International Association of Oil & Gas Producers

SPECIFICATION
S-716

August
2020

Specification for Small Bore Tubing and Fittings

JIP33
JOINT INDUSTRY PROGRAMME

Revision history

VERSION	DATE	PURPOSE
0.1	August 2020	Issued for Public Review

Acknowledgements

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

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Foreword

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

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

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

The JIP33 work groups performed their activities in accordance with IOGP's Competition Law Guidelines (November 2014).

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Introduction

The purpose of this specification is to define a minimum common set of requirements for the design, material selection, installation, testing and inspection, marking of small bore tubing, small bore tubing system components and small bore piping for application in the petroleum and natural gas industries.

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

JIP33 Specification for Procurement Documents
Supplementary Technical Specification

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

IOGP S-716: Specification for small bore tubing and fittings

This specification defines the technical requirements for small bore tubing and fittings.

IOGP S-716Q: Quality Requirements for small bore tubing and fittings

This document 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 systems (CAS) on the basis of evaluation of the associated service and supply chain risks. The applicable CAS level is specified by the purchaser in the purchase order.

IOGP S-716L: Information Requirements for small bore tubing and fittings

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

The terminology used within this specification and the supporting quality and information requirements follows that of the parent standard and is in accordance with ISO/IEC Directives, Part 2 as appropriate.

The IRS is published as an editable document for the purchaser to specify application specific requirements. This specification and QRS are fixed documents.

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

a) regulatory requirements;

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

c) purchaser defined requirements (QRS and IRS);

d) this specification.

1 Scope

This specification provides the requirements for the design, material selection, installation, testing and inspection, marking for the following items covering offshore and onshore environments:

a. Small bore tubing sizes up to 40 mm (1 $^{1}/_{2}$ in):

- for process impulse lines, pneumatic lines, hydraulic lines and analyzer tubing including sample take off;
- for trace heating.

b. Small bore tubing system components up to class 6000#.:

- tube fittings;
- instrument process manifolds;
- instrument air manifolds;
- secondary isolation valves;
- miscellaneous items such as tube clamps, and valves for flushing and bleed rings.

c. Small bore piping components.

This specification excludes the following:

- subsea small bore tubing and fittings;
- other fittings such as welded pipe and tube fittings, Joint Industry Council (JIC) fittings, flexible hoses and applications above 6000#;
- tubing used on piping systems not associated with instrumentation and control;
- process piping.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the references document (including any amendments) applies.

ANSI / NACE MR0103 / ISO 17945, *Petroleum, petrochemical and natural gas industries - Metallic materials resistant to sulfide stress cracking in corrosive petroleum refining environments*

ANSI / NACE MR0175 / ISO 15156, parts 1 to 3, *Petroleum and Natural Gas Industries Materials for Use in H2S-Containing Environments in Oil and Gas Production*

API Recommended Practice 551, *Second Edition, Feb 2016, Process Measurement*

API Recommended Practice 552, *First edition, Oct 1994 Transmission Systems*

API Standard 607, *Fire Test for Quarter-turn Valves and Valves Equipped with Nonmetallic Seats*

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

ASME B16.11, *Forged Fittings, Socket-Welding and Threaded*

ASME B16.36, *Orifice Flanges*

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

ASTM A269/A269M, *Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service*

ASTM A312/A312M, *Standard Specification for Seamless, Welded, and Heavily Cold Worked Austenitic Stainless Steel Pipes*

ASTM A632, *Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing (Small-Diameter) for General Service*

ASTM A733, *Standard Specification for Welded and Seamless Carbon Steel and Austenitic Stainless Steel Pipe Nipples*

ASTM A789 / A789M, *Standard Specification for Seamless and Welded Ferritic/Austenitic Stainless Steel Tubing for General Service*

ASTM A1016/A1016M, *Standard Specification for General Requirements for Ferritic Alloy Steel, Austenitic Alloy Steel, and Stainless Steel Tubes*

ASTM B68 / B68M, *Standard Specification for Seamless Copper Tube, Bright Annealed*

ASTM B75 / B75M, *Standard Specification for Seamless Copper Tube*

ASTM B165, *Standard Specification for Nickel-Copper Alloy Seamless Pipe and Tube*

ASTM B338, *Standard Specification for Seamless and Welded Titanium and Titanium Alloy Tubes for Condensers and Heat Exchangers*

ASTM B423, *Standard Specification for Nickel-Iron-Chromium-Molybdenum-Copper Alloy (UNS N08825, N08221, and N06845) Seamless Pipe and Tube*

ASTM B444, *Standard Specification for Nickel-Chromium-Molybdenum-Columbium Alloys (UNS N06625 and UNS N06852) and Nickel-Chromium-Molybdenum-Silicon Alloy (UNS N06219) Pipe and Tube*

ASTM B622, *Standard Specification for Seamless Nickel and Nickel-Cobalt Alloy Pipe and Tube*

ASTM B677, *Standard Specification for UNS N08925, UNS N08354, and UNS N08926 Seamless Pipe and Tube*

ASTM B706, *Standard Specification for Seamless Copper Alloy (UNS No. C69100) Pipe and Tube*

ASTM B729, *Standard Specification for Seamless Nickel-Iron-Chromium-Molybdenum-Copper Nickel Alloy Pipe and Tube*

ASTM E515, *Standard Practice for Leaks Using Bubble Emission Techniques*

ASTM F1387, *Standard Specification for Performance of Piping and Tubing Mechanically Attached Fittings*

Energy Institute Guidelines, May 2013, *Guidelines for the design, installation and management of small bore tubing Assemblies, 2nd Edition, May 2013*

IEC 61518, *Mating Dimensions between Differential Pressure (Type) Measuring Instruments and Flanged-On Shut-Off Devices up to 413 Bar (41,3 MPa)*

ISO 15848-1, *Industrial valves - Measurement, test and qualification procedures for fugitive emissions – Part 1: Classification system and qualification procedures for type testing of valves*

PIP PCCIP001, *October 2015, Instrument Piping and Tubing Systems Criteria*

MSS SP-99, *Instrument Valves*

3 Terms, definitions, acronyms and abbreviations

3.1 Terms and definitions

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

3.1.1
direct mounted installations
supported directly by the process pipe

3.1.2
remote mounted instruments
conveniently mounted remotely by a tube for easy access or to protect them from adverse conditions

3.1.3
offshore/marine
offshore installation and onshore installation less than 0.5 km from shore

3.1.4
onshore
inland installation more than 0.5 km from shore

3.2 Acronyms and abbreviations

For the purpose of this document, the following acronyms and abbreviations apply.

JIC	joint industry council
HT	heat treated
NPT	national pipe thread
PTFE	polytetrafluoroethylene
UV	ultraviolet

4 Design

4.1 General

4.1.1

The small-bore tubing system shall be designed for the following:

- process fluid;
- process pressure (design range);
- temperature (design range);
- environmental condition in accordance with project specific requirements.

4.1.2

Compression fittings shall be from a single manufacturer.

4.2 Sizing

4.2.1

A project shall not mix metric and imperial fraction tubing sizes indicated in Table 1.

4.2.2

The size of small bore tubes shall comply with Table 1.

Table 1 –Tube Size

Imperial fraction units		Metric units		Typical applications
Tube outside diameter (inch)	**Minimum nominal wall thickness (inch)**	**Tube outside diameter (mm)**	**Minimum nominal wall thickness (mm)**	
1/16	0.028			Analyzer tubing, electrical/heat traced/insulated tubing bundles
1/8	0.028	3	0.8	Analyzer tubing, electrical/heat traced/insulated tubing bundles
3/16	0.028			
1/4	0.028	6	0.8	Analyzer tubing, electrical/heat traced/insulated tubing Bundles, pneumatic supply tubing, Pneumatic signal tubing, steam tracing tubing, vent & drain tubing
5/16	0.035	8	1.0	
3/8	0.035	10	1.0	Process impulse tubing, pneumatic supply tubing, fusible loops tubing, sample tubing,
1/2	0.049	12	1.0	Process impulse tubing, wellhead control & hydraulic, pneumatic supply tubing, fusible loops tubing, sample tubing, vent & drain tubing
		14	1.2	Hydraulic tubing
		15	1.5	
5/8	0.065	16	1.5	
3/4	0.065	18	1.5	Hydraulic tubing
		20	1.8	
7/8	0.083	22	2.0	
1	0.083	25	2.2	Hydraulic tubing
		28	2.5	
1 1/4	0.109	30	3.0	Hydraulic tubing
		32	3.0	
1 1/2	0.134	38	3.5	Hydraulic tubing

4.3 Small bore tubing

4.3.1 Tubes

4.3.1.1

Small bore tubing shall be seamless.

4.3.1.2

Tubes shall be fully annealed.

4.3.1.3

Tubing shall not exceed the maximum acceptable hardness specified by the fittings manufacturer.

4.3.1.4

Tubing of the same material, grade and wall thickness shall be used from source to end destinations including side branches.

4.3.2 Trace heated tube bundles

4.3.2.1

Tube bundles shall be single or dual process tubes.

4.3.2.2

Tube bundle temperature control shall be by self-regulating heating cable up to the recommended temperature limits specified.

4.3.2.3

Tube bundle outer jacket shall be flame retardant, UV (ultra violet) resistant, hydrolytically stabilized, halogen free and abrasion resistant.

4.3.2.4

Outer jacket insulation shall be fibrous glass or mineral wool.

4.3.2.5

Heat tracing tubing shall be sealed in accordance with manufacturer recommendation.

4.4 Small bore tubing system components

4.4.1 General

4.4.1.1

Compression tube fittings shall be flareless, double-ferrule type.

4.4.1.2

Compression tube fittings (Maximum Class 10 tube fittings as per ASTM F1387) shall only be used for operating pressures not exceeding 41.37 MPa at 37.7 °C (6,000 psig at 100 °F).

4.4.1.3

Small bore tubing shall be de-rated as recommended by the manufacturer for the design pressure and temperature limits.

4.4.1.4

NPT (National pipe thread) thread engagement shall conform to ASME B1.20.1:2013, Table 2, column 7 .

4.4.1.5

Elbow fittings shall be used for tubing terminations where insufficient space for bending radius is available.

4.4.1.6

Fitting threads shall be coated with an anti-galling coating.

4.4.1.7

PTFE packing shall not be used for design temperature above 232 °C (450 °F) for instrument valves and manifolds.

4.4.1.8

Manifold valves and mono-flange valves shall be provided with anti-tamper mechanism or removable handles, if specified.

4.4.1.9

Unused vent and drain ports shall be plugged.

4.4.2 Instrument air manifolds

4.4.2.1

Air manifolds shall be 6 way or 12 way type.

4.4.2.2

Air manifolds shall be fabricated using 25 mm (1 in.) or greater pipe.

4.4.2.3

Air manifolds shall be fabricated in SS 316L material.

4.4.2.4

Air manifolds shall include:

- 12 mm ($^1/_2$ in.) ball valve for each individual air consumer; and
- 12 mm ($^1/_2$ in.) drain valve with plug for condensate draining.

4.4.2.5

Valves for air consumers shall be anti tamper proof with lockable design.

4.4.2.6

Spare taps installed on instrument air sub-headers shall be include a valve and plug.

4.4.2.7

Instrument air distribution shall be in accordance with API RP 552, 21.2.11.

Note: Table 7 of API 552 should be used for line sizing of pipe headers and Figure 20 of API 552 should be used for typical installation.

4.4.3 Secondary isolation valves

4.4.3.1

Instrument tubing valves shall be globe, needle or ball type valves.

4.4.3.2

Needle and globe valve handles shall be "T" bar type with non-rotating stem.

4.4.3.3

Instrument valves shall have an anti-blowout stem.

4.4.3.4

Ball valves shall be full bore and tamper proof (or lockable).

4.4.3.5

The valve shall provide bubble tight (zero leakage) shutoff performance.

4.4.3.6

For a single isolation valve arrangement, an additional block and bleed valve arrangement shall be provided for instruments.

Note: Additional block and bleed valves are not required if a valve manifold is used.

4.4.4 Miscellaneous items

4.4.4.1 Tube clamps

4.4.4.1.1

Tube clamps shall use UV and flame retardant polymer with SS 316 mounting hardware.

4.4.4.1.2

Tube clamp assembly shall be self draining design.

4.4.4.2 Flushing and Bleed Rings

4.4.4.2.1

When flushing ring is used, the ring shall be provided with two valves in the 12 o'clock and 6 o'clock positions.

4.5 Small bore piping

4.5.1

Non stainless steel nipples shall be manufactured according to ASTM A733.

4.5.2

Stainless steel nipples shall be manufactured from welded or seamless pipe in accordance to ASTM A312/312M.

4.5.3

For instrument installation, nipples shall be $^{1}/_{2}$ in. Sch.80.

4.6 Process connection

4.6.1

Each instrument shall have a dedicated primary isolation or root valve.

4.6.2

Primary isolation valves shall be accessible from grade, or platform.

4.6.3

With the exception of ASME B16.36 orifice flange taps, the valve size shall be 20 mm ($^{3}/_{4}$ in.) or greater.

4.6.4

ASME B16.36 orifice flanges shall have a 12 mm ($^{1}/_{2}$ in.) connection.

4.6.5

On horizontal pipe in gas or vapor service, taps shall be located at the 12 o'clock position.

4.6.6

On horizontal pipe in clean liquid service, the tap position shall be located between the horizontal and 45° below the plane.

4.6.7

On horizontal pipe in dirty liquid service, the tap shall be located above the horizontal plane.

4.6.8

When a monoflange or monoblock is used for primary isolation, the primary isolation valve design shall be fire safe in accordance with API 607.

4.6.9

Monoflanges shall only be used in clean services above 0 °C (32 °F) subject to risk assessment.

4.6.10

Monoflanges shall not be used for the following applications:

- dirty service
- fouling service

4.6.11

Monoblock shall meet the following:

- single piece design;
- 10 mm (3/8 in) straight through bore;
- anti blowout stem.

4.6.12

Primary isolation valves handle shall be extending outside the insulation.

Note: Where required, an extended bonnet should be considered.

4.7 Insulation

4.7.1

Where steam or electrical tracing is used, the tube/tube bundle shall be insulated.

4.7.2

Prefabricated traced and insulated tube bundles shall be used where practical.

4.7.3

If the process temperature exceeds the instrument temperature limits in non-flowing application up to 540 °C (1000 °F), un-insulated tubing between transmitter and primary isolation valve (at least 150 mm (6 in.) long) shall be provided.

Note: A guard or mechanical protection to cover the un-insulated tubing for personal protection. For temperature above 540 °C (1000 °F), a specific evaluation should be undertaken.

4.7.4

Below -51 °C (-60 °F), the impulse line shall be un-insulated for 200 mm (8 in.) from the instrument.

4.8 Vibration and Thermal Effects

4.8.1

For vibrating service or where the harmonic frequency is equal to or less than 60 Hz, instruments installation shall be designed with:

- independent support decoupled from vibrating source;

- installed with anti vibration pads.

4.8.2

The tubing system design shall follow the Energy Institute publication, Guidelines for the design, installation and management of small bore tubing assemblies:2013, G.4, where thermal expansion could lead to failure of tubing system.

5 Material selection

5.2.1

The material of small bore tubing shall be selected from Table 2.

Table 2 – Material Selection

Tube					Application
Material	**ASTM grade**	**UNS number**	**PREN**	**Max. tube hardness**	
316	A269 A632	S31600	24	HRB 80	1) General hydrocarbon service, onshore 2) Up to 80 °C (176 °F) metal temp 3) Maximum chlorides is 50 ppm at 50 °C. 4) Instrument air, HVAC and inert gases. 5) Steam tracing when steam pressure is above 1.62 MPa g (235 psig) or the item being traced has a maximum temperature above 205 °C (400 °F).
316L	A269 A632	S31603	24	HRB 90	1) General service, onshore 2) Up to 80 °C (176 °F) metal temp. 3) Maximum chlorides is 50 ppm at 50 °C.
Alloy 254 (6Mo)	A269 A632	S31254	42	HRB 90	1) Marine environment 2) Up to 120 °C (248 °F) metal temp. 3) Severe corrosive environment, chloride stress corrosion cracking, pitting and crevice corrosion 4) High pressure (> ASME B16.5 class 2500)
Alloy 6HN (6Mo - 6HN)	A269 A632	N08367	44	HRB 90	1) Same as Alloy 254 (6Mo) 2) Up to 120 °C (248 °F) metal temp. 3) Increased resistance to pitting, crevice corrosion and chloride-induced stress cracking
25Cr Super Duplex SS	A789 / A789M	S32750	40	HRC 32	1) Marine environment 2) Sour Service, NACE 3) Above 80 °C (176 °F) metal temp. 4) Severe corrosive environment 5) High pressure (> ASME B16.5 Class 2500) 6) Sea water
Alloy 400 (Monel)	B165	N04400	Not applicable	HRB 75	1) Resistance to acid, alkali, seawater, organic intermediates 2) Marine environment 3) Chemical plants, including environments using sulfuric acid and hydrofluoric acid 4) Severe corrosive environment 5) Sea water < 60 °C
Copper Alloy (Tungum)	B706	C69100	Not Applicable	HRB 80	1) Marine environment 2) High pressure gas pipework systems (oxygen and inert gases) 3) Low temperature (cryogenic) applications.

Tube					Application
Material	**ASTM grade**	**UNS number**	**PREN**	**Max. tube hardness**	
					5) To be avoided if fluids are contaminated due to H_2S & Mercury, Acetylene, Ammonia. 6) Sensitive to chlorine containing environments 7) Need velocity limitation as the material is very soft and prone to erosion by velocity.
Alloy 625	B444	N06625	45	HRB 93	1) Sea Water 2) High pressure (> ASME B16.5 Class 2500) 3) Sour environment 4) High chlorides 5) Wet sour hydrocarbon gases. 6) Corrosive Oil with high water cut + H_2S + CO_2 + chlorides 7) Glycol
Alloy 825 (Incoloy)	B423	N08825	32	HRB 90	1) Corrosive service and corrosive environment 2) External/internal chlorides 3) Analyzer sample transport tubing 4) Treated Sea Water 5) High pressure 6) Caustic 7) Sulfuric acid, phosphoric acid, sulfur containing flue gases, sour gas and oil wells.
Titanium Gr.2	B338	R50400	Not Applicable	HRB 85	1) Sodium hypochlorite application 2) Mainly dedicated to Heat Exchanger equipment (tubes, plates, etc.).
Alloy C276 (Hastelloy)	B622	N10276	45	HRB 90	1) Non-aerated treated seawater >60 °C 2) HF Acid non-aerated 3) Extremely corrosive conditions 4) Oxidizing and reducing chemicals
Alloy 904L	A269 B677	N08904	34	HRB 80	1) Marine environment 2) Limited resistance to pitting in presence of wet salt spray (sea spray, sea water deluge tests) temperature up to 50 °C
Alloy 20	B729	N08020	25	HRB 95	1) Sulfuric Acid (90% - 98%), Caustic Spent, Caustic, Sour Gas, Acid Gas, organic acids, chlorinated hydrocarbons, sludge acids
Copper	B68 B75	C12200	Not Applicable	60 on Rockwell 15T scale	1) Steam tracing 2) HVAC tubing 3) General plumbing applications 4) Fire sprinkler installations.

5.2.2

The material of small bore tubing system components shall be compatible with the small bore tube material in accordance with Table 3.

Table 3 – Material Compatibility

Tube			Compatible material [1]	
Material	**ASTM grade**	**UNS number**	**Tube fitting**	**Instrument isolation valves**
316	A269 A632	S31600	SS 316	SS 316
316L	A269 A632	S31603	SS 316	SS 316
Alloy 254 (6Mo)	A269 A632	S31254	6Mo	6Mo
Alloy 6HN (6Mo - 6HN)	A269 A632	N08367	6Mo (6HN)	6Mo (6HN)
25Cr Super Duplex SS	A789 / A789M	S32750	25Cr Super duplex SS	25Cr Super duplex SS
Alloy 400 (Monel)	B165	N04400	Alloy 400 or CuNi	Alloy 400 or CuNi
Copper Alloy (Tungum)	B706	C69100	CuCr Alloy mix or SS 316	CuCr Alloy mix or SS 316
Alloy 625	B444	N06625	Alloy 625	Alloy 625
Alloy 825 (Incoloy)	B423	N08825	Alloy 825 or 316	Alloy 825
Titanium Gr.2	B338	R50400	Titanium Gr.4	Titanium Gr.4
Alloy C276 (Hastelloy)	B622	N10276	Alloy C276	Alloy C276
Alloy 904L	A269 B677	N08904	Alloy 904L or SS316	Alloy 904L or SS316
Alloy 20	B729	N08020	Alloy 20	Alloy 20
Copper	B68 B75	C12200	Brass	Brass
Note 1: Valve manifold material shall be selected based on process fluid, design pressure and design temperature.				

5.2.3

For sour service, materials shall be certified in accordance with ANSI / NACE MR0103 / ISO 17945 or ANSI / NACE MR0175 / ISO 15156, parts 1 to 3.

6 Installation

6.1 General

6.1.1

Ancillary equipment shall not be supported using small bore tubing.

6.1.2

Tubes and tube bundles shall be supported using tube clamps in the tube tray.

6.1.3

Threads shall not be seal welded.

6.1.4

Instruments shall be removable without disassembly of surrounding process pipe or impulse lines.

6.1.5

Instrument flag plates (back plate) shall be used with surface mounted instruments/analyzer systems.

6.1.6

Instrument tubing shall be disconnected/capped prior to hydrostatic testing of piping system.

Note: For direct mounted installations, instruments should be mounted only after successful hydrostatic testing of piping system.

6.1.7

When diaphragm seal transmitters are not used, filling tees shall be provided for:

- liquid applications or impulse lines at the process taps that require sealing liquids;
- high temperature condensing and corrosive vapor applications;
- steam applications.

6.1.8

Primary isolation valve with piping "Tee" shall be provided for services prone to plugging to facilitate a rodding device.

Note: Other methods of clearing the plugging should be considered.

6.1.9

Impulse lines shall have a minimum gradient 1:12 between primary isolation valve and the instrument.

Note: For viscosities greater than two centipoises, the gradient of the impulse line should be increased as per manufacturer's recommendation.

6.1.10

For cryogenic applications, instruments shall be mounted 300 mm (12 in.) above the highest point in the impulse line.

6.1.11

For oxygen installation, API Recommended Practice 551:2016, 8.18 shall be followed.

6.1.12 Process Taps and instrument orientation

6.1.12.1 Above the Taps Mounting

6.1.12.1.1

Instruments shall be mounted above the taps with self draining towards process connection for gas, condensing/corrosive vapour, cryogenic and slurry applications.

6.1.12.1.2

Transmitter bodies shall be orientated to prevent trapping of liquid to facilitate self draining towards process.

6.1.12.1.3

Drain fittings shall be located at the lowest part of the transmitter body flange.

6.1.12.1.4

Differential pressure instruments across column trays or packed beds shall be mounted above the top process connection.

6.1.12.2 Below the Taps Mounting

6.1.12.2.1

Instruments in single component condensing vapors, steam or liquid services shall be mounted below the process tap.

Note: Steam or high condensing vapour applications can be mounted above the primary isolation valve, but below the high point in the impulse line. In such cases, the impulse line upstream of the high point shall be free draining back into the process.

6.1.12.2.2

Impulse lines shall be free from pockets.

6.1.12.2.3

Transmitter bodies shall be orientated to prevent trapping of vapors.

6.1.12.2.4

Vapor purge or bleed fittings shall be installed on the upper part of transmitter body flange.

6.1.12.2.5

Instruments shall be located at an elevation below a high point in the impulse line.

6.1.12.2.6

Instruments measuring pressure of flowing two phase liquids shall be mounted below the process tap.

6.2 Small bore tubing system installation

6.2.1 Impulse tube routing

6.2.1.1

Impulse lines shall be routed in accordance with PIP PCCIP001:2015, 3.1.1.

6.2.1.2

Instrument air tubing shall be routed in accordance with PIP PCCIP001:2015, 3.2.2.

6.2.2 Impulse tube supports

6.2.2.1

The maximum span between tubing supports shall be in accordance with the Energy Institute publication, Guidelines for the design, installation and management of small bore tubing assemblies:2013, Table I.1.

6.2.2.2

Static and dynamic loading for support design shall be based on the Energy Institute publication, Guidelines for the design, installation and management of small bore tubing assemblies:2013, Annex G and Annex H.

6.2.2.3

Grouped tubes shall have the same metallurgy and operating temperature parameters.

6.2.2.4

Impulse tube shall be routed through grating or chequer plate, if specific cut-out is provided to allow removal of the chequer or grating plate without disturbing the impulse tubing during maintenance.

6.2.3 Tubing installation

6.2.3.1

The small bore tubing system shall be installed by personnel certified by the fittings manufacturer.

6.2.3.2

The small bore tubing system shall be installed in accordance with sub section 3.1.3 of PIP PCCIP001, October 2015 revision.

6.2.3.3

Sufficient access to in-line fittings shall be provided by:

- 45° bends to lift fittings out of the common tubing plane;
- staggering the fittings installed adjacent to each other.

6.2.3.4

Impulse lines for differential pressure transmitters with the exclusion of level shall be run together.

6.2.3.5

For wall thickness equal to or greater than 1.6 mm (0.065 in.) and tubing size equal to or greater than 12 mm (1/2 in.), hydraulic swaging units and bench benders shall be used in accordance with the manufacturer's instructions.

6.2.4 Tube bundles

6.2.4.1

Heat tracing tubing bundle installation shall be in accordance with PIP PCCIP001:2015, 3.3.3.2.

6.3 Small bore piping installation

6.3.1

Direct mount installations shall use 20 mm (3/4 in.) connection to process.

6.3.2

Pipe shall be 1/2 in. Schedule 80 or heavier pipe.

Note: Corrosion allowance should be considered for selection of schedule.

6.3.3

Fittings and nipples shall be in accordance with ASME B16.11.

6.3.4

ASME B16.11 hex style bushings and flush bushings shall not be used.

6.3.5

Flush or hollow hex pipe plugs shall not be used.

6.3.6

Adapter fittings shall be used for:

- transitions between different threading systems;
- instrument connection changes to a larger impulse tube.

6.3.7

Pipe unions shall not be used.

6.3.8

Welded assemblies shall be used where specified by the piping class.

6.4 Thread Sealant

6.4.1

Sealant/lubricant for threaded instrument piping connections shall be in accordance with the requirements of the process service.

6.4.2

Thread sealant applied to stainless steel shall be a nickel based anti-seize compound.

6.4.3

Anti-seize liquid thread sealant shall be used to seal the screwed connections.

6.4.4

Sealants shall be in accordance with the recommendation from the manufacturer of the fittings.

6.4.5

Polytetrafluoroethylene (PTFE) tape shall not be used as a sealant.

6.4.6

Sealants shall be applied and cured in accordance with the manufacturer's instructions.

6.4.7

Organic sealants shall not be used in oxidizing services.

7 Inspection and testing

7.1

Tubing installations shall be leak tested in accordance with ASTM E515.

7.2

Instrument air systems shall be pressure tested pneumatically using dry air or inert gas.

7.3

The manufacturer's supplied "go/no go" gauge (if applicable), depth insertion and match marking shall be used to verify the correct tightening and tube depth.

Note: The marking pens used should follow the manufacturer's recommendation.

7.4

Small bore fittings shall have type test qualified (standard qualification tests) in accordance with ASTM F1387.

7.5

Instrument valves and manifolds shall be type test qualified in accordance with MSS SP-99.

7.6

Tubing system components and fittings shall be witness tested by package vendor and the following test reports to be submitted for review:

a) visual inspection and dimensional check;

b) positive material identification;

c) representative samples for dismantling and reassembly test.

8 Marking

8.1

Tubing runs on a tube tray, longer analyzer tubing, or hydraulic tubing shall be tagged at both ends using SS 316 tag plates.

8.2

Tag plates shall be tied using SS 316 zip ties or wires.

8.3

Tubes shall be marked in compliance with ASTM A1016/A1016M.

8.4

Tubes tube shall be marked with the following:

- tube outside diameter;
- tube wall thickness;
- heat number;
- "HT", if heat treated.

8.5

Fitting bodies and nuts shall be marked with the manufacturer's name, material, size and heat number.

9 Preservation and packing

Incomplete tube runs or ship loose components and fittings shall be protected with caps or plugs.

Registered Office
City Tower
40 Basinghall Street
14th Floor
London EC2V 5DE
United Kingdom

T +44 (0)20 3763 9700
F +44 (0)20 3763 9701
reception@iogp.org

Brussels Office
Bd du Souverain,165
4th Floor
B-1160 Brussels
Belgium

T +32 (0)2 566 9150
F +32 (0)2 566 9159
reception@iogp.org

Houston Office
10777 Westheimer Road
Suite 1100
Houston, Texas 77042
United States

T +1 (713) 470 0315
reception@iogp.org

www.iogp.org