

OWNER

Welding

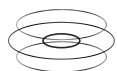


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TORUS

[REDACTED] [REDACTED], [REDACTED] County, [REDACTED]

ISSUE SUMMARY AND APPROVAL

This page records each issue of SPC-SPC-007. The preparer, reviewer and approver sign for each revision.

Rev.	Date	Issue purpose	Description
A	2026-09-29	Issued for Review	First issue

Contributors

Rev.	Discipline	Prepared by	Reviewed by	Approved by
A	Specifications			

SECTION PC-SPC-007 WELDING

PART 1 GENERAL

1.01 SUMMARY

A. Section includes the qualification of welding procedures and welders, welding consumables, preheat and interpass control, production welding, weld identification, repair and removal of defects, and hot work controls for all shop and field welding on pressure-containing piping and on attachments to pressure parts, between IJ-101 and IJ-102 and on the outlet lateral from IJ-102 to the tap valve flange of (the receiving pipeline operator). It applies to carbon steel piping classes A6, A1 and D1, and to the austenitic stainless steel vent and blowdown class S1, including vent stack VS-101, as defined in PIP-SPC-001.

B. Related sections:

1. SPC-SPC-001, General Requirements and Definitions.
2. SPC-SPC-004, Structural Steel, Canopy and Pipe Supports (structural welding to AWS D1.1).
3. SPC-SPC-006, Piping Fabrication and Installation.
4. SPC-SPC-008, Nondestructive Examination.
5. SPC-SPC-011, Hydrostatic Testing, Dewatering and Drying; SPC-SPC-012, Tie-in, Hot Tap Coordination and Purging.
6. SPC-SPC-017, Mechanical Equipment Setting (vendor shop welding records).
7. SPC-SPC-019, Inspection and Test Plan; SPC-SPC-020, Construction Records and Turnover.

C. Work by others: welding on the trunkline and the hot tap fitting is by the receiving pipeline operator, under its procedures, API 1104 Annex B and API RP 2201. Vendor shop welding of pressure equipment is by the vendors.

1.02 GOVERNING CODE BY ITEM

A. Procedures, welders and production acceptance shall follow the code assigned to each item in Table 1-1. Class S1 is qualified to ASME Section IX only, because API 1104 does not cover austenitic stainless steel.

Table 1-1: Welding Code by Item

Item	Procedure and welder qualification	Production acceptance
Girth welds in carbon steel line pipe and MSS SP-75 fittings, NPS 2 and larger, classes A6, A1 and D1	API 1104, 22nd Edition, Clauses 5 and 6, with the supplements of this section	API 1104 Clause 9 and the Owner's additions in SPC-SPC-008

Item	Procedure and welder qualification	Production acceptance
Branch connections (MSS SP-97 outlets, weld-on flanges) and socket welds NPS 1-1/2 and smaller	API 1104 or ASME Section IX	Visual to API 1104, plus magnetic particle or penetrant testing
Shop-fabricated station spools	API 1104 or ASME Section IX, as ASME B31.8 paragraph 823 permits, with the supplements of this section	As field welds
ASME Section VIII items (V-101, PR-101 barrel, H-101 coil manifolds), vendor shop welding	ASME Section IX	ASME Section VIII Division 1 (vendor scope)
Class S1 stainless vent and blowdown piping, orifice downstream flanges and VS-101	ASME Section IX only	3.14 and [REDACTED] SPC-SPC-008
Structural attachments to pressure parts (shoes, trunnions, lugs)	As the pressure part weld; low-hydrogen processes only	Visual and magnetic particle testing
Structural steel not attached to pressure parts	AWS D1.1 under [REDACTED] SPC-SPC-004	AWS D1.1
Any weld on the trunkline, the hot tap fitting or an in-service line	Not in the Contractor's scope (3.09)	

1.03 REFERENCES

A. Codes and standards:

- 49 CFR 192 Subpart E: 192.225 (welding procedures), 192.227 (welder qualification), 192.229 (limitations on welders), 192.231 (protection from weather), 192.233 (miter joints), 192.235 (preparation for welding), 192.241 (inspection and test of welds), 192.243 (nondestructive testing) and 192.245 (repair or removal of defects).
- API Standard 1104, 22nd Edition, Welding of Pipelines and Related Facilities: Clause 5 (procedure qualification), Clause 6 (welder qualification), Clause 7 (production welding), Clause 9 (acceptance standards), Clause 10 (repair and removal of defects) and Annex B (in-service welding).
- ASME B31.8-2022, Chapter II (Welding).
- ASME B31.3-2022, Process Piping, Chapter V, where [REDACTED] PIP-SPC-001 assigns class S1 to it.
- ASME Boiler and Pressure Vessel Code, Section IX, Welding, Brazing and Fusing Qualifications, and Section II Part C (filler metals).
- AWS A5.1, A5.4, A5.5, A5.9, A5.18, A5.20, A5.28 and A5.29 (filler metals); AWS A4.2 (ferrite number measurement); AWS D18.2 (heat tint guide); AWS QC1 (Certified Welding Inspector).
- ASTM A380 and A967 (cleaning and passivation); ASTM E23 (Charpy impact testing); ASTM E92 and E384 (Vickers hardness).
- API RP 2201, Safe Hot Tapping Practices in the Petroleum and Petrochemical Industries (reference to the receiving pipeline operator's work).

9. NFPA 51B, Fire Prevention During Welding, Cutting and Other Hot Work; 29 CFR 1910.252 and 29 CFR 1926 Subpart J.

B. Project documents: GEN-DB-001, Basis of Design; PIP-SPC-001, Piping Material Specification; MEC-LST-001, Line List; MEC-CAL-001, Pipe Wall Thickness; PIP-DWG-004, Tie-in and Outlet Lateral; MEC-LST-004, Tie-in List; CON-RPT-003, Construction HSE Plan.

1.04 DEFINITIONS

- A. WPS and PQR: welding procedure specification and procedure qualification record.
- B. CE(IIW): carbon equivalent, $C + Mn/6 + (Cr + Mo + V)/5 + (Ni + Cu)/15$.
- C. CE(Pcm): $C + Si/30 + (Mn + Cu + Cr)/20 + Ni/60 + Mo/15 + V/10 + 5B$.
- D. Tie-in weld: a girth weld that joins two separately tested sections, or a closure weld.
- E. Repair: removal of part of a weld defect by grinding or gouging, and re-welding with a qualified repair procedure, without cutting out the joint.
- F. Cut-out: removal of the complete weld and heat-affected zone, re-bevelling and re-welding.
- G. In-service welding: welding on piping that contains gas under pressure or flow.
- H. CWI: AWS Certified Welding Inspector.

1.05 SUBMITTALS

- A. The Contractor shall submit the items in Table 1-2 for the action shown.

Table 1-2: Submittal Schedule

No.	Submittal	Timing	Action
07-01	Welding quality plan: organization, CWI, weld tracking system, consumable control, weather protection, repair rate monitoring	30 days before the first production weld	EOR approval
07-02	WPS and supporting PQR for every process, material group, wall range, diameter group, joint type and repair procedure, stating CE limits, preheat, interpass temperature and heat input range	Proposed WPS 30 days before qualification welding; final WPS and PQR 7 days before production	EOR approval
07-03	PQR laboratory reports: tensile, nick-break or macro, bend, Charpy impact at -20 °F, hardness traverse	With the PQR	EOR approval
07-04	Welder qualification records per welder and WPS, and the welder register	Before each welder starts production	Owner review
07-05	Consumable certificates: classification, lot certificates, diffusible hydrogen designation	Before use	Owner review

No.	Submittal	Timing	Action
07-06	Oven, contact thermometer and temperature-indicating crayon calibration records	Before use and every 6 months	Owner review
07-07	Daily weld log: weld ID, welders per pass, WPS, heat numbers on both sides, preheat, interpass, date	Daily	Information
07-08	Weld maps (as-welded isometrics and alignment sheets)	Weekly and at turnover	Owner and EOR review
07-09	Repair and cut-out log with defect type, weld ID, repair WPS and re-examination report	Weekly	Owner review
07-10	Welder continuity log (3.04)	Monthly	Owner review
07-11	Hot work permit procedure and gas monitoring plan (3.10)	14 days before the first hot work	Owner approval
07-12	Tie-in weld procedure and sequence for each tie-in in MEC-LST-004	14 days before the tie-in	EOR approval
07-13	S1 stainless WPS and PQR to ASME Section IX, with the ferrite number of the PQR weld, back-purge method, oxygen limit and interpass limit	30 days before S1 qualification welding	EOR approval
07-14	S1 purge gas certificates (argon 99.995 %) and oxygen analyzer calibration within the previous 6 months	Before S1 welding	Owner review

1.06 QUALITY ASSURANCE

A. Personnel shall meet Table 1-3.

Table 1-3: Welding Personnel

Role	Minimum qualification
Contractor welding quality control	AWS CWI with 3 years of pipeline experience, full time on site during welding
Welders	Qualified under 3.02 (carbon steel) or 3.14 (S1), and qualified under the Owner's operator qualification program for covered tasks
Owner's welding inspector	AWS CWI, or API 1169 with welding endorsement

B. Hold and witness points shall be as listed in 3.15 and in SPC-SPC-019.

1.07 DELIVERY, STORAGE AND HANDLING OF CONSUMABLES

A. Low-hydrogen electrodes shall be stored in unopened hermetic containers, or in holding ovens at 250 to 300 °F once opened. Portable rod ovens at the work front shall be kept at 150 °F minimum and energized at all times.

B. Exposure outside the oven shall not exceed 4 hours for E7018-H4R, or 9 hours for electrodes with the R suffix where the manufacturer certifies it. After exposure, electrodes shall be rebaked

once at the manufacturer's temperature (typically 650 to 800 °F for 1 hour) or discarded.
Electrodes rebaked once and exposed again, and wet or damaged electrodes, shall be discarded.

- C. Cellulosic electrodes shall be stored in closed original containers at ambient temperature, shall never be baked, and shall be discarded if wet.
- D. Flux-cored and solid wire shall be stored dry in original packaging, with partly used spools protected in the feeder or re-bagged.
- E. Consumable lots shall be recorded on the daily weld log for traceability.
- F. Stainless consumables shall be stored apart from carbon steel consumables in labelled containers, with filler rods kept in closed tubes and wiped clean before use. A carbon steel rod found in a stainless rod tube shall quarantine the tube.

1.08 MEASUREMENT AND PAYMENT

- A. Welding shall not be paid separately. It is included in pay items 06.01, 06.02 and 06.03, together with procedure qualification, welder testing, mechanical testing, consumables, heating equipment, shelters, weld maps and records. Repairs and cut-outs, including re-examination, shall be at the Contractor's cost. Standby during the receiving pipeline operator's in-service welding and hot tap is paid under pay item 12.02.

PART 2 PRODUCTS

2.01 BASE METALS

- A. Base metals are defined in GEN-DB-001 and PIP-SPC-001: API 5L X52 PSL2 line pipe, Charpy impact tested at -20 °F (0.500 in wall on outlet lateral 1042 and its 3R riser bends); MSS SP-75 WPHY-52 fittings; ASTM A105N forgings with supplementary Charpy impact testing at -20 °F (ASTM A350 LF2 Class 1 as the alternate) and ASTM A694 F52 where the class requires; ASTM A106 Grade B small-bore pipe; and, for class S1, dual-certified 304/304L or 316/316L stainless pipe, fittings and flanges.
- B. Dissimilar welds between S1 and carbon steel shall not be made. Every S1 to carbon steel class break is a flanged joint.
- C. Each WPS shall cover the actual CE(IIW) range of the heats supplied, as shown on the MTRs. Heats with CE(IIW) above 0.43 shall require a separate WPS, or a PQR demonstrating the preheat of 3.06, approved by the EOR.

2.02 CONSUMABLES

- A. Consumables shall be Contractor-furnished and shall meet Table 2-1.

Table 2-1: Welding Consumables

Process	Use	Consumable (AWS)	Limitation
SMAW, cellulosic	Root and hot pass of butt welds, X52 and lower, downhill	E6010 or E7010-P1	Not for fillet, socket, attachment or repair welds
SMAW, low-hydrogen	Fill and cap; all fillet, socket, attachment, repair and tie-in welds; root where the WPS requires	E7018-H4R, E8018-C3 H4R (uphill) or E8045-P2 H4R (downhill)	Diffusible hydrogen 4 mL/100 g or less
GMAW, mechanized or semi-automatic	Fill and cap; root with internal welder or controlled short-circuit transfer	ER70S-6, ER80S-G	Shielding gas dew point -40 °F or lower; wind protection per 3.07
FCAW, gas or self-shielded	Fill and cap	E71T-1C H4 or E71T8-Ni1 H8	Self-shielded H8 wire only on fill and cap, walls 0.500 in and less
GTAW, carbon steel	Root of small-bore butt welds; socket welds NPS 1-1/2 and smaller	ER70S-2, ER70S-6	Argon 99.99 %
GTAW, stainless (S1)	Root and hot pass of all S1 butt welds; complete welds up to 0.25 in wall; socket welds	ER308L on 304/304L, ER316L on 316/316L	Argon 99.995 % torch and back purge; deposit ferrite number 3 to 8
SMAW, stainless (S1)	Fill and cap on S1 walls over 0.25 in	E308L-16, E316L-16	Stored as low-hydrogen electrodes; no cellulosic or carbon steel consumables on S1

- B. Carbon steel weld metal shall match or overmatch the actual pipe yield strength, by at least 5 % of the X52 specified minimum yield strength unless the PQR shows otherwise, so that strain concentrates in the pipe and not in the weld. Weld metal nickel shall not exceed 1.0 %.

PART 3 EXECUTION

3.01 WELDING PROCEDURE QUALIFICATION

- A. Every WPS shall be qualified by the Contractor with a PQR witnessed by the Owner (hold point HP-07-02) on project material, using line pipe from a supplied heat with a CE near the top of the supplied range where available. The EOR may accept an existing PQR that meets all essential variables and the supplementary tests below.
- B. Testing shall comply with API 1104 Clause 5 (tensile, nick-break, and root and face or side bend) and with the Owner's supplementary tests in Table 3-1. The Charpy and hardness tests are added because API 1104 does not require them and the station operates at -20 °F minimum design metal temperature in dry sweet gas.

Table 3-1: Supplementary Procedure Qualification Tests

Test	Requirement
Charpy V-notch, weld metal and heat-affected zone (fusion line + 2 mm), three specimens each, full size where the wall permits	At -20 °F: average at least 20 ft·lb, single minimum 15 ft·lb (full-size equivalent); shear area reported
Vickers hardness HV10 traverse across cap, root, base metal, heat-affected zone and weld (ASTM E92)	250 HV10 maximum anywhere
Macro-etch cross section	Complete fusion; no cracks or lack of fusion; profile consistent with the WPS
All-weld-metal tensile, where overmatch must be shown	Yield at least 52 ksi; tensile at least 66 ksi

- C. The essential variables of API 1104 Clause 5 shall apply. In addition, the Owner shall treat as essential a heat input more than 10 % outside the PQR range and any decrease in preheat.
- D. Repair procedures (partial thickness, full thickness, back-weld, cap only) shall be qualified under API 1104 Clause 10 with the same supplementary tests.
- E. Each WPS shall state the heat input range in kJ/in and the maximum time from completion of the root to the start of the hot pass (typically 5 minutes for cellulosic roots).

3.02 WELDER QUALIFICATION

- A. Each welder shall be qualified under API 1104 Clause 6 (single or multiple qualification) or ASME Section IX QW-300 for the WPS used, and shall be tested at site under the Owner's witness (hold point HP-07-03). Qualifications from other projects shall not be accepted without a retest on this project, because the Owner wants every welder demonstrated on project materials and procedures.
- B. Test welds shall be examined visually, by radiography under SPC-SPC-008 and by the destructive tests the code requires. Radiography shall replace destructive testing only where API 1104 permits it and the Owner agrees. Welders qualified by multiple qualification shall also make the branch test.
- C. Each qualified welder shall receive a unique ID (for example W-01) and a photo card listing the WPSs and positions qualified, and shall be entered in the welder register (submittal 07-04).

3.03 WELDER PERFORMANCE MONITORING

- A. The repair rate of each welder shall be the number of welds with at least one rejectable indication divided by the number of welds examined, over a rolling 20 welds, reported weekly by welder, WPS and defect type (submittal 07-09).
- B. If a welder's repair rate exceeds 5 %, or the welder has two rejections in the first 10 welds, the Owner may require retraining and retesting. A welder with two consecutive welds rejected for cracks or incomplete fusion shall be removed from production until requalified.

3.04 WELDER CONTINUITY

- A. Under 49 CFR 192.229, a welder shall not weld with a process unless the welder has welded with that process within the preceding 6 calendar months. Because all station piping operates above 20 % of specified minimum yield strength, a welder's qualification shall also lapse unless at least one production weld by that welder was tested and found acceptable within the preceding 6 calendar months. The Contractor shall keep the continuity log (submittal 07-10).

3.05 JOINT PREPARATION AND FIT-UP

- A. Joints shall be prepared and fitted under [REDACTED] SPC-SPC-006. Surfaces to be welded shall be clean and free of paint, oil, rust, scale, moisture and coating for at least 1 in from the bevel, with fusion-bonded epoxy cut back under [REDACTED] SPC-SPC-009. Bevels shall be inspected visually and, on field-cut line pipe ends, checked ultrasonically for laminations under [REDACTED] SPC-SPC-008.

3.06 PREHEAT AND INTERPASS TEMPERATURE, CARBON STEEL

- A. This article applies to classes A6, A1 and D1. Class S1 is covered in 3.14.
- B. Minimum preheat shall be the greater of the WPS value and Table 3-2, applied uniformly for 3 in on each side of the joint (or three times the wall, whichever is greater). It shall be verified by contact thermometer or temperature-indicating crayon 1 in from the bevel on the side opposite the heat source, before tacking, and maintained until the joint is complete. For cellulosic roots, the joint shall be held at preheat at least until 50 % of the wall is deposited.

Table 3-2: Minimum Preheat, Carbon Steel

CE(IIW) of the higher-CE side	Wall 0.375 in and less	Wall over 0.375 to 0.750 in	Wall over 0.750 in
0.38 and less	50 °F (metal dry and warm)	150 °F	200 °F
Over 0.38 to 0.43	150 °F	200 °F	250 °F
Over 0.43 to 0.45	200 °F	250 °F	300 °F, with EOR approval
Over 0.45	Only with a specific PQR and EOR approval		

- C. Preheat shall be at least 200 °F for every cellulosic root pass, tie-in weld, repair weld and attachment fillet weld, regardless of CE and wall, because these joints carry the highest hydrogen cracking risk.
- D. Heating shall be by electric induction or resistance where practicable. Propane torches with rosebud tips are permitted; cutting torches shall not be used for heating.
- E. Interpass temperature shall not exceed 480 °F for line pipe and fittings, and 400 °F measured 3 in from an insulating joint body.

- F. A joint shall not be left with less than 50 % of the wall deposited, and never with only the root and hot pass, unless it is held at preheat. If work is interrupted, the joint shall be slow-cooled under dry insulating blankets, re-preheated before welding resumes, and examined by magnetic particle testing before resumption.
- G. Postweld heat treatment is not required for the walls on this project, unless the EOR determines otherwise. Section VIII items follow their code.

3.07 WEATHER PROTECTION

- A. Welding shall not be done when joint surfaces are wet, during rain, sleet, snow or blowing dust, or when wind would impair the arc or shielding, unless the joint is enclosed in a welding shelter.
- B. Wind at the arc shall not exceed 5 mph for GMAW and gas-shielded FCAW, or 20 mph for SMAW and self-shielded FCAW. Shelters shall be used to achieve these limits.
- C. Below 32 °F ambient, welding shall be done only with the preheat of 3.06 and shelters. Below 0 °F, welding shall be done only with the Owner's approval.
- D. Completed welds shall be protected from rapid cooling with dry insulating blankets until below 200 °F.

3.08 PRODUCTION WELDING

- A. Welding shall follow the approved WPS, and a copy of the WPS shall be kept at each welding station.
- B. On NPS 10 and larger, the root and hot pass shall be made by at least two welders working simultaneously on opposite sides where practicable, to limit distortion and root cooling time.
- C. Each pass shall be cleaned of slag and spatter by power brush or grinder before the next pass, and start and stop points shall be staggered by at least 1 in.
- D. Arc strikes outside the groove shall not be made. Any arc burn shall be removed by grinding, the area etched with ammonium persulfate and examined by magnetic particle testing, and the remaining wall verified by ultrasonic testing. An arc burn that cannot be removed within minimum wall shall be cut out.
- E. Cap reinforcement shall be 1/16 in minimum and 1/8 in maximum above the pipe surface, and the cap shall extend no more than 1/8 in beyond the groove edge on each side. The cap shall not be ground below the pipe surface.
- F. Tie-in welds. Final connections to equipment and to the tap valve are flanged so that no untested closure weld remains. A welded closure that cannot be tested with the system shall be made only where the Owner and the EOR approve it in writing under [REDACTED] SPC-SPC-011 article 3.11; 49 CFR 192 does not exempt such a weld from pressure testing, and the approval is an Owner and EOR decision under a written procedure. An approved closure weld shall be made with a pre-tested pup on each side, 200 °F minimum preheat and low-hydrogen processes for all passes, shall be examined as [REDACTED] SPC-SPC-011 and [REDACTED] SPC-SPC-008 require, and shall be identified as an untested closure weld in the maximum allowable operating pressure records.

- G. Branch connections shall be MSS SP-97 integrally reinforced outlets, with full-penetration groove welds by a low-hydrogen process and preheat under 3.06. Stub-ins and pad reinforcement shall not be used unless shown and approved.
- H. Socket welds shall have a gap of at least 1/16 in between the pipe end and the socket bottom before welding, set with a gap ring or by withdrawal, and shall be made in at least two passes by a low-hydrogen process or GTAW.
- I. Threaded joints in gas service shall not be seal welded unless [REDACTED] PIP-SPC-001 shows it.

3.09 IN-SERVICE WELDING

- A. The Contractor shall not weld, cut, grind or heat the trunkline, the hot tap fitting, the tap valve, or any Owner or third-party piping that contains gas.
- B. The hot tap fitting welding and the hot tap are performed by the receiving pipeline operator or its contractor, under its procedures, API 1104 Annex B and API RP 2201 (HOLD H-01 and H-04). Annex B procedures control burn-through risk, which depends on remaining wall, heat input and internal pressure and flow, and hydrogen cracking risk, which depends on the weld cooling rate. They are qualified on pipe filled with a flowing medium at a representative cooling rate, and the wall at the weld location is measured ultrasonically before welding.
- C. The Contractor shall provide access, the excavation and bell hole at the tap location where assigned under [REDACTED] SPC-SPC-012, shoring, and standby under pay item 12.02.
- D. Any future Owner welding on an in-service Owner line is outside this contract and shall require a separate API 1104 Annex B procedure, a cooling-rate analysis and EOR approval.

3.10 HOT WORK NEAR LIVE GAS

- A. A written hot work permit under NFPA 51B and [REDACTED] CON-RPT-003 shall be required for any welding, cutting or grinding within 50 ft of the trunkline or its right-of-way, of any pressurized Owner piping (including the upstream lateral at IJ-101 once live), of any vent or blowdown point, of T-101, or of any location where gas may accumulate.
- B. Before and during hot work, a calibrated four-gas monitor, bump tested daily, shall read 0 % of the lower explosive limit at the work point and in any adjacent excavation. Monitoring shall be continuous and work shall stop at 10 % of the lower explosive limit.
- C. No Contractor hot work shall take place within 10 ft of the trunkline, measured horizontally from the located pipe edge, or within its right-of-way, without the written approval and presence of the receiving pipeline operator (HOLD H-04).
- D. After any station section is connected to a gas source, welding on it shall take place only after the section is isolated by double block and bleed or a positive blind, depressurized, purged with nitrogen to below 1 % gas by volume, and the Owner has issued the permit.
- E. A fire watch shall be kept during hot work and for 30 minutes after it, with a 20 lb ABC extinguisher at each welding station and combustibles removed or protected within 35 ft.

3.11 REPAIRS AND CUT-OUTS

- A. Every repair shall be authorized by the Owner's inspector (hold point HP-07-05) on the basis of the NDE report and a qualified repair WPS.
- B. Repairs shall be limited as Table 3-3 shows. The Owner's limits are stricter than API 1104 Clause 10, which permits some crack repairs, because a crack in a weld at this design factor indicates a hydrogen or restraint problem that a local repair does not remove.

Table 3-3: Repair Limits

Defect	Disposition
Any crack, including crater, heat-affected zone and transverse cracks	Cut out the complete weld; no crack repair
Rejectable non-crack defects with aggregate repair length up to 30 % of the circumference	One repair attempt per location with the qualified repair WPS
Aggregate repair length over 30 % of the circumference	Cut out
A second repair at the same location	Not permitted; cut out
Repair of a weld previously repaired at a different location	Permitted once, with Owner approval
Back-welding (internal repair)	Only on NPS 24 and larger with EOR approval (not expected on this project)

- C. The defect shall be removed by grinding, or by air-arc gouging followed by grinding to bright metal, and complete removal verified by magnetic particle or penetrant testing before welding. The excavation shall be at least 2 in long. Preheat shall be at least 200 °F with a low-hydrogen process. The whole repaired area plus 2 in on each side shall be re-examined by the original method, and the finished repair by magnetic particle testing.
- D. A cut-out shall remove the weld and at least 1/2 in of base metal on each side. The new bevel shall be checked ultrasonically for laminations and re-welded as a new weld with a new weld ID suffix. Where a cut-out shortens a spool below tolerance, a pup of at least one diameter or 12 in, whichever is greater, shall be inserted with two new welds recorded on the weld map.

3.12 WELD IDENTIFICATION AND WELD MAP

- A. Weld IDs shall take the form (line number)-W(nnn), for example 12"-G-1003-A6-W014. A repair shall add R1 and a cut-out C1 (for the new weld); the second weld of an inserted pup shall take the next sequential number with the note "pup".
- B. The weld ID, the welder IDs for root, hot pass, fill and cap, and the date shall be marked 2 in from the weld on the downstream side with a low-chloride paint marker. Hard stamping of pipe shall not be used.
- C. Weld maps (as-welded isometrics above grade and alignment sheets below grade) shall show for every weld its ID, its location (surveyed coordinates for buried welds under SPC-SPC-006), the heat and joint numbers on each side, the WPS, the welders, the NDE report and result, the repair status, the coating number and the test section.

- D. Weld maps, daily weld logs, NDE reports and MTRs shall be cross-referenced so that each weld is traceable to its materials, procedure, welders, examination and pressure test, as 49 CFR 192.517 and 192.619 require.

3.13 VISUAL INSPECTION

- A. The Contractor's CWI shall inspect 100 % of completed welds before NDE, to the visual acceptance criteria of API 1104 Clause 9 and 3.08 E. S1 welds shall be inspected to the code [REDACTED] PIP-SPC-001 assigns to class S1 and to 3.14.

3.14 WELDING OF CLASS S1 AUSTENITIC STAINLESS STEEL

- A. Code. Procedures and welders shall be qualified to ASME Section IX. API 1104 procedures and qualifications shall not be used on S1. Production welding and examination shall follow the code [REDACTED] PIP-SPC-001 assigns to S1 (ASME B31.3 or B31.8) and [REDACTED] SPC-SPC-008. Every S1 butt weld, shop and field, shall be examined by 100 % radiography, or by ultrasonic testing where radiography is impractical and the EOR approves the technique.
- B. Procedure qualification. Qualification shall be on P-No. 8 base metal with a GTAW root, and GTAW or SMAW fill and cap, tested to ASME Section IX QW-150 and QW-160 (tension and guided bend). Impact testing for the -150 °F minimum design temperature shall follow the governing code. ASME B31.3 Table 323.2.2 exempts austenitic base metal and weld metal at this temperature when the filler and ferrite conditions of that table are met; the EOR shall confirm the exemption. The PQR shall report the weld deposit ferrite number.
- C. Welder qualification. Welders shall be qualified to ASME Section IX QW-300 on the S1 WPS, tested at site under the Owner's witness (hold point HP-07-08), with radiography or bend tests under QW-302, and continuity maintained under QW-322.
- D. Filler. ER308L or E308L-16 shall be used on 304/304L and ER316L or E316L-16 on 316/316L; 316L filler shall be used where 304L and 316L are joined. The deposit ferrite number shall be 3 to 8, enough to resist hot cracking without excess ferrite that would lower toughness at -150 °F. It shall be measured with a calibrated ferrite gauge to AWS A4.2 on the first production weld of each welder and WPS, and on 10 % of production welds thereafter, under [REDACTED] SPC-SPC-008.
- E. Preheat. No preheat shall be applied, except that the joint shall be dry and at least 50 °F. Moisture shall be removed by gentle warming only, and no torch that leaves carbon deposits on the bevel shall be used.
- F. Interpass temperature shall not exceed 350 °F, measured with a contact thermometer at the weld toe before each pass, to limit sensitization. Heat input shall stay within the PQR range, with stringer beads and weave no wider than three times the electrode or filler diameter.
- G. Back purging. The root and first two passes of every butt weld, and of branch welds affecting the inside surface, shall be made with an argon (99.995 %) back purge. Purge dams shall be at least 12 in from the joint, with tape over the open root. Oxygen at the purge exit, measured with a calibrated analyzer, shall be 0.1 % (1,000 ppm) or less before the arc is struck and through the second pass.

- H. Heat tint. Inside-surface oxidation shall be no darker than light straw, level 3 of the AWS D18.2 guide or the Owner-approved photographic standard made on the PQR coupon, and outside heat tint shall be removed after welding. Darker inside tint shall be removed by pickling paste or stainless-only mechanical means and the surface passivated under SPC-SPC-006. Black oxidation, sugaring or evidence of a lost purge shall be rejectable, and the weld shall be cut out, because such surfaces have lost their corrosion resistance.
- I. Cleaning between passes shall use stainless wire brushes and stainless-dedicated grinding media only, with no carbon steel contact, chlorinated solvents or chloride-bearing markers.
- J. Repairs shall follow 3.11 with an ASME Section IX repair WPS. The repaired area shall be re-examined by liquid penetrant testing and by the original method, and the ferrite number re-checked.
- K. Stainless wear pads, lugs and the strake attachments on VS-101 shall be welded to the S1 WPS, with the same purge rules where the inside surface is affected.

3.15 FIELD QUALITY CONTROL

- A. The Contractor shall record the work on QF-07-01 (PQR and laboratory reports), QF-07-02 (welder qualification), QF-07-03 (welding parameter check), QF-07-04 (consumable and oven log), QF-07-05 (repair authorization and record), QF-07-06 (daily weld log) and QF-07-07 (S1 weld check: purge oxygen, interpass, heat tint, ferrite), and shall keep the welder register, continuity log, weld maps and hot work permits. All are turnover records under SPC-SPC-020.
- B. The hold and witness points in Table 3-4 apply. Party codes: C Contractor, O Owner, E EOR, W receiving pipeline operator; H hold, W witness, R review, S surveillance, P perform.

Table 3-4: Hold and Witness Points

ID	Activity	C	O	E	W	Record
HP-07-01	WPS and PQR package and welding quality plan approved before qualification welding	P	R	H	-	Submittals 07-01, 07-02
HP-07-02	Procedure qualification welding and mechanical testing, including Charpy and hardness	P	H	R	-	PQR, QF-07-01
HP-07-03	Welder qualification tests at site	P	H	-	-	QF-07-02
WP-07-01	First production weld of each WPS: preheat, interpass, amperage, voltage and travel speed measured	P	W	-	-	QF-07-03
WP-07-02	Weekly consumable storage and oven audit	P	S	-	-	QF-07-04
HP-07-04	Tie-in welds and any approved untested closure weld: fit-up, preheat and welding	P	H	R	W	QF-07-03, QF-06-03
HP-07-05	Authorization of each weld repair or cut-out	P	H	-	-	QF-07-05
HP-07-06	Hot work permit within 50 ft of live gas and within the trunkline right-of-way	P	H	-	H	Hot work permit

ID	Activity	C	O	E	W	Record
WP-07-03	Visual inspection of completed welds (100 % by Contractor CWI, sampling by Owner)	P	S	-	-	QF-07-06
HP-07-07	Weld map complete and reconciled with NDE reports before the hydrostatic test of each section	P	H	R	-	Weld map, NDE register
HP-07-08	S1 WPS and PQR approved and S1 welder qualification tests at site before any S1 production welding	P	H	H	-	Submittal 07-13, QF-07-02
WP-07-04	First S1 production weld of each welder: purge oxygen, interpass, inside heat tint and ferrite number checked	P	W	-	-	QF-07-07

3.16 ACCEPTANCE

A. Welding is accepted when it meets every criterion in Table 3-5 and the NDE acceptance criteria of SPC-SPC-008.

Table 3-5: Acceptance Criteria

Parameter	Criterion	Method
PQR mechanical tests	API 1104 Clause 5 criteria	Laboratory tests
PQR Charpy at -20 °F	Average 20 ft-lb, single 15 ft-lb minimum (full size)	ASTM E23
PQR hardness	250 HV10 maximum	ASTM E92
Welder qualification	API 1104 Clause 6 or ASME Section IX	Visual, radiography, destructive tests
Preheat	Not less than Table 3-2 at 1 in from the bevel	Contact thermometer or crayon
Interpass temperature	480 °F maximum (400 °F near an insulating joint body); 350 °F for S1	Contact thermometer
Consumables	H4 low-hydrogen control and exposure limits met	Oven log audit
Visual weld quality	API 1104 Clause 9 visual criteria; cap reinforcement 1/16 to 1/8 in; no arc strikes	Visual, gauges
Repairs	One attempt per location; no crack repairs	Repair log audit
Welder repair rate	5 % or less over a rolling 20 welds	Weekly report
Traceability	100 % of welds on the weld map with welders, WPS, heats and NDE result	Audit
S1 qualification	ASME Section IX procedure and welder qualification; no API 1104 qualification used on S1	Submittal and register audit
S1 purge	Oxygen 0.1 % (1,000 ppm) or less at the purge exit before arc strike and through the second pass	Calibrated oxygen analyzer

Owner

Project No.:

Welding

SPC-SPC-007

Rev. A

September 29, 2026

Parameter	Criterion	Method
S1 ferrite	Ferrite number 3 to 8 in the deposit	Ferrite gauge to AWS A4.2
S1 heat tint	Inside no darker than light straw (AWS D18.2 level 3); no sugaring; outside tint removed	Visual; borescope where there is no access

END OF SECTION

