



Offshore Design Section
Engineering Services
ISO – 9001:2008

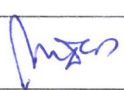


FUNCTIONAL
SPECIFICATION FOR
Instrumentation Bulk
materials

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FUNCTIONAL SPECIFICATION

FOR

Instrumentation Bulk materials

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1.0 SCOPE OF THIS DOCUMENT:

- 1.1 This specification describes the essential considerations in the selection, installation, testing and commissioning of the instrumentation Bulk Materials like tubing, fitting, instrument valves (Miniature valves / Instrument Isolation Valves) & Junction Box.
- 1.2 The Contractor shall be responsible for the selection of the Bulk Materials suitable for its intended application, its procurement, testing, packing, shipment to site, installation and commissioning.
- 1.3 This Functional specification covers a wide variety of requirements as mentioned in above mentioned clauses. However, contractor is required to submit purchase specifications for Instrumentation Tubing & Fitting for company's review & approval.

2.0 REFERENCE SPECIFICATIONS:

- a) Specification No. 3.6: Instrumentation Design Criteria
- b) Basic Bid Work
- c) Project P & IDs

3.0 SCOPE OF SUPPLY:

- 3.1 Installation materials for instrumentation items shall be as per actuals. Bidder shall submit detailed hookup drawings for each instrument installation with MOC and Quantities mentioned therein.

4.0 BULK ITEM REQUIREMENTS FOR INTERFACING:

4.1 INSTRUMENT AIR / GAS HEADERS, BRANCH LINES AND DISTRIBUTION.

- i. Instrument air/gas header shall be in accordance with the piping specification of appropriate service and operation rating as per the piping PMS.
- ii. The size of instrument air/gas mains shall be established in accordance with the table below unless otherwise specified. Connections shall be as per the Annexure IV of the Design Criteria

<u>Nom. Pipe Size</u>	<u>Max. Members of Users</u>
½"	3
¾"	14
1"	23
1½"	50
2"	100

- iii. In General, All take-off for branch lines shall be of minimum SS 316 Grade & shall be from the top of the main header with SS 316 block valves (full bore ball valves) equal in size to the branch line. All low points shall have a ½" valve SS 316 (full bore ball valves) installed as a drain and blow down point. However, Note that, wherever any other MOC for tubings and fittings has been specifically mentioned / specified in the FS, all take-off for branch lines, block valves and any other valves shall be of same MOC.

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- iv. The branches to individual pneumatic instruments shall be as per the Hook-up drawing provided in Annexure IV of Design Criteria.
- v. Every pneumatic instrument requiring instrument air / gas shall be provided with a suitably sized filter regulator (SS 316 Grade), fitted with integral relief valve and pressure gauges to ensure that suitable quality and pressure of air is received by the instrument.
- vi. Wherever the air / gas sub header ends in a distribution manifold, each manifold take-off valve shall supply only one user and shall be labeled with the user's tag number. At least one spare outlets fitted with instrument valves (full bore ball valves) shall be provided for every 20 meters of the Air / Gas distribution manifold, for future use. The total number of spares for future shall be minimum 20% of the total number of outlets per manifold.
- vii. Manufacturer or fabricator or packager supplying equipment or vessels mounted on skids, which incorporate instrumentation requiring pneumatic supply, shall install a pneumatic supply header following the above requirements, of proper size, on the skid with end connection at skid battery limit. All pneumatic instruments mounted on skid shall be fed with pneumatic supply from this header. The non-skid supply piping shall terminate at skid boundary and the location and size of the supply connection shall be noted on vendor approval drawings.
- viii. Where the process gas is used instead of instrument air, MOC selected shall be NACE certified material suitable for the process fluid.

4.2 INSTRUMENT FITTINGS:

4.2.1 (A) Material, Specifications & Sizes: (For material except as at 4.2.1 (B) below)

- a) All fittings shall be imperial sizes, expressed in nominal outside diameter (OD) and all threads shall be NPT. All threaded fittings shall have NPT threads as per ANSI B1.20.1
- b) Fittings shall be of 316 SS material to ASTM A 276 or equivalent (i.e., BS 970-316-S31, DIN4401 or ASME SA 479-316).
- c) Stainless Steel Tube Fittings made from bar stock (straight configurations) should meet ASTM A276/ ASME SA479 standards and those made from forgings (including elbows, crosses and tees) should meet ASTM A182/ ASME SA182, BS 970-316-S31, DIN4401 standards.

4.2.1. (B) For Critical loops (i.e. All ESD/FSD Loops, including all fittings in the loop to and from SDP, and the fittings feeding the ESD/FSD loops from the main Air/Gas Header) on Unmanned WHPs.

The Instrumentation fittings shall be 6Mo (UNS31254) or Super Duplex (UNS32750).

The 6Mo (UNS31254) grade Tube Fittings made from bar stock (straight configurations) shall be as per ASTM A276 / ASTM A479 or equivalent standards and those made from forgings (including elbows, crosses and tees) shall be as per ASTM A182 F44 or equivalent standards.

The Super Duplex (UNS32750) grade Tube fittings made from bar stock (straight configurations) shall be as per ASTM A479 or equivalent standards and those made from

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forgings (including elbows, crosses and tees) shall be as per ASTM A182 F53 or equivalent standards.

- 4.2.1 Fittings shall be ASTM F1387 MAF classification – IV,” Flare-less Mechanical collating grip type” producing a firm grip on the tube without substantially reducing the tube wall thickness. Fittings shall be capable of holding the maximum working pressure of the tubing without any leak after only one and a quarter turn pull up of the nut.
- 4.2.2 Fittings shall have the body, front & back ferrules and nuts. All the components of tube fittings shall be from of the same manufacturer.
- 4.2.3 Nuts for SS fittings shall have silver plated threads to act as a lubricating agent to avoid galling and to reduce tightening torque.
- 4.2.4 All fittings shall have hardness not exceeding RB 90.All the fittings end connections shall be compatible to tube of hardness in the range between RB 70 to 79 and hardness for fittings (Ferrules) shall be such that, there is a minimum hardness difference of 5 to 10 between tube and fittings for better sealing.
- 4.2.5 Bar stock shall be with carbon content <0.05% to provide increased resistance to corrosion.
- 4.2.6 Heat code traceability number shall be stamped or etched on both body and nut of fittings.
- 4.2.7 Threaded connections shall be NPT for all components and piping and tubing systems for process and utilities connections. PTFE threads sealant shall be used on all threaded connections. For high temperature application suitable sealant shall be selected.
- 4.2.8 Above API 10000 and above company’ approval shall be obtained for selection of Fittings.
- 4.2.9 **Testing Requirements for tube fittings.**

4.2.10.1 Type Testing Requirements:

- a. The tests specified in the table below shall be carried out on the samples drawn and in the sequence ,as specified in ASTM F1387-99 (Re-approved 2012).The testing shall consist of all the following tests as per ASTM F1387-99 (Re-approved 2012) for SS316.

Mandatory Test		
1	Examination of specimen	Annexure A2
2	Pneumatic Proof Test	Annexure A3
3	Hydrostatic Proof Test	Annexure A4
4	Impulse Test	Annexure A5
5	Flexure Fatigue Test	Annexure A6
6	Tensile Test	Annexure A7
7	Hydrostatic Burst Test	Annexure A8
8	Repeated Assembly Test	Annexure A9
9	Rotary Flex Test	Annexure A10
Supplementary Test		
1	Thermal Cycling Test	Section S2
2	Stress Corrosion Test	Section S4
3	Vibration Test	Section S8
Sizes to be tested: 1/4”, 1/2”, 3/8”, 3/4”, 1”.		





MOC of tubing used in testing shall be SS316, 6Mo (UNS31254) or Super Duplex (UNS32750) corresponding to the fitting MOC.

Valid 'Type Test' Report either from Accredited Lab / National Test House OR test report for all the tests performed on the samples for all the sizes (as mentioned in the above table) carried out as per ASTM F-1387 (Re-approved 2012) and witnessed by Third Party Inspection (TPI) agency like TUV/DNV/NABL etc. shall be submitted to company for review.

4.2.10.2 Following Tests shall be witnessed by TPIA for the lot of supply and report shall be submitted, along with supply.

- Visual Inspection, Dimensional Check, Heat Code Traceability certificate Review, Material Test certificate Review & check for workmanship.
- Positive Material Identification
- Reviews of certificate for Oxalic Etch Testing for inter-granular corrosion resistance (ASTM A 262)
- Hydrostatic Proof Test
- Pneumatic Proof Test

4.3 INSTRUMENT AIR TUBING

4.3.1 Material, Specifications & Sizes :

- All Tubing shall be imperial sizes, expressed in nominal outside diameter (OD) and all threads shall be NPT ANSIB1.20.1
- Tubing shall be of TP 316/316L (dual certified) material to ASTM 'A 269' or equivalent (i.e. BS 970-316-S31, DIN4401 or ASME SA 479-316), unless otherwise specified. Molybdenum content shall be 2.5% minimum and carbon content of $\leq 0.03\%$. The minimum size shall be $\frac{1}{4}$ " OD.
- Manufacturing Process: Extrusion followed by cold Pilgering and / or cold drawing
- Tolerance on OD : ± 0.08 mm (As Per EN10305-1/DIN 2391)
- Tolerance on wall thickness : $\pm 10\%$ (As Per EN10305-1/DIN 2391)
- Pressure Rating: Shall be minimum 250 bars.
- Roughness value on OD: 1.2 Micron RA (max.)
- Concentricity : As per EN 10305(≤ 0.1)
- Tube Hardness : Up to 80 HRB As per NACE MR 0175 Certification
- Tubing Length: 4-6 meters.



4.3.1.1 For Critical loops (i.e. All ESD/FSD Loops, including all tubing in the loop to and from SDP, and the tubing feeding the ESD/FSD loops from the main Air/Gas Header) on Unmanned WHPs.

Tubing MOC shall be 6Mo (UNS31254) as per ASTM A 269 / Equivalent Standard or Super Duplex (UNS32750) as per ASTM A 789 / Equivalent Standard.

4.3.2 The manufacturer shall provide material compliance certificates confirming that the raw material for fittings conform to ASME section – II.

4.3.3 Fully Bright Annealed Tubes: Tubes shall be annealed in a controlled reducing atmosphere to ensure a clean oxide-free film on the free surface for reduced chances of corrosion.

4.3.4 Stainless steel tubing shall be soft annealed seamless TP 316 / 316L (dual certified) as per ASTM A269. Sizes shall be as follows:

S. No.	Application	Size
1	High-pressure hydraulic lines	¼" O.D. X 0.035" W.T. 3/8" O.D. X 0.049" W.T.
2	ESD/FSD loop	3/8" O.D. X 0.035" W.T.
3	Pneumatic supply to shutdown valves	3/8" O.D. X 0.035" W.T. 316 SS tube
4	Process impulse lines	1/2" O.D X 0.065" W.T. 316 SS tube
5	For Critical loops (i.e. All ESD/FSD Loops, including all tubing in the loop to and from SDP, and the tubing feeding the ESD/FSD loops from the main Air/Gas Header) on Unmanned WHPs.	For instrument tubing with MOC of 6Mo or super duplex, Thickness sizing calculation shall be submitted to company for approval.

4.3.5 Signal transmission shall be through ¼" O.D. X 0.035" W.T. tubing run singly or in bundles

4.3.6 Monel tubing shall be used on sea water and produced water service and shall be fully annealed seamless as per ASTM B-165 with size ½" O.D. X 0.035" W.T.

4.3.7 Tubing shall be supported and protected by stainless steel angle / channel or ladder / tray along the complete length of each run and shall be fastened with stainless steel saddles at a maximum of 1 m intervals on straight runs.

4.3.8 Channel or tray support for tubing runs shall be sized for a minimum capacity of 30% greater than that required.

4.3.9 All pneumatic exhaust ports and breathers shall be fitted with bug screens, installed facing downwards.

4.3.10 Vendors to confirm that following tests shall be carried out by vendor and certificates for the same shall be given along with supply. Test reports submitted by Vendor shall be reviewed by TPIA at the time of Supply.

- Visual Inspection, Dimensional Check, Check for workmanship. Material Test certificate



- Mechanical test: Tensile test (Yield strength, Tensile strength, % Elongation).
- Hardness Test
- Chemical test (Product analysis)
- Microstructure Examination :Ferrite content, single phase
- IGC test (Austenitic): As per ASTM A 262 specification ,Practice E
- Eddy current test: 100% Eddy Current Test according to ASTM 1016 A / ASTM A450
- Flattening Test
- Heat Number Traceability certificate shall be ensured for above mentioned test and shall be reviewed by the TPIA.

4.3.11 **Tubing Installation:**

- a) The primary instrument block valves for all instruments shall be as per piping specifications. MOC of all the drain valves shall be 316 SS / MONEL as a minimum.
- b) All impulse lines shall be run with a slope not less than 1 in 12 except where otherwise specified. Direction of slope is to be downward from the process for liquid service and upward from the process for gas service.
- c) Tubing shall be joined by double compression fittings.
- d) Instrument lines shall be run in the vertical plane as far as possible and shall be run with the Minimum number of changes of directions consistent with good practice and neat appearance. All pipe and tubing shall be run in horizontal and vertical planes only.
- e) Tubing shall be bent with correct size tubing bender where required to avoid the use of fittings. Tubing cutter shall always be used to cut tubing. The use of short lengths of tubing in long runs shall be avoided, to avoid the use of fittings.
- f) All tubing shall be run in such a manner as to give the maximum protection against mechanical damage. Tubing runs shall be grouped together and clamped where possible. Tubing shall be arranged so that couplings can be tightened without distorting lines. Instrument tubing shall not run on trays intended for cables and shall not share the same transit with cables.
- g) Where tubing is run in permanent enclosures, the Contractor shall ensure that entry and exit of such enclosures is clean and smooth.
- h) Pipes or tubes installed but not connected, shall have the ends closed in approved fashion to prevent the entry of foreign material by suitable caps or plugs.
- i) All reasonable precautions shall be taken to prevent foreign material entering tubing /pipelines before and during erection.
- j) No pipe or tube shall be left with mechanical strain on it.



- k) Where the length of transmission tubing exceeds 60 Mtrs. (200 Ft.) the Company should be consulted as to the necessary of installing signal booster relays.
- l) Where permanent enclosures are left with space for instrument tubing to be pulled in at some future date, a galvanized pull wire of adequate size shall be left in the tray.
- m) On tubing to pipe connections and in making of screwed pipe joints, Teflon tape shall be applied to make thread in a manner to insure tape is not over the end of the male fittings.

4.4 PIPING / TUBING SUPPORTS:



- a) Piping and tubing shall be adequately supported and fixed at distances not exceeding those in the following table:

Single Tubing

Max. Distance Between Supports

$\frac{3}{8}$ " O.D. and less	Continuous
$\frac{1}{2}$ " to $\frac{3}{4}$ " Nom. Size	2 Mtrs. (6 ft.)
$\frac{3}{4}$ " to 1" Nom. Size	3 Mtrs. (9ft.)
Multi tube Bundles	3 Mtrs. (9ft.)

- All field-mounted instrument air tubing shall be supported with galvanized steel angles or channels of minimum 1/8" thickness fabricated to present a neat appearance.
- All instrument tubing supports shall be galvanized prior to installation.
- Mechanical ferrule seater shall be used on tubing for pressure 140 kg/cm² (2000 psi) and above.
- Tubing Clamps shall be made of non-corrosive material, stainless steel AISI 316 or flame retardant plastic.
- Galvanic corrosion between tubing and tubing support system shall be avoided. The tubing clamp shall, when installed, not allowed for water / sea water to be accumulated between tubing clamps and tubing, to avoid crevice corrosion. It shall also prevent pitting and cracking corrosion in corrosive environments at offshore installations / platforms.
- Clamps shall be such that it will allow air circulation and reduces moisture retention / trapping. Minimal contact between clamp and tube to be provided to reduces the possibility of contact point corrosion. The tubing support shall limit the effects of impulse and vibration on the tube. The tube support shall provide retaining grooves; maintain tube position and maximum structural integrity. The clamps shall be stronger and provide more secure support for heavy wall tubing in vertical installations





- Valid Certificate conforming to NORSOK Standard Z-CR-010 (Latest edition) shall be certified by Third Party Inspection (TPI) agency like TUV/ DNV/BV/NABL/Lloyds Register etc. shall be submitted for tubing clamps.
 - The design of tubing clamps must be considered to ensure safe, trouble-free performance and simplify installation. It shall be easy to inspect without removal. Compatibility, adequate ratings, proper installation, smooth operation and maintenance shall be considered during the selection of the tubing clamp.
- b) Pipe bushing shall not be used. Plug shall be of bar-stock with hex heads.
- c) If extended lengths of multiple tubing are to be run, multiple bundles and junction boxes with weatherproof entries may be used to the best advantage.
- d) Manufacturer or fabricator supplying skid mounted equipments or vessels with instrumentation, which provides, or utilizes pneumatic, offside alarms, shutdowns, or control functions shall tube signals to a central bulkhead, near skid boundary, available for hook up by the Contractor for connection to offside equipment. Location of the bulkhead shall be noted on vendor drawings.
- e) Differential or static pressure sensing lines shall not exceed 6 Mtrs. (20 Feet) for direct connected or locally mounted instruments.

4.5 JUNCTION BOXES:

- a) Instrument junction boxes shall be certified for use in the hazardous area in which they are installed. For intrinsically safe circuits, boxes certified Increased Safety Ex 'e' shall be used. For non-intrinsically safe circuits, boxes certified Explosion Proof / Flame proof Ex'd' shall be used. Boxes (Ex 'e', Ex'd') shall have minimum IP-66 ingress protection.
- b) Separate Junction boxes shall be used for intrinsically safe wiring. Junction boxes in any cable path from field to control room shall be limited to one only unless otherwise mentioned in Basic scope of work related to instrumentation. Instrument junction boxes shall not be used for electrical power cables.
- c) For Ex'd' junction boxes cable entries shall have NPT threads. Where this is not possible, a certified 316 SS adaptor shall be fitted.
- d) All Ex'e' and Ex'd' enclosures shall have all spare entries sealed with suitably certified 316 SS plugs.
- e) Entries shall be suitably spaced to enable ease of installation of cable glands. Tapped cable entries shall be of good quality, without stripped or damaged threads. The thread shall be continuous and shall permit the cable gland to fit squarely against the gland plate (or enclosure).
- f) Where the gland plate is not thick enough for tapping, cable glands shall be fitted with double locknuts.
- g) The threads of all cable glands and adaptors shall be greased on assembly.
- h) Cable glands fitted to all Ex 'e' enclosures, and industrial enclosures, may have a nylon or lead sealing washer between the cable gland and Gland Plate (or enclosures) to ensure IP 66 protection. Sealing washers shall not be fitted to glands entering Ex'd' enclosures.



- i) All glands, adaptors, reducers and plugs for the Ex 'e' as well as Ex 'd' junction boxes shall be certified for use in Class I.
- j) All junction boxes shall be effectively sealed, once uncanted or fitted into position. All lids shall be replaced during any break in work. Where this is impractical, e.g. large multi-cable junction boxes, a heavy PVC sheet shall be used to cover the junction box to exclude rain and dust.
- k) All terminals (including unused terminals) shall be tightened down. For communing of terminals, feed through cross connection bar shall be used. Comb connectors shall not be used.

Type of Junction Boxes:



a) Increased Safety

- i. Junction box construction shall be 1.5 mm 316 SS. Boxes shall be bottom entry with a removable 316 SS gland plate. The gland plate shall be drilled and tapped, 6 mm thick for tapered threads and 3 mm thick for parallel threads. The plate shall be bolted to the box with 316 SS bolts, sealed with a neoprene gasket and fitted with an 8 mm earthing stud. All incoming cables shall enter from the sides of the junction box. Outgoing cable shall be from the bottom of the junction box.
- ii. Boxes shall have four external mounting lugs, two top and bottom, drilled with 10 mm fixing holes. A full size removable stainless steel gear plate shall be fitted inside each box. Terminals shall be Ex 'e' rail-mounted tunnel-type made of melamine. Wiring ducts shall be colored blue.
- iii. Boxes shall have doors hinged minimum at two points with a neoprene seal fitted all round. Hinges shall be the lifted-off pintle type, constructed of stainless steel; Piano hinges are not acceptable. A restraining mechanism shall prevent opening more than 160°. Screwdriver-operated door latches shall be fitted at the top and bottom.
- iv. In addition to the manufacturer's "Certification" label, each junction box shall have identification label attached to the box with 316 SS screws in a manner which will not invalidate the hazardous area certification. The label shall be constructed of white-black-white laminated plastic. The label shall include an engraved Tag No. An additional tag stating "Intrinsically Safe Circuits" shall be installed. This shall be blue-white-blue laminated plastic.
- v. The contents of Ex 'e' enclosure shall not be altered without the prior approval of the company's electrical or instrumentation engineer.
- vi. The damaged terminals shall be replaced with approved Ex 'e' terminals.

b) Explosion Proof

- i. Explosion proof junction boxes shall be constructed from 316 SS / epoxy coated copper free die- cast Aluminium. Boxes shall have at least four external mounting lugs, drilled with 10 mm fixing holes, and an 8 mm external earth lug. A full size removable stainless steel gear plate shall be fitted inside each box. Cables shall enter from the bottom, and 20% spare entries shall be provided. Cable entries shall be



drilled and tapped to suit the required glands, and fitted with certified 316 SS plugs. Junction box lids shall have cast hinges integral to the box with stainless steel pins.

- ii. Each junction box shall have an identification label, in addition the manufacturer's certification label, attached with 316SS screw in a manner, which will not invalidate the hazardous area certification. The label shall be constructed of white-black-white laminated plastic. Terminals shall be rail-mounted tunnel-type, made of melamine.
- iii. Ex'd' enclosures shall not be drilled or machined under any circumstances after approval from the company.
- iv. Damaged enclosures shall be completely replaced. Flange surfaces shall be clean and undamaged. All fixing bolts shall be present and tightened to the correct torque.
- v. All metal flanges and box lids shall be sealed after assembly with a grease-impregnated cloth.