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IOGP S-718, Specification for Basic Process Measurement Instruments, First Edition, September 2022, including Addendum 1, December 2023

ADDENDUM 2 FOR PUBLIC REVIEW

This addendum will replace Edition 1.0 published in September 2022 and Addendum 1 published in December 2023.

While this addendum primarily adds requirements and data sheet elements for additional level instruments, due to the extent of updates, it should be treated as a new document.

International Association of Oil & Gas Producers

SPECIFICATION
IOGP S-718J
February 2024
Version 1.011
ADDENDUM 2 TO FIRST EDITION (SEPTEMBER 2022)

Specification for Basic Process Measurement Instruments

NOTE This version (S-718J) of the specification document provides the justification statements for each technical requirement, but is otherwise identical in content to S-718.

JIP33
JOINT INDUSTRY PROGRAMME

Revision history

VERSION	DATE	PURPOSE
1.011	February 2024	Addendum 2 for Public Review
1.01	December 2023	Addendum 1
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).

Disclaimer

Copyright notice

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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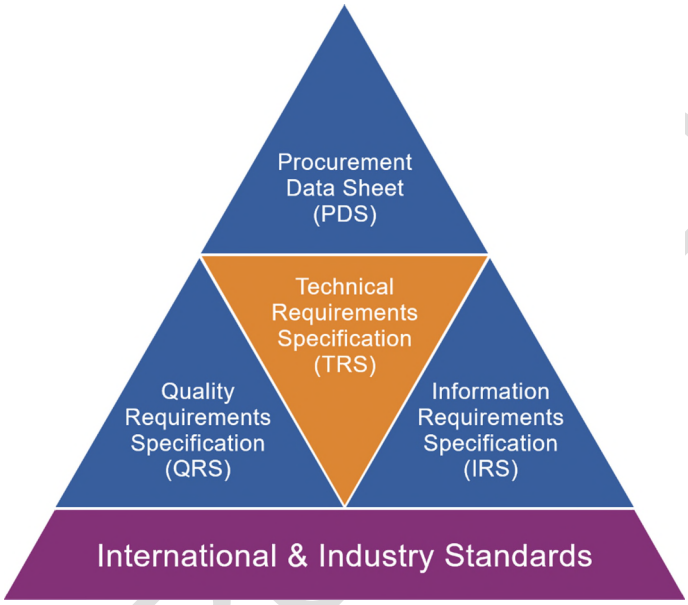
Introduction

The purpose of the IOGP S-718 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.

The IOGP S-718 specification documents follow a common structure (as shown below) comprising a specification, also known as a technical requirements specification (TRS), a procurement data sheet (PDS), an information requirements specification (IRS) and a quality requirements specification (QRS). These four specification documents, together with the purchase order, define the overall technical specification for procurement.



JIP33 Specification for Procurement Documents
Technical Requirements Specification (TRS)

This specification is to be applied in conjunction with the supporting PDS, IRS and QRS as follows.

IOGP S-718: Specification for Basic Process Measurement Instruments

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

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

The PDS defines application-specific requirements. The PDS is applied during the procurement cycle only and does not replace the equipment data sheet. The PDS may also include fields for supplier-provided information required as part of the purchaser's technical evaluation. Additional purchaser-supplied documents may also be incorporated or referenced in the PDS 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 information requirements for the scope of supply. The IRS includes information content, format, timing and purpose to be provided by the supplier, and may also define specific conditions that invoke the 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 PDS or in the purchase order.

The specification documents follow the drafting principles and rules of ISO/IEC Directives, Part 2.

The PDS and IRS are published as editable documents for the purchaser to specify application-specific requirements. The TRS and QRS are fixed documents.

The order of precedence of documents applicable to the supply of the equipment, with the highest authority listed first, shall be as follows:

a) regulatory requirements;

b) contract documentation (e.g. purchase order);

c) purchaser-defined requirements (e.g. PDS, IRS and QRS);

d) this specification;

e) selected instrument-specific normative standards.

1 Scope

1.1 Technologies

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

a) pressure type:

- electronic pressure and differential pressure transmitters, both with manifold and diaphragm seal options;
- pressure and differential pressure gauges.

b) temperature type:

- electronic temperature transmitters;
- RTD and thermocouples;
- thermowells;
- temperature gauges.

c) flow type:

- concentric sharp edge, conic, quadrant edge, multi-hole and eccentric orifice head flow meter elements including quick change assemblies;
- integral orifice run, venturi, flow nozzle, cone, wedge, averaging pitot tube and variable area meter flow elements;
- ultrasonic, magnetic, vortex and turbine volumetric flow meter elements;
- Coriolis and thermal mass flow meter elements.

d) level type:

- magnetic level indicators and transmitters;
- level gauge glass indicator;
- wet leg, diaphragm and bubbler hydrostatic level transmitters;
- level displacer;
- ultrasonic level;
- RF capacitance/admittance;
- guided wave radar level transmitters;
- non-contact radar level transmitters;
- tuning fork;

- nucleonic level.

e) general type:

- Sand monitor;
- Erosion monitor;
- Corrosion monitor.

Justification

The scope of supply has been decided based on the agreed framing proposal from the operating companies.

1.2 Boundaries

This specification covers instrumentation for the following applications:

- upstream production facilities excluding wellhead, drilling and subsea instrumentation;
- midstream transportation and storage;
- downstream refining and distribution.

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

- NACE compliance for H_2S and alkaline service;
- hydrogen service.

Justification

The operating companies have agreed the scope for the boundary conditions mostly commonly encountered for the instrumentation.

1.3 Exclusions

The following general requirements are excluded from this specification:

- Industrial Internet of Things (IIoT);
- signal conditioners.

The following technologies are excluded from this specification:

- multi-point temperature devices;
- skin-type thermocouples;
- magnetic temperature sensors;
- orifice flanges;
- density profilers;
- custody transfer metering and weighing systems;

- wellhead, drilling and subsea instruments;
- multi-phase flowmeters;
- fire and gas detectors;
- all types of quality measurement instruments such as analysers and gas chromatographs;
- process switches (non-smart), pig detectors, position indicators and pushbuttons;
- machine monitoring devices such as vibration and speed/acceleration/phase sensors;
- beacons and sounders;
- naval systems such as ballast tank level measurement;
- ATG.

Justification

There is a vast range of instrumentation that could have been covered within the specification and the above are included, for the avoidance of doubt, where there could be some element of misunderstanding.

2 Normative references

The following publications are referred to in this document, the PDS (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.

ANSI/HPS N43.8, *Classification of Industrial Ionizing Radiation Gauging Devices*

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

API MPMS 5.3, *Manual of Petroleum Measurement Standards Chapter 5—Metering Section 3—Measurement of Liquid Hydrocarbons by Turbine Meters*

API MPMS 22.2, *Manual of Petroleum Measurement Standards Chapter 22—Testing Protocol: Section 2—Differential Pressure Flow Measurement Devices*

API Recommended Practice 551, *Process Measurement*

ASME BPVC, Section I, *Rules for Construction of Power Boilers*

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 B40.100, *Pressure Gauges and Gauge Attachments*

ASME B40.200, *Thermometers, Direct Reading and Remote Reading*

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-12M, *Measurement of Fluid Flow in Closed Conduits Using Multiport Averaging Pitot Primary Elements*

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

ASME MFC-18M, *Measurement of Fluid Flow Using Variable Area Meters*

ASME MFC-21.2, *Measurement of Fluid Flow by Means of Thermal Dispersion Mass Flowmeters*

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

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

ASME PTC 19.5, *Flow Measurement*

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*

EN 837-1, *Pressure Gauges - Part 1: Bourdon Tube Pressure Gauges. Dimensions, Metrology, Requirements and Testing*

EN 13190, *Dial thermometers*

IEC 60079 (all parts), *Explosive atmospheres*

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

IEC 60462, *Nuclear instrumentation – Photomultiplier tubes for scintillation counting – Test procedures*

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 61453, *Nuclear instrumentation – Scintillation gamma ray detector systems for the assay of radionuclides – Calibration and routine tests*

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 62591, *Industrial networks – Wireless communication network and communication profiles – WirelessHART™*

IEC 62598, *Nuclear Instrumentation - Constructional requirements and classification of radiometric gauges*

IEC 62734, *Industrial networks – Wireless communication network and communication profiles – ISA 100.11a*

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

IEC 62828-1:2017, *Reference conditions and procedures for testing industrial and process measurement transmitters — Part 1: General procedures for all types of transmitters*

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

IOGP S-705, *Supplementary Specification to API Recommended Practice 582 Welding Guidelines 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 2715, *Liquid hydrocarbons — Volumetric measurement by turbine flowmeter*

ISO 3966, *Measurement of fluid flow in closed conduits — Velocity area method using Pitot static tubes*

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 5167-3, *Measurement of fluid flow by means of pressure differential devices inserted in circular cross-section conduits running full — Part 3: Nozzles and Venturi nozzles*

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 5167-5, *Measurement of fluid flow by means of pressure differential devices inserted in circular cross-section conduits running full — Part 5: Cone meters*

ISO 5167-6, *Measurement of fluid flow by means of pressure differential devices inserted in circular cross-section conduits running full — Part 6: Wedge meters*

ISO 9951, *Measurement of gas flow in closed conduits — Turbine meters*

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 14511, *Measurement of fluid flow in closed conduits — Thermal mass flowmeters*

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 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 H_2S-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*

NORSOK M-710, *Qualification of non-metallic materials and manufacturers - Polymers*

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

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

– ISO Online browsing platform: available at https://www.iso.org.obp

– IEC Electropedia: available at http://www.electropedia.org/

3.1.1
bluff body
object whose significant portion of the surface area has separated flow

3.1.2
calibrated range
region within which an instrument/device has been bench calibrated to check the actual device output reading against known standards

3.1.3
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

3.1.4
diaphragm seal
chemical seal
remote seal
flexible material used for pressure measurements when the process material is required to be kept away from the pressurized 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.

3.1.5
impulse line
instrument tubing connection provided between the process isolation valve and the measuring element

3.1.6
instrument range
region in which the instrument/device can reliably measure within the supplier-stated performance limits

3.1.7
marine installation
offshore installation
nearshore installation
installation sited in oceans, seas, bays, estuaries and other high salinity water bodies including land up to 1 km (0,6 miles) from shore

3.1.8
multivariable transmitter
device used to measure and simultaneously transmit multiple process variables

Note to entry 1: These process variables can include parameters such as pressure, temperature and flow rate.

3.1.9
name plate
plate, permanently affixed to the instrument, stating identification information

3.1.10
pressure retaining bolting
bolting whose failure to function as intended results in a release of contained fluid into the environment

3.1.11
retractable type instrument
instrument that can be installed and removed from service without interruption to the process

3.1.12
tag plate
identifier plate, normally attached by wire to the instrument, stating the tag number

3.2 Abbreviated terms

ATG automatic tank gauging

DTM device type manager

EDDL electronic device description language

IRS information requirements specification

MDS material data sheet

NDE non-destructive examination

PDS procurement data sheet

PMI positive material identification

PTFE polytetrafluoroethylene

QRS quality requirements specification

RF radio frequency

RTD resistance temperature device

SIL safety integrity level

TRS technical requirements specification

UV ultraviolet

4 Common requirements

4.1 System design

4.1.1 General design codes

Basic process measurement instrumentation shall comply with IEC 62828 (all parts).

Justification

This requirement provides a basis of the code compliance for the instrumentation being supplied.

NOTE The scope of IEC 62828 (all parts) covers performance.

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.

Justification

This requirement provides the minimum configuration needed for the instrument to be functionally ready to be installed and operated.

4.1.2.2

Instrumentation configuration shall be via the specified communication protocol.

Justification

This requirement enforces standardization of tools used to interface with the instrumentation. These tools used have full functionality to configure all parameters within the instrument.

4.1.2.3

The communication protocol shall be backward compatible.

Justification

This requirement ensures that any change to the communication protocol has no impact to the purchaser's configuration from an earlier version/revision.

4.1.2.4

Instrumentation shall be supplied and tested as a single assembly.

Justification

This requirement ensures that instrumentation is supplied complete and tested as a single unit.

4.1.2.5

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

Justification

This requirement ensures that transmitter diagnostics are able to identify all faults with sensing elements.

4.1.3 Electronics

4.1.3.1

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

Justification

This requirement supports the goal of minimal interaction with the field instrument by the operator in the field since the default display is provided. Additionally, the units are configured to the range and units stated on the PDS.

4.1.3.2

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

Justification

This requirement allows the LCD display to be rotated in a single plane supports operations and maintenance by allowing the display to be positioned at the optimal angle.

4.1.3.3

Transmitter displays shall have rotation adjustment.

Justification

This requirement allows the display to be oriented in the optimum angle for operator viewing.

4.1.3.4

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

Justification

This requirement ensures the display does not affect availability of the instrument function.

4.1.3.5

Instrumentation shall maintain configuration settings on loss of power.

Justification

This requirement supports availability of the installation by minimizing operator support.

4.1.3.6

Electrical connections shall be reverse-polarity protected.

Justification

This requirement provides protection to the transmitter electronics.

4.1.3.7

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

Justification

Compliance aims to prevent a single seal failure from allowing process fluids to propagate into the external electrical system.

4.1.4 Safety integrity

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

Justification

A third-party independent assessment body provides an impartial review and ensures validity of the certification provided.

4.1.5 Cyber security

4.1.5.1

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

Justification

The equipment manufacturer ensures that the authorized website is secured by using a signed certificate from a trusted certificate authority. This provides the latest DTM/DD file from the manufacturer of the equipment using a secure communication method.

4.1.5.2

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

Justification

This requirement ensures the file received is the original manufacturer's file that has not been modified or interfered with.

4.1.5.3

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

Justification

This requirement provides a layer of security to prevent unwanted change by unauthorized persons.

4.1.6 Ingress protection

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

Justification

The industry agreed minimum IP rating for externally mounted electronics and is commonly accepted and designed for by suppliers.

4.1.7 Wireless

4.1.7.1

WirelessHART® and ISA 100.11a instruments shall use approved, tested and certified electronic device description language (EDDL) or DTM.

Justification

DTM and EDDL files describe the properties and parameters of the device. Every WirelessHART® device has a driver in DTM and DD format.

4.1.7.2

Battery life expectancy for a one-hour transmit interval at 15 °C (60 °F) shall be at least three years.

Justification

Wireless sensors are typically battery powered although some devices may be powered from other sources such as environmental energy harvesters.
Wireless sensors achieve long battery life through duty-cycled operation, resulting in typical battery life in the range of five years or more. Considerations are made to ensure that the latest battery/booster is selected to comply with the battery life expectancy.

4.1.7.3

The wireless instrument battery or battery pack shall be of pluggable type.

Justification

This requirement ensures high integrity connection of contact surfaces.

4.1.7.4

The wireless instrument battery or battery pack shall permit replacement in the designated hazardous area.

Justification

This requirement minimizes the amount of maintenance needed and optimizes availability.

4.1.7.5

Batteries shall be keyed to prevent reverse polarity.

Justification

The method of "keying" removes the possibility of human error when replacing the battery.

4.1.7.6

Wireless devices shall have non-volatile memory.

Justification

Non-volatile memory ensures that all stored items remain even after loss of power (e.g. during battery changing). Loss of configuration has safety issues if the instrument is started up without it and also places increased burden on the maintenance team if they have to reconfigure every time an instrument loses power or is charging.

4.1.7.7

Wireless devices shall have the capability to transmit battery diagnostic data.

Justification

This requirement ensures that the health of the battery is available to the purchaser.

4.2 Performance

4.2.1

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

Justification

The timescale provided is industry good practice to ensure that sufficient time is available for support of the instrument to ensure minimum impact to maintenance team. In reality, there can be five years between order placement and the instrument being commissioned, leaving only a small time period of use, hence validation of the supplier's plans is critical. Also, note that the transmitter hardware and firmware is supported by the supplier in terms of services and spare parts.

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.

Justification

Vibration limits are stated in API RP 551 which in turn references IEC 60770-1. However, IEC 60770 has been withdrawn and replaced with IEC 62828, hence this requirement.

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.

Justification

The minimum material selection of 316 stainless steel provides increase corrosion resistance for the standard offering.

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.

Justification

The material selection stated mitigates against the potential impact of identified corrosive environments encountered in the oil and gas industry.

4.3.1.1.3

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

Justification

Copper and copper alloys can suffer accelerated corrosion in sour environment.

4.3.1.1.4

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

Justification

This requirement mitigates against the risk of hydrogen atom permeation across the sensor. Over time, hydrogen can permeate into the fill fluid, causing zero and span shifts. In extreme cases, a hydrogen bubble can form in the fill fluid, causing the diaphragm to rupture.

4.3.1.1.5

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

Justification

Mercury use is prohibited due to its health effects. It also has the ability to cause liquid metal embrittlement. Silver alloys are sometime used for brazing parts together and may cause galvanic corrosion for some materials/environments combinations.

4.3.1.1.6

Butt welds in butt joints where the weld root is exposed to the process shall be full penetration.

Justification

This requirement provides a minimum welding requirement to ensure the integrity of the instrument.

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.

Justification

The critical nature of the pressure-retaining bolting and the reference to IOGP S-563 ensures that the correct material is selected for the service. This is only applicable to pressure-retaining bolting and other bolting does not require compliance.

4.3.1.2.2

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

Justification

Pressure-containing bolting is considered to be not in contact with the process medium. However, there have been instances where, should the containment be broken, the liquid can migrate to the bolting and over time attack the bolt/nut material particularly if under insulation. On this basis, because of this risk, this requirement ensures that the material aligns with whether NACE is needed.

4.3.1.2.3

Cadmium-plated bolting shall not be used.

Justification

Plating is not acceptable primarily for HSSE reasons because of its high toxicity.

4.3.1.2.4

Insertion-type instruments shall incorporate physical positive retention elements that prevent the element from being projected under pressure.

Justification

This requirement ensures that the design is inherently safe on removal by the use of measures such as mechanical stops and safety chains.

4.3.1.2.5

Belleville (spring) washers shall be the default spring type for pressure retaining service.

Justification

Standardization on pressure-retaining parts provides a higher integrity seal on the nuts by applying consistent force for the selected services. This has the potential benefit of reduced maintenance and higher integrity design.

4.3.1.3 Housing materials

4.3.1.3.1

The housing material for marine installations shall be minimum 316 stainless steel.

Justification

To provide corrosion resistance, 316 stainless steel is the minimum material selection for marine applications. It is considered that the basis for this choice is to reduce the life cycle cost for the life of the facility compared to the use of other metallic materials.

4.3.1.3.2

Instrumentation shall not contain mercury, asbestos or ceramic fibres.

Justification

This requirement prohibits the use of hazardous substances.

4.3.1.3.3

Instrumentation shall be UV resistant.

Justification

Any instrument enclosure including the display screen needs to be UV resistant to protect the instrument integrity and prevent degradation. If the material and LCD glass are not UV resistant, the plastic on the LCD screen cannot be read.

4.3.1.4 Soft goods

4.3.1.4.1

The selection and evaluation of elastomeric seals shall be in accordance with ISO 23936-1, ISO 23936-2 or NORSOK M-710.

Justification

This requirement provides a selection guide to suppliers for suitable material to prevent the explosive decompression phenomena on pressure containing parts. The selection mitigates against rapid gas decompression.

4.3.1.4.2

Wetted parts for hydrocarbon service shall not use nitrile rubber.

Justification

Hydrocarbons can attack nitrile rubber, hence they are not to be used in hydrocarbon services.

4.3.2 Tag and name plates

4.3.2.1

Tag and name plate information shall be stamped or engraved.

Justification

Experience demonstrates that illegibility causes problems.

4.3.2.2

The material of tag and name plates shall be 316 stainless steel.

Justification

316 stainless steel provides a balance between a resilient material to the wide range of environmental conditions while at the same time cost effective.

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.

Justification

Minimum agreed requirements for information to be contained on the nameplate to allow the instrument to be clearly identified during the production process and also when in the field to identify the tag and base technical parameters.

4.3.2.4

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

Justification

This requirement ensures the integrity of the wire used to affix the tag plate.

4.3.2.5

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

Justification

The material and fixing point are specified for durability as per existing industry best practice.

4.3.3 Cable entry

4.3.3.1

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

Justification

This requirement ensures that no openings remain exposed on completion of the manufacture and so maintain the IP rating and hazardous area certification of the unit. The risk is uncertified plugs could be used which are of lower quality and could compromise the integrity of the unit.

4.3.3.2

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

Justification

This requirement supports installation and troubleshooting.

4.3.4 Retractable instruments

4.3.4.1

The retractable assembly shall have an isolation mechanism for removal of the retractable element.

Justification

This requirement supports the maintenance activity by not requiring the line to be isolated.

4.3.4.2

Retractable-type instruments shall be equipped with a seal for safe removal of the element.

Justification

This requirement supports the maintenance activity by ensuring safe removal of the element.

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.

Justification

This requirement provides the code requirement for pressure testing of pressure containing parts. In general, pressure containing parts are hydrostatically tested to ASME B16.5 but the individual material datasheets (i.e. the relevant datasheet for the selected material from ASME/ASTM) is followed.

4.4.1.2

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

Justification

There are potentially multiple pressure containing parts in the instrument assembly and the process of pressure testing as one ensures integrity of the final assembly. Tests are in accordance with the system hydrostatic testing requirements in ASME B16.5

4.4.1.3

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

Justification

This requirement ensures that the item is tested as a single fully functional unit. An example of this would be manifolds used on hydrostatic pressure applications which are supplied operational with transmitter.

4.4.1.4

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.

Justification

This requirement ensures that if leakage occurs, it is not be possible to build up any pressure inside the instruments.

4.4.2 Non-destructive examination (NDE)

4.4.2.1

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

Justification

The material data sheet (as provided in IOGP S-563) provides prescriptive details of what NDE is required for each part.

4.4.2.2

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

Justification

The standard material specification (e.g. as defined in the ASTM/ASME/ENI/ISO material 'standard specification') provides minimum requirements.

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.

Justification

This requirement ensures that the pressure-containing part material types are confirmed for safety/integrity purposes.

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.

Justification

This requirement ensures that no matter remains on internals, which could degrade and damage internal material.

4.5.2

Temporary plugs shall be distinguishable from permanent plugs.

Justification

This requirement ensures that the correct plugs are removed and also that once in operation only certified plugs remain in place.

4.5.3

Flange faces shall be protected prior to shipping.

Justification

Protection to the flange face prevents damage during shipment, ensuring integrity of facing surfaces.

4.5.4

Flange openings shall be sealed prior to shipping.

Justification

Sealing of the flange opening prevents entry of foreign material to the internals and also prevents damage (which could be to diaphragm seal or internals of an instrument).

4.5.5

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

Justification

There is a potential safety issue if the process fluid is prevented from registering with the installed instrument, or could cause internal damage or malfunction.

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 1.

Justification

This requirement provides a basis of the code compliance for the instrumentation supplied.

5.1.2

Pressure instrumentation supplied in accordance with US standards shall comply with the standards in Table 2.

Justification

This requirement provides a basis of the code compliance for the instrumentation supplied. These are used in addition to those stated in the general section and the general pressure section.

5.1.3

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

Justification

This requirement provides a basis of the code compliance for the instrumentation supplied. These are used in addition to those stated in the general section and the general pressure section.

Table 1 — General standards applicable to pressure instrumentation

Standard number	Scope covered	Pressure gauge	Pressure transmitter
ASME PTC 19.2	Performance test codes	N/A	A
IEC 60381-1	Transmitter signal	N/A [a]	A
IEC 61326-1	EMC	N/A [a]	A
IEC 61326-3-1	EMC	N/A [a]	A
IEC 61508 (all parts)	SIL	N/A	A
IEC 61518	Mating dimensions	N/A	A
IEC 62305 (all parts)	Lightning protection	N/A	A
IEC 62402	Obsolescence management	A	A
IEC 62591 IEC 62734	Wireless	N/A [a]	A
ISO 23936-1	Seals	N/A	A
ISO 23936-2	Seals	N/A	A
ISA 50.00.01	Analog signals	N/A	A
MSS SP-99	Instrument valves	A	A
NAMUR NE 43	Transmitter failure signal level	N/A [a]	A
NAMUR NE 107	Field device diagnostics	N/A [a]	A
NORSOK M-710	Seals	N/A	A
Key A Applicable N/A Not applicable			
[a] Applicable if there is a wireless option.			

Justification

This table provides a basis of the code compliance for the instrumentation supplied.

Table 2 — US standards applicable to pressure instrumentation

Standard number	Scope covered	Pressure gauge	Pressure transmitter
ASME BPVC, Section IX	Welding	A	A
ASME B1.20.1	Threads	A	A
ASME B40.100	Gauges	A	N/A
ISA 50.00.01	Analog signals	N/A	A
NEMA 250	Electrical equipment enclosures	N/A	A
NFPA 70	National electrical code	N/A	A
UL 94	Plastic flammability tests	A [a]	A [a]
Key A Applicable N/A Not applicable			
[a] Code active if weather enclosure (external) is selected as an accessory from the PDS.			

Justification

This table provides a basis of the code compliance for the instrumentation supplied. These are used in addition to those stated in the general section and the general pressure section.

Table 3 — Non-US standards applicable to pressure instrumentation

Standard number	Scope covered	Pressure gauge	Pressure transmitter
EN 837-1	Pressure gauge design	A	N/A
IEC 60695-11-10	Fire tests	A [a]	A [a]
IEC 60695-11-20	Fire tests	A [a]	A [a]
IEC 60079 (all parts)	Explosive atmospheres	N/A	A
IEC 60381-1	Transmitter signal	N/A	A
IEC 60529	Ingress protection	A	A
ISO 261	Threads	A	A
ISO 15614 (all parts)	Welding	A	A
Key A Applicable N/A Not applicable			
[a] Code active if weather enclosure (external) is selected as an accessory from the PDS.			

Justification

This table provides a basis of the code compliance for the instrumentation supplied. These are used in addition to those stated in the general section and the general pressure section.

5.1.4

Pressure transmitters shall have a minimum accuracy of ±0,1 % of the calibrated span.

Justification

This requirement provides a basis of the minimum accuracy requirements for the instrumentation supplied

5.1.5

Gold plating thickness for hydrogen service shall be greater than or equal to 5 µm (196,85 µin).

Justification

This requirement ensures suitability of selection, minimum requirement, for hydrogen service.

5.2 Instrument protection

5.2.1

Diaphragm seal capillary material shall be minimum 316 stainless steel.

Justification

The capillaries are isolated from the process fluid, hence material selection can generally rely on standard 316 stainless steel material.

5.2.2

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

Justification

This requirement ensures that the diaphragm seal is a complete assembly.

5.2.3

The diaphragm material shall be minimum 316 stainless steel.

Justification

The diaphragm seal is in contact with the process fluid, hence material selection is critical.

5.2.4

Diaphragm seal capillary fill fluid shall not be pyrophoric.

Justification

Pyrophoric liquids such as sodium potassium (NaK) explodes if the liquid comes into contact with air. On this basis, any liquid from this category is not acceptable for use.

5.2.5

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

Justification

For incidents or troubleshooting, information has to be available easily to make troubleshooting easier.

5.3 Instrument process manifolds

5.3.1

Manifold valve bonnets shall have a locking pin.

Justification

A pin prevents inadvertent dis-assembly of the needle valve leading to removal of the valve bonnet.

5.3.2

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

Justification

The valve handle and bonnet color code requirements are identified for correct operation. This is recommended by API RP 551:2016, 8.7.4.

5.3.3

Manifold valves shall be fabricated from bar stock material.

Justification

Manifold valves are suited to bar stock due to compact size and also minimizes NDE.

5.3.4

Manifold valves shall be directly mounted on the transmitter.

Justification

This requirement is given in order to have less connection points, which acts as a source of leakage in the tubing system.

5.3.5

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

Justification

The separate vent or test valves can be more helpful during operation and maintenance activity.

5.3.6

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

Justification

This is the minimum acceptable material requirement for needle valve packing.

5.3.7

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

Justification

This requirement helps in preventing packing failures at extreme temperatures and minimizes environmental emissions and operator exposure to process fluids.

5.4 Pressure gauges

5.4.1

The nominal head diameter of pressure gauges installed on piping or process equipment shall be greater than or equal to 100 mm or 4,5 in.

Justification

This requirement standardizes on gauge size. Smaller gauges are acceptable on instrument items where this is included in original design (regulators, positioners, etc.).

5.4.2

For panel-mounted pressure gauges, the nominal head diameter shall be 63 mm (2,5 in).

Justification

The operator can get close to the instrument, hence allowance for reduced size.

5.4.3

Pressure gauges shall have a means of preventing over-range pressure from rotating the pointer past full scale (e.g. a pointer stopper) and back to within scale measurement.

Justification

The pointer could in theory do a 360° rotation and read back within the normal range, which could have serious safety consequences. This could move the pointer to indicate a pressure within scale and yet be at a much higher pressure with all the safety issues that entails. Prevention of over-range can be achieved using a stop or another limiting device.

5.4.4

Pressure gauges in vibrating service shall have damped movements (e.g. be liquid filled).

Justification

This requirement enables the reading of the gauge easier by reducing the effects of vibration.

5.4.5

Pressure gauge pointers shall have an external-type adjustment feature for zero without the need to open the gauge.

Justification

This functionality supports a reduced maintenance regime.

5.4.6

The material of the pressure gauge case shall have a corrosion resistance greater than or equal to 316 stainless steel.

Justification

This requirement provides a minimum requirement to ensure durability and standardization of design.

5.4.7

The material of pressure gauge pressure-containing and moving parts shall be minimum 316 stainless steel for non-welded parts or minimum 316L stainless steel for welded parts.

Justification

This requirement provides a base material requirement for standardization and integrity.

5.4.8

Pressure gauges shall be provided with a blow-out back section, a baffle wall and non-splintering glass.

Justification

The standardization on this higher integrity design provides increased safety. A safety version (code S3 as per EN 837-1 and ASME B40.100 equivalent) has an additional solid baffle wall welded between the dial and the measuring system. In addition, the case has a back wall that can blow out completely. The window is typically made of laminated safety glass. If a pressure builds up in the housing (e.g. from a rupture in the bourdon tube), this pressure exhausts completely through the back wall. The back wall is then ejected from the case by the pressure. A release of pressure through the window cannot occur, so there is no risk to personnel through splinters of flying glass.

5.4.9

The accuracy of pressure gauges shall be graded 1A in accordance with ASME B40.100 or class 1 in accordance with EN 837-1.

Justification

This requirement provides the minimum accuracy consistent across codes at 1% for the supplied pressure gauge.

5.4.10

Bourdon tube design pressure gauges shall have the same socket and tip material as the tube.

Justification

The socket and tip are all-welded to the bourdon tube, hence the same material ensures that there are no issues.

5.4.11

Bourdon tube pressure gauge connections between the socket, tube and tip shall be welded.

Justification

This requirement ensures the integrity of the connection between moving parts.

5.4.12

Pressure gauge socket stems shall be provided with wrench flats.

Justification

This requirement provides a point of access to apply torque for the installation without the need to apply force to the gauge face.

5.4.13

Pressure gauge dials shall be white with black markings.

Justification

This requirement provides standardization of design.

5.4.14

Pressure gauges shall have an anti-parallax dial.

Justification

The dial is designed so that the plane of the graduated portion is nominally the same as the plane of the pointer. This minimizes the reading error effect introduced by visual misalignment.

6 Temperature instrumentation

6.1 General

6.1.1

Temperature instrumentation shall comply with the standards in Table 4.

Justification

This requirement provides a basis of the code compliance for the instrumentation supplied in addition to those listed in the general section.

6.1.2

Temperature instrumentation supplied in accordance with US standards shall comply with the standards in Table 5.

Justification

This requirement provides a basis of the code compliance for the instrumentation supplied. These standards are used in addition to those stated in the general section and the general temperature section.

6.1.3

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

Justification

This requirement provides a basis of the code compliance for the instrumentation supplied.

6.1.4

Temperature transmitters shall have configurable linearization.

Justification

Linearization models are a close fit but configuration is required to optimize the linearity. This requirement provides the function for localized customized linearization for the temperature transmitter in addition to linearization performed at the control system.

6.1.5

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

Justification

This requirement ensures that thermal contact is made of the element with the tip (end) of the thermowell (e.g. spring loaded).

6.1.6

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

Justification

This requirement provides a basis of the minimum accuracy requirements for the instrumentation supplied.

6.1.7

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

Justification

The nipple-union-nipple (n-u-n) fitting allows adjustment of the transmitter fitting to connect the element into the thermowell.

6.1.8

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

Justification

A chain ensures that even if the temperature element head cover is dropped from hand during maintenance, it will remain local.

6.1.9

Temperature element assemblies shall be of duplex type.

Justification

This requirement provides standardization of design.

6.1.10

The thermowell body shall be constructed from a single piece without any welds.

Justification

This requirement ensures the integrity of the thermowell.

Table 4 — General standards applicable to temperature instrumentation

Standard number	Topic covered	Temperature gauge	Temperature transmitter	Temperature clamp-on
ASME PTC 19.3 TW	Thermowell design	A	A	N/A
ASTM B912	Thermowell electropolishing	A	A	N/A
ASTM E230/E230M	Thermocouple EMF tables	N/A	A	N/A
ASTM E235/E235M	Type K and N thermocouples	N/A	A	N/A
ASTM E608/E608M	Thermocouple specification	N/A	A	N/A
ASTM E1137/E1137M	Platinum resistance RTD	A	A	A
IEC 60584-1	Thermocouple EMF specification	A	A	A
IEC 60584-3	Thermocouple tolerances	N/A	A	N/A
IEC 60751	Platinum resistance sensors	A	A	A
IEC 61326-1	EMC	N/A	A	A
IEC 61326-3-1	EMC	N/A	A	A
IEC 61508 (all parts)	SIL	N/A	A	A
IEC 62305 (all parts)	Lightning protection	N/A	A	A
IEC 62402	Obsolescence management	A	A	A
IEC 62591 IEC 62734	Wireless	N/A	A	A
NAMUR NE 43	Transmitter failure signal level	N/A	A	A
NAMUR NE 107	Field device diagnostics	N/A	A	A

Key
A Applicable
N/A Not applicable

Justification

This table provides a basis of the code compliance for the instrumentation supplied in addition to those listed in the general section.

Table 5 — US standards applicable to temperature instrumentation

Standard number	Topic covered	Temperature gauge	Temperature transmitter	Temperature clamp-on
ASME B1.20.1	Threads	A	A	A
ASME B40.200	Gauge design	A	N/A	A
ASTM B912	Thermowell electropolishing	A	A	N/A
ASTM E230/E230M	Thermocouple EMF tables	N/A	A	A
ASTM E235/E235M	Type K and N thermocouples	N/A	A	A
ASTM E608/E608M	Thermocouple specification	N/A	A	A
ASTM E1137/E1137M	Platinum resistance RTD	A	A	A
ISA 50.00.01	Analog signals	N/A	A	A
NEMA 250	Electrical equipment enclosures	N/A	A	A
NFPA 70	National electrical code	N/A	A	A
Key A Applicable N/A Not applicable				

Justification

This table provides a basis of the code compliance for the instrumentation supplied. These are used in addition to those stated in the general section and the general temperature section.

Table 6 — Non-US standards applicable to temperature instrumentation

Standard number	Topic covered	Temperature gauge	Temperature transmitter	Temperature clamp on
ASTM B912	Thermowell electropolishing	A	A	N/A
ASTM E230/E230M	Thermocouple EMF tables	N/A	A	A
ASTM E235/E235M	Type K and N thermocouples	N/A	A	A
ASTM E608/E608M	Thermocouple specification	N/A	A	A
ASTM E1137/E1137M	Platinum resistance RTD	A	A	A
EN 13190	Gauge design	A	N/A	N/A
IEC 60079 (all parts)	Explosive atmospheres	N/A	A	A
IEC 60381-1	Transmitter signals	N/A	A	A
IEC 60529	Ingress protection	A	A	A
ISO 261	Threads	A	A	A
Key A Applicable N/A Not applicable				

Justification

This table provides a basis of the code compliance for the instrumentation supplied.

6.2 Resistance temperature devices (RTDs)

6.2.1

RTD transition pieces shall be hermetically sealed.

Justification

This requirement prevents ingress of moisture within the sheath where moisture could degrade those elements within.

6.2.2

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

Justification

An integral block provides a compact solution and the extra shield terminal allows for the shield of the 3-wire RTD to be taken down to a terminal, although the shield will remain isolated to prevent earth ground loop.

6.3 Temperature Gauges

6.3.1

Temperature gauges shall be of bi-metallic type.

Justification

This requirement provides standardization on technology selection.

6.3.2

The nominal head diameter for temperature gauges installed on piping or process equipment shall be greater than or equal to 100 mm (non-US) or 5 in (US).

Justification

This requirement provides standardization on gauge size. Smaller gauges are acceptable on instrument items where this is included in the original design.

6.3.3

For panel-mounted temperature gauges, the nominal head diameter shall be 63 mm (non-US) or 3 in (US).

Justification

The operator can get close to the instrument, hence allowance for reduced size.

6.3.4

Temperature gauge heads shall be adjustable type when installed on piping or equipment.

Justification

This requirement ensures that temperature gauge heads can be positioned optimally when installed.

6.3.5

The material of temperature gauge cases and bezel rings shall be 316 stainless steel.

Justification

This requirement provides standardization of design.

6.3.6

Temperature gauge dials shall be white with black markings.

Justification

This requirement provides standardization of design.

6.3.7

Temperature gauge dials shall have a black pointer.

Justification

This requirement supports standardization of design.

6.3.8

The material of the temperature gauge stem and connection nuts shall be 316 stainless steel.

Justification

This requirement provides standardization of requirements to minimum material.

6.3.9

Temperature gauges shall have accuracy class 1 in accordance with EN 13190 or grade A in accordance with ASME B40.200.

Justification

This requirement provides standardization of accuracy of the instrument supplied.

6.3.10

Temperature gauge ranges shall be selected from the standard ranges defined in the selected code.

Justification

This requirement provides standardization of the ranges used by mandating that the ranges available for selection are only from the list in the applicable design code and prevents bespoke ranges from being selected and designed to.

6.3.11

The temperature gauge bimetallic element shall be of helix type.

Justification

This requirement provides standardization to the industry standard design.

6.3.12

Temperature gauge stem outside diameter screwed connection shall be ½-14 NPTM.

Justification

This requirement provides standardization on connection sizes.

6.3.13

Temperature gauge stems shall be provided with wrench flats.

Justification

This requirement provides a point of access to apply torque for the installation without the need to apply force to the gauge face.

6.3.14

Temperature gauges shall have an anti-parallax dial.

Justification

The dial is designed so that the plane of the graduated portion is nominally the same as the plane of the pointer. This minimizes the reading error effect introduced by visual misalignment.

7 Flow instrumentation

7.1 General

7.1.1

Flow instrumentation shall comply with the design standards in Table 7.

Justification

This requirement ensures code compliance with relevant standards.

7.1.2

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

Justification

This requirement ensures code compliance with relevant standards.

7.1.3

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

Justification

This requirement ensures code compliance with relevant codes.

Table 7 — General standards applicable to flow instrumentation

Standard number	Topic covered	Head type flow							Volumetric flow				Mass flow	
		Orifice	Venturi	Nozzle	Cone	Wedge	Pitot	Variable area	Ultrasonic	Electro-magnetic	Vortex	Turbine	Coriolis	Thermal
ASME B31.3	Process piping	N/A	A	A	A	A	A	A	A	A	A	A	A	A
IEC 61326-1	EMC	N/A	N/A	N/A	N/A	N/A	N/A	A	A	A	A	A	A	A
IEC 61326-3-1	EMC	N/A	N/A	N/A	N/A	N/A	N/A	A	A	A	A	A	A	A
IEC 61508 (all parts)	SIL	N/A	N/A	N/A	N/A	N/A	N/A	A	A	A	A	A	A	A
IEC 62305 (all parts)	Lightning protection	N/A	N/A	N/A	N/A	N/A	N/A	A	A	A	A	A	A	A
IEC 62402	Obsolescence management	N/A	N/A	N/A	N/A	N/A	N/A	A	A	A	A	A	A	A
IEC 62591	Wireless	N/A	N/A	N/A	N/A	N/A	N/A	N/A	A	A	A	A	A	A
IEC 62734	Wireless	N/A	N/A	N/A	N/A	N/A	N/A	N/A	A	A	A	A	A	A
ISO 2715	Turbine (liquid)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	A	N/A	N/A
ISO 3966	Pitot	N/A	N/A	N/A	N/A	N/A	A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
ISO 5167-1	Differential pressure general	A	N/A	N/A	A	A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
ISO 5167-2	Orifice	A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
ISO 5167-3	Nozzle	N/A	A	A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
ISO 5167-4	Venturi	N/A	A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
ISO 5167-5	Cone	N/A	N/A	N/A	A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
ISO 5167-6	Wedge	N/A	N/A	N/A	N/A	A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
ISO 9951	Turbine (gas)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	A	N/A	N/A
ISO 10790	Coriolis	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	A	N/A
ISO 12764	Vortex	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	A	N/A	N/A	N/A
ISO 14511	Thermal mass	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	A
ISO/TR 15377	Orifice, nozzle and Venturi	A	A	A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Table 7 *(continued)*

Standard number	Topic covered	Head type flow							Volumetric flow				Mass flow	
		Orifice	Venturi	Nozzle	Cone	Wedge	Pitot	Variable area	Ultrasonic	Electro-magnetic	Vortex	Turbine	Coriolis	Thermal
ISO 17089-2	Ultrasonic	N/A	N/A	N/A	N/A	N/A	N/A	N/A	A	N/A	N/A	N/A	N/A	N/A
ISO 20456	Electromagnetic	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	A	N/A	N/A	N/A	N/A
NAMUR NE 43	Transmitter failure signal level	N/A	N/A	N/A	N/A	N/A	N/A	A	A	A	A	A	A	A
NAMUR NE 107	Field device diagnostics	N/A	N/A	N/A	N/A	N/A	N/A	A	A	A	A	A	A	A
NAMUR NE 132	Coriolis	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	A	N/A

Key
A Applicable
N/A Not applicable

Justification

This table provides a list of the general flow codes to be complied with.

Table 8 — US standards applicable to flow instrumentation

Standard number	Topic covered	Head type flow							Volumetric flow				Mass flow	
		Orifice	Venturi	Nozzle	Cone	Wedge	Pitot	Variable area	Ultrasonic	Electro-magnetic	Vortex	Turbine	Coriolis	Thermal
API MPMS 5.3	Turbine	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	A	N/A	N/A
API MPMS 22.2	DP flow testing	A	A	A	A	A	A	A	N/A	N/A	N/A	N/A	N/A	N/A
ASME BPVC, Section IX	Welding	N/A	A	A	A	A	A	A	A	A	A	A	A	A
ASME B1.20.1	Threads	N/A	A	A	N/A	N/A	N/A	N/A	A	A	A	A	A	A
ASME MFC-3M	Orifice, nozzle, wedge and Venturi	A	A	A	N/A	A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
ASME MFC-5.1	Ultrasonic	N/A	N/A	N/A	N/A	N/A	N/A	N/A	A	N/A	N/A	N/A	N/A	N/A
ASME MFC-5.3	Ultrasonic	N/A	N/A	N/A	N/A	N/A	N/A	N/A	A	N/A	N/A	N/A	N/A	N/A
ASME MFC-6M	Vortex	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	A	N/A	N/A	N/A
ASME MFC-11	Coriolis	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	A	N/A
ASME MFC-12M	Pitot	N/A	N/A	N/A	N/A	N/A	A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
ASME MFC-16	Electromagnetic	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	A	N/A	N/A	N/A	N/A
ASME MFC-18M	Variable area	N/A	N/A	N/A	N/A	N/A	N/A	A	N/A	N/A	N/A	N/A	N/A	N/A
ASME PTC 19.5	Flow measurement	A	A	A	A	A	A	A	A	A	A	A	A	A
ASME MFC 21.2	Thermal mass	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	A
ISA 50.00.01	Analog signals	N/A	N/A	N/A	N/A	N/A	N/A	N/A	A	A	A	A	A	A
NEMA 250	Electrical equipment enclosures	N/A	N/A	N/A	N/A	N/A	N/A	N/A	A	A	A	A	A	A
NFPA 70	National electrical code	N/A	N/A	N/A	N/A	N/A	N/A	N/A	A	A	A	A	A	A

Key
A Applicable
N/A Not applicable

Justification

This table provides a list of the general flow codes to be complied with.

Table 9 — Non-US standards applicable to flow instrumentation

Standard number	Topic covered	Head type flow							Volumetric flow				Mass flow	
		Orifice	Venturi	Nozzle	Cone	Wedge	Pitot	Variable area	Ultrasonic	Electro-magnetic	Vortex	Turbine	Coriolis	Thermal
IEC 60079 (all parts)	Explosive atmospheres	N/A	N/A	N/A	N/A	N/A	N/A	N/A	A	A	A	A	A	A
IEC 60381-1	Transmitter signal	N/A	N/A	N/A	N/A	N/A	N/A	N/A	A	A	A	A	A	A
IEC 60529	Ingress protection	N/A	N/A	N/A	N/A	N/A	N/A	N/A	A	A	A	A	A	A
ISO 261	Threads	N/A	A	A	N/A	N/A	N/A	N/A	A	A	A	A	A	A
ISO 15614 (all parts)	Welding	N/A	A	A	A	A	A	A	A	A	A	A	A	A

Key
A Applicable
N/A Not applicable

Justification

This table provides a list of the general flow codes to be complied with.

7.1.4

Flow elements shall be marked with the flow direction.

Justification

Incorrect orientation of the meter when placed in line could at best introduce errors into the measurements and at worst stop the meter from operating.

7.1.5

For bluff bodies, a mechanical integrity report shall be supplied.

Justification

Bluff bodies are potentially under great stress, hence it needs to be demonstrated that the design withstands the process conditions.

7.2 Head meters

7.2.1 Orifice

7.2.1.1

Orifice plate material shall be minimum 316 stainless steel.

Justification

316 stainless steel is considered the minimum austenitic stainless steel grade for this application by the majority of operators. It offers better corrosion resistance than 304 stainless steel, whose use is also discouraged by API RP 551.

7.2.1.2

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.

Justification

This is the minimum requirement to be visibly marked on handle.

7.2.1.3

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

Justification

This requirement removes a potential safety issue by ensuring the operator does not need to retract insulation in order to read details.

7.2.1.4

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

Justification

This requirement ensures correct orientation of the handle in relation with the vent or drain hole.

7.2.2 Cone meter

7.2.2.1

For cones greater than or equal to 80 mm (3 in), calculations confirming the mechanical integrity shall be provided.

Justification

Calculations demonstrate the suitability of the cone design to the submitted operating conditions.

7.2.2.2

The shape of sheet metal cones shall permit additional supports.

Justification

This requirement ensures options to increase rigidity or shift the natural frequency if needed.

7.2.2.3

The clearance of cone meters between the cone and the pipe wall shall be measured at eight equally spaced locations from the starting point.

Justification

This requirement ensures concentricity of the cone in relation to the internal walls of the instrument.

7.2.2.4

The starting point of clearances and direction of measurement of cone meters shall be marked on the downstream flange and downstream face of the cone.

Justification

This requirement allows for performing the identical measurement to verify baseline clearances or determine whether clearances are unchanged when measured later.

7.2.2.5

The maximum allowable misalignment between the pipe and the cone axes of cone meters in linear shift and in angular orientation shall be provided.

Justification

This requirement ensures the adequate validation of the cone alignment.

7.2.2.6

The cone meters welds exposed to the process shall be smooth and free of relevant indications.

Justification

This requirement ensures the quality of welds exposed to the process fluid.

7.2.3 Wedge flow meters

7.2.3.1

The material of wedge meters shall be minimum 316 stainless steel.

Justification

316 stainless steel is considered the minimum austenitic stainless steel grade for this application by most operators. 316 stainless steel offers better corrosion resistance than 304 SS. The use of 304 SS is also discouraged by API Recommended Practice 551.

7.2.4 Average pitot tube

7.2.4.1

Blowout prevention of average pitot tubes shall be provided for removable elements.

Justification

This requirement ensures that the design is inherently safe and does not only rely on operator diligence.

7.2.4.2

Average pitot tubes shall permit zeroing and removal of the transmitter assembly without interrupting the process.

Justification

This requirement ensures minimal impact to the process and reduces maintenance work.

7.2.4.3

Average pitot tubes shall have end support.

Justification

Standardizing on the end support comes at negligible cost difference while removing the potential risk of damage by removing the bending moment on the element.

7.2.5 Variable area (VA) meters

7.2.5.1

Variable area flow meters shall have self-cleaning floats.

Justification

This requirement ensures minimal maintenance and accuracy of reading.

7.2.5.2

Variable area flow meters shall have inlet and outlet float stops.

Justification

This requirement ensures that the float remains within the body of the instrument.

7.2.5.3

For scales in percent, the meter factor for maximum flow at 100 % shall be engraved on the variable area flow meter scale.

Justification

This requirement ensures standardization of the approach. The capacity data is typically supplied in table format with full scale flow Cr defined. Qv = Cr (%scale/100). A volume correction for fluid and float densities that differ from the calculation can be made. From an operations perspective it is preferred to have a procedure that states to set the flow rate to XX % on the VA meter rather than states a flow in units where the actual flow does not match the scale reading. This can potentially lead to confusion later about what the rate should be (e.g. someone not realizing the flow rate has already been compensated may apply another adjustment for the fluid).

7.3 Volumetric meters

7.3.1 Ultrasonic flow instrument

Ultrasonic flow meter accuracy shall be within ± 1 % of full-scale flow.

Justification

This requirement provides the minimum accuracy level.

7.3.2 Electromagnetic flow meter

7.3.2.1

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

Justification

This requirement ensures the magnetic flow meters are always kept liquid full, including during no-flow conditions. When the measuring tube is completely filled, the measuring electrodes are connected to each other and against the reference point of the EMF via the process liquid. The resistance between the measuring electrodes or from one electrode to a reference point is a factor of the conductivity of the process liquid. This resistance is lower with a completely filled measuring tube than with an empty measuring tube. When the measuring tube of a mechanical flowmeter is empty, its flow indicator indicates the value 0 and flow totalizing stops. This is not the case with an EMF device, where the electrodes are no longer in contact with the process liquid and are open. The electrode circuit has high impedance when the tube is empty making it susceptible to electrical interference and coupling from the surroundings which can lead to error flow readings and totalized values. Should a vapour enter then it would lead to the electrodes being exposed and then alarm raised.

7.3.2.2

Electromagnetic flow meter accuracy shall be within ± 1 % of full-scale flow.

Justification

This requirement ensures the minimum accuracy level.

7.3.3 Vortex flow meter

7.3.3.1

Vortex flow meters shall meet the performance requirements at the minimum flow case.

Justification

This requirement provides a deadband between the meter stopping operating and the minimum flow needed to be measured.

7.3.3.2

Vortex flow meters accuracy for liquid flow shall be within ± 1 % of full-scale flow.

Justification

This requirement ensures the minimum accuracy level for the liquid flow.

7.3.3.3

Vortex flow meters accuracy for gas flow shall be within ± 2 % of full-scale flow.

Justification

This requirement ensures the minimum accuracy level for gas flow.

7.3.4 Turbine flow meters

7.3.4.1

The material of the turbine flow meter body housing, rotor hubs, blades and rims shall be minimum 316 stainless steel for non-welded parts or minimum 316L stainless steel for welded parts.

Justification

This requirement provides the minimum material specification to ensure quality design.

7.3.4.2

The accuracy of turbine flow meters in liquid service shall be within ± 0,5 % of full-scale flow.

Justification

This requirement ensures the minimum accuracy level.

7.4 Mass flow meters

7.4.1

Thermal mass flow meter sensors shall have retractable probes.

Justification

This requirement ensures the availability of the system by allowing maintenance to be performed without production interruption.

8 Level instrumentation

8.1 General

8.1.1

Level instrumentation shall comply with the design standards in Table 10.

Justification

This requirement ensures code compliance with the relevant standards.

8.1.2

Level instrumentation supplied in accordance with US standards shall comply with the design standards in Table 11.

Justification

This requirement ensures code compliance with the relevant standards.

8.1.3

Level instrumentation supplied in accordance with non-US standards shall comply with the design standards in Table 12.

Justification

This requirement ensures code compliance with the relevant codes.

8.1.4

The accuracy of level instrumentation shall be within ± 0,1 % of the specified span.

Justification

This requirement provides a basis of the accuracy requirements for the level instrumentation supplied.

8.1.5

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

Justification

Level sketches provide additional information to support the sizing and selection of the level instrumentation, and support the PDS in this task.

8.1.6

If a chamber is specified, the vent and drain valves shall be size ¾-14 NPTM × ¾-14 NPTF.

Justification

This requirement provides standardization of vent and drain valves.

Table 10 — General standards applicable to level instrumentation

Standard number	Topic covered	Magnetic level indicator	Gauge glass	Hydrostatic	Displacer	Ultrasonic	RF capacitance/ admittance	Guided wave radar	Non-contact radar	Tuning fork	Nucleonic
ASME B31.3	Process piping	A	A	N/A	A	A	A	N/A	N/A	A	N/A
ASME PTC 19.2	Performance test codes	N/A	N/A	A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
IEC 60462	Radiation measure	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	A
IEC 61326-1	EMC	A [a]	N/A	A	A	A	A	A	A	A	A
IEC 61326-3-1	EMC	A [a]	N/A	A	A	A	A	A	A	A	A
IEC 61453	Radiation measure	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	A
IEC 61508 (all parts)	SIL	N/A	N/A	A	A	A	A	A	A	A	A
IEC 61518	Mating dimensions	N/A	N/A	A [b]	N/A	N/A	N/A	N/A	N/A	N/A	N/A
IEC 62305 (all parts)	Lightning protection	A [a]	N/A	A	A	A	A	A	A	A	A
IEC 62402	Obsolescence management	A	A	A	A	A	A	A	A	A	A
IEC 62591 / IEC 62734	Wireless	A	N/A	A	A	A	A	A	A	A	A
NAMUR NE 43	Transmitter failure signal level	A [a]	N/A	A	A	A	A	A	A	A	A
NAMUR NE 107	Field device diagnostics	A [a]	N/A	A	A	A	A	A	A	A	A

Key

A Applicable

N/A Not applicable

[a] Only active if the transmitter option is selected.

[b] Only active when the transmitter is connected to a manifold block.

Justification

This table provides a list of general level codes to be complied with.

Table 11 — US standards applicable to level instrumentation

Standard number	Topic covered	Magnetic level indicator	Gauge glass	Hydrostatic	Displacer	Ultrasonic	RF capacitance/ admittance	Guided wave radar	Non-contact radar	Tuning fork	Nucleonic
ANSI/HPS N43.8	Containers	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	A
ASME BPVC, Section IX	Welding	A	A	A	A	A	A	A	A	A	A
ASME B1.20.1	Threads	A	A	A	A	A	A	A	A	A	A
ISA 50.00.01	Analog signals	A [a]	N/A	A	A	A	A	A	A	A	A
NEMA 250	National electrical code	A [a]	A [c]	A	A	A	A	A	A	A	A
NFPA 70	Electrical equipment enclosures	A [a]	A [c]	A	A	A	A	A	A	A	A
UL 94	Plastic flammability tests	N/A	N/A	A [b]	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Key

A Applicable

N/A Not applicable

[a] Only active if the transmitter option is selected.

[b] Code active if the weather enclosure (external) is selected as an accessory from the PDS.

[c] Only active if the illuminator option is selected.

Justification

This table provides a list of the general level codes to be complied with.

Table 12 — Non-US standards applicable to level instrumentation

Standard number	Topic covered	Magnetic level indicator	Gauge glass	Hydrostatic	Displacer	Ultrasonic	RF capacitance/admittance	Guided wave radar	Non-contact radar	Tuning fork	Nucleonic
IEC 60695-11-10	Fire tests	N/A	N/A	A [b]	N/A	N/A	N/A	N/A	N/A	N/A	N/A
IEC 60695-11-20	Fire tests	N/A	N/A	A [b]	N/A	N/A	N/A	N/A	N/A	N/A	N/A
IEC 60079 (all parts)	Explosive atmospheres	A [a]	A [c]	A	A	A	A	A	A	A	A
IEC 60381-1	Transmitter signal	A [a]	N/A	A	A	A	A	A	A	A	A
IEC 60529	Ingress protection	A [a]	A [c]	A	A	A	A	A	A	A	A
IEC 62598	Containers	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	A
ISO 261	Threads	A	A	A	A	A	A	A	A	A	A
ISO 15614 (all parts)	Welding	A	A	A	A	A	A	A	A	A	A

Key

A Applicable

N/A Not applicable

[a] Only active if the transmitter option is selected.

[b] Code active if the weather enclosure (external) is selected as an accessory from the PDS.

[c] Only active if the illuminator option is selected.

Justification

This table provides a list of the general level codes to be complied with.

8.2 Level indicators

8.2.1 Magnetic level indicators

8.2.1.1

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

Justification

This requirement mitigates against the known issue of the follower/floating type losing connection to the magnet and falling to the bottom.

8.2.1.2

Magnetic level indicator flags shall be hermetically sealed.

Justification

This requirement protects moving parts from the external environment.

8.2.1.3

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

Justification

This requirement ensures minimum material integrity against the external environment.

8.2.1.4

Individual magnetic level indicator segments shall not change colour when acted on by external forces.

NOTE Interlocking the magnetic level indicator segments is one method of ensuring that the colour is maintained.

Justification

This requirement ensures that external forces such as vibration do not allow the reading to change from representing the level in the chamber.

8.2.1.5

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

Justification

This requirement ensures that all internals can be removed and replaced from the bottom. The bottom point is noted since this is a more convenient access point, allowing gravity to act on the internals to position at low point.

8.2.1.6

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

Justification

This requirement reduces the impact when the float reaches either extreme position and minimizes wear on the float.

8.2.1.7

Float movement in the magnetic level indicator chamber shall not be affected by process conditions.

Justification

This requirement ensures that process conditions do not affect the performance of the level indicator. Sometimes, the float chamber size may be one size larger than that normally used with the selected float. This option allows a larger space between the float and the float chamber, thus permitting some particles to exist without causing the float to stick. For cryogenic operations near the vapour pressure (e.g. propane chillers), flashing or outgassing service, this option allows excess vapours to pass between the float and the chamber wall without causing the float to move excessively.

8.2.1.8

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

Justification

This requirement ensures that the scale is readable for the life of the instrument.

8.2.2 Level gauge glass

8.2.2.1

Pressure rating at maximum temperature for gauge glass shall be at least twice the maximum operating pressure.

Justification

This requirement provides a factor of safety of 2 which gives added confidence in the integrity of the glass design.

8.2.2.2

Borosilicate glass shall be used in services up to 316 °C (600 °F).

Justification

This requirement covers most use cases and clearly defines the temperature range that borosilicate glass is suitable for.

8.2.2.3

Glass failure shall be with an inter-crystalline fracture without flying particles.

Justification

This requirement ensures inherent safety of the glass on failure.

8.2.2.4

The gauge glass body shall be machined from a solid steel bar or a steel forging.

Justification

This requirement minimizes the risk of potential faults in the selected material.

8.2.2.5

The level gauge chamber and cover shall be provided with a high integrity seal (e.g. flat mating surfaces, machined recess).

Justification

This requirement ensures a high integrity of the sealed unit. There are multiple options from ensuring flat mating surfaces to a machined recess that retains the glass and provides a flat gasket seating surface, ensuring correct alignment of the gasket leading to optimum sealing.

8.2.2.6

The material of gauge glass bolts, nuts and washers shall be minimum 316 stainless steel.

Justification

This provides a minimum material integrity requirement for the pressure containing parts exposed to the atmosphere to resist corrosion and prolong life.

8.2.2.7

Gauge glasses shall have vent and drain valves.

Justification

This requirement ensures integrity of the final assembly by being supplied as a single piece item.

8.2.2.8

Gauge glass vent and drain valves shall be of ball valve type.

Justification

This requirement to standardize on ball valve type provides easier operation, tighter shut-off, easier maintenance, less tendency for plugging and longer life. The valves are provided at the top and bottom of each gauge glass assembly for venting and draining the gauge glass.

8.2.2.9

The level gauge glass total length shall be no longer than 1090 mm (43 in).

Justification

This requirement ensures that the gauge is kept to a manageable length. The gauge assembly becomes very hard to manage and maintain above this length. This length is for three sections joined together which is considered the longest assembly manageable.

8.2.2.10

When gauge glass excess flow check valves are selected, they shall be of offset type.

Justification

This requirement allows the inside of the gage glass to be cleaned easily with minimum disassembly. By removing the vent and drain plugs (or other connection), a straight passage through the gage chamber is opened. A brush can be inserted through the valve vent and drain for glass cleaning.

8.2.2.11

When gauge glass excess flow check valves are selected, they shall be of quick-opening type.

Justification

This requirement ensures that the valve can operate in time to prevent a surge of flow into the gauge.

8.2.2.12

When gauge glass gauge cocks or excess flow ball check valves are required by the application, they shall conform to ASME BPVC, Section I, A-18.

Justification

This requirement confirms the code requirement to be followed when gauge cocks or excess flow ball check valves are used.

8.2.2.13

When the gauge glass excess flow check valve is selected, the pressure shall equalize across the ball.

Justification

This requirement ensures that the ball allows an empty gauge glass to fill from the vessel.

8.2.2.14

When gauge glass excess flow check valves are selected, bonnets shall be bolted.

Justification

This requirement provides a more robust design over the screwed alternative.

8.3 Level transmitters

8.3.1 Non-contact radar transmitter

8.3.1.1

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

Justification

This requirement supports the calibration of the device.

8.3.1.2

The non-contact radar shall have software to display and interpret echo curves.

Justification

This requirement supports the need for trouble shooting software to interpret the radar echo curve as it shows each reflected signal received by the instrument along the path of travel of the signal.

8.3.2 Level displacer

8.3.2.1

The level displacer shall be of removable type.

Justification

This requirement ensures that the largest internal component (worst case) can be maintained.

8.3.2.2

Level displacer vented or pressure-equalized floats and displacers shall not be used.

Justification

This requirement negates the risk of the float taking onboard process fluid and then providing erroneous measurement.

8.3.2.3

External level displacer displays shall have rotatable heads.

Justification

This requirement allows optimum position of the display/viewing angle.

8.3.3 RF capacitance/admittance probe

8.3.3.1

The RF capacitance/admittance probe shall be prevented from flexing whatever its orientation is.

Justification

This requirement addresses the issue of a flexing probe which is of concern in the case it touches an external part causing the capacitance to be affected. Suppliers typically offer solutions such as a centring disc to prevent probe movement.

8.3.3.2

RF capacitance/admittance probes used on non-metallic or lined vessels shall have a separate conductive path for signal return.

Justification

This requirement addresses the challenge of lined and non-metallic tanks. The probe is unable to form a capacitor with the tank wall in these applications, hence a separate electrode is required.

8.3.3.3

Teflon or Kynar® coated RF capacitance/admittance probes shall be used when the process fluid is conductive (> 100 micro mhos).

Justification

This requirement ensures that there is a conductive barrier between the probe and the conductive fluid.

8.3.4 Tuning fork level instrument

8.3.4.1

The tuning fork level instrument shall have self-diagnostic capability.

Justification

This requirement ensures that although historically it could be a simple digital input signal, the request for diagnostic capability ensures continuous monitoring of the health of the instrument.

8.3.5 Nucleonic level

8.3.5.1

Nucleonic level instrument sources shall have a minimum operating life of 10 years.

Justification

This requirement ensures a minimum source life to reduce maintenance needs.

8.3.5.2

The nucleonic level instrument source holder shall have collimating plates to restrict radiation to the specific angle required.

Justification

This requirement optimizes safety by minimizing straying.

8.3.5.3

The nucleonic level instrument source shall have a lockable shutter.

Justification

This requirement is a safety basis to minimize the risk of radiation exposure to the operator, allowing the source to be securely isolated at relevant times (e.g. maintenance, transportation).

8.3.5.4

Hardware for insertion, removal, shipment and storage of nuclear sources shall be provided.

Justification

This requirement supports the lifting and transportation activities.

8.3.5.5

Radiation hazard labels for nucleonic level instruments shall be provided.

Justification

This requirement supports safety by warning personnel of the nucleonic level instruments. Suppliers typically provide the quantities and dimensions of the warning labels.

9 Other types of instrumentation

9.1 General

9.1.1

General instrumentation shall comply with the design standards in Table 13.

Justification

This requirement ensures code compliance with the relevant standards.

Table 13 — General standards applicable to level instrumentation

Standard number	Topic covered	Corrosion	Erosion	Sand
IEC 61326-1	EMC	A	A	A
IEC 61326-3-1	EMC	A	A	A
IEC 62305 (all parts)	Lightning protection	A	A	A
IEC 62402	Obsolescence management	A	A	A
IEC 62591 / IEC 62734	Wireless	A	A	A
NAMUR NE 43	Transmitter failure signal level	A	A	A
NAMUR NE 107	Field device diagnostics	A	A	A
Key A Applicable N/A Not applicable				

Justification

This table provides a list of general codes to be complied with.

9.1.2

General instrumentation supplied in accordance with US standards shall comply with the design standards in Table 14.

Justification

This requirement ensures code compliance with the relevant standards.

Table 14 —US standards applicable to level instrumentation

Standard number	Topic covered	Corrosion	Erosion	Sand
ASME BPVC, Section IX	Welding	A [a]	A [a]	N/A
ASME B1.20.1	Threads	A	A	A
ISA 50.00.01	Analog signals	A	A	A
NEMA 250	National electrical code	A	A	A
NFPA 70	Electrical equipment enclosures	A	A	A
Key A Applicable N/A Not applicable				
[a] Only active if the insertion type option is selected.				

Justification

This table provides a list of general codes to be complied with.

9.1.3

General instrumentation supplied in accordance with non-US standards shall comply with the design codes in Table 15.

Justification

This requirement ensures code compliance with the relevant codes.

Table 15 — Non-US standards applicable to general instrumentation

Standard number	Topic covered	Corrosion	Erosion	Sand
IEC 60079 (all parts)	Explosive atmospheres	A	A	A
IEC 60381-1	Transmitter signal	A	A	A
IEC 60529	Ingress protection	A	A	A
ISO 261	Threads	A	A	A
ISO 15614 (all parts)	Welding	A [a]	A [a]	N/A
Key A Applicable N/A Not applicable				
[a] Only active if the insertion type option is selected.				

Justification

This table provides a list of general codes to be complied with.

9.2 Corrosion and erosion type

9.2.1

Insertion probe erosion sensors shall provide real-time erosion data.

Justification

This requirement allows detailed analysis of how the well or stream is performing and possibly change the control parameters for the system.

9.2.2

Insertion probe erosion sensors shall be retractable.

Justification

This requirement ensures the availability of the system by allowing maintenance to be performed without production interruption.

9.2.3

Ultrasonic detectors shall be of clamp-on type.

Justification

Clamp-on type detectors are used because they can be located externally to the pipe wall safe from the aggressive process media and with flexibility to locate at optimum position.

9.2.4

Ultrasonic detectors shall have the accessories to fix to pipework.

Justification

This requirement ensures that the supplier provides the instrument accessories including the connection to the pipework.

9.2.5

Ultrasonic detectors shall be provided with a coupling medium.

Justification

A coupling medium ensures optimum contact between the pipe wall and the sensor such that the instrument operates correctly.

9.2.6

The material of ultrasonic detectors and mounting parts shall be minimum 316 stainless steel.

Justification

This requirement ensures minimum material integrity.

9.3 Sand type

9.3.1

Acoustic detectors shall have accessories to fix to pipework.

Justification

This requirement ensures that the supplier provides the instrument accessories including the connection to the pipework.

9.3.2

The material of acoustic detectors and mounting parts shall be minimum 316 stainless steel.

Justification

This requirement ensures minimum material integrity.

9.3.3

Acoustic detectors shall be provided with a coupling medium.

Justification

A coupling medium ensures optimum contact between the pipe wall and the sensor such that the instrument operates correctly.

Bibliography

The following documents are informatively cited in the text of this document, the PDS (IOGP S-718D) or the IRS (IOGP S-718L).

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