

Specification for Basic Process Measurement Instruments

Revision history

VERSION	DATE	PURPOSE
1.0	September 2022	First Edition

Acknowledgements

This IOGP Specification was prepared by a Joint Industry Programme 33 Standardization of Equipment Specifications for Procurement organized by IOGP with support by the World Economic Forum (WEF).

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Foreword

This specification was prepared under Joint Industry Programme 33 (JIP33) "Standardization of Equipment Specifications for Procurement" organized by the International Oil & Gas Producers Association (IOGP) with the support from the World Economic Forum (WEF). Companies from the IOGP membership participated in developing this specification to leverage and improve industry level standardization globally in the oil and gas sector. The work has developed a minimized set of supplementary requirements for procurement, with life cycle cost in mind, resulting in a common and jointly agreed specification, building on recognized industry and international standards.

Recent trends in oil and gas projects have demonstrated substantial budget and schedule overruns. The Oil and Gas Community within the World Economic Forum (WEF) has implemented a Capital Project Complexity (CPC) initiative which seeks to drive a structural reduction in upstream project costs with a focus on industry-wide, non-competitive collaboration and standardization. The CPC vision is to standardize specifications for global procurement for equipment and packages. JIP33 provides the oil and gas sector with the opportunity to move from internally to externally focused standardization initiatives and provide step change benefits in the sector's capital projects performance.

This specification has been developed in consultation with a broad user and supplier base to realize benefits from standardization and achieve significant project and schedule cost reductions.

The JIP33 work groups performed their activities in accordance with IOGP's Competition Law Guidelines (November 2020).

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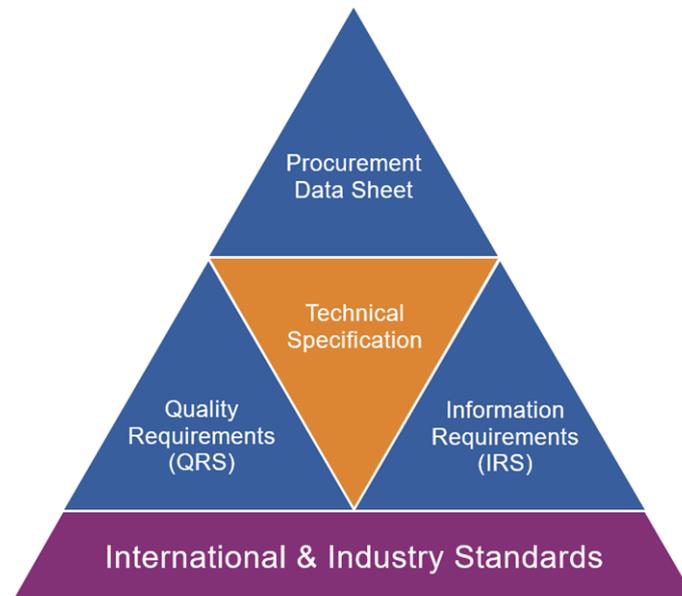
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Introduction

The purpose of this specification is to define a minimum common set of requirements for the procurement of basic process measurement instruments for application in the petroleum and natural gas industries.

This specification follows a common document structure comprising the four documents as shown below, which together with the purchase order define the overall technical specification for procurement.



JIP33 Specification for Procurement Documents Technical Specification

This specification is to be applied in conjunction with the supporting procurement data sheet, information requirements specification (IRS) and quality requirements specification (QRS) as follows.

IOGP S-718: Specification for Basic Process Measurement Instruments

This specification defines the technical requirements for the supply of the equipment.

IOGP S-718D: Procurement Data Sheets for Basic Process Measurement Instruments

The procurement data sheet defines application specific requirements, attributes and options specified by the purchaser for the supply of equipment to the technical specification. The procurement data sheet may also include fields for supplier provided information attributes subject to purchaser's technical evaluation. Additional purchaser supplied documents may also be incorporated or referenced in the procurement data sheet to define scope and technical requirements for enquiry and purchase of the equipment.

IOGP S-718L: Information Requirements for Basic Process Measurement Instruments

The IRS defines the information requirements, including contents, format, timing and purpose to be provided by the supplier. It may also define specific conditions which invoke information requirements.

IOGP S-718Q: Quality Requirements for Basic Process Measurement Instruments

The QRS defines quality management system requirements and the proposed extent of purchaser conformity assessment activities for the scope of supply. Purchaser conformity assessment activities are defined through the selection of one of four generic conformity assessment system (CAS) levels on the basis of evaluation of the associated service and supply chain risks. The applicable CAS level is specified by the purchaser in the data sheet or in the purchase order.

The terminology used within this specification and the supporting procurement data sheet, IRS and QRS is in accordance with ISO/IEC Directives, Part 2.

The procurement data sheet and IRS are published as editable documents for the purchaser to specify application specific requirements. The specification and QRS are fixed documents.

The order of precedence (highest authority listed first) of the documents shall be:

- a) regulatory requirements;
- b) contract documentation (e.g. purchase order);
- c) purchaser defined requirements (procurement data sheet, IRS, QRS);
- d) this specification.

1 Scope

1.1 Technologies

This specification defines the requirements for the design, sizing and selection, materials, inspection and testing, marking and preparation for shipment of basic process measurement instrumentation, for pressure ratings up to class 2500, covering the following technologies:

- electronic pressure and differential pressure transmitters, both with manifold and diaphragm seal options;
- electronic temperature transmitters;
- RTD and thermocouples;
- thermowells;
- concentric sharp edge, conic, quadrant edge and eccentric orifice head flow meter elements including quick change assemblies;
- venturi flow elements;
- ultrasonic flow, magnetic flow and vortex volumetric flow meter elements;
- coriolis mass flow meter elements;
- magnetic level indicators and transmitters;
- wet leg and diaphragm hydrostatic level transmitters;
- guided wave radar level transmitters;
- non-contact radar level transmitters.

1.2 Boundaries

This specification covers instrumentation for the following applications:

- upstream production facilities excluding wellhead, drilling and subsea instrumentation;
- midstream transportation and storage excluding pipelines to ASME B31.8;
- downstream refining and distribution.

In addition to general service this specification is applicable for instrumentation in the following special services:

- NACE compliance for H₂S and alkaline service;
- hydrogen service.

1.3 Exclusions

The following general requirements are excluded from this specification:

- wireless technology;
- IoT;
- signal conditioners.

The following technologies are excluded from this specification:

- electronic remote pressure seals (for level measurement);
- multi-variable pressure transmitters;
- thermowells in reactors;
- skin-type thermocouples;
- magnetic temperature sensors;
- orifice flange, integral orifice run, flow nozzle, v-cone and multi-hole orifice head flow meter elements;
- turbine volumetric flow meter elements;
- gauge glass level indicators;
- hydrostatic bubbler level transmitters;
- displacer, nucleonic level, density profiler and ultrasonic level transmitters.

2 Normative references

The following publications are referred to in this document, the procurement data sheet (IOGP S-718D) or the IRS (IOGP S-718L) in such a way that some or all of their content constitutes requirements of this specification. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

API Recommended Practice 551, *Process Measurement*

ANSI/ISA 12.27.01, *Requirements For Process Sealing Between Electrical Systems and Flammable or Combustible Process Fluids*

ASME BPVC, Section IX, *Welding, Brazing, and Fusing Qualifications*

ASME B1.20.1, *Pipe Threads – General Purpose – Inch*

ASME B16.5, *Pipe Flanges and Flanged Fittings – NPS ½ Through NPS 24 – Metric/Inch Standard*

ASME B31.3, *Process Piping*

ASME B31.8, *Gas Transmission and Distribution Piping Systems*

ASME MFC-3M, *Measurement of Fluid Flow in Pipes Using Orifice, Nozzle, and Venturi*

ASME MFC-5.1, *Measurement of Liquid Flow in Closed Conduits Using Transit-Time Ultrasonic Flowmeters*

ASME MFC-5.3, *Measurement of Liquid Flow in Closed Conduits Using Doppler Ultrasonic Flowmeters*

ASME MFC-6M, *Measurement of Fluid Flow in Pipes Using Vortex Flowmeters*

ASME MFC-11, *Measurement of Fluid Flow by Means of Coriolis Mass Flowmeters*

ASME MFC-16, *Measurement of Liquid Flow in Closed Conduits With Electromagnetic Flowmeters*

ASME PTC 19.2, *Pressure Measurement – Instruments and Apparatus Supplement – Performance Test Codes*

ASME PTC 19.3 TW, *Thermowells – Performance Test Code*

ASTM B912, *Standard Specification for Passivation of Stainless Steels Using Electropolishing*

ASTM E230/E230M, *Standard Specification for Temperature-Electromotive Force (emf) Tables for Standardized Thermocouples*

ASTM E235/E235M, *Standard Specification for Type K and Type N Mineral-Insulated, Metal-Sheathed Thermocouples for Nuclear or for Other High-Reliability Applications*

ASTM E608/E608M, *Standard Specification for Mineral-Insulated, Metal-Sheathed Base Metal Thermocouples*

ASTM E1137/E1137M, *Standard Specification for Industrial Platinum Resistance Thermometers*

IEC 60079 (all parts), *Explosive atmospheres*

IEC 60381-1, *Analogue signals for process control systems – Part 1: Direct current signals*

IEC 60529, *Degrees of protection provided by enclosures (IP Code)*

IEC 60584-1, *Thermocouples – Part 1: EMF specifications and tolerances*

IEC 60584-3, *Thermocouples – Part 3: Extension and compensating cables – Tolerances and identification system*

IEC 60695-11-10, *Fire hazard testing – Part 11-10: Test flames – 50 W horizontal and vertical flame test methods*

IEC 60695-11-20, *Fire hazard testing – Part 11-20: Test flames – 500 W flame test method*

IEC 60751, *Industrial platinum resistance thermometers and platinum temperature sensors*

IEC 61326-1, *Electrical equipment for measurement, control and laboratory use – EMC requirements – Part 1: General requirements*

IEC 61326-3-1, *Electrical equipment for measurement, control and laboratory use – EMC requirements – Part 3-1: Immunity requirements for safety-related systems and for equipment intended to perform safety-related functions (functional safety) – General industrial applications*

IEC 61508 (all parts), *Functional safety of electrical/electronic/programmable electronic safety-related systems*

IEC 61518, *Mating dimensions between differential pressure (type) measuring instruments and flanged-on shut-off devices up to 413 BAR (41,3 MPa)*

IEC 62305 (all parts), *Protection against lightning*

IEC 62402, *Obsolescence management*

IEC 62828 (all parts), *Reference conditions and procedures for testing industrial and process measurement transmitters*

IOGP S-563, *Material Data Sheets for Piping and Valve Components*

IOGP S-705, *Supplementary Specification to API Recommended Practice 582 for Welding of Pressure Containing Equipment and Piping*

ISA 50.00.01, *Compatibility of Analog Signals for Electronic Industrial Process Instruments*

- ISO 261, *ISO general purpose metric screw threads — General plan*
- ISO 5167-1, *Measurement of fluid flow by means of pressure differential devices inserted in circular cross-section conduits running full — Part 1: General principles and requirements*
- ISO 5167-2, *Measurement of fluid flow by means of pressure differential devices inserted in circular cross-section conduits running full — Part 2: Orifice plates*
- ISO 5167-4, *Measurement of fluid flow by means of pressure differential devices inserted in circular cross-section conduits running full — Part 4: Venturi tubes*
- ISO 10790, *Measurement of fluid flow in closed conduits — Guidance to the selection, installation and use of Coriolis flowmeters (mass flow, density and volume flow measurements)*
- ISO 12764, *Measurement of fluid flow in closed conduits — Flowrate measurement by means of vortex shedding flowmeters inserted in circular cross-section conduits running full*
- ISO 15614 (all parts), *Specification and qualification of welding procedures for metallic materials — Welding procedure test*
- ISO 17089-2, *Measurement of fluid flow in closed conduits — Ultrasonic meters for gas — Part 2: Meters for industrial applications*
- ISO 20456, *Measurement of fluid flow in closed conduits — Guidance for the use of electromagnetic flowmeters for conductive liquids*
- ISO 21457, *Petroleum, petrochemical and natural gas industries — Materials selection and corrosion control for oil and gas production systems*
- ISO 23936-1, *Petroleum, petrochemical and natural gas industries — Non-metallic materials in contact with media related to oil and gas production — Part 1: Thermoplastics*
- ISO 23936-2, *Petroleum, petrochemical and natural gas industries — Non-metallic materials in contact with media related to oil and gas production — Part 2: Elastomers*
- ISO/TR 15377, *Measurement of fluid flow by means of pressure-differential devices — Guidelines for the specification of orifice plates, nozzles and Venturi tubes beyond the scope of ISO 5167*
- MSS SP-99, *Instrument Valves*
- NACE MR0175/ISO 15156 (all parts), *Petroleum and natural gas industries — Materials for use in H₂S-containing environments in oil and gas production*
- NACE MR0103/ISO 17945, *Petroleum, petrochemical and natural gas industries — Metallic materials resistant to sulfide stress cracking in corrosive petroleum refining environments*
- NAMUR NE 43, *Standardization of the Signal Level for the Failure Information of Digital Transmitters*
- NAMUR NE 107, *Self-Monitoring and Diagnosis of Field Devices*
- NAMUR NE 132, *Coriolis Mass Meter (CMM)*
- NEMA 250, *Enclosures for Electrical Equipment (1000 Volts Maximum)*
- NFPA 70, *National Electrical Code*
- UL 94, *Standard for Tests for Flammability of Plastic Materials for Parts in Devices and Appliances*

3 Terms, definitions and abbreviated terms

3.1 Terms and definitions

3.1.1

calibrated range

region within which an instrument/device has been bench calibrated to check the actual device output reading against known standards

3.1.2

capillary

flexible tube used to provide a high-integrity connection between the diaphragm seal and the sensing element (transmitter) permitting remote location of the instrument from the process connection

3.1.3

diaphragm seal

chemical seal

remote seal

flexible material used for pressure measurements when the process material is required to be kept away from the pressurised parts of the measuring instrument

Note 1 to entry: The purpose of the seal is to isolate the capillary line fill fluid from the process fluid while permitting the transmission of pressure through to the fill fluid contained within the capillary.

3.1.4

impulse line

instrument tubing connection provided between the process isolation valve and the measuring element

3.1.5

instrument range

region in which the instrument/device can reliably measure within the supplier stated performance limits

3.1.6

name plate

plate, permanently affixed to the instrument, stating identification information

3.1.7

pressure retaining bolting

bolting whose failure to function as intended results in a release of contained fluid into the environment

3.1.8

tag plate

identifier plate, normally attached by wire to the instrument, stating the tag number

3.2 Abbreviated terms

IoT	internet of things
MDS	material data sheet
NDE	non-destructive examination
PMI	positive material identification
PTFE	polytetrafluoroethylene
RTD	resistance temperature device
UV	ultraviolet

4 Common requirements

4.1 System design

4.1.1 General design codes

Basic process measurement instrumentation shall comply with the following general design codes listed in Table 1.

Table 1 — General design codes

Standard number	Scope covered
IEC 62828 (all parts)	Performance
ISO 21457	Materials

4.1.2 Configuration

4.1.2.1

Instrumentation shall be preconfigured with the following data:

- tag number;
- fail safe direction;
- calibrated range;
- units of measure.

4.1.2.2

Instrumentation configuration shall be via the specified communication protocol.

4.1.2.3

The communication protocol shall be backward compatible.

4.1.2.4

Instrumentation shall be supplied and tested as a single assembly.

4.1.2.5

Transmitters shall detect failure of sensors with the upscale or downscale failsafe direction configured.

4.1.3 Electronics

4.1.3.1

Transmitter integral displays shall be configured to display the measured variable and unit of measure.

4.1.3.2

Transmitter housings shall have the facility to be locked in position a minimum of 90° steps.

4.1.3.3

Transmitter displays shall have rotation adjustment.

4.1.3.4

Failure or removal of a transmitter integral local display shall have no effect on the output signal.

4.1.3.5

Instrumentation shall maintain configuration settings on loss of power.

4.1.3.6

Electrical connections shall be reverse-polarity protected.

4.1.3.7

Seals between the process fluid and electrical components, that are integral to the instrument, shall comply with ANSI/ISA 12.27.01.

4.1.4 Safety integrity

Safety instrumented function transmitters shall be provided with a SIL certificate from an independent, internationally-recognized organization.

4.1.5 Cyber security

4.1.5.1

Device type manager and device description files shall be available directly from the equipment manufacturer or from the equipment manufacturer's authorized secure website.

4.1.5.2

Device type manager and device description files shall be signed by the equipment manufacturer using a trusted certificate authority.

4.1.5.3

The instrument shall be protected against inadvertent changes with the use of a physical switch, jumper or password.

4.1.6 Ingress protection

The ingress protection for the instrumentation housing and termination enclosures shall be minimum IP66 or NEMA 4X.

4.2 Performance

4.2.1

Instrument hardware, firmware and software shall be supported for 10 years from order placement.

4.2.2

Transmitters shall have a vibration level resistance of "Field with general application or pipeline with low vibration" in accordance with IEC 62828-1:2017, Table 4.

4.3 Mechanical construction

4.3.1 Metallurgy and soft goods

4.3.1.1 Wetted materials

4.3.1.1.1

Wetted part materials shall be minimum 316/316L stainless steel.

4.3.1.1.2

Alloy C-276 (UNS N10276) or higher corrosion-resistant alloy sensor elements shall be used when in contact with chloride-, amine- or ammonium-containing process fluids.

4.3.1.1.3

Copper and copper alloys shall not be used for parts exposed to sour service process fluids.

4.3.1.1.4

Diaphragm seals in hydrogen service shall be designed to resist hydrogen permeation leading to embrittlement.

4.3.1.1.5

Silver, mercury and alloys containing silver or mercury shall not be used for wetted parts.

4.3.1.2 Pressure-retaining parts

4.3.1.2.1

Pressure-retaining bolting and nuts shall be in accordance with IOGP S-563.

4.3.1.2.2

When the instrument is designated in sour service, exposed and non-exposed bolting shall comply with NACE MR0175/ISO 15156 or NACE MR0103/ISO 17945.

4.3.1.2.3

Cadmium-plated bolting shall not be used.

4.3.1.3 Housing materials

4.3.1.3.1

Housing material for marine/offshore applications shall be minimum 316 stainless steel.

4.3.1.3.2

Instrumentation shall not contain mercury, asbestos or ceramic fibres.

4.3.1.3.3

Instrumentation shall be UV-resistant.

4.3.1.4 Soft goods

4.3.1.4.1

The selection and evaluation of elastomeric seals to mitigate against rapid gas decompression shall be in accordance with ISO 23936-1, ISO 23936-2 or NORSOK M-710.

4.3.1.4.2

Nitrile rubber o-rings shall not be used in hydrocarbon applications.

4.3.2 Tag and name plates

4.3.2.1

Tag and name plate information shall be stamped or engraved.

4.3.2.2

Tag and name plates shall be 316 stainless steel.

4.3.2.3

Name plates shall include the following information:

- manufacturer's name;
- model, type and serial number;
- operating voltage;
- hazardous area certification details.

4.3.2.4

Tag plates shall be secured to the transmitter or remote indicator with 316 stainless steel tie wire.

4.3.2.5

Name plates shall be affixed with 316 stainless steel rivets or screws.

4.3.3 Cable entry

4.3.3.1

Electrical ports shall be fitted with plugs certified to the instrument hazardous area certification.

4.3.3.2

Terminals within the head shall be clearly marked "+" and "-" symbols for the relative voltage applied.

4.4 Inspection and shop tests

4.4.1 Pressure testing

4.4.1.1

Pressure-containing parts shall comply with the respective MDSs of IOGP S-563.

4.4.1.2

The complete instrument assembly shall be hydrostatically pressure tested in accordance with ASME B16.5:2020, 8.2.

4.4.1.3

Assemblies of pressure-containing components shall remain assembled on completion of the hydrostatic test.

4.4.1.4

The design of instrumentation used in hydrocarbon service shall not allow a fault in the primary process barrier to lead to a leak into the main compartment or junction box.

4.4.2 Non-destructive examination

4.4.2.1

NDE of pressure-containing parts shall be in accordance with IOGP S-563.

4.4.2.2

NDE of non-pressure-containing parts shall be in accordance with its associated material standard specification.

4.4.2.3

PMI of pressure-containing parts shall be performed on stainless steel, nickel alloy and non-ferrous alloy instrumentation with frequency, extent and acceptance criteria defined in the PMI procedure.

4.5 Preparation for shipment

4.5.1

Instrumentation internal surfaces shall be free from test fluids, cleaning agents, particles and organic substances prior to shipping.

4.5.2

Temporary plugs shall be distinguishable from permanent plugs.

4.5.3

Flange faces shall be protected prior to shipping.

4.5.4

Flange openings shall be sealed prior to shipping.

4.5.5

The design of covers shall prevent the instrumentation from being installed without prior removal of the covers.

5 Pressure and differential pressure transmitters

5.1 General

5.1.1

Pressure instrumentation shall be designed and tested in accordance with the standards in Table 2.

Table 2 — General standards applicable to pressure instrumentation

Standard number	Scope covered
ASME PTC 19.2	Performance test codes
IEC 60381-1	Transmitter signal
IEC 61326-1	EMC
IEC 61326-3-1	EMC
IEC 61508 (all parts)	SIL
IEC 61518	Mating dimensions
IEC 62305 (all parts)	Lightning protection
IEC 62402	Obsolescence management
ISA 50.00.01	Analog signals
MSS SP-99	Instrument valves
NAMUR NE 43	Transmitter failure signal level
NAMUR NE 107	Field device diagnostics

5.1.2

Pressure instrumentation supplied in accordance with US standards shall comply with the standards in Table 3.

Table 3 — US standards applicable to pressure instrumentation

Standard number	Scope covered
ASME <i>BPVC</i> , Section IX	Welding
ASME B1.20.1	Threads
ISA 50.00.01	Analog signals
NEMA 250	Electrical equipment enclosures
NFPA 70	National electrical code
UL 94	Plastic flammability tests

5.1.3

Pressure instrumentation supplied in accordance with non-US standards shall comply with the standards in Table 4.

Table 4 — Non-US standards applicable to pressure instrumentation

Standard number	Scope covered
IEC 60695-11-10	Fire tests
IEC 60695-11-20	Fire tests
IEC 60079 (all parts)	Explosive atmospheres
IEC 60381-1	Transmitter signal
IEC 60529	Ingress protection
ISO 261	Threads
ISO 15614 (all parts)	Welding

5.1.4

Pressure transmitters shall have an accuracy of $\pm 0,1$ % of the calibrated span or better.

5.2 Instrument protection

5.2.1

Diaphragm seal capillary material shall be minimum 316 stainless steel.

5.2.2

Diaphragm seal capillaries shall be filled and welded to the seals and the instrument.

5.2.3

Diaphragm material shall be minimum 316 stainless steel.

5.2.4

Diaphragm seal capillary fill fluid shall not be pyrophoric.

5.2.5

Diaphragm seals shall be permanently marked to identify the seal fluid.

5.3 Instrument process manifolds

5.3.1

Manifold valve bonnets shall have a locking pin.

5.3.2

Manifold valve process connections shall be flanged type for direct mounted installation.

5.3.3

Manifold valve bonnets shall be fitted with colour-coded ring labels in accordance with API Recommended Practice 551.

5.3.4

Manifold valves shall be fabricated from bar stock material.

5.3.5

Manifold valves shall be directly mounted on the transmitter.

5.3.6

Five-valve manifolds shall be single equalization valve pattern in accordance with API Recommended Practice 551.

5.3.7

Needle valve packing in manifold valves shall be graphite-based or PTFE.

5.3.8

PTFE needle valve packing shall be limited to design temperatures from -40°C (-40 °F) to 200 °C (392 °F).

6 Temperature instrumentation

6.1 General

6.1.1

Temperature instrumentation shall comply with the standards in Table 5.

6.1.2

Temperature instrumentation supplied in accordance with US standards shall comply with the standards in Table 6.

6.1.3

Temperature instrumentation supplied in accordance with non-US standards shall comply with the standards in Table 7.

6.1.4

Temperature transmitters shall have configurable linearization.

6.1.5

The thermal connection between the thermowell tip and tip-sensitive elements shall be maintained with mechanical loading.

6.1.6

Temperature transmitters shall have an accuracy of at least $\pm 0,1$ % of the calibrated span.

Table 5 — General standards applicable to temperature instrumentation

Standard number	Scope covered
ASME PTC 19.3TW	Thermowell design
ASTM B912	Thermowell electropolishing
ASTM E230/E230M	Thermocouple EMF tables
ASTM E235/E235M	Type K and N thermocouples
ASTM E608/E608M	Thermocouple specification
ASTM E1137/E1137M	Platinum resistance thermocouple
IEC 60584-1	Thermocouple EMF specification
IEC 60584-3	Thermocouple tolerances
IEC 60751	Platinum resistance sensors
IEC 61326-1	EMC
IEC 61326-3-1	EMC
IEC 61508 (all parts)	SIL
IEC 62305 (all parts)	Lightning protection
IEC 62402	Obsolescence management
NAMUR NE 43	Transmitter failure signal level
NAMUR NE 107	Field device diagnostics

Table 6 — US standards applicable to temperature instrumentation

Standard number	Scope covered
ASME B1.20.1	Threads
ISA 50.00.01	Analog signals
NEMA 250	Electrical equipment enclosures
NFPA 70	National electrical code

Table 7 — Non-US standards applicable to temperature instrumentation

Standard number	Scope covered
IEC 60079 (all parts)	Explosive atmospheres
IEC 60381-1	Transmitter signals
IEC 60529	Ingress protection
ISO 261	Threads

6.1.7

Temperature transmitter assemblies shall be designed with nipple-union-nipple fittings.

6.1.8

The temperature element head cover shall be attached to the head with a stainless steel chain.

6.1.9

Temperature element assemblies shall be duplex type.

6.1.10

The thermowell body shall not have welds i.e. single piece.

6.2 Resistance temperature devices (RTD)

6.2.1

RTD transition pieces shall be hermetically sealed.

6.2.2

RTD heads shall have an integral terminal block with a shield terminal.

7 Flow instrumentation

7.1 General

7.1.1

Flow instrumentation shall comply with the design standards in Table 8.

7.1.2

Flow instrumentation supplied in accordance with US standards shall comply with the design standards in Table 9.

7.1.3

Flow instrumentation supplied in accordance with non-US standards shall comply with the design standards in Table 10.

7.1.4

Flow elements shall be marked with the flow direction.

7.1.5

The accuracy of flow instrumentation shall not exceed the values in Table 11.

7.1.6

Flow meters shall be wet-calibrated.

Table 8 — General standards applicable to flow instrumentation

Standard number	Scope covered	Venturi	Coriolis	Electro-magnetic	Ultrasonic	Vortex	Orifice
ASME B31.3	Process piping	A	A	A	A	A	N/A
ASME MFC-3M	Orifice	A	N/A	N/A	N/A	N/A	A
ASME MFC-5.1	Ultrasonic	N/A	N/A	N/A	A	N/A	N/A
ASME MFC-5.3	Ultrasonic	N/A	N/A	N/A	A	N/A	N/A
ASME MFC-6M	Vortex	N/A	N/A	N/A	N/A	A	N/A
ASME MFC-11	Coriolis	N/A	A	N/A	N/A	N/A	N/A
ASME MFC-16	Electromagnetic	N/A	N/A	A	N/A	N/A	N/A
IEC 61326-1	EMC	N/A	A	A	A	A	N/A
IEC 61326-3-1	EMC	N/A	A	A	A	A	N/A
IEC 61508 (all parts)	SIL	N/A	A	A	A	A	N/A
IEC 62305 (all parts)	Lightning protection	N/A	A	A	A	A	N/A
IEC 62402	Obsolescence management	N/A	A	A	A	A	N/A
IOGP S-705	Welding	A	A	A	A	A	N/A
ISO 5167-1	Orifice	A	N/A	N/A	N/A	N/A	A
ISO 5167-2	Orifice	N/A	N/A	N/A	N/A	N/A	A
ISO 5167-4	Venturi	A	N/A	N/A	N/A	N/A	N/A
ISO 10790	Coriolis	N/A	A	N/A	N/A	N/A	N/A
ISO 12764	Vortex	N/A	N/A	N/A	N/A	A	N/A
ISO/TR 15377	Orifice and Venturi	A	N/A	N/A	N/A	N/A	A
ISO 17089-2	Ultrasonic	N/A	N/A	N/A	A	N/A	N/A
ISO 20456	Electromagnetic	N/A	N/A	A	N/A	N/A	N/A
NAMUR NE 43	Transmitter failure signal level	N/A	A	A	A	A	N/A
NAMUR NE 107	Field device diagnostics	N/A	A	A	A	A	N/A
NAMUR NE 132	Coriolis	N/A	A	N/A	N/A	N/A	N/A
Key A Applicable N/A Not applicable							

Table 9 — US standards applicable to flow instrumentation

Standard number	Scope covered	Venturi	Coriolis	Electro-magnetic	Ultrasonic	Vortex
ASME BPVC, Section IX	Welding	A	N/A	N/A	N/A	N/A
ASME B1.20.1	Threads	A	A	A	A	A
ISA 50.00.01	Analog signals	N/A	A	A	A	A
NEMA 250	Electrical equipment enclosures	N/A	A	A	A	A
NFPA 70	National electrical code	N/A	A	A	A	A
Key						
A Applicable						
N/A Not applicable						
NOTE Standards and topics not relevant to orifice plates.						

Table 10 — Non-US standards applicable to flow instrumentation

Standard number	Scope covered	Venturi	Coriolis	Electro-magnetic	Ultrasonic	Vortex
IEC 60079 (all parts)	Explosive atmospheres	N/A	A	A	A	A
IEC 60381-1	Transmitter signal	N/A	A	A	A	A
IEC 60529	Ingress protection	N/A	A	A	A	A
ISO 261	Threads	A	A	A	A	A
ISO 15614 (all applicable parts)	Welding	A	N/A	N/A	N/A	N/A
Key						
A Applicable						
N/A Not applicable						
NOTE Standards and topics not relevant to orifice plates.						

Table 11 — Flow instrumentation accuracy

Technology	Accuracy
Ultrasonic	± 1 % of full scale flow
Coriolis	± 1 % of full scale flow
Electromagnetic	± 1 % of full scale flow
Vortex	± 1 % of full scale for liquid flow ± 2 % of full scale for gas flow

7.2 Head meters, orifice

7.2.1

Orifice plate material shall be minimum 316 stainless steel.

7.2.2

Orifice plate handles shall be engraved on the upstream side with the following information:

- "INLET";
- instrument tag;
- bore size;
- plate material;
- plate type;
- line size;
- flange rating.

7.2.3

Orifice plate information shall be visible without the removal of insulation.

7.2.4

The orifice plate tab shall be in line with the drain or vent hole.

7.3 Volumetric meters

7.3.1 Ultrasonic flow meters

For clamp-on ultrasonic instruments, interface material between the clamp-on ultrasonic flow meter and pipe shall be selected dependent on process pipe temperature, pipe wall thickness and process velocity.

7.3.2 Electromagnetic flow meters

The electromagnetic flowmeter shall identify when the pipe is not completely full.

7.3.3 Vortex flow meters

Calculations shall demonstrate that the vortex flow meter meets the performance requirements at the minimum flow case.

8 Level instrumentation

8.1 General

8.1.1

Level instrumentation shall comply with the design standards in Table 12.

8.1.2

Level instrumentation supplied in accordance with US standards shall comply with the design standards in Table 13.

8.1.3

Level instrumentation supplied in accordance with non-US standards shall comply with the design codes in Table 14.

8.1.4

The accuracy of level instrumentation shall not exceed the values in Table 15.

8.1.5

Purchaser-provided level sketches shall be used to size and select the level instrumentation.

Table 12 — General standards applicable to level instrumentation

Standard number	Scope covered	Magnetic level indicator	Hydrostatic	Guided wave radar	Non-contact radar
ASME B31.3	Process piping	A	N/A	N/A	N/A
ASME PTC 19.2	Performance test codes	N/A	A	N/A	N/A
IEC 61326-1	EMC	A ^a	A	A	A
IEC 61326-3-1	EMC	A ^a	A	A	A
IEC 61508 (all parts)	SIL	N/A	A	A	A
IEC 61518	Mating dimensions	N/A	A ^b	N/A	N/A
IEC 62305 (all parts)	Lightning protection	A ^a	A	A	A
IEC 62402	Obsolescence management	A	A	A	A
IOGP S-705	Welding	A	N/A	A	A
NAMUR NE 43	Transmitter failure signal level	A ^a	A	A	A
NAMUR NE 107	Field device diagnostics	A ^a	A	A	A
Key					
A Applicable					
N/A Not applicable					
^a Only active if transmitter option is selected.					
^b Only active when transmitter connected to a manifold block.					

Table 13 — US standards applicable to level instrumentation

Standard number	Scope covered	Magnetic level indicator	Hydrostatic	Guided wave radar	Non-contact radar
ASME BPVC, Section IX	Welding	A	A	A	A
ASME B1.20.1	Threads	A	A	A	A
ISA 50.00.01	Analog signals	A ^a	A	A	A
NEMA 250	National electrical code	A ^a	A	A	A
NFPA 70	Electrical equipment enclosures	A ^a	A	A	A
UL 94	Plastic flammability tests	N/A	A	N/A	N/A
Key					
A Applicable					
N/A Not applicable					
^a Only active if transmitter option is selected.					

Table 14 — Non-US standards applicable to level instrumentation

Standard number	Scope covered	Magnetic level indicator	Hydrostatic	Guided wave radar	Non-contact radar
IEC 60695-11-1	Fire tests	N/A	A	N/A	N/A
IEC 60695-11-20	Fire tests	N/A	A	N/A	N/A
IEC 60079 (all parts)	Explosive atmospheres	A ^a	A	A	A
IEC 60381-1	Transmitter signal	A ^a	A	A	A
IEC 60529	Ingress protection	A ^a	A	A	A
ISO 261	Threads	A	A	A	A
ISO 15614 (all applicable parts)	Welding	A	A	A	A
Key					
A Applicable					
N/A Not applicable					
^a Only active if transmitter option is selected.					

Table 15 — Level instrumentation accuracy

Technology	Accuracy
DP	± 0,1 % of specified span
Radar non-contact	± 3 mm (0,12 in) with an overall operating accuracy within ± 5 mm (0,2 in)
Radar GWR	± 5 mm (± 0,2 in)
Magnetic level indicator	± 5 mm (± 0,2 in)

8.2 Magnetic level indicators

8.2.1

Magnetic level indicators shall not be follower/floating shuttle type.

8.2.2

Magnetic level indicator flags shall be hermetically sealed and be made from 316 stainless steel.

8.2.3

Individual magnetic level indicator segments shall be interlocked to prevent colour change due to external forces.

8.2.4

Magnetic level indicator floats shall be removable through the bottom flange.

8.2.5

Magnetic level indicators shall have float stop springs in the bottom and top of the chamber.

8.2.6

The magnetic level indicator float and chamber design shall ensure that the float movement is not affected by process conditions.

8.2.7

Magnetic level indicator scale markings shall be indelibly stamped or engraved.

8.3 Non-contact radar transmitter

8.3.1

Non-contact radar instrumentation shall be supplied with the functionality to produce echo curves.

8.3.2

Software used to display or interpret the non-contact radar echo curves shall be provided.

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