

OWNER

Instrumentation Installation, Tubing and Calibration

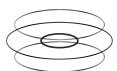


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ISSUE SUMMARY AND APPROVAL

This page records each issue of SPC-SPC-014. 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-014

INSTRUMENTATION INSTALLATION, TUBING AND CALIBRATION

PART 1 GENERAL

1.01 SUMMARY

A. Section includes the receipt, storage, installation, tubing, calibration, loop checking and documentation of every field instrument, analyzer, sample system and instrument valve listed in

INS-LST-001 and shown on PRO-DWG-101 to PRO-DWG-111:

1. Pressure, differential pressure, temperature, level and position instruments, switches and gauges, for example PT-101, PDIT-103, LT-104, LSHH-105, LSLL-106, PT-111, PT-121, TT-111, TT-121, PT-133A, PT-133B, PT-133C, PT-134, TT-135, TT-151, TT-156, PT-164, PT-172, TT-173, LT-191 and LSHH-192, and local gauges.
2. Thermowells, including field verification of insertion length against the wake frequency calculation.
3. Instrument impulse tubing, tube fittings, instrument valves, manifolds, supports and protective enclosures.
4. The analyzer sample system from probe SP-141 to shelter B-101 (line 3/8"-G-1080-T1), its heat tracing and insulation, the sample shutoff SDV-141 with restriction orifice RO-141A, analyzer vents and returns, and calibration gas installation.
5. Installation checks of the custody measurement equipment on meter skid SK-110: ultrasonic meters FE-111 and FE-121, flow conditioners FC-111 and FC-121, transmitters PT-111, PT-121, TT-111 and TT-121, and test thermowells TW-112 and TW-122. PT-111 and PT-121 are absolute-pressure transmitters calibrated in psia.
6. Calibration of every transmitter, switch, gauge and analyzer, with as-found and as-left records for the safety instrumented function transmitters PT-133A, PT-133B and PT-133C.
7. Loop checks from each field device to the remote terminal unit, the safety programmable logic controller (PLC) and flow computer FQI-110, with the Owner's systems integrator.

B. Related sections:

1. SPC-SPC-006, Piping Fabrication and Installation, and SPC-SPC-007, Welding (welded instrument connections on process piping).
2. SPC-SPC-011, Hydrostatic Testing, Dewatering and Drying.
3. SPC-SPC-013, Electrical Installation in Hazardous Locations (cable and raceway to instruments).
4. SPC-SPC-018, Pre-commissioning, Commissioning and Startup (safety instrumented system validation).



C. Work by others:

1. Instruments and analyzers are Owner-furnished. Tubing, tube fittings, instrument valves, manifolds and supports are Contractor-furnished.
2. Flow calibration of the ultrasonic meters is done by the meter vendor at an accredited flow laboratory before delivery and is not repeated in the field.
3. Configuration of the remote terminal unit, safety PLC and flow computer is by the Owner's systems integrator.
4. Root valves and welded instrument connections on process piping are covered by SPC-SPC-006 and SPC-SPC-007. This section begins at the root valve outlet.

1.02 REFERENCES

A. Codes and standards:

1. ISA-5.1-2022, Instrumentation Symbols and Identification; ISA-5.4, Instrument Loop Diagrams.
2. IEC 61511-1:2016+A1:2017 (ANSI/ISA-61511-1), Functional Safety, Safety Instrumented Systems for the Process Industry Sector.
3. ANSI/ISA-12.27.01, Requirements for Process Sealing Between Electrical Systems and Flammable or Combustible Process Fluids; NFPA 70-2023, Article 501.17.
4. ASME B31.8-2022, instrument, control and sampling piping provisions.
5. ASME B16.11 and ASME B16.34.
6. ASTM A269, Austenitic Stainless Steel Tubing for General Service.
7. ASME PTC 19.3 TW-2016, Thermowells.
8. AGA Report No. 9 (2022), Measurement of Gas by Multipath Ultrasonic Meters.
9. API MPMS Chapter 14.1, Collecting and Handling of Natural Gas Samples for Custody Transfer; API MPMS Chapter 21.1, Flow Measurement Using Electronic Metering Systems.
10. GPA 2166 (sampling), GPA 2261 (chromatographic analysis) and GPA 2198 (calibration gas blends).
11. ISO/IEC 17025, General Requirements for the Competence of Testing and Calibration Laboratories.
12. IEEE 515, Testing, Design, Installation and Maintenance of Electrical Resistance Trace Heating.

B. Project documents:

1. INS-LST-001, Instrument Index; INS-DS-001 to INS-DS-014, Instrument Datasheets.
2. INS-LST-002, I/O List; INS-LST-003, Alarm and Trip Setpoint Schedule; INS-LST-004, Cause and Effect Matrix; INS-RPT-001, Control Philosophy and Functional Narrative.
3. SAF-SRS-001, Safety Requirements Specification.



4. MEA-CAL-001, Ultrasonic Meter Sizing and Meter Run Design; MEA-CAL-004, Sampling System Design and Thermowell Wake-Frequency Evaluation.
5. MEA-DS-001, Multipath Ultrasonic Meters; MEC-DS-009, SK-110 Meter Skid; MEA-DS-003 to MEA-DS-006, Analyzer Datasheets; MEA-DS-008, Flow Computer FQI-110.
6. MEA-PRC-001, Meter Verification and Series Comparison Procedure.
7. PIP-SPC-001, Piping Material Specification (class T1); MEC-LST-001, Line List.
8. ELE-RPT-001, Hazardous Area Classification.

1.03 DEFINITIONS

- A. Root valve: the first block valve off the process pipe, in piping class A6. Instrument work starts at its outlet.
- B. As-found and as-left: the instrument reading before and after any adjustment, recorded at every test point.
- C. Test accuracy ratio (TAR): the ratio of the tolerance of the device under test to the uncertainty of the calibration standard.
- D. Safety instrumented function (SIF): the overpressure shutdown function SIF-01, rated SIL 2, in which PT-133A, PT-133B and PT-133C vote 2-out-of-3 to close SDV-102 and SDV-103.
- E. Loop check: verification of the complete signal path from the field device to the control system display and logic, including alarms.

1.04 SUBMITTALS

- A. The Contractor shall submit the items in Table 1-1.

Table 1-1: Submittal Schedule

No.	Submittal	Timing	Action
14-01	Installation plan and hook-up details for each instrument type not covered by the datasheets	30 days before installation	EOR approval
14-02	Tubing and fitting product data: tubing mill certificates to ASTM A269 with hardness; fitting manufacturer and pressure ratings at 150 °F	Before purchase	EOR approval
14-03	Tube fitting installer training certificates (fitting manufacturer's program, or a Contractor program accepted by the Owner)	Before tubing work	Owner review
14-04	Calibration procedures and list of standards with ISO/IEC 17025 certificates, uncertainty, due dates and TAR by device type	21 days before calibration	Owner and EOR approval
14-05	Calibration records (QF-14-01) and the separate SIF record for PT-133A, PT-133B and PT-133C (QF-14-02)	Within 3 days of calibration	Owner review

No.	Submittal	Timing	Action
14-06	Tubing pressure and leak test records (QF-14-03)	Within 3 days of the test	Owner review
14-07	Loop check sheets (QF-14-04) signed by the Contractor, the Owner and the systems integrator	At loop completion	Owner review
14-08	Thermowell field verification (insertion length, bore, material) against the wake frequency calculation	Before installation	EOR review
14-09	Ultrasonic meter and meter tube receiving and installation record (QF-14-05)	At installation	Owner review; receiving pipeline operator copy
14-10	Calibration gas certificates: GPA 2198 gravimetric blend with uncertainty, and hydrogen sulfide, oxygen and water span gases	On delivery	Owner review; receiving pipeline operator copy
14-11	Sample line heat tracing design and circuit list (if Contractor designed), with insulation resistance results	14 days before installation	EOR approval
14-12	Instrument as-built red-lines (locations, tubing routes, hook-up changes)	Weekly; final at turnover	EOR review

1.05 QUALITY ASSURANCE

- A. Calibration standards shall be traceable to the National Institute of Standards and Technology (NIST) through an ISO/IEC 17025 accredited laboratory, within their calibration interval and not more than 12 months old, and shall give a TAR of at least 4:1.
- B. Tube fittings shall be installed only by personnel holding the certificate of submittal 14-03.
- C. Hold and witness points shall be as listed in 3.10 and in SPC-SPC-019. Custody measurement activities are witnessed by (the receiving pipeline operator) under the Interconnect and Operating Agreement (HOLD H-01).

1.06 DELIVERY, STORAGE AND HANDLING

- A. Every instrument shall be checked on receipt against INS-LST-001 and its datasheet for tag, range, material, rating, area classification marking and calibration certificate. Damage or nonconformance shall be reported to the Owner within 24 hours.
- B. Instruments shall be stored indoors in a heated, dry area with covers and caps in place. The ultrasonic meters and meter tubes shall stay on the SK-110 skid with the vendor's end covers until installation.
- C. Tubing shall be delivered capped and stored off the ground. Carbon steel tools shall not touch stainless tubing; dedicated stainless cutters and benders shall be used.

1.07 MEASUREMENT AND PAYMENT

- A. Pay item 14.01, Instrument installation, tubing and supports: lump sum, including receiving and storage of Owner-furnished instruments, mounting stands and supports, all Contractor-furnished

tubing, fittings, valves and manifolds, sample system installation with heat tracing and insulation, the calibration gas rack, tubing pressure and leak tests, meter installation checks and red-line as-builts. It excludes the supply of instruments and analyzers, and root valves and welded connections (pay item 06.01).

- B. Pay item 14.02, Calibration and loop checks: lump sum, including calibration of every instrument with standards and records, the SIF transmitter records, support to the analyzer vendor, and loop checks with the systems integrator. The analyzer vendor's service charges are paid by the Owner. Payment shall be 50 % on completion of calibration with accepted records (HP-14-03) and 50 % on completion of loop checks (HP-14-04).

PART 2 PRODUCTS

2.01 TUBING

- A. Tubing shall be ASTM A269 SMLS (without a weld seam) 316/316L stainless steel, fully annealed, with hardness not above Rockwell B 80 and mill certificates. The ASTM limit is HRB 90; the lower value is required because harder tubing does not seal reliably in compression fittings.
- B. Tubing for process impulse and sample service (1,440 psig design, -20 to 150 °F) shall meet Table 2-1. The fitting manufacturer's published working pressure, derated to 150 °F, shall be at least 1,440 psig, and the 2,160 psig pressure test shall not exceed the tubing manufacturer's published test pressure.

Table 2-1: Tubing Sizes and Minimum Walls

Outside diameter, in	Minimum wall, in	Typical working pressure at 100 °F, psig	Use
1/4	0.035	5,100	Transmitter connections (short runs), calibration gas
3/8	0.049	4,800	Sample line 3/8"-G-1080-T1, analyzer sample
1/2	0.065	4,700	Impulse lines, PDIT-103 and level instrument legs

Note 1: Working pressures are typical of two-ferrule fitting manufacturers' published data for 316 stainless steel tubing; confirm with vendor data (HOLD H-15). The walls match class T1 of PIP-SPC-001.

- C. Sample tubing downstream of SP-141 shall be electropolished or given an inert coating where MEA-DS-003 to MEA-DS-006 require it for hydrogen sulfide service, because bare stainless steel adsorbs hydrogen sulfide and delays the analyzer response.

2.02 TUBE FITTINGS, VALVES AND MANIFOLDS

- A. Compression fittings shall be two-ferrule 316 stainless steel from one manufacturer across the whole station, and components of different manufacturers shall not be mixed. Swagelok, Parker CPI or A-LOK, or an equal accepted by the EOR.
- B. Instrument valves shall be 316 stainless steel bar-stock needle or ball valves rated 6,000 psig at 100 °F minimum, with anti-blowout stems and packing suitable for the temperature.
- C. Manifolds shall be 316 stainless steel: two-valve (block and bleed) for pressure transmitters, and three- or five-valve for PDIT-103, direct mounted where the transmitter allows, with unused vent and bleed ports plugged.
- D. Threaded connections shall be NPT with a PTFE paste compatible with stainless steel and gas service. PTFE tape shall not be used on process-wetted threads of the analyzer sample system, because shreds of tape contaminate the analyzers.
- E. Tubing shall be supported in continuous 316 stainless steel or aluminum channel for multiple runs, or by 316 stainless steel clamps with elastomer inserts at no more than 3 ft for 1/4 and 3/8 in tubing and 5 ft for 1/2 in tubing. Bare tubing shall not be clamped directly against a dissimilar metal.

2.03 SAMPLE SYSTEM AND HEAT TRACING

- A. The sample line from SP-141 to B-101 shall be 3/8 in 316 stainless steel, sloped continuously as the design requires with no pockets, and as short as practical (target under 50 ft).
- B. Heat tracing shall be self-regulating, listed for Class I, Division 2 with a temperature code of T3 or better, and controlled by an RTD controller with a fault alarm to the remote terminal unit, to hold the sample at least 20 °F above its hydrocarbon dewpoint at the reduced sample pressure (MEA-CAL-004 and API MPMS 14.1). A factory pre-insulated tube bundle is preferred.
- C. The analyzer, speed loop and chromatograph carrier and calibration vents shall each have an individual 1/2 in T1 vent tube (lines 1130 to 1135, PRO-DWG-104), routed outside B-101 to atmosphere 3 ft above the roof at the location on ELE-RPT-001, each ending in a downward-facing rain and insect guard. Vents shall not be manifolded to a common header unless the analyzer vendor confirms that back pressure will not affect the analyzers. These vents release about 3.6 standard L/min (183 scf/d) of process gas continuously and are carried as an emission source in REG-CAL-001.
- D. SDV-141, the analyzer sample shutoff at the B-101 west wall, shall be installed with RO-141A (a 1/32 in restriction orifice) immediately downstream, per MEA-CAL-004 and PRO-DWG-104. The orifice limits the gas that can enter the shelter if a sample fitting fails.

2.04 CALIBRATION STANDARDS

- A. Pressure: a deadweight tester or digital calibrator with an uncertainty of 0.025 % of reading or better for the custody transmitters PT-111 and PT-121, and 0.05 % of full scale for other pressure instruments.

- B. Temperature: a reference RTD and readout with a combined uncertainty of 0.05 °F or better in a dry block or stirred bath for TT-111, TT-121, TT-135 and TT-173, and 0.2 °F for others.
- C. Current and voltage: a multifunction process calibrator with 0.01 % of reading on mA.

PART 3 EXECUTION

3.01 INSTRUMENT MOUNTING

- A. Transmitters shall be mounted on galvanized 2 in pipe stands or on skid steel, with the display 3 to 5 ft above grade or platform and reachable without a ladder. They shall not be mounted on process piping except where direct mounting is shown, and then only after a vibration check.
- B. Gauges shall be direct mounted, with a siphon or snubber where pulsation occurs, and shall face the walkway.
- C. Pressure transmitters in gas service shall be mounted above the process tap so that the impulse lines drain back to the process. PDIT-103 shall be mounted above its taps with equal-length legs.
- D. Impulse tubing shall slope continuously back to the process at 1 in 12 or more, with no liquid traps and no more than 20 ft of length unless approved.
- E. LG-104 shall be vertical within 1°. The LT-191 radar antenna shall be centered on its nozzle per the vendor, with no obstruction in the beam.
- F. Each instrument through which process fluid could reach the conduit system shall be listed as single-seal or dual-seal under ANSI/ISA-12.27.01 and NEC 501.17. Where a single-seal device is used, a conduit seal with a vent or drain shall be installed at the device.

3.02 TUBING INSTALLATION

- A. Tubing shall be cut square with a tube cutter, deburred inside and outside and cleaned, with the straight length from a fitting to the start of a bend not less than the manufacturer's minimum (typically 1.5 times the nut length).
- B. Tubing shall be bent with a bender sized for its diameter, at no less than the bender's minimum radius (for example 9/16 in for 1/4 in tubing, 15/16 in for 3/8 in and 1-1/2 in for 1/2 in), with ovality not above 5 % of the diameter and no wrinkles or kinks.
- C. Fittings shall be made up per the manufacturer (typically 1-1/4 turns from finger tight for 1/4 to 1 in sizes) and every fitting checked with the manufacturer's gap gauge. Remade fittings shall follow the manufacturer's remake instructions.
- D. Expansion loops or bends shall be provided between the process tap and any fixed support where thermal movement exceeds 1/8 in, such as at the H-101 outlet and the meter headers.
- E. Tubing shall follow the approved routes, stay at least 6 in from hot surfaces such as the H-101 firebox and stack, and be covered where it crosses walkways. Stainless tubing on galvanized strut shall have an elastomer insert.

- F. Each run shall be blown out with clean dry nitrogen or instrument air before the instrument is connected.

3.03 THERMOWELLS

- A. Thermowells are supplied with the instruments and designed to ASME PTC 19.3 TW-2016 for wake frequency and stress at the maximum velocity of operating case C5 (MEA-CAL-004). The Contractor shall verify the received insertion length, root and tip diameters and bore against the calculation (submittal 14-08) and shall not substitute or shorten any thermowell.
- B. Custody thermowells TW-111 and TW-121 shall be located 2 to 5 pipe diameters downstream of the meters, and test thermowells TW-112 and TW-122 within 1 ft of them, at the positions in MEA-CAL-001. They shall be filled with thermally conductive fluid where the design requires, and insulated with the meter tube.

3.04 CUSTODY MEASUREMENT INSTALLATION

- A. SK-110 arrives assembled, and the meter tubes, flow conditioners and ultrasonic meters are a flow-calibrated set. No meter tube shall be cut, welded, ground, drilled or re-machined in the field, and no taps shall be added, because any change voids the flow calibration. Field welding on SK-110 piping within 10 pipe diameters of an ultrasonic meter is prohibited. Any rework requires written approval of the EOR and the Owner, with notice to the receiving pipeline operator (HOLD H-01).
- B. On installation the Contractor shall verify, against the flow calibration certificates, MEA-DS-001 and MEC-DS-009, that meter serial numbers match their meter tubes and conditioners; flow direction arrows match the process flow; meter orientation (transducer path planes) is as calibrated; conditioner orientation and distance from the meter are as calibrated; alignment pins and gaskets are as calibrated; and gaskets are centered and do not protrude into the bore.
- C. Before flanges are closed, each run shall be inspected internally for debris, scale and damage to the bore and transducer ports, and photographed.
- D. The meters and conditioners are replaced by spools for the vendor's shop hydrotest of the skid (pre-tested unit PT-01 in SPC-SPC-011) and shall not be exposed to the field hydrotest. They shall be reinstalled with new gaskets.
- E. Transducer cabling and meter electronics shall be grounded at a single point per the vendor and SPC-SPC-013.
- F. The zero-flow verification of each meter (AGA Report No. 9 and MEA-PRC-001) is performed during commissioning under SPC-SPC-018 and witnessed by the receiving pipeline operator.

3.05 ANALYZER AND SAMPLING INSTALLATION

- A. SP-141 shall be installed per MEA-DS-009 and API MPMS 14.1, with its tip in the center third of the pipe, at a location free of flow disturbance downstream of the meter runs, and with its insertion depth verified against the vendor's probe calculation.
- B. Composite sampler SMP-146 shall be installed per API MPMS 14.1, with the sample cylinder at or below the probe elevation per the vendor and a clear drain path.
- C. Calibration gas cylinders (the GPA 2198 blend for AT-141 and certified span gases for AT-142, AT-143 and AT-144) shall be installed in a restrained rack outside B-101 or in the ventilated cylinder cabinet, with 316 stainless steel regulators and tubing, labeled, and heated where the blend dewpoint requires.
- D. The sample system shall be leak checked by helium leak detector or by pressure decay (3.07 B).
- E. SDV-141 and RO-141A shall be checked for orifice bore and stamped tag, flow direction, and closure on station emergency shutdown and on B-101 gas detection, as INS-LST-004 requires.
- F. The as-found flow of each analyzer vent and of the speed loop shall be measured and recorded at commissioning (QF-14-01), so that the emission estimate can be confirmed.

3.06 CALIBRATION

- A. Every transmitter shall be calibrated at 0, 25, 50, 75 and 100 % of span, ascending and descending, recording as-found and then as-left at each point, and adjusted only if the as-found reading is outside the as-left tolerance. Ranges and units shall be those of INS-DS-001 to INS-DS-014 and shall not be changed.
- B. Switches (LSHH-105, LSLL-106, LSHH-192, LSL-154, TSHH-155 and others) shall have trip and reset points tested three times.
- C. The custody transmitters PT-111, PT-121, TT-111 and TT-121 shall be calibrated in place at the skid after installation, comparing the flow computer reading with the reference at each point (end to end), with ambient temperature recorded, witnessed by the receiving pipeline operator. PT-111 and PT-121 are absolute-pressure transmitters: the reference shall be an absolute deadweight tester, or a gauge standard corrected by a barometer with 0.01 psi uncertainty, and the flow computer shall be checked for psia configuration with no atmospheric pressure added.
- D. PT-133A, PT-133B and PT-133C shall each be calibrated individually, with as-found and as-left values on QF-14-02, including the value read in the safety PLC, the trip action at the 1,225 psig setpoint and the deviation alarm between transmitters. Each transmitter's configuration shall be write-protected after calibration and the protection verified. The Contractor shall trace each of the three loops from its tap to its card slot and record that each terminates on a separate safety PLC input card, with separate cables and taps, as SAF-SRS-001 requires for the SIL 2 function; a shared card is a nonconformance. This record forms part of the safety instrumented system validation under SPC-SPC-018.

- E. Analyzers shall be calibrated by the analyzer vendor's service engineer with the certified gases; the Contractor shall provide access, utilities and the installation. The gas chromatograph shall pass a repeatability check to GPA 2261 on the calibration blend within the vendor's stated repeatability.
- F. Gauges shall be checked at 0, 50 and 100 % against the standard, and any gauge out of tolerance replaced, not adjusted.

3.07 TUBING PRESSURE AND LEAK TESTS

- A. Tubing that forms part of the pressure boundary up to the instrument isolation valve shall be pressure tested with the connected piping under SPC-SPC-011, or separately with nitrogen or water at 2,160 psig (1.5 times design) for at least 10 min, with instruments of lower rating isolated or removed.
- B. After the instruments are connected, the tubing shall be leak tested with nitrogen at 1,265 psig (110 % of the maximum operating pressure of 1,150 psig) or at the highest pressure the instruments permit. Every fitting shall be checked with leak detection fluid, with no bubbles in 1 min. The sample system shall lose no more than 1 % of its pressure in 30 min.

3.08 LOOP CHECKS

- A. Loop checks shall follow installation, calibration and the cable insulation and continuity tests of SPC-SPC-013, and precede commissioning under SPC-SPC-018.
- B. For each analog input, a signal shall be applied at the field device at 0, 50 and 100 %, and the reading verified at the remote terminal unit, safety PLC, flow computer and operator display, in engineering units, with each alarm setpoint of INS-LST-003 and the fault handling below 3.6 mA and above 21 mA.
- C. Each discrete input shall be proven by operating the device itself, not by jumpering at the marshalling panel.
- D. Each output shall be commanded from the control system and the field action verified: valve stroke and direction, limit switches, position feedback ZT-131 and ZT-132, and stroke time where specified.
- E. Each loop shall be recorded on QF-14-04 and signed by the Contractor, the Owner and the systems integrator.

3.09 ACCEPTANCE

- A. The installation is accepted when every criterion in Table 3-1 is met.

Table 3-1: Acceptance Criteria

Parameter	Criterion	Method
Tubing material	ASTM A269 SMLS 316/316L, HRB 80 maximum, mill certificate for each heat	Certificate review; positive material identification of 5 %
Tubing rating	Working pressure at 150 °F not less than 1,440 psig	Manufacturer data
Fitting make-up	Gap gauge does not enter at any fitting	Gap gauge, 100 %
Bends	Ovality 5 % or less of the diameter; no kinks or wrinkles	Visual, caliper
Impulse slope	1 in 12 or more toward the process; no pockets	Level
Tubing pressure test	2,160 psig for 10 min, no leak, no drop beyond gauge resolution after temperature stabilizes	Gauge or recorder
Leak test	No bubbles in 1 min at any fitting; sample system decay 1 % or less in 30 min	Leak fluid, decay test
Custody pressure transmitters PT-111, PT-121	As-left within ± 0.05 % of span at every point, end to end at the flow computer, in psia	Five-point up and down
Custody temperature TT-111, TT-121	As-left within ± 0.2 °F of the reference, end to end	Three-point bath or dry block, and in-well comparison
Other pressure and differential pressure transmitters	As-left within ± 0.1 % of span	Five-point
Other temperature transmitters	As-left within ± 0.5 °F	Three-point
PT-133A, PT-133B, PT-133C	Each on a separate safety PLC input card; as-left within ± 0.1 % of span; the three agree within 0.25 % of span at the same pressure; trip at $1,225 \pm 5$ psig in the safety PLC; write protection verified	Five-point, trip test, loop trace
Switches	Trip within ± 1 % of span of setpoint (or the datasheet tolerance); three trips within 0.5 %	Functional test
Calibration standards	TAR at least 4:1, NIST traceable, current	Certificate review
Ultrasonic meter installation	Serial numbers, orientation, flow direction and conditioner position match the calibration certificate; no field welding within 10 diameters; gaskets do not protrude	QF-14-05 and photographs
Sample line heat tracing	Sample temperature at the B-101 entry at or above the MEA-CAL-004 setpoint at the day's minimum ambient; trace insulation resistance 20 megohm or more at 2,500 VDC (or the trace manufacturer's value)	Thermometer, megohmmeter
Loop checks	Every loop within the device tolerance plus 0.1 % of span for the control system, with correct alarms and fault handling	QF-14-04

3.10 FIELD QUALITY CONTROL

- A. Records shall use forms QF-14-01 (instrument calibration), QF-14-02 (SIF device calibration, as-found and as-left), QF-14-03 (tubing pressure and leak test), QF-14-04 (loop check), QF-14-05 (ultrasonic meter and meter tube installation) and QF-14-06 (tube fitting inspection).
- B. The hold and witness points in Table 3-2 apply. Party codes: C Contractor, O Owner, E EOR, W receiving pipeline operator; H hold, W witness, R review, S surveillance, P perform.

Table 3-2: Hold and Witness Points

ID	Activity	C	O	E	W	Record
HP-14-01	Calibration procedure and standards approved (TAR 4:1, current certificates) before any calibration	P	H	R	R	Submittal 14-04
WP-14-01	Tube fitting installation and gap gauge inspection; 10 % random sample by the Owner	P	W	-	-	QF-14-06
HP-14-02	Ultrasonic meter and meter tube installation check (serial numbers, direction, orientation, cleanliness) before flanges are closed	P	H	R	W	QF-14-05
WP-14-02	Tubing pressure and leak tests	P	W	-	-	QF-14-03
WP-14-03	End-to-end calibration of custody transmitters PT-111, PT-121, TT-111 and TT-121	P	W	-	W	QF-14-01
WP-14-05	SDV-141 and RO-141A installation and shutdown closure check; analyzer vent flows on lines 1130 to 1135 measured	P	W	-	-	QF-14-01
HP-14-03	Calibration of PT-133A, PT-133B and PT-133C with as-found and as-left values, write protection and separate input card verification, before SIF validation	P	H	R	W	QF-14-02
WP-14-04	Gas chromatograph and analyzer calibration and repeatability check	S	W	-	W	Vendor report
HP-14-04	Loop checks complete, with all category A punch items closed, before commissioning of the system	P	H	R	-	QF-14-04

END OF SECTION