indicated in the Contract Documents.
- If 100% completion cannot be shown, include a list of incomplete items, the value of incomplete Work, and reasons the Work is not complete (the punch list items).
    - All punch list items which are required to turn over and operate the system shall be completed. Only items which are needed for final acceptance should remain on this list when the system is turned over.
- Discontinue and remove temporary facilities from the Site, along with construction tools and similar elements.
- Complete final cleanup requirements.

01100.2.3.2 Inspection Procedures

Inspection procedure on receipt of a request for inspection, Owner will either proceed with inspection or advise Contractor of unfulfilled requirements. Owner will advise the Contractor of any Work that must be completed before Final Acceptance.

- Owner will repeat inspection when requested and assured by Contractor that the Work is Substantially Complete.
- Results of the completed inspection will form the basis of requirements for final acceptance.

01100.2.3.3 Final Acceptance

01100.2.3.3.1 Preliminary Procedures

Before requesting final inspection for certification of final acceptance and final payment, complete the following:

- List all exceptions in the request.
- Submit the final payment request with releases and supporting documentation not previously submitted and accepted.
- Submit a copy of Owner's final inspection list of items to be completed or corrected, endorsed and dated by Owner. The copy of the list shall state that each item has been completed or otherwise resolved for acceptance and shall be endorsed and dated by Owner.
- Submit consent of surety to final payment.
- Submit evidence of final, continuing insurance coverage complying with insurance requirements described in the Contract Documents.

01100.2.3.3.2 Re-inspection Procedure

Owner will re-inspect the Work upon receipt of notice that the Work, including punch list items from earlier inspections, has been completed, except for items whose completion is delayed under circumstances acceptable to Owner.

- Owner will advise Contractor of Work that is incomplete or of obligations that have not been fulfilled but are required for final acceptance.
- If necessary, re-inspection will be repeated.

01100.2.3.3.3 Record Document Submittals

01100.2.3.3.3.1 General

Do not use record documents for construction purposes. Protect record documents from deterioration and loss in a secure, fire-resistant location. Provide access to record documents for Owner's reference during normal working hours.

01100.2.3.3.3.2 Record Drawings

Maintain a clean, undamaged set of blue or black line white prints of Contract Drawings. Mark the set to show the actual installation. Mark which drawing is most capable of showing conditions fully and accurately. Give particular attention to concealed elements that would be difficult to measure and record at a later date.

- Record information concurrently with construction progress.
- Mark record sets with red erasable pencil. Use other colors to distinguish between variations in separate categories of the Work. Mark each document "PROJECT RECORD" in neat, large, printed letters.
- Mark new information that is important to Owner but was not shown on Contract Drawings.
- Note related Change Order numbers where applicable.
- Organize record drawing sheets into manageable sets. Bind sets with durable paper cover sheets; print suitable titles, dates, and other identification on the cover of each set.
- Upon completion of the Work, submit hard-copy record drawings to Owner. Also, supply an electronic copy in PDF and native formats.
- Where Submittals are used for mark-up, record a cross-reference at corresponding location on Drawings.
- Field changes of dimension and detail.
- Changes made by Change Order or other modifications.
- Details not on original Contract Drawings.

01100.2.3.3.3.3 Miscellaneous Record Submittals

Refer to other Specification Sections for requirements of miscellaneous record keeping and Submittals in connection with actual performance of the Work. Immediately prior to the date or dates of Substantial Completion, complete miscellaneous records, and place in good order. Identify miscellaneous records properly and bind or file, ready for continued use and reference. Submit for Contractor's records.

01100.3 Division of Responsibility

The Division of Responsibility Matrix defining the Contractor's scope of supply and the Owner's scope of supply is included at the end of this section and supplements responsibility definition provided throughout the Contract Documents.

Division of Responsibility Matrix				
Item	**Description**	**Contractor**	**UCC**	**Owner**
1.	All nuts, bolts, gaskets, special fasteners, backing rings, and other accessories required for installation of components and furnished equipment.		X	
2.	Piping design drawings		X	
3.	Piping support design drawings		X	
4.	Auxiliary steel design drawings for new supports		X	
5.	Furnish all piping, fittings, piping supports, and auxiliary steel required for system, excluding existing valves and pipe supports to be reused.		X	
6.	Receive, unload, and stage all piping fittings, piping supports, and auxiliary steel	X		
7.	Furnish 10” Sch80 45 deg. elbow connections to bed ash injection tie point	X		
8.	Design for limestone injection sleeve into Intrex piping			X (existing Foster Wheeler drawing 43-7587-5-387)
9.	Furnish and install new limestone injection sleeves	X		
10.	Cap existing limestone injection sleeves	X		
11.	Furnish valves required for system			X
12.	All instruments required for the system			X
13.	All modifications required for new pipe routing interferences			X
14.	Installation of all components discussed in Section 01100.1	X		
15.	Demolition and disposal of all components discussed in Section 01100.1	X		
16.	All access platforms and scaffolding, as necessary, for installation	X		
17.	Furnish identification tags for all piping, valves, equipment and devices.			X
18.	Install identification tags for all piping, valves, equipment, and devices	X		
19.	Solvents and cleaning materials.	X		
20.	Required material handling equipment for offloading, staging, and setting all piping materials.	X		
21.	Leveling blocks, soleplates, thrust blocks, matching blocks, and shims.	X		

Division of Responsibility Matrix				
Item	**Description**	**Contractor**	**UCC**	**Owner**
22.	All other features as specified in this procurement package.	X		
23.	As-built drawings	X		

01100.4 Construction Sequence

The below recommended steps shall be taken, in order, to complete the scope of work detailed above in Section 01100.2:

The following work shall be performed and completed prior to the start of the outage:

- Conduct a pre-job walk down with JEA's construction coordinator to verify scope limits, access provisions, etc.
- Receive materials from UCC
- Conduct inventory on materials supplied by UCC to ensure all components to erect system are onsite.
- Install auxiliary steel for new pipe supports.
- Erect scaffolding.
- Verify that all interferences on design drawings have been resolved by Owner.
    - Resolve any remaining interferences with approval from Owner
- Field fabricate or assemble components, as allowable, to prepare for installation.

The following work shall be completed during the outage:

- Ensure all clearances (LOTO) are in place.
- Verify that the pressure has been bled off and piping is cool.
- Disconnect interconnecting limestone piping at equipment and auxiliary system connections as identified on UCC drawings.
- Remove valves, actuators, and instrumentation from piping so that they can be reinstalled in the new limestone piping.
- Demolish limestone piping.
- Dispose of limestone piping.

Phase 1: Fall 2024 Outage

- Replace limestone lines (A, B, and C) coming from N02 day bin to the furnace
- Install piping and associated components as shown on the isometric drawings and in accordance with all welding specifications.
- Complete post installation testing per documents and specifications.
- Remove lockouts and clearances and return system to service.

Phase 2: Spring 2025 Outage

- Replace limestone lines (A, B, and C) coming from N01 day bin to the furnace
- Install piping and associated components as shown on the isometric drawings and in accordance with all welding specifications.
- Complete post installation testing per documents and specifications.
- Remove lockouts and clearances and return system to service.

Phase 3: Spring 2025 Outage

- Replace three (3) limestone lines coming from the crusher building to the day bins, three (3) diverter valves shall be reused

- Install piping and associated components as shown on the isometric drawings and in accordance with all welding specifications.
- Complete post installation testing per documents and specifications.
- Remove lockouts and clearances and return system to service.

The following work shall be completed after completion of construction:

- Submit all quality records and test reports.
- Closeout of all punch list items.
- Complete construction redline markup of the furnished design drawings and return to JEA Coordinator and Black & Veatch (Email to FlynnAL@bv.com, attention of Alison Flynn, BV Project Manager).
- Clean up and demobilization.

01100.5 Drawings and Technical Attachments

This article lists the drawings and other technical attachments that have been prepared for the work under these specifications.

01100.5.1 Technical Attachments

The following listed attachments shall be part of the Purchase Order:

Drawing No. or Other Designation	Rev. No.	Title
C-55700-14-001	A	GENERAL NOTES AND REFERENCE DRAWINGS PIPING
C-55700-14-002	A	GENERAL NOTES AND REFERENCE DRAWINGS PIPE SUPPORTS
C-55700-14-003		U2 Pipe Support Drawings -- LATER
C-55700-14-004	B	BILL OF MATERIAL LIMESTONE INJECTION REPLACEMENT PIPING FROM DAY BIN OUTLET TEE TO COMBUSTER NOZZLE, UNIT 2
C-55700-14-005	B	SYSTEM ISOMETRIC KEY PLAN LIMESTONE INJECTION REPLACEMENT PIPING FROM DAY BIN OUTLET TO COMBUSTER NOZZLE, UNIT 2
C-55700-14-006	B	PLAN AND DETAILS LIMESTONE INJECTION REPLACEMENT PIPING FROM DAY BIN OUTLET TEE TO COMBUSTER NOZZLE, UNIT 2
C-55700-14-007	B	PLAN AND DETAILS LIMESTONE INJECTION REPLACEMENT PIPING FROM DAY BIN OUTLET TEE TO COMBUSTER NOZZLE, UNIT 2
C-55700-14-008	B	PLAN, SECTION AND DETAILS LIMESTONE INJECTION REPLACEMENT PIPING FROM DAY BIN OUTLET TEE TO COMBUSTER NOZZLE, UNIT 2
C-55700-14-009	B	PLANS AND DETAILS LIMESTONE INJECTION REPLACEMENT PIPING FROM DAY BIN OUTLET TEE TO COMBUSTER NOZZLE, UNIT 2

C-55700-14-010	B	SECTIONS AND DETAILS LIMESTONE INJECTION REPLACEMENT PIPING FROM DAY BIN OUTLET TEE TO COMBUSTER NOZZLE, UNIT 2
C-55700-14-011	B	SECTIONS AND DETAILS LIMESTONE INJECTION REPLACEMENT PIPING FROM DAY BIN OUTLET TEE TO COMBUSTER NOZZLE, UNIT 2
C-55700-14-012	B	SECTIONS AND DETAILS LIMESTONE INJECTION REPLACEMENT PIPING FROM DAY BIN OUTLET TEE TO COMBUSTER NOZZLE, UNIT 2
C-55700-14-013	B	SECTIONS AND DETAILS LIMESTONE INJECTION REPLACEMENT PIPING FROM DAY BIN OUTLET TEE TO COMBUSTER NOZZLE, UNIT 2
C-55700-14-014	B	SECTIONS AND DETAILS LIMESTONE INJECTION REPLACEMENT PIPING FROM DAY BIN OUTLET TEE TO COMBUSTER NOZZLE, UNIT 2
C-55700-14-015	A	BILL OF MATERIAL LIMESTONE INJECTION REPLACEMENT PIPING FROM DAY BIN OUTLET TEE TO COMBUSTER NOZZLE, UNIT 1
C-55700-14-016	A	SYSTEM ISOMETRIC KEY PLAN LIMESTONE INJECTION REPLACEMENT PIPING FROM DAY BIN OUTLET TO COMBUSTER NOZZLE, UNIT 1
C-55700-14-017	A	PLAN AND DETAILS LIMESTONE INJECTION REPLACEMENT PIPING FROM DAY BIN OUTLET TEE TO COMBUSTER NOZZLE, UNIT 1
C-55700-14-018	A	PLAN AND DETAILS LIMESTONE INJECTION REPLACEMENT PIPING FROM DAY BIN OUTLET TEE TO COMBUSTER NOZZLE, UNIT 1
C-55700-14-019	A	PLAN, SECTIONS AND DETAILS LIMESTONE INJECTION REPLACEMENT PIPING FROM DAY BIN OUTLET TEE TO COMBUSTER NOZZLE, UNIT 1
C-55700-14-020	A	PLAN AND DETAILS LIMESTONE INJECTION REPLACEMENT PIPING FROM DAY BIN OUTLET TEE TO COMBUSTER NOZZLE, UNIT 1
C-55700-14-021	A	SECTIONS AND DETAILS LIMESTONE INJECTION REPLACEMENT PIPING FROM DAY BIN OUTLET TEE TO COMBUSTER NOZZLE, UNIT 1
C-55700-14-022	A	SECTIONS AND DETAILS LIMESTONE INJECTION REPLACEMENT PIPING FROM DAY BIN OUTLET TEE TO COMBUSTER NOZZLE, UNIT 1
C-55700-14-023	A	SECTIONS AND DETAILS LIMESTONE INJECTION REPLACEMENT PIPING FROM DAY BIN OUTLET TEE TO COMBUSTER NOZZLE, UNIT 1

C-55700-14-024	A	SECTIONS AND DETAILS LIMESTONE INJECTION REPLACEMENT PIPING FROM DAY BIN OUTLET TEE TO COMBUSTER NOZZLE, UNIT 1
C-55700-14-025	A	SECTIONS AND DETAILS LIMESTONE INJECTION REPLACEMENT PIPING FROM DAY BIN OUTLET TEE TO COMBUSTER NOZZLE, UNIT 1
UCC U1 Pipe Support Drawings		LATER
UCC Common Piping Drawings		LATER
UCC Common Pipe Support Drawings		LATER
43-7587-5-387 (117934)	E	Intrex Sections & Details
JEA Contractor Safety Management Process	4/1/23	JEA Contractor Safety Management Process
12" & 10" Knife Gate Valve Cutsheets		TLCUST8112-SCAV-CYL

01100.6 Construction Progress Updates and Reports

This Section includes requirements for documenting the progress of construction during performance of the Work.

REPORTS:

A. Weekly Construction Progress Reports:
   1. Contractor shall submit a report on actual construction progress on a weekly basis.
   2. Weekly Construction Progress Reports shall consist of the revised construction progress schedule and a narrative report which shall include but not be limited to the following:
      a. Work Activities planned.
      b. Number and size of crews.
      c. Construction equipment on Site.
      d. Major items of material to be installed.
      e. Safety issues and corrective actions.
      f. Comparison of actual progress to planned progress shown on originally accepted Contractor's Schedule.
      g. Summary of activities completed since the previous construction progress report.
      h. Summary of activities planned for next reporting period.
      i. Planned, earned, and spent earned value analysis for the week.
      j. Identification of problem areas.
      k. A description of current and anticipated delaying factors, if any.
      l. Impact of possible delaying factors.
      m. Proposed corrective actions.
      n. Request for Information Log.
      o. Change Order Request Log.
   3. Each Weekly Construction Progress Report to PMT shall be due with the weekly Payment Application Form. Work reported complete but not readily apparent to PMT shall be substantiated with such supporting data as requested by PMT.

4. If eekly Construction Progress Report update reveals that the Work is likely to be completed later than a completion date as provided in the Contractor's Schedule, Contractor shall:
    a. Provide a plan of corrective action to the PMT detailing the steps Contractor proposes to implement to make up the lost time and complete the Work no later than the date for completion set forth in the Contract.
5. Contractor shall provide Weekly Construction Progress Reports to PMT no later than the end of Work Day on the Friday of the Work week.

B. Material Disposition Report: Contractor shall at Biweekly intervals, prepare and submit a comprehensive list of materials delivered to and stored at the Site, including all staging yards. The Material Disposition Report shall be cumulative, showing materials previously reported (and the disposition/consumption thereof) plus items recently delivered.

C. Special Reports:
1. General: Contractor shall submit Special Reports directly to PMT within one (1) Day of an occurrence and shall distribute copies of such report to parties affected of the occurrence.
2. Reporting Unusual Events: When an event of an unusual and significant nature occurs at the Site, whether or not related directly to the Work, Contractor shall prepare and submit a Special Report. Each Special Report shall list the chain of events, persons participating, a response by Contractor's personnel, evaluation of results or effects, and similar pertinent information. In addition, it should include an evaluation of any “Similar Conditions” or Extent of Condition that may exist elsewhere on the project. Contractor shall advise PMT in advance when these events are known or predictable.

01100.7 Schedule of Submittals

This Schedule describes administrative deliverables to be furnished by the Contractor to Owner upon the award of the Contract. The drawings and documents listed herein form an integral part of Contractors commitment to the Contract. As a minimum, all data sheets shall be identified with Project Description, Purchase Order Number, Contractor Name and Client Name. Revision boxes shall be provided to describe any drawing revisions in detail. Indications of dimensions, forces and weights shall be listed in US Customary Units.

Item No.	Reference Document	Submittal Item	Submittal Dates			
			Calendar Days		Event	Due Date
Schedule of Submittals						
	01100	**Scope of Work**			.	
	01100	Construction updates as required in 01100.4	1	After	Effective Date	
	01100	Health and Safety Plan	30	After	Notice to Proceed	
	01100	Acknowledgment and completion of JEA Contractor Safety Management Process documentation	7	After	Notice to Proceed	
	01100	Scaffolding, Lifting and Rigging Plan	30	After	Notice to Proceed	
	01100	Operator Certifications (cranes, forklifts, and other lift equipment)	2	Before	Use of lift equipment	
	01100	Lift Equipment Certification of Inspection and Lift Rating	2	Before	Use of lift equipment	
	01100	Documented Training for First Aid/CPR (at least one employee per shift)	2	Before	Employee site access	
	01100	Documented Training Records for NGS Site Safety Orientation	2	Before	Employee site access	
	01100	Standard 5-Panel Substance Abuse Screen (All Contractor Employees)	7	Before	Employee site access	
	01100	Safety Incident Report	1	After	Post incident	
	01100	Organization Chart with Key Personnel	30	After	Notice to Proceed	
	01100	Level 3 Construction Schedule	30	After	Notice to Proceed	
	01100	Demolition Plan	30	After	Notice to Proceed	
	01100	Materials and Waste Management Plan	30	After	Notice to Proceed	
	01100	Waste Profiles and Manifests	7	After	Disposal	
	01100	Materials Laydown and Management Plan	30	After	Notice to Proceed	
	01100	Piping Erection Plan	30	After	Notice to Proceed	
	01100	Daily Construction Report	1	Before	8:00 AM following each successive workday	

Item No.	Reference Document	Submittal Item	Submittal Dates			
			Calendar Days		Event	Due Date
	01100	QC Test Reports and Documentation	3	After	Contractor's Receipt	
	01100	Weekly Progress Meeting / Report	1	After	Effective Date and then weekly thereafter	
	01100	Substantial Completion Documentation	3	Before	Substantial Completion	
	19000	**Quality System Requirements**			.	
	19000	Certification Letter or Certificate of Authorization (copy), if certified by a registered agency, e.g., ASME Certificate of Authorization, ISO Certificate	30	After	Effective Date	
	19000	Subsupplier listing	5	Before	Issue of Subsupplier Purchase Order	
	19000	Notification of inspection/test (for Owner hold/witness points)	14	Before	Test/Inspection	
	19000	Quality Manual, uncontrolled copy	28	After	Effective Date	
	19000	Inspection and test plan with monthly inspection target dates	28	After	Effective Date and then monthly thereafter	
	Q100	**General Welding Requirements**			.	
	Q100	Welding Procedure Specifications (WPS) with applicable Procedure Qualification Records (PQR)	60	Before	Start of Fabrication	
	Q100	Procedures for storing, issuing, and reconditioning of electrodes, wires, and fluxes	60	Before	Start of Fabrication	
	Q100	Repair procedures associated with a nonconformance report	5	After	Discovery of Repair	
	Q100	Post-weld heat treatment procedures	60	Before	Start of Fabrication	
	Q100	Visual inspectors' qualifications and certificates	60	Before	Start of Fabrication	
	Q100	Nondestructive examination procedures	60	Before	Start of Fabrication	
	Q100	Nonconformance reports	5	After	Discovery of Nonconf.	
	Q100	Radiographs or UT reports	14	After	Fabrication Completion	
	Q121	**General Structural Welding Requirements**			.	

Item No.	Reference Document	Submittal Item	Submittal Dates			
			Calendar Days		Event	Due Date
	Q121	Welding Procedure Specifications (WPS) with applicable Procedure Qualification Records (PQR)	60	Before	Start of Fabrication	
	Q121	Procedures for storing, issuing, and reconditioning of electrodes, wires, and fluxes	60	Before	Start of Fabrication	
	Q121	Repair procedures associated with a nonconformance report	5	After	Discovery of Repair	
	Q121	Visual inspectors' qualifications and certificates	60	Before	Start of Fabrication	
	Q121	Nonconformance reports	5	After	Discovery of Nonconf.	
	Q121	Radiographs or UT reports	14	After	Fabrication Completion	

01100.8 Contractor Safety Management Process

Contractor's should adhere to JEA's Contractor Safety Management Process. The safety document is provided as an attachment to this specification, and can be accessed online through this link (https://www.jea.com/About/Procurement/Contractor_Safety/).

15921 - Piping Erection

15921.1 General

15921.1.1 Scope of Work

The work shall include erection of all piping, fittings, valves, supports, and piping specialties, as called for on the drawings and specifications, and by the codes and standards. Erection of piping systems designated by the system codes and indicated on the drawings listed in Section 01100 are included, except as otherwise specified herein. The Contractor shall furnish all required materials and perform all related work for completion of the work included under these specifications.

If furnishing any piping or fittings; or furnishing and/or installing control and instrument piping is included in the Scope of Work, it shall be performed in accordance with separate sections included in these specifications:

Additional Scope	The additional Scope of Work for this package includes the following items:
System Name	**System Code**
Compressed Air	AC
Bed Ash	NB
Handling Limestone	RH
Lime Preparation	RL
The systems listed above include the following:	
Above grade piping	Yes
Below grade piping	No
In addition to erection of the piping systems defined above, the Scope of Work includes the following services and materials:	
Routing of miscellaneous 2 inch (50 mm) and smaller pipe, fittings, and valves	No
Installation of instrument and control piping and tubing as indicated on the attachments	Yes
Freeze protection required	No
Install pipeline and valve identification	Yes (Furnished by Owner)

15921.1.2 Not Used

15921.1.3 Not Used

15921.1.4 Not Used

15921.1.5 Not Used

15921.1.6 Not Used

15921.1.7 Not Used

15921.1.8 Not Used

15921.1.9 Supplemental Specifications
Technical supplemental specifications that are applicable to the work covered under this technical specification section are identified and included in Section 21000.

15921.2 Not Used

15921.3 Execution
All piping, valves, fittings, and piping specialties shall be erected in accordance with the requirements of this section. Any piping installation not specified herein shall be performed in accordance with good engineering practice.

The drawings indicate the dimensions of the major lines. These dimensions are subject to change to accommodate the equipment, valves, and fittings actually furnished and the variations in equipment as actually installed. If the equipment, valves, fittings, and other components of the piping systems actually furnished differ in dimensions from those indicated, the piping systems shall be altered as required to accommodate these changes. If, due to some unforeseen circumstance, the installation of the piping as indicated would result in an interference, the modifications or corrections required to install the piping free from interferences shall be made.

A field check of all connections to equipment and existing pipe, valves, or fittings for location, size, butt weld end preparation or flange drilling and facing shall be made prior to erecting interconnecting piping.

Allowances in fit-up and modifications to piping spools shall be made as required prior to completion of field welds and hoisting pipe spools into place as applicable. To the extent possible erected pipe should be placed into pipe supports before weld-out and bolt-up to equipment.

The Contractor shall place a label on the pipe section in the flow direction as it is being installed (approximately every 200 ft).

Pipe, fittings, valves, and accessories shall be handled in a manner that will ensure installation in a sound, undamaged condition. Equipment, tools, and methods used in unloading, reloading, hauling, and laying pipe and fittings shall be such that the pipe and fittings are not damaged.

Particular care shall be taken to prevent damage to protective coatings and concrete pipe joint rings. Slings shall be nonabrasive and located between the ends of each pipe section when lifting. Bare wire rope slings or the use of hooks to lift pipe will not be permitted.

15921.3.1 Welding
Field welding shall be in accordance with the requirements of the Supplemental Specifications in Section 21000.

15921.3.2 Miscellaneous Piping
Miscellaneous piping is defined as piping 2 inches (50 mm) and smaller which is not shown on the detailed piping drawings. All miscellaneous piping shall be given special attention such that it is routed

and installed in a neat, rectangular form. All piping shall be installed perpendicular or parallel to the major equipment, building structure, and floor levels except in special cases consented to by the Owner.

If routing of miscellaneous piping is included under these specifications, all piping, including tubing, not located on the drawings shall be routed and installed in accordance with the following requirements:

Pipe routing shall allow unobstructed maintenance of plant equipment.

Piping shall not be installed above, or within a horizontal distance of 3 feet (1 m) from, electrical equipment such as switchgear, switchboards, control panels, motor controls, contactors, communication equipment, batteries, battery chargers, and motor generators unless written consent of the Owner is obtained. Improperly located piping shall be removed and relocated.

All branch piping shall be provided with shutoff valves at the main headers.

Valves shall be installed in such a manner that they can be operated from the main operating floors or platforms without the use of ladders or special operating devices.

Piping shall be installed with a minimum of 7'-6" (2.3 m) headroom over passageways and walkways.

Pipe runs that require condensate drainage shall be installed so that they pitch toward the point of drainage.

Piping subject to freezing shall not be routed in the vicinity of large doors which could be open for the moving of mobile equipment or maintenance.

Where building expansion walls are indicated on the drawings, piping shall not be supported from or located on columns or beams on these walls.

Piping indicated on P&IDs or other drawings as having a connection for the future extension of the piping to another unit shall be routed to a convenient point along the column row adjacent to the unit or the location for a future unit.

Routings shall be selected to avoid interference with planned and dimensioned locations for lighting fixtures, electrical trays, raceways, or conduit. The Contractor shall review the Owner's drawings for electrical construction to avoid such interferences before routing the piping.

Sketches of the proposed routing of all piping not located on the drawings shall be submitted to the Owner. The Owner's acceptance of all routings shall be obtained before the piping is erected.

15921.3.2.1 Vents and Drains. Vents and drains for system filling and draining may not be shown on the drawings for miscellaneous pipe. The Contractor shall furnish and erect all required vents and drains to allow miscellaneous piping to be filled and drained. Each vent and drain shall be sized and shall include a shutoff valve and a screwed plug or cap in accordance with the vents and drains.

15921.3.3 Temporary Piping

All equipment, piping, and valves of a temporary nature shall be installed in a safe and workmanlike manner. This shall include such lines as temporary vents for steam blowing, hydrostatic test lines, chemical cleaning lines, and all other temporary lines required to successfully complete the work. When the temporary piping is no longer required, any Contractor-furnished temporary piping shall be dismantled and removed from the site. Temporary piping furnished by others shall be dismantled and stored as directed by the Owner.

Temporary piping shall ordinarily be removed prior to startup and operation of the facility. If for some reason the temporary piping must remain in place for a time after startup, the piping shall be designed and installed in accordance with the codes/specifications used with the permanent piping to which the temporary piping is attached.

15921.3.4 Piping in Existing Areas

Before installation of piping in existing areas, the routings of new piping to be installed shall be walked down to verify that the piping, insulation, and supports can be installed as designed without interference. If the piping as designed would interfere with existing facilities, the pipe routing shall be reviewed with the Engineer and shall then be altered or existing piping shall be relocated. All pipe routings shall be subject to acceptance by the Owner.

15921.3.5 Alterations and Cut-ins

All alterations and cut-ins to existing piping and equipment indicated on the drawings shall be made as specified herein and as required for proper installation of the new piping and equipment.

All cut-ins shall be performed by sawing, machining, or careful flame cutting as directed by the Owner. Flame cut holes shall be ground smooth. The interior of the piping shall be thoroughly cleaned after cutting.

Whether indicated on the drawings or not, existing miscellaneous piping shall be revised as required to permit installation, without interference, of new piping and equipment. Existing miscellaneous piping that interferes with walkways or presents an unsightly appearance after modification of existing buildings, structures, equipment, or piping shall be relocated as directed by the Owner. The alterations to existing piping shall include any required revisions, additions, or replacements of insulation and pipe supports.

Any piping materials and valves removed and not reused shall be disposed of as directed by the Owner.

All alterations and cut-ins to existing systems shall be made on a time schedule acceptable to the Owner.

After alterations and cut-ins to existing coated equipment or coated piping have been made, the damaged coating shall be repaired. All welds and sharp edges shall be finished smooth and all weld spatter shall be removed. The metal shall be prepared and the coating system applied in strict accordance with the instructions and recommendations of the coating manufacturer.

15921.3.6 Thermal Expansion

All piping shall be installed so that excessive or destructive expansion forces will not exist either in the cold condition or under conditions of maximum temperature.

15921.3.6.1 Critical Piping Systems. The general purpose of these procedures is to assure that the pipe is erected in its correct stress free condition, and that it remains in this position until after the piping is properly fit up to the major equipment:

1. The dimensions of all shop-fabricated sections shall be checked by field measurement, and any errors brought to the attention of the Owner. Any deviations from the requirements stated in this procedure shall be brought to the attention of the Owner.

2. A survey shall be conducted to determine the location of the piping terminal points, such as the steam generator connections and the turbine connections.

3. Bench marks shall be established. These benchmarks shall be relative to the turbine centerline elevation and used to correctly position equipment and piping.

4. Each spool piece shall be installed in a stress free condition in accordance with the isometric drawings. Starting from one of the terminal points or other predefined reference point, successive shop fabricated spools shall be installed to maintain a tolerance of +/- 1/2 inch of the erected dimensions provided on the drawings. Once a spool is properly located and any pipe spools immediately upstream and downstream are confirmed to fit within the tolerances specified, the final erected dimensions shall be recorded and welding and stress relieving may proceed. As erection of the piping system progresses, individual spools within the system may be shifted to match the preceding section so that the dimensions accumulate into the final weld fit-up gap. The tolerance of the final fit-up gap shall not exceed +/- 1/4 inch relative to each weld end after allowances are made for weld shrinkage, or other post erection adjustments, and shall be recorded accordingly. One final adjustment may be made to correct the difference between the final fit-up gap and the fit-up gap defined by the welding procedure prior to welding and stress relieving. Any modifications required to the piping or support system to erect it within these tolerances or in a stress free condition shall have prior approval of the Engineer.

5. Additional temporary supports, if required, shall be installed. Temporary horizontal restraints shall be installed as required to maintain the pipe in its correct position.

6. Care shall be taken to maintain the pipe in its erected position during welding and stress relieving. The final fit-up gap shall be monitored during the welding process to ensure that proper allowances were made for welding shrinkage.

7. The weld at the final fit-up location shall be welded only after all other field welds have been made and stress relieved. The final weld shall be stress relieved prior to removing any temporary rigging installed on the piping system.

8. All permanent horizontal guides shall be installed according to the hanger details based on the erected locations of the piping system. In general, the horizontal guides shall be installed at the angle shown on the pipe support drawings. Minor adjustments shall be made (trim, cope, or add shim plates to structural members) to guides to accommodate actual pipe locations that may vary from design-erected locations due to fabrication and erection tolerances.

After all permanent guides have been installed, temporary supports shall be removed and the spring supports shall be unpinned and adjusted to the cold position. Spring supports shall be adjusted to their proper cold position after all insulation and lagging is installed.

15921.3.6.2 Noncritical Piping Systems. The Contractor shall install the pipe in a stress free condition. Cold spring shall not be used to close the final joint in runs of piping between equipment and anchors. The methods used to erect the piping shall result in an installation which is true to plan. Starting from an established reference point, successive piping spools or piping sections shall be erected such that the installed end is within the established tolerance from the dimensioned drawings for the NPS being erected. Once a spool or piping section is properly located to within the required tolerance steps shall be taken to maintain the location of that piping. Successive spools or piping sections may then be erected while maintaining the required tolerance for the NPS being erected. As erection of the piping system progresses, individual spools or piping sections shall be shifted to match the proceeding section so that the dimensions accumulate into a final weld fit up gap tolerance based on the NPS being erected. The following lists allowable spool or piping sections ends and the final weld fit up gap.

Description	Erected Tolerance From Drawings	Final Weld Fit Up
NPS 2 inch and smaller	+/- 1 inch	+/- ½ inch

NPS 12 inch and smaller	+/- ¾ inch	+/- 3/8 inch
NPS greater than 12 inch	+/- ½ inch	+/- ¼ inch

Note the final weld fit up gap may only be closed by moving the ends of the pipe together if there is at least two unrestrained dead weight spans available perpendicular to the direction of the gap being closed. This restriction prevents excessive loading of nearby lateral and axial restraints.

15921.3.7 Pipe Supports

Welding of pipe supports to structural steel forming a part of the building supporting structure shall be in accordance with the requirements of Supplemental Specification Q280 in Section 21000. Generally, welds shall run parallel with the length of the beam and all welding of lugs or attachments shall be staggered on the sides, with cooling allowed between subsequent weld bead deposits. Loaded beams shall be unloaded or properly shored prior to field welding if 10 percent or more of the flange width or web depth should be heated to over 500° F (260° C) at any one time.

The support assemblies shall not be used for the attachment of rigging to hoist the pipe into place. The piping shall be securely held in place by other means until the pipe support is completely assembled and attached to the pipe and building structures and the spring support set to take care of pipe sway. All rigging shall be removed in such a manner as not to impose a sudden load on the pipe support.

Spring supports on gas filled systems shall not be used during hydrostatic testing of piping systems unless they are pinned or blocked to act as rigid supports. All piping having such supports that are not pinned or blocked shall be held securely in place by other temporary means throughout the testing. After successfully passing the hydrostatic test, the pin or blocking device shall be removed.

15921.3.8 Not Used

15921.3.9 Equipment Connections

When attaching piping to equipment connections, special care shall be taken so that excessive stresses are not transmitted to, and imposed upon, such connections. Piping connections to rotating equipment shall not be finalized until the shaft is aligned and the equipment grouted in. As piping is connected, shaft alignment shall be monitored to determine if piping stress causes any change. An indicator tolerance beyond 0.002” shall typically require correction. The Construction Manager shall make the final determination of tolerance depending on the equipment service.

In the case of flanged connections, the piping shall be installed and supported so that accurate matching of bolt holes and uniform contact over the entire flange area are obtained prior to the installation of any flange bolts. Bolts shall be carefully tightened to uniformly compress the gaskets and minimize flange stress.

Special precautions shall be taken in allowing for shrinkage during the welding of nozzle connections so that excessive stresses are not imposed on the equipment.

Fit-up of the flanges to equipment connections may be checked after the bolting has been installed at the request of the Construction Manager. Such bolting shall be removed and replaced and new gaskets installed if requested by the Owner.

Piping erection connections to rotating equipment shall not commence until the rotating equipment has been installed, aligned, and grouted in place. For connections to rotating equipment, piping erection shall start at equipment connections and progressively build away from the equipment connection to the farthest distance practical; this shall mean, as a minimum, that at least the first three dead weight supports going away from the connection shall be installed on the piping being erected. In addition, the piping must have two offsets or changes in direction. Pipe misalignment adjustments shall not be made within this minimum distance from the rotating equipment. Flange connections should be initially fit and

held in relative position using machine pins or other loose-fitting devices. Flange bolts shall not be installed until after final flange alignment and rough equipment alignment has been completed. Rough alignment is required to ensure that final alignment is achievable. The equipment shall be securely bolted to the structure and grouted before flanges are tightened. Travel stops on spring supports shall remain in place until piping erection is complete, insulation erection is complete, liquid filled piping (if applicable) is filled with the process fluid, and all temporary supports are removed. Travel stops shall be installed and remain in place during hydrostatic testing. If the flanged connections are to be disconnected, the travel stops shall be installed prior to draining the piping system. Pipe support turnbuckles shall be used to adjust the spring supports, as indicated in the pipe support installation instructions, to unload the travel stops prior to removal.

Final alignment checks and manufacturer representative's acceptance of connection alignment shall only be performed with all travel stops in place and all temporary supports removed. Making up of the welded joints on the steam generator, turbine generator, boiler feed pump turbines, boiler feed pumps, and similar equipment shall be performed in strict accordance with the equipment manufacturer's requirements and under the supervision of the equipment manufacturer's representative. It shall be the Contractor's responsibility to determine the manufacturer's requirements.

When welding to the exterior of coated tanks, all tank connections and the immediate tank area shall be wrapped. The wrappings shall be kept wetted. Care shall be taken to protect the tank coating during the welding operation.

After startup, if the connecting piping is found to be exerting excessive strains on the equipment, the piping shall be altered by adjusting the piping supports, cutting and rewelding joints, and removing sections of piping, all as necessary to eliminate the excessive strains.

15921.3.9.1 Equipment Connections Fit Up Tolerances. Fit up tolerances at turbines, compressors, selected pumps and other rotating equipment shall meet the following:

For connections near steam turbines and compressors, other than reciprocating types, fit up shall be within 1/64” (0.4 mm) for each direction including axial and two lateral offsets 90 degrees apart.

For connection near centrifugal pumps, reciprocating compressors and other rotating equipment, fit up shall meet the following for welded and flanged connections.

Welded Connections. Utilize the following table for alignment tolerances.

Description	**NPS ≤ 12**	**14 ≤ NPS ≤ 22**	**NPS ≥ 22**
Axial offset	1/8”	1/16”	1/64”
Lateral offset in each of two directions 90 degrees apart	1/8”	1/16”	1/64”

Flanged Connections. Utilize the following table for flange alignment tolerances.

Description	**NPS ≤ 12**	**14 ≤ NPS ≤ 22**	**NPS ≥ 22**
Vertical bolt hole offset	1/8”	1/16”	1/64”
Horizontal bolt hole offset	1/8”	1/16”	1/64”

Rotational offset	1/8”	1/16”	1/64”
Face parallelism (across dia.)	1/64”	1/64”	1/64”
Face separation plus gasket	+/- 1/8”	+/- 1/16”	+/- 1/64”

Metric equivalents for welded and flanged connections are 1/64” (0.4 mm), 1/16” (1.5 mm) and 1/8” (3mm)

15921.3.10 Making Piping Connections

15921.3.10.1 Flanged Connections. The faces of all flanges and gaskets shall be wiped clean when making up flanged joints. The contact faces of all flanges shall meet squarely, and particular care shall be exercised in pulling up flanged joints to prevent overstressing of flanges or flange bolting.

The threads of all bolting shall be coated with a suitable thread lubricant before the joint is made. The lubricant shall be suitable for the operating temperatures involved.

Flange torque values shall be determined based on the following criteria:

The manufacturer’s suggested torque values shall be followed for bolting to equipment.

Where no information on flange torque values is available, the Contractor shall determine torque values and submit them for review and acceptance.

The manufacturer’s suggested torque values shall be followed for nonmetallic flanges such as FRP. FRP flanges shall have the required torque values stamped on the flange hub.

The following defines three types of gaskets as defined in ASME VIII Division 1 Appendix 2 Mandatory Rules for Bolted Flange Connections with Ring Type Gaskets used on the majority of flanged piping systems addressed in this Specification:

Self-energized types such as o rings, elastomeric, other self-seating types such as red rubber below 75A Shore Durometer.

Low seating stress such as reinforced teflon, graphite and spiral wound with an approximate minimum design seating stress of 5000 psi or less.

Spiral-wound metallic high seating stress with an approximate minimum design seating stress of 10,000 psi.

The following may be used as a reference for torque values for flat face and raised face flanges.

PCC-1 Guidelines for Pressure Boundary Bolted Flange Joint Assembly indicates that the minimum and maximum loading requirements for bolting must be selected by the end user.

Per PCC-1, the maximum loading on bolts is typically in the range of 40% to 70% of the ambient bolt yield stress. The minimum loading on bolts is typically in the range of 20% to 40% of the ambient bolt yield stress.

The elastomeric gasket on flat face flanges should not protrude (extend) out beyond the flange after tightening. In some cases finger tight plus ¼ to ½ turn with a wrench may control in lieu of torque values.

For typical torque values, refer to Article15921.1.8 Technical Attachments.

Flanges shall use the following or similar approved criteria for bolting sequence of flanges.

Tightening method and load control techniques shall be completed with approved methods that utilize a single tool with one of the following methods; hand wrench, slug/hand wrench, impact wrench torque tools and tension tools.

The tightening sequence shall utilize an approved criteria similar to the five step increment rounds shown in Table 2 Torque Increments for Legacy Cross-Pattern Tightening Using a Single Tool and Table 4 Legacy Cross-Pattern Tightening Sequence and Bolt Numbering System When Using a Single Tool and Table 4.1 Alternative to Legacy Cross-Pattern Tightening Sequence and Bold Numbering System When Using a Single Tool found in PCC-1.

Flange fit up shall meet the following tolerances:

Holes for bolts shall be within 1/8” (3 mm)

The flange faces shall be parallel with 1/16” inch/per foot (0.5%) measured across any diameter.

Gaps shall be within 1/16” (1.5 mm) plus space for any required gaskets.

Spiral wound gaskets in gas piping shall have inner retainer rings in accordance with ASME B16.20.

Positive nut locking is required for fasteners of:
- All CL 600 and higher systems.
- Hydrocarbon systems.
- Steam systems.
- Hydrogen systems.

Acceptable positive locking includes lock tabs or plates, lock wires, jam nuts, tack welding, double nutting, and the prevailing torque type lock nuts in accordance with IFI 100/107. Tack welding is discouraged where disassembly would be required. Loctite 263 or equivalent is acceptable for non-critical applications.

Split lock washers and other washers are not considered positive locking.

15921.3.10.2 Threaded Connections. Pipe threads shall be taper pipe threads in accordance with ASME B1.20.1.

Threading shall be performed after bending or heat treatment if possible. Threads cut before bending or heat treatment shall be protected with hi-temp silicone paint.

Threads shall be clean and full cut, concentric with outside of pipe and protected against damage by any subsequent fabricating operations or handling.

Unless specified on the drawings, no thread joints shall be seal welded. When seal welds are specified, care shall be taken to assure that the threads are free of dirt, grease and thread compounds.

15921.3.11 Damage to Machined Surfaces

Special measures shall be taken to avoid damage to machined surfaces such as flange facings or pipe ends that have been prepared for welding. Any damage to welding ends shall be repaired prior to butting up for welding. If a flange facing is marred, scratched, or damaged to such an extent that, in the opinion of the Owner, the flange will be a cause for leakage, such flange shall be repaired or replaced.

When welding to equipment that is in the assembled condition, separate ground leads shall be attached to the equipment, pipes, or components to prevent stray welding currents from arcing the internals of the equipment. Wherever possible, the ground lead shall be 2/0 cable or larger directly and mechanically connected adjacent to the welding area and returned directly to the welding power source.

15921.3.12 Piping Isolation

All necessary flange isolating materials and insulated bushings, unions, and couplings shall be installed as indicated on the drawings and as required to properly isolate the piping. Bolting at insulated flanges shall consist of studs and nuts with sufficient stud length to allow at least one full stud thread protruding through each nut. Sleeves shall extend into the insulating washers. After installation, insulated flanges, bushings, unions, and couplings shall be tested to determine that the piping is properly electrically isolated to the satisfaction of the Owner.

The Contractor shall electrically isolate the designated piping from connecting piping and equipment, reinforcing steel, structural steel, the station grounding system, and other buried piping.

15921.3.12.1 Electrical Inspection. After the field coating work is complete, and just prior to backfilling, 100 percent of all shop and field coated areas shall be inspected by the Contractor using an electrical holiday detector. Holiday detector voltages shall be as follows:

Coating System	Holiday Detector Voltage Range
Shop applied coal tar, fibrous glass, felt	In accordance with the standard specified for coating
Field applied tape	In accordance with manufacturer's recommendation
Field applied shrink sleeves	In accordance with manufacturer's recommendation

Any flaws or holidays found in the coated areas shall be repaired. The pipe coating shall be retested after repair. Testing and repair shall continue until no holidays are detected.

15921.3.12.2.2 Lubrication of threaded components. Thread lubricants used for bolting of carbon and alloy steel shall not be copper based. Lubricants shall not contain lead. Lubricants for austenitic stainless steel bolting shall not contain chlorides. Lubricants shall conform to the following compounds or Owner acceptable equivalent.

Carbon steel 32 F (0 C) to 150 F (65 C)	Graphite and oil
Carbon and alloy steel up to 750 F (400 C)	Fel-Pro Moly Paste, Jet Lube 550
Alloy steel up to 1100 F (600C)	Jet Lube 550
Stainless Steel up to 1600 F (870 C)	Bostic Never Seeze Pure Nickle, Fel-Pro Nickel

Notes

1. Bostic Never Seeze Pure Nickel is acceptable for use down to minus 200 F (minus 130 C).
2. Lubricants listed above are not for use on BPV Code ASME III Nuclear Facility Components.
3. Lubricants shall not be used on any threaded components inside the Condenser.

15921.3.12.3 Not Used

15921.3.12.4 Not Used

15921.3.12.5 Leakage Tests.
The test pressure shall be maintained within a maximum variation of ±5 percent during the entire time that the line leakage measurements are being taken.

Leakage measurements shall not be started until a constant test pressure has been established. Compression of air trapped in unvented pipes or fittings will give false leakage readings under changing pressure conditions. After the test pressure to be used has been established and stabilized, the line leakage shall be measured by means of a water meter installed on the line side of the force pump.

Line leakage is defined as the total amount of water introduced into the line as measured by the meter during the leakage test. No pipeline, or tested section thereof, will be accepted if and while it has a leakage rate in excess of 50 gallons per inch of pipe diameter per mile of pipe (4.6 liters per mm of pipe diameter per kilometer of pipe) in 24 hours.

All joints in piping shall be watertight and free from visible leaks during the prescribed tests. Each leak that is discovered within 1 year after final acceptance of the work by the Owner shall be located and repaired by and at the expense of the Contractor.

If the leakage test is made after the pipeline has been backfilled and the joints have been covered, and such test shows a leakage rate in excess of the permissible maximum, the Contractor shall make all necessary surveys in connection with the location and repair of leaking joints to the extent required to reduce the total leakage to an acceptable amount.

19000 - Quality System Requirements

If the Contractor/Subcontractor believes that an inconsistency exists between this section and other portions of the contract documents, the Contractor/Subcontractor shall immediately notify Owner for resolution.

19000.1 General Quality System Requirements

19000.1.1 Quality System

The Contractor/Subcontractor shall demonstrate a documented Quality Management System (QMS) by providing supporting QMS documentation as defined in the Schedule of Submittals. The Contractor/Subcontractor's quality system shall comply with ISO 9001 Quality Management System and/or ASME, when applicable by contract scope, and the codes and standards listed throughout this document.

The Contractor/Subcontractor's QMS shall ensure that all equipment, assemblies, services, and commodities supplied are in conformance with the contract drawings and specifications.

The Contractor/Subcontractor’s QMS shall provide assurance that design, procurement, materials, installation, inspection and testing, storage, and related services comply with the requirements of the contract documents. The Contractor/Subcontractor’s QMS shall have a defined process for reporting, segregation, evaluation, disposition, and closure of nonconforming product/installation. This QMS shall be available to the Owner for review and/or audit where work is being performed subject to these contract documents.

19000.1.2 Subtier Suppliers

The Contractor/Subcontractor shall obtain the Owner's approval in writing prior to using subtier suppliers for manufacturing, installation/erection or engineering activities.

All applicable requirements of the contract documents (i.e., technical, quality, and administrative) shall be passed on to the applicable organizations within the Contractor/Subcontractor and subtier supplier's companies. The Contractor/Subcontractor shall ensure that subtier suppliers have the capabilities to fulfill contract document requirements. Contractor/Subcontractors shall monitor subtier suppliers’ quality of work and shall indicate the strategy on their inspection and test plan.

Contractor/Subcontractors shall submit required procedures, drawings, quality management documentation, and/or other submittals when required in the Schedule of Submittals for approval and/or information of subtier supplier's capabilities, processes, or in-process work involving the engineering, fabricating, installation, and manufacturing of equipment and commodities for the Owner.

Subtier supplier qualification and monitoring are the responsibility of the Contractor/Subcontractor. Owner has the authority to perform quality audits and inspections and monitor and/or review subtier supplier processes and facilities, at all locations where work is being performed subject to these contract documents.

19000.1.3 Inspection and Test Plan

In accordance with the Schedule of Submittals, a detailed inspection and test plan (i.e., a Quality Control Plan, including construction inspection and test plans) for the work shall be submitted to the Owner as specified in the contract documents prior to starting site installation/erection or commissioning activities as applicable by scope. The Owner will designate any additional test witness points or other inspection points required during review of the Contractor/Subcontractor’s submitted detailed inspection and test plan.

The inspection and test plan (ITP) shall identify the inspection and testing points and include the contract specifications, codes, required documentation, acceptance criteria for major components of the work, relevant procedures, and the location and target date for each inspection or test. The ITP shall be complete when first submitted and shall be maintained current throughout the life of the contract. When the ITP is revised, the Contractor/Subcontractor shall submit a revised ITP for review. The ITP shall also include the Contractor/Subcontractor's strategy for inspecting subtier Contractor/Subcontractor's work, including inspection by the Contractor/Subcontractor.

The Contractor/Subcontractor shall inspect the work of subtier Contractor/Subcontractors to the extent necessary to ensure that proper materials are furnished, and assembly and erection are accomplished in accordance with the contract documents.

The Contractor/Subcontractor shall keep the Owner informed of the progress of the work. When inspection and test points have been designated by the Owner as witness, in-process, and/or hold points, the Contractor/Subcontractor shall notify the Owner at least 14 days in advance of the appropriate times for inspections and testing.

A pre-fabrication inspection is a point prior to fabrication and inspection activities where the Owner will meet with the Contractor/Subcontractor at the primary location of fabrication to review fabrication and inspection related activities that will take place. Discussion typically include, but are not limited to; materials, codes, standards, sub-suppliers, welding processes, test facilities and methods, and shop loading. Inspection target is approximately 2 weeks prior to the start of fabrication.

A witness inspection point (if API – Observe) is a step in the installation where the Contractor/Subcontractor is obligated to notify the Owner in advance of the performed operation so that it may be witnessed unless specified otherwise in the Schedule of Submittals. If the Contractor/Subcontractor properly notified the Owner but the Owner was not present at the time and date specified by the Contractor/Subcontractor, the Contractor/Subcontractor may proceed.

A hold inspection point (if API – Witness) is a designated stopping place during or following a specific activity at which the Owner's inspection or witness is required before further work can be performed. The Contractor/Subcontractor may not proceed beyond the hold point without inspection or witness by the Owner, unless prior written authorization is obtained from the Owner.

An in-process inspection point (If API – Observe) is a Owner inspection that occurs during the manufacture/installation process. If the Owner is not present at the time and date specified by the Contractor/Subcontractor, the Contractor/Subcontractor may proceed.

A preshipment inspection point is a Owner inspection that may include a check of shipping blinds, packaging, loading and/or verification of purges, dimensional check, coatings protection and/or document review (shop quality, shipping documents). Preshipment inspections can be witness or hold points.

A final inspection point is a Owner inspection that may include dimensional check, weld end preps, cleanliness, coatings/coatings protection, and/or shop quality document review. Final inspections can be witness or hold points.

The Owner may waive the witness of tests; waivers for hold points shall be in writing. Waivers in no way absolve or relieve the Contractor/Subcontractor of complying with contractual requirements.

If the Contractor/Subcontractor has notified the Owner defining the specific test date and time and the Contractor/Subcontractor is not ready to conduct the test at the stated date and time, the Contractor/Subcontractor shall be accountable for all additional expenses incurred by the Owner.

The Owner may waive the witness of tests; waivers for hold points shall be in writing. Waivers in no way absolve or relieve the Contractor/Subcontractor of complying with contractual requirements.

The Owner may make additions and deletions of surveillance activities based on, but not limited to, the following:

Contractor/Subcontractor ITP.

Contractor/Subcontractor performance.

Owner requests.

19000.1.4 Inspections by Owner

The Owner may elect to perform assessments, quality audits, or perform inspections at any time during the installation process. The Owner may designate an authorized agent for assessments, witness testing, or quality audits. Authorized agent may be an employee of the Owner or an outside agency. When an outside agency is designated as an authorized agent for the Owner, such designation will be in writing with a copy provided to the Contractor/Subcontractor. When the term "Owner's representative" is used, it may mean the Owner or the authorized agent.

The following requirements shall apply for Owner's inspection at the Contractor/Subcontractor's point of installation, yard, warehouse, or subtier Contractor/Subcontractor's work.

19000.1.4.1 Access. The Owner's representative shall have the right to access the Contractor/Subcontractor's and subtier Contractor/Subcontractor's work and related documents during the installation/erection process without delaying the schedule. The Contractor/Subcontractor shall provide, without cost, reasonable access for personnel, and instruments for demonstrating acceptability of the work.

19000.1.4.2 Surveillance Activities. In accordance with the contract documents, designated hold points for witnessing tests shall be performed in the presence of the Owner's representative unless waived in writing by the Owner's representative. The Contractor/Subcontractor shall bear all costs for such tests, except the compensation and expense of the Owner's representative.

19000.1.4.3 Control of Special Processes. It is the Contractor/Subcontractor's responsibility to ensure that qualified personnel are employed to perform special processes such as welding, nondestructive examination (NDE), coating, painting, etc. If special processes are conducted by unqualified employees, the Owner has the right to validate and test the work at Contractor/Subcontractor's expense and/or reject the work. The Contractor/Subcontractor shall be able to demonstrate the qualifications of personnel in writing.

19000.1.4.4 Nonconformance. Upon identification of a noncompliance of the contract documents and/or applicable codes, the Contractor/Subcontractor shall document the noncompliant issue in accordance to Contractor/Subcontractor's nonconformance procedure. For noncompliance issues where the nonconforming disposition is characterized as "Use-As-Is" or "Repair" as defined in Article 19000.1.4.4.1, the Contractor/Subcontractor shall submit the nonconformance report to the Owner for review and approval. During witness and hold point activities, if the Owner's representative identifies a noncompliance issue, the Contractor/Subcontractor shall document the noncompliance issue and provide a copy of the documentation to the Owner's representative. If the Contractor/Subcontractor disagrees and does not document the noncompliance, the Owner's representative shall issue a nonconformance report to the Contractor/Subcontractor for disposition and action. The Contractor/Subcontractor shall correct, in a timely manner, all deficiencies identified in the nonconformance report.

19000.1.4.4.1 Nonconformance disposition definitions.

Rework - Process by which a nonconforming item is made to conform to a prior specified requirement by completion, correction, reassembling, or other means.

Repair - Process of restoring a nonconforming item to such a condition that the capability of an item to function reliably and safely is unimpaired, even though that item still may not conform to the original requirement.

Use As Is - A disposition which may be used for a nonconforming item when it can be established that the discrepancy will not adversely affect the functional requirements of its intended use (including performance, maintainability, fit, and safety).

Reject/Scrap - Action taken to eliminate a nonconforming item from its specified use and either reject the item or have it scrapped, as appropriate.

19000.1.4.5 Receipt Inspection. Materials or equipment purchased under these contract documents may be inspected at the specified receiving points and will either be accepted or rejected. Receipt inspection may include preservation, maintenance and testing to determine compliance with the contract documents. Initial receipt inspection acceptance tests will be performed by the Contractor/Subcontractor at the Contractor/Subcontractor expense. Items found to be defective may be returned to the Contractor/Subcontractor for correction at the Contractor/Subcontractor's expense, including shipping cost, or the cost to correct and inspect the item will be charged to the Contractor/Subcontractor.

19000.1.4.6 Deviation. Any technical deviations sought by the Contractor/Subcontractor to the contract documents shall require written approval from Owner prior to the deviation or change being implemented.

19000.1.4.7 Repair. The Contractor/Subcontractor shall submit a repair procedure to Owner for all repairs as determined by contract, code, or repair dispositions definition in Article 19000.1.4.4.1. The Contractor/Subcontractor shall obtain Owner approval of the repair procedure prior to starting the repair.

19000.1.5 Code and Non-Code Inspection

19000.1.5.1 Code Inspection. Code inspection includes functions performed by an authorized inspector, his delegates, government agencies, or other independent third-party inspectors to verify compliance with the applicable codes, government regulations and, when specified, the engineering design.

19000.1.5.1.1 Determination of code requirements. All equipment or materials purchased or specified in accordance with a code or government regulation shall be inspected as required by that code or regulation.

The codes, laws, or regulations of record applicable to a project, together with any additional requirements, shall be those referenced in the Project Design Data.

19000.1.5.1.2 Personnel qualifications. Inspections and examinations required by all codes, laws, or government regulations applicable to the project shall be made by inspectors and other personnel who are officially qualified in accordance with those applicable codes, laws, or government regulations.

Welders, nondestructive examination personnel, and other construction specialists required to be tested or certified by the applicable code, law or government regulation shall be verified as having satisfied these requirements.

In no case shall the Owner inspector or inspection representative be construed as the authorized code or independent third-party inspector.

19000.1.5.2 Non-Code Inspection. Non-code inspection includes functions performed by Owner or its authorized agent to:

- Review, monitor, and conduct surveillance of the Owner Quality Control Program and its implementation.
- Perform quality control functions required by Owner standards or specifications that are in addition to code requirements.

The inspection of a Contractor/Subcontractor by Owner or its inspection representative may include, but is not limited to, the complete or partial performance of the following:

1. Verification of the use of qualified welders and qualified welding procedures.

2. Checks on materials, dimensions, and finishes.

3. Review/audit of nondestructive examinations, including alloy verification if required, including ensuring that personnel are qualified to perform these examinations.

4. Witnessing of pressure tests and equipment mechanical and performance tests.

5. Review of documentation.

6. Audit of the Contractors'/Subcontractors' quality control program, including document control and disposition of nonconforming work. Audits shall take place at the point of fabrication.

The extent of inspection to be performed on materials and equipment supplied by each Contractor/Subcontractor shall be determined by considering the Contractor's/Subcontractor's quality control program and previous experience of Owner with the Contractor/Subcontractor.

Owner or a designated representative of Owner may perform inspections in addition to or exceeding code requirements in order to meet quality standards specified by Owner or the Client.

All materials, packaging, equipment, and fabrication items may be subject to non-code inspection during all stages of fabrication, testing, transportation, storage, and erection.

19000.1.5.3 Owner Participation. If applicable, the Owner's inspector shall be given full access to the work. The Owner inspector shall act as the official spokesman in all discussions with the Contractor. Contractor shall refer any conflict between the specification requirements and the Client inspector's requirements to Owner for resolution.

In the event the Contractor inspector is not present when the Owner's inspector encounters an unacceptable condition which may cause a delay in shipment, the Owner's inspector shall immediately send complete information regarding the condition, proposed corrective measures, and estimated delay through the established channels to Contractor for Contractor action.

19000.1.5.4 Code or Third-Party Inspection. Unless the governing code or authority requires the Owner to assume the responsibility for the authorized code inspection, the Owner shall make the necessary arrangement with the Contractor/Subcontractor for all required code or third-party inspections, and shall collect the Authorized Inspectors Reports and the Manufacturer's Data Reports.

19000.1.5.5 General Inspection Requirements.

19000.1.5.6 Items Subject to Inspection. The individual equipment specifications, data sheets and attachments shall define the items subject to inspection, as well as the level of inspection required to ensure adequacy of the Contractor's/Subcontractor's product quality. The items to be inspected as part of a non-code inspection program will also be identified. All materials and equipment requiring alloy

verification are subject to inspection. When the Owner has more stringent inspection requirements than the Contractor, items shall be inspected according to Owner requirements (when contractually specified between Owner and the Contractor).

21000 - Technical Supplemental Specifications

This section contains technical supplemental specifications that provide additional requirements applicable to the work covered under the technical sections.

21000.1 Summary of Applicable Supplementals

The technical supplementals applicable to each technical section are indicated below.

	Technical Section Number	Technical Section Name	Applicable Technical Supplementals
2	15921	Piping Erection	K100, K102, M210, Q100, Q101, Q110, Q210
4	19000	Quality System Requirements	Q100, Q101, Q110, Q210

21000.2 Technical Supplemental Specifications

The technical supplemental specifications follow.

Q100 General Welding Requirements

Unless otherwise specified, the applicable governing edition and addenda to be used for all references to codes or standards specified herein shall be interpreted to be the jurisdictionally approved edition and addenda. If a code or standard is not jurisdictionally mandated, then the current edition and addenda in effect at the time of (contract or specification) approval shall govern.

Q100.1 General

Section Q100 shall be used in conjunction with any other Welding Technical Supplemental Specification section(s) when referenced by other supplementals.

Any conflict identified between the requirements of this Welding Technical Supplemental Specification and the provisions of any applicable industry standard, code, regulation, or any specification, standard, or purchasing document contractually required for a given application shall be referred to Owner for resolution prior to the start of welding.

Where requirements of a referenced code or standard differ from the Welding Technical Supplemental Specification sections, the more stringent or restrictive requirements shall apply.

Any request for deviation from specified requirements shall be submitted in writing and shall include the proposed deviation, rationale for the deviation, any technical data supporting the deviation, and historical experience supporting the deviation.

Q100.2 Welding Processes

Unless otherwise specified, only shielded metal arc welding (SMAW), gas metal arc welding (GMAW), flux cored arc welding (FCAW), submerged arc welding (SAW), plasma arc welding (PAW), stud welding, and gas tungsten arc welding (GTAW) processes shall be permitted within the restrictions or limitations specified in the applicable Welding Technical Supplemental Specification section. Other welding processes may be used, provided the governing code or standard permits it and written approval has been granted by Owner.

Any limitation or restriction specified for GMAW short-circuit arc transfer or a variation of controlled wave-form GMAW short-circuit arc transfer marketed by welding equipment manufacturers such as Miller Electric's RMD and Lincoln Electric's STT process shall be applied the same, whether a constant voltage (CV) power supply or other power supply developed by a welding equipment manufacturer is used.

Q100.3 Welding Procedure Qualification

Welding procedures shall be prepared and qualified in accordance with the referenced code.

Because of the number of different filler metal types and alloys within various alloy P-number groups, WPSs for welding P-Nos. 8, 10H, and 41 - 49 shall identify the required filler metal classification (s) vs the actual base material type(s) to be welded in production to ensure appropriate filler metal selection, e.g., E/ER316 for P-Nos. 8 (Type 316); E/ER308L for P-Nos. 8 Type 304L, etc. Alternatively, filler metal and base metal types may be cross-referenced to the WPS by other means, e.g., a weld map (or a separate listing of WPS and filler metal and base material grades, addendum to the WPS, etc.

Standard Welding Procedure Specifications (SWPSs) produced by the American Welding Society (AWS) may be used when permitted by the jurisdictional code. Any supplemental requirements mandated by the jurisdictional code shall be met.

Q100.3.1 Welding Procedure Submittals

WPSs and applicable Procedure Qualification Records (PQRs) shall be submitted for Owner's review prior to use. This requirement shall apply for shop-fabricated components and field-welded components.

The submittal shall also include a weld map or tabulated listing of WPSs to be used. The weld map/list shall indicate the applicable code(s) of construction, production base material types and grades, thickness ranges, any PWHT requirements, the MDMT, and any requirements for Charpy Impact testing. A map with joint ID with sketch shall be provided for ASME pressure vessels and heat exchangers.

Q100.4 Welder/Welding Operator Performance Qualification

Welders and welding operators shall be qualified in accordance with the referenced code. The welder and welding operator qualification records shall be available at the shop facility or construction site and shall be made available for review when requested.

Field personnel not qualified and certified as welders or welding operators are prohibited from performing any welding activities such as tack welds, temporary welds, permanent welds, manufacturing aids, tools, fixtures, or other welded items. The only field personnel not qualified or certified as welders or welding operators who are permitted to perform welding are personnel completing welding training or performing welding performance qualification testing required by the applicable referenced code or specification.

Shop personnel not qualified and certified as welders or welding operators are prohibited from performing any welding activity on materials designated for permanent or temporary installation, such as tack welds or temporary welds.

Q100.5 Filler Materials

Welding filler metal shall comply with the requirements of the referenced code and any modified requirements specified herein. The filler metal shall be as specified in the applicable WPS.

Unless otherwise specified, the welding filler metal for welding similar base metal types shall have a chemical composition as similar as possible to the base materials to be welded. The finished weld as deposited, or after postweld heat treatment (PWHT) when required, shall be at least equal to the base metal's minimum specified properties or characteristics as they pertain to strength, ductility, notch toughness, corrosion-erosion resistance, or other physical or thermal properties.

Unless otherwise approved in writing, the GTAW or PAW process shall require the addition of filler metal.

Unless otherwise specified or permitted by an approved deviation request, the use of the nonstandard international classifications or nonstandard AWS-G electrode/wire classification is prohibited (comment: welding consumables produced under standard compositions and the requirements specified by national or international filler metal standards are considered acceptable). When permitted, welding procedures

specifying nonstandard classifications or AWS-G classification consumables shall be restricted to the same manufacturer and brand-name consumable used to weld the procedure qualification test coupon. The manufacturer and brand name shall be listed on the WPS and PQR. The manufacturer's standard, including the mechanical properties and chemical analysis, along with the request for using nonstandard classifications (e.g., "G" classification consumables) shall be submitted to Owner prior to fabrication.

SAW multipass weld deposits shall use an essentially neutral flux for welding carbon steels. Alloy, semiactive, or active fluxes shall not be used except as specified otherwise. Fluxes that compensate for losses of alloying elements are permitted. Active flux may be used for single pass welding of carbon steels, provided the weld deposit thickness is approximately 1/4 inch (6 mm) maximum each side for a double-V-groove joint design or approximately 1/4 inch (6 mm) one side for a single-V-groove joint design. The joint thickness shall not exceed 1/2 inch (13 mm) nominal.

When using the SAW process, the flux listed in the WPS is restricted to the specific brand-name flux used in the welding procedure qualification test. Any change in the flux brand name or designation shall require a new welding procedure qualification. For SAW welding of stainless or nickel-base alloy materials, only those fluxes specified by the flux manufacturer as suitable for the particular type of high alloy electrode to be used are permitted.

The SAW process shall not use recrushed slag.

SMAW low-hydrogen type electrodes, including stainless steel and nickel and nickel alloy electrodes, shall be purchased in hermetically sealed or vacuum packed containers only.

Q100.5.1 Filler Material Selection
Unless otherwise specified, filler material selection shall be in accordance with the following requirements.

Q100.5.1.1 Filler Materials for Steels and Low Alloy Steels. For the SMAW process, all filler metal shall be of the low-hydrogen type when welding on either carbon steel or low alloy steel materials. Nonlow-hydrogen type electrodes (E6010/E6011 or E7010-A1 only) may be used only for root pass welding on carbon steel piping, unless otherwise specified by other Welding Technical Supplemental Specification sections. SMAW low-hydrogen type ferrous electrodes for all fill passes shall have a minimum tensile strength of 70,000 psi (495 MPa) as defined by the applicable SFA or AWS specification.

For the FCAW process when welding carbon steel materials, only AWS filler metal Classifications E7XT-1, -5, -9, -12 with shielding gas shall be used (current AWS classifications also utilize either an "M" or "C" after the final digit).

Low alloy FCAW electrodes of nominal composition 2-1/4 Cr - 1 Mo and higher for use on pressure-retaining components shall be purchased with a diffusible hydrogen designation of H4 maximum (SFA-5.29) unless otherwise specified.

The low carbon (-B2L, -B3L, -B6L, and -B8L), low alloy filler metal classifications are prohibited for welding 1-1/4 Cr - 1/2 Mo, 2-1/4 Cr - 1 Mo, 5 Cr-Mo, and 9 Cr-Mo alloy materials. The filler metal for welding these materials shall have a carbon content greater than 0.05 percent. Previously classified low alloy filler metal Classifications ER502, E502-XX, ER505, and E505-XX are not permitted for welding low alloy base materials.

Q100.5.1.2 Filler Material Requirements vs Base Material Types(s).

Carbon Steel or Low Alloy Steel-to-Austenitic Stainless Steels			
Service ≤500° F (260° C)		Service >500° F (260° C)	
ASME	**AWS Classification**	**ASME**	**AWS Classification**
SFA 5.9 or SFA 5.14	ER309 or ER309L ERNiCr-3	SFA 5.14	ERNiCr-3
SFA 5.4 or SFA 5.11	E309 or E309L ENiCrFe-3 or ENiCrFe-2	SFA 5.11	ENiCrFe-3 or ENiCrFe-2
SFA 5.22	E309TX-X or E309LTX-X	N/A	N/A

Where carbon steel or low alloy steel piping is to be welded to austenitic stainless steel components, and the carbon or low alloy steel piping is of such a thickness as to require PWHT, the end of the carbon or low alloy steel pipe shall be buttered with Type 309L, ERNiCr-3, or ENiCrFe-3 filler metal for system service <500° F (260° C) and shall be buttered with Type ERNiCr-3 or ENiCrFe-3 filler metal for system service >500° F (260° C); the buttered end shall be postweld heat treated. The buttering thickness shall be 3/16 inch (5 mm) minimum after final surface preparation. The weld joint shall then be made between the austenitic stainless steel and the buttering on the carbon or low alloy steel as applicable. This joining method is applicable only to groove welds unless written approval has been granted by Owner.

Alloy AL6XN, UNS N08367-to-Carbon Steel	
ASME Specification	**AWS Classification**
SFA 5.14	ERNiCrMo-3 or ERNiCr-3
SFA 5.11	ENiCrMo-3 or ENiCrFe-3

Carbon Steel-to-Nickel-Base Alloys	
ASME Specification	**AWS Classification**
SFA 5.14	ERNiCr-3
SFA 5.11	ENiCrFe-3

Alloy AL6XN, UNS N08367	
ASME Specification	**AWS Classification**
SFA 5.14	ERNiCrMo-3
SFA 5.11	ENiCrMo-3

Alloy 20, UNS N08020	
ASME Specification	**AWS Classification**
SFA 5.9	ER320LR
SFA 5.4	E320LR

Q100.5.1.3 Filler Material for Welding 300 Series Stainless Steels.

ASME P-No. 8 Base Material Type	Filler*
304	308
304L	308L
316	316
316L	316L
321, 347	347
Austenitic H-grade (0.040 wt. percent min. carbon)	0.040 wt. percent min. carbon

*This selection requirement may not necessarily apply to cryogenic applications.

Q100.5.1.4 Filler Material Requirements for 300 Series SSs for High Temp Service. When using Type 308, 316, 317, 321, and 347 filler metals for design temperature applications above 1000° F (538° C), the deposited carbon content shall be 0.040 percent minimum.

For base metal grades 304H, 316H, 321H, 347H, filler metal classification E/ER 16-8-2 may be used for all system design temperatures and base material thicknesses. E/ER 16-8-2 should be used when the system design temperature exceeds 1,000° F (538° C) when base material thickness exceeds 1/2 inch (12 mm).

When FCAW austenitic stainless steel weld deposits require PWHT or are used at service temperatures >1,000° F (538° C), the electrodes shall have a formulation that does not intentionally add bismuth, and bismuth in the deposited weld metal shall not exceed 0.002 weight percent.

Filler metals for austenitic 300 series weld deposits for service temperatures >1000° F (538° C) shall not exceed 10 FN (ferrite number).

Q100.5.2 Filler Material Control
Storage, handling, and drying of SMAW electrodes and SAW flux shall, as a minimum, be in accordance with the manufacturers' recommendations. In addition, SMAW low-hydrogen type carbon and low alloy steel electrodes shall be stored in ovens at 250° F (120° C) minimum after the hermetically sealed or vacuum packed container is opened. Bare rod in straight lengths shall be individually flag tagged, stamped, or otherwise identified with the AWS classification or product classification. Each spool of solid or cored rod shall be tagged, labeled, or otherwise identified with the AWS classification or product classification. SMAW low-hydrogen type covered electrodes shall only be reconditioned one time. Any SMAW electrodes that have been wet or have damaged coatings shall not be used. Any welding filler metals or fluxes not readily identifiable shall not be used.

SAW fluxes for welding low alloy chromium-molybdenum steels (2-1/4 Cr - 1 Mo) and higher nominal weld deposit composition shall be baked prior to use. This requirement does not apply for fluxes used within the same work shift after removal from a hermetically sealed package or container. Flux that is exposed to an atmospheric exposure limit exceeding one work shift shall be baked prior to use, unless the flux is placed in a heated container within 10 hours of issuance. After baking, fluxes should be stored in hermetically sealed containers or (preferably) stored in a heated container until issuance. Storage in a heated container or baking shall be in accordance with the flux manufacturer's directions.

A written procedure for storing, handling, issuing, and reconditioning electrodes, wires, and fluxes shall be available for review by Owner’s inspector if requested.

Q100.6 Fabrication Controls

Q100.6.1 Welding Preheat and Interpass Temperature

The preheat and interpass temperature requirements are mandatory values and shall be in accordance with the referenced code and as specified herein. The WPS for the material being welded shall specify the minimum preheat and maximum interpass temperature requirements. The thickness used to determine preheat requirements shall be the thickness of the thickest part at the point of welding.

The minimum preheat temperature shall be obtained prior to any welding. This shall include tack welding or temporary tack welding.

Preheating shall provide uniform heating over the complete weld or thermal removal process area.

Preheat and interpass temperatures shall be monitored and checked by temperature indicating crayons, thermocouples (TCs), surface contact pyrometers or thermometers, or other suitable methods.

When electric resistance heating pads or induction heating are used for preheating, a thermocouple is required underneath the pads/coil wraps for each control zone in the region of the highest expected temperature to ensure the base material is not overheated.

The minimum preheat temperature shall be the greater of that required by the code of fabrication or as otherwise specified in the applicable Welding Technical Supplemental Specification sections(s).

The maximum interpass temperature for welding carbon steel and low alloy steel materials shall be 600° F (315° C). The maximum interpass temperature for welding carbon steel when impact testing is required shall be 500° F (260° C).

The maximum preheat and interpass temperature for stainless steel, nickel alloy, copper alloy, and titanium alloy materials shall be 350° F (175° C). The minimum preheat temperature shall be sufficient to ensure that moisture is removed from the material to be welded.

Q100.6.2 Postweld Heat Treatment (PWHT)

PWHT shall be performed in accordance with the referenced code and any modified requirements specified herein.

Postweld heat treating may be accomplished by the electric resistance heating, induction, or furnace heating method. Other methods of PWHT shall require review and approval of Owner. Heating in a furnace should be used when practical.

Induction PWHT when used shall be limited to P-No. 5A and lower materials and shall be limited to NPS 14 (DN 350) and smaller pipe size and 0.875 inch (22.3 mm) maximum wall thickness.

The heating method shall provide the desired heating and cooling rates, the required metal temperature, temperature uniformity, and temperature control. Flame impingement during furnace PWHT is prohibited. Direct flame heating shall not be used for PWHT.

When PWHT is performed in a furnace, sufficient TCs shall be properly attached directly to the materials in various representative locations, such as the expected region and material thickness for the highest temperature and the expected region and material thickness for the coolest temperature, to accurately indicate the metal temperature uniformity throughout the heat treating cycle.

For ASME P-Nos. 1, 3, 4, 5A, and 5B, the controlling setpoint temperature shall be set at 50° F (25° C) above the minimum specified by the code of reference, except when Charpy impacts are applicable.

When PWHT is required for parts of two different materials or different ASME P-numbers, special precautions shall be considered to ensure that the temperature does not exceed the lower critical temperature of either of the materials being postweld heat treated. Depending on the materials, this range may be substantially restricted. Review of the applicable construction code or design specification requirements must be performed.

PWHT temperature recording devices shall be calibrated in accordance with the manufacturer's standard or other suitable standard to ensure the accuracy of the recorded temperatures.

TCs and TC wire shall be Type K chromel/alumel.

TC wire shall be temporarily attached directly to materials by using the capacitor discharge method of welding. The capacitor discharge method of welding shall be performed in accordance with the referenced code, as applicable.

The time at PWHT holding temperature shall be measured from the time the last control TC reading the lowest temperature reaches the minimum designated holding temperature setpoint within the specified tolerance.

A time-temperature recording chart/record traceable to the item being postweld heat treated shall be made for all PWHTs and shall be made available to Owner when requested.

Detailed PWHT procedures shall be submitted for review by Owner.

The PWHT procedure shall address the specific PWHT requirements specified herein and any other Welding Technical Supplemental Specification requirements and provide details to accomplish the code required PWHT, including weld joint traceability documentation, heating and cooling rates, holding times, holding temperatures, minimum size of heated zones, precautions to preclude damage, attachment locations of TCs, welding specifications for attaching welding TC wire using the capacitor discharge method (when used), weld joint insulation, defined nominal or control thickness, and recorder calibration.

Procedures for induction PWHT shall additionally include detailed coiling instructions including insulation, the type and size of coil, number of coil wraps per pipe size and schedule, the minimum and maximum spacing between individual coil wraps, the minimum width of insulation on the pipe vs pipe size and schedule, the maximum gap between the coil and the insulating pad and the pad and pipe, and biasing of wraps for dissimilar thickness butt joints (and additional thermocouple attachment locations for dissimilar thickness butt joints). Coil wraps for induction PWHT shall extend at least 1 x SB width beyond each edge of the minimum code-required soak band (SB) width. The procedure shall define the necessary dimension so that the required PWHT temperature is fully achieved within the code-required soak band

Q100.6.2.1 Local PWHT Requirements. When using electric resistance heating for performing local preheat, intermediate heat treatment (e.g., Hydrogen bakeout/Postheating) and PWHT activities the following hierarchy of requirements versus code and code edition shall apply:

ASME Code	Code Edition (3)	Base material P-No. P-No. 15E	Base material P-Nos. 1, 3, 4, 5A, 5B, 6
Sect. I	2015 and earlier	4, 5	4, 5
	2017 and later	2, 5	
B31.1	All	4, 5	
Other Codes	All	4, 5	
Notes:			

1. AWS D10.10, Recommended Practices for Local Heating of Welds in Piping and Tubing. Latest edition.
2. ASME Sect. I -2017 and -2019 Editions, “Nonmandatory Appendix C” (NMA-C):
   In 2021: Reidentified as “Mandatory Appendix VIII” (MA-VIII)
   “*Local Heating of Welds in Cylindrical Components of P-No. 15E Materials When Using Electric Resistance Heating*”
   For P-No. 15E materials the requirements of NMA-C / MA-VIII shall be considered mandatory.
3. The contractually required code edition for the project.
4. Requirements as defined herein shall apply. Alternatively, the requirements defined in Notes (1) or (2) may be applied.
5. When standards such as D10.10 or NMA-C or MA-VIII are used, the more restrictive requirements of those standards and as specified herein shall apply.

TCs shall be properly attached directly to the weld and/or adjacent material to record the required weld and soak band (SB) temperature. For complete penetration welds, TCs should be located on the weld at the approximate weld center line.

The width of the band required by code to be heat treated to the PWHT temperature includes the weld and adjacent base material regions and is identified herein as the SB. The minimum SB dimension is specified in the applicable code of construction (e.g., ASME B31.1, B31.3, ASME Section I, etc.).

The SB consists of the through thickness volume of metal, which is heated to the minimum but does not exceed the maximum required PWHT temperature. As a minimum, it consists of the weld metal, heat affected zone (HAZ), and a portion of the base metal adjacent to the weld being heated. The dimensions of the SB shall be as required by the applicable construction code.

Guidance for the placement of TCs on circumferential butt welds and other type welds is provided in AWS D10.10, "Recommended Practices for Local Heating of Welds in Piping and Tubing." Special consideration shall be given to the placement of TCs when heating welds adjacent to large heat sinks such as valves, flanges, special fittings, or when joining parts of differing thicknesses, to ensure that no part of the materials subject to the heat source exceeds the lower critical temperature of the material.

Q100.6.2.1.1 Minimum heated band width requirements. Since the construction codes typically do not define the terms "control zone," "heated band," and "gradient control band," the latest edition of AWS D10.10 and the requirements specified herein shall be used to determine the minimum heated band (HB) width and the gradient control (insulation) band (GCB) width critical for achieving the required temperature through the weld SB thickness within the SB region. When the dimensions for the AWS D10.10 HB or GCB cannot be achieved because of configuration, space limitations, component manufacturer restrictions, field conditions, or other valid limitations, the documentation package shall provide an explanation for the deviation.

Q100.6.2.1.2 Thermocouple placement requirements. For each local PWHT weld joint, a sketch that shows the TC attachment location(s), SB width, HB width, GCB width, and heating pad sizes (or coil wrapping for induction heating method) and locations, and a heat treatment time-temperature record or chart recording all TC data is required in the documentation package and shall be provided to Owner when requested. The local PWHT equipment shall be capable of providing temperature data log sheets denoting the time and temperature of all TCs at any given time during the PWHT and shall be provided when requested by Owner. All the required information shall be traceable to the PWHT weld joint.

For electric resistance heating, the minimum number of control zones and control thermocouples (CTCs) required for performing a local PWHT shall be in accordance with the following table. A control zone consists of a grouping of one or more heating pads that are controlled (turned off and on) based upon input from a single CTC. One or more control zones may be present in the circumferential and/or axial

directions. Monitoring TCs should also be used as required to confirm temperature uniformity throughout the heat treating cycle as follows.

For induction heating the same number of thermocouples are required as for PWHT by electric resistance heating. Additionally, for thickness exceeding 0.62 inch (15 mm), thermocouples are required at each edge of the soak band.

	Electric Resistance, Minimum Number of Thermocouples and Control Zones (Note 1)		
Pipe Size NPS (DN)	**Control Zones and CTCs On-Weld** (Notes 1 and 2)	**Additional TCs for Each Control**	**Additional TC Locations**
≤6 (150)	One (1) CTC at 12:00	One (1) at 180° opposite the CTC	Note 3
8 - 12 (200 - 300)	Two (2) CTCs at 12:00 and 6:00	None required	
14 -18 (350 - 450)	Three (3) CTCs at 11:00, 1:00, and 6:00	None required	
20 - 30 (500 - 750)	Four (4) CTCs at 12:00, 3:00, 6:00, and 9:00	None required	
>30 (750)	Number of control zones and CTCs as required by the size and spacing of heaters. A minimum of five control zones and five CTCs shall be used.		
For all dissimilar thickness weld joints (Note 4) and all similar thickness weld joints exceeding 2 inches		One monitoring TC for each control heating zone at each outer edge of SB.	

Notes:

1. The control zone references refer to the circumferential direction for any pipe orientation. The indicated CTC clock positions are for pipe oriented in the horizontal position. Additionally, multiple control zones in the pipe's axial direction may be needed, especially for PWHT of joints with thick and thin sections and with increasing pipe diameters.
2. One CTC is required for each control zone. The CTCs designated for "On-Weld" are primarily for complete penetration welds such as butt joints and branch connections. TCs shall be attached at the approximate weld center line for all complete penetration welds. TCs shall be attached adjacent to the weld toe for welds other than complete penetration welds.
3. At least one TC per coil or band of electric resistance heating pads shall be attached under the anticipated highest temperature location. These requirements may require additional TCs than are required by Note 2 to ensure that the materials are not overheated.
4. Dissimilar thickness is defined as when the base material thickness varies by more than 3/8 inch (10 mm) or more than 30 percent** across the SB width. Refer to the following:

   **Thickness variation = $[(T_{tk} - T_{tn}) / (T_{tn})] \times 100$

   where

   T_{tk} = Base material thickness on the thick side of the weld joint at the outer edges of the SB.
   T_{tn} = Base material thickness on the thin side of the weld joint at the outer edges of the SB.

Overlap of electrical resistance heating pads is prohibited. Overlap of heaters controlled by separate TCs is prohibited.

For local PWHT, when the internal surface is accessible for monitoring temperature, the minimum PWHT temperature required is the minimum required by Code.

For local PWHT for ASME P-Nos. 1, 3, 4, 5A, and 5B, for weld joint thickness exceeding 3 inches (75 mm), the minimum controlling setpoint temperature shall be at least 75° F (40° C) above the code minimum temperature.

Q100.6.3 Fabrication Controls for Stainless Steels or Nickel-Base Alloys

The following requirements shall apply when fabricating austenitic stainless, super austenitic stainless, or nickel-base alloy components.

Base materials for new construction are normally supplied with a pickled mill surface (without dark oxides). Except for the localized removal of heat tint, mechanical cleaning of uniform, mill-supplied pickled base material surfaces is not permitted without prior written approval of Owner. Mechanical preparation of weld joints should be limited only to the faces of the joint.

Antispatter compounds, marking fluids, marking pens, tape, temperature indicating crayons, and other tools shall have a total halogen content of less than 200 parts per million.

Austenitic stainless steel instrument tubing shall be welded using only the GTAW process.

Socket welds or butt welds in all austenitic stainless steel instrument tubing lines shall require an inert gas backing (purge) using argon during welding to avoid oxidation.

When service conditions require that austenitic stainless steel material maintain its corrosion resistance, the austenitic stainless steel material shall not be postweld heat treated except by solution annealing. If solution annealing is performed, a procedure detailing the solution annealing process shall be submitted for review by Owner prior to performing solution annealing.

Alloy materials are required to be stored, off the ground or concrete, and stored to minimize contact with stagnant water.

Q100.6.3.1 Requirements for Minimizing Iron Contamination and Disrupted Surfaces. Handling, transportation, and storage practices that minimize the potential for contamination shall be used. Fabrication and erection practices that minimize disrupted surfaces (e.g., disruption from excess grinding, coarse grit blasting, or excessive, heavy power brushing) shall be used. High alloy materials should be protected from steel tools and materials. Whenever possible, protective barriers such as wood or nylon slings, stainless tools, poison pads, etc., should be used.

Control methods shall be implemented, as necessary, to prevent contamination of alloy surfaces from nearby welding and grinding operations on carbon steels. The use of antispatter or other suitable methods shall be considered to prevent the adherence of spatter from welding, grinding, or arc gouging activities.

One of the most common causes of iron contamination is the performance of unnecessary grinding and wire brushing of alloy materials using contaminated tools. Grinding and wire brushing of smooth, base material mill surfaces outside of the immediate weld joint area shall be avoided. Supervisors shall monitor all grinding operations to ensure that grinding is kept to a minimum and that only proper tools are used.

Welders and fitters shall be instructed not to perform unnecessary wire brushing and abrasive finishing operations as well instructed to use any other necessary protective measures to prevent contamination.

Grinding shall be by aluminum oxide, zirconium oxide, or silicon carbide grinding wheels that shall not have been used on carbon or low alloy steels. Hand or power wire brushing shall be by stainless steel brushes that shall not have been used on carbon or low alloy steels. All tools used in fabrication shall be protected to minimize contact with steels or free iron. Grinding wheels and brushes shall be identified and controlled for their use on these materials only to ensure that contamination of these materials does not occur.

Unless otherwise specified, rough-ground surfaces shall be final finished with a 100 grit or finer, flexible-backed abrasive (e.g., sanding disk, flap drum, flap wheel). Burnishing of surfaces with clogged or excessively degraded abrasives is not permitted.

For materials that have been contaminated with steels or free iron, Owner may request a ferroxyl test or wet/dry test to identify iron contamination. Unless otherwise specified, iron contamination identified by the ferroxyl or wet/dry test or by other identification means (e.g., visible rusting) shall be removed by mechanical or chemical cleaning. Mechanical cleaning methods, when used, shall be capable of removing the contamination without smearing or redepositing contaminants on the material surface. Chemical cleaning methods, when used, shall be performed in accordance with ASTM A380, Paragraph 6.4 and Annex A2. If requested, a ferroxyl or wet/dry test procedure and cleaning procedure shall be submitted to Owner for review.

All labels and tape on high alloy surfaces (including stainless steels) shall be removed prior to service. Mechanical removal by grinding or wire brushing is not allowed. All markings and tape and label adhesive residues shall be solvent removed and any remaining oily residues from cleaning solvents removed using a suitable nonchlorinated cleaner with clean cleaning cloths.

Labels intended for permanent equipment identification shall not be removed.

An overall procedure for minimizing disrupted surfaces and protecting and handling these alloyed materials shall be submitted to Owner for review.

Q100.6.3.2 Welding Heat Tint Removal. When removal of welding heat tint is required by design or other technical welding supplementals, acceptable removal methods include chemical or electrochemical, media blasting, or abrasive methods. The fabricator shall submit a heat tint removal procedure to Owner for review.

Mechanical methods for heat tint removal shall be used with caution since the material surface will be disrupted (degraded) and can also inadvertently become contaminated. When power brushing or mechanical abrasive methods are used to remove heat tint, the area cleaned shall be limited to the immediate affected area. Cleaning of contaminated surfaces and restoration of disrupted surfaces shall be the responsibility of the contractor.

Chemical pickling, when used to remove heat tint, shall be nitric-hydrofluoric acid type solutions, and the removal procedure shall be performed in accordance with ASTM A380.

Wire brushing shall not be used for removing heat tint that is darker than light golden.

Heat tint darker (i.e., worse) than indicated below requires removal:

Equipment Type/Surface Location	**Maximum Permissible Discoloration Level (Notes 1 and 2)**
Piping, internal surfaces	Note 3
Piping, external surfaces	Medium blue
Equipment for holding or transporting dry, nonfluid, product, internal surfaces	Medium blue
Equipment for holding or transporting gases or liquids, internal surfaces	Dark golden
Equipment, external surfaces	Medium blue (exception: Note 4).
Structural alloy	Medium blue (exception: none when stainless is used primarily for its architectural aesthetic appearance)

Notes:

1. The following description is used to indicate progressively worse degrees of heat tint: None - light golden - dark golden - light blue - medium blue - dark blue - gray.
2. Gray: Oxidized surfaces, internal or external, indicate excessive overheating and removal is required.
3. Piping: Internal heat tint shall be limited by proper application of inert gas purge during welding and by proper control of welding parameters in order to limit the development of heat tint colors to dark golden or lighter. Any evidence of bluish or darker heat tint may require removal at the discretion of Owner.
4. External surfaces: Heat tint on external surfaces (in regions not associated with the primary welded joint) shall be removed for aesthetic reasons.

For services such as cryogenic service and demin water service and services determined by Engineer to be noncorrosive to stainless steels (with heavy heat tint), heat tint color is not limited except that surfaces which exhibit “sugaring” are not permitted.

Q100.6.3.3 Media Blasting Requirements for Stainless Steels and High Alloy Materials for Removal of Welding Heat Tint and/or Iron Contamination. Media blasting may be used to remove welding heat tint and/or iron contamination with the following restrictions:

Blast media must be compatible with stainless steels and high alloy materials, as applicable. For example, media containing free iron or contaminants such as chlorides, fluorides, and sulfur are prohibited.

Metallic blast media are prohibited without prior written approval of Owner.

Silica-bearing media are prohibited for fabrications supplied for power plants except for flue gas systems performed at nonfield (offsite) locations. Silica-bearing media for any other use require prior written authorization by Owner.

Blast media product data sheets (BMPDSs) shall be submitted to Owner for review and acceptance prior to use. BMPDSs shall identify elemental and complexed analysis of the media including free silica content.

All blast media shall be immediately and completely removed from component(s).

Media blasting, when performed, shall be performed in accordance with the additional restrictions and limitations specified in Black & Veatch (B&V) Blast Media Data Sheet (BMDS) B2, Drawing No. 81113-DM-0701. A media blast procedure and proof of performance coupon shall be submitted to the B&V Materials Applications Section prior to any production in media blasting.

Q100.6.4 Miscellaneous Fabrication Control Requirements
Welding shall not be performed when surfaces of the parts to be welded are wet. The parts to be welded shall be protected from deleterious contamination and from rain, snow, and excessive wind during welding.

Prior to welding, the weld preparation and adjacent base material surfaces shall be cleaned and kept free from paint, oil, grease, dirt, scale, rust, and other foreign materials. This shall include any previously applied paints, coatings and galvanized surfaces. Previous coated, painted or galvanized surfaces shall be completely removed down to bare metal prior to welding. Any previous coated, painted and/or galvanizing surface shall be sufficiently removed from either side of the mating members so that no peeling or melting of the coating enters into the weldment.

The weld end preparation on carbon and low alloy steel materials that will be stored for extended periods of time may consist of coating with deoxaluminate or an equivalent protective material. This coating may be welded through if applied within the manufacturer's maximum weldable limit of 1.25 mils. Complete removal of the coating is neither required nor prohibited, unless signs of rust or other foreign materials such as oil, grease, dirt, or excessive coating are apparent, in which case these areas shall be cleaned.

Acceptable cleaning solvents include new or redistilled acetone (acetone reclaimed by other methods shall not be used), alcohol (ethyl, methanol, or isopropanol), methyl ethyl ketone, or toluene (toluol). Halogenated cleaning solvents shall not be used for cleaning or degreasing.

All groove butt joints shall be complete joint penetration unless specified otherwise by design documents or the applicable code. Partial penetration weld joints not specified by design shall require written approval by Engineer.

Tack welds that are to remain in the completed weld shall have their stopping and starting ends prepared by grinding or other suitable means for satisfactory incorporation into the completed weld. Tack welds that are to become part of the completed weld shall be visually examined; defective tack welds, including cracked tack welds, shall be removed.

When runoff plates are used, they shall be of the same nominal alloy composition as either of the base metals being joined. If runoff plates are used, they shall be properly removed after completion of welding. The method of removal shall not damage the remaining weld or base metal. Runoff plates shall not be knocked off.

Complete penetration joints welded from both sides shall have the root of the first layer or pass chipped, gouged, ground, or machined to sound metal prior to welding from the second side. This requirement is not intended to apply to automated line processes, where the welding from the second side is controlled to provide adequate penetration and ensure full fusion without back gouging.

Welded joints shall be made by completing each weld layer before succeeding weld layers are deposited. Partial fill passes are permitted to correct localized underfill conditions and for the purpose of maintaining alignment. Block welding is prohibited.

As-welded surfaces are permitted; however, the surfaces of welds shall be uniform in width and size throughout their full length. The cover pass shall be free from coarse ripples, grooves, overlaps, abrupt ridges, and valleys. The surface condition of the finished welds shall be suitable for the proper interpretation of nondestructive examination. If the surface of the weld requires grinding to meet the above criteria, care shall be taken to avoid reducing the weld or base material below the minimum required thickness.

All pressure retaining fillet weld joints other than socket welded joints that require a fillet weld size greater than 5/16 inch (8 mm) shall require a minimum of two weld layers, except for those fillet weld joints welded with a mechanized or automatic welding process.

Socket welds shall meet the following requirements within the welding process restrictions and limitations specified in the applicable Welding Technical Supplemental Specification section:

> A minimum of two weld layers is required for pipe or tube over 0.200 inch (5 mm) nominal wall thickness.
>
> For pipe or tube 1/2 inch (13 mm) or less in nominal pipe size, the GTAW process shall be used.

One of the specific criteria for exemption from PWHT under ASME B31.1 and B31.3, 2014 edition and later for ASME P-Nos. 1, 3, 4, and 5A is that multiple weld layers are required for nominal material thickness > 3/16 inch (5 mm).

Welding slag and spatter shall be removed from all welds.

The purity and maximum dew point of a gas or gas mixture used for shielding shall meet latest edition of AWS A5.32M/A5.32, Welding Consumables -Gases and Gas Mixtures for Fusion Welding and Allied Processes.

Field and shop fabricated pipe spools shall be checked for residual magnetism at each end of the machined field pipe weld bevels. Weld bevels containing residual magnetism greater than 5 gauss shall be demagnetized.

Arc strikes outside of the area of permanent welds should be avoided on any base metal. Cracks or blemishes caused by arc strikes shall be ground to a smooth contour and checked to ensure soundness.

Peening is prohibited. The use of power tools for slag removal is not considered peening.

The application of heat to correct weld distortion and dimensional deviation without prior written approval from Owner is prohibited.

Complete joint penetration welds welded from one side without backing, weld repairs welded from one side without backing, or weld repairs in which the base metal remaining after excavation is less than 0.1875 inch (5 mm) from being through wall, which are fabricated from materials with an ASME P-No. of 5B or higher or unassigned metals with similar chemical compositions, shall have the root side of the weld purged with an argon backing gas prior to welding. Unless otherwise specified, backing gas (purge) shall only be argon. The argon backing gas shall be classified as welding grade argon or shall meet Specification SFA-5.32, AWS Classification SG-A. The backing gas (purge) shall be maintained until a minimum of two layers of weld metal have been deposited and as necessary to minimize the development of bluish internal heat tint colors.

Temporary attachments to pressure boundary components outside the weld bevel groove area should be avoided and only used when absolutely necessary. When required, clamps, welded clips, tack welds, or other appropriate means shall be used to properly align the joint for welding. Welded attachments used for fit-up shall be compatible with the base material and shall be welded with a qualified welding procedure. Attachments shall not be knocked off base material. The attachments shall be removed by suitable methods, such as grinding, machining, or sawing, followed by grinding flush with the base material. When thermal cutting is used to remove attachments, approximately 3/16 inch (5 mm) of material shall be left for final removal by grinding. The ground area shall then be visually examined for defects. The area from which attachments have been removed shall be examined as required by the governing code or specification. Any defects found shall be repaired.

Welding across the flanges of Owner's structural steel members (welds that are transverse to the beam or column center line) shall not be an acceptable practice. The Supplier shall design all welded interfaces to Owner's steel structure to specifically avoid this condition. Supplier's design of such interfaces shall achieve full required design strength and stability by means other than welds applied across flanges.

All defects in welds or base materials shall be removed and repaired in accordance with the referenced code.

A written procedure for root side purging shall be described in detail and shall be submitted concurrently with the welding procedures for review by Owner.

Welding machine ground leads and clamps shall be located to avoid passing welding current through equipment, snubbers, bearings, or any other items where transfer of electrical current may result in damage to equipment.

A complete repair procedure for repairs that are documented as the basis of a nonconformance report shall be submitted to Owner for review and approval in writing prior to performing the repair. If repair by welding is required, the applicable WPSs and supporting PQRs shall be submitted with the repair procedure. All nonconformance report dispositions shall comply with applicable code requirements.

Q100.7 Nondestructive Examination (NDE)

All NDE shall be performed in accordance with the methods specified in the referenced code and any supplemental NDE specified within the other Welding Technical Supplemental Specification sections.

NDE shall be performed in accordance with written procedures that are prepared in accordance with the referenced code and as specified herein. NDE procedures other than for visual examination shall be approved by a qualified and certified NDE Level III. The NDE Level III approval shall be shown on the NDE procedure. NDE procedures shall be submitted for review by Owner prior to their use.

NDE personnel performing NDE other than visual shall be qualified and certified for the applicable NDE method. Personnel shall meet written practice ASNT SNT-TC-1A, unless permitted otherwise by the

referencing code or prior written approval from Owner is obtained. NDE personnel qualification records shall be made available for review when requested.

Personnel performing or supervising the visual examination of welds, including ASME Boiler and Pressure Vessel components, shall be qualified as a Certified Welding Inspector (CWI) in accordance with the American Welding Society AWS QC 1 or previously approved equivalent program as determined by Owner. Visual inspectors' qualifications and certificates shall be submitted for review and verification.

The responsible welding inspector shall perform in-process visual inspections at suitable intervals during the fabrication and erection process to ensure the applicable requirements of the referenced code, design specification, and WPS are met. Such inspections, on a sampling basis, shall be performed prior to assembly, during assembly, and during welding.

All welds shall receive 100 percent visual examination. Visual inspection of welds shall be performed prior to any painting, coating, or galvanizing. Visual weld examination acceptance criteria and other NDE acceptance criteria shall be in accordance with applicable referenced codes and design documents. Records of these examinations shall be documented.

The NDE results shall be provided in an NDE Report that is evaluated, interpreted, and accepted by Level II or Level III NDE personnel.

Required field NDE shall be performed by an independent testing company. Any defective weld shall be removed, repaired, and retested.

Owner may order NDE by an independent laboratory in addition to any examinations specified herein. The NDE type, extent, and method shall be the same as that required for the original weld.

Q100.8 Records

Records of inspections, NDE, impact testing, hardness testing, PWHT charts or records, base material test reports, filler material test reports, radiographic film with applicable reader sheets, ultrasonic examination records and reports, deviation requests including resolution documentation, nonconformance reports, and other records, as required, shall be retained for 10 years after completion of the work. If the records cannot be retained for 10 years, the records must be submitted to Owner after completion of the work.

Quality records, including applicable Data Report Forms generated by a manufacturer or assembler in accordance with an approved Quality Control System and applicable Certificates of Authorization from the ASME Boiler & Pressure Vessel Code, shall be provided in accordance with the approved contract or purchase order. Quality records shall be legible, appropriately completed, and sufficiently detailed to permit traceability to the item or activity involved.

Q121 General Structural Welding Requirements

Q121.1 General

This Technical Supplemental Specification provides welding, fabrication and non-destructive examination (NDE) requirements for structural steel, ductwork, stacks, silos, bins, and other structural components fabricated with carbon, low alloy, weathering, or stainless steel.

Unless otherwise specified, the applicable governing edition and addenda to be used for all references to codes or standards specified herein shall be interpreted to be the jurisdictionally approved edition and addenda. If a code or standard is not jurisdictionally mandated, then the current edition and addenda in effect at the time of (contract or specification) approval shall govern.

Any conflict identified between the requirements of this Welding Technical Supplemental Specification and the provisions of any applicable industry standard, code, regulation, or any specification, standard, or

purchasing document contractually required for a given application shall be referred to Owner for resolution prior to the start of welding.

Where requirements of a referenced code or standard differ from this Welding Technical Supplemental Specification, the more stringent or restrictive requirements shall apply.

Any request for deviation from specified requirements shall be submitted to the Owner in writing and shall include the proposed deviation, rationale for the deviation, any technical data supporting the deviation, and historical experience supporting the deviation.

Q121.1.1 Code and Standard References
Fabrication and NDE shall be in accordance with the applicable code and/or standard indicated in the contract documents. For specific components, welding procedures shall be prepared in accordance with standards referenced in Table A in Article Q121.9.

Following is a listing of Codes and Standards referenced herein:

American Welding Society (AWS) Codes
- D1.1, Structural Welding Code - Steel (≥ 1/8” (3mm) thickness)
- D1.3, Structural Welding Code – Sheet Steel (≤ 3/16” (5mm) thickness)
- D1.6, Structural Welding Code - Stainless Steel
- D1.8, Structural Welding Code – Seismic Supplement

Canadian Standards Association (CSA) Standards
- W59, Welded Steel Construction
- W47.1, Certification of Companies for Fusion Welding of Steel

Miscellaneous welding procedure qualification codes
- American Society of Mechanical Engineers (ASME) Section IX, Qualification Standard for Welding Procedures and Welders
- AWS B2.1, Specification for Welding Procedure and Performance Qualification

Q121.1.2 Contractor Submittals
The documents referenced in Article Q121.9 Table A shall be submitted for review prior to welding. If media blasting is used to clean stainless steel, the blast-media data sheets must be submitted for review prior to blasting (refer to Article Q121.6.3.1).

Q121.2 Welding Process Restrictions and Limitations
The following restrictions and limitations are mandatory as applicable to the welding process being used.

The Gas Metal Arc Welding (GMAW) process utilizing the short-circuiting or globular transfer mode is permitted only for welding material 3/16 inch (5 mm) or less thickness.

100 percent CO_2 is not permitted for spray arc transfer for the solid-wire GMAW process.

The GMAW process with globular arc transfer is permitted only for flat, horizontal, and overhead welding positions. For any WPS for the GMAW process utilizing the globular arc transfer mode with 0.045 inch (1.2 mm) dia. electrode, 24V minimum and 180A minimum is required.

The Flux Cored Arc Welding (FCAW) process shall only be used with shielding gas, except as permitted in Q121.3.1

The Submerged Arc Welding (SAW) process shall not use re-crushed slag.

The weld progression for manual or semiautomatic vertical position welds shall be uphill, except downhill progression is permitted for the following:

AWS D1.1 – Undercut may be repaired vertically downward, provided the preheat temperature is in accordance with AWS D1.1, Table 3.2, but not lower than 70° F (20° C).

Seal welds of ductwork lap/fillet welds may be performed in downhill progression. Welders shall be qualified with supplementary fillet weld performance qualification tests.

AWS D1.6 – Using the prequalified Gas Tungsten Arc Welding (GTAW), GMAW-S, and FCAW-G processes, progression may be vertically downward for base metal with a 3/16 inch (5 mm) maximum thickness.

AWS D1.3 – Sheet metal – per applicable weld procedure.

Q121.3 General Filler Material Requirements

Welding filler metal shall comply with the requirements of the referenced code and any modified requirements specified herein.

Unless otherwise specified, the welding filler metal for welding similar base metal types shall have a chemical composition as similar as possible to the base materials to be welded. The finished weld shall be at least equal to the base metal's minimum specified properties in strength, ductility, and notch toughness.

Unless otherwise specified or permitted by an approved deviation request, the use of non-standard international classifications or non-standard AWS-G electrode/wire classifications is prohibited. However, welding consumables produced under standard compositions and the requirements specified by national or international filler metal standards are considered acceptable.

When permitted, welding procedures specifying nonstandard classifications or AWS-G classification consumables shall be restricted to the same manufacturer and brand-name consumable used to weld the procedure qualification test coupon. The manufacturer and brand name shall be listed on the Welding Procedure Specification (WPS) and Procedure Qualification Records (PQR). The manufacturer's standard, including the mechanical properties and chemical analysis, along with the request for using nonstandard classifications (e.g., "G" classification consumables), shall be approved by Owner prior to start of welding.

Q121.3.1 Filler Material Requirements for Carbon and Low Alloy Steels

For the Shielded Metal Arc Welding (SMAW) process, all filler metal shall be of the low-hydrogen type when welding on carbon and low alloy steels. SMAW low-hydrogen type ferrous electrodes for all fill passes shall have a minimum specified ultimate tensile strength of 70,000 psi (490 MPa) as defined by the applicable ASME SFA or AWS specification.

For the FCAW process when welding carbon steel with shielding gas, only AWS filler metal Classifications E7XT-1, -5, -9, -12 with shielding gas shall be used (current AWS classifications also utilize either an "M" or "C" after the final digit).

For the FCAW process when welding carbon steel without shielding gas, the following AWS classifications and limitations are permitted:

E71T-8 for unlimited thickness all position welding.

E70T-6 for unlimited thickness flat and horizontal position welding only.

E71T-11 for 3/8 inch (10 mm) maximum deposit thickness.

SAW multi-pass weld deposits shall use an essentially neutral flux for welding carbon steels. Fluxes that compensate for losses of alloying elements are permitted.

Alloy, semi-active, or active fluxes shall not be used except that active flux may be used for single pass welding of carbon steels, provided the weld deposit thickness is approximately 1/4 inch (6 mm) maximum each side for a double-V-groove joint design or approximately 1/4 inch (6 mm) one side for a single-V-groove joint design. The joint thickness shall not exceed 1/2 inch (13 mm) nominal.

Q121.3.1.1 Filler Material Requirements for Impact Tested Base Materials. For structural steel welds, when the base metal is required to be Charpy V-Notch (CVN) impact tested by the design specification or contract documents, the filler metals shall be classified with Charpy toughness at -20° F (-30° C) or lower temperature.

Q121.3.2 Filler Material Requirements for Weathering Steels
For welds joining weathering steels and left exposed, bare, unpainted, uninsulated, or otherwise visually observable in their final service condition, filler metal shall comply with the requirements specified in AWS D1.1, Section 3.7.3 and Table 3.4.

Q121.3.3 Filler Material Requirements for Stainless Steels
Filler metal for welding the following austenitic stainless steel base material types shall be in accordance with the following:

Base Material Grade	Filler Material Type
304/304L	308L or 316L
316/316L	316L

Q121.3.4 Filler Material Requirements for Stainless Steel Welded to Carbon Steel
Filler metals for welding carbon steel to austenitic stainless steel shall be in accordance with the following requirements:

Service ≤500° F (260° C)		Service >500° F (260° C)	
ASME Specification	**AWS Classification**	**ASME Specification**	**AWS Classification**
SFA 5.9 or SFA 5.14	ER309 or ER309L ERNiCr-3	SFA 5.14	ERNiCr-3
SFA 5.4 or SFA 5.11	E309 or E309L ENiCrFe-3 or ENiCrFe-2	SFA 5.11	ENiCrFe-3 or ENiCrFe-2
SFA 5.22	E309TX-X or E309LTX-X	N/A	N/A

Q121.4 Welding Procedures, Requirements, and Qualification

Welding procedures shall be prepared in accordance with the applicable welding standard or code as defined in Table A in Article Q121.9.

The minimum preheat temperature shall be specified in the WPS.

Q121.4.1 AWS D1.8 Seismic Provisions
All provisions of AWS D1.8, Structural Welding Code - Seismic Supplement are mandatory for structural fabrications designated by design as an element of a Seismic Load Resisting System (SLRS) unless specifically exempted in writing by Owner.

Contractor shall prepare a quality plan in conformance with the requirements of D1.8, D1.1 and this technical welding supplement and submit for approval.

Q121.4.2 Preheat for Prequalified Welding Procedures
For AWS D1.1 prequalified steels, preheat shall be performed in accordance with AWS D1.1, Section 5.7 and Table 5.8.

Q121.4.3 Preheat for Welding Procedures Qualified by Testing
For AWS D1.1 welding procedures qualified by procedure qualification testing, the minimum preheat temperature shall be established based on the greater of the following:

- Using AWS D1.1, Table 5.8 for material type/composition and thickness ranges as a baseline for establishing minimum preheat requirements

- For weld deposits produced with 70 ksi (490 MPa) minimum specified ultimate tensile strength (UTS) filler metals, the minimum preheat shall not be less than the following:

Min. Preheat for 70 ksi (490 MPa) min. specified UTS filler metals.	
Base Metal Thickness at the Point of Welding	**Minimum Preheat Temperature**
< 3/4 inch (20 mm)	32° F (0° C)*
> 3/4 to 1-1/2 inches (> 20 to 38 mm)	50° F (10° C)
> 1-1/2 to 2-1/2 inches (> 38 to 65 mm)	150° F (65° C)
> 2-1/2 inches (> 65 mm)	225° F (110° C)
*When the base metal temperature is <32° F (0° C), 70° F (20° C) minimum preheat is required.	

- The minimum preheat used during the procedure qualification test. However, the minimum preheat specified on the WPS shall not be less than defined in the above table.

Q121.5 Welder/Welding Operator Performance Qualification

Welders and welding operators shall be qualified in accordance with the referenced welding standard used to fabricate the component (reference Table A in Article Q121.9).

Field personnel not qualified and certified as welders or welding operators are prohibited from performing any welding activities such as tack welds, temporary welds, permanent welds, manufacturing aids, tools, fixtures, or other welded items.

Shop personnel not qualified and certified as welders or welding operators are prohibited from performing any welding activity on materials designated for permanent or temporary installation by the contract, such as tack welds or temporary welds.

The Supplier is ultimately responsible for the qualification of welders or welding operators, whether his own or his subsuppliers. Welder or welding operator performance qualification testing shall be performed under the full supervision and control of Supplier.

The welder and welding operator qualification records shall be available at the shop facility or construction site and shall be made available to the Owner for review when requested.

Q121.6 Fabrication Control

Fabrication, assembly, and erection shall be in accordance with the applicable AWS code and the design documents.

When tensile forces are to be transmitted through full penetration groove welds on American Institute of Steel Construction (AISC) material Groups 4 and 5 rolled shapes, or shapes built up by welding plates more than 2 inches (50 mm) thick together to form the cross section, the requirements of AISC J1.7 (9th Edition) or AISC J1.5 and J2.6 (13th Edition), as applicable, shall apply.

Welding shall not be performed when surfaces of the parts to be welded are wet. The parts to be welded shall be protected from deleterious contamination and from rain, snow, and excessive wind during welding.

Prior to welding, the weld preparation and adjacent base material surfaces shall be cleaned and kept free from paint, oil, grease, dirt, scale, rust, and other foreign materials. This shall include any previously applied paints, coatings and galvanized surfaces. Previous coated, painted or galvanized surfaces shall be completely removed down to bare metal prior to welding. Any previous coated, painted and/or galvanizing surface shall be sufficiently removed from either side of the mating members so that no peeling or melting of the coating enters into the weldment.

No coating shall be applied to surfaces within 3 inches (75 mm) of field welded connections, except that the weld end preparation on carbon and low alloy steel materials may consist of an aluminum-based pre-welding consumable coating, such as Deoxaluminate, Bloxide or an equivalent product. This coating may be welded through if applied in accordance with the manufacturer's instructions. Complete removal of the coating is neither required nor prohibited, unless signs of rust or other foreign materials such as oil, grease, dirt, or excessive coating are apparent, in which case these areas shall be cleaned.

Acceptable cleaning solvents include new or redistilled acetone (acetone reclaimed by other methods shall not be used), alcohol (ethyl, methanol, or isopropanol), methyl ethyl ketone, or toluene (toluol). Halogenated cleaning solvents shall not be used for cleaning or degreasing.

All groove butt joints shall be complete joint penetration (CJP) unless specified otherwise by design documents or the applicable code. Partial penetration weld joints not specified by design shall require written approval by Engineer.

Tack welds that are to remain in the completed weld shall have their stopping and starting ends prepared by grinding or other suitable means for satisfactory incorporation into the completed weld. Tack welds that are to become part of the completed weld shall be visually examined; defective tack welds, including cracked tack welds, shall be removed.

When runoff plates are used, they shall be of the same nominal alloy composition as either of the base metals being joined. If runoff plates are used, they shall be properly removed after completion of welding. The method of removal shall not damage the remaining weld or base metal. Runoff plates shall not be knocked off.

Complete penetration joints welded from both sides shall have the root of the first layer or pass chipped, gouged, ground, or machined to sound metal prior to welding from the second side. This requirement is not intended to apply to automated line processes, provided the welding from the second side is controlled to provide adequate penetration and ensure full fusion without back gouging.

Welded joints shall be made by completing each weld layer before succeeding weld layers are deposited. Partial fill passes are permitted to correct localized underfill conditions and for the purpose of maintaining alignment. Block welding is prohibited.

Except as otherwise specified on the drawings, as-welded surfaces are permitted; however, the surfaces of welds shall be uniform in width and size throughout their full length. The cover pass shall be free from coarse ripples, grooves, overlaps, abrupt ridges, and valleys. The surface condition of the finished welds shall be suitable for the proper interpretation of nondestructive examination. If the surface of the weld requires grinding to meet the above criteria, care shall be taken to avoid reducing the weld or base material below the minimum required thickness.

Fillet weld sizes greater than 5/16 inch (8 mm) shall require a minimum of two weld layers, except for those fillet weld joints welded with a mechanized or automatic welding process.

Welding slag and spatter shall be removed from all welds.

The purity and maximum dew point of a gas or gas mixture used for shielding shall meet AWS A5.32 (ISO 14175:2008 MOD)

Arc strikes outside of the area of permanent welds should be avoided on any base metal. Cracks or blemishes caused by arc strikes shall be ground to a smooth contour and checked to ensure soundness.

Peening is prohibited. The use of power tools for slag removal is not considered peening.

The application of heat to correct weld distortion and dimensional deviation without prior written approval from Owner is prohibited.

Temporary welded attachments used for fit-up shall be compatible with the base material and shall be welded with a qualified welding procedure. Attachments shall not be knocked off base material. The attachments shall be removed by suitable methods, such as grinding, machining, or sawing, followed by grinding flush with the base material. When thermal cutting is used to remove attachments, approximately 3/16 inch (5 mm) of material shall be left for final removal by grinding. The ground area shall then be visually examined for non-conforming discontinuities. Any such discontinuities found shall be repaired.

Welding across the flanges of Owner's structural steel members (welds that are transverse to the beam or column center line) shall not be an acceptable practice, and Supplier shall design all welded interfaces to Owner's steel structure to specifically avoid this condition. Supplier's design of such interfaces shall achieve full required design strength and stability by means other than welds applied across flanges.

All non-conforming discontinuities in welds or base materials shall be removed and repaired in accordance with the referenced code.

Welding machine ground leads and clamps shall be located to avoid passing welding current through equipment, snubbers, bearings, or any other items where transfer of electrical current may result in damage to equipment.

A complete repair procedure for repairs that are documented as the basis of a nonconformance report shall be submitted to Owner for review and approval in writing prior to performing the repair. If repair by welding is required, the applicable WPSs and supporting PQRs shall be submitted with the repair procedure. All nonconformance report dispositions shall comply with applicable code requirements.

Q121.6.1 Backing and Retainers
Permanent backing shall not be used unless specified by design. When permitted by design, backing strips shall be continuous unless otherwise permitted by design. When required, backing shall be in accordance with the applicable AWS code.

Nonmetallic retainers or nonfusing metal retainers shall not be used unless specified in the WPS. When used, they shall be removed.

Q121.6.2 Filler Material Control
Storage, handling, and drying of SMAW electrodes and SAW flux shall, as a minimum, be in accordance with the manufacturers' recommendations and the applicable welding code.

SMAW low-hydrogen type electrodes, including stainless steel, shall be purchased in hermetically sealed or vacuum packed containers only.

In addition, SMAW low-hydrogen type carbon and low alloy steel electrodes shall be stored in ovens at 250° F (120° C) minimum after the hermetically sealed or vacuum packed container is opened.

Bare rod in straight lengths shall be individually flag tagged, stamped, or otherwise identified with the AWS classification or product classification.

Each spool of solid or cored rod shall be tagged, labeled, or otherwise identified with the AWS classification or product classification.

Any electrodes or fluxes that have been wet or have damaged coatings shall not be used. Any welding filler metals or fluxes not readily identifiable shall not be used.

The Supplier shall ensure proper storage (dry conditions), issuance, and use of welding consumables. A written procedure for storing, handling, issuing, and reconditioning electrodes, wires, and fluxes is required. The procedure shall be submitted for review by Owner if required by Table A in Article Q121.9. In addition, the procedure shall be made available for review by Owner at Supplier’s shop or field erection site if requested.

Q121.6.3 Fabrication Controls for Austenitic Stainless Steels
The following requirements shall apply when fabricating austenitic stainless steels.

The maximum interpass temperature during welding shall not exceed 350° F (175° C).

Complete joint penetration welds welded from one side without backing, weld repairs welded from one side without backing, or weld repairs in which the base metal remaining after excavation is less than 0.1875 inch (5 mm) from being through wall shall have the root side of the weld purged with an inert backing gas prior to welding. Unless otherwise specified, backing gas (purge) shall be argon or nitrogen. The backing gas (purge) shall be maintained until a minimum of two layers of weld metal have been deposited and as necessary to minimize the development of bluish internal heat tint colors.

Handling, transportation, and storage practices shall minimize the potential for contamination. Alloy materials shall be stored off the ground or floor, and stored/protected to prevent contact with soils and stagnant water.

Control methods shall prevent contamination of alloy surfaces from nearby welding and grinding operations on carbon steels. The use of antispatter or other suitable methods shall be considered to prevent the adherence of spatter from welding, grinding, or arc gouging activities.

Fabrication and erection practices shall minimize disrupted surfaces (e.g., disruption from excessive or unnecessary grinding, coarse grit blasting, or excessive power brushing).

Iron contamination of stainless materials due to unnecessary grinding and wire brushing of alloy materials using contaminated tools shall be avoided. Grinding and wire brushing of smooth base material mill surfaces outside of the immediate weld joint area shall be avoided. Grinding shall be kept to a minimum using only the proper tools. Excessive or unnecessary wire brushing and abrasive finishing shall be avoided.

Grinding wheels and discs used on stainless steel shall not have been previously used on carbon or low alloy steels. Hand or power wire brushing shall be by stainless steel brushes that shall not have been used on carbon or low alloy steels. All tools used in fabrication shall be protected to minimize contact with steels or free iron. Grinding wheels and brushes shall be identified and controlled for their use on stainless materials only to ensure that contamination of stainless materials does not occur.

For materials that have been contaminated with steels or free iron, Owner may request a ferroxyl test or wet/dry test to identify iron contamination. Unless otherwise specified, iron contamination identified by the ferroxyl or wet/dry test or by other identification means (e.g., visible rusting) shall be removed by mechanical or chemical cleaning. Mechanical cleaning methods, when used, shall be capable of removing the contamination without smearing or redepositing contaminants on the material surface. Chemical cleaning methods, when used, shall be performed in accordance with ASTM A380, Paragraph 6.4 and Annex A2. If requested, a ferroxyl or wet/dry test procedure and cleaning procedure shall be submitted to Owner for review.

Unless otherwise specified, rough-ground surfaces shall be final finished with a 100 grit or finer, flexible-backed abrasive (e.g., sanding disk, flap drum, flap wheel). Burnishing of surfaces with clogged or excessively degraded abrasives is not permitted.

Anti-spatter compounds, marking fluids, marking pens, tape, temperature indicating crayons, and other tools shall have a total halogen content of less than 200 parts per million.

All labels and tape on stainless steels shall be removed prior to service. Mechanical removal by grinding or wire brushing is not allowed. All markings and tape and label adhesive residues shall be solvent removed from the material surface using a nonchlorinated solvent. Any oily residues from cleaning solvents shall be removed using a suitable nonchlorinated cleaner with clean cleaning cloths.

Labels specified for permanent equipment identification shall not be removed.

For all stainless steel components, gray oxide scales and gray heat tint is not permitted. Gray oxidized surfaces, internal or external, indicate excessive overheating and removal of the oxidized surface condition is required. For the interior surface of stack liners made of stainless steel, heat tint shall not exceed medium blue color (no darker than AWS D18.2, No. 6). The following description is used to indicate progressively worse degrees of heat tint: none - light golden - dark golden - light blue - medium blue - dark blue - gray.

Chemical pickling, when used to remove heat tint, shall be nitric-hydrofluoric acid type solutions, and the removal procedure shall be performed in accordance with ASTM A380.

Mechanical methods for heat tint removal shall be used with caution since the material surface will be disrupted (degraded) and can also inadvertently become contaminated. When power brushing or mechanical abrasive methods are used to remove heat tint, the area cleaned shall be limited to the immediate affected area. Cleaning of contaminated surfaces and restoration of disrupted surfaces shall be the responsibility of Supplier.

Wire brushing shall not be used for removing heat tint that is darker than light golden.

Q121.6.3.1 Media Blasting Requirements for Stainless Steels and High Alloy Materials for Removal of Welding Heat Tint and/or Iron Contamination. Media blasting may be used to remove welding heat tint and/or iron contamination with the following restrictions:

Blast media must be compatible with stainless steels and high alloy materials, as applicable. For example, media containing free iron or contaminants such as chlorides, fluorides, and sulfur are prohibited.

Metallic blast media are prohibited without prior written approval of Owner.

Silica-bearing media are prohibited for fabrications supplied for power plants except for flue gas systems performed at nonfield (offsite) locations. Silica-bearing media for any other use require prior written authorization by Owner.

Blast media product data sheets (BMPDSs) shall be submitted to Owner for review and acceptance prior to use. BMPDSs shall identify elemental and complexed analysis of the media including free silica content.

Supplier shall be responsible for immediate and complete removal of ALL blast media from the component(s).

Media blasting, when performed, shall be performed in accordance with the additional restrictions and limitations specified in Black & Veatch (B&V) Blast Media Data Sheet (BMDS) B2, Drawing No. 81113-DM-0701. A media blast procedure and proof of performance coupon shall be submitted to the B&V Materials Applications Section prior to any production in media blasting.

Q121.7 Nondestructive Examination (NDE) General Requirements

All NDE shall be performed in accordance with the methods specified in the referenced code and any supplemental NDE specified herein.

NDE shall be performed in accordance with written procedures that are prepared in accordance with the referenced code and as specified herein. NDE procedures other than for visual examination shall be approved by a qualified and certified NDE Level III. The NDE Level III approval shall be documented on the NDE procedure. NDE procedures shall be submitted for review by Owner prior to their use if required by Table A herein.

The NDE results shall be provided in an NDE Report evaluated, interpreted, and accepted by Level II or Level III NDE personnel.

Unless otherwise specified, any non-conforming weld discontinuity identified by NDE shall be re-examined as required by Section 8 or Section 10 Part F (for tubular structures) of AWS D1.1, Section 8 of AWS D1.3, and Section 8 of AWS D1.6, as applicable. All non-conforming discontinuities found shall be removed, repaired, and re-examined using the same NDE method that identified the original discontinuity.

Supplier is responsible for obtaining and paying for all required NDE services.

Owner may order NDE by an independent laboratory in addition to any examinations specified herein. If such testing discloses a significant nonconformance to the code or design requirements, the defective weld shall be repaired and re-examined using the same NDE method that was used to discover the defective weld. The costs for NDE, repair and re-examination shall be paid by the Supplier. If the weld does not contain a significant nonconformance or is otherwise not defective, the NDE costs will be paid by Owner. Weld acceptance standards shall be in accordance with applicable codes and design specifications. If an individual interpretation is in question, the final authority shall be the responsibility of Owner.

Q121.7.1 NDE Personnel Certification and Experience Requirements
Personnel performing NDE other than visual shall be qualified and certified for the applicable NDE method. Personnel shall meet written practice American Society of Nondestructive Testing (ASNT) SNT-TC-1A, unless permitted otherwise by the referencing code or prior written approval from Owner is obtained. NDE personnel qualification records shall be made available for review when requested.

Refer to Table A for certification and/or experience requirements for personnel performing visual examinations.

Q121.7.2 Visual Examination (VE) Requirements
The responsible Supplier's welding inspector shall perform in-process visual inspections at suitable intervals during the fabrication and erection process to ensure the applicable requirements of the referenced code, design specification, and WPS are met. Such inspections, on a sampling basis, shall be performed prior to assembly, during assembly, and during welding.

All completed welds shall receive 100 percent VE.

Visual inspection of welds shall be performed prior to any painting, coating, or galvanizing. Visual weld examination acceptance criteria and other NDE acceptance criteria shall be in accordance with applicable referenced codes and design documents. Records of these examinations shall be documented.

Q121.7.3 Additional Nondestructive Examination (NDE)
In addition to the 100 percent VE required of all welds, the following NDE of welds shall be performed in accordance with the applicable AWS code and the design documents defined herein.

Q121.7.3.1 NDE Requirements of Structures. Structures include buildings and nonbuildings, as defined in American Society of Civil Engineers (ASCE) 7. Nonbuilding structures similar to buildings shall require the same NDE methods as the appropriate building structure type.

The following NDE methods are assigned to those welds that make up the main load-carrying members of structures. Requirements for structures apply to all self supporting members designed to carry loads. These requirements do not apply to auxiliary attachments or to prefabricated enclosures:

Columns and Beams:

CJP Flange Butt-Joints: 100 percent RT or UT.

CJP Web butt-joints: Every 1 of 4 joints minimum: UT or RT.

CJP T-Joints: 100 percent UT or RT.

Plate Girder and Built-Up Flexural Member Joint Welds:

CJP Flange butt-joints: 100 percent RT or UT.

CJP Web butt-joints: 25 percent of weld length by random RT or UT.

Web-to-flange T-joints: 10 percent of weld length each side MT or PT.

Columns and Built-Up Compression Members:

CJP flange butt-joints: 100 percent RT or UT.

CJP Web butt-joints: 25 percent of each weld length by random RT or UT.

Web-to-flange T-joints: 10 percent of weld length each side MT or PT.

Notes: UT: AWS D1.1, Clause 8 (8.13 acceptance criteria). RT: AWS D1.1, Clause 8 (8.12 acceptance criteria). Phased array UT may be used as an alternative to conventional UT. When phased array UT is used, the procedure qualification shall be performed in accordance with AWS D1.1, Clauses 8.34, 8.34.1, and Annex H, with the UT weld acceptance criteria in accordance with AWS D1.1, Clause 8, Part C (8.13).

Q121.7.3.1.1 NDE for Members Designated as SLRS (AWS D1.8). Procedures and acceptance criteria shall be in accordance with AWS D1.8.

All SLRS CJP groove-welds: 100 percent UT.

Protected-zone:

Fillet and groove-welds: 100 percent MT.

Wide-flange k-areas: 100 percent MT.

Beam copes or weld access holes: MT or PT surface examination.

Q121.7.3.2 NDE of Stacks, Chimney Liners, Silos, Bins and Ductwork.

Fabrication Type	UT or RT of CJP Butt-Joints	Other	NDE Method/Accept/Reject Criteria
Steel stacks (single wall, dual wall, and multi-flue)	A, B		F, H
Steel liners of concrete chimneys	A, B		F. H
Coal or limestone silos and bins	A, C		F, H
Structural ductwork (non-HVAC)	D	E	F, G, H, I

A. One spot in the first 10 ft (3 m) for each welder or welding operator for vertical seams and for horizontal seams.
B. Examine 10% of every third shop and every third field circumferential seam with one of the spots at a vertical/horizontal seam junction.
C. Examine one vertical/horizontal junction each shell course. Additional spots shall be examined for each 100 feet (30 m) of weld length and any remaining length over 60 feet (18 m) between spots. Fifty percent of the additional spots shall be vertical and the remaining spots horizontal.
D. Ductwork Plate CJP butt-joints: One spot in the first 10 feet (3 meters) for each welder. If no non-conforming discontinuities are found, one additional spot in every 200 feet (60 meters) of weld shall be examined.
E. Ductwork- sealing, corner, and lap joints: Randomly examine in 1 foot (0.3 meter) lengths by MT or PT for 1 percent minimum of the total length of weld, but at least one examination for each subassembly shall be performed.
F. UT or RT Requirements:
    a. Examination length of each spot RT or UT location: 6 in. (150 mm) of weld length; Junction shots: 2 in. (50 mm) of horizontal weld length on each side of the vertical seam and 3 in. (75 mm) minimum weld length on the vertical seam.

b. For joint thickness ≥ 5/16” (8mm)
    i. AWS D1.1, Clause 8; Acceptance criteria: (UT) Clause 8.13; (RT) Clause 8.12.
    ii. Phased array UT may be used as an alternative to conventional UT. When phased array UT is used, the procedure qualification shall be performed in accordance with AWS D1.1, Clauses 8.34, 8.34.1, and Annex H, with the UT weld acceptance criteria in accordance with AWS D1.1, Clause 8, Part C.
c. For joint thickness < 5/16” (8mm):
    i. UT: AWS D1.1, Annex O: Acceptance criteria: Table O.1. (Statically loaded)
    ii. RT: AWS D1.1, Clause 8 Part E for RT requirements; Rejectable indications: Cracks, lack of fusion and incomplete penetration and slag inclusions longer than 1/4" (6 mm).

G. MT or PT: AWS D1.1, Clause 6, Parts C, 8.10.
H. For welds rejected by UT or RT examination, tracer shots are required until there is at least 3 in. (75 mm) of acceptable weld between the discontinuity and any one edge of the film. Alternatively, the complete discontinuity may be determined (removed) by air carbon arc gouging. A final RT or UT exam shall be taken which includes the final 3 in (75 mm) of the repaired end plus 3 in. (75 mm) past the end of the repair to ensure the entire defect has been removed.
I. Leak Testing of ductwork interior welds: 100% visual examinations required per the AWS D1.1, Table 8.1 - Visual Acceptance Criteria, prior to all leak testing
Acceptance criteria for leak testing is zero leakage
Select from the following (interior weld shall be inspected prior to depositing the exterior weld):
    1. Apply solvent removable liquid dye penetrant to the interior surface side of the welds and apply developer to the other side then examine the exterior location for wicking after 1 hour dwell time.
    2. Apply water soluble liquid dye penetrant to the exterior unwelded surface and apply developer to the weld side of the joint then examine the weld surface for wicking after 1 hour dwell time.
    3. Apply light diesel to the exterior unwelded surface and examine for evidence of wicking on the welded side of the joint after a dwell time of 3 hours minimum. (Remark: Diesel is suitable only for carbon and low alloy steels – not stainless steels).
    4. Vacuum Box Test Method

Q121.7.3.3 Additional Visual Examination Requirements of Welds after Galvanizing. The following welds and immediate adjacent areas (within 1 inch [25 mm] of the weld) shall receive 100 percent VE not less than 48 hours after completion of galvanizing.

Butt joint splices, columns, and beams.

Beam clip angles.

Plate girder and built-up flexural member joint welds.

All areas requiring VE shall be examined for the presence of cracks. The acceptance criteria for the subject welds shall be "free from cracks."

If any cracks are visually identified after galvanizing, Owner shall be notified prior to repair. Owner may request additional NDE by magnetic particle testing (MT) examination of any similar joint types. Any cracks discovered by MT, but not previously identified by VE, shall require 100 percent MT examination of all similar joint types at the expense of Supplier. Any cracking detected by VE or MT shall be repaired at the expense of Supplier.

This examination may be performed by the fabricator's assignee or by the supplier that performs the galvanizing. Personnel must have good visual acuity and be capable of identifying identify narrow cracks. All required visual inspection shall be performed with the eye 24 inches (600 mm) or less of the work and in adequate lighting conditions (e.g. 100 foot candles [1000 lux] minimum).

Q121.8 Records

Records of inspections and NDE), base material test reports, filler material test reports, radiographic film with applicable reader sheets, ultrasonic examination records and reports, deviation requests including resolution documentation, nonconformance reports, and other records, as required, shall be retained by the Supplier for 5 years after completion of the work. Records shall be submitted to Owner, if requested.

Quality records, including applicable Data Report Forms generated by a manufacturer or assembler in accordance with an approved Quality Control System, shall be provided in accordance with the approved contract or purchase order. Quality records shall be legible, appropriately completed, and sufficiently detailed to permit traceability to the item or activity involved.

Q121.9 Table A: Welding Std, Submittal Requirements, Inspector Certification Requirements

	Requirements [a]				
Component	**Welding Procedures[b]**	**WPS/PQR Submittal [d]**	**Filler Metal Storage and Handling Procedure Submittal**	**Inspector Certification, Requirement and Submittal**	**NDE Procedure Submittal**
Storage Silos and Bins	D1.1, ASME IX, D1.6	Yes	Yes	Note c	No
Stacks	D1.1, ASME IX. D1.6	Yes	Yes	Note c	Yes
Structural Ducting (not HVAC)	D1.1, ASME IX, D1.6	Yes	No	Note c	No
Equipment Skids	D1.1	Yes	No	Note c	No
General Structural Steel (Structures)	D1.1	Yes	Yes	Note c	Yes
Seismic (SLRS)	D1.1/D1.8	Yes	Yes	Note c	Yes[e]

Notes:

a. Yes = Required, No = Not required.

b. The requirements of the referenced code are applicable with any restrictions or modification requirements specified herein. Where AWS D1.1, is referenced, CSA W59 is an acceptable alternative. Welder performance qualifications for CSA are covered under CSA W47.1. AWS D1.6 is applicable only for welding stainless steel base materials. AWS D1.3 is permitted only for steels ≤ 3/16" (5 mm) thickness. Where ASME IX is referenced, AWS B2.1 is an acceptable alternative.

c. Personnel performing or supervising the visual examination of welds shall be qualified as a Certified Welding Inspector (CWI) in accordance with the American Welding Society AWS QC 1; or the Canadian Welding Bureau (CWB) in conformance with the requirements of CSA Std. W178.2, Certification of welding Inspectors; or previously approved equivalent program as determined by Owner. Visual inspectors' qualifications and certificates shall be submitted for review and verification.

d. WPSs and applicable Procedure Qualification Records (PQRs) shall be submitted for review to Owner prior to start of welding. Submittal of welding procedures and applicable PQRs shall apply to all Suppliers and subsuppliers. Suppliers shall review the documents in accordance with the applicable code and specification requirements and shall accept all of their subsuppliers' welding procedures and applicable PQRs prior to submitting accepted documents to Owner. The submittal shall also include a general description of the component, the applicable fabrication standards and the alloy type to be welded (e.g., carbon steels, weathering steels, stainless steels and material grade [e.g., 304L, 316L, etc.]).

e. For seismic, contractor shall prepare a quality plan in conformance with the requirements of D1.8, D1.1 and this technical welding supplement and submit for approval.

Q210 Welding of Power Piping

Q210.1 General

This Technical Supplemental Specification provides requirements for welding of ASME B31.1 Power Piping nonboiler external piping (NBEP)and boiler external piping (BEP) components, and shall be used in conjunction with Section Q100 of the Welding Technical Supplemental Specifications.

ASME B31.1 or ASME Section I code cases shall only be permitted for use as specifically approved by Owner.

ASME B31.1 Code Case 183 (use of seamless [9Cr-2W]) is approved, as applicable.

Q210.2 Welding Processes

Permitted welding processes shall be as specified in Section Q100 and shall include the restrictions and limitations applicable to those processes as specified herein.

Q210.2.1 General Welding Process Restrictions and Limitations

Additional root pass welding requirements are defined in Article Q210.7 and its subarticles.

The GMAW process utilizing the constant voltage short-circuiting transfer mode (GMAW-S) or globular arc transfer shall not be used in any application, except that GMAW-S may be used for root pass welding of ASME P-No. 1 (carbon steel) piping systems with low cleanliness requirements (unless for shop welds with high cleanliness requirements the internal service can be cleaned after welding). The GMAW-S process is permitted only for root pass welding of open-root, complete joint penetration (CJP) groove welds without backing.

The GMAW process utilizing the globular or short-circuiting transfer mode shall not be used for attachments, fillets, or socket welds.

Root pass welding using GMAW-S controlled wave-form variations of Miller Electric’s RMD process or Lincoln Electric’s STT process may be used for root pass welding (only) of open-root, complete joint penetration groove welds only if permitted by Article Q210.7 and its subarticles.

GMAW-S or RMD or STT is not allowed in portions of piping systems which connect to critical equipment and, prior to operation, cannot be cleaned by means of chemical flushing, hydro lazing, steam blow, or similar method to remove loose welding splatter.

The weld progression for manual or semiautomatic vertical position welds shall be uphill, except when the GMAW-S (including RMD or STT) is permitted for root pass welding; then, the progression shall be downhill except fully mechanized welding may be up or down.

Root deposits on open root, complete joint penetration (CJP) groove welds made with the following processes require backing or backgouging and backwelding:

The FCAW process

The GMAW process operated in spray arc or globular arc mode.

The SMAW process (except for root pass applications of P-No. 1 carbon steels made using E7010-A1 or E6010 /E6011 (when permitted herein).

The Flux Cored Arc Welding (FCAW) process shall only be used with shielding gas.

Q210.3 Welding Procedure Qualification

Welding procedures shall be prepared and qualified in accordance with ASME Section IX.

Q210.4 Welder/Welding Operator Performance Qualification

Welders and welding operators shall be qualified in accordance with ASME Section IX except as modified by Article Q210.4.1.

Q210.4.1 Welder Performance Qualification Restrictions using GMAW-S (including RMD/STT variations)

The requirements of this article applies only for production welding ASME P-No. 4 and higher base materials.

Welders welding pipe (with the pipe axis in the vertical position) shall be qualified in the 2G pipe test position.

Welders welding pipe (in the fixed position (not rotated) with the pipe axis in the horizontal position) shall be qualified in the 5G pipe test position.

The 6G test position, if used, shall qualify welders only for the flat rotated welding position.

Q210.5 Fabrication Control

Fabrication, assembly, and erection shall be in accordance with ASME B31.1 and design documents.

Q210.5.1 Backing Rings and Retainers

Backing rings for nonboiler external piping shall be used only where specifically permitted by this specification or design documents. When used, backing rings shall only be the split band type with pins. Backing rings that become a permanent part of the weld shall be made from material of weldable quality, compatible with the base material, and the sulfur content shall not exceed 0.05 percent.

Backing rings shall not be used in boiler external piping systems.

Nonmetallic retainers or nonfusing metal retainers shall not be used unless specified in the Welding Procedure Specification (WPS). When used, they shall be removed.

Q210.5.2 Preheat and Postweld Heat Treatment

Preheat and postweld heat treatment (PWHT) shall be in accordance with the WPS, ASME B31.1, and design documents.

Stainless steel flow nozzles inside carbon steel or low alloy steel pipe shall not be postweld heat treated. An acceptable alternative is to butter each pipe member by applying weld metal (buttering) to a minimum thickness of 3/16 inch (5 mm) (after machining), heat treat each pipe member, then weld the two pipe members together with flow nozzle installed. (Refer to ASME Section IX, Article QW-283 Welds with Buttering.)

Q210.5.2.1 Interruption of Welding. The conditions for interruption of welding specified in ASME B31.1, Paragraph 131.6, shall be provided in the WPS or other work control document to ensure that the minimum preheat temperature is maintained as required.

Q210.5.3 Safe End Pipe Connections

Equipment connections such as turbine connections, fabricated from unassigned material specifications, i.e., non-ASME/ASTM materials or materials not permitted by ASME B31.1, shall have a safe end attached by the Supplier on each equipment connection to Owner's piping. The safe end shall comprise a pipe stub of the same ASME/ASTM material specification as the adjoining Owner's piping, including mechanical and chemical properties, dimensional size, and end preparation. Material certifications shall be supplied for all safe end pipe stubs. The minimum safe end stub length shall be as follows:

12 inches (300 mm) for material 6 inches (150 mm) inside diameter or less.

16 inches (400 mm) for material 6 inches (150 mm) through 14 inches (350 mm) inside diameter.

24 inches (600 mm) for material over 14 inches (350 mm) inside diameter.

If the use of safe ends is not feasible, and if acceptable to Owner, then the Supplier shall furnish weld test coupons for Owner's welding procedure qualifications in lieu of safe ends in accordance with the following requirements:

Material certifications shall be supplied with all material used for weld test coupons.

The weld test coupon material shall be of the same material, chemical composition, and mechanical properties, type, and/or grade as the equipment connection, such as the valve or nozzle that it represents.

The material quantity shall be sufficient to complete the required test for the welding procedure qualification prescribed by the governing ASME code and/or standard. As a minimum, the weld test coupon material product form shall be of adequate size and thickness to permit removal of the required test specimens and to qualify the joint thickness required for the production weld.

The weld test coupon material shall be delivered in adequate time to support the welding procedure qualification and production schedules as defined by Owner.

Q210.5.4 Weld End Preparation

Preparation of butt welding ends of piping components shall be as follows:

Shop welds prepared in accordance with the fabricator's standard end preparation details and WPS.

Field welds prepared in accordance with ASME B16.25 and the following tables.*

Table Q210-1 Field Butt Joint Weld Prep

Wall Type	Wall Thickness	ASME B16.25 Detail**
Nominal (schedule)	Over 7/8 inch (22 mm)	Fig. 3 (c)***
	5/8 inch (16 mm) to 7/8 inch (22 mm)	Fig. 2 (c)***
	Under 5/8 inch (16 mm)	

	Valves	Fig. 2 (b)
	Pipe and fittings	Fig. 2 (a)
Special (minimum wall)		Fig. 2 (c)*** or Fig. 3 (c)***

***Exception**: When weld joint details are otherwise specified by design documents, they shall be prepared in accordance with the design documents.

**To prevent damage during shipping and installation, Figures 5 and 6 from ASME B16.25 shall not be used for end preps of field welds.

***No backing rings allowed.

Table Q210-1a. Large Dia. and Other Field Butt Joint Weld Prep (1)

Pipe Dia. (in. (mm))	Wall Thickness (t)	Groove Type (2)	Max. Permitted Misalignment
> 26 - 48 (> 650 – 1200)	All	Single V-groove	1/8” (3 mm) max. permitted at ID surface For OD surface, see Note (4)
> 48 (1200)	< 3/4 (19 mm)	Single V-groove	
> 48 (1200)	≥ 3/4 (19 mm)	Double V-groove (3)	3/8” (10 mm) max. (4)
All	< 1/8 (3 mm)	Ends square	

Notes:

1) Specified joints are applicable only for carbon steel, low energy piping systems with low internal cleanliness requirements.

2) 37.5 +/- 2.5 degree bevel each side, 3/32” +/- 1/32” (2.5 +/- 1 mm) root face.

3) V-groove centered at mid-thickness.

4) If misalignment occurs, the base metal and/or the weld metal face shall be sloped 3:1 to provide a gradual transition. The minimum weld throat thickness shall meet the minimum wall thickness requirements of the pipe.

The difference between major and minor diameters for a distance of 3 inches (75 mm) from the ends of the pipe shall not exceed 1/8 inch (3 mm) or 1 percent of the nominal diameter, whichever is less.

To ensure satisfactory fit-up for circumferential butt welds in piping systems fabricated of rolled and welded plate, the following procedures shall be followed:

Concentricity. If weld metal is used to obtain concentricity, the weld deposit shall be free from porosity or other defects, and the inside surface shall be ground smooth and blended smoothly into the pipe wall.

Nondestructive Examination (NDE). Additional NDEs specified herein shall be evaluated in accordance with ASME B31.1, Power Piping Code, Paragraph 136.4, as applicable.

Radiographic or Ultrasonic Examination. Upon completion of the weld buildup and finishing procedures, the area shall be radiographed or ultrasonically examined (in accordance with ASME B31.1, Paragraph 136.4.5 or 136.4.6, as applicable) prior to shop welding to other sections or prior to shipment. The radiographs or ultrasonic records, as

applicable, shall be submitted to Owner to permit complete analysis of the joint after field radiography or ultrasonic examination.

Pipe ends for socket-weld connections shall be reamed to full inside diameter to remove all burrs and obstructions and to ensure proper assembly in accordance with ASME B31.1, Paragraph 127.3(E).

When weld joint details are specified by design documents, they shall be prepared in accordance with design documents.

Q210.5.5 Stamping of Carbon and Low Alloy Steel Pipe
Information may be stamped directly on carbon or low alloy piping with "low stress" die stamps such as interrupted dot or round nose types.

Carbon steel stamps shall not be used on stainless steel or nickel base alloy materials.

Stamping shall not damage material or reduce the wall thickness to less than design requirements.

Q210.6 Nondestructive Examination (NDE)

NDE of welds shall be performed in accordance with ASME B31.1, Table 136.4, and as defined in the following subarticles.

Q210.6.1 Supplemental NDE for Cold Reheat System Piping
When the cold reheat system design conditions (pressure and temperature) of ASME B31.1, Table 136.4, do not require NDE other than visual examination (VT), the following supplemental NDE is required:

All circumferential piping butt joint welds in piping directly from the steam generator(s) to the steam turbine connection(s) shall be 100 percent examined by radiographic testing (RT) or ultrasonic examination (testing) (UT) and shall meet the acceptance standards of ASME B31.1.

All piping branch connection joint welds that are over 4 inch (100 mm) nominal pipe size connecting to piping directly from the steam generator(s) to the steam turbine connection(s) shall be 100 percent magnetic particle (MT) or liquid penetrant (PT) examined and shall meet the MT or PT acceptance standards of ASME B31.1.

Q210.6.2 Time of NDE Examination
In lieu of the ASME B31.1 paragraph 136.4.1 requirement that final NDE for P-Numbers 3, 4, 5A, 5B, and 15E be performed after PWHT, the Supplier/Subsupplier may perform the final NDE prior to PWHT with the following exceptions:

When the final RT or UT examination of welds is performed prior to PWHT for P-Number 15E (Grades 91 and 92), the applicable welds shall also require a final MT or PT surface examination after completion of PWHT.

Final VT examination of P-Numbers 3, 4, 5A, and 5B welds shall be performed after PWHT.

Q210.6.3 Ultrasonic Examination
UT may be used in lieu of RT when a volumetric examination is required by ASME B31.1, Table 136.4, or is required by design as defined herein, provided all of the following requirements are met:

The UT techniques of phased array ultrasonic examination (PAUT) or time of flight diffraction (TOFD) is required. The UT equipment used to perform the examination shall record the UT data to facilitate the analysis of the data by a third party and to ensure repeatability of subsequent examinations if requested or required by Owner. Where

physical obstructions prevent the use of systems capable of recording the UT data, manual UT may be used, provided Owner approval is granted.

Prior to production weld UT examination, the Supplier shall perform a UT demonstration examination using the same type of equipment as required for the production welds. The Supplier shall perform the demonstration examination using UT examination-qualified and certified individuals, procedures, and equipment to collect and analyze the UT data. The demonstration examination shall be performed on the same type of welds as required for the production welds using approved test blocks. The demonstration examination shall be witnessed by Owner, unless waived in writing by Owner. It is the Supplier's responsibility to schedule the performance demonstration examination in sufficient time to avoid any impact on design documents or production weld schedules.

The Supplier shall provide Owner all required UT equipment clearance dimensions to ensure that the welds can be properly identified for UT examination and that the UT examination can be performed with acceptable results.

The Supplier's qualified and certified UT Level III technician shall approve the procedure and all UT examination reports.

Q210.6.4 NDE of Temporary Attachment Removal Areas

Surface NDE of pressure boundary component temporary attachment weld removal areas outside the weld bevel area shall be performed as follows:

VT and MT or PT are required for temporary attachment removal areas on piping systems that are grouped in the piping design conditions of ASME B31.1, Table 136.4 for "Temperatures Over 750°F (400°C) and at All Pressures." This includes temporary attachment welds made by low energy capacitor discharge welding of thermocouple wire. VT is required for temporary attachment removal areas on all other piping system design conditions, as specified in ASME B31.1, Table 136.4.

Q210.6.5 NDE of Joints with Root Pass Welding Performed with RMD or STT Process (or Joints for Fill Passes Made with GMAW Pulse Spray Arc)

When volumetric examination is required by B31.1 Table 136.4 for pressure welds, the examination method shall be by phased array ultrasonic examination (PAUT) for joints with root passes deposited by GMAW-S and for joints with fill passes deposited with GMAW pulse spray transfer. PAUT shall be performed in accordance with the requirements of and the acceptance criteria defined in ASME B31.1 Clause 136.4.6 and Article Q210.6.3.

Use of radiographic examination (RT) may be used only with prior written approval of Owner. RT may be used for joint configurations that are otherwise not suitable for UT examination.

For groove welds without B31.1 mandatory volumetric examination requirements and which have been welded using the GMAW pulse-spray arc transfer mode a minimum of 10 percent of all pressure-retaining groove joints shall be examined by PAUT (except for piping welds with design temperature 100° C (212° F) or less). This NDE requirement shall apply to the welds deposited for each welder within each of the following pipe diameter ranges: NPS 8 (200 DN) and less and NPS 10 (250 DN) and larger. PAUT shall be performed in accordance with and the acceptance criteria defined in ASME B31 Case 189, “Use of Alternative Ultrasonic Examination Acceptance Criteria in ASME B31.1” (3Jan2013). If a weld fails to meet the acceptance criteria, an additional 10 percent minimum of that welder’s pressure-retaining groove weld joints within the indicated pipe diameter range shall be examined using the same techniques and acceptance criteria. Welds failing to meet the acceptance criteria shall be repaired and re-examined using PAUT.

Q210.7 Root-Pass Welding Process Restrictions and Limitations

Root pass welding requirements shall be in conformance with the assigned weld codes listed on the pipe line lists and as defined by Table Q210-2.

When the weld code definitions of Table Q210-2 for piping systems are not defined by the documents, the root pass installation on single welded complete penetration joints shall be deposited using the GTAW process, unless written approval has been granted by Owner.

Table Q210-2

Weld Code	General System Parameters	Backing Rings	Root Pass Weld Process (1)
W-1 (2)	Any systems that are designated as high energy or any systems that require a high cleanliness level at the completion of welding (without cleaning) or any alloy or stainless steel materials	Not permitted	GTAW (2)
W-2	Carbon steel piping in any moderate or low energy system that requires high cleanliness, for which the high cleanliness can be achieved during cleaning of system	Not permitted	Supplier's Option
W-3	Low energy carbon steel systems classified as low cleanliness	Not permitted	Supplier's option
W-4	Moderate or low energy carbon steel systems with low cleanliness	Permitted	Supplier's option
W-5	Large diameter (26 inch [650 mm] and larger) carbon steel, low energy, low cleanliness	Not permitted	Supplier's option

Notes:
1) Additional welding process restrictions specified herein are applicable.

Q210.7.1 Use of GMAW RMD or STT for Root Pass Welding

When permitted by the project documents and notes, the GMAW RMD or STT process may be used for root pass welding with the following restrictions (Table Q210.3).

Table Q210-3

System (or Alloy or Service)	Purge (Notes 3, 4, 5)
Austenitic Stainless Steel (Services: Demin water, cryogenic or steam)	Not required (1)
Austenitic Stainless Steel (Chemical or Acid Service or other General Service)	Yes
Duplex or Super Duplex Stainless Steels, Nickel alloys	Yes
ASME P-Nos. 3, 4, 5A	Not required
ASME P-No. 5B (5 Cr, 9 Cr)	Not required (2)

Table Q210-3	
System (or Alloy or Service)	**Purge (Notes 3, 4, 5)**
ASME P-No. 15E	(6)
Notes (Refer to Q210.7.1.1): (1) Purge is not required but is permitted. However, when welding stainless steel without purge using the RMD or STT processes, the following high silicon filler metal classifications are required, e.g., for 304L: ER308LSi, for 316L: ER316LSi. When welded without purge, pre-production weld testing of each heat/lot of filler metal is required to verify welds can be produced without internal root surface sugaring. (2) Purge is not required but is permitted; however, when welding without purge using the RMD or STT processes, consumables with silicon towards the upper limit of the allowable range of the filler metal specification (0.35% minimum) are required. When welding without purge, pre-production weld testing of each heat/lot of filler metal is required to verify welds can be produced without internal root surface sugaring. (3) Open root joints without backing. (4) GMAW-S or RMD or STT is not permitted in portions of piping systems which connect to critical equipment and which prior to operation, cannot be cleaned by means of chemical flushing, hydro lazing, steam blow, mechanical plus blowing means or similar methods to remove loose welding splatter. (5) GMAW-S, RMD, STT is not permitted for butt welds < NPS 4 (DN 100) except smaller diameters are permitted when the pipe is automatically rotated during welding. GMAW-S, RMD, STT is not permitted for branch welds < NPS 2 (DN 50). (6) Requirements of Q110, Technical Welding Supplemental requirements for welding grade 91 or grade 92 shall be followed.	

Q210.7.1.1 Allowable Purging Exemption (RMD/STT Processes). As listed in Table Q210-3, for ASME P-No. 5B materials and for service conditions which are considered “noncorrosive” to ASME P-No. 8 stainless steels (such as cryo service, demin water, steam and otherwise as determined by Engineering), root pass welding on piping utilizing controlled wave form variations such as the RMD or the STT welding processes may be performed without inert gas purging when effects of internal oxidation (e.g., sugaring) and excessive internal weld-metal reinforcement can be prevented or adequately controlled.

When operated without purging, each heat/lot of filler metal used with the RMD or STT process for 9Cr and higher chromium content alloys shall be pre-use tested contractor to verify lack of sugaring.

If internal sugaring cannot be adequately controlled without purging, then purging shall be applied during welding.

For “noncorrosive” service conditions, the presence of internal heat tint colors on ASME P-No. 8 stainless steels is not a point of inspection and hence not limited. Where practically feasible, the fabricator shall visually inspect/monitor internal piping surface profiles for unacceptable sugaring, as well as unacceptable conditions as identified in ASME B31.1, Chapter VI or B31.3, Chapter VI as applicable.

In service conditions which are considered corrosive to stainless steel, purging is required to limit the formation of heat tint.

Q210.7.1.2 Hot Pass Welding Precaution. For welds on ASME P-Nos. 5B, 15E and 8 made without purge, if the second pass is produced with excessive heat input, the second pass can remelt the first pass and may cause the root surface to sugar. The hot pass (e.g., second weld pass) should be operated with heat input low enough to avoid complete remelting of the root pass but yet high enough for good fusion.

Q210.7.1.3 Inspection Windows for Root Pass Welding (RMD or STT). For ASME P-Nos. 4, 5A, 5B and 15E and P-No. 8 pipe welds NPS 6 (DN 150) and larger, at least one inspection window is required for the purpose of root pass visual examination. If a weld can be readily examined from an open pipe end an inspection window is not required, but visual examination of the root pass is still required.

Visual examination is to be performed prior to welding the second pass. For horizontal pipe runs, the inspection window shall be located between the 2 and 4 o'clock position. The root pass surface (internal surface) shall be visually examined by the Contractor's inspector (and accepted) prior to completing the remainder of the root pass.

The following conditions are unacceptable: cracks, weld wire whiskers, undercut greater than 1/32 inch (1.0 mm) deep, lack of fusion, incomplete penetration, excessive melt-through, porosity or a hole through the weld.

Q280 Welding of Pipe Supports

Q280.1 General

This Technical Supplemental Specification provides requirements for welding American Society of Mechanical Engineers (ASME) B31.1, B31.3, and B31.12 pipe supports, including shop and field fabrication. This Technical Supplemental Specification shall be used in conjunction with design documents and Section Q100 of the Welding Technical Supplemental Specifications.

References:

- ASME B31.1: Power Piping Code
- ASME B31.3: Process Piping Code
- ASME B31.12: Hydrogen Piping Code
- ASME Sect. IX: Qualification Standard for Welding Procedures and Welders
- AWS D1.1: American Welding Society, Structural Welding Code – Steel
- AWS D1.6: Structural Welding Code – Stainless Steel
- (MSS) SP-58: Manufacturers Standardization Society of Valve and Fitting Industry, Pipe Hangars and Supports.
- Canadian Standards Association (CSA)
  - W59, Welded Steel Construction; W47.1,
  - Certification of Companies for Fusion Welding of Steel.
  - W178.1, Certification of Welding Inspection Organizations
  - W178.2, Certification of Welding Inspectors
  - CAN/CGSB-48.9712, ISO 9712, Non-destructive Testing – Qualification and Certification of T Personnel.

Manufacturing requirement for <u>standard</u> pipe supports (e.g., types defined in SP-58)

Code	Manufacturing Requirement
B31.1	B31.1 Clause 130.1, SP-58
B31.3	SP-58
B31.12	B31.12, GR-3.4.13 (a): SP-58 and specific requirements of Chapter GR and the specific requirements of Part IP or PL

Note: Where SP-58 is referenced, permitted welding standards are as follows:

ASME IX, or AWS D1.1 for carbon steels. B&V will permit AWS D1.6 for austenitic stainless steels.

In lieu of AWS D1.1 for carbon steel fabrication, B&V will permit fabrication of carbon steel under above referenced CSA Standards (contractor to prepare and submit a quality plan for review and acceptance by Owner)

Manufacturing requirement for non-standard pipe supports (e.g., types not defined in SP-58)

Code	Manufacturing Requirement
B31.1	B31.1, Par. 130.2
B31.3	B31.3, Chapter V (or AWS D1.1 for plain carbon steels or AWS D1.6 for austenitic stainless steels)
B31.12	B31.12, GR-3.4.13 (a) and specific requirements of Chapter GR and specific requirements of Part IP or PL.

Q280.1.1 Jurisdiction Boundaries for Pipe Supports

For the purpose of defining the jurisdictional boundary between a pipe support and the building structure, structural members shown on civil/structural drawings of the power plant or other structure and considered in the building structural analysis may be designated a building structure even though it is located in the support load path.

Structural members detailed on pipe support drawings that are installed and used for the primary purpose of supporting piping are considered pipe supports, including the attachment (welded or not welded) to the surface of the building structure or other miscellaneous structural steel.

Unless otherwise specified by a design document, the boundaries of jurisdiction for pipe support welds shall be defined as follows:

Welds attaching pipe supports to a building structure or miscellaneous structural steel shall conform with the following requirements:

Code	Welding
B31.1	Carbon steel to carbon steel: AWS D1.1 Stainless to Stainless: AWS D1.6 or ASME IX. Other Material combinations: ASME IX
B31.3	
B31.12	

The boundaries of jurisdiction for pipe support welds that are attached to the piping pressure boundary system are governed as follows:

Code	Welding and Inspection
B31.1	Welds that attach hangers, supports, guides, anchors, or other attachments to the piping system pressure boundary shall conform to the requirements of the ASME B31.1, B31.3 or B31.12 piping system governing code section and as specified
B31.3	
B31.12	

	in other Welding Technical Supplemental Specifications, as applicable. Welded attachments to the piping system pressure boundary are not applicable to this Technical Supplemental Specification.

Q280.2 Welding Processes

Permitted welding processes shall be as specified in Section Q100 and shall include the restrictions and limitations applicable to those processes as specified herein.

Q280.2.1 Welding Process Restrictions and Limitations

The Gas Metal Arc Welding (GMAW) process shall not be used for welding P-15E (9 Cr-1 Mo-V) material.

The GMAW process utilizing the short-circuiting or globular arc transfer mode shall not be used in any application.

The weld progression for manual or semiautomatic vertical position welds shall be uphill.

The Flux Cored Arc Welding (FCAW) process shall only be used with shielding gas.

The FCAW process shall not be used for root pass applications in single-welded complete penetration weld joints without backing or without backgouging and backwelding.

The Shielded Metal Arc Welding (SMAW) process shall not be used for root pass applications in single-welded complete penetration weld joints of low alloy steel, stainless steel, or nickel alloy steel materials without backing or without backgouging and backwelding. The SMAW process using filler Metal E6010 or E7010-A1 may be used for root pass installation only in single-welded joints of carbon steel materials when the root pass is subsequently removed by backgouging and backwelded.

Q280.3 Welding Procedure and Welder Performance Qualification

Refer to Articles Q280.1 and Q280.1.1.

Q280.4 Fabrication Control

The following materials shall not be welded unless otherwise indicated by the design documents:

Bolting materials, nuts, and washers.

Any carbon or alloy steels containing more than 0.35 percent carbon.

Base metal for mislocated holes shall not be restored by welding.

Welding across the flanges of Owner's structural steel members (welds that are transverse to the beam or column center line) shall not be an acceptable practice, and all welded interfaces to Owner's steel structure shall be designed to specifically avoid this condition. Design of such interfaces shall achieve full required design strength and stability by means other than welds applied across flanges.

The parts to be joined by fillet welds shall be brought into as close contact as practicable. The root opening shall not exceed 3/16 inch (5 mm). If the separation is greater than 1/16 inch (1.6 mm), the legs of the fillet weld shall be increased by the amount of the root opening. For example, if the specified fillet weld size is 3/16 inch, but the root opening is 3/16 inch, the required weld size must be increased to 3/8 inch (10 mm) to be acceptable.

Bolt holes shall not be established by thermal means. Thermal cutting or gouging may be used for other applications. When thermal cutting or gouging methods are used, the final sizing shall be by mechanical means to remove all heat affected material.

Base metal irregularities requiring repair by welding shall be repaired in accordance with the material specification or American Society for Testing and Materials (ASTM) A6, as applicable.

Creep strength enhanced ferritic (P15E) pipe support components that have been hot formed shall be normalized and tempered in accordance with the requirements of MSS SP-58 (or the original mill heat treatment) prior to welding.

Q280.5.1 Backing Strips and Retainers
Backing strips may be used, provided they are removed. Backing strips shall be made from material of weldable quality and shall be compatible with the base material.

Nonmetallic retainers or nonfusing metal retainers shall not be used unless specified in the Welding Procedure Specification (WPS). When used, they shall be removed.

Q280.5.2 Preheat and Post Weld Heat Treatment
For all welding, the minimum preheat shall be performed in accordance with the WPS applicable to the materials listed, the fabrication code or standard, and the design documents. Pipe support welds that attach to the building structure or other miscellaneous structural steel may require an elevated preheat due to the material thickness of the steel and material type. The thickness used to determine preheat requirements shall be the thickness of the thickest part at the point of welding. The minimum preheat temperature shall be specified in the WPS. As a minimum, the preheat temperature of the attachment weld to the building structure or other miscellaneous structural steel shall be 200° F (95° C) for a thickness more than 1-1/4 inch (32 mm). When welding two different P-number or S-number materials, the minimum preheat temperature shall be the higher for the material to be welded. Post weld heat treatment is not required except as required by the fabrication code or standard and the WPS being used.

MSS SP-58 defines the minimum preheat temperature and any required post weld heat treatment. The preheat requirements of MSS SP-58 for standard pipe hangers and supports take precedence over the preheat requirements of AWS D1.1.

Q280.6 Nondestructive Examination

In addition to the 100 percent visual examination required of all welds, other required nondestructive examination (NDE) of welds shall be performed in accordance with the NDE method specified on the applicable pipe support drawing or other specified design document.

Unless otherwise specified on the applicable pipe support drawing or other specified design document, the visual examination (VE) and other NDE acceptance criteria for both ASME B31.1, B31.3, and B31.12 pipe supports shall comply with the following requirements, as applicable.

ASME Code	Inspection and Acceptance Criteria
B31.1	B31.1, Par. 136.4
B31.3	B31.1, Par. 136.4
B31.12	B31.12 Chapter GR-4 and the specific requirements of Chapter IP-10 or PL-3.19. Note: hardness testing of pipe support materials or weld zones is not required.

Welded joints shall not be painted until after welding has been completed and the weld accepted.

All defects found shall be removed, repaired, and re-examined by the same NDE method that identified the original defect.

Q280.6.1 Visual Examination (VE) Acceptance Criteria
The following VE acceptance criteria are applicable to all ASME B31.1, B31.3, B31.12, and MSS SP-58 pipe supports fabricated in accordance with this Technical Supplemental Specification.

The following indications, discontinuities, or conditions are unacceptable:

Any crack regardless of size or location.

Undercut that is greater than 1/32 inch (1.0 mm) deep or encroaches on the minimum required section thickness.

Weld reinforcement greater than 5/32 inch (4.0 mm) for t $\leq$ 1/2, 3/16 inch for t > 1/2 inch-1 inch, and 1/4 inch for t > 1 inch.

Any lack of fusion between adjacent layers of weld metal and between weld metal and base metal.

Any incomplete penetration for complete penetration weld joints (applies only when the inside surface is readily accessible).

Any linear indications greater than 3/16 inch (5.0 mm) long.

Underfill for groove weld butt joints.

Overlap for groove or fillet weld joints.

Note: Only surface porosity whose major surface dimension exceeds 1/16 inch (1.5 mm) shall be considered relevant. Fillet and groove welds that contain surface porosity are unacceptable if the following occurs:

Surface porosity with rounded indications having dimensions greater than 3/16 inch (5 mm) or four or more rounded indications separated by 1/16 inch (1.5 mm) or less edge to edge in any direction.

All craters shall be filled to provide the specified weld size, except for the ends of intermittent fillet welds outside their effective length and craters that occur outside the specified weld length; these are irrelevant, provided there are no cracks.

A fillet weld is permitted to be less than the leg size specified by 1/16 inch (1.5 mm) not to exceed 10 percent of the weld length. Oversized fillet welds are acceptable if the oversized weld does not interfere with mating parts.

Welds shall be visually free of slag. Tightly adherent spatter remaining after the weld and adjacent base metal cleaning operation is acceptable unless its removal is required for the purpose of other required NDE or required coating surface preparation requirements.

Q280.6.2 VE Acceptance Criteria for Attachment Welds to Structural Steel
Welds attaching supports to structural steel shall be visually examined in accordance with AWS D1.1 and acceptance criteria and as specified in design documents.

Q320 Galvanizing

Structural steel members and steel assemblies shall be "pickled" after all cutting, punching, reaming, drilling, tapping, and other fabrication processes, which damage galvanizing, have been completed. The pickling shall be done in accordance with the latest accepted practice and shall continue until all scale,

rust, grease, and other impurities have been completely removed. The steel shall then be hot-dip galvanized.

When either member to be bolted is galvanized and where required by the technical specifications, erection and structural bolts shall be galvanized.

Q320.1 Codes and Standards

Work performed under this specification shall be done in accordance with the following codes and standards. The version that is latest adopted, published, and effective at the date of bid shall apply unless specifically stated otherwise:

Work	In Accordance With
Hot-dip galvanizing	ASTM A123, ASTM A153, ASTM A792, or ISO 1461, ASTM A385
Bolt galvanizing	ASTM B695, F2329

Q320.2 Lead and Chrome Limitations

Galvanizing metal shall contain less than 0.06 percent lead by weight and less than 0.06 percent chrome by weight.

Q320.3 Reflectivity Limitations

Where required by the technical specifications, the surface of newly galvanized structural members shall be dulled utilizing a zinc phosphating process. The zinc phosphate solution may be applied by either spraying or immersion in tanks. Purchaser shall specify the maximum surface reflectivity prior to any work being performed.