

Form No.



**PRODUCT STANDARD**  
**TC ENGINEERING**  
**HYDERABAD**

**TC 65625**

Rev No. 01

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**Instruction to bidders:**

- 1) Bidders are advised to contact BHEL for essential technical queries in writing within one week of issue of Enquiry. Offers with incomplete information will not be considered for evaluation, and are likely to be rejected without any further correspondence with the Bidder.
- 2) Unsolicited requests from bidders for alterations to their already submitted offer will not be permitted. These would not be taken cognizance, and offers will be evaluated without taking into account such requests/correspondence.
- 3) Any technical features over & above BHEL enquiry specification requirements proposed by Bidder will not be given preference for the purpose of evaluation.
- 4) Bidders shall comply BHEL specifications in total. Incomplete offers will be rejected. In case feasible deviations are proposed by the bidder and subsequently withdrawn, no commercial implications can be claimed by the bidder.
- 5) The make of Bidder bought out items shall be as per vendor list. In case Bidder proposes alternate make / model of bought out item due to non-availability of statutory certification etc., the same shall not be binding on BHEL. Such changes shall be explicitly listed in deviation list with applicable price (for removal of the said deviation, if applicable) explicitly indicated (with specific item no) in the PRICED price schedule.
- 6) In the event of any conflict between these specifications, data sheets, related standards, codes etc. the bidder shall refer the matter to the purchaser for clarifications and only after obtaining the same shall proceed with the manufacture / procurement of the items in question.
- 7) Bidder shall submit duly filled deviation format enclosed with this specification along with technical offer, otherwise, it will be presumed that there are no deviations from this specification. Offer without this deviation list will not be evaluated & shall be rejected. If, there are no deviations, bidder shall submit signed copy of deviation format, mentioning "No Deviations".
- 8) Changes if any made by BHEL during technical evaluation on the specification requirements or Bill of material, bidder is requested by the purchase to submit impact price (amount to be reduced or increased to the original offered price) for those changed items only, other items for which there are no technical changes, unit rates shall be maintained as it is.
- 9) **In case of any technical query, bidders may contact the following BHEL engineer:**  
**Name: Venkatadurga Anjibabu L**  
**Designation: Dy Manager**  
**Deptt: TC Engineering**  
**Phone: +91 40 2318 3060**  
**Email: anjibabu@bhel.in**

Ref.  
Doc.

**TECHNICAL ADDENDUM FOR DRY GAS SEAL SKID****Project: IOCL-Dumad-Syn Gas Compressor****1 GENERAL**

This specification is applicable for the variants mentioned in the table below and is an addendum to TC55450-R03 (Specification for Dry Gas Seal Skids for Centrifugal Compressors). Vendor shall explicitly bring out any conflict between this specification and its attachments with TC55450-R03.

**2 VARIANT TABLE**

Project	Description	Material Code	Remarks
DUMAD SYN GAS	SEAL GAS SKID	TC9765625014	Skid rating 600#
	SPARE FILTER ELEMENT DUMAD	TC9765625022	
	DGS SKID MAND SPARES DUMAD	TC9765625030	

**3 DESIGN**

3.1 The project specific requirements shall as per the following attachments:

Sl. No.	Description	Document No.
a	Seal Gas P&ID	Annexure-1 (For reference only). Some instruments / equipment are not indicated.
b	TC55450-R03	Annexure-2
c	Sub Vendor List	Annexure-3
d	Thermowell & TC Drawing	Annexure-4
e	JACOBS / IOCL specification / ITP	Attached

3.2 Vendor shall include automatic change-over arrangement (On-Off valve) from normal to emergency / start up seal gas supply along with all the necessary instrumentation and controls required during start-up & emergencies.

3.3 Valve positioner shall be supplied along with valve diagnostic software / valve signature in USB. This software shall be integrated with customer control system for advance control valve diagnostics like seat ring condition, gland packing condition, actuator leakage etc.

3.4 The primary seal gas supply lines along with all inline equipment & instruments shall be min 2". The gas velocity shall be limited to 30 m/s.

3.5 Seal Gas skid shall be a single or two assemblies based on the space availability. This shall be decided during detailed Engineering stage. No price or delivery implication will be accepted on account of this.

3.6 Vendor to refer DGS specification for all operating & design parameters.

3.7 Vendor shall provide seal gas booster flanged connection at skid edge with isolation valve and NRV. Seal gas booster supply is in BHEL scope.

3.8 Process gas is available as the primary seal gas. Vendor shall consider the condition and dew point of the process gas and the site ambient conditions and confirm the process gas is suitable as the primary seal gas. Else vendor shall provide primary gas conditioning system with heater / cooler / dryer & pre-filter.

Rev. No.	Revisions	Prepared	Checked	Approved	Date
01	Skid Rating changed to 600#	L.V.A.B	Ram	P.D.M	31.08.2021
00	Issued	L.V.A.B	Ram	P.D.M	21.06.2021

**4 PROJECT SPECIFIC REQUIREMENT**

4.1 For all other requirements, formats etc. refer Dry Gas Seal Skid specification TC55450-R03 along with the following project specific requirements.

Clause No	Existing	To be replaced with
2.1-a	Seal Gas P&I Diagram as per Variant Table-4 of this specification	Annexure-1 for reference only. Updated P&ID will be provided later.
2.1-c	List of Instruments, make & model as per Table-1 of this specification	As per this addendum.
3.4	Piping material	Complete skid piping / tubing material shall be SS316L.
4.7	Filtration grade	<u>SEAL GAS DUPLEX FILTER:</u> Filtration efficiency : 99.9 % Particle efficiency : 1.0 micron $\beta_x \geq 1000$ <u>SEC/BARR FILTER:</u> Grade of filtration : 1 $\mu$ m
5.1	The Pipe sizes and terminal points shall be as per the Seal Gas P&ID indicated in variant table-4.	Refer 3.4 above. BHEL shall provide 2" connection or higher if required for primary seal gas.
5.4	Flange connection	All flanges shall be WN RF / RJ.
5.5	PMI & IGC	PMI & IGC is applicable for all instrumentation, piping items.
6.5	All the instruments and quantity shall be as specified in Table-1.	As per this addendum.
7	Instrument installation	The instrument installation shall be piping standard. N2 Lines may be provided with tubing hookup.
6.6, 8.3	Foundation Fieldbus	Not applicable
9	Documentation	Vendor to include documents listed in this specification.
Fig-1 to 5	Typical P&ID	Annexure-1
Table-1	List of Instruments, make & model	As per this addendum.
Table-4	List of variants	As per this addendum.
Table-5	Price Schedule	As per this addendum.
-	Cleanliness Test	No discoloration or hard particles found on 20 mesh screen after module blown for 5 minutes with 7 kg/cm <sup>2</sup> g dry filtered gas.
14	Warranty / guarantee	As per commercial terms and conditions / ITB.
-	Cable tray	Anodized aluminum as per IS 737
-	H2 / Hydrogen service	H2 service applicable. Refer attached H2 service requirements
-	Proven Track record	Refer Pre-Qualification Criteria attached with purchase enquiry.

**5 SEAL GAS SKID DIMENSIONS & PIPING ORIENTATION**

- 5.1 All the seal gas piping nozzles shall be terminated on top of the skids except drains.  
5.2 Every effort shall be done to minimize the skid footprint. Vendor may supply the seal gas skid as a single base frame assembly. Alternatively, separate assemblies for filter skid / control skids also acceptable. In case of separate skids, vendor shall supply interconnecting piping, prefabricated.  
5.3 Vendor shall further try to reduce the above indicated dimensions based on its 3-D modeling of the skids.

**6 DOCUMENTATION**

- 6.1 The following documents as a minimum shall be supplied by the vendor. The number of hard copies & CD/DVD/USB shall be as per TC55450-R03.  
a) 3D model of skids for integration with plant model created by BHEL

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- b) As-built GA drawings.
- c) As-built Instrument datasheets including instrument vendor datasheets, GA drawings & sizing calculations.
- d) Spares list.
- e) Packing list.
- f) Material test certificates.
- g) Filter degree of filtration test certificate.
- h) Explosion protection certificates for all electronic instruments.
- i) Terminal wiring details of Junction Box.
- j) Skid Photographs.
- k) Instruction, Service and Maintenance manual.
- l) Guarantee Certificates.

6.2 Three sets hard copies & one number CD/DVD/USB of the above documents shall be submitted to BHEL prior to dispatch of the skids.

7 **LIST OF INSTRUMENTS:**

SL. No.	Instrument	Qty Note (2)	Minimum Specification	Vendor	Remarks
1	Differential Pressure Gauges	10	Differential Pressure Gauge	Vendor list	
			IP66; panel mount		
			Range: as required		
			Dial Size: 150mm		
			Pr.Conn.: 1/2" NPTF		
2	Pressure Gauges	28	Static Pr. : 100 kg/cm2(g)	Vendor list	
			Pressure gauge		
			IP67; panel mount		
			Accuracy: ±1% of full scale		
			Range: as required		
			Dial Size: 150mm		
			Pr.Conn.: 1/2" NPTM		
Case & Bezel: All SS Construction Wetted parts: *					
Solid front type for seal gas line. Liquid filled with pulsation damper.					
Over range protection: SS316					

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SL. No.	Instrument	Qty Note (2)	Minimum Specification	Vendor	Remarks
3	Differential Pressure Transmitter & Pressure Transmitter	35	Smart-HART Protocol Ex-ia & Ex-d certified for IEC Zone1, Gas IIA, B, C Min Load: 600 ohms All SS construction Pr.Conn.: ½" NPTF Accuracy: 0.04% of span with TD of 1:10 Static Pr.: 100kg/cm2(g) Integral LCD indicator In built lightning & surge protection SIL certified.	Vendor list	
4	Flow Meter	13	Internal magnetic float or Rota meter design or an integral orifice and differential-pressure (DP) cell / thermal mass flow Smart-HART Protocol Range: as required All other requirements same as PT / DPT. Pr.conn: Flanged	Vendor list	Flowmeter may also be used for secondary vent. P&ID will be updated later.
5	Junction Box	6	Ex-d certified for IEC Zone1, Gas IIA, B, C with Ex-d SS316 cable glands	Vendor list	
6	Duplex filter (Coalescing type) with changeover transfer valve	1 set	With changeover valve Startup diff. Pr.: * Max. Pr. For change over: * Filter vessel: SS316L Change over valve: SS 316L	BOLL & KIRCH DONALDSON FLOWERVE FORAIN HYDAC INDUFI ITALVALV JOHN CRANE PALL *Vendor may propose additional filter make with PTR.	Filter sizing shall be as per API614 / 692
7	Pneumatic DP control valve with positioner	2	Material of body: SS316 L Material of Trim: * ANSI / FCI 70.2 Minimum class IV.	Vendor list	

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SL. No.	Instrument	Qty Note (2)	Minimum Specification	Vendor	Remarks
			Noise level shall not exceed 85db. Source treatment for noise shall be by using special trims like anti-noise trims; in case noise exceeds the allowable level. Bellow seal for corrosive & toxic gases like H <sub>2</sub> S, H <sub>2</sub> etc. Actuator: Pneumatic with spring		
8	Secondary and barrier seal gas filters	1 set	Same as duplex filter, except it is particulate filter.	Same as duplex filter	
9	Duplex Pressure regulator / PCV with SS housing and changeover transfer valve	4 sets	As per system requirement	Vendor list	
10	In line check valves	A.R.	As per system requirement	Vendor list	
11	Needle valves	A.R.	As per system requirement	Vendor list	
12	Instrument root & Isolation valves	A.R.	As per system requirement	Vendor list	
13	Tube fittings	A.R.	As per system requirement	Swagelok, Parker Hannifin corp.	Additional vendor list not applicable for this item
14	Cable	A.R.	Single pair 1.5 mm <sup>2</sup> .	Vendor list	
15	Change over valve in startup gas & Condensate Drain valve with PST positioner	1	Full bore, On-off ball valve ANSI / FCI 70.2 Minimum class VI TSO. The valve shall be firesafe and fireproofing shall be provided. Actuator: Pneumatic cylinder with spring return SOV: Ex-i, SIL 3 certified, Universal type, class H insulation. Proximity type IS SIL certified limit switches, P&F make	Vendor list	

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SL. No.	Instrument	Qty Note (2)	Minimum Specification	Vendor	Remarks
16	Temperature Gauges	4	Bi-metallic thermometer, every angle	Vendor list	
			IP67, direct mount		
			Accuracy: $\pm 1\%$ of full scale		
			Range: as per requirement		
			Dial Size: 150mm		
			Inst Conn: $\frac{1}{2}$ " NPTM bottom.		
			Case & Bezel: All SS Construction		
Solid front type for gas line					
17	Temperature Gauge thermowell	4	Instrument connection: $\frac{1}{2}$ " NPTF	Vendor list	
			Pr. Connections: 1- $\frac{1}{2}$ " flanged. Rating as per skid rating. Line size shall be blown to 6" for thermowell mounting.		
			All SS316 Construction.		
			NACE certification		
18	Canopy for all transmitters, positioners & junction boxes	A.R.		Vendor list	
19	MIMIC Panel	1			As per final P&ID

Notes:-

- All instrument makes shall be as per this list.
- Any item not covered in this list shall be from a reputed manufacturer unless otherwise specified in this specification elsewhere.
- For the items, which are not covered in the list or vendors not indicated, vendor shall procure the same from their standard sub-vendors.
- Since the instrument quantity indicated in the above table is more than the numbers required as per project specific P&I diagram, the additional quantity left unused after P&ID finalization shall be supplied loose.
- All the items of the same type of instrument shall be of same make.
- Vendor List as attached.
- In case the above listed quantity is less than that required by the vendor as per vendor proposed P&ID, these additional instruments shall be considered by vendor.

8 **DEVIATION FORMAT:**

Bidder shall submit duly filled deviation format (as given below) along with technical offer, otherwise, it will be presumed that there are no deviations from this specification. Offer without this

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deviation list will not be evaluated & shall be considered for rejection. If, there are no deviations, bidder shall submit signed copy of this format, mentioning "No Deviations".

Sl. No.	Clause No. of Spec	Deviation	Reason for deviation	Deviation category	
				Product/design limitation	Optimization
1					

**9 CHECKLIST:**

(TO BE FILLED BY THE VENDOR AND SUBMITTED ALONG WITH THE OFFER WITHOUT WHICH OFFER WILL NOT BE CONSIDERED)

Sl. No.	Requirement	Vendor Confirmation YES / NO
a.	Compliance to BHEL specification and its annexures.	
b.	Deviation (if any) included in offer with reason.	
c.	Price implication for deviation removal is indicated in Priced offer in case of any deviation.	
d.	Skid GA & BOM (with make/model) attached with technical offer.	
e.	Signed and stamped copy of BHEL specification attached with technical offer.	
f.	Spares BOM (with make/model) attached with technical offer.	
g.	Price schedule attached with technical offer with 'QUOTED' marked against each item.	
h.	PTR attached with technical offer.	

**10 SPARES PHILOSOPHY:****10.1 Filter element spare (TC9765625022):**

Sl. No.	SPARE ITEM DESCRIPTION / SPARE PHILOSOPHY
a	Seal gas filter element with gaskets / O-rings (1 set is equal to 1 duplex filter element with o-rings / gaskets) of each type / make / model.

**10.2 DGS Skid spares (TC976562530):**

Sl. No.	SPARE ITEM DESCRIPTION / SPARE PHILOSOPHY	QTY
a	Local Gauges: DP, Pressure, flow, temperature (including Thermowell), level etc.-20% or min 02 no. each type with all accessories	1 set
b	i. Transmitters: DP, Pressure, Level, Flow etc.-10% or min.1 no. each type with all accessories	
	ii. Junction Boxes: 10% or min. 1 no each type. iii. variable area flowmeter (rotameters): 20% or min. 2 no each type vi. Orifices:10%	
c	<u>Control valve &amp; On-Off Valve, Pressure Regulating Valve (self-Actuated) spares:</u> i. Trim consisting of seat, seat ring/ seal ring, plug with stem, cage (wherever applicable), packing material- 10 % or minimum 1 no of each type and size	
	ii. Positioners (Smart) with links of each type and make- 20% (subject to minimum of 2 no of each type and size).	
	iii. Actuator Diaphragm-20% (subject to minimum of 2 no of each type and size).	
	iv. Solenoid valve-20% (subject to minimum of 2 no of each type and size).	
	v. Proximity switch-10% (subject to minimum of 1 no of each type and size).	
	vi. Air filter regulators of each type and size-20% (subject to minimum of 2 no of each type and size).	
	vii. Bonnet Gaskets/ gland packing's, piston O-rings, bearing & liner-10% (subject to minimum of 1 no of each type and size).	

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Sl. No.	SPARE ITEM DESCRIPTION / SPARE PHILOSOPHY	QTY
	viii. Any special accessories provided along with the control valve like boosters, position transmitters (wherever applicable), etc-10% (subject to minimum of 1 no of each type and size). ix. 10% (subject to minimum of One number) of Seal kit consisting of O rings, gaskets, gland packing etc. against each type, size and rating of valve. X. One number of Repair kit consisting of orifice, plug, spring, gasket, diaphragm, O-ring for each valve.	
d	<u>Instrument valves, manifolds &amp; fittings:</u> i. Fittings, lugs, nipples, sockets, blinds, unions: 10% or min. 2 no each type. ii. ½", ¾", 1", 1-½", 2" (etc.) valves (Ball, Globe, Gate, Needle, NRV etc.): 10% or min. 1 no each type. iii. 2 valve & 3 valve manifolds, isolation valves, instrument valves, tube fittings, check valves, filter, regulator, orifice plates etc.: 10% or min. 1 no each type. iv. Pipe/SS tubes: 10% if installed quantity.	

**10.3 DGS SKID 2 YEAR O&M SPARES: OPTIONAL**

SL NO	SPARE ITEM DESCRIPTION / SPARE PHILOSOPHY	QTY
a	Local Gauges: DP, Pressure, flow, temperature (including Thermowell), level etc. and Transmitters: DP, Pressure, Level, Flow etc.-10% or min.1 no. each type with all accessories -10% or min 01 no. each type with all accessories	1 set

**11 PRICE SCHEDULE:**
 Enquiry ref. no.  
 Offer ref no.

 Date:  
 Date:

Sl no.	DESCRIPTION	MATL CODE	Qty	UNIT PRICE	TOTAL PRICE
1.	<b>Seal Gas Control system consists of the following:</b>				
a	SEAL GAS SKID DUMAD SYN GAS	TC9765625014	1 SET		
b	SPARE FILTER ELEMENT SET DUMAD SYN GAS (as per clause 10.1)	TC9765625022	12 SETS		
c	SEAL GAS SKID SPARES DUMAD SYN GAS (as per clause 10.2)	TC9765625030	1 SET		
d	2 YEAR O&M SPARES (as per clause 10.3)	---	Not App.		
2.	<b>Additional price to withdraw the deviations to following clauses: &lt;Vendor To Indicate Clause Nos with Price&gt;</b>				
3.	<b>Optional offer for addition of each of the following instrument inclusive of root valves, piping &amp; installation materials etc.</b>			<b>Optional price for each item</b>	
a	Filter cartridges / elements with gaskets / O-rings	---	1 set		---
b	Pressure Transmitter	---	1 unit		---
c	DP Transmitter	---	1 unit		---
d	Pressure Gauge	---	1 unit		---
e	Differential Pressure Gauge	---	1 unit		---
f	Smart Positioner	---	1 unit		---
g	Solenoid valve	---	1 unit		---
h	Flow transmitter	---	1 unit		---

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Sl no.	DESCRIPTION	MATL CODE	Qty	UNIT PRICE	TOTAL PRICE
i	Level transmitter	---	1 unit		---
j	On-Off Valve	---	1 unit		---
k	PDCV	---	1 unit		---
l	PCV	---	1 unit		---
4.	<b><u>Pre-Commissioning, Commissioning Supervision</u></b>				
a	Per diem for Commissioning activities for seal gas skid at site inclusive of Travel, boarding, lodging, and local conveyance.		Per diem		---
5.	<b>Total Price for Evaluation {1+2}</b>				

Notes:

- i. The word 'TYPE' means the Make, Model no., Type, Range, Size/ Length, Rating, Material as applicable.
- ii. The individual prices for the spares and optional items above are valid for one year to order as and when the requirement arises.
- iii. Any additional requirements which are essential for proper functioning of the dry gas seal system but not indicated in specification are included in the offer.
- iv. BHEL will inform applicability of Optional items before commercial bid opening.

**Vendor's signature & seal**

Ref.  
Doc.

FIRST ANGLE PROJECTION

(ALL DIMENSIONS ARE IN mm)

4CM43000922

DRG. NO.

SH.1 OF 7

LEGEND:

S: SUCTION

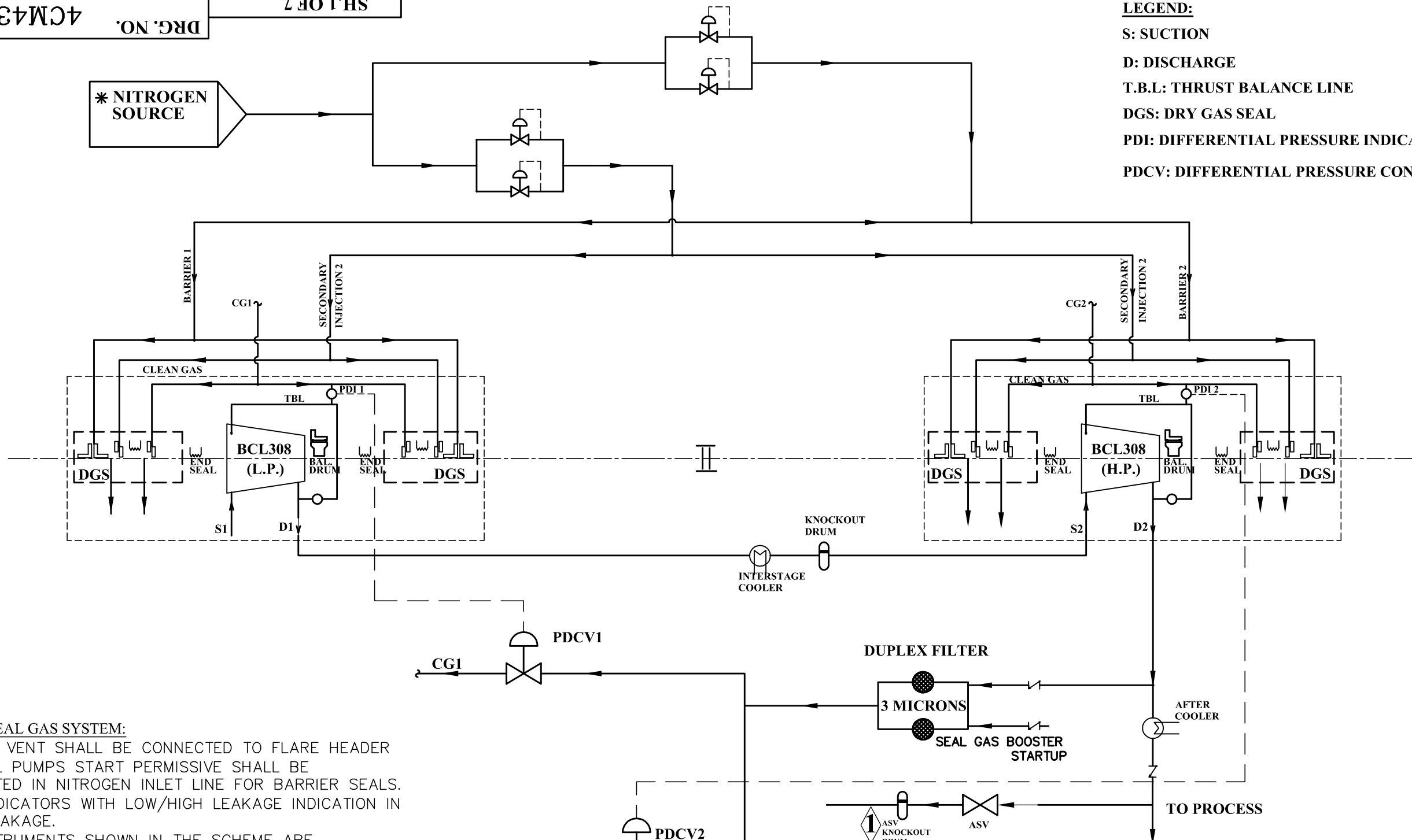
D: DISCHARGE

T.B.L: THRUST BALANCE LINE

DGS: DRY GAS SEAL

PDI: DIFFERENTIAL PRESSURE INDICATOR

PDCV: DIFFERENTIAL PRESSURE CONTROL VALVE



NOTE FOR SEAL GAS SYSTEM:

- 1) PRIMARY VENT SHALL BE CONNECTED TO FLARE HEADER
- 2) LUBE OIL PUMPS START PERMISSIVE SHALL BE INCORPORATED IN NITROGEN INLET LINE FOR BARRIER SEALS.
- 3) FLOW INDICATORS WITH LOW/HIGH LEAKAGE INDICATION IN PRIMARY LEAKAGE.
- 4) THE INSTRUMENTS SHOWN IN THE SCHEME ARE NECESSARY. OTHER NECESSARY INSTRUMENTATION FOR PROTECTION AND CONTROLS SHALL BE SUITABLY ADDED WHEREVER REQUIRED AS PER STANDARD PRACTICE AND JOB SPECIFIC REQUIREMENTS COOLER AND SEPERATOR SHOWN ABOVE.
- 5) THE BRANCH OFF LINES TO INDIVIDUAL SEALS AFTER DPCV SHALL BE EQUAL IN LENGTH

\* As per Site utility data.

GENERAL DIMENSIONAL LIMITS, FITS & TOLERANCES AS PER HY0230261

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SIGN. AND DATE REF. DRG. NO.

INVENTORY NO

TYPE OF PRODUCT OR NAME OF CUSTOMER/PROJECT M/s IOCL GUJARAT SYN GAS DUMMAD BCL 308 (LP) + BCL 308 (HP)

	BHARAT HEAVY ELECTRICALS LTD.		NAME	SIGN.	DATE	NO.OF VAR.
	HYDERABAD		DRN.	RNR	20.05.21	
			CHD.	NEMA	20.05.21	
		APPD.	YVRL	20.05.21	-N.A.-	

DEPT. COMPR. CODE 420	UNTOL. DIMS. GR. -C/M/T-		SCALE N.T.S	WEIGHT (KG) -N.A.-	REF. TO ASSY. DRG. -N.A.-	ITEM NO. -N.A.-	NO.OF ITEMS -N.A.-
-----------------------	--------------------------	--	-------------	--------------------	---------------------------	-----------------	--------------------

TITLE SEALING SCHEME		CARD CODE N.A.	DRAWING NO. 4CM43000922	REV. 02
		SHT. No 1	NO. OF SHT. 7	

REV.	DATE	ALTERED	REV.	DATE	ALTERED RNR	REV.	DATE	ALTERED RNR
		CHD/APPD	02	04.10.21	CHD/APPD YVRL	01	04.06.21	CHD/APPD YVRL
ZONE			ZONE		Sheet 5 is revised	ZONE		Anti surge KOD placed after ASV

4CM43000922

DRG. NO.

SH.2 OF 7

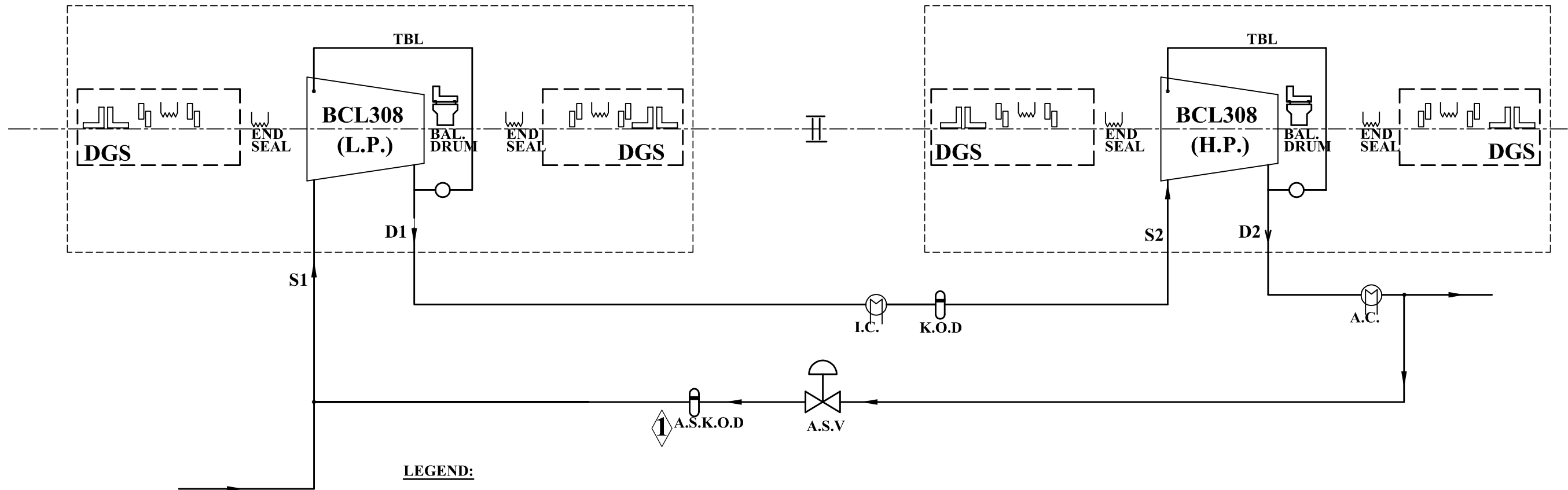
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COMPUTER FILE NAME

SIGN. AND DATE REF. DRG. NO.

INVENTORY NO

GENERAL DIMENSIONAL LIMITS, FITS & TOLERANCES AS PER HY0230261



**LEGEND:**

- S1: FIRST SUCTION
- D1: FIRST DISCHARGE
- S2: SECOND SUCTION
- D2: SECOND DISCHARGE
- T.B.L.: THRUST BALANCE LINE
- A.S.V: ANTI SURGE VALVE
- A.S.K.O.D: ANTI SURGE KNOCKOUT DRUM
- I.C. : INTERSTAGE COOLER
- A.C.: AFTER COOLER
- K.O.D: KNOCK OUT DRUM

TYPE OF PRODUCT OR M/s IOCL GUJARAT SYN GAS DUMMAD  
 NAME OF CUSTOMER/PROJECT BCL 308 (LP) + BCL 308 (HP)

	BHARAT HEAVY ELECTRICALS LTD.		NAME	SIGN.	DATE	NO.OF VAR.
	HYDERABAD		DRN.	RNR	20.05.21	
			CHD.	NEMA	20.05.21	
		APPD.	YVRL		20.05.21	-N.A.-

DEPT. COMPR.	UNTOL. DIMS. GR. -C/M/F-		SCALE	WEIGHT (KG)	REF. TO ASSY. DRG.	ITEM NO.	NO.OF ITEMS
420			N.T.S	-N.A.-	-N.A.-	-N.A.-	-N.A.-

TITLE		CARD CODE	DRAWING NO.	REV.
PROCESS FLOW SCHEME		N.A.	4CM4300092	02
		SHT. No	2	NO. OF SHT.
				7

REV.	DATE	ALTERED	REV.	DATE	ALTERED RNR	REV.	DATE	ALTERED RNR
		CHD/APPD	02	04.10.21	CHD/APPD YVRL	01	04.06.21	CHD/APPD YVRL
ZONE			ZONE		Sheet 5 is revised	ZONE		Anti surge KOD placed after ASV



MASS BALANCE DATA

OPERATING CONDITION	FLANGE	Average Mol Wt	Pressure kg/cm2(a)	Temp °C	Flow Kg/s	Flow Am <sup>3</sup> /hr	Surge Flow Am <sup>3</sup> /hr	Kv	Z	Viscosity @ 0°C (N-s/m <sup>2</sup> )	Flow in TBL* Kg/s
										Correction Factor	
RATED	S1	8.629	11.92	45.00	2.0860	1977.30	1479	1.410	1.004	1.39E-05	0.0330
	D1		17.74	96.30		1546.50		1.411	1.006	0.687	
	S2	8.629	17.44	40.00	2.0860	1333.10	938	1.416	1.006	1.39E-05	0.0480
	D2		25.83	91.52		1051.40		1.419	1.010	0.687	
NORMAL	S1	8.629	11.99	45.00	1.8140	1709.30	1365	1.410	1.004	1.39E-05	0.0330
	D1		17.81	95.75		1337.40		1.411	1.006	0.687	
	S2	8.629	17.51	40.00	1.8140	1154.40	891	1.416	1.006	1.39E-05	0.0480
	D2		25.74	90.64		915.40		1.419	1.009	0.687	
80%_RATED	S1	8.629	11.92	45.00	1.6690	1581.90	1342	1.410	1.004	1.39E-05	0.0330
	D1		17.80	96.64		1234.00		1.411	1.006	0.687	
	S2	8.629	17.50	40.00	1.6690	1062.70	883	1.416	1.006	1.39E-05	0.0480
	D2		25.81	91.59		842.00		1.419	1.010	0.687	
RAT_MINMW	S1	8.502	11.92	45.00	2.0020	1926.30	1461	1.410	1.004	1.39E-05	0.0330
	D1		17.74	96.17		1506.10		1.411	1.006	0.687	
	S2	8.502	17.44	40.00	2.0020	1298.70	934	1.416	1.006	1.39E-05	0.0480
	D2		25.79	91.30		1025.20		1.419	1.010	0.687	
RAT_MAXMW	S1	10.500	11.92	45.00	2.5380	1974.70	1431	1.392	1.003	1.32E-05	0.0370
	D1		17.68	94.33		1541.80		1.389	1.005	0.698	
	S2	10.500	17.38	40.00	2.5380	1334.90	888	1.398	1.004	1.32E-05	0.0540
	D2		25.80	89.89		1046.40		1.397	1.008	0.698	

OPERATING CONDITION	FLANGE	Average Mol Wt	Pressure kg/cm2(a)	Temp °C	Flow Kg/s	Flow Am <sup>3</sup> /hr	Surge Flow Am <sup>3</sup> /hr	Kv	Z	Viscosity @ 0°C (N-s/m <sup>2</sup> )	Flow in TBL* Kg/s
										Correction Factor	
NOR_MINMW	S1	8.502	11.99	45.00	1.7870	1709.30	1372	1.410	1.004	1.39E-05	0.0330
	D1		17.82	95.82		1337.00		1.411	1.006	0.687	
	S2	8.502	17.52	40.00	1.7870	1153.90	896	1.416	1.006	1.39E-05	0.0480
	D2		25.75	90.71		914.90		1.419	1.010	0.687	
NOR_MAXMW	S1	10.500	11.99	45.00	2.2070	1707.10	1300	1.392	1.003	1.32E-05	0.0370
	D1		17.78	93.52		1330.00		1.389	1.005	0.698	
	S2	10.500	17.48	40.00	2.2070	1154.10	835	1.398	1.004	1.32E-05	0.0530
	D2		25.75	88.62		908.40		1.397	1.008	0.698	
RATED_DOL	S1	8.629	11.92	45.00	2.0860	1977.30	1479	1.410	1.004	1.39E-05	0.0330
	D1		17.74	96.30		1546.50		1.411	1.006	0.687	
	S2	8.629	17.44	40.00	2.0860	1333.10	938	1.416	1.006	1.39E-05	0.0480
	D2		25.83	91.52		1051.40		1.419	1.010	0.687	

**Notes:**

- For Gas composition, pl refer to the enclosed sheet "Gas Composition" in page 6.
- The Suction nozzle is 6"600# & Discharge nozzle is 6" 600# for both LP & HP Compressors
- Anti Surge Valve is from 2nd discharge to 1st Suction.  
 The Guarantee Condition is **"NORMAL"**.  
 The Anti Surge Valve shall be sized for this operating condition.  
 Suitability for other conditons shall be checked.
- \*Thrust balancing line leakages are at suction pressure and discharge temperature.

**DATA FOR FILTER SIZING**

OPERATING CONDITION	NORMAL	RATED	80%_Rated	RATED_MIN MOL WT	RATED_MAX MOL WT	NORMAL_MIN MOL WT	NORMAL_MA X MOL WT	DOL
Gas	SYN GAS	SYN GAS	SYN GAS	SYN GAS	SYN GAS	SYN GAS	SYN GAS	SYN GAS
Mol. wt.	8.630	8.630	8.630	8.500	10.500	8.500	10.500	8.630
Pr. in the Seal gas line upstream of filter (Kg/cm2-g)	<b>24.73</b>	<b>24.81</b>	<b>24.81</b>	<b>24.81</b>	<b>24.81</b>	<b>24.73</b>	<b>24.73</b>	<b>24.81</b>
Temp in Seal gas Line upstream of filter (°C)	91.00	92.00	92.00	91.00	90.00	91.00	89.00	92.00
Clean gas pressure (down stream of PDCV1) (Kg/cm2-g)	17.30	17.20	17.30	17.20	17.20	17.30	17.30	17.20
Clean gas temperature (down stream of PDCV1) (°C)	91.00	92.00	92.00	91.00	90.00	91.00	89.00	92.00
Clean gas pressure (down stream of PDCV2) (Kg/cm2-g)	25.23	25.31	25.31	25.31	25.31	25.23	25.23	25.31
Clean gas temperature (down stream of PDCV2) (°C)	91.00	92.00	92.00	91.00	90.00	91.00	89.00	92.00
Shaft speed (rpm)	11829	<b>12270</b>	11733	12250	11401	<b>11906</b>	<b>10918</b>	<b>12270</b>
Total clean gas leaking into Compr. through end labyrinth seals (both ends) Downstream of DPCV1 (into BCL 308-LP)	Nor Kg/hr	93	93	93	92	103	93	93
	Nor Am <sup>3</sup> /hr	27	27	27	27	24	27	27
	Max Kg/hr	140	139	139	139	154	139	139
	Max Am <sup>3</sup> /hr	40	40	40	41	36	40	36
Total clean gas leaking into Compr. through end labyrinth seals (both ends) Downstream of DPCV2 (into BCL 308-HP)	Nor Kg/hr	112	112	112	111	141	112	112
	Nor Am <sup>3</sup> /hr	22	22	22	23	18	23	22
	Max Kg/hr	169	168	168	167	211	167	168
	Max Am <sup>3</sup> /hr	34	34	33	34	27	34	30
Total clean gas leaking into both compressors(LP + HP)	Max Kg/hr	309	307	307	306	365	306	342

**Total kg/hr (max.) to be handled by the filter:**

**Notes:**

- The gas viscosity and properties are as indicated in the antisurge line data.
- Gas composition is as per the enclosed sheets
- The filter shall be sized for the Guarantee condition "NORMAL" and shall be checked for suitability of all other operating conditions mentioned above. The maximum flow indicated above includes the primary seal gas required for Recycle Gas Compressor during start up.
- The clean gas pressure shall be normally maintained 0.3 to 0.5 ata above Thrust Balance Line Pressure .
- The filter shall be designed to withstand a pressure of 31.3 kg/cm2-g & a maximum operating temp of 150°C.
- Seal Gas Booster will be used for startup.



**GAS COMPOSITION**

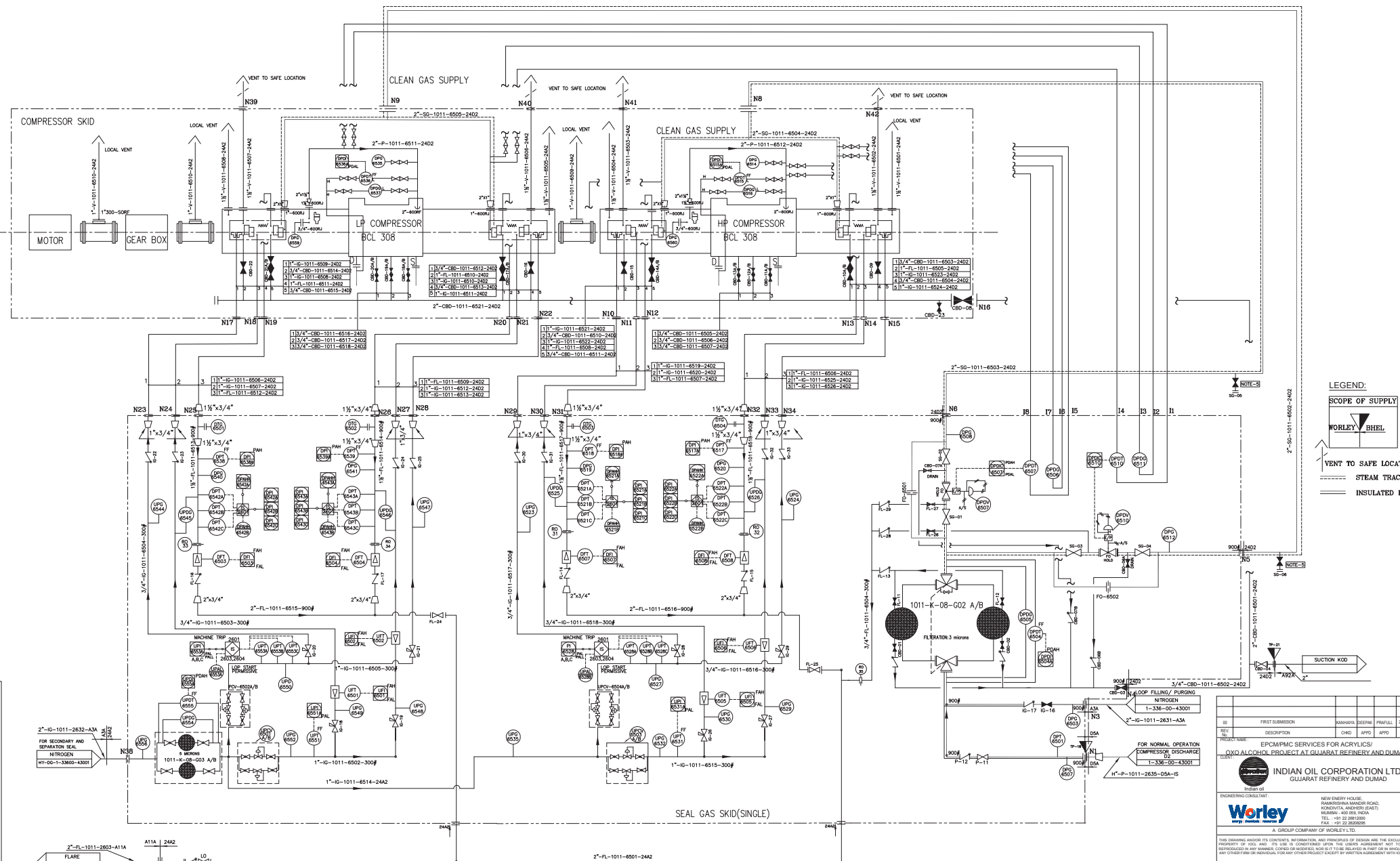
GAS ANALYSIS:		NORMAL	RATED	80%_RATE D	RATED MIN MOL WT	RATED MAX MOL WT	NORMAL MIN MW	NORMAL MAX MW	DOL
MOL %	MW								
ARGON	39.95								
OXYGEN	32.000								
NITROGEN	28.016	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
WATER VAPOR	18.016	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.81
CARBON MONOXIDE	28.010	24.55	24.55	24.55	24.06	24.55	24.06	24.55	24.55
CARBON DIOXIDE	44.010	50 ppm	50 ppm	50 ppm	50 ppm	50 ppm	50 ppm	50 ppm	50 ppm
HYDROGEN SULFIDE	34.076								
HYDROGEN	2.016	73.93	73.93	73.93	74.42	60.59	74.42	60.59	73.93
METHANE	16.042	0.69	0.69	0.69	0.69	14.03	0.69	14.03	0.69
ETHYLENE	28.052								
ETHANE	30.068								
PROPYLENE	42.078								
PROPANE	44.094								
I-BUTANE	58.120								
n-BUTANE	58.120								
I-PENTANE	72.146								
n-PENTANE	72.146								
HEXANE PLUS (AVG MW)									
OTHERS									
TOTAL		100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
AVG. MOL. WT.		8.63	8.63	8.63	8.50	10.50	8.50	10.50	8.63

	Initial Start up with operating conditions		Startup from settle out	
	LP (BCL 308)	HP (BCL 308)	LP (BCL 308)	HP (BCL 308)
Flow (kg/hr)	10	12	16	16
Gas available pressure kg/cm2a	11.99	17.5	19	19
Gas pressure required at seal (kg/cm2a) ( <b>Note 3</b> )	11.9926	17.5026	19.00360	19.00360

## Note:

1. Process Gas from compressor discharge (make-up) will be used as primary seal gas during normal operation.
2. Booster will be used during normal startup / startup from settleout condition and also during settle out condition.
3. Pressure required at dry gas seal is indicated. Request to consider dry gas seal skid drop while sizing the booster.
4. Settle out pressure considered 18 kg/cm2-g

# ANNEXURE-1



**LEGEND:**

- SCOPE OF SUPPLY
- WORLEY BHEL
- VENT TO SAFE LOCATION
- STEAM TRACING
- INSULATED LINE

**REFERENCE DRAWINGS:**

- 1. LUBE OIL P&I DIAGRAM : HY-00-0-336-00-40002
- 2. PROCESS GAS P&I DIAGRAM : HY-00-1-336-00-40901

**NOTES:**

1. ALL INSTRUMENT TAG NO'S SHALL BE PREFIXED WITH UNIT NO."
2. ALL LOCK AND LOP MOUNTED INSTRUMENTS ARE IN BHEL SCOPE OF SUPPLY.
3. FOR INTERLOCK TABLE, REFER ---
4. ALL THE PRESSURE INSTRUMENTS SHALL HAVE A PROCESS CONNECTION OF 3/4" SW GATE VALVE. THE TEMPERATURE INSTRUMENTS SHALL HAVE A PROCESS CONNECTION OF 1/2" 300F RP.
5. A 3/4" DRAIN CONNECTION WITH VALVE TO BE PROVIDED AT THE LOWEST POINT IN THE PIPING. IN ALL THE PRIMARY, SECONDARY AND BARRIER SEAL GAS SUPPLY LINES TO THE COMPRESSOR SKID.
6. SINGLE SEAL GAS SKID IS PROVIDED AS OF NOW. ACTUAL NUMBER OF SKID SHALL BE FINALIZED AFTER SEAL SKID PO PLACEMENT.

NO	DESCRIPTION	DATE	BY	CHKD	APPD	DATE
01	FIRST DEDICATION	22.05.2021	KANWALYA	DEEPAK	PRAFULL	22.05.2021
02	DESIGN/ISSUE					
03	FOR APPROVAL					
04	FOR APPROVAL					

PROJECT NAME: EPC/M&M SERVICES FOR ACRYLICS/OXO ALCOHOL PROJECT AT GUJARAT REFINERY AND DUMAD

CLIENT: INDIAN OIL CORPORATION LTD. GUJARAT REFINERY AND DUMAD

ENGINEERING CONSULTANT: Worley

NEW ENERGY HOUSE, BANARASINDRA BANGSAR ROAD, BANARASINDRA BANGSAR (SECTOR) MUMBAI - 400 084 INDIA. TEL: +91 22 26100001 FAX: +91 22 26100005

CONTRACTOR DOCUMENT NO: HY-DG-1-33600-33002.

FILE NO:	44ACB100	DRAWING NO:	44ACB100-BHEL-1051-P-01-0002-A1	SHEET:	1 OF 1	REV:	0
DATE:	28.MAY.20	REVISED:	XXXX-XXXX	SCALE:	1:100	TITLE:	SEAL GAS SYSTEM


NO	DATE	BY	CHKD	APPD	DATE
01	28.MAY.20	KANWALYA	DEEPAK	PRAFULL	28.05.20
02	28.MAY.20	KANWALYA	DEEPAK	PRAFULL	28.05.20

TITLE: PIPING & INSTRUMENT DIAGRAM

SEAL GAS SYSTEM

GENERAL DIMENSIONAL LIMITS/FITS & TOLERANCES AS PER HY023/026/1

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Fc R T m ev D- N . 1 7 0 o . 6 -		<b>PRODUCT STANDARD</b> <b>TURBINES AND COMPRESSORS</b> <b>HYDERABAD</b>			<b>TC-55450</b>
					REV No.: <b>03</b>
					Page 1 of 32
<b><u>SPECIFICATION FOR DRY GAS SEAL SKIDS FOR CENTRIFUGAL COMPRESSORS</u></b>					
<p><b>1. Scope</b></p> <p>This specification covers the minimum requirements of design, detail engineering, fabrication and supply of completely assembled Gas Seal Control System (with impulse piping, tubing and wiring) for a Centrifugal Gas Compressor consisting of (a) Seal Gas Filter Skid &amp; (b) Seal Gas Control Skid compatible with Dry gas seals. The detail of the different operating cases, Gas composition, ambient conditions and design parameters of the different lines, etc are furnished in the project specific DGS specification which is a part of this enquiry.</p>					
<p><b>2. Brief description of Seal Gas Filter Skid and Seal Gas Control Skid for Centrifugal Compressor:</b></p> <p>2.1 The Vendors minimum Scope of Supply and Work shall be as indicated below.</p> <p style="color: red;">a) <del>Seal Gas P&amp;I Diagram as per Variant Table 4 of this specification.</del></p> <p>b) Latest edition of API 614.</p> <p style="color: red;">c) <del>List of Instruments, make &amp; model as per Table 1 of this specification.</del></p> <p>2.2 The scope of supply shall include the following for each compressor:</p> <ol style="list-style-type: none"> <li>1) Seal Gas Filter Skid</li> <li>2) Seal Gas Control Skid</li> <li>3) Mating flanges with gaskets, bolts and nuts at terminal points</li> <li>4) Spare filter cartridges – 05 sets (Each set consists of number of cartridges required for one Filter Bowl).</li> <li>5) Loose supplied items like:             <ol style="list-style-type: none"> <li>i. Interconnection pipes and fittings between both assemblies.</li> <li>ii. Loose cable glands.</li> <li>iii. Foundation bolts and accessories</li> <li>iv. Instruments not mounted on the skids, etc.</li> <li>v. Any other item in Vendor's scope but not assembled on the skids</li> </ol> </li> </ol> <p>2.3 The function of the system is: -</p> <ul style="list-style-type: none"> <li>- To supply and monitor process gas/ Nitrogen/ other gas, as applicable for primary injection to dry gas seals.</li> <li>- To supply and monitor Nitrogen/ start up gas for purging</li> <li>- To supply and monitor Inert gas (Nitrogen) for Secondary seals</li> <li>- To supply and monitor Inert gas (Nitrogen)/ Instrument Air for barrier seals</li> <li>- To monitor primary gas leakage and initiate Alarms/Shutdown in response to variation in leakage.</li> </ul>					
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Ref. Doc	C	COMP. FILE	FILE NAME		
TC55450.		DOC			
Rev. No.	Revisions	Prepared	Approved	Date	
03	Refer to record of revisions	RAM	VVS	17/09/2010	

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- 2.4 The project specific P&I diagram shall be provided after the placement of the order during the detailed engineering. The availability of the gas for start up in primary injection line and barrier seal shall be finalized as per P&I diagram.
- 2.5 The total design and selection of the equipment of Seal gas filter skid and seal gas control skid is the responsibility of the Vendor. The ranges and set values of the Instruments are to be furnished by Seal Gas Control Skid & Seal gas filter skid Vendor for BHEL/Customer's review during detailed engineering after the placement of the order.
- 2.6 The primary seal gas line within filter skid shall be steam traced and insulated. All Piping, Valves and fittings forming a part of steam tracing shall be IBR certified. The steam parameters shall be provided during detailed engineering.

**3. General arrangement of the skid Assemblies**

- 3.1 Gas Seal Control System shall be designed as two Package Units: - a) Seal Gas control skid and b) Seal Gas filter skid. Each skid shall be stand-alone type and shall be formed out of suitable structural steel. ~~A common skid shall be supplied in place of individual skids at a) and b) above, whenever indicated in the enquiry.~~
- 3.2 Equipments, Instruments, Regulators, Shut off ball valves, Modulating valves, Isolating valves, In-line check valves, Piping/Tubing with fittings, etc. shall be mounted and assembled on the respective skid.
- 3.3 All the materials in contact with primary seal gas inlet and vent shall be of SS 316L or Equivalent forging/casting materials and suitable for the gas composition specified in Dry Gas Seal specification. Also ,they shall comply with NACE-MR-01-75 latest edition
- 3.4 All the materials in secondary seal inlet and vent lines, barrier seal inlet and vent lines shall be of ~~SS316~~ or Equivalent forging/casting materials.
- 3.5 Vendor to ensure that the Primary seal leakage to flare header lines along with the instruments shall be designed for the design parameters of seal gas lines up to NRV.
- 3.6 ~~Vendor to provide the condensing pot as per design code ASME VIII div I as required along with control system instrumentation for automatic draining as part of scope of supply, for variants as per Table-4. Also, vendor to check the requirement and indicate in their offer for other variants in case of the following instances.~~
  - a) The gas passes through various elements in the system and shall be mixed with Hydrocarbons, which may become condensed on cooling. The vendor to provide suitable arrangement, if required to keep dryness in the gas in all operating conditions and removal of condensate as required for seals. Vendor to provide DEW point curve for our review along with the offer.
- 3.7 Whenever, the condensate pot is provided, the level transmitter shall be provided by selecting either of the following options which shall be selected after the placement of the order.
  - a) Guided wave radar type instrument shall be used for level measurement up to 1219 mm. For all level measurement above 1219 mm diaphragm seal type differential



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pressure transmitter shall be used. The Guided wave radar type level transmitter shall be with flange size and rating suitable for the design pressure of the system.

b) The level transmitter using remote diaphragm sealed DP transmitter shall be with 3" flange size and rating suitable for the design pressure of the system. The suitable flushing rings along with drain & vent valves shall be provided.

3.8 Whenever, the condensate pot is provided, the following shall be provided.

a) A solenoid valve operated drain control valve with proximity type limit switches designed for the condensate/oil flow envisaged for the project.

b) A level transmitter specified in 3.7 above.

c) A level gauge for local indication.

3.9 The Vendor shall note that the appearance engineering is one of the most important aspects. The whole Rack shall be very compact and shall give an aesthetically good look as this equipment is mounted on the operating floor of the compressor.

3.10 The Vendor shall take care of good accessibility for operation and maintenance of all parts. The Instruments and Components disposition /location on the rack and Piping/Tubing layout are paramount important aspect.

3.11 External paint shall be with the thickness 80-150 microns and internal paint shall be with the thickness 40-60 microns. The project specific painting specification, if applicable shall be provided during detailed engineering; vendor to carry out the same without any commercial implication.

3.12 The Skids shall be provided with lifting lugs for a 4-point lift.

3.13 Foundation holes shall be oval in shape to help in installation.

**4. Seal Gas Duplex Filter (Coalescing)**

4.1 The Duplex gas Filter shall be **coalescing** type as per design code ASME VIII div I, consisting of two filter bowls mounted in parallel with a change over valve. Each filter bowl is 100 % capacity. Clean Process gas is supplied to primary seal through a Duplex Filter with required filtration grade for liquids and solids as required for DGS.

4.2 The collapsible pressure for the cartridge is min. 10 kg/cm2 (g) differential.

4.3 The Gas Pressure to Primary Seal is maintained 0.5 kg/cm2 (g) more than Operating Gas by means of differential pressure controller and control valve.

4.4 While finalising the capacity (Flow) of Duplex Filter assembly, the maximum leakage through the labyrinth into the compressor and the primary seal leakage indicated in DGS specification shall be taken into account along with required margins.

4.5 The changeover valve is used for switching over from one filter bowl during operation so that one filter open to operating gas flow and other closed off for changing filter elements. There shall not be any reduction of flow during switching over operation. Arrows shall be provided on filter assembly to indicate the filter in operation. The change over valve shall be of Trans flow type. Double stage change over valve is preferred.

4.6 The filters shall be provided with drain and vent connections with valves.



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4.7 Filtration grade:

- a) Solids: Beta 75(98.7% efficient) on 2 microns or greater.
- b) Liquids : Beta 75(98.7% efficient) on 1 microns or greater.

**5. Piping**

5.1 The ~~Pipe sizes~~ and terminal points shall be as per the Seal Gas P&ID ~~indicated in variant table-4.~~

5.2 The exact pipe size and terminal points shall be finalised as per the project specific P&I diagram provided during detailed Engineering after the placement of order.

5.3 Vendor shall supply the companion flanges, gaskets, O-rings, Stud nuts, etc. for all flanged end connections.

5.4 All piping and other items shall be as described below

Item	For rating upto #300	For rating upto #600	For rating #900 & # 1500
Pipe Schedule	Schedule 80 S	Schedule 80 S	Schedule 160 S
Flanges & 2" Valves	# 300 RF	# 600 RTJ	#900RTJ & #1500RTJ as applicable
Fittings & Valves upto 1½"	SW # 3000 rating	SW # 3000 rating	BW # Sch 160
Fittings for 2"	BW # Sch 80	BW # Sch 80	BW # Sch 160
SS Piping/ Tubing for instruments and control valve	<del>½" piping (schedule 80S) / 12.7x2.1 mm thk Tubing for primary seal inlet and vent lines</del> ( Please refer Table 4 and Material code for requirement of Piping / Tubing against this enquiry)		<del>¾" piping (schedule 160S) for primary seal inlet and vent lines</del>
	12.7mm x 2.1mm thk for Secondary & Barrier seal lines		
	6mm x 1mm thk for pneumatic line for control valve		

5.5 Materials shall be as described below. PMI to be done for all materials, fittings & weld materials.

Item	Seal gas inlet & vent upto flare	Sec.seal inlet & vent	Barrier seal inlet & vent
Pipes and tubes	SS 316L	SS 316	SS316
Flanges & Valves	SS 316L	SS 316	SS316
Fittings	SS 316L	SS 316	SS316
Manifolds	SS 316L	SS 316	SS316
Filters	SS 316L	SS 316	SS316

5.6 The dimension of all fittings shall be as per ASME/ANSI standard.

5.7 In general, the following type of valves shall be provided.

- a) For piping root valves Globe valves shall be used.



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- b) For isolation, gate valves shall be used
  - c) For equalisation and bypass, globe valves shall be used
  - d) For instrument air, Ball valves shall be used
  - e) For throttling in secondary and barrier seal lines, needle/globe valves shall be used.
- 5.8 All Butt-welded joints shall be TIG welded and the welds shall be 100% radio graphed.
- 5.9 Vent/ Drain/ Any header shall be bigger in size than the individual lines connected to it.
- 5.10 Supports shall be provided for all items inclusive of pipelines/ tubing/instruments.
- 5.11 All lines shall be cleaned in order to remove all dust, rust, slag, and all other foreign particles from internal and external parts.
- 5.12 All the vent/ drain holes, if any shall be plugged with threaded plugs/caps.
- 5.13 All the instruments shall be provided with individual root isolating valves. The double valves shall be provided for all high-pressure (pressures more than 40 ata) isolation, equalization, vent & drains.
- 5.14 Design pressure **at 170° C** of all piping, valves, fittings, instruments, filters shall be as described below

Item	For #300 rating	For #600 rating	For rating #900 & # 1500
Primary seal inlet and vent lines	<b>30 Kg/cm<sup>2</sup>(g)</b>	<b>60 Kg/cm<sup>2</sup> (g)</b>	<b>90 Kg/cm<sup>2</sup> (g) for #900 &amp; 152 Kg/cm<sup>2</sup>(g) for #1500</b>
Secondary & Barrier seal lines	20 Kg/cm <sup>2</sup> (g)	20 Kg/cm <sup>2</sup> (g)	20 Kg/sq.cm(g)

**5.15 Hydro test pressures for seal gas filter skid and seal gas control skid shall be carried out with water after the instrument dismounting and isolation of tubing line. After the test the piping should be blown with air. The hydraulic pressure is as follows:**

Item	For #300 rating	For #600 rating	For rating #900 & # 1500
<b>Primary seal inlet and vent lines</b>	<b>60 Kg/sq.cm(g)</b>	<b>120 Kg/sq.cm(g)</b>	<b>180 Kg/cm<sup>2</sup> (g) for #900&amp; 300 Kg/cm<sup>2</sup>(g) for #1500</b>
<b>Secondary &amp; Barrier seal lines</b>	<b>30 Kg/sq.cm(g)</b>	<b>30 Kg/sq.cm(g)</b>	<b>30 Kg/sq.cm(g)</b>

- 5.16 The items used for Seal gas inlet & vent upto flare, the following shall be strictly followed
- a) All austenitic stainless steel grades shall be solution annealed after welding.
  - b) Ferrite No. Test: For all austenitic stainless steels, the weld deposit shall be checked for ferrite content. Ferrite No. (FN) not less than 3% and not more than 10% is required to avoid sigma phase embrittlement during heat treatment. FN shall be determined by Ferrite scope prior to post weld heat treatment.

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- c) All girth welded joints (longitudinal and circumferential) shall be 100% radiographed in accordance with UW-51 of ASME Section VIII, Div-1 and ASME Section V.
- d) VALVES:
  - i. All valve castings shall be of radiographic quality.
  - ii. All cast valve flanges & bodies with flange rating of Class 1500 shall be examined in accordance with paragraphs 7.2 through 7.5 of Appendix-7 of ASME SEC-VIII, DIV.1, regardless of casting quality factor.
  - iii. Body / bonnet / cover joints & stuffing box of all valves shall have low emission and shall be helium leak tested as per ASME Sec.V, Subsection A, Article 10 (Detector Probe Technique), Appendix IV at a minimum of 25% of the allowable (rated) cold working pressure. Sampling for helium leak Test shall be one valve selected at random for each item of the material requisition. The failure of helium leak test shall call for testing of remaining valves of that item at vendor's cost. The valve shall show no leakage. No leakage is defined as a total leakage rate of less than 0.0001 ml/s of helium. Test Duration shall be 12 Minutes
  - iv. Casting and test bar shall be heat treated together. Valve casting shall be in solution heat treated and pickled condition.
  - v. Critical body and bonnet casing section typically defined by ASME B16.34 shall be radiographed and shall meet ASTM E446 (upto 2" thick) Category A,B & CA Level 2, Category CB, OC & CD Level 3, Category D,B & F Level 0. For wall thickness 2" to 4.5" comparable plates of ASTM E186 shall be used. ASTM E94 and ASTM E142 shall be used for recommended practice & controlling quality of radiography as guide. The entire surface of all castings shall be dye-penetrant inspected after pickling.
  - vi. Repair welds shall be 100% radiographed and evaluated in accordance with paragraph 344.5 of ASME B31.3 with a minimum casting quality factor of 0.95. Dye Penetration test shall be as per ASTM E165 Procedure B-2, Interpretation as per Appendix-8 of ASME-VIII Div.1.

**6. Instrumentation**

- 6.1 The detailed technical specifications of Instruments, Filter Regulators, Valves, Junction Boxes and other equipment shall be furnished by the vendor.
- 6.2 All instruments & junction boxes shall be weather proof to IP-65 and shall be certified suitable for use in intrinsic safe circuit and explosion proof for area classification IEC Zone-1, Gr. IIA, IIB and IIC, T3 certified by a statutory body.
- 6.3 All Instruments shall have internal terminal blocks of anti-vibration type for cable termination suitable for terminating a minimum of 1.5sq.mm size cable conductors. Flying Leads are not acceptable.
- 6.4 All the instruments shall have Proven Track Record of 8000 hours of successful uninterrupted operation.

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- 6.5 ~~All the instruments and quantity shall be as specified in Table 1. The project specific requirements shall be finalised after the order placement. All the instruments shall be of Smart type and compatible to Hart communication until and unless specified otherwise.~~
- 6.6 ~~In some specific projects as indicated in variants of table-4,~~ the transmitters connected to DCS shall be of Foundation field bus type. The instruments and their accessories like field bus cables, connectors, junction boxes, etc shall be supplied compatible for FF Bus.(FNICO/FISCO)
- 6.7 Vendor to confirm compliance for the sub-vendors indicated as per Table-1. For the items, which are not covered in the list or vendors are not indicated, **vendor has to procure from their standard sub-vendors**
- 6.8 Vendor shall confirm that the bill of material furnished along with offer is only indicative and the final BOM, which shall be furnished during detailed Engineering (after order placement) for the approval of BHEL. The additional items, if any required for complying BHEL specification at later stage or for the satisfactory working of the seals shall be supplied by vendor without any price/delivery implications.
- 6.9 The body of the control valves shall be as per Piping Material Specification and as a minimum trim shall be with stellinging.
- 6.10 The vendor shall furnish the following test certificates for the instruments
  - a) Calibration/ test certificates
  - b) Material test certificates
  - c) Sub-vendor conformity certificates.
  - d) Third part statutory certificates
- 6.11 Vendor shall submit necessary statutory body certificates for the instruments & Junction Boxes, cable glands, etc from the following statutory authorities.
  - a) BIS (Bureau of Indian Standards)
  - b) CIMFR, Dhanbad
  - c) Petroleum and Explosives Safety Organization (PESO), Nagpur India (earlier CCOE)
 Please note that the above are mandatory for all flame proof instruments of Indian origin.
- 6.12 Vendor shall submit necessary statutory body certificates for the instruments & Junction Boxes, cable glands, etc from Petroleum and Explosives Safety Organization (PESO), Nagpur India (earlier CCOE) in addition to the certificates from the country of origin for all flame proof items of foreign origin.
- 6.13 All the Device Description (DD) and common file format (CFF) files for all HART and FF instruments shall be supplied in CD/DVD for configuration.
- 6.14 The earth connections of all electrical components shall be brought to common bar for further connection to earth pit at site.
- 6.15 Electrical Junction Box shall be with LM-6 body, 2Nos of Outlet Connections of 1½" NPT at bottom and 12nos of Inlets of size ½" NPT. All inlets and outlets shall be complete with double compression cable glands. Blanking plugs shall be provided for all spare inlets/outlets. Material of cable gland shall be Nickel plated Brass material with PVC hood.

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Cable glands, JB's and blanking plug shall be suitable for area Classification IEC Zone 1, Gas ~~IA, IB~~ and IIC "EExd" type Cable OD for outlet gland shall be furnished during detailed engineering. Telephone sockets and plugs shall be provided in JB. External paint shade Light Blue Shade 101 as per IS 5.

6.16 Signal cable shall be as follows:

- 6.16.1. Single pair 7 stranded/ 0.53 mm dia (1.5 mm<sup>2</sup>) annealed tinned copper conductors of electrolytic grade copper, PVC insulated.
- 6.16.2. FRLS type, armoured and of 1100V grade and shall meet insulation resistance, voltage and spark test requirements as per BS 5308 part-2.
- 6.16.3. Conductors as per BS6360
- 6.16.4. Pr. Insulation: Fire retardant (FR) shall be as per standard IEC 60332. Shall have mica insulation and shall be as per IEC-331 CAT –A type. Primary insulation and inner jacket of polyethylene with maximum capacitance of 80 pf/m.
- 6.16.5. Conductor DC resistance at 20° C : ≤ 12.3 ohms / km ; Inductance : ≤ 0.9 μ H /Km between conductors at 1000 HZ; Capacitance ≤ 0.06 μ F / Km between conductors at 1000 Hz; Insulation resistance 100 M ohm / Km.
- 6.16.6. Color coding: Core insulation: Black & Blue; Inner Jacket: Black; Outer Jacket: Light blue for intrinsically safe application and black for others.

6.17 Spur cable between FF instruments and FF JB shall be Type A as per IEC61158 part2.

**7. Instrument Installation Standards**

- 7.1 The Pressure & DP Gauges shall be grouped as per operational requirement and mounted on the Gauge Board in the front side of the Skids.
- 7.2 All the instruments mounted on the skids shall be installed as per hook up diagrams (to be furnished during the detailed engineering). Based on these, Vendor shall develop & submit a tag number wise installation Standard (hook up) directory for all the instruments supplied/ mounted in the skids based on the above diagrams for BHEL/Customer approval.
- 7.3 The tubing for Control valves (from air filter regulator, I/P converter and control valve) shall be of stainless steel tubing and the same is in vendor's scope.
- 7.4 Integral manifolds shall be used if hook up is envisaged as tubing. Integral manifolds shall be used in piping hook-ups for 300#.**
- 7.5 If hook up is specified as "piping" in the variant table-4, the piping hookup with welded joints shall be considered for primary seal gas inlet and vent lines. Installation of impulse lines shall be as per piping class.
- 7.6 Tubing for impulse line to instruments shall be made of SS 316L (for primary seal gas inlet and vent) or SS316 (for secondary seal inlet and vent, barrier seal inlet and vent) tube with double compression fittings of "Swagelok"/"Parker" make and of material SS 316L (for primary seal gas inlet and vent) or SS316 (for secondary seal inlet and vent, barrier seal inlet and vent).
- 7.7 Instead of union; flange to be used in all impulse pipes and tubes irrespective of class.

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- 7.8 For pipe class 600# and above, the impulse piping shall be as per pipe class. In these cases no integral type manifold shall be used. 2-valve or 3-valve manifold shall be fabricated with gate valve and pipe. Equalization with globe valve only. Closed coupled installation shall be considered for high viscous services or hydrocarbons containing water for flow/pressure transmitter. The size (NB) of impulse pipe shall be ¾" for corrosive/congealing and high pressure services to avoid frequent chocking.
- 7.9 For pipe class below 600#, the impulse piping shall be as per pipe class. However small portion of tubing from impulse line to transmitter shall be made of tube with double compression fittings of "Swagelok"/"Parker" make. In those cases the tube material shall be suitable for that process fluid condition. In these cases the transmitter with integral manifold shall be used.
- 7.10 Bypass line with isolation valves must be provided for inline instruments like Rotameters, Integral orifice, Control/On-Off valves.
- 7.11 For impulse line with viscous / congealing services a tee off with blind flange shall be provided for cleaning purpose near to first isolation valve.
- 7.12 All the transmitters shall have horizontal impulse entry to have easy interchangeability.
- 7.13 The double valves (2 valves in series) shall be provided for all high-pressure (pressures more than 40 ata) isolation, vent & drain application.

**7.14 The instruments shall not be mounted directly on its hook-up. The instruments shall first be mounted on gauge board / 2" pipe and then the hook-up shall be connected.**

**8. Electrical Installation**

- 8.1 Junction boxes shall be weather proof to IP-65 and shall be certified suitable for use in intrinsic safe circuit and explosion proof for area classification IEC Zone-1, Gr. IIA, IIB and IIC, T3 certified by a statutory body, as specified in cause no 6.12.
- 8.2 Separate Junction box shall be provided for the following signals and grouping of instruments shall be carried out accordingly.
  - a) Analog Signals for DCS
  - b) Analog Signals for PLC
  - c) Field Bus Signals
  - d) Proximity signals
  - e) Digital signals
  - f) Solenoid valves
  - g) Intrinsic/Explosion proof signals
- 8.3 Field bus junction boxes (FNICO/ FISCO/HPT).
  - a) Junction boxes shall be provided with wiring/ termination blocks.
  - b) Each Fieldbus junction box shall contain wiring terminal blocks for two Fieldbus segments. Wiring / termination block for each segment shall have four spur connections. However vendor shall use only three spur connections and one shall be kept as spare for future connection.



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- c) In each Fieldbus segment, only one close loop can be connected (if applicable), remaining spur connection in the segment can be used for open loop.
- d) Wiring/ termination blocks shall have built-in short circuit protectors.
- e) Vendor shall provide field terminator for each segment inside Fieldbus junction box.
- f) The junction boxes shall have metallic enclosure.

8.4 Tag plates shall be provided for all the Equipment, instruments & cables. Cable tags shall be provided for both ends.

**8.5 All components (instruments, valves, cable glands, junction box etc.) shall be identified by means of a plate placed on the structure with stainless material tearing rivets. All instruments shall have a second stainless steel plate fixed to the instrument body by means of a steel wire. The junction boxes shall be equipped with a second plate fixed to its cover by means of an oil-proof adhesive (Loctite or similar). ALL THE PLATES SHALL BE MANUFACTURED AND ENGRAVED ACCORDING TO PROJECT SPECIFIC P&ID.**

8.6 Identification ferrules and lugs for termination shall be provided at junction box end and instrument end.

8.7 All the Electrical Instruments shall be neatly concealed wired and terminated in a local junction box requiring only connection to purchaser's wiring. The cable connecting the instrument to junction box shall be armoured.

8.8 Stainless Steel perforated Cable Trays shall be used for cable laying. The edges of cable trays shall be covered suitably using rubber sleeve.

8.9 The JB grouping and terminal allocation shall be as per BHEL cable schedule (provided during detailed engineering).

**8.10 Junction boxes will be installed on the side plates of the panel; the distance between the bottom of these junction boxes and the ground must be at least 800 mm and 500 mm in case of adjacent boxes.**

**8.11 Seal gas gauge board shall be equipped with n°2 earthing bosses.**

**8.12 Inside each panel a SS bar measuring 16 mm<sup>2</sup>, rectangular-sectioned shall be included for the connection of ground cables coming from the instruments or other.**

**9. The supplier shall furnish the following Documents**

9.1 Along with offer:

- a) Compliance for BHEL specification and its Annexures
- b) Signed and stamped Filled up check-list (Table-2).
- c) Price Schedule as per table-5.
- d) Proven Track Record as indicated in Clause no 10.0.
- e) Dew Point Curve.

9.2 Within 2 weeks of Placement of Order/ LOI:

- a) Vendor shall visit BHEL office within one week of receipt of PO / LOI to collect the project specific information for engineering their drawings / documents.



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- b) Vendor shall submit following in 10 sets for approval for the documents as mentioned below within 2 weeks of Placement of PO /LOI:
  - i. General Arrangement drawing of Gas Seal Control System Skids giving overall dimensions. It shall show location /disposition of various equipments/Instruments on the Rack and location of customer termination connection.
  - ii. Bill of Material of all the equipments, instruments, components etc. The Bill of Material should clearly show the make and model of each component, which are subjected to BHEL/CUSTOMER approval.
  - iii. Instruments Data sheets as per ISA format.
  - iv. Filled in dry gas seal system data sheet as per API format.
  - v. Quality assurance plan.
  - vi. Spares list

- 9.3 Final Documentation: Vendor shall furnish (17 sets of hard copies for a) to c) below + 2 DVD's for all documents mentioned below)
- a) Documents mentioned 9.2 above.
  - b) Terminal wiring details of Junction Box.
  - c) Instruction, Service and Maintenance manual
  - d) Test and Inspection reports : 3 copies
  - e) Guarantee Certificates : 3 copies
  - f) Photographs for all views : 2 sets (In DVD, the digital photos shall be provided).

**10. Acceptance Criteria**

- 10.1 The offered Dry Gas Seal system skids (Control system and filter) shall be proven and validly similar to the specified operating parameters, process gas service, pressures and configuration as compared to at least TWO UNITS designed, manufactured, tested and supplied from the proposed manufacturing plant and at least one of these units shall have been successfully operated in the field for at least 8000 hours of continuous operation without any major overhaul as on the date of issue of enquiry.
- 10.2 Vendor shall furnish complete reference list / details (Proven track record) along with the offer. These details shall include Plant name, year of commissioning, number of operating hours completed and name of contact person(s) etc. for the skids similar to one being offered.

**11. Inspection and Tests**

All the equipments shall be subject to inspection and witness tests by BHEL/CUSTOMER/CONSULTANT. The schedule of quality checks shall be furnished by the vendor in the quality plan which is subject to the approval of customer/consultant/ BHEL. The minimum shall be as indicated in clause 12.0 below and Table-3 Quality Plan.



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**12. Material tests for filter and Changeover Valve for Duplex Filter (as a minimum)**

	Type of Check and Test	Certificate Designation	Type of Inspection
12.1	Chemical Analysis	Mills Certificates	Verification of test report certificates by Lloyds
12.2	Mechanical Tests	Certified check by manufacturer	- do -
12.3	Non destructive Tests (as per manufacturer's standard)	- do -	- do -
12.4	Hydrostatic Test (Filter Housing and valve body)	Witness	Lloyds
12.5	Degree of filtration (filter element)	Certificate from manufacturer	Verification of test report certificates by Lloyds

**13. Marking and Shipping**

**13.1 Name plates**

The Individual components shall be provided with Nameplates giving important details like make, model etc. Each component shall be provided with stainless steel Tag plates duly punching Tag Nos. as applicable on it.

**13.2 Preparation for Shipment**

- a) Equipment shall be suitably prepared for shipment. The preparation shall make the equipment suitable for 6 months of outdoor storage from the date of shipment.
- b) Each assembly shall be marked with details like, drawing no, job number, PO No. etc. at a convenient location.
- c) Exterior carbon Steel surfaces shall be given at least two coats of Epoxy paint.
- d) Flanges openings shall be provided with metal closures.
- e) Pipe union openings shall be suitably closed with Swagelok (or Parker) fittings.
- f) Lifting Points and lifting lugs shall be clearly identified.
- g) All Loose supplied items like interconnection pipe and fittings between both assemblies, loose cable glands, spare filter cartridges, foundation bolts, etc., which are in Vendor's scope shall be listed out separately in the packing list.
- h) Adequate amount of silica gel or equivalent shall be provided in the box before despatch for the removal of moisture till installation.
- i) All safety instructions for storage and handling shall be indicated on external surface of the box.

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**14. Guarantee**

The Gas Seal Control System Skids and each component of the unit shall be guaranteed for 24 months of trouble free performance from the date of shipment or 18 months from the date of commissioning whichever is earlier

**15. Bids**

Technical bids and Price bids are to be submitted in separate sealed covers. Un-priced copy of the price bid shall be furnished along with Technical bid.

**16. Services:**

Vendor shall provide services of their engineers for commissioning of Gas Seal Systems at site for 7 working days per compressor train

**17. Training:**

Vendor shall at no extra cost to the purchaser, undertake to train 4 engineers selected by the purchaser for a period of 5 working days at BHEL Hyderabad or Vendors works or site

**18. SPECIAL NOTES**

- 18.1 Vendor should bring out in his offer clause wise deviations if any, with respect to proposed supply along with price adder for withdrawing the deviation to comply with specification. Failure to highlight the same will be construed as acceptance on the part of the vendor to meet the requirement of this specification totally.**
- 18.2 Vendor shall provide the relevant technical information and supporting documents whenever asked for by the customer/ consultant.**
- 18.3 Vendor to clearly bring out any additional requirements which are essential for proper functioning of the dry gas seal system. This shall be included in the offer.**

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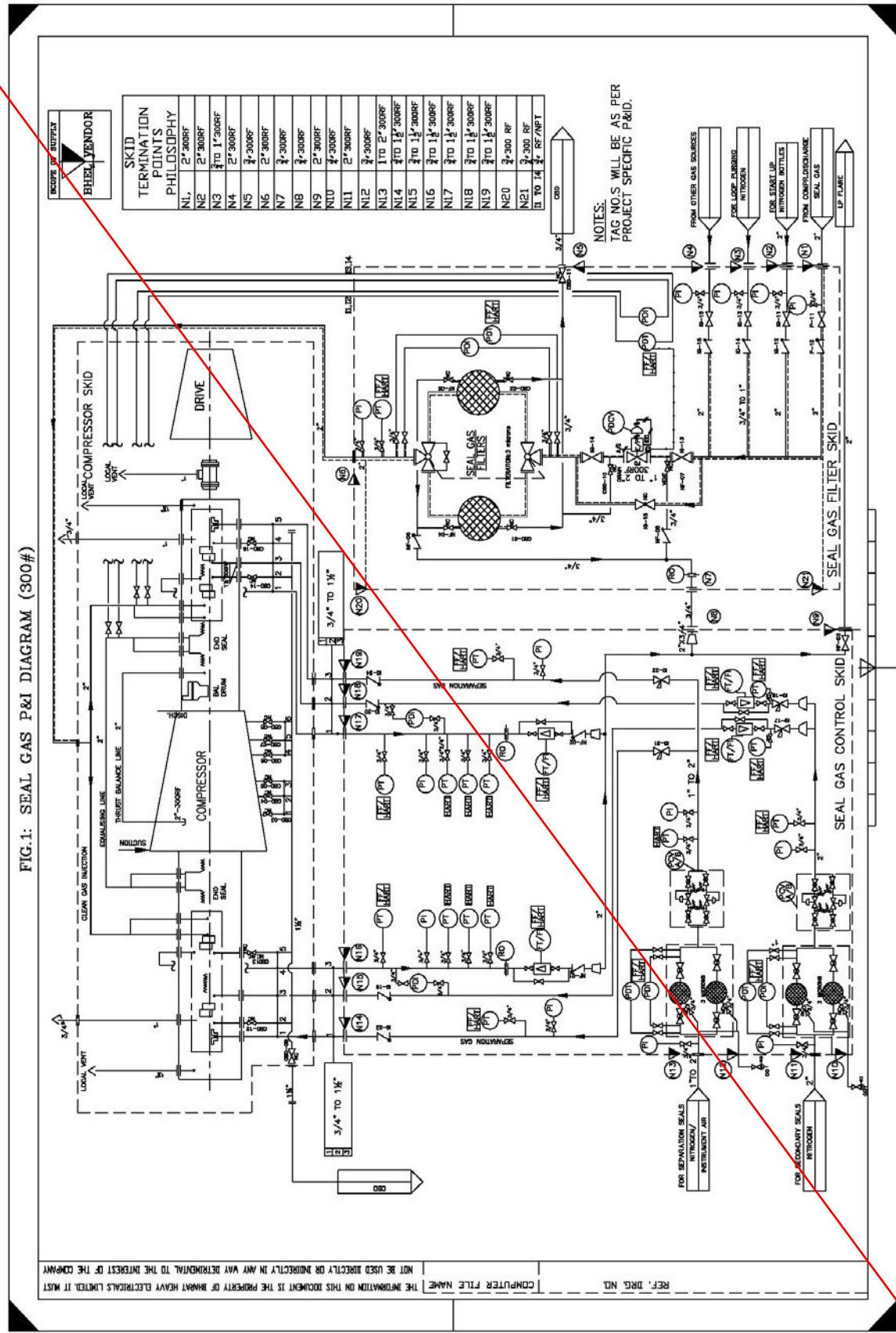
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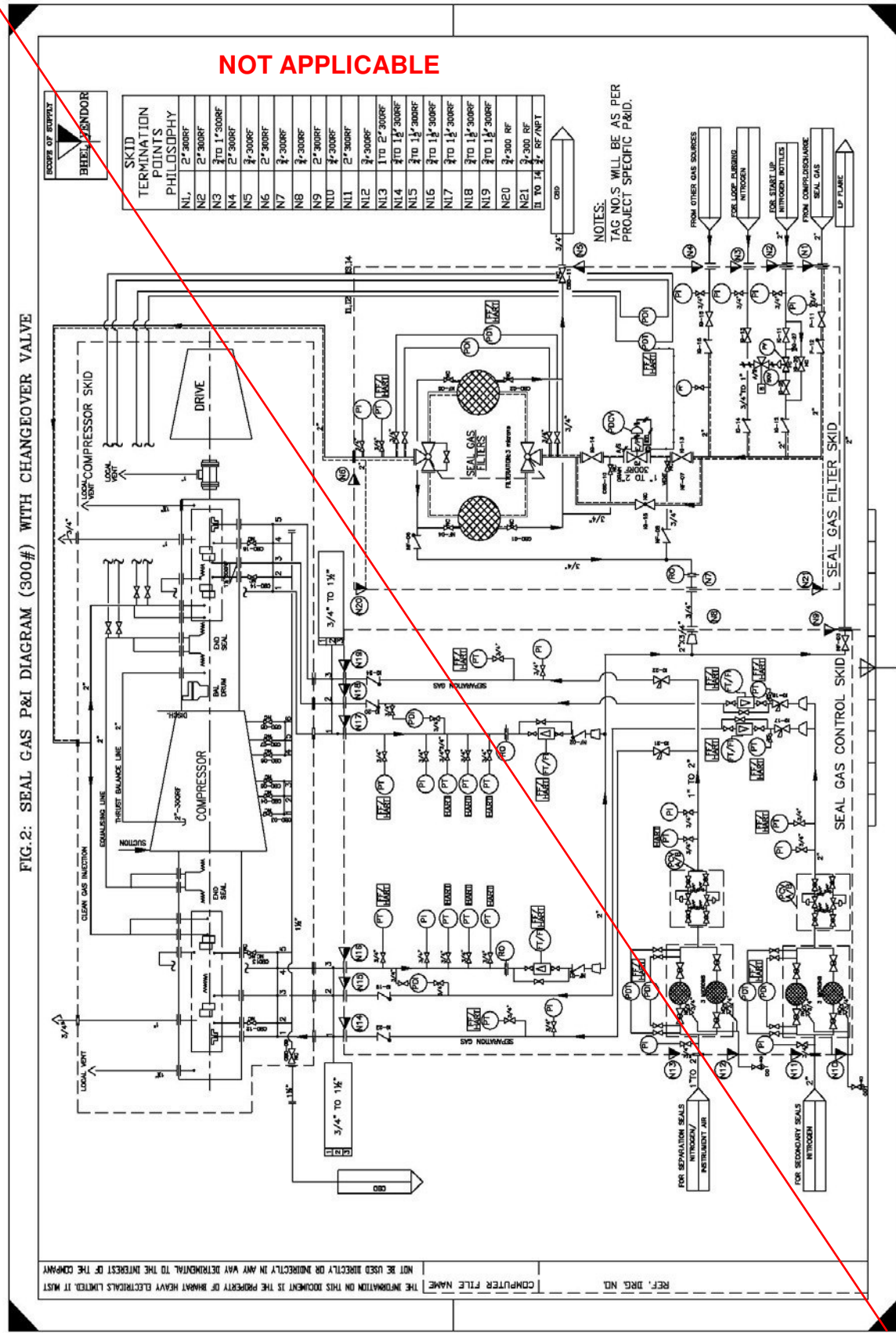
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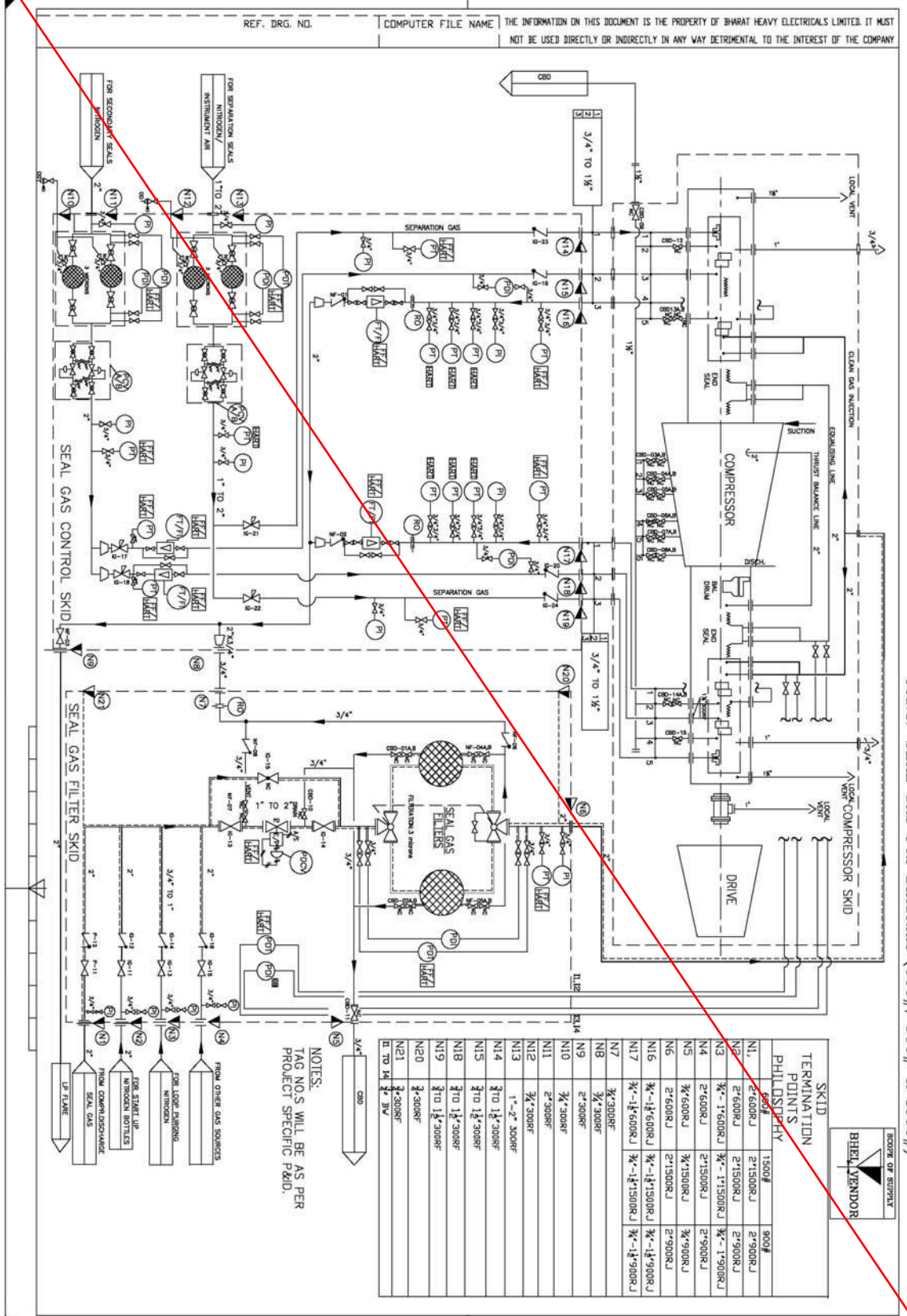


FIG. 3: SEAL GAS P&I DIAGRAM (600#, 900# & 1500#)

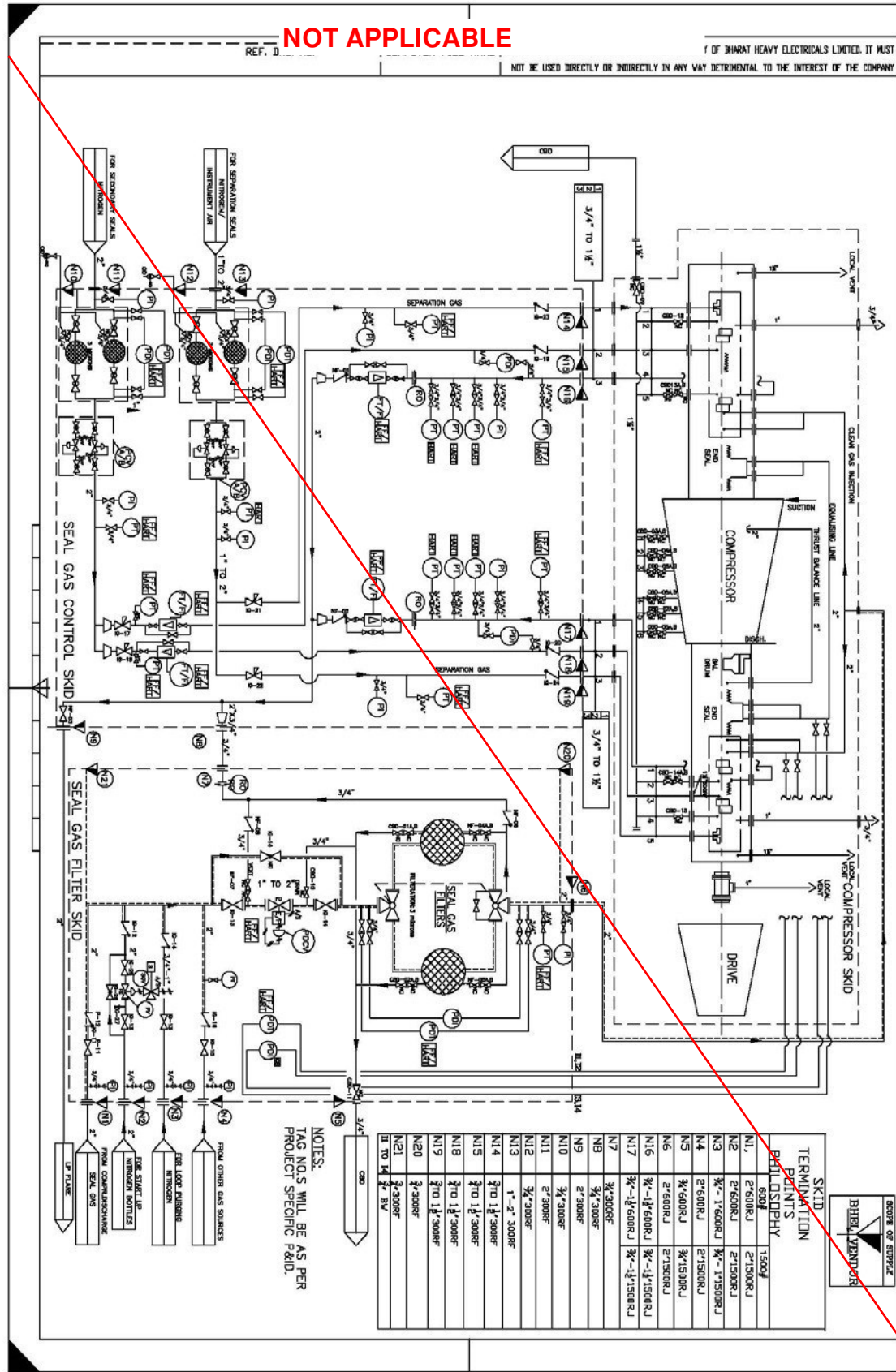


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NOTES:  
TAG NOS WILL BE AS PER PROJECT SPECIFIC P&ID.

TERMINATION POINTS	SKID
N1	2" 600R J 1500#
N2	2" 600R J 271500R J
N3	3/4" 1600R J 271500R J
N4	2" 600R J 271500R J
N5	3/4" 600R J 3/4" 1500R J
N6	2" 600R J 271500R J
N7	3/4" 1600R J 3/4" 1500R J
N8	3/4" 300R F
N9	2" 300R F
N10	3/4" 300R F
N11	2" 300R F
N12	3/4" 300R F
N13	1" - 2" 300R F
N14	3/4" to 1 1/2" 300R F
N15	3/4" to 1 1/2" 300R F
N18	3/4" to 1 1/2" 300R F
N19	3/4" to 1 1/2" 300R F
N20	3/4" 300R F
N21	3/4" 300R F
N22	1" to 1 1/2" 300R F

FIG. 4: SEAL GAS P&ID DIAGRAM (600# & 1500#)



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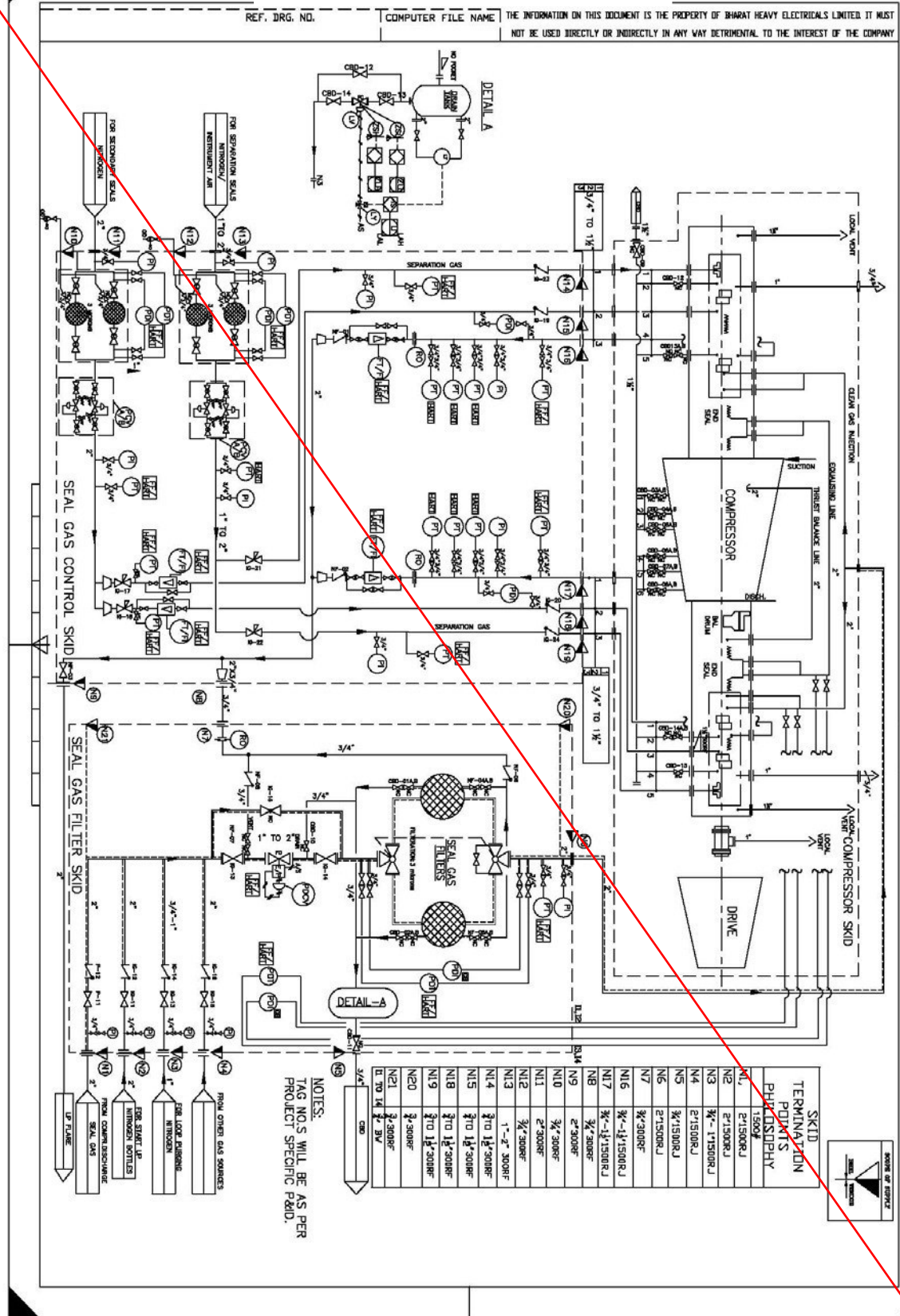


FIG.5: SEAL GAS P&ID DIAGRAM (1500#) WITH DRAIN ARRANGEMENT





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**Table 1: Technical Specifications of Instruments and other components**  
(\* Vendor to furnish Information along with offer)

SL. No.	Instrument	Qty Note (2)	Minimum Specification	Vendor	Model
1	Differential Pressure Gauges	6 nos.	Differential Pressure Indicator	Switzer	109-V-E-2-6-0-S
			<b>IP66; panel mount</b>		
			Range : *		
			Dial Size : 150mm		
			Pr.Conn. : 1/4"PT-F		
			Static Pr. : 210 kg/cm2(g)		
2	Pressure Gauges	16 nos	Pressure gauge	GIC/ WIKA/ WAREE	
			<b>IP67; panel mount</b>		
			Accuracy: ± 1% of full scale		
			Range : *		
			Dial Size : 150mm		
			Pr. Connections: 1/2"NPT-M		
			Case and Bezel : All SS Construction		
			Wetted parts : *		
			Gold plating for diaphragm seal type in seal gas line		
Solid front type for seal gas line					
			Over range protection: SS316		
3	Differential Pressure Transmitters	6 nos	Smart (Hart Protocol/ FF) Transmitters	Emerson	HART model: 3051CD 3A 07A1 J B7 KD L4 M5 Q4 QT T1 DF D1 TR
			Range : *		FF model: 3051CD 3F 07 A1 J D01 B7 IE(or IA) L4 M6 Q4 T1 DF
			intrinsic safe & explosion proof IEC Zone 1, Gas IIA, B & C		
			Min Load: 600 ohms		
			All SS construction		
			Pr. Connections: 1/2"NPT-F		
			Accuracy: 0.075% of span		
			Min. Static Pr.: 210 kg/cm2(g)		
			LCD indicator		
			In built lightning & surge protection		
			Integral Manifold: SS 316L 3-way valve for DP and 2-way valve for pressure (Below 600# only. For 600# and above integral manifold not to be used) shall be included in the model number by the vendor		
			SIL certified( for HART)		
4	Pressure Transmitters	21 nos (for fig. 2 & 4)	Smart (Hart Protocol/ FF) Transmitters	Emerson	HART model: 3051CG X A 07A1 J B7 KD L4 M5 Q4 QT T1 DF D1 TR Note : X is as per range
			Range : *		
		17 nos (for fig. 1, 3 & 5)	Others same as sl.no. 3		FF(FNICO/FISCO) model: 3051CG X F 07A1 J D01 B7 IE(or IA) L4 M6 Q4 T1 DF Note : X is as per range

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				YIL	HART model: EJX XXX A E X S4 GU 2 CEB/ V1U/A /D4/A1 Note : X is as per range
					FF model: EJX XXX A F X S4 GU 2 CDB/ D4/ A / A1/ FS1 (or KS2) / LC1/ <b>D46</b> Note : XXX is as per range
5	Smart Positioner for DP control valve (sl.no 15)	1 no	Smart(Hart Protocol/ FF) Positioner with dual certification (Explosion proof and Intrinsic safe) and metallic housing  "Valve's operating signatures" in the form of hard copy and also CD along with each control valve to be supplied with smart positioner.	Metso	HART model: ND 930 X H X1 T Note : X as per requirement
					FF model: ND 930 X F X1 T Note : X as per requirement
6	Flow Meters	4 nos	Metal Tube Variable Area flow meter (with 2 electrical entries with 1 blind plug), 2 wire  SMART (HART protocol /FF )  Range : *  intrinsic safe & explosion proof IEC Zone 1, Gas IIA, B & C	Krohne	H250/RR/X/MX/EG/ESK/ EEx Note : X as per requirement
7	Guided wave radar LT for drain pot	1no.	Smart (Hart Protocol/ FF) Transmitters Pr.conn: Flanged	Emerson or E&H or Magnetrol or Krohne	
8	Diaphragm seal type LT for drain pot	1 nos	Smart (Hart Protocol/ FF) Transmitters  Range : *  Others same as sl.no. 3  Pr. Connections: 3" Flanged	Emerson	HART model: 3051CD 2A <b>02</b> A1 J S2 B7 KD L4 M5 Q4 QT T1 DF D1 TR + 1199 WDF XX A FFW 76 DA A 9 H U + 1199 MDF XX A FFW 76 DA A 9 H U Note : XX as per requirement
				YIL	FF model: 3051CD 2F <b>02</b> A1 J <b>D01</b> B7 IE(or IA) L4 M6 Q4 T1 DF + 1199 WDF XX A FFW 76 DA A 9 H U + 1199 MDF XX A FFW 76 DA A 9 H U Note : XX as per requirement
			Flush flange with spacer ring minimum SS316 with Flushing / Filling Connection (1/2"size)		Equivalent models for HART and FF
9	Magnetic level gauge for drain pot	1no.	Body matl.: SS 316L Pr.conn: 1" Flanged The maximum visible range of a single gauge shall not exceed 1470 mm	Levcon or Chemtrols or Technomatic or Krohne	



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			Ball check valve (offset design) required.		
10	Drain valve for drain pot	1no.	Smart/FF positioner as per sl.no 5 Others as per sl.no 15		
11	Change over valve in startup gas	1no.	On-off ball valve ANSI / FCI 70.2 Minimum class VI. the body as well as the actuator shall meet the testing requirements as per API 617 latest revision. Actuator: Pneumatic cylinder with spring return scotch yoke type SS, Universal type, IS or Exp.proof (as per project reqt.), Voltage (as per project reqt.) Solenoid valve : Make: Norgren or ASCO Proximity type IS SIL certified limit switches	Flowserve or IL, palghat or Koso, palghat or Tyco	
12	---	5 nos	Electrical Junction Box with LM-6 body	Baliga lighting or FCG flame proof control gears Or FCG Power Industries Or Flameproof Equipments P Limited	
13		2 nos	FF JB		FF JB Loose supply by BHEL. Vendor to make provision for mounting the same.
14	Duplex filter (Coalescing type) with change over transfer valve	1 nos	- Each filter 100% capacity with change over valve - Startup diff. Pr. : * - Max. Pr. For change over : * - Filter vessel : SS 316L - Change over valve : SS 316L	Forain Italy or Indfil Germany or Bolt & kirch, Germany; or Hydac, Germany.	
15	Pneumatically operated control valve for DP control valve	1 nos	Material of body : SS 316 L Material of Trim : * Suitable for use in IEC Zone 1, Gas IIA, and IIB & IIC area. ANSI / FCI 70.2 Minimum class IV. Noise level shall not exceed 85db. Source treatment for noise shall be by using special trims like anti-noise trims, in case noise exceeds the allowable level. Bellow seal for corrosive & toxic gases like H2S, H2 etc. Actuator: Pneumatic diaphragm/ cylinder with spring return scotch yoke type	Fisher-Sanmar or IL, Palghat or Dresser valve India Pvt Ltd.	

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16	Duplex Filter, regulator with SS housing and changeover transfer valve	2 nos.	As per system requirement	Norgren or Parker or Boll & kirch, or Hydac	
17	In line check valves		As per system requirement	Audco or BDK or ATIPL	
18	Needle valves		As per system requirement	Audco or BDK or ATIPL	
19	Instrument root & Isolation valves		As per system requirement	Audco or BDK or ATIPL	
20	Tubes, Tube fittings and manifolds		As per system requirement	Swagelok / Parker Hannifin corp.	
21	Instrument cable	As reqd	Single pair 1.5 mm2.		
22	Spur Cable for FF instr.	As reqd	Type A as per IEC 61158-2	Belden	

**Notes:**

- (1) All instrument makes shall be as per this list. Any item not covered in this list shall be from a reputed manufacturer unless otherwise specified in this specification elsewhere. For the items, which are not covered in the list or vendors not indicated, vendor has to procure from their standard sub-vendors.
- (2) If the quantity indicated above is more than the numbers required as per project specific P&I diagram, the additional quantity with ranges same as used within skid shall be supplied loose.
- (3) All the items of the same type of instrument shall be of same make.

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**Table 2: Check List**  
**(TO BE FILLED BY THE VENDOR AND SUBMITTED ALONG WITH THE OFFER WITH OUT WHICH OFFER WILL NOT BE CONSIDERED)**

Cl.no	Description	Vendor's Confirmation (Yes/No)
9.1(a)	Compliance for BHEL specification and its Annexure	
2.1	Compliance to clause no 2.1.	
3.3,3.4, 5.1,5.4 & 5.5	Compliance of materials and sizes to clause no 3.3, 3.4, 5.1, 5.4 & 5.5.	
3.6(b)	The DEW point curve enclosed along with the offer.	
6.7	Compliance for the sub-vendors list indicated as per Table-1. For the items, which are not covered in the list or vendors not indicated, <b>vendor has to procure from their standard sub-vendors.</b> Vendor to confirm compliance for the same.	
6.8	Vendor shall confirm that the bill of material furnished along with offer is only indicative and the final BOM, which shall be furnished during detailed Engineering (after order placement) for the approval of BHEL. The additional items, if any required at later stage for complying BHEL specification or for the satisfactory working of the seals shall be supplied by vendor without any price/delivery implications.	
9.1(c)	Price Schedule as per table-5 enclosed.  Also, signed filled copy of Price schedule ( without prices) enclosed with technical offer	
9.1(d)	Proven Track Record as indicated in Clause no 10.0 enclosed.	
18.3	Any additional requirements which are essential for proper functioning of the dry gas seal system included in the offer.	

**Vendor's Signature**

**Vendor's Company seal**

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**Table – 3: Quality Plan**

Sl. No.	Description	Type of check Quantum of check 100%	Ref. Documents	Type of Inspection	Agency
1	Assembly of Skids	- Location of equipment - Correctness of flow Schematics - Overall dimensions	- Approved GA drg. of Skids	Physical check	BHEL/ CUSTOMER
2	Welding (if applicable)	Type	Manufacturing drawings.	-Review of Radiograph certificate -Welding efficiency of 1	--Do--
3	Duplex Filter	- Material Certification - Hydrostatic test - Degree of filtration- Type Test	-BHEL/ CUSTOMER Specification - Approved drg./docts.	Verification of test report certificate	--Do--
4	Control Valves	- Calibration test certificate -Seat leakage test certificate -100% radiography test certificate (two shall be taken from each area to be tested) -magnetic particle test certificate -hardening test certificate -charpy test -confirmity test certificate -Material Certification - Explosion proof/ Intrinsic safe certification - Hydrostatic test - Control valve functional test	--DO--	- Verification - Review of Certificates	--Do--
5	Valves	- Material Certification - Hydrostatic test - Control valve functional test	--DO--	- Verification - Review of Certificates	--Do--
6	Pressure Gauges, Diff. Pr. Gauges,	- Make, Model - Materials Certification	--DO--	--Do--	--Do--

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	Diff. Pr. Transmitters, I/P converters, DP Switch, Pr. Switches, Junction Box, Flow meters	- Calibration certification - Explosion proof/ Intrinsic safe certification			
7	Filter regulators, Valves	- Make, Model	--Do--	--Do--	--Do--
8	Piping/Tubing	- Materials Certification	--Do--	- Review of Mills certificates	
9	Pipe fittings and swagelok type fittings	- Materials Certification	--Do--	-Verification - Review of Certificates	--Do--
10	Instrument Hook-ups	- Material Certificate	--Do--	Review of certificates	--Do--
11	Line cleaning	Compliance	--Do--	Verification	--Do--
12	Hydraulic Testing of Piping	- Leakage	-Do--	Witness	--Do--
13	HP test with Helium or Nitrogen as per API 614	- Leakage	--Do--	Witness	--Do--
14	Air Leak test for the Hydraulic tested lines	- Leakage	--Do--	Witness	--Do--
15	Name Plates	- Correctness	--Do--	Physical check	--Do--
16	Painting - Pre-Treatment, Chemical Cleaning, Degreasing De-rusting and Phosphating - Two coats of Primer and Two coats of final Paint	- Thoroughness	No Rust  Finish	Physical check  Physical check	Supplier  BHEL/CUSTOMER
17	Wiring	- Continuity	Wiring diagram	Verification	--Do--





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**Table – 4: Variant Table**

VAR NO.	DESCRIPTION	MATERIAL CODE	REMARKS
1	FILTER SKID- IOCL BARODA WGC	TC9755450017	
2	CONTROL SKID- IOCL BARODA WGC	TC9755450025	
3	FILTER SKID- BPCL-NET GAS-LP	TC9755450033	
4	CONTROL SKID- BPCL-NET GAS-LP	TC9755450041	
5	FILTER SKID- IOCL BARODA VGO	TC9755450050	
6	CONTROL SKID- IOCL BARODA VGO	TC9755450068	
7	NOT USED	NOT USED	
8	CONTROL SKID- BPCL NET GAS-HP	TC9755450084	
9	FILTER SKID- BPCL-CCR(MOTOR)	TC9755450092	
10	CONTROL SKID- BPCL-CCR(MOTOR)	TC9755450106	
11	FILTER SKID- IOCL VADODARA NHT	TC9755450114	
12	CONTROL SKID- IOCL VADODARA NHT	TC9755450122	
13	FILTER SKID- CPCL DHDT	TC9755450130	
14	CONTROL SKID- CPCL DHDT	TC9755450149	
15	FILTER SKID- GGSR-HPCL MITTAL	TC9755450157	
16	CONTROL SKID- GGSR-HPCL MITTAL	TC9755450165	
17	FILTER SKID- HMEL CCR	TC9755450173	
18	CONTROL SKID- HMEL CCR	TC9755450181	
19	FILTER SKID- HMEL DHDT	TC9755450190	
20	CONTROL SKID- HMEL DHDT	TC9755450203	
21	FILTER SKID- HMEL DCU	TC9755450211	
22	CONTROL SKID- HMEL DCU	TC9755450220	
23	FILTER SKID- ONGC TRIPURA	TC9755450238	
24	CONTROL SKID- ONGC TRIPURA	TC9755450246	
25	FILTER SKID- BRPL	TC9755450254	
26	CONTROL SKID- BRPL	TC9755450262	
27	FILTER SKID- MRPL DCU	TC9755450270	
28	CONTROL SKID- MRPL DCU	TC9755450289	
29	FILTER SKID- MRPL DHDT	TC9755450297	
30	CONTROL SKID- MRPL DHDT	TC9755450300	
31	FILTER SKID- GSFC-HP-2BCL 507	TC9755450319	As per CCI-MCA-1001-27
32	CONTROL SKID- GSFC-HP-2BCL 507	TC9755450327	As per CCI-MCA-1001-27
33	FILTER SKID- GSFC-BCL 407A	TC9755450335	As per CCI-MCA-1001-27
34	CONTROL SKID- GSFC-BCL 407A	TC9755450343	As per CCI-MCA-1001-27
35	FILTER SKID- GSFC-LP-2BCL 407A	TC9755450351	As per CCI-MCA-1001-27
36	CONTROL SKID- GSFC-LP-2BCL 407A	TC9755450360	As per CCI-MCA-1001-27

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37	FILTER SKID- MRPL CHTU	TC9755450378	Item Same as M.code: TC9755450904
38	CONTROL SKID- MRPL CHTU	TC9755450386	Item Same as M.code: TC9755450912
39	FILTER SKID- MRPL PFCCU	TC9755450394	As per CCI-MCN-1001-27
40	CONTROL SKID- MRPL PFCCU	TC9755450408	As per CCI-MCN-1001-27
41	SGS SKID- TABRIZ	TC9755450416	As per CCI-CA217-27
42	SGS SKID- SPARES- TABRIZ	TC9755450424	As per CCI-CA217-27
43	Shifted to Table-4		
44	Shifted to Table-4		
45	Shifted to Table-4		
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**Table – 4: Variant Table**

Var No	Description	Requirements	Material code	Reference P&ID
51	Seal gas Filter Skid	Rating: #300 Insts Tubing Hookup:	TC9755450513	Fig.1
52	Seal gas Control Skid	DCS Insts: HART Protocol	TC9755450521	Fig.1
53	Spares for Seal gas filter skid and control skid		TC9755450530	Fig.1
54	Seal gas Filter Skid	Rating: #300 Insts Piping Hookup:	TC9755450548	Fig.1
55	Seal gas Control Skid	DCS Insts: HART Protocol	TC9755450556	Fig.1
56	Spares for Seal gas filter skid and control skid		TC9755450564	Fig.1
57	Seal gas Filter Skid	Rating: #300 Insts Hookup: Tubing DCS Insts: HART Protocol	TC9755450572	Fig.2
58	Seal gas Control Skid	Startup Gas: With Changeover valve	TC9755450580	Fig.2
59	Spares for Seal gas filter skid and control skid		TC9755450599	Fig.2
60	Seal gas Filter Skid	Rating Insts Hookup #300 Piping DCS Insts HART Protocol	TC9755450602	Fig.2
61	Seal gas Control Skid	Startup Gas: With Changeover valve	TC9755450610	Fig.2
62	Spares for Seal gas filter skid and control skid		TC9755450629	Fig.2
63	Seal gas Filter Skid	Rating #300 Insts Hookup Tubing	TC9755450637	Fig.1
64	Seal gas Control Skid	DCS Insts FF Instruments	TC9755450645	Fig.1
65	Spares for Seal gas filter skid and control skid		TC9755450653	Fig.1
66	Seal gas Filter Skid	Rating #300 Insts Hookup Piping DCS Insts FF Instruments	TC9755450661	Fig.1
67	Seal gas Control Skid		TC9755450670	Fig.1
68	Spares for Seal gas filter skid and control skid		TC9755450688	Fig.1
69	Seal gas Filter Skid	Rating #300 Insts Hookup Tubing DCS Insts FF Instruments	TC9755450696	Fig.2
70	Seal gas Control Skid		TC9755450700	Fig.2

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71	Spares for Seal gas filter skid and control skid	Startup Gas	With Change over valve	TC9755450718	Fig.2
72	Seal gas Filter Skid	Rating Insts Hookup	#300 Piping	TC9755450726	Fig.2
73	Seal gas Control Skid	DCS Insts	FF Instruments	TC9755450734	Fig.2
74	Spares for Seal gas filter skid and control skid	Startup Gas:	With Changeover valve	TC9755450742	Fig.2
43	<b>Seal gas Filter Skid</b>	<b>Rating Insts Hookup</b>	<b>#600 Piping/Tubing</b>	<b>TC9755450432</b>	<b>Fig.3</b>
44	<b>Seal gas Control Skid</b>	<b>DCS Insts</b>	<b>HART Protocol</b>	<b>TC9755450440</b>	<b>Fig.3</b>
45	<b>Spares for Seal gas filter skid and control skid</b>			<b>TC9755450459</b>	<b>Fig.3</b>
78	Seal gas Filter Skid	Rating Insts Hookup	#600 Piping/Tubing	TC9755450785	Fig.3
79	Seal gas Control Skid	DCS Insts	FF Instruments	TC9755450793	Fig.3
80	Spares for Seal gas filter skid and control skid			TC9755450807	Fig.3
81	Seal gas Filter Skid	Rating Insts Hookup	#600 Piping/Tubing	TC9755450815	Fig.4
82	Seal gas Control Skid	DCS Insts	HART Protocol	TC9755450823	Fig.4
83	Spares for Seal gas filter skid and control skid	Startup Gas:	With Changeover valve	TC9755450831	Fig.4
84	Seal gas Filter Skid	Rating Insts Hookup	#600 Piping/Tubing	TC9755450840	Fig.4
85	Seal gas Control Skid	DCS Insts	FF Instruments	TC9755450858	Fig.4
86	Spares for Seal gas filter skid and control skid	Startup Gas:	With Changeover valve	TC9755450866	Fig.4
87	Seal gas Filter Skid	Rating Insts Hookup	#1500 Piping HART Protocol	TC9755450874	Fig.3
88	Seal gas Control Skid	DCS Insts		TC9755450882	Fig.3
89	Spares for Seal gas filter skid and control skid			TC9755450890	Fig.3

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90	Seal gas Filter Skid	Rating #1500	TC9755450904	Fig.3
91	Seal gas Control Skid	Insts Hookup Piping	TC9755450912	Fig.3
92	Spares for Seal gas filter skid and control skid	DCS Insts FF Instruments	TC9755450920	Fig.3
93	Seal gas Filter Skid	Rating #1500	TC9755450939	Fig.5
94	Seal gas Control Skid	Insts Hookup Piping	TC9755450947	Fig.5
95	Spares for Seal gas filter skid and control skid	DCS Insts HART Protocol Drain pot System	TC9755450955	Fig.5
96	Seal gas Filter Skid	Rating #1500	TC9755450963	Fig.5
97	Seal gas Control Skid	Insts Hookup Piping	TC9755450971	Fig.5
98	Spares for Seal gas filter skid and control skid	DCS Insts FF Instruments Drain Pot system	TC9755450980	Fig.5

**Table – 4-A: Variant Table**

75	Seal gas Filter Skid	Rating #900 Insts Hookup Piping/Tubing	TC9755450750	Fig.3
76	Seal gas Control Skid	DCS Insts HART Protocol	TC9755450769	Fig.3
77	Spares for Seal gas filter skid and control skid		TC9755450777	Fig.3

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**PRODUCT STANDARD**  
**TURBINES AND COMPRESSORS**  
**HYDERABAD**

**TC-55450**  
REV No.: **03**  
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**Table-5**  
**PRICE SCHEDULE**  
**SEAL GAS CONTROL SYSTEM**

Enquiry ref. No:  
Offer ref no.

Date:  
Date:

SI no.	DESCRIPTION	Qty	PRICE
01	Seal Gas Control system consists of the following	1 set	
	a) Seal Gas Filter Skid		
	b) Seal Gas control skid		
	c) Filter cartridges – 5 sets		
	d) Matting flanges & accessories for all terminal points– 1 set		
02	Seal Gas Control system Spares as per following	1 set	
	a) Pressure Gauges, Differential Pressure Gauges, level gauges-10% or min 1 no. each type.		
	b) Transmitters (both Fieldbus and SMART) for Pressure, Level, Variable area Flow & Differential Pressure-10% or min.1 no each type.		
	c) Control valve spares-10% or min 1 no. each type of the following: i. Proximity type limit switches. ii. Airfilter Regulator. iii. Solenoid valve. iv. Bonnet Gasket/Special Gasket. v. Gland packing. vi. Stem seal o-rings/Piston o-ring. vii. SMART/Fieldbus positioner. viii. Trim set. ix. Diaphragm, actuator assembly		
	d) Manifolds- 3.way and 5 way, isolation valves, instrument valves, tube fittings, check valves, filter regulators -10% or min.1 no each type.		
03	Optional offer for addition of each of the following instrument inclusive of root valves, piping, & installation materials etc.		
	a) Pressure Transmitter	1 set	
	b) DP Transmitter	1 set	
	c) Pressure Gauge	1 set	
	d) DP Gauge	1 set	
	e) Smart Positioner as per sl.no 5 of table-1	1 set	
	f) Solenoid valve.	1 set	
04	g) Variable area Flow transmitter.	1 set	
	Additional price to with draw the deviations to following clauses:		

The word "TYPE" means the make, model no, range, size/length, rating, material as applicable

**Note:**

- (1) The individual prices for the spares and optional items against sl nos 02 and 03 above are valid for one year to order as and when the requirement arises.
- (2) Any additional requirements which are essential for proper functioning of the dry gas seal system but not indicated in specification are included in the offer.

**Vendor's signature & seal**





This document i.e. CPMSL is valid for the month of November'2020

**COMMON PROJECT MASTER SUPPLIER LIST  
(CPMSL)-IOCL-2020**

**DOC. NO. : RHQ-IOCL-CPMSL-2020**

**SECTION - A    MECHANICAL EQUIPMENTS**

**SECTION - B    BULK PIPING ITEMS**

**SECTION - C    Electrical**

**SECTION - D    Instrumentation**




**Refineries Division**

**INDIAN OIL CORPORATION LIMITED**

2	31-10-2020	Common Projects Master Supplier List			
1	30-09-2020	Common Projects Master Supplier List			
0	31-08-2020	Common Projects Master Supplier List			
<b>REV</b>	<b>DATE</b>	<b>DESCRIPTION</b>	<b>PREP. BY</b>	<b>REVIEWED BY</b>	<b>APPROVED BY</b>
				KKR	CGM (PJ-Engg.)

**INDIAN OIL CORPORATION LIMITED  
REFINERY HEADQUATERS**


 IndianOil		
EQUIPMENTS AND BULK PIPING ITEMS	Doc. No.:	RHR-IOCL-MSL-2020
DOCUMENT TITLE :- COMMON PROJECT MASTER SUPPLIER LIST (CPMSL)-IOCL-2020	Rev:	2
INDIAN OIL CORPORATION LIMITED (IOCL) -REFINERIES DIVISION	Date:	31-Oct-20
GENERAL NOTES		
<p><b>A PURPOSE :</b> The Common Projects Master Supplier List (CPMSL) is a list of Vendors appropriately sub-categorized by commodity for the supply of goods and services. The document has primarily been issued to govern purchase of Project Materials for Projects executed from RHQ, DELHI.</p> <p><b>B EPCM / PMC shall ensure/review the followings prior to floating the tender enquiry :-</b></p> <p>A) Vendors which are under IOCL holiday list and IOCL Watchlist</p> <p>B) Vendor in NCLT (National Company Law Tribunal) or insolvency as published by IBBI.</p> <p>C) Statutory / Government Policy directives, etc</p> <p>D) Addition/Deletion of Vendors w.r.t workload, financial capability, manufacturing range, credentials, Stability, etc.</p> <p>E) Licensor's Recommendations.</p> <p><b>C</b> It is understood that, should the name of vendors be changed due to change in their Company or Corporate shareholding, IOCL will accept such Vendors under its new name with prior approval.</p> <p><b>D</b> The approved vendors list for fabricated equipment (Vessels, Columns, Heat Exchangers, Ejectors etc.) is for fabrication alone. Where mechanical design of the equipment is included in Vendor 's scope, EPCM/PMC shall either be responsible for approval / review of Mechanical design calculations as per codes / specifications specified elsewhere in the Bid / Contract document of purchase order.</p> <p><b>E</b> If EPCM/PMC becomes aware of any serious issues of VENDOR's / SUPPLIER's performance or financial status or any such issues of the approved MSL, it shall be intimated to IOCL with proper back-up/justification for IOCL consideration and updation in the MSL</p> <p><b>F</b> Domestic manufacturer Iron &amp; steel policy 2019 prohibits foreign sourcing of Items with HSN Codes covered under Annexure-A of the Policy</p> <p><b>G</b> As per Government notification dated 15.06.2020, No global tender will be invited for procurement of Items and Services with estimated value upto Rs 200 Cr. PMC/EPCM shall provide the list of items wherein global tendering cannot be avoided along with full justifications while finalisation of MSL or during the procurement stage so that prior approval can be taken by IOCL in advance.</p> <p><b>H</b> MSL shall include sub-ordered Major items / components also of the Main Item. PMC/EPCM shall define the major items/components in their tender and including the supplier's of the same in the tender from the IOCL MSL</p> <p><b>I</b> EPCM/PMC may request additions to the approved MSL. In such cases, it is EPCM/PMC responsibility to ensure any VENDOR proposed for addition to the list is technically qualified to carry out the required work, operates a quality system in accordance with latest ISO norms or equivalent, is financially stable, can demonstrate past satisfactory experience of similar work, has the availability of technical support and resources, satisfactory after sales and complies with necessary Secrecy Declarations, and shop loading/Capacity to complete the required scope of work. Further, EPCM / PMC shall submit the credentials of the proposed vendors. Consideration/approval of proposed alternate vendors is at the sole discretion of the IOCL.</p> <p><b>J ABBREVIATIONS</b></p> <p>OWNER : Indian Oil Corporation Limited (IOCL)</p> <p>MSL : Master Supplier List</p> <p>ECPM/PMC : Consultant for the Project</p>		

 IndianOil				
<b>INDEX SHEET : EQUIPMENTS AND BULK PIPING ITEMS</b>				RHQ-IOCL-CPMSL-2020
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<b>ITEM CATEGORY INDEX SHEET</b>				
Sr.No	ITEM	Indian Vendors	Remarks	Rev.
<b>SECTION-A : EQUIPMENTS</b>				
1	<b>STATIC EQUIPMENT</b>			
1.1	PRESSURE VESSEL -CS (UP TO 25MM)	77		
1.2	POLYMERISER REACTOR SYSTEM	1		
1.3	PRESSURE VESSEL -CS (26-50MM)	50		
1.4	PRESSURE VESSEL-CS (51-100MM)	22		
1.5	PRESSURE VESSEL-CS (>100MM)	9		
1.6	PRESSURE VESSEL-SS (UP TO 25MM)	59		
1.7	PRESSURE VESSEL-SS (FROM 26MM to 50 MM)	33		
1.8	PRESSURE VESSEL-SS ( > 50 MM)	11		
1.9	PRESSURE VESSEL -LOW ALLOY STEEL	26		
1.10	PRESSURE VESSEL – LTCS	36		
1.11	PRESSURE VESSEL-CS/LAS+SS CLAD	25		
1.12	PRESSURE VESSEL-MONEL CLADDED	13		
1.13	PRESSURE VESSEL- MONEL	4		
1.14	CYCLONES (REACTOR & REGENERATOR)	0		
1.15	DEMISTER-WIRE MESH TYPE	8		
1.16	COLUMN/TOWER CARBON STEEL	31		
1.17	COLUMN/TOWER STAINLESS STEEL	25		
1.18	COLUMN/TOWER - LOW ALLOY STEEL	12		
1.19	COLUMN/TOWER - LTCS	17		
1.20	COLUMN/TOWER-CS/LAS+SS CLADDED	18		
1.21	COLUMN - MONEL CLAD	11		
1.22	CCR PLATFORMING REACTOR	3		
1.23	REACTOR/SEPARATOR-SS CLAD 1.25 Cr 0.5 MO	6		
1.24	REACTOR/SEPARATOR-SS CLAD-2.25 Cr-1 Mo	4		
1.25	REACTOR/SEPARATOR- CLAD 2.25Cr 1Mo 0.25V	2		
1.26	COLUMN/TOWER-CS (51-100MM THK)	12		
1.27	HEAT EXCHANGER CARBON STEEL	42		
1.28	HEAT EXCHANGER-ROD AND PLATE TYPE BAFFLE	0		
1.29	HEAT EXCHANGER STAINLESS STEEL.	36		
1.30	HEAT EXCHANGER LOW ALLOY STEEL.	21		
1.31	HEAT EXCHANGER LTCS.	21		
1.32	HEAT EXCHANGER 3.5 % NI STEEL	7		
1.33	HEAT EXCHANGER-CS/LAS+SS CLAD	20		
1.34	HEAT EXCHANGER( PLATES-WELDED)	9		
1.35	HEAT EXCHANGERS (PLATE -GASKETTED)	8		
1.36	HEAT EXCHANGER NF- (BRASS, CU-Ni)	19		
1.37	AIR FIN COOLER (CS & SS)	13		
1.38	AIR FIN COOLERS (DUPLEX SS)	4		
1.39	SAMPLE COOLER	11		
1.40	CRYOGENIC VAPORIZER-DIRECT STEAM HEATED	0		
1.41	HEAT EXCHANGER (AL. BRAZED FIN TYPE)	1		
1.42	HEAT EXCH. MONEL / MONEL CLAD	6		
1.43	HEAT EXCH. NICKEL / NICKEL CLAD	3		
1.44	HEAT EXCH. HASTALLOY / HASTALLOY CLAD	4		
1.45	ELECTRIC HEATER	3		


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1.46	HEAT EXCHANGER SS-DUPLEX	15			
1.47	HEAT EXCHNAGER - ALLOY 625	7			
1.48	LOUVERS FOR AIR FIN COOLERS	1			
1.49	EJECTOR (ENGINEERED)	7			
1.50	EJECTOR (UNENGINEERED)	3			
1.51	SILENCER	8			
1.52	VACUUM EJECTOR CONDENSER SYS(ENGINEERED)	2			
1.53	VACUUM EJECTOR CONDSR SYS (UNENGINEERED)	3			
1.54	DEMISTER-VANE TYPE	5			
1.55	EXPANSION JOINT-METALLIC	6			
1.56	AIR PRE-HEATER (CAST)	1			
1.57	AIR PRE-HEATER (GLASS TUBE)	1			
1.58	BURNER-CONVENTIONAL	2			
1.59	BURNER-LOW NOx (PROCESS FIRED HEATER)	1			
1.60	BURNER-SRU	1			
1.61	AIR HEATER (DIRECT FIRED)	1			
1.62	LNG VAPORIZER	0			
1.63	TOWER PACKING: METALLIC (NON-PROPRIETARY)	6			
1.64	TOWER PCKG & ASSTD INTL: METALLIC (PROPRTRY)	4			
1.65	TOWER PKG:NON METALLIC(PROPRIETARY)	4			
1.66	TOWER PACKING: CERAMIC	8			
1.67	COLUMN TRAYS-HIGH CAPACITY	5			
1.68	NON-PROP. PACKGS WITH CONVENL INTERNALS	7			
1.69	NON-PROP PKG,HIGH QUAL DISR& INL-UN ENGIN	6			
1.70	INLET FEED DEVICE (VANE TYPE )	3			
1.71	SEPARATOR INTERNALS	5			
1.72	REACTOR INTERNAL	11			
1.73	SPRAY NOZZLE-PROCESS	9			
1.74	SPRAY NOZZLE-TORCH OIL	2			
1.75	TOWER PACKING:CARBON	3			
1.76	TOWER PACKINGS:PVC & PP(NON-PROPRIETARY)	3			
1.77	WASTE HEAT BOILERS	9			
1.78	REFRACTORY FIRE BRICKS	23			
1.79	INSULATING REFRACTORY CASTABLE	15			
1.80	SULPHUR TRAPS	0			
1.81	STORAGE TANKS, BULLETS & MOUNDED BULLETS	0			
1.82	DEAERATOR	6			
1.83	FILTER - BASKET	13			
1.84	FILTER - CARTRIDGE/CANDLE	25			
1.85	FILTER - PRESSURE	0			
1.86	FURNACE	0			
1.87	FLARE STACK COMPONENTS	4			
1.88	MAIN COMBUSTN. CHAMBR PKG(SRU)-ENGINEERED	6			
1.89	INCINERATOR PACKAGE FOR SRU	3			
1.90	FIRED HEATERS	11			
1.91	COLUMN / DRUM (SITE FABRICATED)	2			
1.92	HAIRPIN EXCHANGER	6			
1.93	SILOS	0			


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1.94	LOW FIN HEAT EXCHANGER	5			
<b>2</b>	<b>ROTARY EQUIPMENT</b>				
2.1	PUMP-CENT.HOR(GPP)	22			
2.2	PUMP-CENT.HOR(SPP)	14			
2.3	PUMP-CENT.HOR(GWS)	20			
2.4	PUMP-CENT.HOR(LCWS)	22			
2.5	PUMP-CENT.HOR.(MOLTEN SULPHUR)	2			
2.6	PUMP-CENT.VERT(GPP)	18			
2.7	PUMP-CENT.VERT. BARREL TYPE(SPP)	12			
2.8	PUMP-CENT.VERT.(GWS)	19			
2.9	PUMP-CENT.VERT(LCWS)	18			
2.10	PUMP-CENT.VERT.(MOLTEN SULPHUR)	2			
2.11	PUMP-CENT. (BFW)	17			
2.12	PUMP-CENT.SU.M(CRYO)	0			
2.13	PUMP-CENT.H/V(FW)	7			
2.14	PUMP-CENT.HOR.MULTI STAGE(SPP)	9			
2.15	PUMP-CENT. (LOW CAPACITY HIGH HEAD)	1			
2.16	PUMP-ROTARY.SCREW	12			
2.17	PUMP-ROTARY.GEAR	9			
2.18	PUMP-ROTARY.SL.VANE	3			
2.19	PUMP-ROT.SCR.ARC(ES)	3			
2.20	PUMP-ROTARY(LOBE)	4			
2.21	PUMP-SLURRY.RECIPRO	0			
2.22	PUMP-SLURRY.CENT.H/V	9			
2.23	PUMP-RECIPRO (API 674)	10			
2.24	PUMP-A.F.PROPELLER	4			
2.25	PUMP - AIR OPERATED DIAPHRAGM	5			
2.26	EDUCTOR	3			
2.27	COMP-RECIPRO(SPP)	9			
2.28	COMP-RECIPRO(PIANS)	11			
2.29	COMP-RECIPRO(DIAPHRAGM)	2			
2.30	COMP-RECIPRO(LABYRINTH)	1			
2.31	COMP. HIGH PRESSURE(PIANS)	1			
2.32	COMP-CENT.(SPP)	7			
2.33	COMP-ROT.LIQUID RING/VP(PS)	10			
2.34	COMP-ROT.LIQUID RING / VP(AS)	9			
2.35	MECH.SEAL FOR PUMPS/AGITATORS	6			
2.36	MECHANICAL SEALS (API 682 TYPE & DRY GAS SEAL)	6			
2.37	COMP-ROT.SCREW(PS)	8			
2.38	COMP-ROT.SCREW(PIAS)	6			
2.39	COMP-EXPANDER(PRO)	1			
2.40	COMP-EXPANDER(AIR)	1			
2.41	TURBINE-STEAM(GP)	9			
2.42	TURBINE-STEAM(SP)	11			
2.43	TURBINE-GAS	6			
2.44	FAN-ID/FD	16			
2.45	FAN-AXIAL FLOW	2			
2.46	BLOWER-TURBO CENTRIFUGAL	16			

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2.47	POSITIVE DISPLACEMENT PUMPS RECIPROCATING - (CONTROLLED VOLUME)	10			
2.48	AGITATOR	13			
2.49	Centrifugal Pumps - Sealless General Service	2			
2.50	Special Purpose Gear Unit	1			
2.51	ONE WAY CLUTCH	0			
2.52	FLEXIBLE METALLIC COUPLING	4			
2.53	Centrifugal Pumps - Non Metallic / Lined	6			
2.54	VACUUM PUMPS	5			
2.55	PUMP-CRITICAL TEMPERATURE COLD SERVICE	0			
3	<b>FIRE FIGHTING EQUIPMENT</b>				
3.1	FIRE EXTINGUISHERS (PORTABLE)	17			
3.2	SAFETY SHOWER & EYE WASHER	6			
3.3	CLEAN AGENT SYSTEM	12			
3.4	DELUGE VALVE AND HEAT DETECTORS	7			
3.5	HOSE DELIVERY	9			
3.6	FIRE HOSE ACCESSORIES	11			
3.7	FOAM MAKER	4			
3.8	VAPOUR SEAL CHAMBER	3			
3.9	BRANCH PIPES	11			
3.10	INLINE INDUCTORS	4			
3.11	WATER SPRINKLER	5			
3.12	FIXED FOAM SYSTEM (FOAM PACKAGE)	3			
3.13	HYDRANT/LANDING VALVE	12			
3.14	SPRAY NOZZLE- FIRE FIGHTING	4			
3.15	AUTO DCP EXTINGUISHING SYSTEM	2			
3.16	HV/MV SPRAY SYSTEMS	12			
3.17	RIM SEAL FIRE PROTECTION SYSTEM	2			
3.18	WATER MONITOR	14			
3.19	WATER CUM FOAM MONITOR	9			
3.20	LONG RANGE MONITOR	6			
3.21	REMOTE CONTROLLED MONITORS	6			
4	<b>HVAC &amp; MISCELLANEOUS</b>				
4.1	DESALTER PACKAGE (COALESCER - ELECTROSTATIC)	0			
4.2	VACUUM EJECTOR CONDENSER SYS(ENGINEERED)	2			
4.3	VACUUM EJECTOR CONDSR SYS(UNENGINEERED)	1			
4.4	DOSING PACKAGE(SKID MOUNTED)	11			
4.5	PRU (Propylene Recovery Unit) DRYER	0			
4.6	PNEUMATIC CONVEYING PACKAGE	1			
4.7	EXTRUDER / PELLETIZER PACKAGE	0			
4.8	CATALYST, ADDITIVES UNLOADING PACKAGE	0			
4.9	LOSS-IN WEIGHT FEEDER PACKAGE / SCREW CONVEYOR	0			
4.10	ROTARY FEEDER	0			
4.11	BAGGING PLANT	0			
4.12	VACUUM CLEANING SYSTEMS	0			
4.13	DRIER-AIR/G	16			
4.14	FILTER BAG TYPE	5			
4.15	PLANT & INSTRUMENT AIR COMPRESSOR PACKAGE	2			

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Sr.No	ITEM	Indian Vendors	Remarks	Rev.	
4.16	COOLING TOWER	0			
4.17	NITROGEN PLANT (CRYOGENIC)	9			
4.18	DM WATER & CONDENSATE POLISHING UNIT	4			
4.19	EFFLUENT TREATMENT PACKAGE	11			
4.20	EMERGENCY DIESEL GENERATOR	6			
4.21	CRANE-H.O.T / E.O.T / ELECTRIC HOISTS	30			
4.22	REFRIGERATION SYSTEM- VAPOUR ABSORPTION	5			
4.23	VENTILATION & PRESSURISATION SYSTEM	12			
4.24	AIR CONDITIONING SYSTEM - PACKAGE UNIT	7			
4.25	AIR CONDITIONING SYSTEM - CENTRAL	8			
4.26	CHILLER PACKAGE /CONDENSING UNIT	9			
4.27	AIR HANDLING UNIT	11			
4.28	CHEMICAL FILTER (HVAC)	4			
4.29	CENTRIFUGAL FAN (HVAC)	7			
4.30	EXHAUST AXIAL FAN (HVAC)	3			
4.31	SPLIT / WINDOW AC	11			
4.32	AIR FILTERS (HVAC)	5			
4.33	3 WAY MODULATING VALVE FOR HVAC APPLICATION	5			
4.34	FIRE DAMPER	6			
4.35	VOLUME CONTROL DAMPERS / LOUVERS	6			
4.36	GRILL / DIFFUSER FOR AIR CONDITIONING SYSTEM	8			
4.37	DAMPER ACTUATOR	4			
4.38	MODULATING DAMPER ACTUATOR	5			
4.39	G.I. SHEETS (HVAC DUCTING)	3			
4.40	REFRIGERATION SYSTEM - PROCESS	6			
4.41	ELECTRONIC WEIGH SCALE	5			
4.42	PSA HYDROGEN PLANT	2			
4.43	STATIC MIXER	7			
4.44	COALESCER	6			
4.45	FEED FLTR AUTO BACK WASH HYD.CRAKR DHDT	2			
4.46	FILTER- ROTARY	1			
4.47	FILTER-VACUUM	0			
4.48	QUICK OPENING CLOSURE(FILTER/SEPARATOR)	3			
4.49	LIFTS (PASSENGER & GOODS)	5			
4.50	LOADING/UNLOADING ARM	5			
4.51	TOWER PACKING CARBON	3			
4.52	TOWER PACKINGS;PVC&PP(NON-PROPRIETRY)	3			
4.53	SPIRAL HEAT EXCHNAGER	2			
4.54	HASTOLLOY SOLID REACTORS	3			
4.55	DUPLEX SOLID REACTORS	3			




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<b>SECTION-B : BULK PIPING ITEMS</b>					
<b>1</b>	<b>PIPING &amp; FITTINGS</b>				
1.1	NON STANDARD FORGINGS-CARBON STEEL	24			
1.2	NON STANDARD FORGINGS-ALLOY STEEL	15			
1.3	NON STANDARD FORGINGS- STAINLESS STEEL	18			
1.4	LINING (RUBBER)	10			
1.5	LINING-FRP(TANKS & VESSELS)	11			
1.6	PVDF/FRP EQUIPMENTS	8			
1.7	ROCK WOOL INSULATION PRODUCTS	14			
1.8	GLASS WOOL INSULATION PRODUCTS	1			
1.9	CALCIUM SILICATE PRODUCTS	2			
1.10	PU FOAM & POLYISOCYANURATE FOAM	3			
1.11	LINE PIPES (HELICAL SAW)	6			
1.12	LINE PIPES ERW	11			
1.13	LINE PIPES SEAMLESS	4			
1.14	LONG RADIUS BENDS	2			
1.15	FLANGE- CARBON STEEL	32			
1.16	FLANGE-ALLOY STEEL	20			
1.17	FLANGE-STAINLESS STEEL	26			
1.18	FLANGES-EXOTIC	1			
1.19	COMPACT FLANGE	0			
1.20	CLAMP CONNECTOR	0			
1.21	SIGHT FLOW INDICATORS (SIGHT GLASSES)	8			
1.22	PIPE-CARBON STEEL TO INDIAN STANDARDS	35			
1.23	PIPES & TUBULARS TO A.P.I.STANDARDS	15			
1.24	PIPE/TUBE-C S (SEAMLESS)TO ASTM STDS	14			
1.25	PIPE-CARBON STEEL(WELDED)TO ASTM STDS	6			
1.26	PIPE/TUBE- A S (SEAMLESS)TO ASTM STDS	12			
1.27	PIPE/TUBE-SS(S.LESS & WELDED)TO ASTM STD	26			
1.28	PIPE/TUBE-S.LESS(DUPLEX/SUPER DUPLEX SS)	3			
1.29	PIPE / FITTINGS -PTFE LINED	6			
1.30	PIPES -SS WELDED TO A 358	5			
1.31	DUPLEX/SUPER DUPLEX SS WELDED PIPES	0			
1.32	PIPES- INDIAN STOCKIST	22			
1.33	PIPE-CLADDED	0			
1.34	PIPE-WELDED ALLOY STEEL	2			
1.35	PIPE-PVDF/FRP	3			
1.36	PIPE-FRP	12			
1.37	PIPE-GRE	0			
1.38	PIPE-TITANIUM	0			
1.39	PIPING SYSTEM-CLAD(SHOP FABRICATED)	7			
1.40	PRE-FABRICATED PIPING SPOOL	5			
1.41	PIPING SYSTEM-GRE/GRP	1			
1.42	TUBE-WELDED CARBON STEEL	0			
1.43	TUBE-WELDED ALLOY STEEL	0			
1.44	TUBE-TITANIUM	0			

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1.45	TUBE COPPER AND ALLOYS	6		
1.46	FITTINGS-FOREIGN AGENTS/STOCKIST/TRADERS	1		
1.47	FITTING BLOCK FORGED-CARBON STEEL	16		
1.48	FITTING BLOCK FORGED-ALLOY STEEL	11		
1.49	FITTING BLOCK FORGED-STAINLESS STEEL	13		
1.50	WELDOLETS/SOCKOLETS/ELBOWLET	11		
1.51	FITTINGS BLOCK FORGED-EXOTIC MATLS.	1		
1.52	FITTINGS FROM SEAMLESS PIPE-CARBON STEEL	23		
1.53	FITTINGS FROM SEAMLESS PIPE- ALLOY STEEL	17		
1.54	FITTINGS FROM SEAMLESS PIPE- S.S.	20		
1.55	FITTINGS FROM S/LESS PIPES-EXOTIC MATLS	3		
1.56	FIITINGS CROSS-FROM SEAMLESS PIPES	2		
1.57	FITTING-GRE	0		
1.58	FITTINGS TO IS-1239	8		
1.59	FITTINGS FABRICATED FROM PLATE - C.S.	15		
1.60	FITTINGS FABRICATED FROM PLATE - A.S.	12		
1.61	FITTINGS FABRICATED FROM PLATE - S.S.	12		
1.62	FITTINGS FAB. FROM PLATES-EXOTIC MATLS.	1		




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1.63	FITTINGS PIPE CAP (C S)	18		
1.64	FITTINGS PIPE CAP (A S)	13		
1.65	FITTINGS PIPE CAP (S S)	15		
1.66	FITTINGS PIPE CAP (EXOTIC)	0		
1.67	GASKET (IMPORTED)	0		
1.68	GASKET NON-ASBESTOS	10		
1.69	GASKET METALLIC & SOFT IRON	6		
1.70	GASKET METAL JACKETED	7		
1.71	GASKET SPIRAL WOUND	12		
1.72	HOSE- RUBBER (STEAM/GAS/AIR/WATER/CHEM.)	9		
1.73	HOSE METALLIC FLEXIBLE SS	10		
1.74	FASTENERS	23		
1.75	FASTENERS: HIGH TEMPERATURE TO A 453	3		
1.76	EXPANSION JOINTS (RUBBER)	6		
1.77	SPRING SUPPORTS	10		
1.78	STRAINERS	0		
1.79	STRAINERS (FAB/CAST/FORGED)	9		
1.80	STEAM TRAPS-BUCKET/TH.DYN/TH.STAT/FLOAT	7		
1.81	COMPACT STEAM TRAPING ASSY+SS/CR MANFOLD	3		
1.82	STEAM TRAPS	6		
1.83	STEAM SUPPLY / COND. RECOVERY MANIFOLD	3		
1.84	VALVE GATE (THRU CONDUIT) (AP16D)	1		
1.85	VALVE GATE- (FOREIGN SUPPLIERS)	2		
1.86	VALVE GATE CAST	36		
1.87	VALVE GATE CRYOGENIC CAST	9		
1.88	VALVE GATE FORGED	27		
1.89	VALVE GATE CRYOGENIC FORGED	9		
1.90	VALVE GATE GUNMETAL/BRASS/BRONZE	5		
1.91	VALVE GATE (MOTOR OPERATED)	16		
1.92	VALVE KNIFE GATE	5		
1.93	VALVE GLOBE- (FOREIGN SUPPLIERS)	2		
1.94	VALVE GLOBE CAST	30		
1.95	VALVE GLOBE CRYOGENIC CAST	9		
1.96	VALVE GLOBE FORGED	26		
1.97	VALVE GLOBE CRYOGENIC FORGED	7		
1.98	VALVE GLOBE GUNMETAL/BRASS/BRONZE	4		
1.99	Y TYPE GLOBE & STOP CHECK VALVES	7		
1.100	VALVE- BLOWDOWN (Straight/Angle Pattern)	7		
1.101	VALVE CHECK- (FOREIGN SUPPLIERS)	2		
1.102	VALVE CHECK CAST	33		
1.103	VALVE CHECK CRYOGENIC CAST	8		
1.104	VALVE CHECK FORGED	27		
1.105	VALVE CHECK CRYOGENIC FORGED	4		
1.106	VALVE CHECK GUNMETAL/BRASS/BRONZE	6		
1.107	VALVE CHECK (DUAL PLATE TYPE)	9		
1.108	VALVE CHECK EXCESS FLOW	1		
1.109	VALVE-NON SLAM CHECK (NOZZLE)	2		
1.110	VALVE BALL- (FOREIGN SUPPLIERS)	3		

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1.111	VALVE BALL CRYOGENIC	3		
1.112	VALVE BALL NON FIRE SAFE-CAST CARBON STEEL	32		
1.113	VALVE BALL NON FIRE SAFE-CAST STAINLESS STEEL	26		
1.114	VALVE BALL FIRE SAFE-CCS	25		
1.115	VALVE BALL FIRE SAFE-CSS	19		
1.116	VALVE BALL - FIRE SAFE (FORGED)	10		
1.117	VALVE BALL NON FIRE SAFE-FORGED CARBON STEEL	13		
1.118	VALVE BALL NON FIRE SAFE-FORGED STAINLESS STEEL	13		
1.119	VALVE BALL JACKETED - NON FIRE SAFE	2		
1.120	VALVE BALL MULTIPORT NON FIRE SAFE	2		

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1.121	VALVE BUTTERFLY- (FOREIGN SUPPLIERS)	1			
1.122	VALVE BUTTERFLY – CAST CARBON STEEL	22			
1.123	VALVE BUTTERFLY -CAST STAINLESS STEEL	17			
1.124	VALVE BUTTERFLY -CAST ALLOY STEEL	5			
1.125	VALVE BUTTERFLY (PTFE SEATED)	9			
1.126	VALVE BELLOW SEALED	6			
1.127	VALVE-BUTTERFLY (TRIPLE OFFSET)	8			
1.128	VALVE DIAPHRAGM-(FOREIGN SUPPLIERS)	0			
1.129	VALVE DIAPHRAGM CAST CARBON STEEL	3			
1.130	VALVE DIAPHRAGM CAST STAINLESS STEEL	3			
1.131	VALVE PLUG- (FOREIGN SUPPLIERS)	0			
1.132	VALVE PLUG CONCENTRIC- CAST CARBON STEEL (F.S & N.F.S)	8			
1.133	VALVE PLUG CONCENTRIC -CAST STAINLESS STEEL (F.S & N.F.S)	5			
1.134	VALVE PLUG CONCENTRIC-CAST ALLOY STEEL (F.S. & N.F.S.)	1			
1.135	VALVE PISTON (GLANDLESS)	3			
1.136	VALVE PLUG DBB EXPANDING TYPE	1			
1.137	VALVE PLUG MULTIPOINT - NON FIRE SAFE	1			
1.138	VALVE NEEDLE	7			
1.139	VALVE DOUBLE DISC GATE	1			
1.140	VALVE SLIDE	0			
1.141	VALVE SHUT DOWN	2			
1.142	VALVE CRYOGENIC SS /LTCS	1			
1.143	VALVE SPECIAL CATEGORY	5			
1.144	VALVE TANK BOTTOM/FLUSH BOTTOM	2			
1.145	HASTELLOY PIPING COMPONENTS	11			
1.146	TITANIUM PIPING COMPONENTS	11			
1.147	LOW PRESSURE DROP BALL CHECK VALVE	0			
1.148	EXPANSION JOINT (METAL)	4			
1.149	EXPANSION JOINT (PRESSURE BALANCE)	1			
1.150	BIRD SCREEN	3			
1.151	EYE WASHER & SAFETY SHOWER	6			
1.152	INSULATING GASKET	2			
1.153	POST INDICATOR VALVES	3			
1.154	COPPER TUBING	8			
1.155	3-WAY VALVE	5			
1.156	LTCS (LOW TEMPERATURE CARBAN STEEL) FLANGE	26			




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<b>SECTION-C : ELECTRICAL</b>				
5	STATIC EQUIPMENT			
5.1	SWITCHBOARD-HV (Indoor) WITH VCB BREAKER (complete)	8		
5.2	SWITCHBOARD-MV: MCC/ASB/LDB-FIXED TYP	7		
5.3	SWITCHBOARD-M.V. : MCC/PCC/PMCC-DRAWOUT	6		
5.4	SWITCHBOARD FIXED TYPE FOR PACKAGE EQUIPTS	12		
5.5	OUTDOOR SWITCHYARD PACKAGE	11		
5.6	GIS upto 245kV (Indoor)	6		
5.7	RELAY & CONTROL PANEL	8		
5.8	PROTECTION RELAY (NUMERICAL TYPE)	8		
5.9	AUX. RELAYS	9		
5.10	BIMETAL RELAYS	6		
5.11	(BASE+ADVANCE) ELECTRIC CONTROL SYSTEM (ECS)	8		
5.12	INSTRUMENT TRANSFORMERS – CT & PT (HV)	8		
5.13	INSTRUMENT TRANSFORMERS – CT & PT (MV)	9		
5.14	CIRCUIT BREAKER SF-6 /OUT DOOR EHV	6		
5.15	VACCUM CIRCUIT BREAKERS	8		
5.16	AIR CIRCUIT BREAKER	6		
5.17	ISOLATORS / LOAD BREAK SWITCHES (HV INDOOR)	3		
5.18	CONTACTOR	7		
5.19	MCCB	6		
5.20	TIMERS	7		
5.21	PUSH BUTTON & INDICATING LAMPS (Independent supply / Retrofitting / Alteration / Modification work)	9		
5.22	MCCB (Independent supply / Retrofitting / Alteration / Modification work)	9		
5.23	HEAVY DUTY SWITCHES (Independent supply / Retrofitting / Alteration / Modification work)	4		
5.24	CONTROL SWITCHES FOR BREAKER (Independent supply / Retrofitting / Alteration / Modification work)	3		
5.25	CONTROL SWITCHES / SELECTOR SWITCHES (Independent supply / Retrofitting / Alteration / Modification work)	7		
5.26	EARTH LEAKAGE CIRCUIT BREAKER (Independent supply / Retrofitting / Alteration / Modification work)	7		
5.27	FUSES (Independent supply / Retrofitting / Alteration / Modification work)	6		
5.28	TRANSFORMERS-POWER-ABOVE 5MVA	9		
5.29	TRANSFORMERS-DISTRIBUTION-UPTO 5MVA	12		
5.30	TRANSFORMER-DISTRIBUTION (DRY TYPE)	14		
5.31	DRY TYPE LIGHTING TRANSFORMER (LV)	13		
5.32	Neutral Grounding Resistors/Transformers (NGR / NGT)	5		
5.33	BUS DUCT (HV)	10		
5.34	BUS DUCT (MV)	12		
5.35	CAPACITOR BANK (MV/HV)	10		
5.36	BATTERIES-LEAD ACID (FLOODED)	3		
5.37	BATTERY CHARGERS	8		
5.38	BATTERIES-LEAD ACID (VRLA)	5		
5.39	BATTERIES-NICKLE CADMIUM	2		
5.40	UPS SYSTEM	8		
5.41	A.C. VARIABLE SPEED DRIVE	18		
5.42	LIGHTNING ARRESTORS	6		

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5.43	EARTHING & LIGHTNING PROTECTION	4		
5.44	MOTOR-INDUCTION-HV (INDUSTRIAL. TYPE SAFE AREA, EXD/EXE)	12		
5.45	MOTOR-INDUCTION (HV INCREASED SAFETY ZN2, FLP/PRESSURIZED)	8		
5.46	MOTOR INDUCTION-MV (INDL.TYPE SAFE AREA, EXD/EXE)	9		
5.47	MOTOR-INDUCTION- MV (ZONE 2-TYPE E & N, FLP/PRESSURIZED)	8		
5.48	MOTOR-INDUCTION-MV (FLAME PROOF)	9		
5.49	SYNCHRONOUS MOTOR	7		
5.50	MOTORS - IMPORTED	0		

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5.51	SYNCHRONOUS GENERATORS (HV)	5			
5.52	DG SET / EMERGENCY GENERATORS (MV)	18			
5.53	ACTUATORS-MOV	9			
5.54	CONTROL STATIONS- WEATHERPROOF	11			
5.55	CONTROL STATIONS / PANEL-FLAME PROOF	14			
5.56	JUNCTION BOXES (FLAME PROOF)	12			
5.57	LIGHTING FIXTURE & ACCESSORIES-HAZARDOUS	15			
5.58	LIGHTING & POWER PANELS (FLP)	7			
5.59	PLUGS/SOCKETS/HANDLAMPS (FLAME PROOF)	9			
5.60	HIGH MAST LIGHTING SYSTEM	3			
5.61	LIGHTING FIXTURES (SAFE AREA)	7			
5.62	LIGHTING & POWER PANELS (SAFE AREA)	14			
5.63	EXTRA HIGH VOLTAGE –XLPE CABLES	8			
5.64	CABLES-HIGH VOLTAGE-XLPE (FRLS)	14			
5.65	MV POWER CABLE - FIRE SURVIVAL (FRLS)	9			
5.66	CABLES-MEDIUM VOLTAGE-POWER-XLPE & PVC	21			
5.67	CABLES: CONTROL-XLPE & PVC	29			
5.68	CABLES-FIRE ALARM AND COMMN.	7			
5.69	CONTROL CABLE - FIRE SURVIVAL (FRLS)	9			
5.70	CABLES COMMUNICATION (JELLY FIELD)	10			
5.71	PLANT COMMUNICATION (PA / PAGING) SYSTEM	2			
5.72	TELEPHONE (Instrument / EPABX)	10			
5.73	TETRA SYSTEM	5			
5.74	FIRE ALARM SYSTEM	8			
5.75	ELECTRICAL HEAT TRACING SYSTEM	8			
5.76	CATHODIC PROTECTION SYSTEM	10			
5.77	CABLE TRAYS GI /SS (Perforated /Ladder) & CABLE DUCTS	14			
5.78	CABLE TRAYS FRP	4			
5.79	CABLE JOINTS & TERMINATION KITS	7			
5.80	CABLE GLANDS (FOR HAZARDOUS AREA)	10			
5.81	LIGHTING POLES (GALVANISED)	3			
5.82	NIFPS (NITROGEN INJECTED FIRE PROTECTION SYSTEM)	1			
5.83	DC MOTORS	0			




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6.2	INSTRUMENT TUBING	6			
6.3	MACHINE MONITORING SYSTEMS	3			
6.4	THERMO COUPLE EXTN.CABLES	8			
6.5	SIGNAL CABLES	16			
6.6	OPTICAL FIBRE CABLE & ASSOC.ITEM	14			
6.7	FIELD BUS SIGNAL CABLES	4			
6.8	SIGNAL CABLE - FIRE RESISTANT	12			
6.9	SPECIAL LEVEL INSTRUMENTS (TUNNING FORK)	7			
6.1	COPPER TUBES (COATED, BARE)	8			
6.11	CORROSION MONITORS	4			
6.12	CONTROL VALVE POSITIONER / SMART POSITIONER	5			
6.13	SOLENOID VALVES	7			
6.14	CONTROL VALVES	19			
6.15	PRESSURE RELIEF VALVE	13			
6.16	INSTRUMENT VALVES & MANIFOLDS	21			
6.17	TANK PR. PROTECT. DEVICES / FLAME ARRESSTER	6			
6.18	ON-OFF VALVES	19			
6.19	SELF ACTUATED PR. CONTROL VALVES	10			
6.20	SPECIAL CONTROL VALVES (BUTTERFLY)	16			
6.21	DESUPERHEATERS & PRDS	16			
6.22	PR. REGULATOR & SLAM SHUT VALVES	3			
6.23	PILOT OPERATED SAFETY VALVES	10			
6.24	PROCESS STREAM ANALYSERS (O2-ZIRCONIA)	6			
6.25	GAS CHROMATOGRAPH (PROCESS)	6			
6.26	STACK GAS ANALYSER SYSTEMS (EXTRACTIVE)	8			
6.27	AMBIENT AIR ANALYSER SYSTEMS	3			
6.28	PROCESS STREAM ANALYSER (IR/UV)	7			
6.29	PROCESS STREAM ANALYSER (H.C.-TCD/FID)	5			
6.30	ANALYSER SYSTEMS	8			
6.31	STACK GAS ANALYSER SYSTEMS (INSITU)	7			
6.32	STACK GAS ANALYSERS (SPM)	7			
6.33	ORIFICE PLATES & FLANGES	12			
6.34	FLOW ELEMENTS : (VENTURI, FLOW NOZZLES)	9			
6.35	TEMP. ELEMENTS, THERMOWELLS	13			
6.36	SKIN THERMOCOUPLES	8			
6.37	SPECIAL TEMPERATURE ELEMENTS	5			
6.38	SURGE RELIEF VALVE	1			
6.39	SPECIAL CONTROL VALVES (PLUG)	1			
6.40	SPECIAL CONTROL VALVE ( FLUSH BOTTOM)	2			
6.41	WATER QUALITY ANALYSERS (SILICA)	5			
6.42	WATER QUALITY ANALYSER-DISSOLVED OXYGEN	9			
6.43	WATER QUALITY ANALYSER SYSTEMS	7			
6.44	PROCESS STREAM ANALYSER-MOISTURE/ DEW PT	2			
6.45	PROCESS STREAM ANALYSER(PARAMAGNETIC-O2)	7			
6.46	WATER QUALITY ANALYSERS (PH)	9			

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6.48	PRODUCT QUALITY ANALYSER SYSTEMS	6			
6.49	WATER QUALITY ANALYSERS (TURBIDITY)	7			
6.50	WATER QUALITY ANALYSERS (CONDUCTIVITY)	9			
6.51	PROCESS STREAM ANALYSER(IR/UV)	6			
6.52	SO2 ANALYSER	2			
6.53	WATER QUALITY ANALYSER-OIL IN H2O TOC/TC	4			
6.54	WATER QUALITY ANALYSER-OIL IN H2O DISLVD	1			
6.55	WATER QUALITY ANALYSERS(CHLORINE)	5			
6.56	FLOW ELEMENTS-WEDGE TYPE	2			
6.57	GAS DETECTION SYSTEMS	11			
6.58	FIRE & GAS DETECTION SYSTEMS	6			
6.59	PRODUCT QUALITY ANALYSERS (NIR)	4			
6.60	PRODUCT QUALITY ANALYSERS (VISCOSITY)	2			
6.61	PRODUCT QUALITY ANALYSERS (DENSITY)	2			
6.62	PRODUCT QUALITY ANALYSERS (FLASH POINT)	3			
6.63	PRODUCT QUALITY ANALYSERS (DISTILLATION)	1			
6.64	PRODUCT QUALITY ANALYSER (SULPHUR)	2			
6.65	STACK GAS ANALYSERS (O2-ZIRCONIA) + CO + CO2	5			
6.66	ANALYSER-DENSITY/SP. GRAVITY (NUCLEONIC)	4			
6.67	ANALYSER-DENSITY/SP GRAVITY (VIB CYLINDR)	3			
6.68	ANALYSER-DENSITY/SP GRAVITY (CORIOLIS)	5			
6.69	VEGA INDIA LEVEL & PRESSURE MEASUREMENT PVT LTD	2			
6.70	WOBBE METERS	0			
6.71	PROGRAMMABLE LOGIC CONTROLLERS (DMR)	9			
6.72	PROGRAMMABLE LOGIC CONTROLLERS (TMR/QMR, SIL3 CERTIFIED)	7			
6.73	PRESSURE GAUGES	13			
6.74	DRAFT GAUGES	4			
6.75	DIFFERENTIAL PRESSURE GAUGES	8			
6.76	TEMP.GAUGES(BI METALLIC,FILLED SYSTEM)	11			
6.77	VARIABLE AREA FLOW METERS(I,T)	12			
6.78	MAGNETIC FLOW METERS	7			
6.79	TERMINAL AUTOMATION SYSTEM	6			
6.80	POSITIVE DISPLACEMENT METERS	4			
6.81	ULTRASONIC FLOW METER	10			
6.82	VORTEX FLOW METER	7			
6.83	TURBINE FLOW METERS	6			
6.84	MASS FLOW METERS	11			
6.85	GAUGE GLASSES & COCKS	11			
6.86	DRUM LEVEL INSTRUMENTS (ELECTRONIC)	4			
6.87	DRUM LEVEL INSTRUMENTS (BI-COLOUR GAUGE)	2			
6.88	TANK LEVEL INSTRUMENTS (FLOAT OPERATED)	6			
6.89	MAGNETIC LEVEL INSTRUMENTS	16			
6.90	SPL. LEVEL INSTRUMENTS-GUIDED WAVE RADAR	6			
6.91	TANK FARM MANAGEMENT SYSTEM	6			
6.92	TANK LEVEL INSTRUMENT (SERVO TYPE)	4			
6.93	SPECIAL LEVEL INSTRUMENTS (RF TYPE)	5			
6.94	SPECIAL LEVEL INSTRUMENTS (CAP.& COND.)	8			

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6.96	CLOSED CIRCUIT TV	9			
6.97	FIELD INSTRUMENTS/TRANSMITTERS (P,DP,F,L,T,TD)	10			
6.98	TANK LEVEL INSTRUMENT (RADAR,ULTRASONIC)	11			
6.99	SPEED TANSMITTERS	3			
6.100	CONTROL PANEL & ACCESSORIES	11			
6.101	PREFABRICATED INSTRUMENT HOOKUPS	5			
6.102	SP. CONTROL VALVE ( KNIFE GATE)	5			
6.103	FIRE PROTECTION SYSTEM (VALVES & ACC.)	2			
6.104	ANALYSER-DENSITY/SP.GRAVITY(V.CYLNDR,CORLIS)	6			
6.105	ANALYSER (AIR DEMAND/TOTAL SULPHUR)	0			
6.106	AVERAGING PITOT TUBES	6			
6.107	ANALYSERS (HYDROGEN SULPHIDE)	3			
6.108	VISCOSITY METER	5			
6.109	RUPTURE DISCS	2			
6.110	METER PROVERS	2			
6.111	GAS PRESSURE REDUCING SKIDS	8			
6.112	GAS METERING SYSTEM (ULTRASONIC)	5			
6.113	GAS METERING SYSTEM (TURBINE)	7			
6.114	GAS METERING SYSTEM -DUAL CHAMBR ORIFICE	3			
6.115	LIQUID METERING SYSTEM (ULTRASONIC)	2			
6.116	LIQUID METERING SYSTEM (TURBINE)	4			
6.117	LIQUID METERING SYSTEM (P D METERS)	1			
6.118	LIQUID METERING SYSTEM (MASS FLOW METER)	6			
6.119	DISPLACER LEVEL INSTRUMENTS	7			
6.120	DISTRIBUTED CONTROL SYSTEMS	8			
6.121	TELEPHONE AND PAGING SYSTEMS	10			
6.122	FOUNDATION FIELD BUS (FF JB'S)	3			
6.123	JUNCTION BOXES (Flame Proof)	8			
6.124	FLAME SCANNERS	2			
6.125	PLC CABINETS / LOCAL CONTROL PANEL	7			
6.126	OPACITY ANALYSERS	1			
6.127	THERMAL MASS FLOWMETERS	4			
6.128	MCT BLOCKS	4			
6.129	BARRIERS (IS) / BARRIERS (FF)	2			
6.130	BEACONS / HOOTERS/ MCP	5			
6.131	AIR FILTER REGULATORS	13			
6.132	ACCESS CONTROL SYSTEM	4			
6.133	ANALYSER SHELTER	8			
6.134	LOOP POWERED INDICATORS	7			
6.135	FIRE PROOFING FOR INSTRUMENT ITEMS (FOR CABLE TRAYS/DUCTS)	3			
6.136	SUNSHADE FOR FIELD INSTRUMENTS	2			
6.137	METER RUN ASSEMBLY (INTEGRAL ORIFICE)	2			
6.138	PROXIMITY TYPE LIMIT SWITCH	2			
6.139	POSITION INDICATION SWITCHBOXES	2			
6.140	TERMINAL BLOCKS	4			
6.141	CABLE TRAY	14			
6.142	INSTRUMENT DB&B BALL VALVES	6			

 <b>INDEX SHEET : EQUIPMENTS AND BULK PIPING ITEMS</b>					RHQ-IOCL-CPMSL-2020
DOCUMENT TITLE :- COMMON PROJECT MASTER SUPPLIER LIST (CPMSL)-IOCL-2020					2
INDIAN OIL CORPORATION LIMITED (IOCL) / REFINERIES DIVISION					31-Oct-20
ITEM CATEGORY INDEX SHEET					
Sr.No	ITEM	Indian Vendors	Remarks	Rev.	
6.143	MOTOR OPERATED VALVES	8			
6.144	CORROSION COUPONS	0			
6.145	OPTICAL PYROMETERS	0			
6.146	SPECIAL CONTROL VALVES (AXIAL)	0			
6.147	SPECIAL CONTROL VALVES (PISTON)	0			
6.148	AUTOMATIC GAS SAMPLER	1			
6.149	PRODUCT QUALITY ANALYSERS (RVP)	2			
6.150	TARGET FLOWMETERS	0			
6.151	RECEIVER INSTRUMENTS	1			
6.152	INFRARED TEMP MEASUREMENT SYSTEM	0			
6.153	ANTI SURGE CONTROL	0			
6.154	SPEED GOVERNOR FOR TURBINE	0			
6.155	PRESSURE SWITCHES	8			
6.156	SPECIAL CONTROL VALVES ( ECC ROTARY PLUG)	6			
6.157	BLENDING AUTOMATION SYSTEMS	5			
6.158	GAUGE GLASSES & COCKS (HIGH PRESSURE SERVICES 900# & ABOVE)	4			
6.159	MAGNETIC LEVEL GAUGES (HIGH PRESSURE SERVICES 900# & ABOVE)	2			
6.160	PORTABLE NUCLEONIC SURVEY METER (BETA-GAMMA-NEUTRON)	0			
6.161	SP CONTROL VALVES (ECCENTRIC DISC HI PERFORMANCE TYPE)	6			
6.162	SPECIAL CONTROL VALVES (SEGMENTAL)	6			
6.163	SPECIAL CONTROL VALVES (BALL CONTROL)	4			
6.164	SPECIAL CONTROL VALVES (VARIABLE CV)	3			
6.165	SPECIAL CONTROL VALVES (LOW CV)	5			
6.166	SAFETY VALVE BOILER SERVICE	3			
6.167	INTERFACE DEVICES	2			
6.168	ACTUATORS-MOV	6			
6.169	PROCESS STREAM ANALYSERS(ELECTROCHEM-02)	4			
6.170	ALARM PANEL / ALARM ANNUNCIATOR	7			
6.171	PUSH BUTTON AND INDICATING LAMPS	12			
6.172	TUBE FITTINGS (SEAL OIL, LUBE OIL, HYDROCARBON & OTHER CRITICAL APPLICATIONS)	16			
6.173	DIGITAL INDICATOR / DIGITAL MULTIPOINT INDICATOR	2			
6.174	CONTROL VALVE - ANGLE TYPE	1			
6.175	I/P CONVERTER	2			
6.176	FLOW METER ULTRASONIC TYPE - For Flare Gas Application	2			
6.177	CLAMP-ON ULTRASONIC FLOW TRANSMITTER	1			
6.178	INSTRUMENT VALVES & MANIFOLDS FOR ANALYSERS / SAMPLING SYSTEMS	3			
6.179	PRESSURE REGULATOR FOR ANALYSERS / SAMPLING SYSTEMS	4			
6.180	GAS CYLINDER PRESSURE REGULATOR DUAL STAGE WITH PRESSURE GAUGE & SAFETY VALVE FOR ANALYSERS / SAMPLING SYSTEMS	5			
6.181	PELLIER / COMPRESSOR COOLER FOR GAS SAMPLE FOR ANALYSERS / SAMPLING SYSTEMS	3			
6.182	DIAPHRAGM PUMP SINGLE / DOUBLE STAGE / HEAD PUMP FOR GAS SAMPLE FOR ANALYSERS / SAMPLING SYSTEMS	3			
6.183	PURGE CONTROLLER FOR PANEL FOR ANALYSERS / SAMPLING SYSTEMS	2			
6.184	VORTEX COOLER FOR ANALYSERS FOR ANALYSERS / SAMPLING SYSTEMS	1			
6.185	FILTERS FOR ANALYSERS / SAMPLING SYSTEMS	4			
6.186	HOT EXTRACTION SAMPLE PROBE FOR ANALYSERS / SAMPLING SYSTEMS	2			
6.187	BULK POWER SUPPLY WITH SMPS (24 V DC) FOR ANALYSERS / SAMPLING SYSTEMS	3			
6.188	ETHERNET SWITCHES	0			

 IndianOil				
<b>INDEX SHEET : EQUIPMENTS AND BULK PIPING ITEMS</b>				<b>RHQ-IOCL-CPMSL-2020</b>
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<b>INDIAN OIL CORPORATION LIMITED (IOCL) / REFINERIES DIVISION</b>				<b>31-Oct-20</b>
<b>ITEM CATEGORY INDEX SHEET</b>				
Sr.No	ITEM	Indian Vendors	Remarks	Rev.
6.189	HMI SOFTWARE	0		
6.190	ELECTROMECHANICAL RELAY	9		
6.191	CONDITION MONITORING SYSTEM	0		



<b>SECTION-A MECHANICAL EQUIPMENTS</b>		Doc. No.	IOCL-MSL-2020
<b>DOCUMENT TITLE :- PROJECT MASTER SUPPLIER LIST (PMSL)-IOCL-2020</b>		REV :	2
<b>M/s. INDIAN OIL CORPORATION LIMITED (IOCL)</b>		Date :	31-Oct-20
<b>COMMON PROJECTS MASTER SUPPLIER LIST-SECTION-A (MECHANICAL EQUIPMENTS)</b>			
Sr.No	VENDOR NAME	COUNTRY	REMARK
<b>1</b>	<b>STATIC EQUIPMENT</b>		
<b>1.1</b>	<b>PRESSURE VESSEL -CS (UP TO 25MM)</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
1.1.1	ABF ENGINEERING INTERNATIONAL PVT. LTD.	INDIA	
1.1.2	ACOUSTICS INDIA PVT LTD	INDIA	
1.1.3	ADOR WELDING LTD.	INDIA	
1.1.4	AERO ENGINEERS	INDIA	
1.1.5	ALFA LAVAL INDIA LTD	INDIA	
1.1.6	ALSTOM PROJECTS INDIA LIMITED (ABB – ABL LTD.)	INDIA	
1.1.7	ANUP ENGINEERING LIMITED (THE)	INDIA	
1.1.8	BARODA EQUIPMENT AND VESSELS PVT LTD	INDIA	
1.1.9	BEEKAY ENGINEERING CORPORATION	INDIA	
1.1.10	BHEL	INDIA	
1.1.11	BILFINGER PLANT EQUIPMENTS PVT LTD (FML)	INDIA	
1.1.12	BTL EPC LIMITED	INDIA	
1.1.13	BUILDWORTH LIMITED	INDIA	
1.1.14	CHANDERPUR INDUSTRIES PVT LTD	INDIA	
1.1.15	CICB-CHEMICON PVT.LTD.	INDIA	
1.1.16	ESSAR HEAVY ENGG SERVICES (UNIT OF EPIL)	INDIA	
1.1.17	EXPO GAS CONTAINERS LTD.	INDIA	
1.1.18	FABTECH PROJECTS & ENGINEERS LTD.	INDIA	
1.1.19	FAB-TECH WORKS & CONSTN. PVT LTD.	INDIA	
1.1.20	FACT ENGINEERING WORKS	INDIA	
1.1.21	FURNACE FABRICA (INDIA) LIMITED	INDIA	
1.1.22	GEECY ENGINEERING PVT LTD	INDIA	
1.1.23	GMM PFAUDLER LTD	INDIA	
1.1.24	GODREJ & BOYCE MFG. CO. LTD.	INDIA	
1.1.25	GR ENGINEERNG PRIVATE LTD (TARAPORE)	INDIA	
1.1.26	GRAND PRIX ENGINEERING PVT LTD.	INDIA	
1.1.27	GRASIM INDUSTRIES	INDIA	
1.1.28	HDO TECHNOLOGIES LTD. INDIA	INDIA	
1.1.29	INDCON PROJECTS & EQUIPMENTS LTD	INDIA	
1.1.30	INDIA TUBE MILLS & METAL IND LTD	INDIA	
1.1.31	INDUS PROJECTS LIMITED	INDIA	
1.1.32	INDUSTRIAL MANUFACTURERS	INDIA	
1.1.33	ISGEC HEAVY ENGINEERING LTD	INDIA	
1.1.34	ISGEC HITACHI ZOSEN LTD	INDIA	
1.1.35	JINDAL STEEL & POWER LTD	INDIA	
1.1.36	LLOYDS STEELS INDUSTRIES LTD.	INDIA	
1.1.37	LOYAL EQUIPMENT PVT. LTD.	INDIA	
1.1.38	MCNALLY SAYAJI ENGINEERING LTD	INDIA	
1.1.39	MEENAKSHI ASSOCIATES PVT LTD	INDIA	
1.1.40	MULTIMAX ENGINEERING WORKS PVT LTD	INDIA	Rev.1: Name Change



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<b>COMMON PROJECTS MASTER SUPPLIER LIST-SECTION-A (MECHANICAL EQUIPMENTS)</b>			
<b>Sr.No</b>	<b>VENDOR NAME</b>	<b>COUNTRY</b>	<b>REMARK</b>
1.1.41	MULTITEX FILTRATION ENGINEERS LTD.	INDIA	
1.1.42	NEW FIELD INDUSTRIAL EQUIPMENT PVT LTD	INDIA	
1.1.43	NEWTON ENGG & CHEMICALS LTD	INDIA	
1.1.44	NILE LIMITED	INDIA	
1.1.45	NOVATECH PROCESS EQUIPMENT	INDIA	
1.1.46	NOVATECH PROJECTS INDIA PVT LTD	INDIA	
1.1.47	ORIENTAL ENTERPRISE PVT. LTD	INDIA	
1.1.48	OSWAL INFRASTRUCTURE LIMITED	INDIA	
1.1.49	PATELS AIRTEMP (INDIA) LTD	INDIA	
1.1.50	PHILS HEAVY ENGINEERING PVT LIMITED	INDIA	
1.1.51	PRABHA STEEL INDUSTRIES	INDIA	
1.1.52	PRAJ INDUSTRIES LIMITED	INDIA	
1.1.53	PRECISION EQUIPMENTS (CHENNAI) PVT LTD	INDIA	
1.1.54	PROGEN SYSTEMS & TECHNOLOGIES LTD	INDIA	
1.1.55	R. D. ENGINEERS (INDIA) PVT. LTD	INDIA	
1.1.56	RADIANT HEAT EXCHANGER PVT.LTD.	INDIA	
1.1.57	RAJ ENGINEERING COMPANY	INDIA	
1.1.58	RAVI INDUSTRIES	INDIA	
1.1.59	RELIANCE FABRICATIONS PVT LTD	INDIA	
1.1.60	SAURASHTRA ENGINEERING CORPN. PVT LTD	INDIA	
1.1.61	SHARP TANKS & STRUCTURALS (P) LTD	INDIA	
1.1.62	SHREE SATYANARAYAN IND. SUPP. PVT. LTD	INDIA	
1.1.63	SHRI LAKSHMI PRABHA ENGG INDUSTRIES P LTD	INDIA	
1.1.64	SREE RAMAKRISHNA ENGINEERING ENTERPRISES	INDIA	
1.1.65	SUDHIR BROTHERS	INDIA	
1.1.66	TECHNIP INDIA LTD.	INDIA	
1.1.67	TECHNO PROCESS EQUIPMENTS (INDIA) PV LTD	INDIA	
1.1.68	TEMASME VESELEX INDIA PVT. LTD.	INDIA	
1.1.69	TITANIUM EQUIPMENT AND ANODE MFG.CO.LTD	INDIA	
1.1.70	UNIQUE CHEMOPLANT EQUIPMENTS	INDIA	
1.1.71	UNITED HEAT TRANSFER PVT LTD	INDIA	
1.1.72	VIJAY TANKS & VESSELS PVT LTD	INDIA	
1.1.73	WALCHANDNAGAR INDUSTRIES LTD.	INDIA	
1.1.74	ISHAN EQUIPMENT PVT LTD	INDIA	
1.1.75	NUBERG ENGINEERING LTD	INDIA	
1.1.76	REYNOLDS CHEM EQUIPMENT PVT LTD	INDIA	
1.1.77	UNIVERSAL HEAT EXCHANGERS LTD.	INDIA	
<b>1.2</b>	<b>POLYMERISER REACTOR SYSTEM</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
1.2.1	ZEPPELIN SYSTEMS GMBH India	INDIA	
<b>1.3</b>	<b>PRESSURE VESSEL -CS (26-50MM)</b>		



<b>SECTION-A MECHANICAL EQUIPMENTS</b>		Doc. No.	IOCL-MSL-2020
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<b>M/s. INDIAN OIL CORPORATION LIMITED (IOCL)</b>		Date :	31-Oct-20
<b>COMMON PROJECTS MASTER SUPPLIER LIST-SECTION-A (MECHANICAL EQUIPMENTS)</b>			
Sr.No	VENDOR NAME	COUNTRY	REMARK
<b>A</b>	<b>INDIAN BIDDERS</b>		
1.3.1	ALSTOM PROJECTS INDIA LIMITED (ABB – ABL LTD.)	INDIA	
1.3.2	ANUP ENGINEERING LIMITED (THE)	INDIA	
1.3.3	BEEKAY ENGINEERING CORPORATION	INDIA	
1.3.4	BHEL	INDIA	
1.3.5	BILFINGER PLANT EQUIPMENTS PVT LTD (FML)	INDIA	
1.3.6	BUILDWORTH LIMITED	INDIA	
1.3.7	CHANDERPUR INDUSTRIES PVT LTD	INDIA	
1.3.8	ESSAR HEAVY ENGG SERVICES (UNIT OF EPIL)	INDIA	
1.3.9	EXPO GAS CONTAINERS LTD.	INDIA	
1.3.10	FABTECH PROJECTS & ENGINEERS LTD.	INDIA	
1.3.11	FAB-TECH WORKS & CONSTN. PVT LTD.	INDIA	
1.3.12	GEECY ENGINEERING PVT LTD	INDIA	
1.3.13	GMM PFAUDLER LTD	INDIA	
1.3.14	GODREJ & BOYCE MFG. CO. LTD.	INDIA	
1.3.15	GR ENGINEERNG PRIVATE LTD (TARAPORE)	INDIA	
1.3.16	GRAND PRIX ENGINEERING PVT LTD.	INDIA	
1.3.17	GRASIM INDUSTRIES	INDIA	
1.3.18	INDCON PROJECTS & EQUIPMENTS LTD	INDIA	
1.3.19	INDIAN TUBE MILLS & METAL IND. LTD	INDIA	
1.3.20	INDUS PROJECTS LIMITED	INDIA	
1.3.21	INDUSTRIAL MANUFACTURERS	INDIA	
1.3.22	ISGEC HEAVY ENGINEERING LTD	INDIA	
1.3.23	ISGEC HITACHI ZOSEN LTD	INDIA	
1.3.24	JINDAL STEEL & POWER LTD	INDIA	
1.3.25	THE KCP LIMITED	INDIA	
1.3.26	LARSEN & TOUBRO LTD	INDIA	
1.3.27	LLOYDS STEELS INDUSTRIES LTD.	INDIA	
1.3.28	MEENAKSHI ASSOCIATES PVT. LTD.	INDIA	
1.3.29	MULTITEX FILTRATION ENGINEERS LTD.	INDIA	
1.3.30	NEW FIELD INDUSTRIAL EQUIPMENT PVT LTD	INDIA	
1.3.31	NILE LIMITED	INDIA	
1.3.32	ORIENTAL ENTERPRISE PVT. LTD	INDIA	
1.3.33	PATELS AIRTEMP (INDIA) LTD	INDIA	
1.3.34	PHILS HEAVY ENGINEERING PVT LIMITED	INDIA	
1.3.35	PRABHA STEEL INDUSTRIES	INDIA	
1.3.36	PRAJ INDUSTRIES LIMITED	INDIA	
1.3.37	PRECISION EQUIPMENTS (CHENNAI) PVT LTD	INDIA	
1.3.38	R. D. ENGINEERS (INDIA) PVT. LTD	INDIA	
1.3.39	RAJ ENGINEERING COMPANY	INDIA	
1.3.40	RAVI INDUSTRIES	INDIA	
1.3.41	SAURASHTRA ENGINEERING CORPN. PVT LTD	INDIA	
1.3.42	SHARP TANKS & STRUCTURALS (P) LTD	INDIA	





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<b>COMMON PROJECTS MASTER SUPPLIER LIST-SECTION-A (MECHANICAL EQUIPMENTS)</b>			
Sr.No	VENDOR NAME	COUNTRY	REMARK
1.3.43	TECHNO PROCESS EQUIPMENTS (INDIA) PV LTD	INDIA	
1.3.44	UNIQUE CHEMOPLANT EQUIPMENTS	INDIA	
1.3.45	VIJAY TANKS & VESSELS PVT LTD	INDIA	
1.3.46	WALCHANDNAGAR INDUSTRIES LTD.	INDIA	
1.3.47	HINDUSTAN DORR OLIVER	INDIA	
1.3.48	ISHAN EUIPMENTS PVT LTD	INDIA	
1.3.49	NEWTON ENGINEERING AND CHEMICAL	INDIA	
1.3.50	UNIVERSAL HEAT EXCHANGERS	INDIA	
<b>1.4</b>	<b>PRESSURE VESSEL-CS (51-100MM)</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
1.4.1	ALSTOM PROJECTS INDIA LIMITED (ABB – ABL LTD.)	INDIA	
1.4.2	ANUP ENGINEERING LIMITED (THE)	INDIA	
1.4.3	BHEL	INDIA	
1.4.4	BILFINGER PLANT EQUIPMENTS PVT LTD (FML)	INDIA	
1.4.5	ESSAR HEAVY ENGG SERVICES (UNIT OF EPIL)	INDIA	
1.4.6	FAB-TECH WORKS & CONSTN. PVT LTD.	INDIA	
1.4.7	GODREJ & BOYCE MFG. CO. LTD.	INDIA	
1.4.8	GR ENGINEERNG PRIVATE LTD (TARAPORE)	INDIA	
1.4.9	INDUS PROJECTS LIMITED	INDIA	
1.4.10	ISGEC HEAVY ENGINEERING LTD	INDIA	
1.4.11	ISGEC HITACHI ZOSEN LTD	INDIA	
1.4.12	THE KCP LIMITED	INDIA	
1.4.13	LARSEN & TOUBRO LTD	INDIA	
1.4.14	LLOYDS STEELS INDUSTRIES LTD.	INDIA	
1.4.15	PATELS AIRTEMP (INDIA) LTD	INDIA	
1.4.16	PHILS HEAVY ENGINEERING PVT LIMITED	INDIA	
1.4.17	PRAJ INDUSTRIES LIMITED	INDIA	
1.4.18	PRECISION EQUIPMENTS (CHENNAI) PVT LTD	INDIA	
1.4.19	TECHNO PROCESS EQUIPMENTS (INDIA) PV LTD	INDIA	
1.4.20	VIJAY TANKS & VESSELS PVT LTD	INDIA	
1.4.21	WALCHANDNAGAR INDUSTRIES LTD.	INDIA	
1.4.22	INDIA TUBE MILLS AND METALS INDIA LTD	INDIA	
<b>1.5</b>	<b>PRESSURE VESSEL-CS (&gt;100MM)</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
1.5.1	BHEL	INDIA	
1.5.2	ESSAR HEAVY ENGG SERVICES (UNIT OF EPIL)	INDIA	
1.5.3	GODREJ & BOYCE MFG. CO. LTD.	INDIA	
1.5.4	GR ENGINEERNG PRIVATE LTD	INDIA	
1.5.5	ISGEC HEAVY ENGINEERING LTD	INDIA	
1.5.6	ISGEC HITACHI ZOSEN LTD	INDIA	
1.5.7	LARSEN & TOUBRO LTD	INDIA	



<b>SECTION-A MECHANICAL EQUIPMENTS</b>		<b>Doc. No.</b>	<b>IOCL-MSL-2020</b>
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<b>M/s. INDIAN OIL CORPORATION LIMITED (IOCL)</b>		<b>Date :</b>	<b>31-Oct-20</b>
<b>COMMON PROJECTS MASTER SUPPLIER LIST-SECTION-A (MECHANICAL EQUIPMENTS)</b>			
<b>Sr.No</b>	<b>VENDOR NAME</b>	<b>COUNTRY</b>	<b>REMARK</b>
1.5.8	LLOYDS STEELS INDUSTRIES LTD	INDIA	
1.5.9	PRAJ INDUSTRIES LIMITED	INDIA	
<b>1.6</b>	<b>PRESSURE VESSEL-SS (UP TO 25MM)</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
1.6.1	ABF ENGINEERING INTERNATIONAL PVT. LTD.	INDIA	
1.6.2	ACOUSTICS INDIA PVT LTD	INDIA	
1.6.3	ADOR WELDING LTD.	INDIA	
1.6.4	AERO ENGINEERS	INDIA	
1.6.5	ALFA LAVAL INDIA LTD	INDIA	
1.6.6	ALSTOM PROJECTS INDIA LIMITED (ABB – ABL LTD.)	INDIA	
1.6.7	BHEL	INDIA	
1.6.8	BTL EPC LIMITED	INDIA	
1.6.9	ESSAR HEAVY ENGG SERVICES (UNIT OF EPIL)	INDIA	
1.6.10	EXPO GAS CONTAINERS LTD.	INDIA	
1.6.11	FABTECH PROJECTS & ENGINEERS LTD.	INDIA	
1.6.12	FAB-TECH WORKS & CONSTN. PVT LTD.	INDIA	
1.6.13	GEECY ENGINEERING PVT LTD	INDIA	
1.6.14	GEMINI ENGI-FAB LIMITED	INDIA	
1.6.15	GMM PFAUDLER LTD	INDIA	
1.6.16	GODREJ & BOYCE MFG. CO. LTD.	INDIA	
1.6.17	GR ENGINEERNG PRIVATE LTD (TARAPORE)	INDIA	
1.6.18	GRAND PRIX ENGINEERING PVT LTD.	INDIA	
1.6.19	INDCON PROJECTS & EQUIPMENTS LTD	INDIA	
1.6.20	INDUS PROJECTS LIMITED	INDIA	
1.6.21	INDUSTRIAL MANUFACTURERS	INDIA	
1.6.22	ISGEC HEAVY ENGINEERING LTD	INDIA	
1.6.23	ISGEC HITACHI ZOSEN LTD	INDIA	
1.6.24	JINDAL STEEL & POWER LTD	INDIA	
1.6.25	LARSEN & TOUBRO LTD	INDIA	
1.6.26	LLOYDS STEELS INDUSTRIES LTD.	INDIA	
1.6.27	MULTITEX FILTRATION ENGINEERS LTD.	INDIA	
1.6.28	NEW FIELD INDUSTRIAL EQUIPMENT PVT LTD	INDIA	
1.6.29	NILE LIMITED	INDIA	
1.6.30	NOVATECH PROJECTS INDIA PVT LTD	INDIA	
1.6.31	ORIENTAL ENTERPRISE PVT. LTD	INDIA	
1.6.32	PATELS AIRTEMP (INDIA) LTD	INDIA	
1.6.33	PHILS HEAVY ENGINEERING PVT LIMITED	INDIA	
1.6.34	PRABHA STEEL INDUSTRIES	INDIA	
1.6.35	PRAJ INDUSTRIES LIMITED	INDIA	
1.6.36	PRECISION EQUIPMENTS (CHENNAI) PVT LTD	INDIA	
1.6.37	R. D. ENGINEERS (INDIA) PVT. LTD	INDIA	
1.6.38	RADIANT HEAT EXCHANGER PVT.LTD.	INDIA	



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<b>DOCUMENT TITLE :- PROJECT MASTER SUPPLIER LIST (PMSL)-IOCL-2020</b>		<b>REV :</b>	<b>2</b>
<b>M/s. INDIAN OIL CORPORATION LIMITED (IOCL)</b>		<b>Date :</b>	<b>31-Oct-20</b>
<b>COMMON PROJECTS MASTER SUPPLIER LIST-SECTION-A (MECHANICAL EQUIPMENTS)</b>			
<b>Sr.No</b>	<b>VENDOR NAME</b>	<b>COUNTRY</b>	<b>REMARK</b>
1.6.39	RAJ ENGINEERING COMPANY	INDIA	
1.6.40	RELIANCE FABRICATIONS PVT LTD	INDIA	
1.6.41	SHARP TANKS & STRUCTURALS (P) LTD	INDIA	
1.6.42	SHREE SATYANARAYAN IND. SUPP. PVT. LTD	INDIA	
1.6.43	SPARKON ENGINEERS	INDIA	
1.6.44	TECHNIP INDIA LTD.	INDIA	
1.6.45	TECHNO PROCESS EQUIPMENTS (INDIA) PV LTD	INDIA	
1.6.46	THE KCP LIMITED	INDIA	
1.6.47	TITANIUM EQUIPMENT AND ANODE MFG.CO.LTD	INDIA	
1.6.48	VIJAY TANKS & VESSELS PVT LTD	INDIA	
1.6.49	WALCHANDNAGAR INDUSTRIES LTD.	INDIA	
1.6.50	ARJUN TECHNOLOGIES (INDIA) LTD	INDIA	
1.6.51	HDO TECHNOLOGIES LTD	INDIA	
1.6.52	INDIA TUBE MILLS & METALS INDIA LTD	INDIA	
1.6.53	ISHAN EQUIPMENTS PVT LTD	INDIA	
1.6.54	LOYAL EQUIPMENTS PVT LTD	INDIA	
1.6.55	MEENAKSHI ASSOCIATES PVT LTD	INDIA	
1.6.56	NUBERG ENGINEERING LTD	INDIA	
1.6.57	REYNOLD CHEM EQUIPMENTS PVT LTD	INDIA	
1.6.58	SUNGJIN GEOTECH CO.LTD	INDIA	
1.6.59	UNIVERSAL HEAT EXCHANGERS LTD	INDIA	
<b>1.7</b>	<b>PRESSURE VESSEL-SS (FROM 26MM to 50 MM)</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
1.7.1	ANUP ENGINEERING LIMITED	INDIA	
1.7.2	ALSTOM PROJECTS INDIA LIMITED (ABB – ABL LTD.)	INDIA	
1.7.3	BHEL	INDIA	
1.7.4	CHANDERPUR INDUSTRIES PVT.LTD.	INDIA	
1.7.5	ESSAR HEAVY ENGG SERVICES (UNIT OF EPIL)	INDIA	
1.7.6	EXPO GAS CONTAINERS LTD.	INDIA	
1.7.7	FABTECH PROJECTS & ENGINEERS LTD	INDIA	
1.7.8	GEECY ENGINEERING PVT LTD	INDIA	
1.7.9	GMM PFAUDLER LTD	INDIA	
1.7.10	GODREJ & BOYCE MFG. CO. LTD.	INDIA	
1.7.11	GR ENGINEERNG PRIVATE LTD	INDIA	
1.7.12	INDUS PROJECTS LIMITED	INDIA	
1.7.13	INDUSTRIAL MANUFACTURERS	INDIA	
1.7.14	ISGEC HEAVY ENGINEERING LTD	INDIA	
1.7.15	ISGEC HITACHI ZOSEN LTD	INDIA	
1.7.16	THE KCP LIMITED	INDIA	
1.7.17	LARSEN & TOUBRO LTD	INDIA	
1.7.18	LLOYDS STEELS INDUSTRIES LTD	INDIA	
1.7.19	NEW FIELD INDUSTRIAL EQUIPMENT PVT LTD	INDIA	



<b>SECTION-A MECHANICAL EQUIPMENTS</b>		Doc. No.	IOCL-MSL-2020
<b>DOCUMENT TITLE :- PROJECT MASTER SUPPLIER LIST (PMSL)-IOCL-2020</b>		REV :	2
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<b>COMMON PROJECTS MASTER SUPPLIER LIST-SECTION-A (MECHANICAL EQUIPMENTS)</b>			
Sr.No	VENDOR NAME	COUNTRY	REMARK
1.7.20	NILE LIMITED	INDIA	
1.7.21	ORIENTAL ENTERPRISE PVT. LTD	INDIA	
1.7.22	PATELS AIRTEMP (INDIA) LTD	INDIA	
1.7.23	PHILS HEAVY ENGINEERING PVT LIMITED	INDIA	
1.7.24	PRAJ INDUSTRIES LIMITED	INDIA	
1.7.25	PRECISION EQUIPMENTS (CHENNAI) PVT LTD	INDIA	
1.7.26	R. D. ENGINEERS (INDIA) PVT. LTD	INDIA	
1.7.27	RADIANT HEAT EXCHANGER PVT.LTD.	INDIA	
1.7.28	SHARP TANKS & STRUCTURALS (P) LTD	INDIA	
1.7.29	VIJAY TANKS & VESSELS PVT LTD	INDIA	
1.7.30	CHANDERPUR INDUSTRIES PVT.LTD.	INDIA	
1.7.31	WALCHANDNAGAR INDUSTRIES LTD.	INDIA	
1.7.32	INDIA TUBE MILLS & METALS INDIA LTD	INDIA	
1.7.33	SUNGJIN GEOTECH CO.LTD	INDIA	
<b>1.8</b>	<b>PRESSURE VESSEL-SS (&gt; 50 MM)</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
1.8.1	BHEL	INDIA	
1.8.2	GODREJ & BOYCE MFG. CO. LTD.	INDIA	
1.8.3	GR ENGINEERNG PRIVATE LTD	INDIA	
1.8.4	ISGEC HEAVY ENGINEERING LTD	INDIA	
1.8.5	ISGEC HITACHI ZOSEN LTD	INDIA	
1.8.6	LARSEN & TOUBRO LTD	INDIA	
1.8.7	LLOYDS STEELS INDUSTRIES LTD	INDIA	
1.8.8	PATELS AIRTEMP (INDIA) LTD	INDIA	
1.8.9	PHILS HEAVY ENGINEERING PVT LIMITED	INDIA	
1.8.10	PRECISION EQUIPMENTS (CHENNAI) PVT LTD	INDIA	
1.8.11	TITANIUM EQUIPMENT AND ANODE MFG.CO.LTD.	INDIA	
<b>1.9</b>	<b>PRESSURE VESSEL -LOW ALLOY STEEL</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
1.9.1	ANUP ENGINEERING LIMITED (THE)	INDIA	
1.9.2	BHEL	INDIA	
1.9.3	ESSAR HEAVY ENGG SERVICES (UNIT OF EPIL)	INDIA	
1.9.4	FABTECH PROJECTS & ENGINEERS LTD.	INDIA	
1.9.5	GMM PFAUDLER LTD	INDIA	
1.9.6	GODREJ & BOYCE MFG. CO. LTD.	INDIA	
1.9.7	GR ENGINEERNG PRIVATE LTD (TARAPORE)	INDIA	
1.9.8	INDCON PROJECTS & EQUIPMENTS LTD	INDIA	
1.9.9	INDUS PROJECTS LIMITED	INDIA	
1.9.10	ISGEC HEAVY ENGINEERING LTD	INDIA	
1.9.11	ISGEC HITACHI ZOSEN LTD	INDIA	
1.9.12	LARSEN & TOUBRO LTD	INDIA	



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<b>COMMON PROJECTS MASTER SUPPLIER LIST-SECTION-A (MECHANICAL EQUIPMENTS)</b>			
<b>Sr.No</b>	<b>VENDOR NAME</b>	<b>COUNTRY</b>	<b>REMARK</b>
1.9.13	LLOYDS STEELS INDUSTRIES LTD.	INDIA	
1.9.14	PATELS AIRTEMP (INDIA) LTD	INDIA	
1.9.15	PHILS HEAVY ENGINEERING PVT LIMITED	INDIA	
1.9.16	PRECISION EQUIPMENTS (CHENNAI) PVT LTD	INDIA	
1.9.17	RAJ ENGINEERING COMPANY	INDIA	
1.9.18	TECHNIP INDIA LTD.	INDIA	
1.9.19	TECHNO PROCESS EQUIPMENTS (INDIA) PV LTD	INDIA	
1.9.20	VIJAY TANKS & VESSELS PVT LTD	INDIA	
1.9.21	WALCHANDNAGAR INDUSTRIES LTD.	INDIA	
1.9.22	HDO TECHNOLOGIES LTD	INDIA	
1.9.23	HYUNDAI HEAVY INDUSTRIES CO.LTD	INDIA	
1.9.24	IL SUNG ENGINEERING & COST CO.LTD	INDIA	
1.9.25	SUNGJIN GEOTECH CO.LTD	INDIA	
1.9.26	UNIVERSAL HEAT EXCHANGERS LTD	INDIA	
<b>1.10</b>	<b>PRESSURE VESSEL – LTCS</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
1.10.1	AERO ENGINEERS	INDIA	
1.10.2	ANUP ENGINEERING LIMITED (THE)	INDIA	
1.10.3	BHEL	INDIA	
1.10.4	ESSAR HEAVY ENGG SERVICES (UNIT OF EPIL)	INDIA	
1.10.5	EXPO GAS CONTAINERS LTD.	INDIA	
1.10.6	FABTECH PROJECTS & ENGINEERS LTD.	INDIA	
1.10.7	FAB-TECH WORKS & CONSTN. PVT LTD.	INDIA	
1.10.8	GMM PFAUDLER LTD	INDIA	
1.10.9	GODREJ & BOYCE MFG. CO. LTD.	INDIA	
1.10.10	GR ENGINEERING PRIVATE LTD (TARAPORE)	INDIA	
1.10.11	GRAND PRIX ENGINEERING PVT LTD.	INDIA	
1.10.12	INDCON PROJECTS & EQUIPMENTS LTD	INDIA	
1.10.13	INDIA TUBE MILLS AND METAL INDIA LTD.	INDIA	
1.10.14	INDUS PROJECTS LIMITED	INDIA	
1.10.15	ISGEC HEAVY ENGINEERING LTD	INDIA	
1.10.16	ISGEC HITACHI ZOSEN LTD	INDIA	
1.10.17	JINDAL STEEL & POWER LTD	INDIA	
1.10.18	LARSEN & TOUBRO LTD	INDIA	
1.10.19	LLOYDS STEELS INDUSTRIES LTD.	INDIA	
1.10.20	MEENAKSHI ASSOCIATES PVT. LTD.	INDIA	
1.10.21	NILE LIMITED	INDIA	
1.10.22	ORIENTAL ENTERPRISE PVT. LTD	INDIA	
1.10.23	PATELS AIRTEMP (INDIA) LTD	INDIA	
1.10.24	PHILS HEAVY ENGINEERING PVT LIMITED	INDIA	
1.10.25	PRECISION EQUIPMENTS (CHENNAI) PVT LTD	INDIA	
1.10.26	R. D. ENGINEERS (INDIA) PVT. LTD	INDIA	



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<b>COMMON PROJECTS MASTER SUPPLIER LIST-SECTION-A (MECHANICAL EQUIPMENTS)</b>			
<b>Sr.No</b>	<b>VENDOR NAME</b>	<b>COUNTRY</b>	<b>REMARK</b>
1.10.27	RAJ ENGINEERING COMPANY	INDIA	
1.10.28	SUNGJIN GEOTECH CO. LTD	INDIA	
1.10.29	TECHNO PROCESS EQUIPMENTS (INDIA) PV LTD	INDIA	
1.10.30	TEMASME VESELEX INDIA PVT. LTD.	INDIA	
1.10.31	VIJAY TANKS & VESSELS PVT LTD	INDIA	
1.10.32	WALCHANDNAGAR INDUSTRIES LTD.	INDIA	
1.10.33	HDO TECHNOLOGIES LTD	INDIA	
1.10.34	INDUSTRIAL MANUFACTURERS	INDIA	
1.10.35	REYNOLDS CHEM EQUIPMENTS LTD	INDIA	
1.10.36	UNIVERSAL HEAT EXCHANGERS	INDIA	
<b>1.11</b>	<b>PRESSURE VESSEL-CS/LAS+SS CLAD</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
1.11.1	ALFA LAVAL INDIA LTD	INDIA	
1.11.2	ANUP ENGINEERING LIMITED (THE)	INDIA	
1.11.3	BHEL	INDIA	
1.11.4	ESSAR HEAVY ENGG SERVICES (UNIT OF EPIL)	INDIA	
1.11.5	EXPO GAS CONTAINERS LTD.	INDIA	
1.11.6	FABTECH PROJECTS & ENGINEERS LTD.	INDIA	
1.11.7	GEECY ENGINEERING PVT LTD	INDIA	
1.11.8	GODREJ & BOYCE MFG. CO. LTD.	INDIA	
1.11.9	GR ENGINEERNG PRIVATE LTD (TARAPORE)	INDIA	
1.11.10	INDIA TUBE MILLS AND METALS INDIA LTD.	INDIA	
1.11.11	INDUS PROJECTS LIMITED	INDIA	
1.11.12	ISGEC HEAVY ENGINEERING LTD	INDIA	
1.11.13	ISGEC HITACHI ZOSEN LTD	INDIA	
1.11.14	LARSEN & TOUBRO LTD	INDIA	
1.11.15	LLOYDS STEELS INDUSTRIES LTD.	INDIA	
1.11.16	PATELS AIRTEMP (INDIA) LTD	INDIA	
1.11.17	PHILS HEAVY ENGINEERING PVT LIMITED	INDIA	
1.11.18	PRECISION EQUIPMENTS (CHENNAI) PVT LTD	INDIA	
1.11.19	R. D. ENGINEERS (INDIA) PVT. LTD	INDIA	
1.11.20	TECHNO PROCESS EQUIPMENTS (INDIA) PV LTD	INDIA	
1.11.21	TITANIUM EQUIPMENT AND ANODE MFG.CO.LTD	INDIA	
1.11.22	VIJAY TANKS & VESSELS PVT LTD	INDIA	
1.11.23	INDUSTRIAL MANUFACTURERS	INDIA	
1.11.24	UNIVERSAL HEAT EXCHANGERS	INDIA	
1.11.25	WALCHANDNAGAR INDUSTRIES LTD	INDIA	
<b>1.12</b>	<b>PRESSURE VESSEL-MONEL CLADED</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
1.12.1	ALFA LAVAL INDIA LTD	INDIA	
1.12.2	ANUP ENGINEERING LIMITED (THE)	INDIA	



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<b>M/s. INDIAN OIL CORPORATION LIMITED (IOCL)</b>		<b>Date :</b>	<b>31-Oct-20</b>
<b>COMMON PROJECTS MASTER SUPPLIER LIST-SECTION-A (MECHANICAL EQUIPMENTS)</b>			
<b>Sr.No</b>	<b>VENDOR NAME</b>	<b>COUNTRY</b>	<b>REMARK</b>
1.12.3	BHEL	INDIA	
1.12.4	ESSAR HEAVY ENGG SERVICES( UNIT OF EPIL)	INDIA	
1.12.5	EXPO GAS CONTAINERS LTD. India	INDIA	
1.12.6	GEECY ENGINEERING PVT LTD India	INDIA	
1.12.7	GODREJ & BOYCE MFG. CO. LTD. India	INDIA	
1.12.8	ISGEC HEAVY ENGINEERING LTD India	INDIA	
1.12.9	ISGEC HITACHI ZOSEN LTD India	INDIA	
1.12.10	LARSEN & TOUBRO LTD India	INDIA	
1.12.11	PHILS HEAVY ENGINEERING PVT LIMITED India	INDIA	
1.12.12	R. D. ENGINEERS (INDIA) PVT. LTD India	INDIA	
1.12.13	TITANIUM EQUIPMENT AND ANODE MFG.CO.LTD	INDIA	
<b>1.13</b>	<b>PRESSURE VESSEL- MONEL</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
1.13.1	ALFA LAVAL INDIA LTD	INDIA	
1.13.2	ANUP ENGINEERING LIMITED (THE)	INDIA	
1.13.3	PHILS HEAVY ENGINEERING PVT LIMITED India	INDIA	
1.13.4	TITANIUM EQUIPMENT AND ANODE MFG.CO.LTD	INDIA	
<b>1.14</b>	<b>CYCLONES (REACTOR &amp; REGENERATOR)</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
	NO INDIAN BIDDER AVAILABLE		
<b>1.15</b>	<b>DEMISTER-WIRE MESH TYPE</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
1.15.1	CONTINENTAL PROFILES LTD	INDIA	
1.15.2	EVERGREEN TECHNOLOGIES PVT.LTD.	INDIA	
1.15.3	HAYER STANDARD INDIA PVT LTD	INDIA	
1.15.4	MUNTERS INDIA HUMISITY CONTROL PVT. LTD.	INDIA	
1.15.5	KOCH CHEMICAL TECH. GROUP INDIA PVT LTD	INDIA	
1.15.6	KEVIN ENTERPRISES PVT LTD	INDIA	
1.15.7	PACE ENGINEERING INDUSTRIES PVT. LTD.	INDIA	
1.15.8	JEETMULL JAICHANDLALL PVT LTD INDIA	INDIA	
<b>1.16</b>	<b>COLUMN/TOWER CARBON STEEL</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
1.16.1	ALFA LAVAL INDIA LTD	INDIA	
1.16.2	ANUP ENGINEERING LIMITED (THE)	INDIA	
1.16.3	BHEL	INDIA	
1.16.4	BTL EPC LIMITED	INDIA	
1.16.5	ESSAR HEAVY ENGG SERVICES (UNIT OF EPIL)	INDIA	
1.16.6	EXPO GAS CONTAINERS LTD.	INDIA	
1.16.7	FABTECH PROJECTS & ENGINEERS LTD.	INDIA	
1.16.8	FAB-TECH WORKS & CONSTN. PVT LTD.	INDIA	



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<b>COMMON PROJECTS MASTER SUPPLIER LIST-SECTION-A (MECHANICAL EQUIPMENTS)</b>			
<b>Sr.No</b>	<b>VENDOR NAME</b>	<b>COUNTRY</b>	<b>REMARK</b>
1.16.9	GEECY ENGINEERING PVT LTD	INDIA	
1.16.10	GEMINI ENGI-FAB LTD	INDIA	
1.16.11	GODREJ & BOYCE MFG. CO. LTD.	INDIA	
1.16.12	GR ENGINEERNG PRIVATE LTD (TARAPORE)	INDIA	
1.16.13	IL SUNG ENGINEERING	INDIA	
1.16.14	INDIA TUBE MILLS & METALS INDIA LTD	INDIA	
1.16.15	INDUS PROJECTS LIMITED	INDIA	
1.16.16	INDUSTRIAL MANUFACTURERS INDIA	INDIA	
1.16.17	ISGEC HEAVY ENGINEERING LTD	INDIA	
1.16.18	ISGEC HITACHI ZOSEN LTD	INDIA	
1.16.19	LARSEN & TOUBRO LTD	INDIA	
1.16.20	LLOYDS STEELS INDUSTRIES LTD.	INDIA	
1.16.21	PHILS HEAVY ENGINEERING PVT LIMITED	INDIA	
1.16.22	PRAJ INDUSTRIES LIMITED	INDIA	
1.16.23	PRECISION EQUIPMENTS (CHENNAI) PVT LTD	INDIA	
1.16.24	R. D. ENGINEERS (INDIA) PVT. LTD	INDIA	
1.16.25	RAJ ENGINEERING COMPANY	INDIA	
1.16.26	SHARP TANKS & STRUCTURALS (P) LTD	INDIA	
1.16.27	TECHNO PROCESS EQUIPMENTS (INDIA) PV LTD	INDIA	
1.16.28	THE KCP LIMITED	INDIA	
1.16.29	UNIVERSAL HEAT EXCHANGERS LTD	INDIA	
1.16.30	VIJAY TANKS & VESSELS PVT LTD	INDIA	
1.16.31	WALCHANDNAGAR INDUSTRIES LTD.	INDIA	
<b>1.17</b>	<b>COLUMN/TOWER STAINLESS STEEL</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
1.17.1	ALFA LAVAL INDIA LTD	INDIA	
1.17.2	ANUP ENGINEERING LIMITED (THE)	INDIA	
1.17.3	BHEL	INDIA	
1.17.4	BTL EPC LIMITED	INDIA	
1.17.5	ESSAR HEAVY ENGG SERVICES (UNIT OF EPIL)	INDIA	
1.17.6	EXPO GAS CONTAINERS LTD.	INDIA	
1.17.7	FAB-TECH WORKS & CONSTN. PVT LTD.	INDIA	
1.17.8	GEECY ENGINEERING PVT LTD	INDIA	
1.17.9	GODREJ & BOYCE MFG. CO. LTD.	INDIA	
1.17.10	GR ENGINEERNG PRIVATE LTD (TARAPORE)	INDIA	
1.17.11	INDIA TUBE MILLS AND METALS INDIA LTD.	INDIA	
1.17.12	INDUS PROJECTS LIMITED	INDIA	
1.17.13	INDUSTRIAL MANUFACTURER	INDIA	
1.17.14	ISGEC HEAVY ENGINEERING LTD	INDIA	
1.17.15	ISGEC HITACHI ZOSEN LTD	INDIA	
1.17.16	LARSEN & TOUBRO LTD	INDIA	
1.17.17	LLOYDS STEELS INDUSTRIES LTD.	INDIA	





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<b>COMMON PROJECTS MASTER SUPPLIER LIST-SECTION-A (MECHANICAL EQUIPMENTS)</b>			
Sr.No	VENDOR NAME	COUNTRY	REMARK
1.17.18	PHILS HEAVY ENGINEERING PVT LIMITED	INDIA	
1.17.19	PRAJ INDUSTRIES LIMITED	INDIA	
1.17.20	R. D. ENGINEERS (INDIA) PVT. LTD	INDIA	
1.17.21	SHARP TANKS & STRUCTURALS (P) LTD	INDIA	
1.17.22	TECHNO PROCESS EQUIPMENTS (INDIA) PV LTD	INDIA	
1.17.23	THE KCP LIMITED	INDIA	
1.17.24	UNIVERSAL HEAT EXCHANGERS	INDIA	
1.17.25	VIJAY TANKS & VESSELS PVT LTD	INDIA	
<b>1.18</b>	<b>COLUMN/TOWER - LOW ALLOY STEEL</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
1.18.1	ANUP ENGINEERING LIMITED (THE)	INDIA	
1.18.2	BHEL	INDIA	
1.18.3	ESSAR HEAVY ENGG SERVICES (UNIT OF EPIL)	INDIA	
1.18.4	GODREJ & BOYCE MFG. CO. LTD.	INDIA	
1.18.5	GR ENGINEERNG PRIVATE LTD	INDIA	
1.18.6	ISGEC HEAVY ENGINEERING LTD	INDIA	
1.18.7	ISGEC HITACHI ZOSEN LTD	INDIA	
1.18.8	LARSEN & TOUBRO LTD	INDIA	
1.18.9	LLOYDS STEELS INDUSTRIES LTD.	INDIA	
1.18.10	PHILS HEAVY ENGINEERING PVT LIMITED	INDIA	
1.18.11	TECHNO PROCESS EQUIPMENTS (INDIA) PV LTD	INDIA	
1.18.12	VIJAY TANKS & VESSELS PVT LTD	INDIA	
<b>1.19</b>	<b>COLUMN/TOWER - LTCS</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
1.19.1	BHEL	INDIA	
1.19.2	ESSAR HEAVY ENGG SERVICES (UNIT OF EPIL)	INDIA	
1.19.3	EXPO GAS CONTAINERS LTD.	INDIA	
1.19.4	GODREJ & BOYCE MFG. CO. LTD.	INDIA	
1.19.5	GR ENGINEERNG PRIVATE LTD	INDIA	
1.19.6	INDIA TUBE MILLS & METALS LTD	INDIA	
1.19.7	INDUS PROJECTS LIMITED	INDIA	
1.19.8	INDUSTRIAL MANUFACTURERS INDIA	INDIA	
1.19.9	ISGEC HEAVY ENGINEERING LTD	INDIA	
1.19.10	ISGEC HITACHI ZOSEN LTD	INDIA	
1.19.11	LARSEN & TOUBRO LTD	INDIA	
1.19.12	LLOYDS STEELS INDUSTRIES LTD.	INDIA	
1.19.13	PHILS HEAVY ENGINEERING PVT LIMITED	INDIA	
1.19.14	R. D. ENGINEERS (INDIA) PVT. LTD	INDIA	
1.19.15	TECHNO PROCESS EQUIPMENTS (INDIA) PV LTD	INDIA	
1.19.16	UNIVERSAL HEAT EXCHANGERS LTD	INDIA	
1.19.17	VIJAY TANKS & VESSELS PVT LTD	INDIA	



<b>SECTION-A MECHANICAL EQUIPMENTS</b>		Doc. No.	IOCL-MSL-2020
<b>DOCUMENT TITLE :- PROJECT MASTER SUPPLIER LIST (PMSL)-IOCL-2020</b>		REV :	2
<b>M/s. INDIAN OIL CORPORATION LIMITED (IOCL)</b>		Date :	31-Oct-20
<b>COMMON PROJECTS MASTER SUPPLIER LIST-SECTION-A (MECHANICAL EQUIPMENTS)</b>			
Sr.No	VENDOR NAME	COUNTRY	REMARK
<b>1.20</b>	<b>COLUMN/TOWER-CS/LAS+SS CLADDED</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
1.20.1	ALFA LAVAL INDIA LTD	INDIA	
1.20.2	ANUP ENGINEERING LIMITED (THE)	INDIA	
1.20.3	BHEL	INDIA	
1.20.4	ESSAR HEAVY ENGG SERVICES (UNIT OF EPIL)	INDIA	
1.20.5	EXPO GAS CONTAINERS LTD.	INDIA	
1.20.6	GEECY ENGINEERING PVT LTD	INDIA	
1.20.7	GODREJ & BOYCE MFG. CO. LTD.	INDIA	
1.20.8	GR ENGINEERING PRIVATE LTD	INDIA	
1.20.9	INDUS PROJECTS LIMITED	INDIA	
1.20.10	INDUSTRIAL MANUFACTURERS	INDIA	
1.20.11	ISGEC HEAVY ENGINEERING LTD	INDIA	
1.20.12	ISGEC HITACHI ZOSEN LTD	INDIA	
1.20.13	LARSEN & TOUBRO LTD	INDIA	
1.20.14	LLOYDS STEELS INDUSTRIES LTD.	INDIA	
1.20.15	PHILS HEAVY ENGINEERING PVT LIMITED	INDIA	
1.20.16	R. D. ENGINEERS (INDIA) PVT. LTD	INDIA	
1.20.17	TECHNO PROCESS EQUIPMENTS (INDIA) PV LTD	INDIA	
1.20.18	VIJAY TANKS & VESSELS PVT LTD	INDIA	
<b>1.21</b>	<b>COLUMN - MONEL CLAD</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
1.21.1	BHEL	INDIA	
1.21.2	ESSAR HEAVY ENGG SERVICES (UNIT OF EPIL)	INDIA	
1.21.3	EXPO GAS CONTAINERS LTD.	INDIA	
1.21.4	GEECY ENGINEERING PVT LTD	INDIA	
1.21.5	GODREJ & BOYCE MFG. CO. LTD.	INDIA	
1.21.6	ISGEC HEAVY ENGINEERING LTD	INDIA	
1.21.7	ISGEC HITACHI ZOSEN LTD	INDIA	
1.21.8	LARSEN & TOUBRO LTD	INDIA	
1.21.9	PHILS HEAVY ENGINEERING PVT LIMITED	INDIA	
1.21.10	R. D. ENGINEERS (INDIA) PVT. LTD	INDIA	
1.21.11	TECHNO PROCESS EQUIPMENTS (INDIA) PV LTD	INDIA	
<b>1.22</b>	<b>CCR PLATFORMING REACTOR</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
1.22.1	GODREJ & BOYCE MFG. CO. LTD.	INDIA	
1.22.2	ISGEC HEAVY ENGINEERING LTD	INDIA	
1.22.3	LARSEN & TOUBRO LTD	INDIA	
<b>1.23</b>	<b>REACTOR/SEPARATOR-SS CLAD 1.25 Cr 0.5 MO</b>		



<b>SECTION-A MECHANICAL EQUIPMENTS</b>		Doc. No.	IOCL-MSL-2020
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<b>COMMON PROJECTS MASTER SUPPLIER LIST-SECTION-A (MECHANICAL EQUIPMENTS)</b>			
Sr.No	VENDOR NAME	COUNTRY	REMARK
<b>A</b>	<b>INDIAN BIDDERS</b>		
1.23.1	ESSAR HEAVY ENGG SERVICES (UNIT OF EPIL)	INDIA	
1.23.2	GODREJ & BOYCE MFG. CO. LTD.	INDIA	
1.23.3	ISGEC HEAVY ENGINEERING LTD	INDIA	
1.23.4	ISGEC HITACHI ZOSEN LTD	INDIA	
1.23.5	LARSEN & TOUBRO LTD	INDIA	
1.23.6	TECHNO PROCESS EQUIPMENTS (INDIA) PV LTD	INDIA	
<b>1.24</b>	<b>REACTOR/SEPARATOR-SS CLAD-2.25 Cr-1 Mo</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
1.24.1	GODREJ & BOYCE MFG. CO. LTD.	INDIA	
1.24.2	ISGEC HEAVY ENGINEERING LTD	INDIA	
1.24.3	ISGEC HITACHI ZOSEN LTD	INDIA	
1.24.4	LARSEN & TOUBRO LTD	INDIA	
<b>1.25</b>	<b>REACTOR/SEPARATOR- CLAD 2.25Cr 1Mo 0.25V</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
1.25.1	ISGEC HITACHI ZOSEN LTD	INDIA	
1.25.2	LARSEN & TOUBRO LTD	INDIA	
<b>1.26</b>	<b>COLUMN/TOWER-CS (51-100MM THK)</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
1.26.1	BHEL	INDIA	
1.26.2	ESSAR HEAVY ENGG SERVICES (UNIT OF EPIL)	INDIA	
1.26.3	GODREJ & BOYCE MFG. CO. LTD.	INDIA	
1.26.4	GR ENGINEERNG PRIVATE LTD (TARAPORE)	INDIA	
1.26.5	INDUS PROJECTS LIMITED	INDIA	
1.26.6	ISGEC HEAVY ENGINEERING LTD	INDIA	
1.26.7	ISGEC HITACHI ZOSEN LTD	INDIA	
1.26.8	LARSEN & TOUBRO LTD	INDIA	
1.26.9	LLOYDS STEELS INDUSTRIES LTD.	INDIA	
1.26.10	PHILS HEAVY ENGINEERING PVT LIMITED	INDIA	
1.26.11	TECHNO PROCESS EQUIPMENTS (INDIA) PV LTD	INDIA	
1.26.12	VIJAY TANKS & VESSELS PVT LTD	INDIA	
<b>1.27</b>	<b>HEAT EXCHANGER CARBON STEEL</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
1.27.1	ADOR WELDING LTD.	INDIA	
1.27.2	AERO ENGINEERS	INDIA	
1.27.3	ALFA LAVAL INDIA LTD	INDIA	
1.27.4	ANUP ENGINEERING LIMITED (THE)	INDIA	
1.27.5	BHEL	INDIA	
1.27.6	BTL EPC LIMITED	INDIA	
1.27.7	BUILDWORTH LIMITED	INDIA	
1.27.8	CICB-CHEMICON PVT.LTD.	INDIA	



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<b>COMMON PROJECTS MASTER SUPPLIER LIST-SECTION-A (MECHANICAL EQUIPMENTS)</b>			
Sr.No	VENDOR NAME	COUNTRY	REMARK
1.27.9	COPERION IDEAL PVT. LTD.	INDIA	
1.27.10	ESSAR HEAVY ENGG SERVICES (UNIT OF EPIL)	INDIA	
1.27.11	EXPO GAS CONTAINERS LTD.	INDIA	
1.27.12	GANSONS LTD	INDIA	
1.27.13	GEECY ENGINEERING PVT LTD	INDIA	
1.27.14	GMM PFAUDLER LTD	INDIA	
1.27.15	GODREJ & BOYCE MFG. CO. LTD.	INDIA	
1.27.16	GR ENGINEERING PRIVATE LTD (TARAPORE)	INDIA	
1.27.17	INDCON PROJECTS & EQUIPMENTS LTD	INDIA	
1.27.18	INDIA TUBE MILLS AND METAL INDUSTRIES LTD.	INDIA	
1.27.19	INDUS PROJECTS LIMITED	INDIA	
1.27.20	INDUSTRIAL MANUFACTURERS	INDIA	
1.27.21	ISGEC HEAVY ENGINEERING LTD	INDIA	
1.27.22	ISGEC HITACHI ZOSEN LTD	INDIA	
1.27.23	LARSEN & TOUBRO LTD	INDIA	
1.27.24	LLOYDS STEELS INDUSTRIES LTD.	INDIA	
1.27.25	MEENAKSHI ASSOCIATES PVT LTD	INDIA	
1.27.26	MULTIMAX ENGINEERING WORKS PVT LTD	INDIA	Rev.1: Name Change
1.27.27	NEW FIELD INDUSTRIAL EQUIPMENT PVT LTD	INDIA	
1.27.28	NEWTON ENGG & CHEMICALS LTD	INDIA	
1.27.29	ORIENTAL ENTERPRISE PVT. LTD	INDIA	
1.27.30	PATELS AIRTEMP (INDIA) LTD	INDIA	
1.27.31	PHILS HEAVY ENGINEERING PVT LIMITED	INDIA	
1.27.32	PRABHA STEEL INDUSTRIES	INDIA	
1.27.33	PRECISION EQUIPMENTS (CHENNAI) PVT LTD	INDIA	
1.27.34	R. D. ENGINEERS (INDIA) PVT. LTD	INDIA	
1.27.35	RADIANT HEAT EXCHANGER PVT.LTD.	INDIA	
1.27.36	RAJ ENGINEERING COMPANY	INDIA	
1.27.37	RELIANCE FABRICATIONS PVT LTD	INDIA	
1.27.38	TECHNO PROCESS EQUIPMENTS (INDIA) PV LTD	INDIA	
1.27.39	TEMA INDIA LTD.	INDIA	
1.27.40	TEMASME VESELEX INDIA PVT. LTD.	INDIA	
1.27.41	TITANIUM EQUIPMENT AND ANODE MFG.CO.LTD	INDIA	
1.27.42	WALCHANDNAGAR INDUSTRIES LTD.	INDIA	
<b>1.28</b>	<b>HEAT EXCHANGER-ROD AND PLATE TYPE BAFFLE</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
	NO INDIAN BIDDER AVAILABLE		
<b>1.29</b>	<b>HEAT EXCHANGER STAINLESS STEEL.</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
1.29.1	ADOR WELDING LTD.	INDIA	
1.29.2	AERO ENGINEERS	INDIA	



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<b>COMMON PROJECTS MASTER SUPPLIER LIST-SECTION-A (MECHANICAL EQUIPMENTS)</b>			
<b>Sr.No</b>	<b>VENDOR NAME</b>	<b>COUNTRY</b>	<b>REMARK</b>
1.29.3	ALFA LAVAL INDIA LTD	INDIA	
1.29.4	ANUP ENGINEERING LIMITED (THE)	INDIA	
1.29.5	BHEL	INDIA	
1.29.6	BTL EPC LIMITED	INDIA	
1.29.7	CICB-CHEMICON PVT.LTD.	INDIA	
1.29.8	COPERION IDEAL PVT. LTD.	INDIA	
1.29.9	ESSAR HEAVY ENGG SERVICES (UNIT OF EPIL)	INDIA	
1.29.10	GANSONS LTD	INDIA	
1.29.11	GEECY ENGINEERING PVT LTD	INDIA	
1.29.12	GMM PFAUDLER LTD	INDIA	
1.29.13	GODREJ & BOYCE MFG. CO. LTD.	INDIA	
1.29.14	GR ENGINEERNG PRIVATE LTD (TARAPORE)	INDIA	
1.29.15	INDCON PROJECTS & EQUIPMENTS LTD	INDIA	
1.29.16	INDIA TUBE MILLS & METALS LTD	INDIA	
1.29.17	INDUS PROJECTS LIMITED	INDIA	
1.29.18	INDUSTRIAL MANUFACTURERS	INDIA	
1.29.19	ISGEC HEAVY ENGINEERING LTD	INDIA	
1.29.20	ISGEC HITACHI ZOSEN LTD	INDIA	
1.29.21	LARSEN & TOUBRO LTD	INDIA	
1.29.22	LLOYDS STEELS INDUSTRIES LTD.	INDIA	
1.29.23	NEW FIELD INDUSTRIAL EQUIPMENT PVT LTD	INDIA	
1.29.24	ORIENTAL ENTERPRISE PVT. LTD	INDIA	
1.29.25	PATELS AIRTEMP (INDIA) LTD	INDIA	
1.29.26	PHILS HEAVY ENGINEERING PVT LIMITED	INDIA	
1.29.27	PRABHA STEEL INDUSTRIES	INDIA	
1.29.28	PRECISION EQUIPMENTS (CHENNAI) PVT LTD	INDIA	
1.29.29	RADIANT HEAT EXCHANGER PVT.LTD.	INDIA	
1.29.30	RAJ ENGINEERING COMPANY	INDIA	
1.29.31	RELIANCE FABRICATIONS PVT LTD	INDIA	
1.29.32	TECHNO PROCESS EQUIPMENTS (INDIA) PV LTD	INDIA	
1.29.33	TEMA INDIA LTD	INDIA	
1.29.34	TITANIUM EQUIPMENT AND ANODE MFG.CO.LTD	INDIA	
1.29.35	UNIVERSAL HEAT EXCHANGERS LTD.	INDIA	
1.29.36	WALCHANDNAGAR INDUSTRIES LTD.	INDIA	
<b>1.30</b>	<b>HEAT EXCHANGER LOW ALLOY STEEL</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
1.30.1	ANUP ENGINEERING LIMITED (THE)	INDIA	
1.30.2	BHEL	INDIA	
1.30.3	ESSAR HEAVY ENGG SERVICES (UNIT OF EPIL)	INDIA	
1.30.4	GEECY ENGINEERING PVT LTD	INDIA	
1.30.5	GEMINI ENGI-FAB LIMITED	INDIA	
1.30.6	GNASONS	INDIA	



<b>SECTION-A MECHANICAL EQUIPMENTS</b>		Doc. No.	IOCL-MSL-2020
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<b>M/s. INDIAN OIL CORPORATION LIMITED (IOCL)</b>		Date :	31-Oct-20
<b>COMMON PROJECTS MASTER SUPPLIER LIST-SECTION-A (MECHANICAL EQUIPMENTS)</b>			
Sr.No	VENDOR NAME	COUNTRY	REMARK
1.30.7	GODREJ & BOYCE MFG. CO. LTD.	INDIA	
1.30.8	GR ENGINEERNG PRIVATE LTD (TARAPORE)	INDIA	
1.30.9	INDUSTRIAL MANUFACTURERS	INDIA	
1.30.10	ISGEC HEAVY ENGINEERING LTD	INDIA	
1.30.11	ISGEC HITACHI ZOSEN LTD	INDIA	
1.30.12	LARSEN & TOUBRO LTD	INDIA	
1.30.13	LLYODS STEEL INDUSTRIES LTD	INDIA	
1.30.14	PATELS AIRTEMP (INDIA) LTD	INDIA	
1.30.15	PHILS HEAVY ENGINEERING PVT LIMITED	INDIA	
1.30.16	PRECISION EQUIPMENTS (CHENNAI) PVT LTD	INDIA	
1.30.17	TECHNO PROCESS EQUIPMENTS (INDIA) PV LTD	INDIA	
1.30.18	TEMA INDIA LTD	INDIA	
1.30.19	TITANIUM EQUIPMENT AND ANODE MFG.CO.LTD	INDIA	
1.30.20	UNIVERSAL HEAT EXCHANGERS	INDIA	
1.30.21	WALCHANDNAGAR INDUSTRIES LTD.	INDIA	
<b>1.31</b>	<b>HEAT EXCHANGER LTCS.</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
1.31.1	AERO ENGINEERS	INDIA	
1.31.2	ANUP ENGINEERING LIMITED (THE)	INDIA	
1.31.3	BHEL	INDIA	
1.31.4	ESSAR HEAVY ENGG SERVICES (UNIT OF EPIL)	INDIA	
1.31.5	GMM PFAUDLER LTD	INDIA	
1.31.6	GODREJ & BOYCE MFG. CO. LTD.	INDIA	
1.31.7	GR ENGINEERNG PRIVATE LTD (TARAPORE)	INDIA	
1.31.8	INDIA TUBE MILLS AND METAL INDIA LTD.	INDIA	
1.31.9	ISGEC HEAVY ENGINEERING LTD	INDIA	
1.31.10	ISGEC HITACHI ZOSEN LTD	INDIA	
1.31.11	LARSEN & TOUBRO LTD	INDIA	
1.31.12	MEENAKSHI ASSOCIATES PVT. LTD.	INDIA	
1.31.13	NEW FIELD INDUSTRIAL EQUIPMENT PVT LTD	INDIA	
1.31.14	PATELS AIRTEMP (INDIA) LTD	INDIA	
1.31.15	PHILS HEAVY ENGINEERING PVT LIMITED	INDIA	
1.31.16	PRECISION EQUIPMENTS (CHENNAI) PVT LTD	INDIA	
1.31.17	RAJ ENGINEERING COMPANY	INDIA	
1.31.18	TECHNO PROCESS EQUIPMENTS (INDIA) PV LTD	INDIA	
1.31.19	TEMA INDIA LTD	INDIA	
1.31.20	TEMASME VESELEX INDIA PVT. LTD.	INDIA	
1.31.21	UNIVERSAL HEAT EXCHANGERS	INDIA	
<b>1.32</b>	<b>HEAT EXCHANGER 3.5 % NI STEEL</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
1.32.1	ANUP ENGINEERING LIMITED (THE)	INDIA	



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<b>COMMON PROJECTS MASTER SUPPLIER LIST-SECTION-A (MECHANICAL EQUIPMENTS)</b>			
Sr.No	VENDOR NAME	COUNTRY	REMARK
1.32.2	BHEL	INDIA	
1.32.3	GODREJ & BOYCE MFG. CO. LTD.	INDIA	
1.32.4	INDUS PROJECTS LIMITED	INDIA	
1.32.5	LARSEN & TOUBRO LTD	INDIA	
1.32.6	TITANIUM EQUIPMENT AND ANODE MFG.CO.LTD.	INDIA	
1.32.7	UNIVERSAL HEAT EXCHANGERS LTD.	INDIA	
<b>1.33</b>	<b>HEAT EXCHANGER-CS/LAS+SS CLAD</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
1.33.1	ALFA LAVAL INDIA LTD	INDIA	
1.33.2	ANUP ENGINEERING LIMITED (THE)	INDIA	
1.33.3	BHEL	INDIA	
1.33.4	ESSAR HEAVY ENGG SERVICES (UNIT OF EPIL)	INDIA	
1.33.5	GEECY ENGINEERING PVT LTD	INDIA	
1.33.6	GODREJ & BOYCE MFG. CO. LTD.	INDIA	
1.33.7	GR ENGINEERNG PRIVATE LTD (TARAPORE)	INDIA	
1.33.8	INDIA TUBE MILLS AND METAL INDIA LTD.	INDIA	
1.33.9	INDUSTRIAL MANUFACTURERS	INDIA	
1.33.10	ISGEC HEAVY ENGINEERING LTD	INDIA	
1.33.11	ISGEC HITACHI ZOSEN LTD	INDIA	
1.33.12	LARSEN & TOUBRO LTD	INDIA	
1.33.13	PATELS AIRTEMP (INDIA) LTD	INDIA	
1.33.14	PHILS HEAVY ENGINEERING PVT LIMITED	INDIA	
1.33.15	PRECISION EQUIPMENTS (CHENNAI) PVT LTD	INDIA	
1.33.16	TECHNO PROCESS EQUIPMENTS (INDIA) PV LTD	INDIA	
1.33.17	TEMA INDIA LIMITED	INDIA	
1.33.18	TITANIUM EQUIPMENT AND ANODE MFG.CO.LTD	INDIA	
1.33.19	WALCHANDNAGAR INDUSTRIES LTD.	INDIA	
1.33.20	UNIVERSAL HEAT EXCHANGERS	INDIA	
<b>1.34</b>	<b>HEAT EXCHANGER (PLATES-WELDED)</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
1.34.1	ALFA LAVAL INDIA LTD	INDIA	
1.34.2	DOVER INDIA PVT LTD	INDIA	
1.34.3	IDMC LTD	INDIA	
1.34.4	FUNKE HEAT EXCHANGERS INDIA LTD.	INDIA	
1.34.5	KELVION INDIA PRIVATE LIMITED	INDIA	
1.34.6	SONDEX HEAT EXCHANGERS INDIA PVT. LTD.	INDIA	
1.34.7	TRANter INDIA PRIVATE LIMITED	INDIA	
1.34.8	GEA ECOFLEX INDIA PVT LTD (GEA GROUP)	INDIA	
1.34.9	GEA VIEX INC (GEA GROUP)	INDIA	
<b>1.35</b>	<b>HEAT EXCHANGERS (PLATE -GASKETTED)</b>		



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<b>COMMON PROJECTS MASTER SUPPLIER LIST-SECTION-A (MECHANICAL EQUIPMENTS)</b>			
<b>Sr.No</b>	<b>VENDOR NAME</b>	<b>COUNTRY</b>	<b>REMARK</b>
<b>A</b>	<b>INDIAN BIDDERS</b>		
1.35.1	ALFA LAVAL INDIA LTD	INDIA	
1.35.2	FUNKE HEAT EXCHANGERS INDIA LTD.	INDIA	
1.35.3	KELVION INDIA PRIVATE LIMITED	INDIA	
1.35.4	IDMC LIMITED	INDIA	
1.35.5	LARSEN & TOUBRO LTD	INDIA	
1.35.6	GEA ECOFLEX INDIA PVT LTD (GEA GROUP)	INDIA	
1.35.7	SONDEX HEAT EXCHANGERS INDIA PVT. LTD.	INDIA	
1.35.8	TRANTER INDIA PRIVATE LIMITED	INDIA	
<b>1.36</b>	<b>HEAT EXCHANGER NF- (BRASS, CU-Ni)</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
1.36.1	AERO ENGINEERS	INDIA	
1.36.2	ALFA LAVAL INDIA LTD	INDIA	
1.36.3	BHEL	INDIA	
1.36.4	CICB-CHEMICON PVT.LTD.	INDIA	
1.36.5	ESSAR HEAVY ENGG SERVICES (UNIT OF EPIL)	INDIA	
1.36.6	GEMINI ENGI-FAB LIMITED	INDIA	
1.36.7	GODREJ & BOYCE MFG. CO. LTD.	INDIA	
1.36.8	GR ENGINEERING PRIVATE LTD (TARAPORE)	INDIA	
1.36.9	INDIA TUBE MILLS & METALS IND. LTD.	INDIA	
1.36.10	INDUSTRIAL MANUFACTURERS	INDIA	
1.36.11	ISGEC HEAVY ENGINEERING LTD	INDIA	
1.36.12	LARSEN & TOUBRO LTD	INDIA	
1.36.13	PATELS AIRTEMP (INDIA) LTD	INDIA	
1.36.14	PRECISION EQUIPMENTS (CHENNAI) PVT LTD	INDIA	
1.36.15	REYNOLDS CHEM EQUIP PVT LTD	INDIA	
1.36.16	TECHNO PROCESS EQUIPMENTS (INDIA) PV LTD	INDIA	
1.36.17	TEMA INDIA LIMITED	INDIA	
1.36.18	UNIVERSAL HEAT EXCHANGERS	INDIA	
1.36.19	WALCHANDNAGAR INDUSTRIES LTD.	INDIA	
<b>1.37</b>	<b>AIR FIN COOLER (CS &amp; SS)</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
1.37.1	AKSHAR PRECISION TUBES PVT LIMITED	INDIA	
1.37.2	APPLIED ENGINEERING SINGAPORE/ APPLIED ENGINEERING PTE LTD	INDIA	
1.37.3	BGR ENERGY SYSTEMS LIMITED	INDIA	
1.37.4	BHEL	INDIA	
1.37.5	ENGINEMATES HEAT TRANSFER PVT. LTD.	INDIA	
1.37.6	GEA Bt INDIA /INTERNATIONAL	INDIA	
1.37.7	JORD INTERNATIONAL PVT Ltd - AUSTRALIA	INDIA	
1.37.8	KELVION INDIA PRIVATE LIMITED	INDIA	
1.37.9	KNM INTERNATIONAL	INDIA	





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Sr.No	VENDOR NAME	COUNTRY	REMARK
1.37.10	LARSEN & TOUBRO LTD	INDIA	
1.37.11	PAHARPUR COOLING TOWERS LTD.	INDIA	
1.37.12	PATELS AIRTEMP (INDIA) LTD	INDIA	
1.37.13	GEI INDUSTRIAL SYSTEM LTD	INDIA	
<b>1.38</b>	<b>AIR FIN COOLERS (DUPLEX SS)</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
1.38.1	KELVION INDIA PRIVATE LIMITED	INDIA	
1.38.2	BGR ENERGY SYSTEMS LIMITED	INDIA	
1.38.3	BHEL	INDIA	
1.38.4	GEI INDUSTRIAL SYSTEM LTD	INDIA	
<b>1.39</b>	<b>SAMPLE COOLER</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
1.39.1	AERO ENGINEERS	INDIA	
1.39.2	CHEMTRON SCIENCE LABORATORIES PVT. LTD. INDIA	INDIA	
1.39.3	ENPRO INDUSTRIES PVT LTD	INDIA	
1.39.4	FLOWLINE INSTRUMENTATION PVT. LTD. INDIA	INDIA	
1.39.5	FORBES MARSHALL PVT. LTD. INDIA	INDIA	
1.39.6	GRAND PRIX ENGINEERING PVT LTD.	INDIA	
1.39.7	GRASIM INDUSTRIES	INDIA	
1.39.8	MEENAKSHI ASSOCIATES PVT LTD	INDIA	
1.39.9	PRECISION EQUIPMENTS (CHENNAI) PVT LTD	INDIA	
1.39.10	RELIANCE FABRICATIONS PVT LTD	INDIA	
1.39.11	TUBE WELD ENGINEERING WORKS LTD.	INDIA	
<b>1.40</b>	<b>CRYOGENIC VAPORIZER-DIRECT STEAM HEATED</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
	NO INDIAN BIDDER AVAILABLE		
<b>1.41</b>	<b>HEAT EXCHANGER (AL. BRAZED FIN TYPE)</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
1.41.1	SUMITOMO PRECISION PRODUCTS CO LTD	INDIA	
<b>1.42</b>	<b>HEAT EXCH. MONEL / MONEL CLAD</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
1.42.1	ALFA LAVAL INDIA LTD	INDIA	
1.42.2	ESSAR HEAVY ENGG SERVICES (UNIT OF EPIL)	INDIA	
1.42.3	GR ENGINEERNG PRIVATE LTD (TARAPORE)	INDIA	
1.42.4	PRECISION EQUIPMENTS (CHENNAI) PVT LTD	INDIA	
1.42.5	TITANIUM EQUIPMENT AND ANODE MFG.CO.LTD	INDIA	
1.42.6	TEMA INDIA LTD	INDIA	



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Sr.No	VENDOR NAME	COUNTRY	REMARK
<b>1.43</b>	<b>HEAT EXCH. NICKEL / NICKEL CLAD</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
1.43.1	ALFA LAVAL INDIA LTD	INDIA	
1.43.2	PRECISION EQUIPMENTS (CHENNAI) PVT LTD	INDIA	
1.43.3	TITANIUM EQUIPMENT AND ANODE MFG.CO.LTD	INDIA	
<b>1.44</b>	<b>HEAT EXCH. HASTALLOY / HASTALLOY CLAD</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
1.44.1	ALFA LAVAL INDIA LTD	INDIA	
1.44.2	ESSAR HEAVY ENGG SERVICES (UNIT OF EPIL)	INDIA	
1.44.3	TITANIUM EQUIPMENT AND ANODE MFG.CO.LTD	INDIA	
1.44.4	TEMA INDIA LTD	INDIA	
<b>1.45</b>	<b>ELECTRIC HEATER</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
1.45.1	ESCORTS LIMITED	INDIA	
1.45.2	ETIREX CHROMALOX	INDIA	
1.45.3	SANDVIK ASIA PVT LTD-KANTHAL DIVISION	INDIA	
1.45.4	KANTILAL, CHUNILAL & SONS	INDIA	Rev.1: Addition
<b>1.46</b>	<b>HEAT EXCHANGER SS-DUPLEX</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
1.46.1	ALFA LAVAL INDIA LTD	INDIA	
1.46.2	ANUP ENGINEERING LIMITED (THE)	INDIA	
1.46.3	BHEL	INDIA	
1.46.4	GODREJ & BOYCE MFG. CO. LTD.	INDIA	
1.46.5	GR ENGINEERNG PRIVATE LTD (TARAPORE)	INDIA	
1.46.6	INDUSTRIAL MANUFACTURERS INDIA	INDIA	
1.46.7	ISGEC HEAVY ENGINEERING LTD	INDIA	
1.46.8	LARSEN & TOUBRO LTD	INDIA	
1.46.9	PATELS AIR TEMP	INDIA	
1.46.10	PRECISION EQUIPMENTS (CHENNAI) PVT LTD	INDIA	
1.46.11	REYNODS CHEM EQUIP PVT LTD	INDIA	
1.46.12	TITANIUM EQUIPMENT AND ANODE MFG.CO.LTD	INDIA	
1.46.13	TEMA INDIA LTD	INDIA	
1.46.14	UNIVERSAL	INDIA	
1.46.15	WALCHANNAGAR INDUSTRIES LTD	INDIA	
1.46.16	TECHNO PROCESS EQUIPMENTS (INDIA) PV LTD	INDIA	Rev.1: Name Change
<b>1.47</b>	<b>HEAT EXCHANGER - ALLOY 625</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
1.47.1	FLASH FORGE PVT LTD.	INDIA	
1.47.2	GODREJ & BOYCE	INDIA	



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<b>Sr.No</b>	<b>VENDOR NAME</b>	<b>COUNTRY</b>	<b>REMARK</b>
1.47.3	ISGEC	INDIA	
1.47.4	LARSEN & TOUBRO	INDIA	
1.47.5	PRECISION EQUIPMENTS (CHENNAI) PVT LTD	INDIA	
1.47.6	TEMA INDIA LIMITED	INDIA	
1.47.7	TITANIUM EQUIPMENT AND ANODE MFG.CO.LTD	INDIA	
<b>1.48</b>	<b>LOUVERS FOR AIR FIN COOLERS</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
1.48.1	GEI INDUSTRIAL SYSTEM LTD	INDIA	
<b>1.49</b>	<b>EJECTOR (ENGINEERED)</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
1.49.1	BHEL	INDIA	
1.49.2	CRYSTAL INDUSTRIAL SYNDICATE PVT LTD.	INDIA	
1.49.3	GODREJ & BOYCE MFG. CO. LTD.	INDIA	
1.49.4	MAZDA LIMITED	INDIA	
1.49.5	MICRO PRECISION PRODUCTS PVT LTD	INDIA	
1.49.6	NEW FIELD INDUSTRIAL EQUIPMENT PVT LTD	INDIA	
1.49.7	SSP PVT LTD	INDIA	
<b>1.50</b>	<b>EJECTOR (UNENGINEERED)</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
1.50.1	CHEM PROCESS SYSTEM PVT. LTD.	INDIA	
1.50.2	MAZDA LIMITED	INDIA	
1.50.3	NEW FIELD INDUSTRIAL EQUIPMENT PVT LTD	INDIA	
<b>1.51</b>	<b>SILENCER</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
1.51.1	ACOUSTICS INDIA PVT LTD	INDIA	
1.51.2	BBM ACOUSTIC INDIA PVT LTD	INDIA	
1.51.3	BURGESS MANNING(INDIA) PVT LTD	INDIA	
1.51.4	FLO-DYNE CONTROLS(INDIA)PVT LTD	INDIA	
1.51.5	GRAND PRIX ENGINEERING PVT LTD.	INDIA	
1.51.6	INDIRA INDUSTRIES	INDIA	
1.51.7	MICROPRECESION PRODUCTS	INDIA	
1.51.8	PR ACOUSTICAL & ENGINEERING WORKS(P)LTD	INDIA	
<b>1.52</b>	<b>VACUUM EJECTOR CONDENSER SYS(ENGINEERED)</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
1.52.1	GODREJ & BOYCE MFG. CO. LTD	INDIA	
1.52.2	BHEL	INDIA	
<b>1.53</b>	<b>VACUUM EJECTOR CONDSR SYS (UNENGINEERED)</b>		



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Sr.No	VENDOR NAME	COUNTRY	REMARK
<b>A</b>	<b>INDIAN BIDDERS</b>		
1.53.1	BHARAT HEAVY ELECTRICALS LTD	INDIA	
1.53.2	NEW FIELD INDUSTRIAL EQUIPMENT	INDIA	
1.53.3	SSP LTD	INDIA	
<b>1.54</b>	<b>DEMISTER-VANE TYPE</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
1.54.1	FINEPAC STRUCTURES PVT. LTD.	INDIA	
1.54.2	GRAND PRIX ENGINEERING PVT LTD	INDIA	
1.54.3	MUNTERS INDIA HUMIDITY CONTROL PVT. LTD.	INDIA	
1.54.4	KOCH CHEMICAL TECH. GROUP INDIA PVT LTD	INDIA	
1.54.5	SULZER INDIA LIMITED	INDIA	
<b>1.55</b>	<b>EXPANSION JOINT-METALLIC</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
1.55.1	FLEXATHERM EXPANLLOW PVT LTD	INDIA	
1.55.2	FLEXICAN BELLOWS AND HOSES PRIVATE LIMITED	INDIA	
1.55.3	FLEXOCON ENGINEERS PRIVATE LIMITED	INDIA	
1.55.4	LONESTAR INDUSTRIES	INDIA	
1.55.5	METALLIC BELLOWS (INDIA) PRIVATE LIMITED	INDIA	
1.55.6	WITZENMANN GMBH	INDIA	
<b>1.56</b>	<b>AIR PRE-HEATER (CAST)</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
1.56.1	KAMAL ENGINEERING CORPORATION	INDIA	
<b>1.57</b>	<b>AIR PRE-HEATER (GLASS TUBE)</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
1.57.1	KAMAL ENGINEERING CORPORATION	INDIA	
<b>1.58</b>	<b>BURNER-CONVENTIONAL</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
1.58.1	AIROIL FLAREGAS (INDIA) LTD.	INDIA	
1.58.2	JOHN ZINK INTERNATIONAL LUXEMBOURG SARL	INDIA	
<b>1.59</b>	<b>BURNER-LOW NO<sub>x</sub> (PROCESS FIRED HEATER)</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
1.59.1	JOHN ZINK INTERNATIONAL LUXEMBOURG SARL	INDIA	
<b>1.60</b>	<b>BURNER-SRU</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
1.60.1	JOHN ZINK INTERNATIONAL LUXEMBOURG SARL	INDIA	



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Sr.No	VENDOR NAME	COUNTRY	REMARK
<b>1.61</b>	<b>AIR HEATER (DIRECT FIRED)</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
1.61.1	JOHN ZINK INTERNATIONAL LUXEMBOURG SARL	INDIA	
<b>1.62</b>	<b>LNG VAPORIZER</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
	NO INDIAN BIDDER AVAILABLE		
<b>1.63</b>	<b>TOWER PACKING: METALLIC (NON-PROPRIETARY)</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
1.63.1	HI-PACK MASS TRANSFER PRODUCTS	INDIA	
1.63.2	MUNTERS INDIA HUMIDITY CONTROL PVT. LTD.	INDIA	
1.63.3	KOCH CHEMICAL TECH. GROUP INDIA PVT LTD	INDIA	
1.63.4	MASS TRANSFER PRODUCT INDUSTRIES	INDIA	
1.63.5	KEVIN ENTERPRISES PVT LTD	INDIA	
1.63.6	SWAN ENTERPRISES PVT LTD	INDIA	
<b>1.64</b>	<b>TOWER PCKG &amp; ASSTD INTL: METALLIC (PROPRIETARY)</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
1.64.1	MUNTERS INDIA HUMIDITY CONTROL PVT. LTD.	INDIA	
1.64.2	KOCH CHEMICAL TECH. GROUP INDIA PVT LTD	INDIA	
1.64.3	SULZER INDIA LIMITED	INDIA	
1.64.4	KEVIN ENTERPRISES PVT LTD	INDIA	
<b>1.65</b>	<b>TOWER PKG:NON METALLIC(PROPRIETARY)</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
1.65.1	KOCH CHEMICAL TECH. GROUP INDIA PVT LTD	INDIA	
1.65.2	KOCH GLITSCH	INDIA	
1.65.3	SULZER INDIA PVT LTD	INDIA	
1.65.4	KEVIN ENTERPRISES (MUNTER)	INDIA	
<b>1.66</b>	<b>TOWER PACKING: CERAMIC</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
1.66.1	DEVSON INSULATORS PVT. LTD.	INDIA	
1.66.2	TOPACK CERAMICS PVT LTD	INDIA	
1.66.3	Khyati Ceramics	INDIA	
1.66.4	Fullmoon Industrial Ceramics (P) Ltd	INDIA	
1.66.5	Filtra Catalysts & Chemicals Limited	INDIA	
1.66.6	Nilgiri Chemical Stoneware Co. Private Limited	INDIA	
1.66.7	Oxide (India) Pvt. Ltd	INDIA	
1.66.8	Excel Micron Poona PVT LTD	INDIA	
<b>1.67</b>	<b>COLUMN TRAYS-HIGH CAPACITY</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		



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Sr.No	VENDOR NAME	COUNTRY	REMARK
1.67.1	MUNTERS INDIA HUMIDITY CONTROL PVT. LTD.	INDIA	
1.67.2	KOCH CHEMICAL TECH. GROUP INDIA PVT LTD	INDIA	
1.67.3	SULZER INDIA LIMITED	INDIA	
1.67.4	UOP	INDIA	
1.67.5	KEVIN ENTERPRISES PVT LTD	INDIA	
<b>1.68</b>	<b>NON-PROP. PACKGS WITH CONVENL INTERNALS</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
1.68.1	GODREJ & BOYCE MFG. CO. LTD.	INDIA	
1.68.2	KAMAL ENGINEERING CORPORATION	INDIA	
1.68.3	MUNTERS INDIA HUMIDITY CONTROL PVT. LTD.	INDIA	
1.68.4	KOCH CHEMICAL TECH. GROUP INDIA PVT LTD	INDIA	
1.68.5	LARSEN & TOUBRO LTD	INDIA	
1.68.6	SULZER INDIA LIMITED	INDIA	
1.68.7	KEVIN ENTERPRISES PVT LTD	INDIA	
<b>1.69</b>	<b>NON-PROP PKG,HIGH QUAL DISR&amp; INL-UN ENGIN</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
1.69.1	GODREJ & BOYCE MFG. CO. LTD.	INDIA	
1.69.2	KAMAL ENGINEERING CORPORATION	INDIA	
1.69.3	MUNTERS INDIA HUMIDITY CONTROL PVT. LTD.	INDIA	
1.69.4	KOCH CHEMICAL TECH. GROUP INDIA PVT LTD	INDIA	
1.69.5	SULZER INDIA LIMITED	INDIA	
1.69.6	KEVIN ENTERPRISES PVT LTD	INDIA	
<b>1.70</b>	<b>INLET FEED DEVICE (VANE TYPE )</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
1.70.1	GODREJ & BOYCE MFG. CO. LTD.	INDIA	
1.70.2	KAMAL ENGINEERING CORPORATION	INDIA	
1.70.3	MUNTERS INDIA HUMIDITY CONTROL PVT. LTD.	INDIA	
<b>1.71</b>	<b>SEPARATOR INTERNALS</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
1.71.1	GODREJ & BOYCE MFG. CO. LTD.	INDIA	
1.71.2	KAMAL ENGINEERING CORPORATION	INDIA	
1.71.3	MUNTERS INDIA HUMIDITY CONTROL PVT. LTD.	INDIA	
1.71.4	KOCH CHEMICAL TECH. GROUP INDIA PVT LTD	INDIA	
1.71.5	SULZER INDIA LIMITED	INDIA	
<b>1.72</b>	<b>REACTOR INTERNALS</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
1.72.1	ANDRITZ EUROSLOT INDIA PVT. LTD.	INDIA	
1.72.2	AQSEPTENCE GROUP INDIA PVT. LTD.	INDIA	



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Sr.No	VENDOR NAME	COUNTRY	REMARK
1.72.3	BILFINGER WATER TECHNOLOGIES (I) PVT LTD	INDIA	
1.72.4	EUROSLOT KDSS INDIA PVT LTD	INDIA	
1.72.5	EVERGREEN TECHNOLOGIES PVT LTD INDIA	INDIA	
1.72.6	GODREJ AND BOYCE MFG. CO. LTD.	INDIA	
1.72.7	HEAVY ENGINEERING SERVICES (A UNIT OF EPC CONSTRUCTIONS INDIA LTD)	INDIA	
1.72.8	ISGEC HITACHI ZOSEN LIMITED	INDIA	
1.72.9	KAMAL ENGG INDIA	INDIA	
1.72.10	LARSEN & TOUBRO LTD	INDIA	
1.72.11	TECHNO PROCESS EQUIPMENTS (INDIA) PV LTD	INDIA	
<b>1.73</b>	<b>SPRAY NOZZLE-PROCESS</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
1.73.1	DEMACH ENGINEERS (P) LTD.	INDIA	
1.73.2	DE'S TECHNICO	INDIA	
1.73.3	FIRE TECH EQUIPMENTS & SYSTEMS PVT LTD	INDIA	
1.73.4	HD FIRE PROTECT PRIVATE LTD INDIA	INDIA	
1.73.5	JOHN ZINK COMPANY LTD	INDIA	
1.73.6	LECHLER (INDIA) PVT LIMITED	INDIA	
1.73.7	SIDDHARTH ENTERPRISES	INDIA	
1.73.8	SPRAYING SYSTEMS (INDIA) PVT. LTD.	INDIA	
1.73.9	SPRAYTECH	INDIA	
<b>1.74</b>	<b>SPRAY NOZZLE-TORCH OIL</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
1.74.1	JOHN ZINK INTERNATIONAL LUXEMBOURG SARL	INDIA	
1.74.2	SPRAYING SYSTEMS LTD.	INDIA	
<b>1.75</b>	<b>TOWER PACKING:CARBON</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
1.75.1	BLAST CARBOBLOCKS PVT. LTD.	INDIA	
1.75.2	CARBON PRODUCTS INDIA	INDIA	
1.75.3	SUGUNA INTERNATIONAL	INDIA	
<b>1.76</b>	<b>TOWER PACKINGS:PVC &amp; PP(NON-PROPRIETARY)</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
1.76.1	HI-PACK MASS TRANSFER PRODUCTS	INDIA	
1.76.2	MUNTERS INDIA HUMIDITY CONTROL PVT. LTD.	INDIA	
1.76.3	MASS TRANSFER PRODUCT INDUSTRIES	INDIA	
<b>1.77</b>	<b>WASTE HEAT BOILERS</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
1.77.1	ALSTOM PROJECTS INDIA LTD	INDIA	
1.77.2	BHEL	INDIA	



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Sr.No	VENDOR NAME	COUNTRY	REMARK
1.77.3	CHEEMA BOILERS	INDIA	
1.77.4	ISGEC	INDIA	
1.77.5	L&T	INDIA	
1.77.6	THERMAL SYSTEMS	INDIA	
1.77.7	THERMAX BABCOCK & WILCOX LTD.	INDIA	
1.77.8	THERMAX LIMITED	INDIA	
1.77.9	WALCHANDNAGAR INDUSTRIES LTD.	INDIA	
<b>1.78</b>	<b>REFRACTORY FIRE BRICKS</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
1.78.1	ABS REFRACTORIES PVT. LTD	INDIA	
1.78.2	ASHOKE REFRACTORIES PVT LTD	INDIA	
1.78.3	ASSOCIATED CERAMICS LTD.	INDIA	
1.78.4	CHAMPION CERAMICS PVT LTD	INDIA	
1.78.5	CONTINENTAL REFRACTORIES PVT LTD	INDIA	
1.78.6	DALMIA REFRACTORIES LTD.	INDIA	
1.78.7	GITA REFRACTORIES PVT LIMITED	INDIA	
1.78.8	MAHAKOSHAL REFRACTORIES PVT.LTD.	INDIA	
1.78.9	MAITHAN CERAMIC LTD	INDIA	
1.78.10	MANISHRI REFRACTORIES & CERAMICS PVT LTD	INDIA	
1.78.11	MPR REFRACTORIES	INDIA	
1.78.12	NATIONAL REFRACTORIES	INDIA	
1.78.13	NILACHAL REFRACTORIES LTD	INDIA	
1.78.14	OCL INDIA LTD	INDIA	
1.78.15	PACIFIC REFRACTORIES LTD	INDIA	
1.78.16	PREMIER REFRACTORIES OF INDIA PVT LTD	INDIA	
1.78.17	RAASI REFRACTORIES LTD	INDIA	
1.78.18	RAJ CERAMICS	INDIA	
1.78.19	RAJHANS REFRACTORIES (P) LTD	INDIA	
1.78.20	RHI CLASIL LTD	INDIA	
1.78.21	SHRI VALLEY REFRACTORIES LIMITED	INDIA	
1.78.22	TRL KROSAKI REFRACTORIES LIMITED	INDIA	
1.78.23	SHREEKANT INDUS	INDIA	
<b>1.79</b>	<b>INSULATING REFRACTORY CASTABLE</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
1.79.1	CALDERYS INDIA REF.LTD	INDIA	
1.79.2	CARBORUNDUM UNIVERSAL LTD	INDIA	
1.79.3	CASTWELL INDUSTRIES PVT. LTD.	INDIA	
1.79.4	JSL REFRACTORIES LIMITED	INDIA	
1.79.5	MAHAKOSHAL REFRACTORIES PVT.LTD.	INDIA	
1.79.6	MAITHAN CERAMIC LTD	INDIA	
1.79.7	MPR REFRACTORIES	INDIA	





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<b>COMMON PROJECTS MASTER SUPPLIER LIST-SECTION-A (MECHANICAL EQUIPMENTS)</b>			
Sr.No	VENDOR NAME	COUNTRY	REMARK
1.79.8	OCL INDIA LTD	INDIA	
1.79.9	PACIFIC REFRACTORIES LTD	INDIA	
1.79.10	PREMIER REFRACTORIES OF INDIA PVT LTD	INDIA	
1.79.11	PROGRESSIVE REFRACTORY & MONOLITHICS P.L	INDIA	
1.79.12	SHARAD REFRACTORIES PVT LTD	INDIA	
1.79.13	SHARADAA CERAMICS PVT. LTD.	INDIA	
1.79.14	TRL KROSAKI REFRACTORIES LIMITED	INDIA	
1.79.15	VESUVIUS INDIA LTD.	INDIA	
<b>1.80</b>	<b>SULPHUR TRAPS</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
	NO INDIAN BIDDER AVAILABLE		
<b>1.81</b>	<b>STORAGE TANKS, BULLETS &amp; MOUNDED BULLETS (Deleted)</b>		<b>Rev.2: Deleted</b>
<b>1.82</b>	<b>DEAERATOR</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
1.82.1	ANUP ENGINEERING LIMITED (THE)	INDIA	
1.82.2	ESSAR HEAVY ENGG SERVICES (UNIT OF EPIL)	INDIA	
1.82.3	G.R. ENGINEERING PRIVATE LIMITED	INDIA	
1.82.4	GODREJ & BOYCE MFG. CO. LTD.	INDIA	
1.82.5	ISGEC	INDIA	
1.82.6	PHILS HEAVY ENGINEERING PVT LIMITED	INDIA	
<b>1.83</b>	<b>FILTER - BASKET</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
1.83.1	BOMBAY CHEMICAL EQUIPMENTS	INDIA	
1.83.2	FIL SEP EQUIPMENTS PVT LTD	INDIA	
1.83.3	FILTRATION ENGINEER (I) PVT LTD	INDIA	
1.83.4	FLASH POINT EQUIPMENTS PVT LTD	INDIA	
1.83.5	GRAND PRIX ENGINEERING PVT LTD	INDIA	
1.83.6	GUJARAT OTOFILT	INDIA	
1.83.7	MAHLE FILTER SYSTEMS (INDIA) PRIVATE LIMITED	INDIA	
1.83.8	MULTITEX FILTRATION ENGINEERS LTD	INDIA	
1.83.9	PALL	INDIA	
1.83.10	PETROMAR ENGINEERED SOLN. P LTD	INDIA	
1.83.11	SUNGOV ENGINEERING PVT LTD	INDIA	
1.83.12	SUPERFLO FILTERS PVT LTD INDIA	INDIA	
1.83.13	BARTOM FIRTOP ENGINEERING CO LTD	INDIA	
<b>1.84</b>	<b>FILTER - CARTRIDGE/CANDLE</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
1.84.1	3M ELECTRO & COMMUNICATION INDIA	INDIA	



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<b>COMMON PROJECTS MASTER SUPPLIER LIST-SECTION-A (MECHANICAL EQUIPMENTS)</b>			
Sr.No	VENDOR NAME	COUNTRY	REMARK
1.84.2	AAF INDIA PVT LTD	INDIA	
1.84.3	CECO FILTER INDIA PVT LTD	INDIA	
1.84.4	CLARK RELIANCE (FOR GAS APPLICATION)	INDIA	
1.84.5	DOLLINGER	INDIA	
1.84.6	FIL SEP EQUIPMENT PVT LTD	INDIA	
1.84.7	FILTRATION ENGINEERS (I) PVT LTD	INDIA	
1.84.8	FLASH POINT EQUIPMENTS PVT. LTD.	INDIA	
1.84.9	GAS PROCESSING EQUIPMENT PVT. LTD	INDIA	
1.84.10	GEOFLUID PROCESSORS PVT LTD	INDIA	
1.84.11	GRAND PRIX ENGINEERING PVT LTD.	INDIA	
1.84.12	GUJARAT OTOFILT	INDIA	
1.84.13	INDCON PROJECTS & EQUIPMENTS LTD	INDIA	
1.84.14	JONELL	INDIA	
1.84.15	MULTITEX FILTRATION ENGINEERS LTD	INDIA	
1.84.16	NIRMAL INDUSTRIAL CONTROL PVT LTD	INDIA	
1.84.17	PALL INDIA PVT LTD	INDIA	
1.84.18	PARKER HANFIN	INDIA	
1.84.19	PEERLESS	INDIA	
1.84.20	PETROMAR ENGINEERED SOLN. P LTD	INDIA	
1.84.21	SPX INDIA PVT LTD	INDIA	
1.84.22	ULTRAFILTER (INDIA) PVT LTD	INDIA	
1.84.23	EPE PROCESS FILTERS & ACCUMULATORS	INDIA	
1.84.24	HYDAC INDIA PVT. LTD.	INDIA	
1.84.25	FILTER CONCEPT PRIVATE LIMITED		
<b>1.85</b>	<b>FILTER - PRESSURE</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
	NO INDIAN BIDDER AVAILABLE		
<b>1.86</b>	<b>FURNACE (Deleted)</b>		<b>Rev.2: Deleted</b>
<b>1.87</b>	<b>FLARE/FLARE STACK COMPONENTS</b>		
1.87.1	ADOR WELDING LTD.	INDIA	
1.87.2	ADVANI-OERLIKON LTD (ADOR SAMIA LTD)	INDIA	
1.87.3	AIR OIL FLAREGAS PVT LTD.	INDIA	
1.87.4	JOHN ZINK INDIA	INDIA	
<b>1.88</b>	<b>MAIN COMBUSTN. CHAMBR PKG(SRU)-ENGINEERED</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
1.88.1	BHEL	INDIA	
1.88.2	GODREJ & BOYCE MFG. CO. LTD.	INDIA	
1.88.3	ISGEC HEAVY ENGINEERING LTD	INDIA	
1.88.4	LARSEN & TOUBRO LTD	INDIA	
1.88.5	THERMAL SYSTEMS (HYDERABAD) PVT LTD	INDIA	



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<b>COMMON PROJECTS MASTER SUPPLIER LIST-SECTION-A (MECHANICAL EQUIPMENTS)</b>			
Sr.No	VENDOR NAME	COUNTRY	REMARK
1.88.6	THERMAX LIMITED	INDIA	
<b>1.89</b>	<b>INCINERATOR PACKAGE FOR SRU</b>		
1.89.1	JOHN ZINK INDIA	INDIA	
1.89.2	PARAMOUNT POLLUTION CONTROL LTD.	INDIA	
1.89.3	JOHN ZINK COMPANY LTD	INDIA	
<b>1.90</b>	<b>FIRED HEATERS</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
1.90.1	LARSEN & TOUBRO LTD.	INDIA	
1.90.2	THERMAX LIMITED	INDIA	
1.90.3	PETRON ENGINEERING & CONSTRUCTION LTD	INDIA	
1.90.4	BRIDGE & ROOF CO (INDIA) LTD.	INDIA	
1.90.5	MUKAND LTD.	INDIA	
1.90.6	ENGINEERING CONSTRUCTION CORP. LTD.	INDIA	
1.90.7	ESTEEM PROJECTS PVT. LTD.	INDIA	
1.90.8	TECHNICAS REUNIDAS	INDIA	
1.90.9	JNK HEATERS LTD	INDIA	
1.90.10	HEURTEY PETROCHEM	INDIA	
1.90.11	TECHNIP KT INDIA LTD	INDIA	
<b>1.91</b>	<b>COLUMN / DRUM (SITE FABRICATED)</b>		
1.91.1	ISGEC India	INDIA	
1.91.2	VIJAY TANKS & VESSELS PVT LTD	INDIA	
<b>1.92</b>	<b>HAIRPIN EXCHANGER</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
1.92.1	PATELS AIRTEMP (INDIA) LTD	INDIA	
1.92.2	PRECISION EQUIPMENTS (CHENNAI) PVT LTD	INDIA	
1.92.3	HRS PROCESS SYSTEMS LTD	INDIA	
1.92.4	KINAM ENGINEERING INDUSTRIES	INDIA	
1.92.5	INDUSTRIAL MANUFACTURERS	INDIA	
1.92.6	TEMA INDIA LIMITED	INDIA	
<b>1.93</b>	<b>SILOS</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
	NO INDIAN BIDDER AVAILABLE		
<b>1.94</b>	<b>LOW FIN HEAT EXCHANGER</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
1.94.1	THE ANUP ENGINEERING LIMITED	INDIA	
1.94.2	TECHNO PROCESS EQUIPMENT (INDIA) LIMITED	INDIA	
1.94.3	ISGEC (a unit of Saraswati Industrial syndicate Ltd.)	INDIA	



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<b>COMMON PROJECTS MASTER SUPPLIER LIST-SECTION-A (MECHANICAL EQUIPMENTS)</b>			
Sr.No	VENDOR NAME	COUNTRY	REMARK
1.94.4	LARSEN & TOUBRO LTD.	INDIA	
1.94.5	GODREG & BOYCE MFG. CO	INDIA	
<b>2</b>	<b>ROTARY EQUIPMENT</b>		
<b>2.1</b>	<b>PUMP-CENT.HOR(GPP)</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
2.1.1	BEACON WEIR LTD. INDIA	INDIA	
2.1.2	SPX FLOW (CLYDE UNION PUMP)	INDIA	
2.1.3	FLOWSERVE INDIA CONTROLS PVT LTD	INDIA	
2.1.4	FLOWSERVE (THOMPSONS KELLY&LEWIS PTY LTD)	INDIA	
2.1.5	HAYWARD TYLER FLUID DYNAMICS LTD.	INDIA	
2.1.6	ITT CORPORATION INDIA PVT LTD	INDIA	
2.1.7	KIRLOSKAR BROTHERS LTD	INDIA	
2.1.8	KIRLOSKAR EBARA PUMPS LTD	INDIA	
2.1.9	KSB PUMPS LTD	INDIA	
2.1.10	MATHER & PLATT PUMPS LTD.	INDIA	
2.1.11	NUOVO PIGNONE INTERNATIONAL S.R.L. (GE OIL CO.)	INDIA	
2.1.12	RUHRPUMPEN INDIA PVT LTD.	INDIA	
2.1.13	SAM TURBO INDUSTRY PVT. LTD	INDIA	
2.1.14	SU MOTORS PVT LTD	INDIA	
2.1.15	SULZER PUMPS INDIA LIMITED	INDIA	
2.1.16	WILO MATHER AND PLATT PUMPS PVT. LTD.	INDIA	
2.1.17	FLOWMORE LTD	INDIA	
2.1.18	GOULDS PUMPS INC	INDIA	
2.1.19	SUNDYNE NIKKISO	INDIA	
2.1.20	SHIN NIPPON MACHINERY CO LTD	INDIA	
2.1.21	JYOTI LTD	INDIA	
2.1.22	MICROFINISH PUMPS PVT. LTD.	INDIA	
<b>2.2</b>	<b>PUMP-CENT.HOR(SPP)</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
2.2.1	SPX FLOW (CLYDE UNION PUMP)	INDIA	
2.2.2	FLOWSERVE INDIA CONTROLS PVT LTD	INDIA	
2.2.3	FLOWSERVE (THOMPSONS KELLY&LEWIS PTY LTD)	INDIA	
2.2.4	HAYWARD TYLER FLUID DYNAMICS LTD.	INDIA	
2.2.5	ITT CORPORATION INDIA PVT LTD	INDIA	
2.2.6	KIRLOSKAR EBARA PUMPS LTD	INDIA	
2.2.7	KSB PUMPS LTD	INDIA	
2.2.8	NUOVO PIGNONE INTERNATIONAL S.R.L. (GE OIL CO.)	INDIA	
2.2.9	RUHRPUMPEN INDIA PVT LTD	INDIA	
2.2.10	SULZER PUMPS INDIA LIMITED	INDIA	
2.2.11	GOULDS PUMPS INC	INDIA	
2.2.12	SHIN NIPPON MACHINERY CO LTD	INDIA	



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<b>COMMON PROJECTS MASTER SUPPLIER LIST-SECTION-A (MECHANICAL EQUIPMENTS)</b>			
Sr.No	VENDOR NAME	COUNTRY	REMARK
2.2.13	DMW CORPORATION INDIA PRIVATE LIMITED (Approved for Model Series: SMKP, DF/NDF; Max Rating: upto 800 KW)	INDIA	Rev.2: Addition
2.2.14	MICROFINISH PUMPS PVT. LTD.	INDIA	
<b>2.3</b>	<b>PUMP-CENT.HOR(GWS)</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
2.3.1	BEACON WEIR LIMITED	INDIA	
2.3.2	SPX FLOW (CLYDE UNION PUMP)	INDIA	
2.3.3	FLOWMORE LIMITED	INDIA	
2.3.4	FLOWSERVE INDIA CONTROLS PVT LTD	INDIA	
2.3.5	FLOWSERVE (THOMPSONS KELLY&LEWIS PTY LTD)	INDIA	
2.3.6	ITT CORPORATION INDIA PVT LTD	INDIA	
2.3.7	KIRLOSKAR BROTHERS LTD	INDIA	
2.3.8	KSB PUMPS LTD	INDIA	
2.3.9	RUHRPUMPEN INDIA PVT LTD.	INDIA	
2.3.10	SAM TURBO INDUSTRYPVT. LTD (ENQ-ACE MKTG)	INDIA	
2.3.11	SU MOTORS PVT LTD	INDIA	
2.3.12	SULZER PUMPS INDIA LIMITED	INDIA	
2.3.13	WILO MATHER AND PLATT PUMPS PVT. LTD.	INDIA	
2.3.14	WPIL LTD	INDIA	
2.3.15	FLOWMORE LTD	INDIA	
2.3.16	GOULDS PUMPS INC	INDIA	
2.3.17	RUHRPUMPEN INDIA PVT LTD.	INDIA	
2.3.18	SHIN NIPPON MACHINERY CO LTD	INDIA	
2.3.19	SUNDYNE NIKKISO	INDIA	
2.3.20	MICROFINISH PUMPS PVT. LTD.	INDIA	
<b>2.4</b>	<b>PUMP-CENT.HOR(LCWS)</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
2.4.1	BEACON WEIR LIMITED	INDIA	
2.4.2	SPX FLOW (CLYDE UNION PUMP)	INDIA	
2.4.3	FLOWMORE LIMITED	INDIA	
2.4.4	FLOWSERVE INDIA CONTROLS PVT LTD	INDIA	
2.4.5	FLOWSERVE (THOMPSONS KELLY&LEWIS PTY LTD)	INDIA	
2.4.6	ITT CORPORATION INDIA PVT LTD	INDIA	
2.4.7	KIRLOSKAR BROTHERS LTD	INDIA	
2.4.8	MATHER & PLATT PUMPS LTD.	INDIA	
2.4.9	KSB PUMPS	INDIA	
2.4.10	NUOVO PIGNONE INTERNATIONAL S.R.L. (GE OIL CO.)	INDIA	
2.4.11	RUHRPUMPEN INDIA PVT LTD.	INDIA	
2.4.12	SULZER PUMPS INDIA LIMITED	INDIA	
2.4.13	WILO MATHER AND PLATT PUMPS PVT. LTD.	INDIA	
2.4.14	WPIL Ltd	INDIA	
2.4.15	FLOWMORE LTD	INDIA	



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Sr.No	VENDOR NAME	COUNTRY	REMARK
2.4.16	ENSIVAL MORET BELGIUM SA	INDIA	
2.4.17	GOULDS PUMPS INC	INDIA	
2.4.18	SHIN NIPPON MACHINERY CO LTD	INDIA	
2.4.19	HAYWARD TYLER FLUID DYNAMICS LTD.	INDIA	
2.4.20	JYOTI LTD	INDIA	
2.4.21	RUHRPUMPEN INDIA PVT LTD.	INDIA	
2.4.22	MICROFINISH PUMPS PVT. LTD.	INDIA	
<b>2.5</b>	<b>PUMP-CENT.HOR.(MOLTEN SULPHUR)</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
2.5.1	GOULDS PUMPS INC (C/o ITT Corporation)	INDIA	
2.5.2	FLOWSERVE CORPORATION	INDIA	
<b>2.6</b>	<b>PUMP-CENT.VERT(GPP)</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
2.6.1	SPX FLOW (CLYDE UNION PUMP)	INDIA	
2.6.2	FLOWSERVE INDIA CONTROLS PVT LTD	INDIA	
2.6.3	FLOWSERVE (THOMPSONS KELLY&LEWIS PTY LTD)	INDIA	
2.6.4	ITT CORPORATION INDIA PVT LTD	INDIA	
2.6.5	KIRLOSKAR BROTHERS LTD	INDIA	
2.6.6	KIRLOSKAR EBARA PUMPS LTD	INDIA	
2.6.7	KISHOR PUMPS PVT LTD.	INDIA	
2.6.8	KSB PUMPS	INDIA	
2.6.9	NUOVO PIGNONE INTERNATIONAL S.R.L. (GE OIL CO.)	INDIA	
2.6.10	RUHRPUMPEN INDIA PVT LTD	INDIA	
2.6.11	SAM TURBO INDUSTRYPVT. LTD (ENQ-ACE MKTG)	INDIA	
2.6.12	SU MOTORS PVT LTD	INDIA	
2.6.13	SULZER PUMPS INDIA LIMITED	INDIA	
2.6.14	WILO MATHER AND PLATT PUMPS PVT. LTD.	INDIA	
2.6.15	WPIL Ltd	INDIA	
2.6.16	FLOWMORE LTD	INDIA	
2.6.17	GOULDS PUMPS INC	INDIA	
2.6.18	DENCIL PUMPS & SYSTEMS PVT. LTD.	INDIA	
<b>2.7</b>	<b>PUMP-CENT.VERT. BARREL TYPE(SPP)</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
2.7.1	SPX FLOW (CLYDE UNION PUMP)	INDIA	
2.7.2	FLOWSERVE INDIA CONTROLS PVT LTD	INDIA	
2.7.3	FLOWSERVE (THOMPSONS KELLY&LEWIS PTY LTD)	INDIA	
2.7.4	ITT CORPORATION INDIA PVT LTD	INDIA	
2.7.5	KIRLOSKAR EBARA PUMPS LTD	INDIA	
2.7.6	KSB PUMPS LTD	INDIA	
2.7.7	LAWRENCE PUMPS ASIA PTE LTD.	INDIA	



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<b>COMMON PROJECTS MASTER SUPPLIER LIST-SECTION-A (MECHANICAL EQUIPMENTS)</b>			
<b>Sr.No</b>	<b>VENDOR NAME</b>	<b>COUNTRY</b>	<b>REMARK</b>
2.7.8	NUOVO PIGNONE INTERNATIONAL S.R.L. (GE OIL CO.)	INDIA	
2.7.9	RUHRPUMPEN INDIA PVT LTD	INDIA	
2.7.10	SULZER PUMPS INDIA LIMITED	INDIA	
2.7.11	GOULDS PUMPS INC	INDIA	
2.7.12	SHIN NIPPON MACHINERY CO LTD	INDIA	
<b>2.8</b>	<b>PUMP-CENT.VERT.(GWS)</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
2.8.1	SPX FLOW (CLYDE UNION PUMP)	INDIA	
2.8.2	FLOWMORE LIMITED	INDIA	
2.8.3	FLOWSERVE INDIA CONTROLS PVT LTD	INDIA	
2.8.4	FLOWSERVE (THOMPSONS KELLY&LEWIS PTY LTD)	INDIA	
2.8.5	ITT CORPORATION INDIA PVT LTD	INDIA	
2.8.6	KIRLOSKAR BROTHERS LTD	INDIA	
2.8.7	KISHOR PUMPS PVT LTD.	INDIA	
2.8.8	KSB PUMPS LTD	INDIA	
2.8.9	NUOVO PIGNONE INTERNATIONAL S.R.L. (GE OIL CO.)	INDIA	
2.8.10	SAM TURBO INDUSTRYPVT. LTD (ENQ-ACE MKTG)	INDIA	
2.8.11	SU MOTORS PVT LTD	INDIA	
2.8.12	SULZER PUMPS INDIA LIMITED	INDIA	
2.8.13	WILO MATHER AND PLATT PUMPS PVT. LTD.	INDIA	
2.8.14	WPIL LTD	INDIA	
2.8.15	FLOWMORE LTD	INDIA	
2.8.16	RUHRPUMPEN INDIA PVT LTD	INDIA	
2.8.17	JYOTI LTD	INDIA	
2.8.18	SHIN NIPPON MACHINERY CO LTD	INDIA	
2.8.19	DENCIL PUMPS & SYSTEMS PVT. LTD.	INDIA	
<b>2.9</b>	<b>PUMP-CENT.VERT(LCWS)</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
2.9.1	SPX FLOW (CLYDE UNION PUMP)	INDIA	
2.9.2	FLOWMORE LIMITED	INDIA	
2.9.3	FLOWSERVE INDIA CONTROLS PVT LTD	INDIA	
2.9.4	FLOWSERVE (THOMPSONS KELLY&LEWIS PTY LTD)	INDIA	
2.9.5	ITT CORPORATION INDIA PVT LTD	INDIA	
2.9.6	KIRLOSKAR BROTHERS LTD	INDIA	
2.9.7	KISHOR PUMPS PVT. LTD.	INDIA	
2.9.8	KSB PUMPS	INDIA	
2.9.9	NUOVO PIGNONE INTERNATIONAL S.R.L. (GE OIL CO.)	INDIA	
2.9.10	SAM TURBO INDUSTRY LTD.	INDIA	
2.9.11	WILO MATHER AND PLATT PUMPS PVT. LTD.	INDIA	
2.9.12	WPIL LTD	INDIA	
2.9.13	FLOWMORE LTD	INDIA	



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Sr.No	VENDOR NAME	COUNTRY	REMARK
2.9.14	SULZER PUMPS	INDIA	
2.9.15	RUHRPUMPEN INDIA PVT LTD	INDIA	
2.9.16	JYOTI LTD	INDIA	
2.9.17	SHIN NIPPON MACHINERY CO LTD	INDIA	
2.9.18	MICROFINISH PUMPS PVT. LTD.	INDIA	
<b>2.10</b>	<b>PUMP-CENT.VERT.(MOLTEN SULPHUR)</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
2.10.1	GOULDS PUMPS INC (C/o ITT Corporation)	INDIA	
2.10.2	FLOWSERVE CORPORATION	INDIA	
<b>2.11</b>	<b>PUMP-CENT. (BFW)</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
2.11.1	BHEL	INDIA	
2.11.2	SPX FLOW (CLYDE UNION PUMP)	INDIA	
2.11.3	GOULDS PUMPS INC (C/o ITT Corporation)	INDIA	
2.11.4	FLOWSERVE INDIA CONTROLS PVT LTD	INDIA	
2.11.5	FLOWSERVE (THOMPSONS KELLY&LEWIS PTY LTD)	INDIA	
2.11.6	ITT CORPORATION INDIA PVT LTD	INDIA	
2.11.7	KIRLOSKAR EBARA PUMPS LTD	INDIA	
2.11.8	KSB PUMPS LTD	INDIA	
2.11.9	NUOVO PIGNONE INTERNATIONAL S.R.L. (GE OIL CO.)	INDIA	
2.11.10	RUHRPUMPEN INDIA PVT LTD	INDIA	
2.11.11	STERLING FLUID SYSTEMS LTD	INDIA	
2.11.12	SULZER PUMPS INDIA LIMITED	INDIA	
2.11.13	ENSIVAL MORET BELGIUM SA	INDIA	
2.11.14	SUNDYNE NIKKISO	INDIA	
2.11.15	WEIR GABBIONETA SPA	INDIA	
2.11.16	SHIN NIPPON MACHINERY CO LTD	INDIA	
2.11.17	CNP PUMPS INDIA PVT LTD	INDIA	
<b>2.12</b>	<b>PUMP-CENT.SU.M(CRYO)</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
	No Indian Bidders Available		
<b>2.13</b>	<b>PUMP-CENT.H/V(FW)</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
2.13.1	FLOWMORE LIMITED	INDIA	
2.13.2	KIRLOSKAR BROTHERS LTD	INDIA	
2.13.3	WILO MATHER AND PLATT PUMPS PVT. LTD.	INDIA	
2.13.4	WPIL LTD	INDIA	
2.13.5	FLOWSERVE	INDIA	
2.13.6	ITT	INDIA	





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<b>COMMON PROJECTS MASTER SUPPLIER LIST-SECTION-A (MECHANICAL EQUIPMENTS)</b>			
Sr.No	VENDOR NAME	COUNTRY	REMARK
2.13.7	KSB	INDIA	
<b>2.14</b>	<b>PUMP-CENT.HOR.MULTI STAGE(SPP)</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
2.14.1	SPX FLOW (CLYDE UNION PUMP)	INDIA	
2.14.2	FLOWSERVE INDIA CONTROLS PVT LTD	INDIA	
2.14.3	FLOWSERVE (THOMPSONS KELLY&LEWIS PTY LTD)	INDIA	
2.14.4	ITT CORPORATION INDIA PVT LTD	INDIA	
2.14.5	KIRLOSKAR EBARA PUMPS LTD	INDIA	
2.14.6	KSB PUMPS LTD	INDIA	
2.14.7	NUOVO PIGNONE INTERNATIONAL S.R.L. (GE OIL CO.)	INDIA	
2.14.8	RUHRPUMPEN INDIA PVT LTD	INDIA	
2.14.9	SULZER PUMPS INDIA LIMITED	INDIA	
<b>2.15</b>	<b>PUMP-CENT. (LOW CAPACITY HIGH HEAD)</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
2.15.1	FLOWSERVE INDIA CONTROLS PVT LTD.	INDIA	
<b>2.16</b>	<b>PUMP-ROTARY.SCREW</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
2.16.1	ALEKTON ENGG INDUSTRIES PVT. LTD	INDIA	
2.16.2	FLOWSERVE INDIA CONTROLS PVT LTD	INDIA	
2.16.3	NETZSCH TECHNOLOGIES INDIA PVT.LTD	INDIA	
2.16.4	ROTO PUMPS LTD	INDIA	
2.16.5	SEEPPEX GMBH	INDIA	
2.16.6	ALLWEILER INDIA PVT LTD. (A CIRCOR BUSINESS UNIT)	INDIA	
2.16.7	TUSHACO PUMPS PVT. LTD	INDIA	
2.16.8	UT PUMPS & SYSTEMS PVT. LTD. (BORNEMAN)	INDIA	
2.16.9	ITT	INDIA	
2.16.10	KSB	INDIA	
2.16.11	PLENTY MIRRLESS PUMPS(SPX FLOW)	INDIA	
2.16.12	MADAV FLUID SOLUTIONS-(VIKING)	INDIA	
<b>2.17</b>	<b>PUMP-ROTARY.GEAR</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
2.17.1	DEL PD PUMPS & GEARS PVT. LTD.	INDIA	
2.17.2	FLOWSERVE INDIA CONTROLS PVT LTD	INDIA	
2.17.3	TUSHACO PUMPS PVT. LTD	INDIA	
2.17.4	ITT	INDIA	
2.17.5	KSB	INDIA	
2.17.6	ALLWEILER INDIA PVT LTD	INDIA	
2.17.7	NETZSCH TECHNOLOGIES INDIA PVT.LTD.	INDIA	
2.17.8	MADAV FLUID SOLUTIONS-(VIKING)	INDIA	
2.17.9	PLENTY MIRRLESS PUMPS(SPX FLOW)	INDIA	



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Sr.No	VENDOR NAME	COUNTRY	REMARK
<b>2.18</b>	<b>PUMP-ROTARY.SL.VANE</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
2.18.1	KSB	INDIA	
2.18.2	FLOWSERVE	INDIA	
2.18.3	ITT	INDIA	
<b>2.19</b>	<b>PUMP-ROT.SCR.ARC(ES)</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
2.19.1	KSB	INDIA	
2.19.2	FLOWSERVE	INDIA	
2.19.3	ITT	INDIA	
<b>2.20</b>	<b>PUMP-ROTARY(LOBE)</b>		
2.20.1	FLOWSERVE	INDIA	
2.20.2	GOULDS PUMPS INC	INDIA	
2.20.3	KSB PUMPS LTD	INDIA	
2.20.4	VOGELSANG INDIA PVT LTD	INDIA	
<b>2.21</b>	<b>PUMP-SLURRY.RECIPRO</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
	NO INDIAN BIDDER AVAILABLE		
<b>2.22</b>	<b>PUMP-SLURRY.CENT.H/V</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
2.22.1	SPX FLOW (CLYDE UNION PUMP)	INDIA	
2.22.2	FLOWSERVE CORPORATION	INDIA	
2.22.3	FLOWSERVE(THOMPSONS KELLY&LEWIS PTY LTD)	INDIA	
2.22.4	ITT CORPORATION INDIA PVT LTD	INDIA	
2.22.5	KIRLOSKAR BROTHERS LTD	INDIA	
2.22.6	KSB PUMPS LTD (POONA)	INDIA	
2.22.7	SAM TURBO INDUSTRYPVT. LTD(ENQ-ACE MKTG)	INDIA	
2.22.8	SULZER PUMPS INDIA LIMITED	INDIA	
2.22.9	SULZER BROTHERS LTD	INDIA	
<b>2.23</b>	<b>PUMP-RECIPRO (API 674)</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
2.23.1	DENCIL PUMPS AND SYSTEMS PVT LTD	INDIA	
2.23.2	FLOWSERVE INDIA CONTROLS PVT LTD	INDIA	
2.23.3	GOMA ENGINEERING PVT LTD	INDIA	
2.23.4	HIRO NISHA SYSTEMS PVT. LTD.	INDIA	
2.23.5	ITT	INDIA	
2.23.6	KSB	INDIA	



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Sr.No	VENDOR NAME	COUNTRY	REMARK
2.23.7	SWELORE ENGG. PVT. LTD.	INDIA	
2.23.8	V.K. PUMPS INDUSTRIES PVT. LTD.	INDIA	
2.23.9	POSITIVE METERING PUMP PVT. LTD.	INDIA	
2.23.10	ACCUDYNE INDUSTRIES INDIA PVT. LTD.	INDIA	
<b>2.24</b>	<b>PUMP-A.F.PROPELLER</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
2.24.1	SPX FLOW (CLYDE UNION PUMP)	INDIA	
2.24.2	FLOWSERVE CORPORATION	INDIA	
2.24.3	ITT	INDIA	
2.24.4	KSB	INDIA	
<b>2.25</b>	<b>PUMP - AIR OPERATED DIAPHRAGM</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
2.25.1	HI-LIFE MANUFACTURING CO.	INDIA	
2.25.2	MONIBA ANAND ELECTRICALS PVT LTD	INDIA	
2.25.3	ITT	INDIA	
2.25.4	FLOWSERVE	INDIA	
2.25.5	KSB	INDIA	
<b>2.26</b>	<b>EJECTOR</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
2.26.1	MAZDA LIMITED	INDIA	
2.26.2	NEW FIELD INDUSTRIAL EQUIPMENT PVT LTD	INDIA	
2.26.3	CHEM PROCESS	INDIA	
<b>2.27</b>	<b>COMP-RECIPRO(SPP)</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
2.27.1	BURCKHARDT COMPRESSION (INDIA) PVT.LTD.	INDIA	
2.27.2	SIEMENS (FORMER DRESSER RAND INDIA PVT LTD)	INDIA	
2.27.3	GARDNER DENVER	INDIA	
2.27.4	HITACHI LTD. INTERNATIONAL	INDIA	
2.27.5	NEUMAN & ESSER ENGINEERING INDIA PVT LTD	INDIA	
2.27.6	ATLAS COPCO	INDIA	
2.27.7	DRESSER RAND	INDIA	
2.27.8	HOWDEN	INDIA	
2.27.9	EMERSON COPELAND	INDIA	
<b>2.28</b>	<b>COMP-RECIPRO(PIANS)</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
2.28.1	BURCKHARDT COMPRESSION (INDIA) PVT. LTD.	INDIA	
2.28.2	DRESSER RAND INDIA PVT LTD	INDIA	
2.28.3	SIEMENS (FORMER DRESSER RAND INDIA PVT LTD)	INDIA	
2.28.4	GARDNER DENVER	INDIA	



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Sr.No	VENDOR NAME	COUNTRY	REMARK
2.28.5	HITACHI LTD	INDIA	
2.28.6	INGERSOLL-RAND (INDIA) LTD.	INDIA	
2.28.7	KIRLOSKAR PNEUMATIC CO LTD	INDIA	
2.28.8	NEUMAN & ESSER ENGINEERING INDIA PVT LTD	INDIA	
2.28.9	NUOVO PIGNONE SPA	INDIA	
2.28.10	ATLAS COPCO	INDIA	
2.28.11	EMERSON COPELAND	INDIA	
<b>2.29</b>	<b>COMP-RECIPRO(DIAPHRAGM)</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
2.29.1	NEUMAN & ESSER ENGINEERING INDIA PVT LTD	INDIA	
2.29.2	SUNDYNE	INDIA	
<b>2.30</b>	<b>COMP-RECIPRO(LABYRINTH)</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
2.30.1	BURCKHARDT COMPRESSION AG	INDIA	
<b>2.31</b>	<b>COMP. HIGH PRESSURE(PIANS)</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
2.31.1	NEUMAN & ESSER ENGINEERING (I) PVT LTD.	INDIA	
<b>2.32</b>	<b>COMP-CENT.(SPP)</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
2.32.1	BHEL	INDIA	
2.32.2	NUOVO PIGNONE INTERNATIONAL S.R.L. (GE OIL CO.)	INDIA	
2.32.3	HITACHI LTD	INDIA	
2.32.4	MAN TURBOMASCHINEN AG	INDIA	
2.32.5	mitsubishi heavy industries ltd	INDIA	
2.32.6	SIEMENS (FORMER DRESSER RAND INDIA PVT LTD)	INDIA	
2.32.7	ATLAS COPCO	INDIA	
<b>2.33</b>	<b>COMP-ROT.LIQUID RING/VP(PS)</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
2.33.1	BUSCH GVT LTD (FORMER GRAHAM PRECISION PUMP)	INDIA	
2.33.2	EDWARDS LTD (PROCESS VACUUM SYSTEMS)	INDIA	
2.33.3	GARDNER DENVER NASH ENGINEERED PRODUCTS INDIA PVT LTD	INDIA	
2.33.4	JB SAWANT ENGG PVT LTD	INDIA	
2.33.5	PPI SYSTEM	INDIA	



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Sr.No	VENDOR NAME	COUNTRY	REMARK
2.33.6	SIEMENS (FORMER DRESSER RAND INDIA PVT LTD)	INDIA	
2.33.7	SIHI PUMPS ( SHANGHAI) CO.,LTD	INDIA	
2.33.8	SWAM PNEUMATICS PVT. LTD.	INDIA	
2.33.9	UNOZAWA GUMI IRON WORKS LTD	INDIA	
2.33.10	FLOWSERVE	INDIA	
<b>2.34</b>	<b>COMP-ROT.LIQUID RING / VP(AS)</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
2.34.1	GARDNER DENVER NASH ENGINEERED PRODUCTS INDIA PVT LTD	INDIA	
2.34.2	BUSCH GVT LTD (FORM GRAHAM PRECISION PUMP	INDIA	
2.34.3	EDWARDS LTD (PROCESS VACUUM SYSTEMS)	INDIA	
2.34.4	JB SAWANT ENGG PVT LTD	INDIA	
2.34.5	PPI SYSTEM	INDIA	
2.34.6	SIHI PUMPS ( SHANGHAI) CO.,LTD	INDIA	
2.34.7	SWAM PNEUMATICS PVT. LTD.	INDIA	
2.34.8	DRESSER RAND	INDIA	
2.34.9	PRECISION PNEUMATICS INDUSTRIES	INDIA	
<b>2.35</b>	<b>MECH.SEAL FOR PUMPS/AGITATORS</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
2.35.1	AESSEAL INDIA PVT.LTD.	INDIA	
2.35.2	CHHETRA SEALS INDIA PVT. LTD.	INDIA	
2.35.3	EAGLEBURGMANN INDIA PVT LTD	INDIA	
2.35.4	FLOWSERVE SANMAR LTD	INDIA	
2.35.5	JOHN CRANE SEALING SYSTEMS INDIA PVT. LTD.	INDIA	
2.35.6	LEAK PROOF ENGG (I) PVT LTD	INDIA	
<b>2.36</b>	<b>MECHANICAL SEALS (API 682 TYPE &amp; DRY GAS SEAL)</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
2.36.1	AESSEAL INDIA PVT.LTD.	INDIA	
2.36.2	CHHETRA SEALS INDIA PVT. LTD.	INDIA	
2.36.3	EAGLEBURGMANN INDIA PVT LTD	INDIA	
2.36.4	FLOWSERVE SANMAR LTD	INDIA	
2.36.5	JOHN CRANE SEALING SYSTEMS INDIA PVT. LTD.	INDIA	
2.36.6	LEAK PROOF ENGG (I) PVT LTD	INDIA	
<b>2.37</b>	<b>COMP-ROT.SCREW(PS)</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
2.37.1	ATLAS COPCO	INDIA	
2.37.2	NUOVO PIGNONE INTERNATIONAL S.R.L. (GE OIL CO.)	INDIA	
2.37.3	HOWDEN SOLYVENT (INDIA) PVT. LTD. (C/O Howden Thomassen India Pvt Ltd)	INDIA	
2.37.4	INGERSOL RAND	INDIA	
2.37.5	KIRLOSKAR PNEUMATIC CO LTD	INDIA	



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Sr.No	VENDOR NAME	COUNTRY	REMARK
2.37.6	MAN TURBOMASCHINEN AG	INDIA	
2.37.7	SIEMENS	INDIA	
2.37.8	ELGI EQUIPMENT LIMITED	INDIA	
<b>2.38</b>	<b>COMP-ROT.SCREW(PIAS)</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
2.38.1	ELGI EQUIPMENTS LTD.	INDIA	
2.38.2	HOWDEN SOLYVENT (INDIA) PVT. LTD. (C/O Howden Thomassen India Pvt Ltd)	INDIA	
2.38.3	INGERSOLL-RAND (INDIA) LTD.	INDIA	
2.38.4	KIRLOSKAR PNEUMATIC CO LTD- (PUNE)	INDIA	
2.38.5	MAN TURBOMASCHINEN AG	INDIA	
2.38.6	ATLAS COPCO	INDIA	
<b>2.39</b>	<b>COMP-EXPANDER(PRO)</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
2.39.1	NUOVO PIGNONE INTERNATIONAL S.R.L. (GE OIL CO.)	INDIA	
<b>2.40</b>	<b>COMP-EXPANDER(AIR)</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
2.40.1	NUOVO PIGNONE INTERNATIONAL S.R.L. (GE OIL CO.)	INDIA	
<b>2.41</b>	<b>TURBINE-STEAM(GP)</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
2.41.1	BELLISS INDIA LTD	INDIA	
2.41.2	HITACHI LTD.	INDIA	
2.41.3	MAN TURBOMASCHINEN AG	INDIA	
2.41.4	MITSUBISHI HEAVY INDUSTRIES LTD	INDIA	
2.41.5	NUOVO PIGNONE INTERNATIONAL S.R.L. (GE OIL CO.)	INDIA	
2.41.6	SIEMENS (FORMER DRESSER RAND INDIA PVT LTD)	INDIA	
2.41.7	WESTINGHOUSE ELECTRIC CORPORATION	INDIA	
2.41.8	TRIVENI TURBINE LIMITED	INDIA	Rev.2: Addition
2.41.9	KIRLOSKAR EBARA PUMPS LTD.	INDIA	
<b>2.42</b>	<b>TURBINE-STEAM(SP)</b>		
2.42.1	ABB LTD	INDIA	
2.42.2	BHEL	INDIA	
2.42.3	GEC ALSTHOM TURBINE GENERATORS	INDIA	
2.42.4	HITACHI LTD.	INDIA	
2.42.5	MAN TURBOMASCHINEN AG	INDIA	
2.42.6	MITSUBISHI HEAVY INDUSTRIES LTD	INDIA	
2.42.7	NUOVO PIGNONE INTERNATIONAL S.R.L. (GE OIL CO.)	INDIA	
2.42.8	SIEMENS (FORMER DRESSER RAND INDIA PVT LTD)	INDIA	
2.42.9	TRIVENI TURBINE LIMITED	INDIA	Rev.2: Addition



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Sr.No	VENDOR NAME	COUNTRY	REMARK
2.42.10	WESTINGHOUSE ELECTRIC CORPORATION	INDIA	
2.42.11	KIRLOSKAR EBARA PUMPS LTD.	INDIA	
<b>2.43</b>	<b>TURBINE-GAS</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
2.43.1	BHEL	INDIA	
2.43.2	MAN TURBOMASCHINEN AG	INDIA	
2.43.3	MITSUBISHI HEAVY INDUSTRIES LTD	INDIA	
2.43.4	NUOVO PIGNONE INTERNATIONAL S.R.L. (GE OIL CO.)	INDIA	
2.43.5	SIEMENS INDUSTRIAL TURBO MACHINERY LTD.	INDIA	
2.43.6	WESTINGHOUSE ELECTRIC CORPORATION	INDIA	
<b>2.44</b>	<b>FAN-ID/FD</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
2.44.1	ABB ALVI	INDIA	
2.44.2	AEROTO BOLDROCCHI (I) P.LTD.	INDIA	
2.44.3	AIR CONTROL & CHEMICAL ENGG.CO.LTD.	INDIA	
2.44.4	ANDREW YULE & CO LTD-KOLKATA	INDIA	
2.44.5	BHEL	INDIA	
2.44.6	CBI Group	INDIA	
2.44.7	EBARA CORPORATION	INDIA	
2.44.8	FLAKT (INDIA) LTD (UPTO 130 KW CHENNAI)	INDIA	
2.44.9	HOWDEN SOLYVENT (INDIA) PVT. LTD.	INDIA	
2.44.10	MITSUBISHI HEAVY INDUSTRIES LTD	INDIA	
2.44.11	REITZ INDIA LTD	INDIA	
2.44.12	SOLYVENT FLAKT (INDIA) PVT. LIMITED	INDIA	
2.44.13	THERMAX LTD	INDIA	
2.44.14	TLT ENGINEERING INDIA PVT LTD	INDIA	
2.44.15	HOWDEN PROCESS COMPRESSORS	INDIA	
2.44.16	TUTHILL	INDIA	
<b>2.45</b>	<b>FAN-AXIAL FLOW</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
2.45.1	MARATHON ELECTRIC MOTOR I LTD-	INDIA	
2.45.2	PATELS AIRFLOW LTD.	INDIA	
<b>2.46</b>	<b>BLOWER-TURBO CENTRIFUGAL</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
2.46.1	AIR CONTROL & CHEMICAL ENGG.CO.LTD.	INDIA	
2.46.2	BATLIBOI ENVIRONMENTAL ENGG.LIMITED	INDIA	
2.46.3	BOLDROCCHI (I) PVT. LTD.	INDIA	
2.46.4	HITACHI LTD.	INDIA	
2.46.5	HOWDEN SOLYVENT (INDIA) PVT. LTD.	INDIA	



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Sr.No	VENDOR NAME	COUNTRY	REMARK
2.46.6	MAN TURBOMASCHINEN AG	INDIA	
2.46.7	MARATHON ELECTRIC MOTOR I LTD-	INDIA	
2.46.8	mitsubishi heavy industries ltd	INDIA	
2.46.9	NUOVO PIGNONE INTERNATIONAL S.R.L. (GE OIL CO.)	INDIA	
2.46.10	PATELS AIRFLOW LTD.	INDIA	
2.46.11	SOLYVENT FLAKT (INDIA) PVT. LTD.	INDIA	
2.46.12	HOWDEN PROCESS COMPRESSORS	INDIA	
2.46.13	SIEMENS	INDIA	
2.46.14	TUTHILL	INDIA	
2.46.15	TMVT INDUSTRIES PVT. LTD.	INDIA	
2.46.16	PPI SYSTEM	INDIA	
<b>2.47</b>	<b>POSITIVE DISPLACEMENT PUMPS RECIPROCATING - (CONTROLLED VOLUME)</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
2.47.1	ACCUDYNE INDUSTRIES	INDIA	
2.47.2	FLOWSERVE	INDIA	
2.47.3	GOULDS PUMPS INC (M/s ITT Corporation Ltd.)	INDIA	
2.47.4	KSB PUMPS LTD	INDIA	
2.47.5	POSITIVE METERING SYSTEM	INDIA	
2.47.6	SPX FLOW TECHNOLOGIES PVT. LTD.	INDIA	
2.47.7	SWELORE ENGG (P) LTD.	INDIA	
2.47.8	V.K.PUMPS INDUSTRIES	INDIA	
2.47.9	MILTON ROY	INDIA	
2.47.10	SHAPO TOOLS	INDIA	
<b>2.48</b>	<b>AGITATOR</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
2.48.1	A J SERVICES	INDIA	
2.48.2	CEECONS INDIA	INDIA	
2.48.3	GMM PFAUDLER LTD	INDIA	
2.48.4	HITACHI LTD.	INDIA	
2.48.5	METSO MINERALS CANADA INC.	INDIA	
2.48.6	MIXRITE CORPORATION	INDIA	
2.48.7	MIXRITE MIXING SYSTEMS	INDIA	
2.48.8	RATHI MIXERS PVT LTD	INDIA	
2.48.9	REMI PROCESS PLANT & MACHINERY LTD	INDIA	
2.48.10	SHAPOTOOLS INDIA	INDIA	
2.48.11	STANDARD ENGINEERS	INDIA	
2.48.12	SUDARSHAN CHEMICAL INDUSTRIES LTD (FORMERLY DIV. KNOWN AS RATHI VESSELS & SYSTEMS PVT LTD ) INDIA	INDIA	
2.48.13	SPX PROCESS EQUIPMENT LTD	INDIA	
<b>2.49</b>	<b>Centrifugal Pumps - Sealless General Service</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
2.49.1	FLOWSERVE	INDIA	





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Sr.No	VENDOR NAME	COUNTRY	REMARK
<b>2.50</b>	<b>Special Purpose Gear Unit</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
2.50.1	TRIVENI	INDIA	
2.50.6	TRIVENI	INDIA	
<b>2.51</b>	<b>ONE WAY CLUTCH</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
	NO INDIAN BIDDER AVAILABLE		
<b>2.52</b>	<b>FLEXIBLE METALLIC COUPLING</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
2.52.1	EUROFLEX (NON API 617)	INDIA	
2.52.2	RATHI (NON API 617)	INDIA	
2.52.3	UNIQUE (NON API 617)	INDIA	
2.52.4	JOHNCRANE	INDIA	
<b>2.53</b>	<b>Centrifugal Pumps - Non Metallic / Lined</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
2.53.1	FLOWSERVE	INDIA	
2.53.2	ITT (GOULDS PUMPS)	INDIA	
2.53.3	AMBICA	INDIA	
2.53.4	Bhagwati Engineering Works	INDIA	
2.53.5	Process Pumps (I) Pvt.Ltd.	INDIA	
2.53.6	Leak-Proof Pumps (I) Pvt.Ltd.	INDIA	
<b>2.54</b>	<b>VACUUM PUMPS</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
2.54.1	PPI PUMPS PVT. LTD.	INDIA	
2.54.2	VINDI VAK PUMP PVT. LTD.	INDIA	
2.54.3	JOYAM ENGINEERS & CONSULTANTS PVT. LTD.	INDIA	
2.54.4	INDO-AIR COMPRESSORS PVT. LTD.	INDIA	
2.54.5	CORE ENERGY SYSTEMS PVT. LTD.	INDIA	
2.54.9	GARDNER DENVER ENGINEERING PRODUCTS INDIA PVT. LTD.	INDIA	
<b>2.55</b>	<b>PUMP-CRITICAL TEMPERATURE COLD SERVICE</b>		
<b>3</b>	<b>FIRE FIGHTING EQUIPMENT</b>		
<b>3.1</b>	<b>FIRE EXTINGUISHERS (PORTABLE)</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
3.1.1	ASCO STRUMECH PVT LTD	INDIA	
3.1.2	BHARAT ENGG. WORKS	INDIA	
3.1.3	BRIJBASI HI-TECH UDYOG	INDIA	



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Sr.No	VENDOR NAME	COUNTRY	REMARK
3.1.4	FIRE SAFETY DEVICES PVT. LIMITED	INDIA	
3.1.5	GUNNEBO INDIA LIMITED	INDIA	
3.1.6	INTEGRATED FIRE PROTECTION PVT. LTD.	INDIA	
3.1.7	INTIME FIRE APPLIANCES PVT LTD	INDIA	
3.1.8	KANADIA FYR FYTER PVT. LTD.	INDIA	
3.1.9	KIDDE INDIA LTD.	INDIA	
3.1.10	NEWAGE INDUSTRIES	INDIA	
3.1.11	NITIN FIRE PROTECTION INDUSTRIES LTD	INDIA	
3.1.12	SAFEX FIRE SERVICES LTD.	INDIA	
3.1.13	SUPREMEX EQUIPMENTS	INDIA	
3.1.14	UNITED FIRE EQUIPMENTS PVT. LTD.	INDIA	
3.1.15	VIMAL FIRE CONTROLS PVT LTD	INDIA	
3.1.16	ZENITH FIRE SERVICES (INDIA) PVT. LTD.	INDIA	
3.1.17	MINIMAX	INDIA	
<b>3.2</b>	<b>SAFETY SHOWER &amp; EYE WASHER</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
3.2.1	CREATIVE ENGINEERS	INDIA	
3.2.2	PRADEEP SAFETY PVT LTD.	INDIA	
3.2.3	FRANCIS LESLIE & CO.	INDIA	
3.2.4	STAR ENGINEERS	INDIA	
3.2.5	TYCO FIRE & INTEGRATED SOLUTIONS	INDIA	
3.2.6	UNICARE EMERGENCY EQPT	INDIA	
<b>3.3</b>	<b>CLEAN AGENT SYSTEM</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
3.3.1	CHETAN CORPORATION	INDIA	
3.3.2	MX SYSTEMS INTERNATIONAL PVT. LTD.	INDIA	
3.3.3	NEW FIRE ENGINEERS (P) LTD	INDIA	
3.3.4	NITIN FIRE PROTECTION INDUSTRIES LTD	INDIA	
3.3.5	SIEMENS LIMITED	INDIA	
3.3.6	TYCO FIRE & SECURITY INDIA PVT. LTD	INDIA	
3.3.7	UNITECH NOHMI FIRE PROTECTION SYS(P)LTD	INDIA	
3.3.8	CHETAN ENGINEERS	INDIA	
3.3.9	MINIMAX	INDIA	
3.3.10	VIMAL FIRE CONTROLS PVT LTD.	INDIA	
3.3.11	STERLING FIRE FIGHTING SERVICES PVT LTD.	INDIA	
3.3.12	WILSON FIRE FIGHTING EQUIPMENTS	INDIA	
<b>3.4</b>	<b>DELUGE VALVE AND HEAT DETECTORS</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
3.4.1	DE'S TECHNICO PVT LTD	INDIA	
3.4.2	FIRETECH EQUIPMENTS & SYSTEM PVT. LTD.	INDIA	



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Sr.No	VENDOR NAME	COUNTRY	REMARK
3.4.3	FLOW-TEK VALVES & CONTROLS INC	INDIA	
3.4.4	HD FIREPROTECT PVT. LTD.	INDIA	
3.4.5	UTC FIRE AND SECURITY INDIA	INDIA	
3.4.6	TYCO FIRE AND INTEGRATED SOLUTIONS	INDIA	
3.4.7	MINIMAX	INDIA	
<b>3.5</b>	<b>HOSE DELIVERY</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
3.5.1	CHHATARIYA FIRETECH INDUSTRIES	INDIA	
3.5.2	DEWAS HYDROQUIP PVT LTD	INDIA	
3.5.3	HELIFLEX HYDRAULICS & ENGG.CO.	INDIA	
3.5.4	INDUSTRIAL COMMERTIAL CORPORATION	INDIA	
3.5.5	NEWAGE FIRE PROTECTION INDUSTRIES P LTD	INDIA	
3.5.6	NEWAGE FIREFIGHTING CO, LTD.	INDIA	
3.5.7	NITIN FIRE PROTECTION INDUSTRIES LTD	INDIA	
3.5.8	SUKAN EQUIPMENTS PVT LTD	INDIA	
3.5.9	CHHATARIYA RUBBER & CHEMICAL INDUSTRIES	INDIA	
<b>3.6</b>	<b>FIRE HOSE ACCESSORIES</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
3.6.1	ASCO STRUMECH PVT.LTD.	INDIA	
3.6.2	BRIJBASI HI-TECH UDYOG	INDIA	
3.6.3	GUNNEBO INDIA LIMITED	INDIA	
3.6.4	KIDDE INDIA LTD.	INDIA	
3.6.5	NEWAGE FIRE PROTECTION INDUSTRIES P LTD	INDIA	
3.6.6	NEWAGE INDUSTRIES	INDIA	
3.6.7	SHAH BHOGILAL JETHALAL & BROTHERS	INDIA	
3.6.8	SUKAN EQUIPMENTS PVT LTD	INDIA	
3.6.9	SUPREMEX EQUIPMENTS	INDIA	
3.6.10	UNITED FIRE EQUIPMENTS PVT. LTD.	INDIA	
3.6.11	VIMAL FIRE CONTROLS PVT LTD	INDIA	
<b>3.7</b>	<b>FOAM MAKER</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
3.7.1	BRIJBASI HI-TECH UDYOG	INDIA	
3.7.2	FIRETECH EQUIPMENTS & SYSTEM PVT. LTD.	INDIA	
3.7.3	HD FIREPROTECT PVT. LTD.	INDIA	
3.7.4	NEWAGE INDUSTRIES	INDIA	
<b>3.8</b>	<b>VAPOUR SEAL CHAMBER</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
3.8.1	BRIJBASI HI-TECH UDYOG	INDIA	
3.8.2	HD FIREPROTECT PVT. LTD.	INDIA	



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Sr.No	VENDOR NAME	COUNTRY	REMARK
3.8.3	NEWAGE FIREFIGHTING CO, LTD.	INDIA	
<b>3.9</b>	<b>BRANCH PIPES</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
3.9.1	ASCO STRUMECH PVT LTD	INDIA	
3.9.2	BRIJBASI HI-TECH UDYOG	INDIA	
3.9.3	GUNNEBO INDIA LIMITED	INDIA	
3.9.4	NEWAGE FIREFIGHTING CO.LTD.	INDIA	
3.9.5	NITIN FIRE PROTECTION INDUSTRIES LTD	INDIA	
3.9.6	SHAH BHOGILAL JETHALAL & BROTHERS	INDIA	
3.9.7	SUKAN EQUIPMENTS PVT LTD	INDIA	
3.9.8	SUPREMEX EQUIPMENTS	INDIA	
3.9.9	UNITED FIRE EQUIPMENTS PVT. LTD.	INDIA	
3.9.10	VIMAL FIRE CONTROLS PVT LTD	INDIA	
3.9.11	ZENITH FIRE SERVICES (INDIA) PVT. LTD.	INDIA	
<b>3.1</b>	<b>INLINE INDUCTORS</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
3.10.1	BRIJBASI HI-TECH UDYOG	INDIA	
3.10.2	FIRETECH EQUIPMENTS & SYSTEM PVT. LTD.	INDIA	
3.10.3	INTEGRATED FIRE PROTECTION PVT. LTD.	INDIA	
3.10.4	NEWAGE FIREFIGHTING CO.LTD.	INDIA	
<b>3.11</b>	<b>WATER SPRINKLER</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
3.11.1	HD FIREPROTECT PVT. LTD.	INDIA	
3.11.2	MX SYSTEMS INTERNATIONAL PVT. LTD.	INDIA	
3.11.3	NITIN FIRE PROTECTION INDUSTRIES LTD	INDIA	
3.11.4	TYCO FIRE & SECURITY INDIA PVT. LTD	INDIA	
3.11.5	MINIMAX	INDIA	
<b>3.12</b>	<b>FIXED FOAM SYSTEM (FOAM PACKAGE)</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
3.12.1	BRIJBASI HI-TECH UDYOG	INDIA	
3.12.2	HD FIREPROTECT PVT. LTD.	INDIA	
3.12.3	MX SYSTEMS INTERNATIONAL PVT. LTD.	INDIA	
<b>3.13</b>	<b>HYDRANT/LANDING VALVE</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
3.13.1	ASCO STRUMECH PVT.LTD.	INDIA	
3.13.2	BRIJBASI HI-TECH UDYOG	INDIA	
3.13.3	GUNNEBO INDIA LIMITED	INDIA	
3.13.4	NEWAGE FIREFIGHTING CO.LTD.	INDIA	



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Sr.No	VENDOR NAME	COUNTRY	REMARK
3.13.5	NITIN FIRE PROTECTION INDUSTRIES LTD	INDIA	
3.13.6	SHAH BHOGILAL JETHALAL & BROTHERS	INDIA	
3.13.7	SUKAN EQUIPMENTS PVT LTD	INDIA	
3.13.8	UNITED FIRE EQUIPMENTS PVT. LTD.	INDIA	
3.13.9	VENUS PUMP & ENGINEERING WORKS	INDIA	
3.13.10	KIDDE INDIA LTD	INDIA	
3.13.11	TYCO FIRE & INTEGRATED FIRE SOLUTION	INDIA	
3.13.12	ZENITH FIRE SERVICES	INDIA	
<b>3.14</b>	<b>SPRAY NOZZLE- FIRE FIGHTING</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
3.14.1	FIRETECH EQUIPMENTS & SYSTEM PVT. LTD.	INDIA	
3.14.2	HD FIREPROTECT PVT. LTD.	INDIA	
3.14.3	TYCO FIRE & INTEGRATED FIRE SOLUTION	INDIA	
3.14.4	UTC FIRE AND SECURITY INDIA LTD	INDIA	
<b>3.15</b>	<b>AUTO DCP EXTINGUISHING SYSTEM</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
3.15.1	MX SYSTEMS INTERNATIONAL PVT. LTD.	INDIA	
3.15.2	VIJAY FIRE VEHICLES AND PUMPS LTD	INDIA	
<b>3.16</b>	<b>HV/MV SPRAY SYSTEMS</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
3.16.1	AGNICE FIRE PROTECTION. PVT LTD.	INDIA	
3.16.2	DE'S TECHNICO PVT LTD.	INDIA	
3.16.3	HD FIREPROTECT PVT. LTD.	INDIA	
3.16.4	HONEYWELL AUTOMATION INDIA LTD	INDIA	
3.16.5	KIDDE INDIA LTD.	INDIA	
3.16.6	Wilo MATHER & PLATT PUMPS LTD.	INDIA	
3.16.7	MX SYSTEMS INTERNATIONAL PVT. LTD.	INDIA	
3.16.8	NEW FIRE ENGINEERS (P) LTD	INDIA	
3.16.9	TECHNO FIRE PROTECTION SERVICES PVT LTD	INDIA	
3.16.10	THERMOSYSTEMS PVT LTD	INDIA	
3.16.11	MEHTA AND ASSO FIRE PROTECTION SYSTEM	INDIA	
3.16.12	TYCO ENGINEERING AND CONSTRUCTION PVT LTD	INDIA	
<b>3.17</b>	<b>RIM SEAL FIRE PROTECTION SYSTEM</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
3.17.1	HSE ENGINEERS PVT. LTD.	INDIA	
3.17.3	VIMAL FIRE CONTROLS PVT LTD	INDIA	
<b>3.18</b>	<b>WATER MONITOR</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
3.18.1	AKRON BRASS COMPANY	INDIA	



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Sr.No	VENDOR NAME	COUNTRY	REMARK
3.18.2	BRIJBASI HI-TECH UDYOG	INDIA	
3.18.3	DE'S TECHNICO PVT LTD.	INDIA	
3.18.4	FIRETECH EQUIPMENTS & SYSTEM PVT. LTD.	INDIA	
3.18.5	GUNNEBO INDIA LIMITED	INDIA	
3.18.6	HD FIREPROTECT PVT. LTD.	INDIA	
3.18.7	NEWAGE FIREFIGHTING CO.LTD.	INDIA	
3.18.8	NEWAGE INDUSTRIES	INDIA	
3.18.9	SHAH BHOGILAL JETHALAL & BROTHERS	INDIA	
3.18.10	SUPREMEX EQUIPMENTS	INDIA	
3.18.11	VIMAL FIRE CONTROLS PVT LTD	INDIA	
3.18.12	VISHAL FIRE PROTECTION EQUIPMENTS	INDIA	
3.18.13	ZENITH FIRE SERVICES (INDIA) PVT LTD.	INDIA	
3.18.14	MINIMAX	INDIA	
<b>3.19</b>	<b>WATER CUM FOAM MONITOR</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
3.19.1	AKRON BRASS COMPANY	INDIA	
3.19.2	FIRETECH EQUIPMENTS & SYSTEM PVT. LTD.	INDIA	
3.19.3	HD FIREPROTECT PVT. LTD.	INDIA	
3.19.4	NEWAGE FIREFIGHTING CO.LTD.	INDIA	
3.19.5	SHAH BHOGILAL JETHALAL & BROTHERS	INDIA	
3.19.6	VIMAL FIRE CONTROLS PVT LTD	INDIA	
3.19.7	ANGUS FIRE ARMER LTD	INDIA	
3.19.8	TYCO FIRE AND INTEGRATED SOLUTIONS	INDIA	
3.19.9	VISHAL FIRE PROTECTION EQUIPMENTS	INDIA	
<b>3.2</b>	<b>LONG RANGE MONITOR</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
3.20.1	AKRON BRASS COMPANY	INDIA	
3.20.2	HD FIREPROTECT PVT. LTD.	INDIA	
3.20.3	NEWAGE FIREFIGHTING CO.LTD.	INDIA	
3.20.4	NEWAGE INDUSTRIES	INDIA	
3.20.5	SHAH BHOGILAL JETHALAL & BROTHERS	INDIA	
3.20.6	VIMAL FIRE CONTROLS PVT LTD	INDIA	
<b>3.21</b>	<b>REMOTE CONTROLLED MONITORS</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
3.21.1	AKRON BRASS COMPANY	INDIA	
3.21.2	HD FIRE PROTECT PRIVATE LTD	INDIA	
3.21.3	NEWAGE FIREFIGHTING CO.LTD.	INDIA	
3.21.4	NEWAGE INDUSTRIES	INDIA	
3.21.5	SHAH BHOGILAL JETHALAL & BROTHERS	INDIA	
3.21.6	VIMAL FIRE CONTROLS PVT LTD	INDIA	



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Sr.No	VENDOR NAME	COUNTRY	REMARK
<b>4</b>	<b>PACKAGES , HVAC &amp; MISCELLANEOUS</b>		
<b>4.1</b>	<b>DESALTER PACKAGE (COALESCER - ELECTROSTATIC)</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
	NO INDIAN BIDDER AVAILABLE		
<b>4.2</b>	<b>VACUUM EJECTOR CONDENSER SYS(ENGINEERED)</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
4.2.1	GODREJ & BOYCE MFG. CO. LTD.	INDIA	
4.2.2	MAZDA LIMITED.	INDIA	
<b>4.3</b>	<b>VACUUM EJECTOR CONDSR SYS(UNENGINEERED)</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
4.3.1	MAZDA LIMITED.	INDIA	
<b>4.4</b>	<b>DOSING PACKAGE(SKID MOUNTED)</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
4.4.1	ACCUDYNE INDUSTRIES INDIA PVT. LTD.	INDIA	
4.4.2	DENCIL PUMPS AND SYSTEMS PVT. LTD.	INDIA	
4.4.3	ENPRO INDUSTRIES PVT LTD	INDIA	
4.4.4	SWELORE ENGG. (P) LTD	INDIA	
4.4.5	V.K. PUMPS INDUSTRIES PVT. LTD	INDIA	
4.4.6	METAPOW ENGINEERS PVT. LTD.	INDIA	
4.4.7	METACHEM CORPORATION		
4.4.8	MILTON ROY INDIA PVT LTD	INDIA	
4.4.9	PSI ENGG SYSTEMS P.LTD.		
4.4.10	RAVI INDUSTRIES		
4.4.11	SHAPOTOOLS DOSING & METERING PUMPS		
<b>4.5</b>	<b>PRU (Propylene Recovery Unit) DRYER</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
	NO INDIAN BIDDER AVAILABLE		
<b>4.6</b>	<b>PNUEMATIC CONVEYING PACKAGE(FLUID START PIPE)</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
4.6.1	COPERION IDEAL PVT LTD	INDIA	
<b>4.7</b>	<b>EXTRUDER / PELLETIZER PACKAGE</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
	NO INDIAN BIDDER AVAILABLE		
<b>4.8</b>	<b>CATALYST, ADDITIVES UNLOADING PACKAGE</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		



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Sr.No	VENDOR NAME	COUNTRY	REMARK
	NO INDIAN BIDDER AVAILABLE		
<b>4.9</b>	<b>LOSS-IN WEIGHT FEEDER PACKAGE / SCREW CONVEYOR</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
	NO INDIAN BIDDER AVAILABLE		
<b>4.10</b>	<b>ROTARY FEEDER</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
	NO INDIAN BIDDER AVAILABLE		
<b>4.11</b>	<b>BAGGING PLANT</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
	NO INDIAN BIDDER AVAILABLE		
<b>4.12</b>	<b>VACUUM CLEANING SYSTEMS</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
	NO INDIAN BIDDER AVAILABLE		
<b>4.13</b>	<b>DRIER-AIR/GAS</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
4.13.1	CICB-CHEMICON PVT.LTD.	INDIA	
4.13.2	DELAIR INDIA PVT LTD	INDIA	
4.13.3	GAS PROCESSING EQUIPMENT PVT. LTD	INDIA	
4.13.4	INDCON PROJECTS & EQUIPMENTS LTD	INDIA	
4.13.5	LLOYDS STEELS INDUSTRIES LTD.	INDIA	
4.13.6	PURIFLAIR INDIA PVT LIMITED	INDIA	
4.13.7	SUMMITS HYGRONICS PVT.LTD	INDIA	
4.13.8	TRIDENT PNEUMATIC PVT LTD	INDIA	
4.13.9	ULTRAFILTER (INDIA) PVT. LTD	INDIA	
4.13.10	UTTAM VALUE STEELS LTD	INDIA	
4.13.11	CLEAN AIR	INDIA	
4.13.12	GASO ENERGY SYSTEMS INDIA PVT LTD	INDIA	
4.13.13	KILBURN ENGINEERING	INDIA	
4.13.14	PROCESS EQUIPMENT ENGINEERING	INDIA	
4.13.15	ADVANCED COMPAIR SYSTEM, INDIA	INDIA	
4.13.16	AIROX NIGEN EQUIPMENTS PVT LTD	INDIA	
<b>4.14</b>	<b>FILTER BAG TYPE</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
4.14.1	BATLIBOI ENVIRONMENTAL ENGG.LIMITED	INDIA	
4.14.2	COPERION IDEAL PVT. LTD.	INDIA	
4.14.3	F.HARLEY & CO. PVT LTD.	INDIA	





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Sr.No	VENDOR NAME	COUNTRY	REMARK
4.14.4	THERMAX LIMITED	INDIA	
4.14.5	PALL	INDIA	
<b>4.15</b>	<b>PLANT &amp; INSTRUMENT AIR COMPRESSOR PACKAGE</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
4.15.1	KIRLOSKAR PNEUMATIC CO. LTD	INDIA	
4.15.2	BHARAT HEAVY ENGINEERING LIMITED (BHEL)	INDIA	
<b>4.16</b>	<b>COOLING TOWER (Deleted)</b>		Rev.2: Deleted
<b>4.17</b>	<b>NITROGEN PLANT (CRYOGENIC)</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
4.17.1	AIR LIQUIDE GLOBAL E&C SOLUTIONS INDIA PRIVATE LIMITED	INDIA	
4.17.2	AIR LIQUIDE ENGINEERING INDIA PRIVATE LTD (ALEI)	INDIA	
4.17.3	BHARAT HEAVY ELECTRICALS LTD - HPVP	INDIA	
4.17.4	CRYOGAS EQUIPMENT PRIVATE LIMITED	INDIA	
4.17.5	GARDNER DENVER ENGINEERED PRODUCTS INDIA PVT LTD	INDIA	
4.17.6	INOX AIR PRODUCTS LTD.	INDIA	
4.17.7	NIRMAL INDUSTRIAL CONTROLS PVT. LTD.	INDIA	
4.17.8	LINDE	INDIA	
4.17.9	INOX INDIA PVT. LTD.	INDIA	
<b>4.18</b>	<b>DM WATER &amp; CONDENSATE POLISHING UNIT</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
4.18.1	AQUATECH SYSTEMS (ASIA) PVT. LTD	INDIA	
4.18.2	ION EXCHANGE (INDIA) LTD	INDIA	
4.18.3	VA TECH WABAG LTD	INDIA	
4.18.4	WIPRO WATER	INDIA	
<b>4.19</b>	<b>EFFLUENT TREATMENT PACKAGE</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
4.19.1	BIOTECH SERVICES	INDIA	
4.19.2	CAMERON MANUFACTURING (INDIA) PVT.LIMITED (Group of Schlumberger Ltd)	INDIA	
4.19.3	DOSHION VEOLIA WATER SOLUTIONS PVT LTD	INDIA	
4.19.4	ECOTECH LABS	INDIA	
4.19.5	ENPRO ENVIROTECH AND ENGINEERS PVT LTD.	INDIA	
4.19.6	GEO MILLER & CO. PVT. LTD.	INDIA	
4.19.7	ION EXCHANGE (INDIA) LTD	INDIA	
4.19.8	ROCHEM SEPARATION SYSTEMS	INDIA	
4.19.9	VA TECH WABAG LTD	INDIA	
4.19.10	SUEZ WATER TECHNOLOGIES & SOLUTIONS INDIA	INDIA	
4.19.11	TOSHIBA WATER SOLUTIONS PVT. LTD. INDIA	INDIA	



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Sr.No	VENDOR NAME	COUNTRY	REMARK
<b>4.20</b>	<b>EMERGENCY DIESEL GENERATOR</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
4.20.1	BHEL	INDIA	
4.20.2	FUJI ELECTRIC INDIA PVT LTD	INDIA	
4.20.3	KIRLOSKAR OIL ENGINES LTD	INDIA	
4.20.4	STERLING AND WILSON POWERGEN PVT. LTD	INDIA	
4.20.5	JAKSONS	INDIA	
4.20.6	WARTSILA	INDIA	
<b>4.21</b>	<b>CRANE-H.O.T / E.O.T / ELECTRIC HOISTS</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
4.21.1	ANUPAM INDUSTRIES LIMITED (ANAND)	INDIA	
4.21.2	ARMSEL MHE PVT LTD	INDIA	
4.21.3	AVON CRANES PVT. LTD. INDIA	INDIA	
4.21.4	BOMBAY POWERLIFT E.H. PVT. LTD. INDIA	INDIA	
4.21.5	BRAITHWAITE & CO. LTD. INDIA	INDIA	
4.21.6	CONSOLIDATED HOISTS PVT LTD.	INDIA	
4.21.7	EDDY CRANES ENGRS (P) LTD	INDIA	
4.21.8	ELECTROMECH MATERIAL HANDLING SYSTEMS	INDIA	
4.21.9	FURNACE AND FOUNDRY EQUIPMENT CO.	INDIA	
4.21.10	GRIP ENGINEERS PVT.LTD	INDIA	
4.21.11	HEAVY ENGINEERING CORPORATION LTD	INDIA	
4.21.12	HERCULES HOISTS LTD	INDIA	
4.21.13	HINDUSTAN MOTORS LTD. INDIA	INDIA	
4.21.14	JESSOP & CO. LTD. INDIA	INDIA	
4.21.15	KALINGA ENGINEERS LTD. INDIA	INDIA	
4.21.16	LIFTING EQUIPMENT & ACCESSORIES INDIA	INDIA	
4.21.17	MEEKA MACHINERY PVT LTD	INDIA	
4.21.18	MUKAND LIMITED	INDIA	
4.21.19	RHS CRANES & COMPONENTS	INDIA	
4.21.20	SAFEX ELECTROMECH PVT LTD	INDIA	
4.21.21	SAFEX ENERGY PVT LTD	INDIA	
4.21.22	SAVY ENGINEERING CORPORATION LTD. INDIA	INDIA	
4.21.23	SOUTHERN STRUCTURALS LTD. INDIA	INDIA	
4.21.24	TATA STEEL GROWTH SHOP	INDIA	
4.21.25	TECHNO INDUSTRIES	INDIA	
4.21.26	TRACTEL TIRFOR (I) PVT. LTD.	INDIA	
4.21.27	TUNGABHADRA STEEL PRODUCTS LTD. INDIA	INDIA	
4.21.28	UNIQUE INDUSTRIAL HANDLERS PVT. LTD.	INDIA	
4.21.29	W.H.BRADY & CO.LTD	INDIA	
4.21.30	WMI KONECRANES INDIA LTD.	INDIA	
<b>4.22</b>	<b>REFRIGERATION SYSTEM- VAPOUR ABSORPTION</b>		



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Sr.No	VENDOR NAME	COUNTRY	REMARK
<b>A</b>	<b>INDIAN BIDDERS</b>		
4.22.1	ALFA LAVAL	INDIA	
4.22.2	ETA ENGINEERING PVT. LTD.	INDIA	
4.22.3	KIRLOSKAR PNEUMATIC CO. LTD.	INDIA	
4.22.4	THERMAX LIMITED	INDIA	
4.22.5	VOLTAS LIMITED	INDIA	
<b>4.23</b>	<b>VENTILATION &amp; PRESSURISATION SYSTEM</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
4.23.1	ADVANCE VENTILATION PVT. LTD	INDIA	
4.23.2	BLUE STAR LTD	INDIA	
4.23.3	C DOCTOR INDIA PVT LTD	INDIA	
4.23.4	CARRIER CORPORATION	INDIA	
4.23.5	DUSTVEN PVT LTD	INDIA	
4.23.6	EMERSON NETWORK POWER (I) PVT LTD	INDIA	
4.23.7	ENGINEERS FABRICATORS	INDIA	
4.23.8	KPC	INDIA	
4.23.9	ROOTS COOLING SYSTEMS PVT LTD	INDIA	
4.23.10	S K SYSTEMS PVT LTD	INDIA	
4.23.11	VERTIV ENERGY PRIVATE LIMITED	INDIA	
4.23.12	VOLTAS LIMITED	INDIA	
<b>4.24</b>	<b>AIR CONDITIONING SYSTEM - PACKAGE UNIT</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
4.24.1	ADVANCE VENTILATION PVT. LTD	INDIA	
4.24.2	AIR PERFECTION	INDIA	
4.24.3	BLUE STAR LTD	INDIA	
4.24.4	EMERSON NETWORK POWER (I) PVT LTD ( VERTIV INDIA )	INDIA	
4.24.5	ETA ENGINEERING PVT. LTD.	INDIA	
4.24.6	ROOTS COOLING SYSTEMS PVT LTD	INDIA	
4.24.7	VOLTAS LIMITED	INDIA	
<b>4.25</b>	<b>AIR CONDITIONING SYSTEM - CENTRAL</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
4.25.1	ABB LTD.	INDIA	
4.25.2	ADVANCE VENTILATION PVT LTD	INDIA	
4.25.3	BATLIBOI	INDIA	
4.25.4	BLUE START LTD	INDIA	
4.25.5	CARRIER	INDIA	
4.25.6	KIRLOSKAR PNEUMATIC CO. LTD.	INDIA	
4.25.7	ROOTS COOLING SYSTEMS PVT LTD	INDIA	
4.25.8	VOLTAS LTD	INDIA	



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Sr.No	VENDOR NAME	COUNTRY	REMARK
<b>4.26</b>	<b>CHILLER PACKAGE /CONDENSING UNIT</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
4.26.1	BLUESTAR	INDIA	
4.26.2	CARRIER	INDIA	
4.26.3	DAIKIN	INDIA	
4.26.4	HITACHI	INDIA	
4.26.5	KIRLOSKAR	INDIA	
4.26.6	LG	INDIA	
4.26.7	TRANE	INDIA	
4.26.8	VOLTAS	INDIA	
4.26.9	YORK	INDIA	
<b>4.27</b>	<b>AIR HANDLING UNIT</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
4.27.1	BLUESTAR	INDIA	
4.27.2	CARYAIRE	INDIA	
4.27.3	EDGETECH	INDIA	
4.27.4	SUVIDHA(SAVEAIR)	INDIA	
4.27.5	VOLTAS	INDIA	
4.27.6	ZECO	INDIA	
4.27.7	CARRIER	INDIA	
4.27.8	TRANE	INDIA	
4.27.9	YORK	INDIA	
4.27.10	ABB	INDIA	
4.27.11	FLAKT	INDIA	
<b>4.28</b>	<b>CHEMICAL FILTER (HVAC)</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
4.28.1	BRY AIR	INDIA	
4.28.2	CAMFIL	INDIA	
4.28.3	CARYAIRE	INDIA	
4.28.4	PURAFIL	INDIA	
<b>4.29</b>	<b>CENTRIFUGAL FAN (HVAC)</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
4.29.1	ADVANCE VENTILATION	INDIA	
4.29.2	AIR CONTROL	INDIA	
4.29.3	FLAKT (INDIA)	INDIA	
4.29.4	KRIGER	INDIA	
4.29.5	LTD	INDIA	
4.29.6	NICOTRA	INDIA	
4.29.7	S.K.SYSTEM	INDIA	
<b>4.30</b>	<b>EXHAUST AXIAL FAN (HVAC)</b>		



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Sr.No	VENDOR NAME	COUNTRY	REMARK
<b>A</b>	<b>INDIAN BIDDERS</b>		
4.30.1	GE POWER INDIA LIMITED	INDIA	
4.30.2	CROMPTON GREAVES LTD.	INDIA	
4.30.3	PATEL AIRFLOW LTD	INDIA	
<b>4.31</b>	<b>SPLIT / WINDOW AC</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
4.31.1	BLUESTAR	INDIA	
4.31.2	CARRIER	INDIA	
4.31.3	DAIKIN	INDIA	
4.31.4	HITACHI	INDIA	
4.31.5	MITSHUBISHI	INDIA	
4.31.6	PANASONIC	INDIA	
4.31.7	SHARP	INDIA	
4.31.8	VOLTAS	INDIA	
4.31.9	LG	INDIA	
4.31.10	LYODS	INDIA	
4.31.11	VEDIOCON	INDIA	
<b>4.32</b>	<b>AIR FILTERS (HVAC)</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
4.32.1	AIRTECH	INDIA	
4.32.2	ANFILCO	INDIA	
4.32.3	DYNA	INDIA	
4.32.4	TENACITY	INDIA	
4.32.5	THERMADYNE	INDIA	
<b>4.33</b>	<b>3 WAY MODULATING VALVE FOR HVAC APPLICATION</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
4.33.1	DANFOSS	INDIA	
4.33.2	HONEYWELL	INDIA	
4.33.3	JHONSON CONTROLS	INDIA	
4.33.4	PSL LTD	INDIA	
4.33.5	SIEMENS	INDIA	
<b>4.34</b>	<b>FIRE DAMPER</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
4.34.1	CARYAIRE	INDIA	
4.34.2	GEORGE RAO & CO	INDIA	
4.34.3	RAVISTAR	INDIA	
4.34.4	TSC INSTRUMENTS	INDIA	
4.34.5	RUSKIN	INDIA	
4.34.6	ACTION AIR	INDIA	



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<b>4.35</b>	<b>VOLUME CONTROL DAMPERS / LOUVERS</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
4.35.1	ADVANCE VENTILATION	INDIA	
4.35.2	AIR MASTER	INDIA	
4.35.3	CARRYAIRE	INDIA	
4.35.4	DYNACRAFT	INDIA	
4.35.5	RAVISTAR	INDIA	
4.35.6	S.K.SYSTEMS	INDIA	
<b>4.36</b>	<b>GRILL / DIFFUSER FOR AIR CONDITIONING SYSTEM</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
4.36.1	AIR MASTER	INDIA	
4.36.2	CARRYAIRE	INDIA	
4.36.3	DYNACRAFT	INDIA	
4.36.4	RAVISTAR	INDIA	
4.36.5	TITUS	INDIA	
4.36.6	TROX	INDIA	
4.36.7	METAL AIRE	INDIA	
4.36.8	WATERLOO	INDIA	
<b>4.37</b>	<b>DAMPER ACTUATOR</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
4.37.1	BELIMO	INDIA	
4.37.2	DANFOSS	INDIA	
4.37.3	HONEYWELL	INDIA	
4.37.4	SIEMENS	INDIA	
<b>4.38</b>	<b>MODULATING DAMPER ACTUATOR</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
4.38.1	HONEYWELL	INDIA	
4.38.2	INDFOSS	INDIA	
4.38.3	JHONSON CONTROLS	INDIA	
4.38.4	PENN	INDIA	
4.38.5	SIEMENS	INDIA	
<b>4.39</b>	<b>G.I. SHEETS (HVAC DUCTING)</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
4.39.1	JINDAL	INDIA	
4.39.2	SAIL	INDIA	
4.39.3	TATA	INDIA	
<b>4.40</b>	<b>REFRIGERATION SYSTEM - PROCESS</b>		



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<b>COMMON PROJECTS MASTER SUPPLIER LIST-SECTION-A (MECHANICAL EQUIPMENTS)</b>			
Sr.No	VENDOR NAME	COUNTRY	REMARK
<b>A</b>	<b>INDIAN BIDDERS</b>		
4.40.1	ALFA LAVAL INDIA LTD.	INDIA	
4.40.2	KIRLOSKAR PNEUMATIC CO LTD- (PUNE)	INDIA	
4.40.3	SYSTEMS & COMPONENTS (INDIA) PVT. LTD.	INDIA	
4.40.4	TRANE	INDIA	
4.40.5	VOLTAS LIMITED	INDIA	
4.40.6	YORK INDIA LTD (A JOHNSON CONTROLS CO.)	INDIA	
<b>4.41</b>	<b>ELECTRONIC WEIGH SCALE</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
4.41.1	AVERY INDIA LTD	INDIA	
4.41.2	BLUE STAR LTD	INDIA	
4.41.3	HYDERABAD TULAMAN LTD	INDIA	
4.41.4	IPA PVT LTD.	INDIA	
4.41.5	PRECIA MOLEN INDIA PVT. LTD.	INDIA	
<b>4.42</b>	<b>PSA HYDROGEN PLANT</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
4.42.1	UOP INDIA PVT LTD	INDIA	
4.42.2	UOP LLC	INDIA	
<b>4.43</b>	<b>STATIC MIXER</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
4.43.1	MIXRITE MIXING SYSTEMS	INDIA	
4.43.2	RATHI MIXERS PVT LTD(FRM RL MPL)	INDIA	
4.43.3	REMI PROCESS PLANT & MACHINERY LTD.	INDIA	
4.43.4	STANDARD ENGINEERS	INDIA	
4.43.5	SUDARSHAN CHEMICAL INDUSTRIES LTD (FORMERLY DIV. KNOWN AS RATHI VESSELS & SYSTEMS PVT LTD.)	INDIA	
4.43.6	SULZER INDIA LIMITED	INDIA	
4.43.7	SULZER BROTHERS LTD	INDIA	
<b>4.44</b>	<b>COALESCER - FILTER</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
4.44.1	GRAND PRIX ENGINEERING PVT LTD.	INDIA	
4.44.2	LARSEN & TOUBRO LTD.	INDIA	
4.44.3	MULTITEX FILTRATION ENGINEERS LTD.	INDIA	
4.44.4	PALL INDIA PVT LTD	INDIA	
4.44.5	PETROMAR ENGINEERED SOLN. P LTD	INDIA	
4.44.6	PALL PHARMA LAB.	INDIA	
<b>4.45</b>	<b>FEED FLTR AUTO BACK WASH HYD.CRAKR DHDT</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
4.45.1	EATON INDUSTRIES PTE LIMITED	INDIA	



<b>SECTION-A MECHANICAL EQUIPMENTS</b>		Doc. No.	IOCL-MSL-2020
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<b>COMMON PROJECTS MASTER SUPPLIER LIST-SECTION-A (MECHANICAL EQUIPMENTS)</b>			
Sr.No	VENDOR NAME	COUNTRY	REMARK
4.45.2	PALL INDIA PVT LTD	INDIA	
<b>4.46</b>	<b>FILTER- ROTARY</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
4.46.1	EIMCO KCP LIMITED (THE)	INDIA	
<b>4.47</b>	<b>FILTER-VACUUM</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
	NO INDIAN BIDDERS AVAILABLE		
<b>4.48</b>	<b>QUICK OPENING CLOSURE(FILTER/SEPARATOR)</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
4.48.1	FLASH POINT EQUIPMENTS PVT. LTD.	INDIA	
4.48.2	MULTITEX FILTRATION ENGINEERS LTD.	INDIA	
4.48.3	PALL	INDIA	
<b>4.49</b>	<b>LIFTS (PASSENGER &amp; GOODS)</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
4.49.1	AILMAK	INDIA	
4.49.2	OTIS ELEVATOR COMPANY (I) LTD.	INDIA	
4.49.3	SCHINDLER INDIA PVT LTD	INDIA	
4.49.4	KONE ELEVATOR INDIA PVT LTD	INDIA	
4.49.5	THYSSENKRUPP ELEVATOR (INDIA) PVT. LTD.	INDIA	
<b>4.50</b>	<b>DEMISTER-VANE TYPE</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
4.50.1	FINEPAC STRUCTURES PVT LTD	INDIA	
4.50.2	GRANDPRIX ENGINEERING PVT LTD	INDIA	
4.50.3	KEVIN ENTERPRISES PVT LTD	INDIA	
4.50.4	KOCH CHEMICAL TECH. GROUP INDIA PVT LTD	INDIA	
4.50.5	SULZER INDIA PVT LTD	INDIA	
<b>4.51</b>	<b>TOWER PACKING CARBON</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
1.51.1	BLAST CARBOBLOCKS PVT LTD	INDIA	
1.51.2	CARBON PRODUCTS PVT LTD	INDIA	
1.51.3	SUGUNA INTERNATIONAL	INDIA	
<b>4.52</b>	<b>TOWER PACKINGS;PVC&amp;PP(NON-PROPRIETRY)</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
4.52.1	HI-PACK MASS TRANSFER PRODUCTS	INDIA	
4.52.2	KEVIN ENTERPISES PVT LTD	INDIA	
4.52.3	MASS TRANSFER PRODUCT INDUSTRIES	INDIA	





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COMMON PROJECTS MASTER SUPPLIER LIST-SECTION-A (MECHANICAL EQUIPMENTS)			
Sr.No	VENDOR NAME	COUNTRY	REMARK
<b>4.53</b>	<b>SPIRAL HEAT EXCHNAGER</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
4.53.1	TEMA INDIA	INDIA	
4.53.2	ALFA LAVAL	INDIA	
<b>4.54</b>	<b>HASTOLLOY SOLID REACTORS</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
4.54.1	LARSEN AND TOUBRO	INDIA	
4.54.2	ISGEC	INDIA	
4.54.3	GODREJ AND BOYCE MFG CO LTD	INDIA	
<b>4.55</b>	<b>DUPLEX SOLID REACTORS</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
4.55.1	LARSEN AND TOUBRO	INDIA	
4.55.2	ISGEC	INDIA	
4.55.3	GODREJ AND BOYCE MFG CO LTD	INDIA	
<b>4.56</b>	<b>DEHYDRATION PACKAGE</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
4.56.1	URIEL	INDIA	
4.56.2	KILBURN ENGINEERING LIMITED	INDIA	
4.56.3	GAS PROCESSING EQUIPMENTS PVT. LTD.	INDIA	
4.56.4	MOJJ ENGINEERING SYSTEMS LTD.	INDIA	
4.56.5	PRAJ INDUSTRIES LTD.	INDIA	
4.56.6	NARAN LALA PVT. LTD.	INDIA	
<b>4.57</b>	<b>BIOMASS SEPARATION PACKAGE</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
4.57.1	KILBURN ENGINEERING LIMITED	INDIA	
4.57.2	PENNWALT INDIA LTD.	INDIA	
4.57.3	ISGEC HEAVY ENGINEERING LTD.	INDIA	
4.57.4	SPAN HYDROTECH PVT. LTD.	INDIA	
<b>4.58</b>	<b>FALLING FILM EVAPORATOR</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
4.58.1	SULZER INDIA PVT. LTD.	INDIA	
4.58.2	SPRAY ENGINEERING DEVICES LTD.	INDIA	
4.58.3	URIEL	INDIA	
4.58.4	GRAND PRIX ENGINEERING PVT. LTD.	INDIA	
4.58.5	MULTITEX FILTRATION ENGINEERS LIMITED	INDIA	
<b>4.59</b>	<b>INOCULATOR FEED GAS CONDITIONING PACKAGE</b>		



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<b>COMMON PROJECTS MASTER SUPPLIER LIST-SECTION-A (MECHANICAL EQUIPMENTS)</b>			
Sr.No	VENDOR NAME	COUNTRY	REMARK
<b>A</b>	<b>INDIAN BIDDERS</b>		
4.59.1	KILBURN ENGINEERING LIMITED	INDIA	



<b>SECTION-B BULK PIPING ITEMS</b>		<b>Doc. No.</b>	<b>IOCL-MSL-2020</b>
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<b>M/s. INDIAN OIL CORPORATION LIMITED (IOCL)</b>		<b>Date :</b>	<b>31-Oct-20</b>
<b>COMMON PROJECTS MASTER SUPPLIER LIST-SECTION-B (BULK PIPING ITEMS)</b>			
<b>Sr.No</b>	<b>VENDOR NAME</b>	<b>COUNTRY</b>	<b>REMARK</b>
<b>1</b>	<b>PIPING &amp; FITTINGS</b>		
<b>1.1</b>	<b>NON STANDARD FORGINGS-CARBON STEEL</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
1.1.1	BAY FORGE (FORMERLY KNOWN - FOMAS INDIA)	INDIA	
1.1.2	BHARAT FORGE LTD.	INDIA	
1.1.3	BRITEX ENGINEERING WORKS	INDIA	
1.1.4	CD ENGINEERING CO.	INDIA	
1.1.5	CD INDUSTRIES	INDIA	
1.1.6	CHW FORGE PVT LTD (FR. CHAUDHRY HAMMER)	INDIA	
1.1.7	ECHJAY INDUSTRIES PVT LTD. (RAJKOT)	INDIA	
1.1.8	EMPEE ENGINEERING CORPORATION	INDIA	
1.1.9	GOOD LUCK ENGINEERING CO.	INDIA	
1.1.10	HEAVY ENGINEERING CORPORATION LTD	INDIA	
1.1.11	JAV FORGINGS & ENGINEERINGS PVT LTD	INDIA	Rev.1: Name Change
1.1.12	KISAAN STEEL (P) LTD	INDIA	
1.1.13	KUNJ FORGINGS PVT LTD	INDIA	
1.1.14	L&T SPECIAL STEELS AND HEAVY FORGINGS	INDIA	
1.1.15	LAL METAL FORGE LTD	INDIA	
1.1.16	MACKEIL ISPAT & FORGING LTD	INDIA	
1.1.17	METAL FORGINGS PVT LTD	INDIA	
1.1.18	PALLAVI INDUSTRIES	INDIA	
1.1.19	PARAMOUNT FORGE	INDIA	
1.1.20	R D FORGE	INDIA	
1.1.21	SANGHVI FORGINGS & ENGINEERING LTD	INDIA	
1.1.22	SE FORGE LIMITED	INDIA	
1.1.23	TRIVENI REFRACTORIES PVT LTD	INDIA	
1.1.24	WONIL F&T CO. LTD	INDIA	
<b>1.2</b>	<b>NON STANDARD FORGINGS-ALLOY STEEL</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
1.2.1	BAY FORGE (FORMERLY KNOWN - FOMAS INDIA)	INDIA	
1.2.2	BHARAT FORGE LTD.	INDIA	
1.2.3	CD ENGINEERING CO.	INDIA	
1.2.4	CHW FORGE PVT LTD (FR. CHAUDHRY HAMMER)	INDIA	
1.2.5	ECHJAY INDUSTRIES PVT LTD. (RAJKOT)	INDIA	Rev.1: Name Change
1.2.6	GOOD LUCK ENGINEERING CO.	INDIA	
1.2.7	JAV FORGINGS & ENGINEERINGS PVT LTD	INDIA	
1.2.8	KUNJ FORGINGS PVT LTD	INDIA	
1.2.9	L&T SPECIAL STEELS AND HEAVY FORGINGS	INDIA	
1.2.10	MACKEIL ISPAT & FORGING LTD	INDIA	
1.2.11	METAL FORGINGS PVT LTD	INDIA	Rev.1: Name Change
1.2.12	R D FORGE	INDIA	
1.2.13	SANGHVI FORGINGS & ENGINEERING LTD	INDIA	
1.2.14	SE FORGE LIMITED	INDIA	
1.2.15	WONIL F&T CO. LTD	INDIA	



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<b>COMMON PROJECTS MASTER SUPPLIER LIST-SECTION-B (BULK PIPING ITEMS)</b>			
<b>Sr.No</b>	<b>VENDOR NAME</b>	<b>COUNTRY</b>	<b>REMARK</b>
<b>1.3</b>	<b>NON STANDARD FORGINGS- STAINLESS STEEL</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
1.3.1	BAY FORGE (FORMERLY KNOWN - FOMAS INDIA)	INDIA	
1.3.2	BHARAT FORGE LTD.	INDIA	
1.3.3	BRITEX ENGINEERING WORKS	INDIA	
1.3.4	CD ENGINEERING CO.	INDIA	
1.3.5	CD INDUSTRIES	INDIA	
1.3.6	CHW FORGE PVT LTD (FR. CHAUDHRY HAMMER)	INDIA	
1.3.7	ECHJAY INDUSTRIES PVT LTD	INDIA	
1.3.8	EMPEE ENGINEERING CORPORATION	INDIA	
1.3.9	GOOD LUCK ENGINEERING CO.	INDIA	
1.3.10	JAV FORGINGS & ENGINEERINGS PVT LTD	INDIA	Rev.1: Name Change
1.3.11	L&T SPECIAL STEELS AND HEAVY FORGINGS	INDIA	
1.3.12	METAL FORGINGS PVT LTD	INDIA	
1.3.13	PALLAVI INDUSTRIES	INDIA	
1.3.14	PARAMOUNT FORGE	INDIA	
1.3.15	R D FORGE	INDIA	
1.3.16	SANGHVI FORGINGS & ENGINEERING LTD	INDIA	
1.3.17	SE FORGE LIMITED	INDIA	
1.3.18	WONIL F&T CO. LTD	INDIA	
<b>1.4</b>	<b>LINING (RUBBER)</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
1.4.1	ARUL RUBBER PVT LTD	INDIA	
1.4.2	CORI ENGINEERS PVT LTD	INDIA	
1.4.3	JASMINO POLYMERTech PVT.LTD.	INDIA	
1.4.4	LATHIA RUBBER MFG CO	INDIA	
1.4.5	LEBRACS RUBBER LININGS PVT LTD	INDIA	
1.4.6	MIL INDUSTRIES LIMITED	INDIA	
1.4.7	POLY RUBBER PRODUCTS	INDIA	
1.4.8	SHRI RAM RUBTECH PVT LIMITED	INDIA	
1.4.9	SRM EXOFLEX PVT. LTD.	INDIA	
1.4.10	TEGA INDUSTRIES LTD	INDIA	
<b>1.5</b>	<b>LINING-FRP(TANKS &amp; VESSELS)</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
1.5.1	CARBORUNDUM UNIVERSAL LTD-PRODORITE DIVN	INDIA	
1.5.2	CHEMICAL PROCESS EQPTS. PVT. LTD.	INDIA	
1.5.3	DOLF INDUSTRIES	INDIA	
1.5.4	EPP COMPOSITE PVT LTD	INDIA	
1.5.5	GANDHI & ASSOCIATES	INDIA	
1.5.6	INDUSTRIAL SERVICES	INDIA	
1.5.7	JASMINO POLYMERTech PVT.LTD.	INDIA	
1.5.8	MUNDOZ CORPORATION	INDIA	
1.5.9	POLY PLAST CHEMI-PLANT (I) LTD.	INDIA	
1.5.10	RUIA CHEMICALS P. LTD.	INDIA	



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<b>COMMON PROJECTS MASTER SUPPLIER LIST-SECTION-B (BULK PIPING ITEMS)</b>			
<b>Sr.No</b>	<b>VENDOR NAME</b>	<b>COUNTRY</b>	<b>REMARK</b>
1.5.11	SUNRISE INDUSTRIES (INDIA) LTD	INDIA	
<b>1.6</b>	<b>PVDF/FRP EQUIPMENTS</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
1.6.1	CARBORUNDUM UNIVERSAL LTD-PRODORITE DIVN	INDIA	
1.6.2	DOLF INDUSTRIES	INDIA	
1.6.3	GANDHI & ASSOCIATES	INDIA	
1.6.4	INDUSTRIAL SERVICES	INDIA	
1.6.5	PRAVEEN REINFORCED PLASTICS PVT LTD	INDIA	
1.6.6	RUIA CHEMICALS P. LTD.	INDIA	
1.6.7	STRATEGIC ENGINEERING (P) LTD	INDIA	
1.6.8	SUNRISE INDUSTRIES (INDIA) LTD	INDIA	
<b>1.7</b>	<b>ROCK WOOL INSULATION PRODUCTS</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
1.7.1	GOENKA ROCKWOOL (INDIA)PVT.LTD.	INDIA	
1.7.2	JAMSHEDPUR MINERALWOOL MFG.CO. (P) LTD.	INDIA	
1.7.3	LAPINUS ROCKWOOL PVT LTD	INDIA	
1.7.4	LLOYD ROCK FIBRES LTD	INDIA	
1.7.5	MINWOOL ROCK FIBRES LTD	INDIA	
1.7.6	NGP INDUSTRIES LTD (UNIT- ROCKWOOL INDST)	INDIA	
1.7.7	NGP INDUSTRIES LTD- (UNIT PUNJ STAR)	INDIA	
1.7.8	POLYBOND INSULATION PVT LTD	INDIA	
1.7.9	ROCKWOOL INDIA LTD	INDIA	
1.7.10	SHREERAM EQUITECH PRIVATE LTD	INDIA	
1.7.11	THERMOCARE ROCKWOOL (I)PVT.LTD.	INDIA	
1.7.12	ROCKWOOL INDIA PVT. LTD.	INDIA	
1.7.13	HI-TECH ROCK FIBER PVT LTD	INDIA	
1.7.14	ROXUL ROCKWOOL INSULATION INIA PVT LTD	INDIA	
<b>1.8</b>	<b>GLASS WOOL INSULATION PRODUCTS</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
1.8.1	UP TWIGA FIBRE GLASS LTD	INDIA	
<b>1.9</b>	<b>CALCIUM SILICATE PRODUCTS</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
1.9.1	HYDERABAD INDUSTRIES LTD (DHARUHERA)	INDIA	
1.9.2	NEWKEM INDUSTRIES	INDIA	
<b>1.10</b>	<b>PU FOAM &amp; POLYISOCYANURATE FOAM</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
1.10.1	ISOLLOYD ENGG. TECHNOLOGIES LTD	INDIA	
1.10.2	LLOYD INSULATIONS (INDIA) LTD	INDIA	
1.10.3	MALANPUR ENTECH PVT LTD	INDIA	
<b>1.11</b>	<b>LINE PIPES (HELICAL SAW)</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
1.11.1	ARCELORMITTAL NIPPON STEEL INDIA LIMITED	INDIA	Rev.2: Name Change
1.11.2	JINDAL SAW LTD	INDIA	



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<b>Sr.No</b>	<b>VENDOR NAME</b>	<b>COUNTRY</b>	<b>REMARK</b>
1.11.3	MAN INDUSTRIES (INDIA) LTD	INDIA	
1.11.4	RATNAMANI METALS AND TUBES LTD	INDIA	
1.11.5	TOPWORTH PIPES & TUBES PVT. LTD.	INDIA	
1.11.6	WELSPUN CORP LIMITED	INDIA	
<b>1.12</b>	<b>LINE PIPES ERW</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
1.12.1	BHANDARI FOILS & TUBES LTD	INDIA	
1.12.2	JINDAL (INDIA) LIMITED	INDIA	
1.12.3	JINDAL INDUSTRIES LTD	INDIA	
1.12.4	MAHARASHTRA SEAMLESS LTD.	INDIA	
1.12.5	MITTAL PRECISION HITECH STEELS	INDIA	
1.12.6	RATNAMANI METALS AND TUBES LTD	INDIA	
1.12.7	REMI EDELSTAHL TUBES LTD	INDIA	
1.12.8	SHUBHALAXMI METALS & TUBES PVT LTD	INDIA	
1.12.9	SURYA ROSHNI LTD	INDIA	
1.12.10	WELSPUN CORP LIMITED	INDIA	
1.12.11	BHUSHAN STEEL LIMITED	INDIA	
<b>1.13</b>	<b>LINE PIPES SEAMLESS</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
1.13.1	JINDAL SAW LTD (NASHIK WORKS)	INDIA	
1.13.2	MAHARASHTRA SEAMLESS LTD.	INDIA	
1.13.3	REMI EDELSTAHL TUBES LTD	INDIA	
1.13.4	SHUBHALAXMI METALS & TUBES PVT LTD	INDIA	
<b>1.14</b>	<b>LONG RADIUS BENDS</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
1.14.1	JINDAL SAW LTD	INDIA	
1.14.2	WELSPUN CORP LIMITED	INDIA	
<b>1.15</b>	<b>FLANGE- CARBON STEEL</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
1.15.1	ABASI ENGINEERING WORKS	INDIA	
1.15.2	ANANDMAYEE FORGINGS PVT LTD	INDIA	
1.15.3	BHARAT FORGE LTD.	INDIA	
1.15.4	BRITEX ENGINEERING WORKS	INDIA	
1.15.5	CD ENGINEERING CO.	INDIA	
1.15.6	CD INDUSTRIES	INDIA	
1.15.7	CHW FORGE PVT LTD (FR. CHAUDHRY HAMMER)	INDIA	
1.15.8	ECHJAY INDUSTRIES PVT LTD	INDIA	
1.15.9	FIVEBROS FORGINGS PVT.LTD.	INDIA	
1.15.10	GOOD LUCK ENGINEERING CO.	INDIA	
1.15.11	HILTON METAL FORGING LIMITED	INDIA	
1.15.12	JAI AUTO PVT LTD	INDIA	
1.15.13	JAV FORGINGS & ENGINEERINGS PVT LTD	INDIA	Rev.1: Name Change



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<b>COMMON PROJECTS MASTER SUPPLIER LIST-SECTION-B (BULK PIPING ITEMS)</b>			
<b>Sr.No</b>	<b>VENDOR NAME</b>	<b>COUNTRY</b>	<b>REMARK</b>
1.15.14	KISAAN DIETECH PVT LTD	INDIA	
1.15.15	KISAAN STEEL (P) LTD	INDIA	
1.15.16	KUNJ FORGINGS PVT LTD	INDIA	
1.15.17	LAL METAL FORGE LTD	INDIA	
1.15.18	M.S. FITTINGS MFG. CO PVT LTD	INDIA	
1.15.19	MAASS FLANGE INDIA PVT. LTD	INDIA	
1.15.20	METAL FORGINGS PVT LTD	INDIA	
1.15.21	P.K.TUBES & FITTINGS PVT.LTD.	INDIA	
1.15.22	PARAMOUNT FORGE	INDIA	
1.15.23	PRADEEP METALS LIMITED	INDIA	
1.15.24	R D FORGE	INDIA	
1.15.25	R.N.GUPTA & CO. LTD	INDIA	
1.15.26	SANGHVI FORGINGS & ENGINEERING LTD	INDIA	
1.15.27	STEEL AIDS ENTERPRISE PVT LTD	INDIA	
1.15.28	UTSAH ENGINEERING PVT LTD(A CD ENGG COMP	INDIA	
1.15.29	TRIVENI REFRACTORIES PVT LTD	INDIA	
1.15.30	MAXELL FORGE INDUSTRIES	INDIA	
1.15.31	GAYATRI FORGE PVT LTD	INDIA	
1.15.32	K S PIPE FITTINGS PRIVATE LIMITED	INDIA	
<b>1.16</b>	<b>FLANGE-ALLOY STEEL</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
1.16.1	ANANDMAYEE FORGINGS PVT LTD	INDIA	
1.16.2	BHARAT FORGE LTD.	INDIA	
1.16.3	CD ENGINEERING CO.	INDIA	
1.16.4	CHW FORGE PVT LTD (FR. CHAUDHRY HAMMER)	INDIA	
1.16.5	ECHJAY INDUSTRIES PVT LTD	INDIA	Rev.1: Name Change
1.16.6	FIVEBROS FORGINGS PVT.LTD.	INDIA	
1.16.7	GOOD LUCK ENGINEERING CO.	INDIA	
1.16.8	JAV FORGINGS & ENGINEERINGS PVT LTD	INDIA	Rev.1: Name Change
1.16.9	KUNJ FORGINGS PVT LTD	INDIA	
1.16.10	LAL METAL FORGE LTD	INDIA	
1.16.11	M.S. FITTINGS MFG. CO PVT LTD	INDIA	
1.16.12	METAL FORGINGS PVT LTD	INDIA	
1.16.13	P.K.TUBES & FITTINGS PVT.LTD.	INDIA	
1.16.14	PARAMOUNT FORGE	INDIA	
1.16.15	R D FORGE	INDIA	
1.16.16	SANGHVI FORGINGS & ENGINEERING LTD	INDIA	
1.16.17	UTSAH ENGINEERING PVT LTD(A CD ENGG COMP	INDIA	
1.16.18	MAXELL FORGE INDUSTRIES	INDIA	
1.16.19	GAYATRI FORGE PVT LTD	INDIA	
1.16.20	K S PIPE FITTINGS PRIVATE LIMITED	INDIA	
<b>1.17</b>	<b>FLANGE-STAINLESS STEEL</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
1.17.1	ANANDMAYEE FORGINGS PVT LTD	INDIA	



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<b>Sr.No</b>	<b>VENDOR NAME</b>	<b>COUNTRY</b>	<b>REMARK</b>
1.17.2	BHARAT FORGE LTD.	INDIA	
1.17.3	BRITEX ENGINEERING WORKS	INDIA	
1.17.4	CD ENGINEERING CO.	INDIA	
1.17.5	CD INDUSTRIES	INDIA	
1.17.6	CHANDAN STEEL LTD	INDIA	
1.17.7	CHW FORGE PVT LTD (FR. CHAUDHRY HAMMER)	INDIA	
1.17.8	ECHJAY INDUSTRIES PVT LTD	INDIA	
1.17.9	FIVEBROS FORGINGS PVT.LTD.	INDIA	
1.17.10	GOOD LUCK ENGINEERING CO.	INDIA	
1.17.11	HILTON METAL FORGING LIMITED	INDIA	
1.17.12	JAV FORGINGS & ENGINEERINGS PVT LTD	INDIA	Rev.1: Name Change
1.17.13	KUNJ FORGINGS PVT LTD	INDIA	
1.17.14	LAL METAL FORGE LTD	INDIA	
1.17.15	METAL FORGINGS PVT LTD	INDIA	
1.17.16	P.K.TUBES & FITTINGS PVT.LTD.	INDIA	
1.17.17	PARAMOUNT FORGE	INDIA	
1.17.18	PRADEEP METALS LIMITED	INDIA	
1.17.19	R D FORGE	INDIA	
1.17.20	SANGHVI FORGINGS & ENGINEERING LTD	INDIA	
1.17.21	UTSAH ENGINEERING PVT LTD(A CD ENGG COMP	INDIA	
1.17.22	VIRAJ PROFILES LIMITED	INDIA	
1.17.23	MAXELL FORGE INDUSTRIES	INDIA	
1.17.24	GAYATRI FORGE PVT LTD	INDIA	
1.17.25	MAASS FLANGE INDIA PVT. LTD	INDIA	
1.17.26	K S PIPE FITTINGS PRIVATE LIMITED	INDIA	
<b>1.18</b>	<b>FLANGES-EXOTIC</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
1.18.1	BRITEX ENGINEERING WORKS	INDIA	
<b>1.19</b>	<b>COMPACT FLANGE</b>		
<b>1.20</b>	<b>CLAMP CONNECTOR</b>		
<b>1.21</b>	<b>SIGHT FLOW INDICATORS (SIGHT GLASSES)</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
1.21.1	BLISS ANAND PVT LTD	INDIA	
1.21.2	LEVCON INSTRUMENTS PVT LTD	INDIA	
1.21.3	PRATOLINA INSTRUMENTS PVT LTD	INDIA	
1.21.4	SIGMA INSTRUMENTS CO	INDIA	
1.21.5	AMARAMA ENGINEERS	INDIA	
1.21.6	CHEMTROLS	INDIA	
1.21.7	C-TRU PROCESS EQUIPMENTS	INDIA	
1.21.8	TELFLO INSTRUMENT AND CONTROLS	INDIA	
<b>1.22</b>	<b>PIPE-CARBON STEEL TO INDIAN STANDARDS</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
1.22.1	A.S.T. PIPES PVT. LTD.(AST GROUP)	INDIA	
1.22.2	ASIAN MILLS PVT LTD	INDIA	





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<b>Sr.No</b>	<b>VENDOR NAME</b>	<b>COUNTRY</b>	<b>REMARK</b>
1.22.3	ASIAN TUBES LTD.	INDIA	
1.22.4	ASRANI TUBES LIMITED	INDIA	
1.22.5	DADU PIPES (P) LTD	INDIA	
1.22.6	GOODLUCK STEEL TUBES LTD	INDIA	
1.22.7	INDUS TUBE LIMITED	INDIA	
1.22.8	JCO GAS PIPE LIMITED	INDIA	
1.22.9	JINDAL (INDIA) LIMITED	INDIA	
1.22.10	JINDAL INDUSTRIES LTD	INDIA	
1.22.11	JINDAL PIPES LTD	INDIA	
1.22.12	JINDAL SAW LTD (KOSI WORKS)	INDIA	
1.22.13	LAL BABA SEAMLESS TUBES PVT. LTD	INDIA	
1.22.14	LALIT PIPES & PIPES LTD	INDIA	
1.22.15	MAHARASHTRA SEAMLESS LTD.	INDIA	
1.22.16	MAN INDUSTRIES (INDIA) LTD	INDIA	
1.22.17	MUKAT TANKS & VESSELS PVT ITD	INDIA	Rev.1: Name Change
1.22.18	NEZONE TUBES LIMITED	INDIA	
1.22.19	NORTH EASTERN TUBES LIMITED	INDIA	
1.22.20	P S STEEL TUBES LTD	INDIA	
1.22.21	PRATIBHA INDUSTRIES LIMITED	INDIA	
1.22.22	RAMA STEEL TUBES LTD.	INDIA	
1.22.23	RATNAMANI METALS AND TUBES LTD	INDIA	
1.22.24	RAVINDRA TUBES LIMITED	INDIA	
1.22.25	SAMSHI PIPE INDUSTRIES LIMITED	INDIA	
1.22.26	SURYA ROSHNI LTD	INDIA	
1.22.27	SWASTIK PIPES LTD	INDIA	
1.22.28	UTKARSH TUBES & PIPES LTD ( FORMLY. BMW)	INDIA	
1.22.29	WELSPUN CORP LIMITED	INDIA	
1.22.30	ZENITH BIRLA (INDIA) LIMITED	INDIA	
1.22.31	ADVANCED STEEL TUBE LTD	INDIA	
1.22.32	APL APOLLO TUBE LTD	INDIA	
1.22.33	CAPACITY STRUCTURES LTD	INDIA	
1.22.34	ARCELORMITTAL NIPPON STEEL INDIA LIMITED	INDIA	Rev.2: Name Change
1.22.35	ZENITH FIRE SERVICE INDIA PVT LTD	INDIA	Rev.2: Deleted
<b>1.23</b>	<b>PIPES &amp; TUBULARS TO A.P.I.STANDARDS</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
1.23.1	BHARAT HEAVY ELECTRICALS LIMITED	INDIA	
1.23.2	ARCELORMITTAL NIPPON STEEL INDIA LIMITED	INDIA	Rev.2: Name Change
1.23.3	ISMT LTD	INDIA	
1.23.4	JCO GAS PIPE LIMITED	INDIA	
1.23.5	JINDAL PIPES LTD	INDIA	
1.23.6	JINDAL SAW LTD (KOSI WORKS)	INDIA	
1.23.7	JINDAL SAW LTD (NASHIK WORKS)	INDIA	



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<b>COMMON PROJECTS MASTER SUPPLIER LIST-SECTION-B (BULK PIPING ITEMS)</b>			
<b>Sr.No</b>	<b>VENDOR NAME</b>	<b>COUNTRY</b>	<b>REMARK</b>
1.23.8	LALIT PIPES & PIPES LTD	INDIA	
1.23.9	MAHARASHTRA SEAMLESS LTD.	INDIA	
1.23.10	MUKAT TANKS & VESSELS PVT ITD	INDIA	Rev.1: Name Change
1.23.11	PRATIBHA INDUSTRIES LIMITED	INDIA	
1.23.12	RATNAMANI METALS AND TUBES LTD	INDIA	
1.23.13	SURYA ROSHNI LTD	INDIA	
1.23.14	SWASTIK PIPES LTD	INDIA	
1.23.15	WELSPUN CORP LIMITED	INDIA	
<b>1.24</b>	<b>PIPE/TUBE-C S (SEAMLESS)TO ASTM STDS</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
1.24.1	ANAND SEAMLESS TUBES PVT. LTD	INDIA	
1.24.2	AVON TUBETECH PVT LTD	INDIA	
1.24.3	BHARAT HEAVY ELECTRICALS LIMITED	INDIA	
1.24.4	HEAVY METALS & TUBES LIMITED(MEHSANA)	INDIA	
1.24.5	ISMT LTD-AHMEDNAGAR	INDIA	
1.24.6	JINDAL SAW LTD (NASHIK WORKS)	INDIA	
1.24.7	JR SEAMLESS PVT.LTD	INDIA	
1.24.8	LAL BABA SEAMLESS TUBES PVT. LTD	INDIA	
1.24.9	MAHALAXMI SEAMLESS LIMITED	INDIA	
1.24.10	MAHARASHTRA SEAMLESS LTD.	INDIA	
1.24.11	PATELS AIRFLOW LTD.	INDIA	
1.24.12	RATNADEEP METAL AND TUBES LTD.	INDIA	
1.24.13	SAINEST TUBES PVT LTD	INDIA	
1.24.14	SN TUBES PRIVATE LIMITED	INDIA	
<b>1.25</b>	<b>PIPE-CARBON STEEL(WELDED)TO ASTM STDS</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
1.25.1	ARCELORMITTAL NIPPON STEEL INDIA LIMITED	INDIA	Rev.2: Name Change
1.25.2	JINDAL SAW LTD (KOSI WORKS)	INDIA	
1.25.3	LALIT PIPES & PIPES LTD	INDIA	
1.25.4	MAN INDUSTRIES (INDIA) LTD	INDIA	
1.25.5	MUKAT TANKS & VESSELS PVT ITD	INDIA	Rev.1: Name Change
1.25.6	RATNAMANI METALS AND TUBES LTD	INDIA	
<b>1.26</b>	<b>PIPE/TUBE- A S (SEAMLESS)TO ASTM STDS</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
1.26.1	ANAND SEAMLESS TUBES PVT. LTD	INDIA	
1.26.2	BHARAT HEAVY ELECTRICALS LIMITED	INDIA	
1.26.3	HEAVY METALS & TUBES LIMITED(MEHSANA)	INDIA	
1.26.4	ISMT LTD-AHMEDNAGAR	INDIA	
1.26.5	ISMT LTD	INDIA	
1.26.6	JINDAL SAW LTD (NASHIK WORKS)	INDIA	
1.26.7	JR SEAMLESS PVT.LTD	INDIA	
1.26.8	MAHALAXMI SEAMLESS LIMITED	INDIA	
1.26.9	MAHARASHTRA SEAMLESS LTD.	INDIA	
1.26.10	PATELS AIRFLOW LTD.	INDIA	



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<b>Sr.No</b>	<b>VENDOR NAME</b>	<b>COUNTRY</b>	<b>REMARK</b>
1.26.11	RATNADEEP METAL AND TUBES LTD.	INDIA	
1.26.12	SAINEST TUBES PVT LTD	INDIA	
<b>1.27</b>	<b>PIPE/TUBE-SS(S.LESS &amp; WELDED)TO ASTM STD</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
1.27.1	APEX TUBES PVT LTD	INDIA	
1.27.2	JINDAL SAW LTD (NASHIK WORKS)	INDIA	
1.27.3	KRYSTAL GLOBAL ENGINEERING LTD.	INDIA	Rev.2: Name Change
1.27.4	MAHALAXMI SEAMLESS LIMITED	INDIA	
1.27.5	MAXIM TUBES COMPANY PVT LTD	INDIA	
1.27.6	MBM TUBES PVT LTD	INDIA	
1.27.7	PRODUCTOS TUBULARES S.A.U.	INDIA	
1.27.8	RATNADEEP METAL AND TUBES LTD.	INDIA	
1.27.9	RATNAMANI METALS AND TUBES LTD	INDIA	
1.27.10	SANDVIK ASIA PVT. LIMITED (AHMEDABAD)	INDIA	
1.27.11	SCODA TUBES LTD	INDIA	
1.27.12	SCORODITE STAINLESS (INDIA) PVT. LTD.(IOCL Holiday list Upto 23.09.2021)	INDIA	
1.27.13	SEAH STEEL CORPORATION	INDIA	
1.27.14	SHALCO INDUSTRIES PVT LTD.	INDIA	
1.27.15	SHUBHLAXMI METALS AND TUBES PVT. LTD	INDIA	
1.27.16	SOSTA GMBH	INDIA	
1.27.17	STEAMLINE INDUSTRIES Ltd	INDIA	
1.27.18	ARVIND PIPES & FITTINGS IND PVT LTD	INDIA	
1.27.19	BHANDARI FOILS AND TUBES	INDIA	
1.27.20	CHANDAN STEEL	INDIA	
1.27.21	DIVINE TUBES	INDIA	
1.27.22	HEAVY METALS AND TUBS LIMITED	INDIA	
1.27.23	HELIOS TUBE ALLOYS PVT LTD	INDIA	
1.27.24	SLS TUBES PVT LTD	INDIA	
1.27.25	SURAJ LIMITED	INDIA	
1.27.26	TUBACEX PRAKASH INDIA PVT LTD	INDIA	

<b>1.28</b>	<b>PIPE/TUBE-S.LESS(DUPLEX/SUPER DUPLEX SS)</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
1.28.1	RATNADEEP METAL AND TUBES LTD.	INDIA	
1.28.2	RATNAMANI METALS AND TUBES LTD	INDIA	
1.28.3	SANDVIK ASIA PVT. LIMITED (AHMEDABAD)	INDIA	
<b>1.29</b>	<b>PIPE / FITTINGS -PTFE LINED</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
1.29.1	D.V.POLYMERS INDIA (P) LTD	INDIA	
1.29.2	DIP-FLON ENGINEERING & CO.	INDIA	
1.29.3	HORIZON POLYMER ENGG. LTD.	INDIA	
1.29.4	MIL INDUSTRIES LIMITED	INDIA	



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<b>Sr.No</b>	<b>VENDOR NAME</b>	<b>COUNTRY</b>	<b>REMARK</b>
1.29.5	PLASTRULON PROCESSORS LTD	INDIA	
1.29.6	SUPER INDUSTRIAL LINING PVT LTD	INDIA	
<b>1.30</b>	<b>PIPES -SS WELDED TO A 358</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
1.30.1	OUTOKUMPU STAINLESS TUBULAR P.AB	INDIA	
1.30.2	RATNAMANI METALS AND TUBES LTD	INDIA	
1.30.3	SCORODITE STAINLESS (INDIA) PVT. LTD	INDIA	
1.30.4	TUBACEX PRAKASH INDIA PVT. LTD.	INDIA	
1.30.5	REMI EDELSTAHL TUBULARS LTD	INDIA	
<b>1.31</b>	<b>DUPLEX/SUPER DUPLEX SS WELDED PIPES</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
<b>1.32</b>	<b>PIPES- INDIAN STOCKIST</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
1.32.1	BHARAT ENTERPRISES	INDIA	
1.32.2	EVERGREEN SEAMLESS PIPES & TUBES PVT. LT	INDIA	
1.32.3	GREEN LINE PIPE AND FITTINGS	INDIA	
1.32.4	HI TECH METAL AND TUBES	INDIA	
1.32.5	INDUSTRIAL METAL CORPORATION	INDIA	
1.32.6	KWALITY TUBES	INDIA	
1.32.7	MOKSHI INDUSTRIES PVT. LTD	INDIA	
1.32.8	MOTILAL LAXMICHAND SANGHVI	INDIA	
1.32.9	N-PIPE SOLUTION INC	INDIA	
1.32.10	PIPES AND FLOW PRODUCTS	INDIA	
1.32.11	PK FORGE & FITTINGS INDUSTRIES	INDIA	
1.32.12	RAJENDRA PIPING & FITTINGS	INDIA	
1.32.13	SADAF TRADING COMPANY	INDIA	
1.32.14	STAR METAL AND TUBES	INDIA	
1.32.15	VENUS TRADING COMPANY	INDIA	
1.32.16	VINAYAK PIPES & TUBES PVT LTD	INDIA	
1.32.17	S SEVENTILAL & COMPANY	INDIA	
1.32.18	SEVANTILAL & SONS PVT. LTTD	INDIA	Rev.1: Name Change
1.32.19	MUKESH METAL INDUSTRIES	INDIA	
1.32.20	CHAMPAK STEEL & ENGG CO	INDIA	Rev.1: Name Change
1.32.21	MAHALAXMI METAL CORPORATION	INDIA	
<b>1.33</b>	<b>PIPE-CLADDED</b>		
<b>1.34</b>	<b>PIPE-WELDED ALLOY STEEL</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
1.34.1	LALIT PIPES & PIPES LTD	INDIA	
1.34.2	RATNAMANI METALS AND TUBES LTD	INDIA	
<b>1.35</b>	<b>PIPE-PVDF/FRP</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
1.35.1	GANDHI & ASSOCIATES	INDIA	
1.35.2	PRAVEEN REINFORCED PLASTICS PVT LTD	INDIA	



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<b>Sr.No</b>	<b>VENDOR NAME</b>	<b>COUNTRY</b>	<b>REMARK</b>
1.35.3	SUNRISE INDUSTRIES (INDIA) LTD	INDIA	
<b>1.36</b>	<b>PIPE-FRP</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
1.36.1	CARBON EVERFLOW LTD.	INDIA	
1.36.2	CARBORUNDUM UNIVERSAL LTD-PRODORITE DIVN	INDIA	
1.36.3	CHEMICAL PROCESS EQPTS. PVT. LTD.	INDIA	
1.36.4	DOLF INDUSTRIES	INDIA	
1.36.5	EPP COMPOSITE PVT LTD	INDIA	
1.36.6	GANDHI & ASSOCIATES	INDIA	
1.36.7	INDUSTRIAL SERVICES	INDIA	
1.36.8	POLY PLAST CHEMI-PLANT (I) LTD.	INDIA	
1.36.9	PRAVEEN REINFORCED PLASTICS PVT LTD	INDIA	
1.36.10	RUIA CHEMICALS P. LTD.	INDIA	
1.36.11	STRATEGIC ENGINEERING (P) LTD	INDIA	
1.36.12	SUNRISE INDUSTRIES (INDIA) LTD	INDIA	
<b>1.37</b>	<b>PIPE-GRE</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
	NO INDIAN BIDDER AVAILABLE		
<b>1.38</b>	<b>PIPE-TITANIUM (HS CODE - 8108)</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
	NO INDIAN BIDDER AVAILABLE		
<b>1.39</b>	<b>PIPING SYSTEM-CLAD(SHOP FABRICATED)</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
1.39.1	BHARAT HEAVY ELECTRICALS LIMITED	INDIA	
1.39.2	CRYSTAL INDUSTRIAL SYNDICATE PVT LTD.	INDIA	
1.39.3	GR ENGINEERNG PRIVATE LTD (TARAPORE)	INDIA	
1.39.4	INDUS PROJECTS LIMITED	INDIA	
1.39.5	ISGEC HEAVY ENGINEERING LTD	INDIA	
1.39.6	LARSEN & TOUBRO LTD	INDIA	
1.39.7	TECHNO PROCESS EQUIPMENTS (INDIA) PV LTD	INDIA	
<b>1.40</b>	<b>PRE-FABRICATED PIPING SPOOL</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
1.40.1	BHARAT HEAVY ELECTRICAL LTD.	INDIA	
1.40.2	DEE DEVELOPMENT ENGINEERS LIMITED	INDIA	
1.40.3	GUJRAT INFRAPIPES PVT. LIMITED	INDIA	
1.40.4	LARSEN & TOUBRO LTD	INDIA	
1.40.5	ISGEC HEAVY ENGINEERING LTD	INDIA	
<b>1.41</b>	<b>PIPING SYSTEM-GRE/GRP</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
1.41.1	EPP COMPOSITE PVT LTD	INDIA	
<b>1.42</b>	<b>TUBE-WELDED CARBON STEEL</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		



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<b>COMMON PROJECTS MASTER SUPPLIER LIST-SECTION-B (BULK PIPING ITEMS)</b>			
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<b>1.43</b>	<b>TUBE-WELDED ALLOY STEEL</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		

<b>1.44</b>	<b>TUBE-TITANIUM (HS CODE - 8108)</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		

<b>1.45</b>	<b>TUBE COPPER AND ALLOYS</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
1.45.1	ACCENT METALS PVT.LTD.	INDIA	
1.45.2	CUBEX TUBING PVT LTD	INDIA	
1.45.3	INDUSTRIAL TUBES MANUFACTURERS PVT. LTD.	INDIA	
1.45.4	MEHTA TUBES LIMITED	INDIA	
1.45.5	METAL ALLOYS CORPORATION	INDIA	
1.45.6	MULTIMETALS LIMITED	INDIA	

<b>1.46</b>	<b>PIPES &amp; FITTINGS-FOREIGN AGENTS/STOCKIST/TRADERS</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
1.46.1	STAR METAL AND TUBES	INDIA	

<b>1.47</b>	<b>FITTING BLOCK FORGED-CARBON STEEL</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
1.47.1	CSA FITTINGS	INDIA	
1.47.2	EBY FASTENERS	INDIA	
1.47.3	FLASH FORGE PVT LTD	INDIA	
1.47.4	HILTON METAL FORGING LIMITED	INDIA	
1.47.5	LEADER VALVES LTD	INDIA	
1.47.6	M.S. FITTINGS MFG. CO PVT LTD	INDIA	
1.47.7	P.K.TUBES & FITTINGS PVT.LTD.	INDIA	
1.47.8	TUBE BEND (CALCUTTA) PVT LTD	INDIA	
1.47.9	U I PIPE FITTINGS PVT LTD	INDIA	
1.47.10	VIJAY CYCLE & STEEL INDUSTRIES	INDIA	
1.47.11	SIDHARTH & GAUTAM ENGINEERS	INDIA	
1.47.12	TOPAZ PIPING INDUSTRIES	INDIA	
1.47.13	VAIBHAV FITTING INDIA PVT LTD	INDIA	
1.47.14	MAXELL FORGE INDUSTRIES	INDIA	
1.47.15	GAYATRI FORGE PVT LTD	INDIA	
1.47.16	K S PIPE FITTINGS PRIVATE LIMITED	INDIA	

<b>1.48</b>	<b>FITTING BLOCK FORGED-ALLOY STEEL</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
1.48.1	CSA FITTINGS	INDIA	
1.48.2	EBY FASTENERS	INDIA	
1.48.3	FLASH FORGE PVT LTD	INDIA	
1.48.4	LEADER VALVES LTD	INDIA	
1.48.5	M.S. FITTINGS MFG. CO PVT LTD	INDIA	



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<b>Sr.No</b>	<b>VENDOR NAME</b>	<b>COUNTRY</b>	<b>REMARK</b>
1.48.6	SIDHARTH & GAUTAM ENGINEERS	INDIA	
1.48.7	TOPAZ PIPING INDUSTRIES	INDIA	
1.48.8	VAIBHAV FITTING INDIA PVT LTD	INDIA	
1.48.9	MAXELL FORGE INDUSTRIES	INDIA	
1.48.10	GAYATRI FORGE PVT LTD	INDIA	
1.48.11	K S PIPE FITTINGS PRIVATE LIMITED	INDIA	
<b>1.49</b>	<b>FITTING BLOCK FORGED-STAINLESS STEEL</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
1.49.1	CSA FITTINGS	INDIA	
1.49.2	EBY FASTENERS	INDIA	
1.49.3	FLASH FORGE PVT LTD	INDIA	
1.49.4	HILTON METAL FORGING LIMITED	INDIA	
1.49.5	LEADER VALVES LTD	INDIA	
1.49.6	M.S. FITTINGS MFG. CO PVT LTD	INDIA	
1.49.7	VIJAY CYCLE & STEEL INDUSTRIES	INDIA	
1.49.8	SIDHARTH & GAUTAM ENGINEERS	INDIA	
1.49.9	TOPAZ PIPING INDUSTRIES	INDIA	
1.49.10	VAIBHAV FITTING INDIA PVT LTD	INDIA	
1.49.11	MAXELL FORGE INDUSTRIES	INDIA	
1.49.12	GAYATRI FORGE PVT LTD	INDIA	
1.49.13	K S PIPE FITTINGS PRIVATE LIMITED	INDIA	
<b>1.50</b>	<b>WELDOLETS/SOCKOLETS/ELBOWLET</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
1.50.1	CSA FITTINGS	INDIA	
1.50.2	EBY FASTENERS	INDIA	
1.50.3	FLASH FORGE PVT LTD	INDIA	
1.50.4	M.S. FITTINGS MFG. CO PVT LTD	INDIA	
1.50.5	SIDHARTH & GAUTAM ENGINEERS	INDIA	
1.50.6	TOPAZ PIPING INDUSTRIES	INDIA	
1.50.7	TUBE TURN INDIA PVT LTD	INDIA	
1.50.8	CD ENGG CO	INDIA	
1.50.9	SAWAN ENGINEERS PVT LTD	INDIA	
1.50.10	P.K.TUBES & FITTINGS PVT.LTD.	INDIA	
1.50.11	VAIBHAV FITTING INDIA PVT LTD	INDIA	
<b>1.51</b>	<b>FITTINGS BLOCK FORGED-EXOTIC MATLS. (HS CODE - 8108)</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
1.51.1	SAWAN ENGINEERS PVT LTD	INDIA	
<b>1.52</b>	<b>FITTINGS FROM SEAMLESS PIPE-CARBON STEEL</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
1.52.1	CSA FITTINGS	INDIA	
1.52.2	DEE DEVELOPMENT ENGINEERS LIMITED	INDIA	
1.52.3	FITTECH INDUSTRIES PVT LTD	INDIA	



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<b>COMMON PROJECTS MASTER SUPPLIER LIST-SECTION-B (BULK PIPING ITEMS)</b>			
<b>Sr.No</b>	<b>VENDOR NAME</b>	<b>COUNTRY</b>	<b>REMARK</b>
1.52.4	GAYATRI FORGE PVT LTD	INDIA	
1.52.5	GUJARAT INFRAPIPES PVT. LIMITED	INDIA	
1.52.6	INTERTECH FITTINGS INDIA PVT LTD	INDIA	
1.52.7	K S PIPE FITTINGS PRIVATE LIMITED	INDIA	
1.52.8	K.S.PIPE FITTINGS (P) LTD	INDIA	Rev.2: Duplicate
1.52.9	M.S. FITTINGS MFG. CO PVT LTD	INDIA	
1.52.10	MAXELL FORGE INDUSTRIES	INDIA	
1.52.11	P.K.TUBES & FITTINGS PVT.LTD.	INDIA	
1.52.12	PARAS ENGINEERING WORKS (MUMBAI) PVT LTD	INDIA	
1.52.13	PATTECH FITWELL TUBE COMPONENTS	INDIA	
1.52.14	PETRO CHEM INDUSTRIES	INDIA	
1.52.15	SAWAN ENGINEERS PVT LTD	INDIA	
1.52.16	SIDHARTH & GAUTAM ENGINEERS	INDIA	
1.52.17	TEEKAY TUBES PVT LTD	INDIA	
1.52.18	TOPAZ PIPING INDUSTRIES	INDIA	
1.52.19	TUBE BEND (CALCUTTA) PVT LTD	INDIA	
1.52.20	TUBE INNOVATIVE (INDIA)	INDIA	
1.52.21	TUBES INDIA	INDIA	
1.52.22	TUBE TURN (INDIA) PVT LTD	INDIA	
1.52.23	U I PIPE FITTINGS PVT LTD	INDIA	
<b>1.53</b>	<b>FITTINGS FROM SEAMLESS PIPE- ALLOY STEEL</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
1.53.1	CSA FITTINGS	INDIA	
1.53.2	DEE DEVELOPMENT ENGINEERS LIMITED	INDIA	
1.53.3	FITTECH INDUSTRIES PVT LTD	INDIA	
1.53.4	GUJARAT INFRAPIPES PVT. LIMITED (IOCL Holiday list Upto 27.06.2021)	INDIA	
1.53.5	INTERTECH FITTINGS INDIA PVT LTD	INDIA	
1.53.6	P.K.TUBES & FITTINGS PVT.LTD.	INDIA	
1.53.7	PARAS ENGINEERING WORKS (MUMBAI) PVT LTD	INDIA	
1.53.8	SAWAN ENGINEERS PVT LTD	INDIA	
1.53.9	TEEKAY TUBES PVT LTD	INDIA	
1.53.10	TOPAZ PIPING INDUSTRIES	INDIA	
1.53.11	SIDHARTH & GAUTAM ENGINEERS	INDIA	
1.53.12	MAXELL FORGE INDUSTRIES	INDIA	
1.53.13	GAYATRI FORGE PVT LTD	INDIA	
1.53.14	K S PIPE FITTINGS PRIVATE LIMITED	INDIA	
1.53.15	TUBE INNOVATIVE (INDIA)	INDIA	
1.53.16	TUBES INDIA	INDIA	
1.53.17	TUBE TURN (INDIA) PVT LTD	INDIA	
<b>1.54</b>	<b>FITTINGS FROM SEAMLESS PIPE- S.S.</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
1.54.1	CSA FITTINGS	INDIA	
1.54.2	DEE DEVELOPMENT ENGINEERS LIMITED	INDIA	





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<b>Sr.No</b>	<b>VENDOR NAME</b>	<b>COUNTRY</b>	<b>REMARK</b>
1.54.3	FITTECH INDUSTRIES PVT LTD	INDIA	
1.54.4	GUJARAT INFRAPIPES PVT. LIMITED (IOCL Holiday list Upto 27.06.2021)	INDIA	
1.54.5	INTERTECH FITTINGS INDIA PVT LTD	INDIA	
1.54.6	K.S.PIPE-FITTINGS (P) LTD	INDIA	Rev.2: Duplicate
1.54.7	M.S. FITTINGS MFG. CO PVT LTD	INDIA	
1.54.8	P.K.TUBES & FITTINGS PVT.LTD.	INDIA	
1.54.9	PARAS ENGINEERING WORKS (MUMBAI) PVT LTD	INDIA	
1.54.10	PETRO CHEM INDUSTRIES	INDIA	
1.54.11	SAWAN ENGINEERS PVT LTD	INDIA	
1.54.12	TEEKAY TUBES PVT LTD	INDIA	
1.54.13	TOPAZ PIPING INDUSTRIES	INDIA	
1.54.14	SIDHARTH & GAUTAM ENGINEERS	INDIA	
1.54.15	MAXELL FORGE INDUSTRIES	INDIA	
1.54.16	GAYATRI FORGE PVT LTD	INDIA	
1.54.17	K S PIPE FITTINGS PRIVATE LIMITED	INDIA	
1.54.18	TUBE INNOVATIVE (INDIA)	INDIA	
1.54.19	TUBES INDIA	INDIA	
1.54.20	TUBE TURN (INDIA) PVT LTD	INDIA	
<b>1.55</b>	<b>FITTINGS FROM S/LESS PIPES-EXOTIC MATLS (HS CODE - 8108)</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
1.55.1	SAWAN ENGINEERS PVT LTD	INDIA	
1.55.2	SIDHARTH & GAUTAM ENGINEERS	INDIA	
1.55.3	TOPAZ PIPING INDUSTRIES	INDIA	
<b>1.56</b>	<b>FITTINGS CROSS-FROM SEAMLESS PIPES</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
1.56.1	GUJRAT INFRAPIPES PVT. LIMITED	INDIA	
1.56.2	M.S. FITTINGS MFG. CO PVT LTD	INDIA	
<b>1.57</b>	<b>FITTING-GRE</b>		
<b>1.58</b>	<b>FITTINGS TO IS-1239</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
1.58.1	CSA FITTINGS	INDIA	
1.58.2	M.S. FITTINGS MFG. CO PVT LTD	INDIA	
1.58.3	NAVKAR FITTINGS & FORGINGS PVT LTD	INDIA	Rev.2: Name Change
1.58.4	VIJAY CYCLE & STEEL INDUSTRIES	INDIA	
1.58.5	PARAS ENGINEERING WORKS (MUMBAI) PVT LTD	INDIA	
1.58.6	TUBE INNOVATIVE (INDIA)	INDIA	
1.58.7	TUBES INDIA	INDIA	
1.58.8	TUBE TURN (INDIA) PVT LTD	INDIA	
<b>1.59</b>	<b>FITTINGS FABRICATED FROM PLATE - C.S.</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
1.59.1	DEE DEVELOPMENT ENGINEERS LIMITED	INDIA	



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<b>Sr.No</b>	<b>VENDOR NAME</b>	<b>COUNTRY</b>	<b>REMARK</b>
1.59.2	GUJARAT INFRAPIPES PVT. LIMITED	INDIA	
1.59.3	NAVKAR FITTINGS & FORGINGS PVT LTD	INDIA	Rev.2: Name Change
1.59.4	P.K.TUBES & FITTINGS PVT.LTD.	INDIA	
1.59.5	PARAS ENGINEERING WORKS (MUMBAI) PVT LTD	INDIA	
1.59.6	PETRO CHEM INDUSTRIES	INDIA	
1.59.7	SAWAN ENGINEERS PVT LTD	INDIA	
1.59.8	SIDHARTH & GAUTAM ENGINEERS	INDIA	
1.59.9	TEEKAY TUBES PVT LTD	INDIA	
1.59.10	TOPAZ PIPING INDUSTRIES	INDIA	
1.59.11	TOPAZ PIPING INDUSTRIES	INDIA	Rev.2: Deleted
1.59.12	TUBE BEND (CALCUTTA) PVT LTD	INDIA	
1.59.13	TUBE INNOVATIVE (INDIA)	INDIA	
1.59.14	TUBES INDIA	INDIA	
1.59.15	TUBE TURN (INDIA) PVT LTD	INDIA	
<b>1.60</b>	<b>FITTINGS FABRICATED FROM PLATE - A.S.</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
1.60.1	DEE DEVELOPMENT ENGINEERS LIMITED	INDIA	
1.60.2	GUJARAT INFRAPIPES PVT. LIMITED	INDIA	
1.60.3	NAVKAR FITTINGS & FORGINGS PVT LTD	INDIA	Rev.2: Name Change
1.60.4	P.K.TUBES & FITTINGS PVT.LTD.	INDIA	
1.60.5	PARAS ENGINEERING WORKS (MUMBAI) PVT LTD	INDIA	
1.60.6	SAWAN ENGINEERS PVT LTD	INDIA	
1.60.7	TEEKAY TUBES PVT LTD	INDIA	
1.60.8	SIDHARTH & GAUTAM ENGINEERS	INDIA	
1.60.9	TOPAZ PIPING INDUSTRIES	INDIA	
1.60.10	TUBE INNOVATIVE (INDIA)	INDIA	
1.60.11	TUBES INDIA	INDIA	
1.60.12	TUBE TURN (INDIA) PVT LTD	INDIA	
<b>1.61</b>	<b>FITTINGS FABRICATED FROM PLATE - S.S.</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
1.61.1	DEE DEVELOPMENT ENGINEERS LIMITED	INDIA	
1.61.2	GUJARAT INFRAPIPES PVT. LIMITED	INDIA	
1.61.3	NAVKAR FITTINGS & FORGINGS PVT LTD	INDIA	Rev.2: Name Change
1.61.4	P.K.TUBES & FITTINGS PVT.LTD.	INDIA	
1.61.5	PARAS ENGINEERING WORKS (MUMBAI) PVT LTD	INDIA	
1.61.6	SAWAN ENGINEERS PVT LTD	INDIA	
1.61.7	TEEKAY TUBES PVT LTD	INDIA	
1.61.8	SIDHARTH & GAUTAM ENGINEERS	INDIA	
1.61.9	TOPAZ PIPING INDUSTRIES	INDIA	
1.61.10	TUBE INNOVATIVE (INDIA)	INDIA	
1.61.11	TUBES INDIA	INDIA	
1.61.12	TUBE TURN (INDIA) PVT LTD	INDIA	
<b>1.62</b>	<b>FITTINGS FAB. FROM PLATES-EXOTIC MATLS. (HA CODE - 8108)</b>		



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<b>A</b>	<b>INDIAN BIDDERS</b>		
1.62.1	SAWAN ENGINEERS PVT LTD	INDIA	
<b>1.63</b>	<b>FITTINGS PIPE CAP (C S)</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
1.63.1	CSA FITTINGS	INDIA	
1.63.2	DEE DEVELOPMENT ENGINEERS LIMITED	INDIA	
1.63.3	GUJARAT INFRAPIPES PVT. LIMITED	INDIA	
1.63.4	K.S.PIPE FITTINGS (P) LTD	INDIA	
1.63.5	M.S. FITTINGS MFG. CO PVT LTD	INDIA	
1.63.6	NAVKAR FITTINGS & FORGINGS PVT LTD	INDIA	Rev.2: Name Change
1.63.7	P.K.TUBES & FITTINGS PVT.LTD.	INDIA	
1.63.8	PARAS ENGINEERING WORKS (MUMBAI) PVT LTD	INDIA	
1.63.9	PATTECH FITWELL TUBE COMPONENTS	INDIA	
1.63.10	PETRO CHEM INDUSTRIES	INDIA	
1.63.11	SAWAN ENGINEERS PVT LTD	INDIA	
1.63.12	TEEKAY TUBES PVT LTD	INDIA	
1.63.13	TUBE BEND (CALCUTTA) PVT LTD	INDIA	
1.63.14	SIDHARTH & GAUTAM ENGINEERS	INDIA	
1.63.15	TOPAZ PIPING INDUSTRIES	INDIA	
1.63.16	TUBE INNOVATIVE (INDIA)	INDIA	
1.63.17	TUBES INDIA	INDIA	
1.63.18	TUBE TURN (INDIA) PVT LTD	INDIA	
<b>1.64</b>	<b>FITTINGS PIPE CAP (A S)</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
1.64.1	CSA FITTINGS	INDIA	
1.64.2	DEE DEVELOPMENT ENGINEERS LIMITED	INDIA	
1.64.3	GUJARAT INFRAPIPES PVT. LIMITED	INDIA	
1.64.4	NAVKAR FITTINGS & FORGINGS PVT LTD	INDIA	Rev.2: Name Change
1.64.5	P.K.TUBES & FITTINGS PVT.LTD.	INDIA	
1.64.6	PARAS ENGINEERING WORKS (MUMBAI) PVT LTD	INDIA	
1.64.7	SAWAN ENGINEERS PVT LTD	INDIA	
1.64.8	TEEKAY TUBES PVT LTD	INDIA	
1.64.9	SIDHARTH & GAUTAM ENGINEERS	INDIA	
1.64.10	TOPAZ PIPING INDUSTRIES	INDIA	
1.64.11	TUBE INNOVATIVE (INDIA)	INDIA	
1.64.12	TUBES INDIA	INDIA	
1.64.13	TUBE TURN (INDIA) PVT LTD	INDIA	
<b>1.65</b>	<b>FITTINGS PIPE CAP (S S)</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
1.65.1	CSA FITTINGS	INDIA	
1.65.2	DEE DEVELOPMENT ENGINEERS LIMITED	INDIA	
1.65.3	GUJARAT INFRAPIPES PVT. LIMITED	INDIA	
1.65.4	K.S.PIPE FITTINGS (P) LTD	INDIA	
1.65.5	NAVKAR FITTINGS & FORGINGS PVT LTD	INDIA	Rev.2: Name Change



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<b>COMMON PROJECTS MASTER SUPPLIER LIST-SECTION-B (BULK PIPING ITEMS)</b>			
<b>Sr.No</b>	<b>VENDOR NAME</b>	<b>COUNTRY</b>	<b>REMARK</b>
1.65.6	P.K.TUBES & FITTINGS PVT.LTD.	INDIA	
1.65.7	PARAS ENGINEERING WORKS (MUMBAI) PVT LTD	INDIA	
1.65.8	PETRO CHEM INDUSTRIES	INDIA	
1.65.9	SAWAN ENGINEERS PVT LTD	INDIA	
1.65.10	TEEKAY TUBES PVT LTD	INDIA	
1.65.11	SIDHARTH & GAUTAM ENGINEERS	INDIA	
1.65.12	TOPAZ PIPING INDUSTRIES	INDIA	
1.65.13	TUBE INNOVATIVE (INDIA)	INDIA	
1.65.14	TUBES INDIA	INDIA	
1.65.15	TUBE TURN (INDIA) PVT LTD	INDIA	
<b>1.66</b>	<b>FITTINGS PIPE CAP (EXOTIC) (HS CODE - 8108)</b>		
<b>1.67</b>	<b>GASKET (IMPORTED)</b>		
<b>1.68</b>	<b>GASKET NON-ASBESTOS</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
1.68.1	CHAMPION JOINTINGS PVT LTD.	INDIA	
1.68.2	DAVE ENGINEERS PVT.LTD	INDIA	
1.68.3	GOODRICH GASKET PVT LTD	INDIA	
1.68.4	IGP ENGINEERS PVT. LIMITED	INDIA	
1.68.5	JAMES WALKER INMARCO INDUSTREIS PVT. LTD	INDIA	
1.68.6	MADRAS INDUSTRIAL PRODUCTS	INDIA	
1.68.7	NEOSEAL ENGINEERING PRIVATE LIMITED	INDIA	
1.68.8	SEALANT AND GASKET INDIA PVT LTD	INDIA	
1.68.9	STARFLEX SEALING INDIA PVT LTD	INDIA	
1.68.10	UNI KLINGER LTD	INDIA	
<b>1.69</b>	<b>GASKET METALLIC &amp; SOFT IRON</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
1.69.1	GOODRICH GASKET PVT LTD	INDIA	
1.69.2	IGP ENGINEERS PVT. LIMITED	INDIA	
1.69.3	MADRAS INDUSTRIAL PRODUCTS	INDIA	
1.69.4	MICRO PRECISION PRODUCTS PVT LTD	INDIA	
1.69.5	STARFLEX SEALING INDIA PVT LTD	INDIA	
1.69.6	TEADIT PACKING AND GASKETS PVT LTD	INDIA	
<b>1.70</b>	<b>GASKET METAL JACKETED</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
1.70.1	DAVE ENGINEERS PVT.LTD	INDIA	
1.70.2	GOODRICH GASKET PVT LTD	INDIA	
1.70.3	IGP ENGINEERS PVT. LIMITED	INDIA	
1.70.4	MADRAS INDUSTRIAL PRODUCTS	INDIA	
1.70.5	STARFLEX SEALING INDIA PVT LTD	INDIA	
1.70.6	TEEKAY FLOWFLEX PVT. LTD.	INDIA	



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<b>COMMON PROJECTS MASTER SUPPLIER LIST-SECTION-B (BULK PIPING ITEMS)</b>			
<b>Sr.No</b>	<b>VENDOR NAME</b>	<b>COUNTRY</b>	<b>REMARK</b>
1.70.7	UNI KLINGER LTD	INDIA	
<b>1.71</b>	<b>GASKET SPIRAL WOUND</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
1.71.1	BOMBAY CHEMICAL EQUIPMENTS	INDIA	
1.71.2	CHAMPION JOINTINGS PVT LTD.	INDIA	
1.71.3	DAVE ENGINEERS PVT.LTD	INDIA	
1.71.4	GOODRICH GASKET PVT LTD	INDIA	
1.71.5	IGP ENGINEERS PVT. LIMITED	INDIA	
1.71.6	JAMES WALKER INMARCO INDUSTREIS PVT. LTD	INDIA	
1.71.7	MADRAS INDUSTRIAL PRODUCTS	INDIA	
1.71.8	NEOSEAL ENGINEERING PRIVATE LIMITED	INDIA	
1.71.9	STARFLEX SEALING INDIA PVT LTD	INDIA	
1.71.10	TEADIT PACKING AND GASKETS PVT LTD	INDIA	
1.71.11	TEEKAY FLOWFLEX PVT. LTD.	INDIA	
1.71.12	UNI KLINGER LTD	INDIA	
<b>1.72</b>	<b>HOSE- RUBBER (STEAM/GAS/AIR/WATER/CHEM.)</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
1.72.1	DEWAS HYDROQUIP PVT LTD	INDIA	
1.72.2	GAYTRI INDUSTRIAL CORPORATION	INDIA	
1.72.3	HELIFLEX HYDRAULICS & ENGG.CO.	INDIA	
1.72.4	INSAP ENGINEERS PVT. LTD	INDIA	
1.72.5	PIX TRANSMISSIONS LIMITED	INDIA	
1.72.6	RM APPLIED ENGINEERS	INDIA	
1.72.7	SRIDHAR ENGG. & RUBER PRODUCTS PVT LTD.	INDIA	
1.72.8	SWAGELOK CO.	INDIA	
1.72.9	RIYAL INDIA CORP	INDIA	
<b>1.73</b>	<b>HOSE METALLIC FLEXIBLE SS</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
1.73.1	BENGAL INDUSTRIES PVT LTD	INDIA	
1.73.2	DEWAS HYDROQUIP PVT LTD	INDIA	
1.73.3	GAYTRI INDUSTRIAL CORPORATION	INDIA	
1.73.4	HELIFLEX HYDRAULICS & ENGG.CO.	INDIA	
1.73.5	INDIA FLEX INDUSTRIES PVT.LTD.	INDIA	
1.73.6	INSAP ENGINEERS PVT. LTD	INDIA	
1.73.7	RM APPLIED ENGINEERS	INDIA	
1.73.8	SENIOR INDIA PRIVATE LIMITED	INDIA	
1.73.9	SWAGELOK CO.	INDIA	
1.73.10	INSAP FLEXIBLE AND ENGINEERS PVT LTD	INDIA	
<b>1.74</b>	<b>FASTENERS</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		



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<b>Sr.No</b>	<b>VENDOR NAME</b>	<b>COUNTRY</b>	<b>REMARK</b>
1.74.1	AEP COMPANY	INDIA	
1.74.2	DEEPAK FASTENERS LIMITED (DORAHA UNIT)	INDIA	
1.74.3	FASTENERS & ALLIED PRODUCTS PVT LTD.	INDIA	
1.74.4	FIX FIT FASTENERS MFG. PVT.LTD.	INDIA	
1.74.5	HARDWIN FASTENERS PVT LTD.	INDIA	
1.74.6	HEM INDUSTRIES	INDIA	
1.74.7	INDUSTRIAL ENGINEERING CORP.	INDIA	
1.74.8	KUNDAN INDUSTRIES LTD.	INDIA	
1.74.9	LAKSHMI PRECISION SCREWS LTD	INDIA	
1.74.10	MEGA ENGINEERING PVT. LTD.	INDIA	
1.74.11	MULTI FASTENERS PVT LTD	INDIA	
1.74.12	NITIN FASTNERS PVT LTD	INDIA	
1.74.13	PANKAJ INTERNATIONAL	INDIA	
1.74.14	PIONEER NUTS & BOLTS PVT LTD	INDIA	
1.74.15	PRECISION AUTO ENGINEERS	INDIA	
1.74.16	PRECISION ENGG. INDUSTRIES	INDIA	
1.74.17	PRESIDENT ENGINEERING WORKS	INDIA	
1.74.18	PROCYON TCHNOLOGY	INDIA	
1.74.19	SAVETA ENGINEERING CO.PVT.LTD.	INDIA	
1.74.20	SOUVENIR INTERNATIONAL	INDIA	
1.74.21	SYNDICATE ENGINEERING INDUSTRIES	INDIA	
1.74.22	UDEHRA FASTNERS LTD	INDIA	
1.74.23	UDEHRA MECHANICAL WORKS	INDIA	
<b>1.75</b>	<b>FASTENERS:HIGH TEMPERATURE TO A 453</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
1.75.1	FASTENERS & ALLIED PRODUCTS PVT LTD.	INDIA	
1.75.2	PRESIDENT ENGINEERING WORKS	INDIA	
1.75.3	SYNDICATE ENGINEERING INDUSTRIES	INDIA	
<b>1.76</b>	<b>EXPANSION JOINTS (RUBBER)</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
1.76.1	CORI ENGINEERS PVT LTD	INDIA	
1.76.2	MIL INDUSTRIES LIMITED	INDIA	
1.76.3	RM APPLIED ENGINEERS	INDIA	
1.76.4	SRM EXOFLEX PVT. LTD.	INDIA	
1.76.5	FLEXOCON ENGINEERS PVT LTD	INDIA	
1.76.6	RRD DECORS PVT LTD	INDIA	
<b>1.77</b>	<b>SPRING SUPPORTS</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
1.77.1	AAA SUPPORTS PVT. LTD.,VADODARA	INDIA	
1.77.2	ACME PROCESS SYSTEMS PVT LTD.	INDIA	
1.77.3	PIPE HANGERS & SUPPORTS PVT LTD	INDIA	
1.77.4	PIPE SUPPORTS CO	INDIA	
1.77.5	PIPING & ENERGY PRODUCTS ( P ) LTD	INDIA	



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<b>Sr.No</b>	<b>VENDOR NAME</b>	<b>COUNTRY</b>	<b>REMARK</b>
1.77.6	PROCYON TECHNO INDUSTRY	INDIA	
1.77.7	SARATHI ENGINEERING ENTERPRISES PVT LTD.	INDIA	
1.77.8	SPRING SUPPORTS MFG CO	INDIA	
1.77.9	TECHNO INDUSTRY	INDIA	
1.77.10	TECHNO SPRINGS INDIA PVT LTD	INDIA	
<b>1.78</b>	<b>STRAINERS</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
	NO INDIAN BIDDER AVAILABLE		
<b>1.79</b>	<b>STRAINERS (FAB/CAST/FORGED)</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
1.79.1	BOMBAY CHEMICAL EQUIPMENTS	INDIA	
1.79.2	ESCO STEAMCON PVT. LTD.	INDIA	
1.79.3	FORBES MARSHALL PRIVATE LIMITED	INDIA	Rev.2: Name Change
1.79.4	GRAND PRIX ENGINEERING PVT LTD.	INDIA	
1.79.5	GUJARAT OTOFILT	INDIA	
1.79.6	LEADER VALVES LTD	INDIA	
1.79.7	MULTITEX FILTRATION ENGINEERS LTD.	INDIA	
1.79.8	PENNANT ENGINEERING PVT LTD	INDIA	
1.79.9	SUNGOV ENGINEERING PVT LTD	INDIA	
<b>1.80</b>	<b>STEAM TRAPS-BUCKET/TH.DYN/TH.STAT/FLOAT</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
1.80.1	ARMSTRONG INTERNATIONAL PVT LTD.	INDIA	
1.80.2	ESCO STEAMCON PVT. LTD.	INDIA	
1.80.3	FORBES MARSHALL PRIVATE LIMITED	INDIA	Rev.2: Name Change
1.80.4	GESTRA AG (FLOWSERVE GROUP)	INDIA	
1.80.5	LEADER VALVES LTD	INDIA	
1.80.6	PENNANT ENGINEERING PVT LTD	INDIA	
1.80.7	UNI KLINGER LTD	INDIA	
<b>1.81</b>	<b>COMPACT STEAM TRAPING ASSY+SS/CR MANFOLD</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
1.81.1	ARMSTRONG INTERNATIONAL PVT LTD.	INDIA	
1.81.2	FORBES MARSHALL PRIVATE LIMITED	INDIA	Rev.2: Name Change
1.81.3	UNI KLINGER LTD	INDIA	
<b>1.82</b>	<b>STEAM TRAPS</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
1.82.1	ARMSTRONG INTERNATIONAL PVT LTD.	INDIA	
1.82.2	SPX Flow Technology INDIA Pvt Ltd (Former PLENTY STEAM TRAPS, PLENTY LIMITED)	INDIA	
1.82.3	YARWAY CORPORATION	INDIA	
1.82.4	SPIRAX MARSHALL	INDIA	
1.82.5	GUJARAT OTOFILT	INDIA	
1.82.6	THERMAX C&H DIVISION - SERVICES SBU	INDIA	



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<b>Sr.No</b>	<b>VENDOR NAME</b>	<b>COUNTRY</b>	<b>REMARK</b>
<b>1.83</b>	<b>STEAM SUPPLY / COND. RECOVERY MANIFOLD</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
1.83.1	ARMSTRONG INTERNATIONAL PVT LTD.	INDIA	
1.83.2	FORBES MARSHALL PRIVATE LIMITED	INDIA	Rev.2: Name Change
1.83.3	UNI KLINGER LTD	INDIA	
<b>1.84</b>	<b>VALVE GATE (THRU CONDUIT) (AP16D)</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
1.84.1	EMERSON PROCESS MANAGEMENT (INDIA) PVT LTD	INDIA	Rev.1: Name Change
<b>1.85</b>	<b>VALVE GATE-(FOREIGN SUPPLIERS)</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
1.85.1	VELAN INC	INDIA	
1.85.2	FLOWSERVE INDIA CONTROLS PVT LTD	INDIA	Rev.2: Name Change
<b>1.86</b>	<b>VALVE GATE CAST</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
1.86.1	AMPO VALVES INDIA PVT LTD	INDIA	
1.86.3	ASSOCIATED TOOLING	INDIA	
1.86.4	AV VALVES LIMITED	INDIA	
1.86.5	BHARAT HEAVY ELECTRICALS LIMITED	INDIA	
1.86.6	CRI PUMPS PVT LTD (UNIT-VALVES)	INDIA	
1.86.7	EXPERT ENGINEERING ENTERPRISES	INDIA	
1.86.8	FLOWSERVE INDIA CONTROLS PVT LTD	INDIA	Rev.2: Name Change
1.86.9	FLUIDLINE VALVES CO.PVT LTD	INDIA	
1.86.10	FORWARD ALLOYS & CASTINGS	INDIA	
1.86.11	FOURESS ENGG (I) LTD. (AURANGABAD)	INDIA	
1.86.12	GM ENGINEERING PVT. LTD.	INDIA	
1.86.13	HAWA ENGINEERS LTD	INDIA	
1.86.14	INTERVALVE POONAWALLA LIMITED	INDIA	
1.86.15	KSB PUMPS LTD (COIMBATTORE)	INDIA	
1.86.16	L & T VALVES LIMITED	INDIA	
1.86.17	LEADER VALVES LTD	INDIA	
1.86.18	MH VALVES PVT LTD.	INDIA	
1.86.19	MICON ENGINEERS (HUBLI) PVT LTD	INDIA	
1.86.20	NILON VALVES PRIVATE LIMITED	INDIA	
1.86.21	NITON VALVE INDUSTRIES PRIVATE LTD .	INDIA	
1.86.22	NSSL PVT. LTD. (NECO SCHUBERT & SALZER)	INDIA	
1.86.23	OSWAL INDUSTRIES LTD	INDIA	
1.86.24	PANCHVATI VALVES & FLANGES PVT LTD	INDIA	
1.86.25	PEE INDUSTRIAL VALVES PVT. LTD.	INDIA	
1.86.26	SAKHI ENGINEERS PVT. LTD.	INDIA	
1.86.27	SHALIMAR VALVES PVT LTD	INDIA	
1.86.28	SHAYBURG VALVES PVT LTD	INDIA	





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<b>Sr.No</b>	<b>VENDOR NAME</b>	<b>COUNTRY</b>	<b>REMARK</b>
1.86.29	STEEL STRONG VALVES INDIA PVT LTD	INDIA	
1.86.30	T.S. PUMPS AND VALVES PVT.LTD	INDIA	
1.86.31	VALTECH INDUSTRIES	INDIA	
1.86.32	VELAN VALVES INDIA PVT LTD	INDIA	
1.86.33	TRILLIUM FLOW TECHNOLOGIES INDIA PRIVATE LIMITED	INDIA	Rev.1: Name Change
1.86.34	XOMOX SANMAR LTD-PACIFIC VALVES DIVISION	INDIA	
1.86.35	NUTECH CONTROLS	INDIA	
1.86.36	FLOTEK INDUSTRIES	INDIA	Rev.1: Addition
<b>1.87</b>	<b>VALVE GATE CRYOGENIC CAST</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
1.87.1	L & T VALVES LIMITED	INDIA	
1.87.2	LEADER VALVES LTD	INDIA	
1.87.3	NITON VALVE INDUSTRIES PRIVATE LTD .	INDIA	
1.87.4	NSSL PVT. LTD. (NECO SCHUBERT & SALZER)	INDIA	
1.87.5	OSWAL INDUSTRIES LTD	INDIA	
1.87.6	PANCHVATI VALVES & FLANGES PVT LTD	INDIA	
1.87.7	STEEL STRONG VALVES INDIA PVT LTD	INDIA	
1.87.8	VELAN INC	INDIA	
1.87.9	TRILLIUM FLOW TECHNOLOGIES INDIA PRIVATE LIMITED	INDIA	Rev.1: Name Change
<b>1.88</b>	<b>VALVE GATE FORGED</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
1.88.1	ASSOCIATED TOOLINGS INDIA PVT LTD	INDIA	
1.88.2	AUTOCAP INDUSTRIES	INDIA	
1.88.3	AV VALVES LIMITED	INDIA	
1.88.4	BHARAT HEAVY ELECTRICALS LIMITED	INDIA	
1.88.5	FLUIDLINE VALVES CO.PVT LTD	INDIA	
1.88.6	GM VALVES PRIVATE LIMITED	INDIA	Rev.2: Name Change
1.88.7	HAWA ENGINEERS LTD	INDIA	
1.88.8	INTERVALVE POONAWALLA LIMITED	INDIA	
1.88.9	KSB PUMPS LTD	INDIA	
1.88.10	L & T VALVES LIMITED	INDIA	
1.88.11	LEADER VALVES LTD	INDIA	
1.88.12	MH VALVES PVT LTD.	INDIA	
1.88.13	MICON ENGINEERS (HUBLI) PVT LTD	INDIA	
1.88.14	NITON VALVE INDUSTRIES PRIVATE LTD.	INDIA	
1.88.15	NSSL LTD	INDIA	
1.88.16	OSWAL INDUSTRIES LTD	INDIA	
1.88.17	PANCHVATI VALVES & FLANGES PVT LTD	INDIA	
1.88.18	PEE INDUSTRIAL VALVES PVT. LTD.	INDIA	
1.88.19	SHALIMAR VALVES PVT LTD	INDIA	
1.88.20	SHAYBURG VALVES PVT LTD	INDIA	
1.88.21	STEEL STRONG VALVES INDIA PVT LTD	INDIA	



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<b>Sr.No</b>	<b>VENDOR NAME</b>	<b>COUNTRY</b>	<b>REMARK</b>
1.88.22	VEE TECH VALVES PRIVATE LIMITED	INDIA	
1.88.23	VELAN VALVES INDIA PVT LTD	INDIA	
1.88.24	TRILLIUM FLOW TECHNOLOGIES INDIA PRIVATE LIMITED	INDIA	Rev.1: Name Change
1.88.25	RASAI FLOW LINES PVT LTD.	INDIA	
1.88.26	JMD ENGINEERING	INDIA	
1.88.27	NUTECH CONTROLS	INDIA	
<b>1.89</b>	<b>VALVE GATE CRYOGENIC FORGED</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
1.89.1	ASSOCIATED TOOLINGS INDIA PVT LTD	INDIA	
1.89.2	L & T VALVES LIMITED	INDIA	
1.89.3	LEADER VALVES LTD	INDIA	
1.89.4	NITON VALVE INDUSTRIES PRIVATE LTD .	INDIA	
1.89.5	OSWAL INDUSTRIES LTD	INDIA	
1.89.6	PANCHVATI VALVES & FLANGES PVT LTD	INDIA	
1.89.7	STEEL STRONG VALVES INDIA PVT LTD	INDIA	
1.89.8	VELAN VALVES INDIA PVT LTD	INDIA	
1.89.9	TRILLIUM FLOW TECHNOLOGIES INDIA PRIVATE LIMITED	INDIA	Rev.1: Name Change
<b>1.90</b>	<b>VALVE GATE GUNMETAL/BRASS/BRONZE</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
1.90.1	AV VALVES LIMITED	INDIA	
1.90.2	H. SARKER & COMPANY	INDIA	
1.90.3	LEADER VALVES LTD	INDIA	
1.90.4	SANT VALVES PVT LTD	INDIA	
1.90.5	ZOLOTO INDUSTRIES	INDIA	
<b>1.91</b>	<b>VALVE GATE (MOTOR OPERATED)</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
1.91.1	AMPO VALVES INDIA PVT LTD	INDIA	
1.91.2	BHARAT HEAVY ELECTRICALS LIMITED	INDIA	
1.91.3	FLOWSERVE INDIA CONTROLS PVT LTD	INDIA	Rev.2: Name Change
1.91.4	FLUIDLINE VALVES CO.PVT LTD	INDIA	
1.91.5	GM ENGINEERING PVT. LTD.	INDIA	
1.91.6	INTERVALVE POONAWALLA LIMITED	INDIA	
1.91.7	KSB PUMPS LTD (COIMBATTORE)	INDIA	
1.91.8	L & T VALVES LIMITED	INDIA	
1.91.9	LEADER VALVES LTD	INDIA	
1.91.10	NITON VALVE INDUSTRIES PRIVATE LTD .	INDIA	
1.91.11	NSSL. LTD (NECO SCHUBERT & SALZER LTD)	INDIA	
1.91.12	OSWAL INDUSTRIES LTD	INDIA	
1.91.13	STEEL STRONG VALVES INDIA PVT LTD	INDIA	
1.91.14	VELAN VALVES INDIA PVT LTD	INDIA	
1.91.15	TRILLIUM FLOW TECHNOLOGIES INDIA PRIVATE LIMITED	INDIA	Rev.1: Name Change



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<b>M/s. INDIAN OIL CORPORATION LIMITED (IOCL)</b>		<b>Date :</b>	<b>31-Oct-20</b>
<b>COMMON PROJECTS MASTER SUPPLIER LIST-SECTION-B (BULK PIPING ITEMS)</b>			
<b>Sr.No</b>	<b>VENDOR NAME</b>	<b>COUNTRY</b>	<b>REMARK</b>
1.91.16	XOMOX SANMAR LTD-PACIFIC VALVES DIVISION	INDIA	
<b>1.92</b>	<b>VALVE KNIFE GATE</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
1.92.1	BRAY CONTROLS INDIA PVT. LTD.	INDIA	
1.92.2	EXPERT ENGINEERING ENTERPRISES	INDIA	
1.92.3	JASH ENGINEERING LTD.	INDIA	
1.92.4	MICROFINISH VALVES PVT LIMITED	INDIA	
1.92.5	VAAS INDUSTRIES PVT LTD	INDIA	
<b>1.93</b>	<b>VALVE GLOBE-(FOREIGN SUPPLIERS)</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
1.93.1	FLOWSERVE INDIA CONTROLS PVT LTD	INDIA	Rev.2: Name Change
1.93.2	VELAN INC	INDIA	
<b>1.94</b>	<b>VALVE GLOBE CAST</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
1.94.1	AMPO VALVES INDIA PVT LTD	INDIA	
1.94.2	AV VALVES LIMITED	INDIA	
1.94.3	BHARAT HEAVY ELECTRICALS LIMITED	INDIA	
1.94.4	CRI PUMPS PVT LTD (UNIT-VALVES)	INDIA	
1.94.5	EXPERT ENGINEERING ENTERPRISES	INDIA	
1.94.6	FLUIDLINE VALVES CO.PVT LTD	INDIA	
1.94.7	FORWARD ALLOYS & CASTINGS	INDIA	
1.94.8	FOURESS ENGG (I) LTD. (AURANGABAD)	INDIA	
1.94.9	GM ENGINEERING PVT. LTD.	INDIA	
1.94.10	HAWA ENGINEERS LTD	INDIA	
1.94.11	INTERVALVE POONAWALLA LIMITED	INDIA	
1.94.12	KSB PUMPS LTD (COIMBATTORE)	INDIA	
1.94.13	L & T VALVES LIMITED	INDIA	
1.94.14	LEADER VALVES LTD	INDIA	
1.94.15	MH VALVES PVT LTD.	INDIA	
1.94.16	MICON ENGINEERS (HUBLI) PVT LTD	INDIA	
1.94.17	NILON VALVES PRIVATE LIMITED	INDIA	
1.94.18	NITON VALVE INDUSTRIES PRIVATE LTD .	INDIA	
1.94.19	NSSL PVT. LTD. (NECO SCHUBERT & SALZER)	INDIA	
1.94.20	OSWAL INDUSTRIES LTD	INDIA	
1.94.21	PANCHVATI VALVES & FLANGES PVT LTD	INDIA	
1.94.22	PEE INDUSTRIAL VALVES PVT. LTD.	INDIA	
1.94.23	SAKHI ENGINEERS PVT. LTD.	INDIA	
1.94.24	SHALIMAR VALVES PVT LTD	INDIA	
1.94.25	SHAYBURG VALVES PVT LTD	INDIA	
1.94.26	STEEL STRONG VALVES INDIA PVT LTD	INDIA	
1.94.27	TRILLIUM FLOW TECHNOLOGIES INDIA PRIVATE LIMITED	INDIA	Rev.1: Name Change



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<b>Sr.No</b>	<b>VENDOR NAME</b>	<b>COUNTRY</b>	<b>REMARK</b>
1.94.28	XOMOX SANMAR LTD-PACIFIC VALVES DIVISION	INDIA	
1.94.29	NUTECH CONTROLS	INDIA	
1.94.30	FLOTEK INDUSTRIES	INDIA	
<b>1.95</b>	<b>VALVE GLOBE CRYOGENIC CAST</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
1.95.1	L & T VALVES LIMITED	INDIA	
1.95.2	LEADER VALVES LTD	INDIA	
1.95.3	NITON VALVE INDUSTRIES PRIVATE LTD.	INDIA	
1.95.4	NSSL PVT. LTD. (NECO SCHUBERT & SALZER)	INDIA	
1.95.5	OSWAL INDUSTRIES LTD	INDIA	
1.95.6	PANCHVATI VALVES & FLANGES PVT LTD	INDIA	
1.95.7	STEEL STRONG VALVES INDIA PVT LTD	INDIA	
1.95.8	VELAN INC	INDIA	
1.95.9	TRILLIUM FLOW TECHNOLOGIES INDIA PRIVATE LIMITED	INDIA	Rev.1: Name Change
<b>1.96</b>	<b>VALVE GLOBE FORGED</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
1.96.1	ASSOCIATED TOOLINGS INDIA PVT LTD	INDIA	
1.96.2	AUTOCAP INDUSTRIES	INDIA	
1.96.3	AV VALVES LIMITED	INDIA	
1.96.4	BHARAT HEAVY ELECTRICALS LIMITED	INDIA	
1.96.5	FLOWSERVE INDIA CONTROLS PVT LTD	INDIA	Rev.2: Name Change
1.96.6	FLUIDLINE VALVES CO.PVT LTD	INDIA	
1.96.7	GM VALVES PRIVATE LIMITED	INDIA	Rev.2: Name Change
1.96.8	HAWA ENGINEERS LTD	INDIA	
1.96.9	INTERVALVE POONAWALLA LIMITED	INDIA	
1.96.10	KSB PUMPS LTD (COIMBATTORE)	INDIA	
1.96.11	L & T VALVES LIMITED	INDIA	
1.96.12	LEADER VALVES LTD	INDIA	
1.96.13	MICON ENGINEERS (HUBLI) PVT LTD	INDIA	
1.96.14	NITON VALVE INDUSTRIES PRIVATE LTD.	INDIA	
1.96.15	OSWAL INDUSTRIES LTD	INDIA	
1.96.16	PANCHVATI VALVES & FLANGES PVT LTD	INDIA	
1.96.17	PEE INDUSTRIAL VALVES PVT. LTD.	INDIA	
1.96.18	SEMPELL VALVES PVT LTD	INDIA	
1.96.19	SHALIMAR VALVES PVT LTD	INDIA	
1.96.20	SHAYBURG VALVES PVT LTD	INDIA	
1.96.21	STEEL STRONG VALVES INDIA PVT LTD	INDIA	
1.96.22	VEE TECH VALVES PRIVATE LIMITED	INDIA	
1.96.23	VELAN VALVES INDIA PVT LTD	INDIA	
1.96.24	TRILLIUM FLOW TECHNOLOGIES INDIA PRIVATE LIMITED	INDIA	Rev.1: Name Change
1.96.25	NUTECH CONTROLS	INDIA	
1.96.26	JMD ENGINEERS	INDIA	



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<b>COMMON PROJECTS MASTER SUPPLIER LIST-SECTION-B (BULK PIPING ITEMS)</b>			
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Sr.No	VENDOR NAME	COUNTRY	REMARK
<b>1.97</b>	<b>VALVE GLOBE CRYOGENIC FORGED</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
1.97.1	ASSOCIATED TOOLINGS INDIA PVT LTD	INDIA	
1.97.2	L & T VALVES LIMITED	INDIA	
1.97.3	LEADER VALVES LTD	INDIA	
1.97.4	NITON VALVE INDUSTRIES PRIVATE LTD.	INDIA	
1.97.5	OSWAL INDUSTRIES LTD	INDIA	
1.97.6	STEEL STRONG VALVES INDIA PVT LTD	INDIA	
1.97.7	TRILLIUM FLOW TECHNOLOGIES INDIA PRIVATE LIMITED	INDIA	Rev.1: Name Change
<b>1.98</b>	<b>VALVE GLOBE GUNMETAL/BRASS/BRONZE</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
1.98.1	AV VALVES LIMITED	INDIA	
1.98.2	H. SARKER & COMPANY	INDIA	
1.98.3	LEADER VALVES LTD	INDIA	
1.98.4	SANT VALVES PVT LTD	INDIA	
<b>1.99</b>	<b>Y TYPE GLOBE &amp; STOP CHECK VALVES</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
1.99.1	AMPO VALVES INDIA PVT LTD	INDIA	
1.99.2	FLOWSERVE INDIA CONTROLS PVT LTD	INDIA	Rev.2: Name Change
1.99.3	L & T VALVES LIMITED	INDIA	
1.99.4	NITON VALVE INDUSTRIES PRIVATE LTD.	INDIA	
1.99.5	SchuF Speciality valves INDIA Pvt Ltd	INDIA	
1.99.6	VELAN INC	INDIA	
1.99.7	VELAN VALVES INDIA PVT LTD	INDIA	
<b>1.100</b>	<b>VALVE- BLOWDOWN (Straight/Angle Pattern)</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
1.100.1	BHARAT HEAVY ELECTRICALS LIMITED	INDIA	
1.100.2	GESTRA AG (FLOWSERVE GROUP)	INDIA	
1.100.3	INSTRUMENTATION LTD	INDIA	Rev.1: Name Change
1.100.4	EMERSON PROCESS MANAGEMENT (INDIA) PVT LTD	INDIA	Rev.1: Name Change
1.100.5	SCHUF SPECIALITY VALVES INDIA PVT LTD	INDIA	
1.100.6	SEMPELL VALVES PVT LTD	INDIA	
1.100.7	YARWAY CORPORATION	INDIA	

<b>1.101</b>	<b>VALVE CHECK- (FOREIGN SUPPLIERS)</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
1.101.1	FLOWSERVE INDIA CONTROLS PVT LTD	INDIA	Rev.2: Name Change
1.101.2	VELAN INC	INDIA	



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Sr.No	VENDOR NAME	COUNTRY	REMARK
<b>1.102</b>	<b>VALVE CHECK CAST</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
1.102.1	AMPO VALVES INDIA PVT LTD	INDIA	
1.102.2	AV VALVES LIMITED	INDIA	
1.102.3	BHARAT HEAVY ELECTRICALS LIMITED	INDIA	
1.102.4	CRI PUMPS PVT LTD (UNIT-VALVES)	INDIA	
1.102.5	FLUIDLINE VALVES CO.PVT LTD	INDIA	
1.102.6	FORWARD ALLOYS & CASTINGS	INDIA	
1.102.7	FOURESS ENGG (I) LTD. (AURANGABAD)	INDIA	
1.102.8	GESTRA AG (FLOWSERVE GROUP)	INDIA	
1.102.9	GM ENGINEERING PVT. LTD.	INDIA	
1.102.10	HAWA ENGINEERS LTD	INDIA	
1.102.11	INTERVALVE POONAWALLA LIMITED	INDIA	
1.102.12	KSB PUMPS LTD (COIMBATTORE)	INDIA	
1.102.13	L & T VALVES LIMITED	INDIA	
1.102.14	LEADER VALVES LTD	INDIA	
1.102.15	MH VALVES PVT LTD.	INDIA	
1.102.16	MICON ENGINEERS (HUBLI) PVT LTD	INDIA	
1.102.17	NILON VALVES PRIVATE LIMITED	INDIA	
1.102.18	NITON VALVE INDUSTRIES PRIVATE LTD .	INDIA	
1.102.19	NSSL PVT. LTD. (NECO SCHUBERT & SALZER)	INDIA	
1.102.20	OMKAR VAVES PVT LTD	INDIA	
1.102.21	OSWAL INDUSTRIES LTD	INDIA	
1.102.22	PANCHVATI VALVES & FLANGES PVT LTD	INDIA	
1.102.23	PEE INDUSTRIAL VALVES PVT. LTD.	INDIA	
1.102.24	SAKHI ENGINEERS PVT. LTD.	INDIA	
1.102.25	SHALIMAR VALVES PVT LTD	INDIA	
1.102.26	SHAYBURG VALVES PVT LTD	INDIA	
1.102.27	STEEL STRONG VALVES INDIA PVT LTD	INDIA	
1.102.28	T.S. PUMPS AND VALVES PVT.LTD	INDIA	
1.102.29	VELAN VALVES INDIA PVT LTD	INDIA	
1.102.30	TRILLIUM FLOW TECHNOLOGIES INDIA PRIVATE LIMITED	INDIA	Rev.1: Name Change
1.102.31	XOMOX SANMAR LTD-PACIFIC VALVES DIVISION	INDIA	
1.102.32	NUTECH CONTROLS	INDIA	
<b>1.103</b>	<b>VALVE CHECK CRYOGENIC CAST</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
1.103.1	L & T VALVES LIMITED	INDIA	
1.103.2	NITON VALVE INDUSTRIES PRIVATE LTD .	INDIA	
1.103.3	NSSL PVT. LTD. (NECO SCHUBERT & SALZER)	INDIA	
1.103.4	OSWAL INDUSTRIES LTD	INDIA	
1.103.5	PANCHVATI VALVES & FLANGES PVT LTD	INDIA	
1.103.6	STEEL STRONG VALVES INDIA PVT LTD	INDIA	
1.103.7	VELAN INC	INDIA	



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<b>Sr.No</b>	<b>VENDOR NAME</b>	<b>COUNTRY</b>	<b>REMARK</b>
1.103.8	LEADER VALVES	INDIA	
<b>1.104</b>	<b>VALVE CHECK FORGED</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
1.104.1	ASSOCIATED TOOLINGS INDIA PVT LTD	INDIA	
1.104.2	AUTOCAP INDUSTRIES	INDIA	
1.104.3	AV VALVES LIMITED	INDIA	
1.104.4	BHARAT HEAVY ELECTRICALS LIMITED	INDIA	
1.104.5	FLOWSERVE INDIA CONTROLS PVT LTD	INDIA	Rev.2: Name Change
1.104.6	FLUIDLINE VALVES CO.PVT LTD	INDIA	
1.104.7	GM VALVES PRIVATE LIMITED	INDIA	Rev.2: Name Change
1.104.8	HAWA ENGINEERS LTD	INDIA	
1.104.9	INTERVALVE POONAWALLA LIMITED	INDIA	
1.104.10	KSB PUMPS LTD (COIMBATTORE)	INDIA	
1.104.11	L & T VALVES LIMITED	INDIA	
1.104.12	LEADER VALVES LTD	INDIA	
1.104.13	MICON ENGINEERS (HUBLI) PVT LTD	INDIA	
1.104.14	NITON VALVE INDUSTRIES PRIVATE LTD.	INDIA	
1.104.15	NSSL LTD	INDIA	
1.104.16	OMKAR VAVES PVT LTD	INDIA	
1.104.17	OSWAL INDUSTRIES LTD	INDIA	
1.104.18	PANCHVATI VALVES & FLANGES PVT LTD	INDIA	
1.104.19	PEE INDUSTRIAL VALVES PVT. LTD.	INDIA	
1.104.20	SHALIMAR VALVES PVT LTD	INDIA	
1.104.21	SHAYBURG VALVES PVT LTD	INDIA	
1.104.22	STEEL STRONG VALVES INDIA PVT LTD	INDIA	
1.104.23	VEE TECH VALVES PRIVATE LIMITED	INDIA	
1.104.24	VELAN VALVES INDIA PVT LTD	INDIA	
1.104.25	TRILLIUM FLOW TECHNOLOGIES INDIA PRIVATE LIMITED	INDIA	Rev.1: Name Change
1.104.26	NUTECH CONTROLS	INDIA	
1.104.27	JMD ENGINEERS	INDIA	
<b>1.105</b>	<b>VALVE CHECK CRYOGENIC FORGED</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
1.105.1	ASSOCIATED TOOLINGS INDIA PVT LTD	INDIA	
1.105.2	LEADER VALVES LTD	INDIA	
1.105.3	OSWAL INDUSTRIES LTD	INDIA	
1.105.4	STEEL STRONG VALVES INDIA PVT LTD	INDIA	
<b>1.106</b>	<b>VALVE CHECK GUNMETAL/BRASS/BRONZE</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
1.106.1	AV VALVES LIMITED	INDIA	
7.106.2	H. SARKER & COMPANY	INDIA	
7.106.3	LEADER VALVES LTD	INDIA	



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<b>Sr.No</b>	<b>VENDOR NAME</b>	<b>COUNTRY</b>	<b>REMARK</b>
7.106.4	SANT VALVES PVT LTD	INDIA	
7.106.5	ATAM VALVES PVT LTD	INDIA	
7.106.6	ZOLOTO INDUSTRIES	INDIA	
<b>1.107</b>	<b>VALVE CHECK (DUAL PLATE TYPE)</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
1.107.1	ADVANCE VALVES PVT LTD.	INDIA	
1.107.2	CRANE STOCKHAM VALVE LTD	INDIA	
1.107.3	FLOVEL VALVES PVT.LTD.	INDIA	
1.107.4	GESTRA AG (FLOWERVE GROUP)	INDIA	
1.107.5	LEADER VALVES LTD	INDIA	
1.107.6	NITON VALVE INDUSTRIES PRIVATE LTD .	INDIA	
1.107.7	OMKAR VAVES PVT LTD	INDIA	
1.107.8	SHALIMAR VALVES PVT LTD	INDIA	
1.107.9	TRILLIUM FLOW TECHNOLOGIES INDIA PRIVATE LIMITED	INDIA	
<b>1.108</b>	<b>VALVE CHECK EXCESS FLOW</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
1.108.1	CHANDRA ENGG. & MECH PVT LTD.	INDIA	
<b>1.109</b>	<b>VALVE-NON SLAM CHECK (NOZZLE)</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
1.109.1	CRANE STOCKHAM VALVE LTD	INDIA	
1.109.2	FLOVEL VALVES PVT.LTD.	INDIA	
<b>1.110</b>	<b>VALVE BALL-(FOREIGN SUPPLIERS)</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
1.110.1	FRANZ SCHUCK GMBH (FORMERLY BORSIG)	INDIA	
1.110.2	NELES INDIA PVT LTD	INDIA	Rev.1: Name Change
1.110.3	CAMERON LTD. (Group of Schlumberger Ltd)	INDIA	
<b>1.111</b>	<b>VALVE BALL CRYOGENIC</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
1.111.1	BELGAUM AQUA VALVES PVT. LTD.	INDIA	
1.111.2	MICROFINISH VALVES PVT LIMITED	INDIA	
1.111.3	TRILLIUM FLOW TECHNOLOGIES INDIA PRIVATE LIMITED	INDIA	Rev.1: Name Change
<b>1.112</b>	<b>VALVE BALL NON FIRE SAFE-CCS</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
1.112.1	AMPO VALVES INDIA PVT LTD	INDIA	Rev.2: Name Change
1.112.2	ANAND TEKNOVA AIDS ENGINEERING INDIA LTD	INDIA	
1.112.3	AQUA CONTROL VAVES PVT LTD	INDIA	
1.112.4	BELGAUM AQUA VALVES PVT. LTD.	INDIA	
1.112.5	BRAY CONTROLS INDIA PVT LTD	INDIA	





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<b>Sr.No</b>	<b>VENDOR NAME</b>	<b>COUNTRY</b>	<b>REMARK</b>
1.112.6	DELVAL FLOW CONTROLS PRIVATE LIMITED	INDIA	
1.112.7	DEMBLA VALVES LTD.	INDIA	
1.112.8	FLOW CHEM INDUSTRIES	INDIA	
1.112.9	FLOWJET VAVES PVT LTD	INDIA	
1.112.10	FLUIDLINE VALVES CO.PVT LTD	INDIA	
1.112.11	FRANZ SCHUCK GMBH (FORMERLY BORSIG- B506)	INDIA	
1.112.12	GM ENGINEERING PVT. LTD.	INDIA	
1.112.13	HAWA ENGINEERS LTD	INDIA	
1.112.14	INTERVALVE POONAWALLA LIMITED	INDIA	
1.112.15	L & T VALVES LIMITED	INDIA	
1.112.16	LEADER VALVES LTD	INDIA	
1.112.17	NELES INDIA PVT LTD	INDIA	Rev.1: Name Change
1.112.18	MEVADA ENGG.WORKS PVT LTD	INDIA	
1.112.19	MICON ENGINEERS (HUBLI) PVT LTD	INDIA	
1.112.20	MICROFINISH VALVES PVT LIMITED	INDIA	
1.112.21	NITON VALVE INDUSTRIES PRIVATE LTD.	INDIA	
1.112.22	NSSL LTD.	INDIA	
1.112.23	OSWAL INDUSTRIES LTD	INDIA	
1.112.24	RAPPID VALVES INDIA PVT LTD	INDIA	
1.112.25	REYNOLD VALVES LTD	INDIA	
1.112.26	SHALIMAR VALVES PVT LTD	INDIA	
1.112.27	SHAYBURG VALVES PVT LTD	INDIA	
1.112.28	VAAS AUTOMATION PVT LTD	INDIA	
1.112.29	VIRGO VALVES & CONTROLS PVT LTD.	INDIA	
1.112.30	TRILLIUM FLOW TECHNOLOGIES INDIA PRIVATE LIMITED	INDIA	Rev.1: Name Change
1.112.31	DEMBLA VALVES LIMITED	INDIA	
1.112.32	ANAND TEKNOVA AIDS ENGINEERING INDIA LTD.	INDIA	
<b>1.113</b>	<b>VALVE BALL NON FIRE SAFE-CSS</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
1.113.1	ANAND TEKNOVA AIDS ENGINEERING INDIA LTD	INDIA	
1.113.2	<del>ANAND TEKNOVA AIDS ENGINEERING INDIA LTD.</del>	INDIA	Rev.2: Deleted
1.113.3	AQUA CONTROL VAVES PVT LTD	INDIA	
1.113.4	BELGAUM AQUA VALVES PVT. LTD.	INDIA	
1.113.5	BRAY CONTROLS INDIA PVT LTD	INDIA	
1.113.6	DELVAL FLOW CONTROLS PRIVATE LIMITED	INDIA	
1.113.7	DEMBLA VALVES LIMITED	INDIA	
1.113.8	FLOW CHEM INDUSTRIES	INDIA	
1.113.9	FLOWJET VAVES PVT LTD	INDIA	
1.113.10	GM ENGINEERING PVT. LTD.	INDIA	
1.113.11	HAWA ENGINEERS LTD	INDIA	
1.113.12	INTERVALVE POONAWALLA LIMITED	INDIA	
1.113.13	L & T VALVES LIMITED	INDIA	
1.113.14	LEADER VALVES LTD	INDIA	



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<b>COMMON PROJECTS MASTER SUPPLIER LIST-SECTION-B (BULK PIPING ITEMS)</b>			
Sr.No	VENDOR NAME	COUNTRY	REMARK
1.113.15	NELES INDIA PVT LTD	INDIA	
1.113.16	MEVADA ENGG.WORKS PVT LTD	INDIA	
1.113.17	MICON ENGINEERS (HUBLI) PVT LTD	INDIA	
1.113.18	MICROFINISH VALVES PVT LIMITED	INDIA	
1.113.19	NITON VALVE INDUSTRIES PRIVATE LTD .	INDIA	
1.113.20	NSSL LTD.	INDIA	
1.113.21	OSWAL INDUSTRIES LTD	INDIA	
1.113.22	RAPPID VALVES INDIA PVT LTD	INDIA	
1.113.23	REYNOLD VALVES LTD	INDIA	
1.113.24	SHAYBURG VALVES PVT LTD	INDIA	
1.113.25	VAAS AUTOMATION PVT LTD	INDIA	
1.113.26	VIRGO VALVES & CONTROLS PVT LTD.	INDIA	
<b>1.114</b>	<b>VALVE BALL FIRE SAFE-CCS</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
1.114.1	ANAND TEKNOV AIDS ENGINEERING INDIA LTD	INDIA	
1.114.2	ANAND TEKNOV AIDS ENGINEERING INDIA LTD.	INDIA	Rev.2: Deleted
1.114.3	AQUA CONTROL VAVES PVT LTD	INDIA	
1.114.4	BELGAUM AQUA VALVES PVT. LTD.	INDIA	
1.114.5	BRAY CONTROLS INDIA PVT LTD	INDIA	
1.114.6	DEMBLA VALVES LIMITED	INDIA	
1.114.7	FLOW CHEM INDUSTRIES	INDIA	
1.114.8	FLOWJET VAVES PVT LTD	INDIA	
1.114.9	GM ENGINEERING PVT. LTD.	INDIA	
1.114.10	HAWA ENGINEERS LTD	INDIA	
1.114.11	INTERVALVE POONAWALLA LIMITED	INDIA	
1.114.12	L & T VALVES LIMITED	INDIA	
1.114.13	LEADER VALVES LTD	INDIA	
1.114.14	NELES INDIA PVT LTD	INDIA	Rev.1: Name Change
1.114.15	MICON ENGINEERS (HUBLI) PVT LTD	INDIA	
1.114.16	MICROFINISH VALVES PVT LIMITED	INDIA	
1.114.17	NITON VALVE INDUSTRIES PRIVATE LTD .	INDIA	
1.114.18	NSSL LTD.	INDIA	
1.114.19	OSWAL INDUSTRIES LTD	INDIA	
1.114.20	RAPPID VALVES INDIA PVT LTD	INDIA	
1.114.21	REYNOLD VALVES LTD	INDIA	
1.114.22	SHAYBURG VALVES PVT LTD	INDIA	
1.114.23	VAAS AUTOMATION PVT LTD	INDIA	
1.114.24	VIRGO VALVES & CONTROLS PVT LTD.	INDIA	
1.114.25	TRILLIUM FLOW TECHNOLOGIES INDIA PRIVATE LIMITED	INDIA	Rev.1: Name Change
<b>1.115</b>	<b>VALVE BALL FIRE SAFE-CSS</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		



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<b>COMMON PROJECTS MASTER SUPPLIER LIST-SECTION-B (BULK PIPING ITEMS)</b>			
<b>Sr.No</b>	<b>VENDOR NAME</b>	<b>COUNTRY</b>	<b>REMARK</b>
1.115.1	ANAND TEKNOV AIDS ENGINEERING INDIA LTD.	INDIA	
1.115.2	BELGAUM AQUA VALVES PVT. LTD.	INDIA	
1.115.3	CRANE PROCESS FLOW TECHNOLOGES (I) LTD	INDIA	
1.115.4	DELVAL FLOW CONTRLS PVT LTD	INDIA	
1.115.5	FLOW CHEM INDUSTRIES	INDIA	
1.115.6	GM ENGINEERING PVT. LTD.	INDIA	
1.115.7	INTERVALVE POONAWALLA LIMITED	INDIA	
1.115.8	L & T VALVES LIMITED	INDIA	
1.115.9	LEADER VALVES LTD	INDIA	
1.115.10	NELES INDIA PVT LTD	INDIA	
1.115.11	MICON ENGINEERS (HUBLI) PVT LTD	INDIA	
1.115.12	MICROFINISH VALVES PVT LIMITED	INDIA	
1.115.13	NITON VALVE INDUSTRIES PRIVATE LTD .	INDIA	
1.115.14	NSSL LTD.	INDIA	
1.115.15	OMKAR VALVES PVT LTD	INDIA	
1.115.16	REYNOLD VALVES LTD	INDIA	
1.115.17	VAAS AUTOMATION PVT LTD	INDIA	
1.115.18	VIRGO VALVES & CONTROLS PVT LTD.	INDIA	
1.115.19	TRILLIUM FLOW TECHNOLOGIES INDIA PRIVATE LIMITED	INDIA	Rev.1: Name Change
<b>1.116</b>	<b>VALVE BALL - FIRE SAFE (FORGED)</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
1.116.1	ANAND TEKNOV AIDS ENGINEERING INDIA LTD.	INDIA	
1.116.2	BELGAUM AQUA VALVES PVT. LTD.	INDIA	
1.116.3	CRANE PROCESS FLOW TECHNOLOGES (I) LTD	INDIA	
1.116.4	DELVAL FLOW CONTRLS PVT LTD	INDIA	
1.116.5	INTERVALVE POONAWALLA LIMITED	INDIA	
1.116.6	MICON ENGINEERS (HUBLI) PVT LTD	INDIA	
1.116.7	MICROFINISH VALVES PVT LIMITED	INDIA	
1.116.8	OMKAR VALVES PVT LTD	INDIA	
1.116.9	SHAYBURG VALVES PVT LTD	INDIA	
1.116.10	TRILLIUM FLOW TECHNOLOGIES INDIA PRIVATE LIMITED	INDIA	Rev.1: Name Change
<b>1.117</b>	<b>VALVE BALL NON FIRE SAFE-FCS</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
1.117.1	BELGAUM AQUA VALVES PVT. LTD.	INDIA	
1.117.2	CRANE PROCESS FLOW TECHNOLOGES (I) LTD	INDIA	
1.117.3	DELVAL FLOW CONTRLS PVT LTD	INDIA	
1.117.4	FLOW CHEM INDUSTRIES	INDIA	
1.117.5	HAWA ENGINEERS LTD	INDIA	
1.117.6	INTERVALVE POONAWALLA LIMITED	INDIA	
1.117.7	LEADER VALVES LTD	INDIA	
1.117.8	MEVADA ENGG.WORKS PVT LTD	INDIA	
1.117.9	MICROFINISH VALVES PVT LIMITED	INDIA	



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<b>COMMON PROJECTS MASTER SUPPLIER LIST-SECTION-B (BULK PIPING ITEMS)</b>			
<b>Sr.No</b>	<b>VENDOR NAME</b>	<b>COUNTRY</b>	<b>REMARK</b>
1.117.10	NITON VALVE INDUSTRIES PRIVATE LTD.	INDIA	
1.117.11	OMKAR VALVES PVT LTD	INDIA	
1.117.12	SHAYBURG VALVES PVT LTD	INDIA	
1.117.13	ANAND TEKNOVA AIDS ENGINEERING INDIA LTD.	INDIA	
<b>1.118</b>	<b>VALVE BALL NON FIRE SAFE-FSS</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
1.118.1	BELGAUM AQUA VALVES PVT. LTD.	INDIA	
1.118.2	CRANE PROCESS FLOW TECHNOLOGES (I) LTD	INDIA	
1.118.3	DELVAL FLOW CONTRLS PVT LTD	INDIA	
1.118.4	FLOW CHEM INDUSTRIES	INDIA	
1.118.5	HAWA ENGINEERS LTD	INDIA	
1.118.6	INTERVALVE POONAWALLA LIMITED	INDIA	
1.118.7	LEADER VALVES LTD	INDIA	
1.118.8	MEVADA ENGG.WORKS PVT LTD	INDIA	
1.118.9	MICROFINISH VALVES PVT LIMITED	INDIA	
1.118.10	NITON VALVE INDUSTRIES PRIVATE LTD .	INDIA	
1.118.11	OMKAR VALVES PVT LTD	INDIA	
1.118.12	SHAYBURG VALVES PVT LTD	INDIA	
1.118.13	ANAND TEKNOVA AIDS ENGINEERING INDIA LTD.	INDIA	
<b>1.119</b>	<b>VALVE BALL JACKETED - NON FIRE SAFE</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
1.119.1	BELGAUM AQUA VALVES PVT. LTD.	INDIA	
1.119.2	MICROFINISH VALVES PVT LIMITED	INDIA	
<b>1.120</b>	<b>VALVE BALL MULTI PORT NON FIRE SAFE</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
1.120.1	BELGAUM AQUA VALVES PVT. LTD.	INDIA	
1.120.2	MICROFINISH VALVES PVT LIMITED	INDIA	
<b>1.121</b>	<b>VALVE BUTTERFLY-(FOREIGN SUPPLIERS)</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
1.121.1	EMERSON PROCESS MANAGEMENT (INDIA) PVT LTD	INDIA	Rev.1: Name Change
<b>1.122</b>	<b>VALVE BUTTERFLY - CCS</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
1.122.1	ADVANCE VALVES PVT LTD.	INDIA	
1.122.2	BRAY CONTROLS	INDIA	Rev.2: Deleted
1.122.3	CRANE PROCESS FLOW TECHNOLOGIES IND. LTD	INDIA	
1.122.4	DELVAL FLOW CONTRLS PVT LTD	INDIA	
1.122.5	DEMBLA VALVES LTD.	INDIA	Rev.2: Deleted
1.122.6	FLOWSERVE INDIA CONTROLS PVT LTD	INDIA	Rev.1: Name Change
1.122.7	FLUIDLINE VALVES CO.PVT LTD	INDIA	



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<b>Sr.No</b>	<b>VENDOR NAME</b>	<b>COUNTRY</b>	<b>REMARK</b>
1.122.8	FOURESS ENGG.(INDIA) LTD.(BLR.WORK )	INDIA	
1.122.9	GM ENGINEERING PVT. LTD.	INDIA	
1.122.10	HAWA ENGINEERS LTD	INDIA	
1.122.11	INSTRUMENTATION LTD	INDIA	Rev.1: Name Change
1.122.12	INTERVALVE POONAWALLA LIMITED	INDIA	
1.122.13	L & T VALVES LIMITED	INDIA	
1.122.14	LEADER VALVES LTD	INDIA	
1.122.15	MASCOT VALVES PVT LIMITED	INDIA	
1.122.16	NELES INDIA PVT LTD	INDIA	
1.122.17	OMKAR VALVES PVT LTD	INDIA	
1.122.18	EMERSON PROCESS MANAGEMENT (INDIA) PVT LTD	INDIA	Rev.1: Name Change
1.122.19	STAFFORD CONTROLS LIMITED	INDIA	
1.122.20	TRILLIUM FLOW TECHNOLOGIES INDIA PRIVATE LIMITED	INDIA	Rev.1: Name Change
1.122.21	BRAY CONTROLS INDIA PVT LTD.	INDIA	
1.122.22	DEMBLA VALVES LIMITED	INDIA	
<b>1.123</b>	<b>VALVE BUTTERFLY -CSS</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
1.123.1	ADVANCE VALVES PVT LTD.	INDIA	
1.123.2	BRAY CONTROLS INDIA PVT LTD.	INDIA	
1.123.3	CRANE PROCESS FLOW TECHNOLOGIES IND. LTD	INDIA	
1.123.4	DELVAL FLOW CONTRLS PVT LTD	INDIA	
1.123.5	FLOWSERVE INDIA CONTROLS PVT LTD	INDIA	Rev.1: Name Change
1.123.6	FLUIDLINE VALVES CO.PVT LTD	INDIA	
1.123.7	FOURESS ENGG.(INDIA) LTD.(BLR.WORK )	INDIA	
1.123.8	INSTRUMENTATION LTD	INDIA	Rev.1: Name Change
1.123.9	INTERVALVE POONAWALLA LIMITED	INDIA	
1.123.10	L & T VALVES LIMITED	INDIA	
1.123.11	LEADER VALVES LTD	INDIA	
1.123.12	MASCOT VALVES PVT LIMITED	INDIA	
1.123.13	NELES INDIA PVT LTD	INDIA	
1.123.14	OMKAR VALVES PVT LTD	INDIA	
1.123.15	EMERSON PROCESS MANAGEMENT (INDIA) PVT LTD	INDIA	Rev.1: Name Change
1.123.16	STAFFORD CONTROLS LIMITED	INDIA	
1.123.17	TRILLIUM FLOW TECHNOLOGIES INDIA PRIVATE LIMITED	INDIA	Rev.1: Name Change
1.123.18	DEMBLA VALVES LIMITED	INDIA	
<b>1.124</b>	<b>VALVE BUTTERFLY -CAS</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
1.124.1	BRAY CONTROLS INDIA PVT LTD.	INDIA	
1.124.2	CRANE PROCESS FLOW TECHNOLOGIES IND. LTD	INDIA	
1.124.3	DELVAL FLOW CONTRLS PVT LTD	INDIA	
1.124.4	LEADER VALVES LTD	INDIA	
1.124.5	OMKAR VALVES PVT LTD	INDIA	



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<b>Sr.No</b>	<b>VENDOR NAME</b>	<b>COUNTRY</b>	<b>REMARK</b>
<b>1.125</b>	<b>VALVE BUTTERFLY (PTFE SEATED)</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
1.125.1	BRAY CONTROLS INDIA PVT LTD.	INDIA	
1.125.2	CRANE PROCESS FLOW TECHNOLOGIES IND. LTD	INDIA	
1.125.3	DELVAL FLOW CONTROLS PRIVATE LIMITED	INDIA	
1.125.4	DEMBLA VALVES LIMITED	INDIA	
1.125.5	EMERSON (TYCO VALVES & CONTROLS-PANTAIR)	INDIA	
1.125.6	GM ENGINEERING PVT. LTD.	INDIA	
1.125.7	HI TECH BUTTERFLY VALVES INDIA PVT LTD.	INDIA	
1.125.8	INTERVALVE POONAWALLA LIMITED	INDIA	
1.125.9	TRILLIUM FLOW TECHNOLOGIES INDIA PRIVATE LIMITED	INDIA	Rev.1: Name Change
<b>1.126</b>	<b>VALVE BELLOW SEALED</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
1.126.1	BELL-O-SEAL VALVES PVT LTD	INDIA	
1.126.2	L & T VALVES LIMITED	INDIA	
1.126.3	MICROFINISH VALVES PVT LIMITED	INDIA	
1.126.4	UNI KLINGER LTD	INDIA	
1.126.5	VELAN INC	INDIA	
1.126.6	VELAN VALVES INDIA PVT LTD	INDIA	
<b>1.127</b>	<b>VALVE-BUTTERFLY (TRIPLE OFFSET)</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
1.127.1	ADVANCE VALVES PVT LTD.	INDIA	
1.127.2	BRAY CONTROLS INDIA PVT LTD.	INDIA	
1.127.3	DELVAL FLOW CONTROLS PRIVATE LIMITED	INDIA	
1.127.4	DEMBLA VALVES LIMITED	INDIA	
1.127.5	INTERVALVE POONAWALLA LIMITED	INDIA	
1.127.6	L & T VALVES LIMITED	INDIA	
1.127.7	EMERSON PROCESS MANAGEMENT (INDIA) PVT LTD	INDIA	
1.127.8	VIRGO VALVES & CONTROLS PVT LTD.	INDIA	
<b>1.128</b>	<b>VALVE DIAPHRAGM-(FOREIGN SUPPLIERS)</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
<b>1.129</b>	<b>VALVE DIAPHRAGM CAST CARBON STEEL</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
1.129.1	CRANE PROCESS FLOW TECHNOLOGIES IND. LTD	INDIA	
1.129.2	PROCON ENGINEERS	INDIA	
1.129.3	TRILLIUM FLOW TECHNOLOGIES INDIA PRIVATE LIMITED	INDIA	Rev.1: Name Change
<b>1.130</b>	<b>VALVE DIAPHRAGM CAST STAINLESS STEEL</b>		



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<b>Sr.No</b>	<b>VENDOR NAME</b>	<b>COUNTRY</b>	<b>REMARK</b>
<b>A</b>	<b>INDIAN BIDDERS</b>		
1.130.1	CRANE PROCESS FLOW TECHNOLOGIES IND. LTD	INDIA	
1.130.2	PROCON ENGINEERS	INDIA	
1.130.3	TRILLIUM FLOW TECHNOLOGIES INDIA PRIVATE LIMITED	INDIA	Rev.1: Name Change
<b>1.131</b>	<b>VALVE PLUG-(FOREIGN SUPPLIERS)</b>		
<b>1.132</b>	<b>VALVE PLUG CONCENTRIC- CCS (F.S &amp; N.F.S)</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
1.132.1	CHEMTROLS SAMIL (INDIA) PVT LTD	INDIA	
1.132.2	FLOWERVE INDIA CONTROLS PVT LTD	INDIA	Rev.1: Name Change
1.132.3	GM ENGINEERING PVT. LTD.	INDIA	
1.132.4	RASAI FLOW LINES PVT LTD.	INDIA	
1.132.5	TRILLIUM FLOW TECHNOLOGIES INDIA PRIVATE LIMITED	INDIA	
1.132.6	XOMOX SANMAR LIMITED	INDIA	
1.132.7	ZHEJIANG FLOWTECH MACHINERY CO.LTD	INDIA	
1.132.8	SOUDARSHINI VALVE PRIVATE LIMITED	INDIA	
<b>1.133</b>	<b>VALVE PLUG CONCENTRIC -CSS (F.S &amp; N.F.S)</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
1.133.1	CHEMTROLS SAMIL (INDIA) PVT LTD	INDIA	
1.133.2	FLOWERVE INDIA CONTROLS PVT LTD	INDIA	Rev.1: Name Change
1.133.3	RASAI FLOW LINES PVT LTD.	INDIA	
1.133.4	TRILLIUM FLOW TECHNOLOGIES INDIA PRIVATE LIMITED	INDIA	Rev.1: Name Change
1.133.5	XOMOX SANMAR LIMITED	INDIA	
<b>1.134</b>	<b>VALVE PLUG CONCENTRIC-CAS(F.S. &amp; N.F.S.)</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
1.134.1	XOMOX SANMAR LIMITED	INDIA	
<b>1.135</b>	<b>VALVE PISTON (GLANDLESS)</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
1.135.1	ARMSTRONG INTERNATIONAL PVT LTD.	INDIA	
1.135.2	FORBES MARSHALL PRIVATE LIMITED	INDIA	Rev.2: Name Change
1.135.3	UNI KLINGER LTD	INDIA	
<b>1.136</b>	<b>VALVE PLUG DBB EXPANDING TYPE</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
1.136.1	GHATGE PATIL INDUSTRIES LIMITED	INDIA	
<b>1.137</b>	<b>VALVE PLUG MULTIPOINT - NON FIRE SAFE</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		



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<b>Sr.No</b>	<b>VENDOR NAME</b>	<b>COUNTRY</b>	<b>REMARK</b>
1.137.1	XOMOX SANMAR LIMITED	INDIA	
<b>1.138</b>	<b>VALVE NEEDLE</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
1.138.1	ASSOCIATED TOOLINGS INDIA PVT LTD	INDIA	
1.138.2	EXCELSIOR ENGG. WORKS	INDIA	
1.138.3	LEADER VALVES LTD	INDIA	
1.138.4	ASTEC VALVES AND FITTINGS PVT LTD	INDIA	
1.138.5	ATAM VALVES PVT LTD	INDIA	
1.138.6	PACHVATI VALVES AND FLANGES	INDIA	
1.138.7	TECHNOMATIC IDNIA PVT LTD	INDIA	
<b>1.139</b>	<b>VALVE DOUBLE DISC GATE</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
1.139.1	L & T VALVES LIMITED	INDIA	
<b>1.140</b>	<b>VALVE SLIDE</b>		
<b>1.141</b>	<b>VALVE SHUT DOWN</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
1.141.1	NITON VALVE INDUSTRIES PRIVATE LTD .	INDIA	
1.141.2	SPX VALVES & CONTROLS (FORMERLY DEZURIK)	INDIA	
<b>1.142</b>	<b>VALVE CRYOGENIC SS /LTCS</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
1.142.1	VELAN INC	INDIA	
<b>1.143</b>	<b>VALVE SPECIAL CATEGORY</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
1.143.1	AMPO VALVES INDIA PVT LTD	INDIA	
1.143.2	AMPO VALVES INDIA PVT LTD	INDIA	Rev.2: Name Change
1.143.3	L & T VALVES LIMITED	INDIA	
1.143.4	EMERSON PROCESS MANAGEMENT (INDIA) PVT LTD	INDIA	Rev.1: Name Change
1.143.5	SCHUF SPECIALITY VALVES INDIA PVT LTD	INDIA	
<b>1.144</b>	<b>VALVE TANK BOTTOM/FLUSH BOTTOM</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
1.144.1	MICROFINISH VALVES PVT LIMITED	INDIA	
1.144.2	SCHUF SPECIALITY VALVES INDIA PVT LTD	INDIA	
<b>1.145</b>	<b>HASTELLOY PIPING COMPONENTS</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
1.145.1	TITANIUM TANTALUM PRODUCTS INDIA	INDIA	





<b>SECTION-B BULK PIPING ITEMS</b>		<b>Doc. No.</b>	<b>IOCL-MSL-2020</b>
<b>DOCUMENT TITLE :- PROJECT MASTER SUPPLIER LIST (PMSL)-IOCL-2020</b>		<b>REV :</b>	<b>2</b>
<b>M/s. INDIAN OIL CORPORATION LIMITED (IOCL)</b>		<b>Date :</b>	<b>31-Oct-20</b>
<b>COMMON PROJECTS MASTER SUPPLIER LIST-SECTION-B (BULK PIPING ITEMS)</b>			
<b>Sr.No</b>	<b>VENDOR NAME</b>	<b>COUNTRY</b>	<b>REMARK</b>
1.145.2	SAI TITANIUM PRODUCTS PVT. LTD. INDIA	INDIA	
1.145.3	TITANIUM TECHNIQUES INDIA	INDIA	
1.145.4	D.K. CORPORATION INDIA	INDIA	
1.145.5	SANGHVI BOTHRA ENGG. CO. PVT. LTD. INDIA	INDIA	
1.145.6	LARSEN & TURBO INDIA	INDIA	
1.145.7	TINITA ENGINEERING PRIVATE LIMITED INDIA	INDIA	
1.145.8	JLS INTERNATIONAL INDIA	INDIA	
1.145.9	SHALCO INDUSTRIES PVT LTD INDIA	INDIA	
1.145.10	NEEKA TUBES INDIA	INDIA	
1.145.11	LOTERIOS	INDIA	
<b>1.146</b>	<b>TITANIUM PIPING COMPONENTS</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
1.146.1	TITANIUM TANTALUM PRODUCTS INDIA	INDIA	
1.146.2	SAI TITANIUM PRODUCTS PVT. LTD. INDIA	INDIA	
1.146.3	TITANIUM TECHNIQUES INDIA	INDIA	
1.146.4	D.K. CORPORATION INDIA	INDIA	
1.146.5	SANGHVI BOTHRA ENGG. CO. PVT. LTD. INDIA	INDIA	
1.146.6	LARSEN & TURBO INDIA	INDIA	
1.146.7	TINITA ENGINEERING PRIVATE LIMITED INDIA	INDIA	
1.146.8	JLS INTERNATIONAL INDIA	INDIA	
1.146.9	SHALCO INDUSTRIES PVT LTD INDIA	INDIA	
1.146.10	NEEKA TUBES INDIA	INDIA	
1.146.11	LOTERIOS	INDIA	
<b>1.147</b>	<b>LOW PRESSURE DROP BALL CHECK VALVE</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
	NO INDIAN BIDDER AVAILABLE		
<b>1.148</b>	<b>EXPANSION JOINT (METAL)</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
1.148.1	METALLIC BELLOWS (ONLY FOR PIPING) INDIA	INDIA	
1.148.2	FLEXICAN BELLOWS (ONLY FOR PIPING) INDIA	INDIA	
1.148.3	LONESTAR INDUSTRIES INDIA	INDIA	
1.148.4	WITZENMANN GMBH INDIA	INDIA	
<b>1.149</b>	<b>EXPANSION JOINT (PRESSURE BALANCE)</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
1.149.1	FLEXICAN BELLOWS & HOSES PVT. LTD.	INDIA	
<b>1.150</b>	<b>BIRD SCREEN</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
1.150.1	SUNRISE PROCESS EQUIPMENTS	INDIA	
1.150.2	ESFOUR ENGINEERING	INDIA	



<b>SECTION-B BULK PIPING ITEMS</b>		<b>Doc. No.</b>	<b>IOCL-MSL-2020</b>
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<b>COMMON PROJECTS MASTER SUPPLIER LIST-SECTION-B (BULK PIPING ITEMS)</b>			
<b>Sr.No</b>	<b>VENDOR NAME</b>	<b>COUNTRY</b>	<b>REMARK</b>
1.150.3	NJ TECH ENGINEERING	INDIA	
<b>1.151</b>	<b>EYE WASHER &amp; SAFETY SHOWER</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
1.151.1	FRANCIS LESLIE & CO INDIA	INDIA	
1.151.2	PRADEEP SAFETY PVT LTD. INDIA	INDIA	
1.151.3	STAR ENGINEERS INDIA	INDIA	
1.151.4	UNICARE EMERGENCY EQUIPMENT INDIA	INDIA	
1.151.5	CREATIVE ENGINEERS INDIA	INDIA	
1.151.6	TYCO FIRE AND INETRATED SOLUTIONS	INDIA	
<b>1.152</b>	<b>INSULATING GASKET</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
1.152.1	GOODRICH GASKET PRIVATE LIMITED	INDIA	
1.152.2	IGP ENGINEERS PVT LTD	INDIA	
<b>1.153</b>	<b>POST INDICATOR VALVES</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
1.153.1	L&T VALVES - INDIA	INDIA	
1.153.2	AMPO POYAM- INDIA	INDIA	
1.153.3	TRILLIUM FLOW TECHNOLOGIES INDIA PRIVATE LIMITED	INDIA	
<b>1.154</b>	<b>COPPER TUBING</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
1.154.1	ALCOBEX METALS PVT. LTD. INDIA	INDIA	
1.154.2	MULTIMETALS LTD. INDIA	INDIA	
1.154.3	RAJCO METAL INDUSTRIES PVT. LTD. INDIA	INDIA	
1.154.4	INDUSTRIAL TUBES INDIA	INDIA	
1.154.5	KAMANI TUBES INDIA	INDIA	
1.154.6	HINDUSTAN STEEL & METAL WORKS INDIA	INDIA	
1.154.7	RELIANCE ENGINEERS LTD	INDIA	
1.154.8	MEHTA TUBES LIMITED	INDIA	
<b>1.155</b>	<b>3-WAY VALVES</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
1.155.1	2L Engineers	INDIA	
1.155.2	Rajeev & Company	INDIA	
1.155.3	Flow Chem Industries	INDIA	
1.155.4	General Engineering Consortium	INDIA	
1.155.5	Asian Industrial Valves and Instruments	INDIA	
<b>1.156</b>	<b>LTCS (LOW TEMPERATURE CARBAN STEEL) FLANGE</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
1.156.1	ANANDMAYEE FORGINGS PVT LTD	INDIA	
1.156.2	BHARAT FORGE LTD.	INDIA	
1.156.3	BRITEX ENGINEERING WORKS	INDIA	



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<b>COMMON PROJECTS MASTER SUPPLIER LIST-SECTION-B (BULK PIPING ITEMS)</b>			
<b>Sr.No</b>	<b>VENDOR NAME</b>	<b>COUNTRY</b>	<b>REMARK</b>
1.156.4	CD ENGINEERING CO.	INDIA	
1.156.5	CD INDUSTRIES	INDIA	
1.156.6	CHANDAN STEEL LTD	INDIA	
1.156.7	CHW FORGE PVT LTD (FR. CHAUDHRY HAMMER)	INDIA	
1.156.8	ECHJAY INDUSTRIES PVT LTD	INDIA	Rev.1: Name Change
1.156.9	FIVEBROS FORGINGS PVT.LTD.	INDIA	
1.156.10	GOOD LUCK ENGINEERING CO.	INDIA	
1.156.11	HILTON METAL FORGING LIMITED	INDIA	
1.156.12	JAV FORGINGS & ENGINEERINGS PVT LTD	INDIA	Rev.1: Name Change
1.156.13	KUNJ FORGINGS PVT LTD	INDIA	
1.156.14	LAL METAL FORGE LTD	INDIA	
1.156.15	METAL FORGINGS PVT LTD	INDIA	
1.156.16	P.K.TUBES & FITTINGS PVT.LTD.	INDIA	
1.156.17	PARAMOUNT FORGE	INDIA	
1.156.18	PRADEEP METALS LIMITED	INDIA	
1.156.19	R D FORGE	INDIA	
1.156.20	SANGHVI FORGINGS & ENGINEERING LTD	INDIA	
1.156.21	UTSAH ENGINEERING PVT LTD(A CD ENGG COMP	INDIA	
1.156.22	VIRAJ PROFILES LIMITED	INDIA	
1.156.23	MAXELL FORGE INDUSTRIES	INDIA	
1.156.24	GAYATRI FORGE PVT LTD	INDIA	
1.156.25	MAASS FLANGE INDIA PVT. LTD	INDIA	
1.156.26	K S PIPE FITTINGS PRIVATE LIMITED	INDIA	



SECTION-C ELECTRICAL ITEMS		Doc. No.	IOCL-MSL-2020
DOCUMENT TITLE :- PROJECT MASTER SUPPLIER LIST (PMSL)-IOCL-2020		REV :	2
M/s. INDIAN OIL CORPORATION LIMITED (IOCL)		Date :	31-Oct-20
COMMON PROJECTS MASTER SUPPLIER LIST-SECTION-C (ELECTRICAL)			
Sr.No	VENDOR NAME	COUNTRY	REMARK
<b>5.1</b>	<b>SWITCHBOARD-HV (Indoor) WITH VCB BREAKER (complete)</b>		
<b>A</b>	<b>Indian Bidders</b>		
5.1.1	ABB INDIA LIMITED	INDIA	Rev.2: Name Change
5.1.2	BHARAT HEAVY ELECTRICALS LIMITED	INDIA	Rev.2: Name Change
5.1.3	CG Power and Industrial Solutions Ltd	INDIA	
5.1.4	Jyoti Limited	INDIA	
5.1.5	LARSEN & TOUBRO LIMITED	INDIA	Rev.2: Name Change
5.1.6	Megawin Switchgear P Ltd	INDIA	
5.1.7	Schneider Electric Infrastructure Ltd	INDIA	
5.1.8	Siemens Limited	INDIA	
<b>5.2</b>	<b>SWITCHBOARD-MV: MCC/ASB/LDB-FIXED TYP</b>		
<b>A</b>	<b>Indian Bidders</b>		
5.2.1	ABB INDIA LIMITED	INDIA	Rev.2: Name Change
5.2.2	C & S Electric Ltd	INDIA	
5.2.3	Controls & Schematics Ltd	INDIA	
5.2.4	LARSEN & TOUBRO LIMITED	INDIA	Rev.2: Name Change
5.2.5	M.K. Engineers & Controls Pvt. Ltd.	INDIA	
5.2.6	Schneider Electric India Pvt Ltd	INDIA	
5.2.7	Siemens Ltd	INDIA	
<b>5.3</b>	<b>SWITCHBOARD-M.V. : MCC/PCC/PMCC-DRAWOUT</b>		
<b>A</b>	<b>Indian Bidders</b>		
5.3.1	ABB INDIA LIMITED	INDIA	Rev.2: Name Change
5.3.2	C & S Electric Ltd	INDIA	
5.3.3	Controls & Schematics Ltd	INDIA	
5.3.4	LARSEN & TOUBRO LIMITED	INDIA	Rev.2: Name Change
5.3.5	Schneider Electric India Pvt Ltd	INDIA	
5.3.6	Siemens Ltd	INDIA	
<b>5.4</b>	<b>SWITCHBOARD FIXED TYPE FOR PACKAGE EQUIPTS</b>		
<b>A</b>	<b>Indian Bidders</b>		
5.4.1	Accusonic Controls Pvt Ltd	INDIA	
5.4.2	Dharia Switchgear & Control.	INDIA	
5.4.3	Electro Allied Products	INDIA	
5.4.4	LARSEN & TOUBRO LIMITED	INDIA	Rev.2: Name Change
5.4.5	M.K. Engineers & Controls Pvt. Ltd.	INDIA	
5.4.6	Maktel Systems	INDIA	
5.4.7	Nitya Electro Controls	INDIA	
5.4.8	Popular Switchgears Pvt Ltd	INDIA	
5.4.9	Positronics Pvt Ltd	INDIA	
5.4.10	Tricolite Electrical Industries Pvt Ltd	INDIA	
5.4.11	Vidhyut Control (India) Pvt Ltd	INDIA	
5.4.12	Zenith Engineering Corp.	INDIA	
<b>5.5</b>	<b>OUTDOOR SWITCHYARD PACKAGE</b>		
<b>A</b>	<b>Indian Bidders</b>		

5.5.1	ABB INDIA LIMITED	INDIA	Rev.2: Name Change
5.5.2	BGR Energy	INDIA	
5.5.3	Bharat Bijlee Limited	INDIA	
5.5.4	CG Power and Industrial Solutions Ltd	INDIA	
5.5.5	GE T&D India Ltd	INDIA	
5.5.6	Godrej & Boyce Mfg. Co. Ltd	INDIA	
5.5.7	KEC International Ltd	INDIA	
5.5.8	LARSEN & TOUBRO LIMITED	INDIA	Rev.2: Name Change
5.5.9	Siemens	INDIA	
5.5.10	Sterling & Wilson India	INDIA	
5.5.11	Toshiba Transmission & Distribution Systems (India) Private Limited	INDIA	
<b>5.6</b>	<b>GIS upto 245kV (Indoor)</b>		
<b>A</b>	<b>Indian Bidders</b>		
5.6.1	ABB INDIA LIMITED	INDIA	Rev.2: Name Change
5.6.2	GE T&D India Ltd	INDIA	
5.6.3	CG Power and Industrial Solutions Ltd (upto 33 kV only)	INDIA	
5.6.4	Schneider Electric India Pvt Ltd	INDIA	
5.6.5	Siemens India	INDIA	
5.6.6	Toshiba Transmission & Distribution Systems (India) Private Limited	INDIA	
<b>5.7</b>	<b>RELAY &amp; CONTROL PANEL</b>		
<b>A</b>	<b>Indian Bidders</b>		
5.7.1	ABB INDIA LIMITED	INDIA	Rev.2: Name Change
5.7.2	Danish Private Limited	INDIA	
5.7.3	Easun Reyrolle Ltd	INDIA	
5.7.4	Enpro Industrial Automation Pvt Ltd	INDIA	
5.7.5	GE T&D India Limited	INDIA	
5.7.6	Schneider Electric India Pvt Ltd	INDIA	
5.7.7	Siemens Limited	INDIA	
5.7.8	Toshiba Transmission & Distribution Systems (India) Private Limited	INDIA	
<b>5.8</b>	<b>PROTECTION RELAY (NUMERICAL TYPE)</b>		
<b>A</b>	<b>Indian Bidders</b>		
5.8.1	ABB INDIA LIMITED	INDIA	Rev.2: Name Change
5.8.2	Easun Reyrolle Ltd	INDIA	
5.8.3	GE T&D India Limited	INDIA	
5.8.4	LARSEN & TOUBRO LIMITED	INDIA	Rev.2: Name Change
5.8.5	Schneider Electric India Pvt Ltd	INDIA	
5.8.6	Schweitzer Engineering Laboratories	INDIA	
5.8.7	Siemens Ltd.	INDIA	
5.8.8	Toshiba Transmission & Distribution Systems (India) Private Limited	INDIA	
<b>5.9</b>	<b>AUX. RELAYS</b>		
<b>A</b>	<b>Indian Bidders</b>		
5.9.1	ABB INDIA LIMITED	INDIA	Rev.2: Name Change
5.9.2	C&S Electric Ltd	INDIA	
5.9.3	Easun Reyrolle Ltd	INDIA	
5.9.4	GE T&D India Limited	INDIA	
5.9.5	Jyoti Ltd	INDIA	
5.9.6	LARSEN & TOUBRO LIMITED	INDIA	Rev.2: Name Change
5.9.7	OMRON	INDIA	
5.9.8	Schneider Electric India Pvt. Ltd	INDIA	
5.9.9	Siemens Ltd	INDIA	

<b>5.10</b>	<b>BIMETAL RELAYS</b>		
<b>A</b>	<b>Indian Bidders</b>		
5.10.1	ABB INDIA LIMITED	INDIA	Rev.2: Name Change
5.10.2	C&S Electric Ltd	INDIA	
5.10.3	GE T&D India Limited	INDIA	
5.10.4	LARSEN & TOUBRO LIMITED	INDIA	Rev.2: Name Change
5.10.5	Schneider Electric India Pvt. Ltd	INDIA	
5.10.6	Siemens Ltd	INDIA	
<b>5.11</b>	<b>ELECTRIC CONTROL SYSTEM (ECS) / SCADA / PMS</b>		
<b>A</b>	<b>Indian Bidders</b>		
5.11.1	ABB INDIA LIMITED	INDIA	Rev.2: Name Change
5.11.2	BHARAT HEAVY ELECTRICALS LIMITED	INDIA	Rev.2: Name Change
5.11.3	Emerson Process Management India Pvt Ltd	INDIA	
5.11.4	Honeywell Automation India Ltd.	INDIA	
5.11.5	Rockwell Automation India	INDIA	
5.11.6	Schneider Electric Infrastructure Ltd	INDIA	
5.11.7	Schweitzer Engineering Laboratories	INDIA	
5.11.8	Siemens Ltd	INDIA	
<b>5.12</b>	<b>INSTRUMENT TRANSFORMERS – CT &amp; PT (HV)</b>		
<b>A</b>	<b>Indian Bidders</b>		
5.12.1	ABB INDIA LIMITED	INDIA	Rev.2: Name Change
5.12.2	Electrical Controls & Systems	INDIA	
5.12.3	Kalpa Elektrikal Pvt Ltd	INDIA	
5.12.4	Kappa Electricals	INDIA	
5.12.5	Megawin Switchgear P Ltd	INDIA	
5.12.6	Pragati Electricals Pvt. Ltd.	INDIA	
5.12.7	Schneider Electric India Pvt. Ltd	INDIA	
5.12.8	Siemens Ltd	INDIA	
<b>5.13</b>	<b>INSTRUMENT TRANSFORMERS – CT &amp; PT (MV)</b>		
<b>A</b>	<b>Indian Bidders</b>		
5.13.1	C&S Electric Limited	INDIA	
5.13.2	Gilbert & Maxwell Electricals Pvt. Ltd	INDIA	
5.13.3	Kalpa Elektrikal Pvt Ltd	INDIA	
5.13.4	Kappa Electricals	INDIA	
5.13.5	LARSEN & TOUBRO LIMITED	INDIA	Rev.2: Name Change
5.13.6	Narayan Powertech Pvt. Ltd.	INDIA	
5.13.7	Pragati Electricals Pvt. Ltd.	INDIA	
5.13.8	Precise Electricals	INDIA	
5.13.9	Silkaans Electricals Pvt. Ltd.	INDIA	
<b>5.14</b>	<b>CIRCUIT BREAKER SF-6 /OUT DOOR EHV</b>		
<b>A</b>	<b>Indian Bidders</b>		
5.14.1	ABB INDIA LIMITED	INDIA	Rev.2: Name Change
5.14.2	BHARAT HEAVY ELECTRICALS LIMITED	INDIA	Rev.2: Name Change
5.14.3	CG Power and Industrial Solutions Ltd	INDIA	
5.14.4	GE T&D India Ltd	INDIA	
5.14.5	Siemens Ltd	INDIA	
5.14.6	Toshiba Transmission & Distribution Systems (India) Private Limited	INDIA	
<b>5.15</b>	<b>VACCUM CIRCUIT BREAKERS</b>		
<b>A</b>	<b>Indian Bidders</b>		
5.15.1	LARSEN & TOUBRO LIMITED	INDIA	Rev.2: Name Change

5.15.2	Siemens Ltd	INDIA	
5.15.3	Schneider Electric India Pvt. Ltd	INDIA	
5.15.4	ABB INDIA LIMITED	INDIA	Rev.2: Name Change
5.15.5	BHARAT HEAVY ELECTRICALS LIMITED	INDIA	Rev.2: Name Change
5.15.6	CG Power and Industrial Solutions Ltd	INDIA	
5.15.7	Megawin Switchgear P Ltd	INDIA	
5.15.8	Jyoti Ltd	INDIA	

<b>5.16</b>	<b>AIR CIRCUIT BREAKER</b>		
<b>A</b>	<b>Indian Bidders</b>		
5.16.1	ABB INDIA LIMITED	INDIA	Rev.2: Name Change
5.16.2	C&S Electric Limited	INDIA	
5.16.3	GE T&D India Ltd	INDIA	
5.16.4	LARSEN & TOUBRO LIMITED	INDIA	Rev.2: Name Change
5.16.5	Schneider Electric India Pvt. Ltd	INDIA	
5.16.6	Siemens Ltd	INDIA	
<b>5.17</b>	<b>ISOLATORS / LOAD BREAK SWITCHES (HV INDOOR)</b>		
<b>A</b>	<b>Indian Bidders</b>		
5.17.1	Driescher Panickker Switchgear Ltd India	INDIA	
5.17.2	Siemens Ltd	INDIA	
5.17.3	S & S Power Switchgear Ltd	INDIA	
<b>5.18</b>	<b>CONTACTOR</b>		
<b>A</b>	<b>Indian Bidders</b>		
5.18.1	ABB INDIA LIMITED	INDIA	Rev.2: Name Change
5.18.2	BCH Electric Ltd	INDIA	
5.18.3	C&S Electric Ltd	INDIA	
5.18.4	GE T&D India Limited	INDIA	
5.18.5	LARSEN & TOUBRO LIMITED	INDIA	Rev.2: Name Change
5.18.6	Schneider Electric India Pvt. Ltd	INDIA	
5.18.7	Siemens Ltd	INDIA	
<b>5.19</b>	<b>MCCB</b>		
<b>A</b>	<b>Indian Bidders</b>		
5.19.1	ABB INDIA LIMITED	INDIA	Rev.2: Name Change
5.19.2	GE T&D India Limited	INDIA	
5.19.3	Havells India Ltd	INDIA	
5.19.4	LARSEN & TOUBRO LIMITED	INDIA	Rev.2: Name Change
5.19.5	Schneider Electric India Pvt Ltd	INDIA	
5.19.6	Siemens Ltd	INDIA	

<b>5.2</b>	<b>TIMERS</b>		
<b>A</b>	<b>Indian Bidders</b>		
5.20.1	Electronic Automation Pvt Ltd	INDIA	
5.20.2	Honeywell Automation India Limited	INDIA	
5.20.3	ICA Pvt. Limited (Omron)	INDIA	
5.20.4	LARSEN & TOUBRO LIMITED	INDIA	Rev.2: Name Change
5.20.5	OEN	INDIA	
5.20.6	Siemens Limited	INDIA	
5.20.7	GE T&D India Limited	INDIA	

<b>5.21</b>	<b>PUSH BUTTON &amp; INDICATING LAMPS (independent supply / Retrfitting / Alteration / Modification work)</b>		
<b>A</b>	<b>Indian Bidders</b>		
5.21.1	C & S Electric Ltd	INDIA	

5.21.2	Essen Deinki	INDIA	
5.21.3	Hotline Switchgear & Controls	INDIA	
5.21.4	LARSEN & TOUBRO LIMITED	INDIA	Rev.2: Name Change
5.21.5	Precifine Products Pvt. Ltd.	INDIA	
5.21.6	Schneider Electric India Pvt Ltd	INDIA	
5.21.7	Shri Tulsi Switchgears Pvt Ltd	INDIA	
5.21.8	Siemens Limited	INDIA	
5.21.9	Teknic Electric (I) Pvt. Ltd.	INDIA	

<b>5.22</b>	<b>MCB (Independent supply / Retrofitting / Alteration / Modification work)</b>		
<b>A</b>	<b>Indian Bidders</b>		
5.22.1	ABB INDIA LIMITED	INDIA	Rev.2: Name Change
5.22.2	C & S Electric Ltd	INDIA	
5.22.3	Havells India Ltd	INDIA	
5.22.4	Novateur Electrical & Digital Systems P	INDIA	
5.22.5	Indiana Current Control Ltd	INDIA	
5.22.6	Legrand (India) Pvt. Ltd	INDIA	
5.22.7	Siemens Limited	INDIA	
5.22.8	Standard Electricals Ltd	INDIA	
5.22.9	Schneider Electric India Pvt Ltd	INDIA	

<b>5.23</b>	<b>HEAVY DUTY SWITCHES (Independent supply / Retrofitting / Alteration / Modification work)</b>		
<b>A</b>	<b>Indian Bidders</b>		
5.23.1	C & S Electric Ltd	INDIA	
5.23.2	LARSEN & TOUBRO LIMITED	INDIA	Rev.2: Name Change
5.23.3	Novateur Electrical & Digital Systems P	INDIA	
5.23.4	Siemens Ltd	INDIA	

<b>5.24</b>	<b>CONTROL SWITCHES FOR BREAKER (Independent supply / Retrofitting / Alteration / Modification work)</b>		
<b>A</b>	<b>Indian Bidders</b>		
5.24.1	GE T&D India Limited	INDIA	
5.24.2	Reliable Electronic Components Pvt Ltd	INDIA	
5.24.3	Switron Devices	INDIA	
		INDIA	
<b>5.25</b>	<b>CONTROL SWITCHES / SELECTOR SWITCHES (Independent supply / Retrofitting / Alteration / Modification work)</b>	INDIA	
<b>A</b>	<b>Indian Bidders</b>		
5.25.1	GE T&D India Limited	INDIA	
5.25.2	Hotline Switchgear & Controls	INDIA	
5.25.3	Kaycee Industries Ltd.	INDIA	
5.25.4	LARSEN & TOUBRO LIMITED	INDIA	Rev.2: Name Change
5.25.5	Reliable Electronic Components Pvt Ltd	INDIA	
5.25.6	Siemens Limited	INDIA	
5.25.7	Switron Devices	INDIA	
<b>5.26</b>	<b>EARTH LEAKAGE CIRCUIT BREAKER (Independent supply / Retrofitting / Alteration / Modification work)</b>		
<b>A</b>	<b>Indian Bidders</b>		
5.26.1	ABB INDIA LIMITED	INDIA	Rev.2: Name Change
5.26.2	GE T&D India Limited	INDIA	
5.26.3	Havells India Ltd	INDIA	
5.26.4	Legrand (India) Pvt. Ltd	INDIA	
5.26.5	Novateur Electrical & Digital Systems P	INDIA	
5.26.6	Schneider Electric India Pvt Ltd	INDIA	
5.26.7	Siemens Ltd	INDIA	
<b>5.27</b>	<b>FUSES (Independent supply / Retrofitting / Alteration / Modification work)</b>		



<b>A</b>	<b>Indian Bidders</b>		
5.27.1	Cooper Bussman India Pvt Ltd	INDIA	
5.27.2	GE T&D India Limited	INDIA	
5.27.3	Havells India Ltd	INDIA	
5.27.4	LARSEN & TOUBRO LIMITED	INDIA	Rev.2: Name Change
5.27.5	Novateur Electrical & Digital Systems P	INDIA	
5.27.6	Siemens Ltd	INDIA	

<b>5.28</b>	<b>TRANSFORMERS-POWER-ABOVE 5MVA</b>		
<b>A</b>	<b>Indian Bidders</b>		
5.28.1	Bharat Bijlee Limited	INDIA	
5.28.2	BHARAT HEAVY ELECTRICALS LIMITED	INDIA	Rev.2: Name Change
5.28.3	CG Power and Industrial Solutions Ltd	INDIA	
5.28.4	EMCO Limited	INDIA	
5.28.5	GE T&D India Ltd	INDIA	
5.28.6	Kirloskar Electric Co Ltd	INDIA	
5.28.7	Schneider Electric India Pvt Ltd	INDIA	
5.28.8	Toshiba Transmission & Distribution Systems (India) Private Limited	INDIA	
5.28.9	Voltamp Transformers Ltd	INDIA	
<b>5.29</b>	<b>TRANSFORMERS-DISTRIBUTION-UPTO 5MVA</b>		
<b>A</b>	<b>Indian Bidders</b>		
5.29.1	Bharat Bijlee Limited	INDIA	
5.29.2	CG Power and Industrial Solutions Ltd	INDIA	
5.29.3	EMCO Limited	INDIA	
5.29.4	Kirloskar Electric Co Ltd	INDIA	
5.29.5	Kirloskar Power Equipments Ltd	INDIA	
5.29.6	Pete - Hammond Power Solutions Pvt Ltd.	INDIA	
5.29.7	Raychem RPG Ltd. (Canara Electric Divn)	INDIA	
5.29.8	RIMA Transformers And Conductors Ltd	INDIA	
5.29.9	Schneider Electric India Pvt Ltd	INDIA	
5.29.10	Transformers & Rectifiers (I) Ltd	INDIA	
5.29.11	Vijay Electricals	INDIA	
5.29.12	Voltamp Transformers Ltd	INDIA	
<b>5.30</b>	<b>TRANSFORMER-DISTRIBUTION (DRY TYPE)</b>		
<b>A</b>	<b>Indian Bidders</b>		
5.30.1	Automatic Electric Ltd	INDIA	
5.30.2	Bharat Bijlee	INDIA	
5.30.3	BHARAT HEAVY ELECTRICALS LIMITED	INDIA	Rev.2: Name Change
5.30.4	CAHORS (Transfix)	INDIA	
5.30.5	CG Power and Industrial Solutions Ltd	INDIA	
5.30.6	Indcoil Products	INDIA	
5.30.7	Intra Vidyut Pvt Ltd	INDIA	
5.30.8	Kappa Electricals	INDIA	
5.30.9	Megawin Switchgear P Ltd	INDIA	
5.30.10	Pete - Hammond Power Solutions Pvt Ltd.	INDIA	
5.30.11	Raychem Rpg Ltd. (Canara Electric Divn)	INDIA	
5.30.12	Sudhir Intra Vidyut Pvt. Ltd	INDIA	
5.30.13	Transtron Electricals Pvt Ltd	INDIA	
5.30.14	Voltamp Transformers Ltd	INDIA	
<b>5.31</b>	<b>DRY TYPE LIGHTING TRANSFORMER (LV)</b>		
<b>A</b>	<b>Indian Bidders</b>		
5.31.1	Automatic Electric	INDIA	

5.31.2	Bharat Bijlee	INDIA	
5.31.3	BHARAT HEAVY ELECTRICALS LIMITED	INDIA	Rev.2: Name Change
5.31.4	CG Power And Industrial Solutions Ltd	INDIA	
5.31.5	Indcoil Products	INDIA	
5.31.6	Indcoil Transformers	INDIA	
5.31.7	Intra Vidyut Pvt. Ltd	INDIA	
5.31.8	Kappa Electricals	INDIA	
5.31.9	Kirloskar Electric Co. Ltd India	INDIA	
5.31.10	Raychem Rpg India	INDIA	
5.31.11	Sudhir Intra Vidyut Pvt. Ltd	INDIA	
5.31.12	Transtron Electricals Pvt Ltd India	INDIA	
5.31.13	Voltamp Transformors	INDIA	
<b>5.32</b>	<b>Neutral Grounding Resistors/Transformers (NGR / NGT)</b>		
<b>A</b>	<b>Indian Bidders</b>		
5.32.1	Iresco Electricals Pvt. Ltd. India	INDIA	
5.32.2	National Switchgears	INDIA	
5.32.3	Resitech Electricals Pvt Ltd	INDIA	
5.32.4	RSI Switchgear Pvt Ltd	INDIA	
5.32.5	S.R. Narkhede Engineering Pvt Ltd	INDIA	
<b>5.33</b>	<b>BUS DUCT (HV)</b>		
<b>A</b>	<b>Indian Bidders</b>		
5.33.1	BHARAT HEAVY ELECTRICALS LIMITED	INDIA	Rev.2: Name Change
5.33.2	C & S Electric Ltd	INDIA	
5.33.3	Elemech	INDIA	
5.33.4	ENPRO Engineering	INDIA	
5.33.5	Globe Electric	INDIA	
5.33.6	LARSEN & TOUBRO LIMITED	INDIA	Rev.2: Name Change
5.33.7	Narmada Switchgear Pvt. Ltd.	INDIA	
5.33.8	Spearhead Busducts Pvt Ltd	INDIA	
5.33.9	Stardrive Busducts Ltd (formerly KGS Engineering Ltd.)	INDIA	
5.33.10	United Electric Co (Delhi) Pvt Ltd	INDIA	
<b>5.34</b>	<b>BUS DUCT (MV)</b>		
<b>A</b>	<b>Indian Bidders</b>		
5.34.1	Adlec Power Pvt. Ltd.	INDIA	
5.34.2	C & S Electric Ltd.	INDIA	
5.34.3	Elemech	INDIA	
5.34.4	Enpro Engineering India	INDIA	
5.34.5	Entraco BKS Busducts Pvt Ltd	INDIA	
5.34.6	Globe Electrical Ind	INDIA	
5.34.7	Intrelec	INDIA	
5.34.8	Jasper Engineers Pvt. Ltd.,	INDIA	
5.34.9	M K Engineers & Controls Pvt Ltd	INDIA	
5.34.10	Narmada Switchgear Pvt. Ltd.	INDIA	
5.34.11	Stardrive Busducts Ltd (formerly KGS Engineering Ltd.)	INDIA	
5.34.12	United Electric Co (Delhi) Pvt Ltd	INDIA	
<b>5.35</b>	<b>CAPACITOR BANK (MV/HV) WITH APFC</b>		
<b>A</b>	<b>Indian Bidders</b>		
5.35.1	ABB INDIA LIMITED	INDIA	Rev.2: Name Change
5.35.2	BHARAT HEAVY ELECTRICALS LIMITED	INDIA	Rev.2: Name Change
5.35.3	CG Power and Industrial Solutions Ltd	INDIA	
5.35.4	Clariant Power System Ltd	INDIA	

5.35.5	Kapsales Electrical Ltd	INDIA	
5.35.6	Madhav Capacitors Pvt Ltd	INDIA	
5.35.7	Shakti Capacitors	INDIA	
5.35.8	Shreem Capacitors Pvt Ltd	INDIA	
5.35.9	Shreem Electric	INDIA	
5.35.10	Universal Cables Ltd (Unistar)	INDIA	
<b>5.36</b>	<b>BATTERIES-LEAD ACID (FLOODED)</b>		
<b>A</b>	<b>Indian Bidders</b>		
5.36.1	Exide Industries Ltd.	INDIA	
5.36.2	HBL Power Systems Ltd	INDIA	
5.36.3	Amron	INDIA	
<b>5.37</b>	<b>BATTERY CHARGERS</b>		
<b>A</b>	<b>Indian Bidders</b>		
5.37.1	Amara Raja Power Systems (P) Ltd	INDIA	
5.37.2	Chhabi Electricals Pvt Limited	INDIA	
5.37.3	Chloride Power Systems & Solutions Ltd	INDIA	
5.37.4	Dubas Engineering Pvt Ltd	INDIA	
5.37.5	HBL Power Systems Ltd	INDIA	
5.37.6	Mass-Tech Controls Pvt Ltd	INDIA	
5.37.7	Universal Instrument Mfg Co Pvt Ltd	INDIA	
5.37.8	Borri Power India Pvt Ltd (Subsidiary of Borri SpA, Italy)	INDIA	
5.37.9	Vertive Energy Pvt Limited	INDIA	Rev.1: Name Change
<b>5.38</b>	<b>BATTERIES-LEAD ACID (VRLA)</b>		
<b>A</b>	<b>Indian Bidders</b>		
5.38.1	Amara Raja Batteries Ltd	INDIA	
5.38.2	Exide Industries Ltd.	INDIA	
5.38.3	HBL Power Systems Ltd	INDIA	
5.38.4	NED Energy Limited	INDIA	
5.38.5	Kirloskar Batteries Ltd	INDIA	
<b>5.39</b>	<b>BATTERIES-NICKLE CADMIUM</b>		
<b>A</b>	<b>Indian Bidders</b>		
5.39.1	Amco Saft India Ltd	INDIA	
5.39.2	HBL Power Systems Ltd	INDIA	
<b>5.40</b>	<b>UPS SYSTEM</b>		
<b>A</b>	<b>Indian Bidders</b>		
5.40.1	Ametek Solid State Controls	INDIA	
5.40.2	Borri Power India Pvt Ltd	INDIA	
5.40.3	Consul Neowatt Power Solutions Pvt Ltd	INDIA	
5.40.4	DB Power Electronics (P) Ltd	INDIA	
5.40.5	Gutor Electronics Ltd	INDIA	
5.40.6	Hitachi Hi-Rel Power Electronics Ltd	INDIA	
5.40.7	Toshiba Mitsubishi-Electric Industrial System Corporation (TMEIC Industrial Systems India Private Limited)	INDIA	
5.40.8	Vertiv Energy Private Limited	INDIA	
<b>5.41</b>	<b>A.C. VARIABLE SPEED DRIVE / VARIABLE FREQUENCY DRIVE (VFD)</b>		
<b>A</b>	<b>Indian Bidders</b>		
5.41.1	ABB INDIA LIMITED	INDIA	Rev.2: Name Change
5.41.2	Alstom Projects India Ltd	INDIA	
5.41.3	APS Power Systems Pvt. Ltd.	INDIA	
5.41.4	Baldor Electric Company	INDIA	

5.41.5	BHARAT HEAVY ELECTRICALS LIMITED	INDIA	Rev.2: Name Change
5.41.6	Control Technique India Pvt Ltd	INDIA	
5.41.7	Danfoss Industries Pvt Ltd	INDIA	
5.41.8	Eurotherm Del India Limited	INDIA	
5.41.9	GE Energy Power Conversion France SAS	INDIA	
5.41.10	Hitachi Hirel Power Electronics Pvt. Ltd	INDIA	
5.41.11	LARSEN & TOUBRO LIMITED	INDIA	Rev.2: Name Change
5.41.12	NIDEC Corporation	INDIA	
5.41.13	Rockwell Automation India Pvt Ltd	INDIA	
5.41.14	Schneider Electric India Pvt. Ltd	INDIA	
5.41.15	Siemens Ltd	INDIA	
5.41.16	Spectrum Automation And Controls	INDIA	
5.41.17	Toshiba Mitsubishi-Electric Industrial System Corporation	INDIA	
5.41.18	Vacon Controls And Drives Pvt. Ltd	INDIA	
<b>5.42</b>	<b>LIGHTNING ARRESTORS</b>		
<b>A</b>	<b>Indian Bidders</b>		
5.42.1	ABB INDIA LIMITED	INDIA	Rev.2: Name Change
5.42.2	CG Power and Industrial Solutions Ltd	INDIA	
5.42.3	Elpro International Ltd	INDIA	
5.42.4	Oblum Electrical Ind Pvt Ltd	INDIA	
5.42.5	Siemens Ltd	INDIA	
5.42.6	W. Insulation of India	INDIA	
<b>5.43</b>	<b>EARTHING &amp; LIGHTNING PROTECTION</b>		
<b>A</b>	<b>Indian Bidders</b>		
5.43.1	Controls & Switchgear Co.Ltd	INDIA	
5.43.2	Metalite Industries India	INDIA	
5.43.3	Premier Power Products Cal Pvt. Ltd	INDIA	
5.43.4	Vatco Elec Power Pvt Ltd	INDIA	
<b>5.44</b>	<b>MOTOR-INDUCTION-HV (INDUSTRIAL. TYPE SAFE AREA, EXD/EXE)</b>		
<b>A</b>	<b>Indian Bidders</b>		
5.44.1	ABB INDIA LIMITED	INDIA	Rev.2: Name Change
5.44.2	BHARAT HEAVY ELECTRICALS LIMITED	INDIA	Rev.2: Name Change
5.44.3	CG Power and Industrial Solutions Ltd.	INDIA	
5.44.4	Deumont Electric	INDIA	
5.44.5	Fuji Electric India Pvt Ltd	INDIA	
5.44.6	Hitachi Ltd	INDIA	
5.44.7	Kirloskar Electric Co Ltd	INDIA	
5.44.8	Marathon Electric Motor I Ltd	INDIA	
5.44.9	Siemens	INDIA	
5.44.10	TMEIC Industrial Systems India Pvt Ltd	INDIA	
5.44.11	Toshiba Mitsubishi-Electric Industrial System Corporation	INDIA	
5.44.12	WEG	INDIA	
<b>5.45</b>	<b>MOTOR-INDUCTION (HV INCREASED SAFETY ZN2, FLP/PRESSURIZED)</b>		
<b>A</b>	<b>Indian Bidders</b>		
5.45.1	ABB INDIA LIMITED	INDIA	Rev.2: Name Change
5.45.2	Alstom Ltd	INDIA	
5.45.3	BHARAT HEAVY ELECTRICALS LIMITED	INDIA	Rev.2: Name Change
5.45.4	CG Power and Industrial Solutions Ltd	INDIA	
5.45.5	GE Power India Ltd	INDIA	
5.45.6	Kirloskar Electric Co Ltd	INDIA	
5.45.7	Marathon Electric Motor I Ltd	INDIA	

5.45.8	TMEIC Industrial Systems India Pvt Ltd	INDIA	
<b>5.46</b>	<b>MOTOR INDUCTION-MV (INDL.TYPE SAFE AREA, EXD/EXE)</b>		
<b>A</b>	<b>Indian Bidders</b>		
5.46.1	ABB INDIA LIMITED	INDIA	Rev.2: Name Change
5.46.2	Bharat Bijlee Limited	INDIA	
5.46.3	CG Power and Industrial Solutions Ltd	INDIA	
5.46.4	Kirloskar Electric Co Ltd	INDIA	
5.46.5	Laxmi Hydraulics Pvt Ltd	INDIA	
5.46.6	Marathon Electric Motor I Ltd	INDIA	
5.46.7	NIDEC (Formerly Ansaldo System Indust/Asiroboticon)	INDIA	
5.46.8	Siemens Limited	INDIA	
5.46.9	TMEIC Industrial Systems India Pvt Ltd	INDIA	
<b>5.47</b>	<b>MOTOR-INDUCTION- MV (ZONE 2-TYPE E &amp; N, FLP/PRESSURIZED)</b>		
<b>A</b>	<b>Indian Bidders</b>		
5.47.1	ABB INDIA LIMITED	INDIA	Rev.2: Name Change
5.47.2	Bharat Bijlee Limited	INDIA	
5.47.3	CG Power and Industrial Solutions Ltd	INDIA	
5.47.4	Kirloskar Electric Co Ltd	INDIA	
5.47.5	Laxmi Hydraulics Pvt Ltd	INDIA	
5.47.6	Marathon Electric Motor I Ltd	INDIA	
5.47.7	TMEIC Industrial Systems India Pvt Ltd	INDIA	
5.47.8	WEG Electric India Pvt Ltd	INDIA	
<b>5.48</b>	<b>MOTOR-INDUCTION-MV (FLAME PROOF)</b>		
<b>A</b>	<b>Indian Bidders</b>		
5.48.1	ABB INDIA LIMITED	INDIA	Rev.2: Name Change
5.48.2	Bharat Bijlee Limited	INDIA	
5.48.3	CEMP	INDIA	
5.48.4	CG Power and Industrial Solutions Ltd	INDIA	
5.48.5	Kirloskar Electric Co Ltd	INDIA	
5.48.6	Laxmi Hydraulics Pvt Ltd	INDIA	
5.48.7	Marathon Electric Motor I Ltd	INDIA	
5.48.8	Siemens Limited	INDIA	
5.48.9	TMEIC Industrial Systems India Pvt Ltd	INDIA	
<b>5.49</b>	<b>SYNCHRONOUS MOTOR</b>		
<b>A</b>	<b>Indian Bidders</b>		
5.49.1	ABB INDIA LIMITED	INDIA	Rev.2: Name Change
5.49.2	BHARAT HEAVY ELECTRICALS LIMITED	INDIA	Rev.2: Name Change
5.49.3	GE Energy Power Conversion France SAS	INDIA	
5.49.4	Hitachi Ltd	INDIA	
5.49.5	NIDEC Corporation	INDIA	
5.49.6	Siemens Ltd	INDIA	
5.49.7	Toshiba Mitsubishi-Electric Industrial System Corporation (TMEIC Industrial Systems India Pvt Ltd)	INDIA	
<b>5.50</b>	<b>MOTORS - IMPORTED</b>		
<b>5.51</b>	<b>SYNCHRONOUS GENERATORS (HV)</b>		
<b>A</b>	<b>Indian Bidders</b>		
5.51.1	ABB INDIA LIMITED	INDIA	Rev.2: Name Change
5.51.2	Andritz Hydro Pvt Ltd	INDIA	
5.51.3	AVK Deutschland GmbH & Co. Kg	INDIA	

5.51.4	T D Power Systems Limited	INDIA	
5.51.5	Toshiba Mitsubishi-Electric Industrial System Corporation	INDIA	
<b>5.52</b>	<b>DG SET / EMERGENCY GENERATORS (MV)</b>		
<b>A</b>	<b>Indian Bidders</b>		
5.52.1	BHARAT HEAVY ELECTRICALS LIMITED	INDIA	Rev.2: Name Change
5.52.2	CG Power and Industrial Solutions Ltd	INDIA	
5.52.3	Clarke Energy System	INDIA	
5.52.4	Cummins Genrator Technolgies I Ltd	INDIA	
5.52.5	Diesel Locomotive Works	INDIA	
5.52.6	Greaves Cotton Ltd.	INDIA	
5.52.7	Jaksons Limited	INDIA	
5.52.8	Jeevan Diesels & Electrical Ltd	INDIA	
5.52.9	Kirloskar Oil Engines Ltd	INDIA	
5.52.10	Man B & W Diesel Ltd	INDIA	
5.52.11	Nishishiba Electic Co. Ltd	INDIA	
5.52.12	Powerica Ltd	INDIA	
5.52.13	Rai Industrial Power Pvt. Ltd.	INDIA	
5.52.14	Sterling Generators Pvt. Ltd.	INDIA	
5.52.15	Sudhir Power Ltd	INDIA	
5.52.16	TIL Limited (Sahibabad Works)	INDIA	
5.52.17	Trading Engineers(International) Ltd	INDIA	
5.52.18	Wartsila India Ltd	INDIA	
<b>5.53</b>	<b>ACTUATORS-MOV</b>		
<b>A</b>	<b>Indian Bidders</b>		
5.53.1	Auma India Private Ltd	INDIA	
5.53.2	Automatic Electric Ltd	INDIA	
5.53.3	Cair Euromatic Automation Pvt Ltd	INDIA	
5.53.4	Caldyne Automatic (P) Ltd	INDIA	
5.53.5	Flowserve Limitorque	INDIA	
5.53.6	Hind Rectifier Ltd	INDIA	
5.53.7	Limitorque India Limited	INDIA	
5.53.8	Marsh Automation Pvt. Ltd.	INDIA	
5.53.9	Rotork Controls (India) Ltd	INDIA	
<b>5.54</b>	<b>CONTROL STATIONS- WEATHERPROOF</b>		
<b>A</b>	<b>Indian Bidders</b>		
5.54.1	Baliga Lighting Equipments (P) Limited	INDIA	
5.54.2	Electrical Equipment Corporation	INDIA	
5.54.3	Ex-Protecta	INDIA	
5.54.4	FCG Flamproof Control Gears P. Ltd	INDIA	
5.54.5	FCG Power Industries Pvt Ltd	INDIA	
5.54.6	Flameproof Equipments Pvt.Ltd	INDIA	
5.54.7	Flexpro Electricals Pvt Ltd	INDIA	
5.54.8	PEPPERL & FUCHS MANUFACTURING (INDIA) PRIVATE LIMITED / OEM Authorised bidder: M/s. Pepperl & Fuchs (India) Pvt Ltd. – INDIA	INDIA	Rev.1: Name Change
5.54.9	Prompt Engineering Works	INDIA	
5.54.10	Sudhir Switchgears Pvt Ltd	INDIA	
5.54.11	Victory Luminaires	INDIA	
<b>5.55</b>	<b>CONTROL STATIONS / PANEL-FLAME PROOF</b>		
<b>A</b>	<b>Indian Bidders</b>		
5.55.1	Baliga Lighting Equipments (P) Limited	INDIA	
5.55.2	Cooper Crouse-Hinds	INDIA	
5.55.3	CG Power and Industrial Solutions Ltd	INDIA	
5.55.4	FCG Flamproof Control Gears P. Ltd	INDIA	

5.55.5	FCG Power Industries Pvt Ltd	INDIA	
5.55.6	Flameproof Equipments Pvt.Ltd	INDIA	
5.55.7	Flexpro Electricals Pvt Ltd	INDIA	
5.55.8	Kaysons Techno Equipment P Ltd.	INDIA	
5.55.9	PEPPERL & FUCHS MANUFACTURING (INDIA) PRIVATE LIMITED / OEM Authorised bidder: M/s. Pepperl & Fuchs (India) Pvt Ltd. – INDIA	INDIA	Rev.1: Name Change
5.55.10	Prompt Engineering Works	INDIA	
5.55.11	R Sthal Pvt Ltd.	INDIA	
5.55.12	Sudhir Switchgears Pvt Ltd	INDIA	
5.55.13	Victory Luminaires	INDIA	
<b>5.56</b>	<b>JUNCTION BOXES (FLAME PROOF)</b>		
<b>A</b>	<b>Indian Bidders</b>		
5.56.1	Baliga Lighting Equipments (P) Limited	INDIA	
5.56.2	Cooper Crouse-Hinds	INDIA	
5.56.3	FCG Flamproof Control Gears P. Ltd	INDIA	
5.56.4	FCG Power Industries Pvt Ltd	INDIA	
5.56.5	Flameproof Equipments Pvt.Ltd	INDIA	
5.56.6	Flexpro Electricals Pvt Ltd	INDIA	
5.56.7	Kaysons Techno Equipment P Ltd.	INDIA	
5.56.8	PEPPERL & FUCHS MANUFACTURING (INDIA) PRIVATE LIMITED / OEM Authorised bidder: M/s. Pepperl & Fuchs (India) Pvt Ltd. – INDIA	INDIA	Rev.1: Name Change
5.56.9	Prompt Engineering Works	INDIA	
5.56.10	R Stahl Pvt Ltd.	INDIA	
5.56.11	Sudhir Switchgears Pvt Ltd	INDIA	
<b>5.57</b>	<b>LIGHTING FIXTURE &amp; ACCESSORIES-HAZARDOUS</b>		
<b>A</b>	<b>Indian Bidders</b>		
5.57.1	Bajaj Electricals Ltd	INDIA	
5.57.2	Baliga Lighting Equipments (P) Limited	INDIA	
5.57.3	Cooper Crouse-Hinds	INDIA	
5.57.4	CG Power and Industrial Solutions Ltd	INDIA	
5.57.5	FCG Flamproof Control Gears P. Ltd	INDIA	
5.57.6	FCG Power Industries Pvt Ltd	INDIA	
5.57.7	Flameproof Equipments Pvt.Ltd	INDIA	
5.57.8	Flexpro Electricals Pvt Ltd	INDIA	
5.57.9	Kaysons Techno Equipment P Ltd.	INDIA	
5.57.10	PEPPERL & FUCHS MANUFACTURING (INDIA) PRIVATE LIMITED / OEM Authorised bidder: M/s. Pepperl & Fuchs (India) Pvt Ltd. – INDIA	INDIA	Rev.1: Name Change
5.57.11	Prompt Engineering Works	INDIA	
5.57.12	R Stahl	INDIA	
5.57.13	Sudhir Switchgears Pvt Ltd	INDIA	
5.57.14	Victor Product PLC	INDIA	
<b>5.58</b>	<b>LIGHTING &amp; POWER PANELS (FLP)</b>		
<b>A</b>	<b>Indian Bidders</b>		
5.58.1	Baliga Lighting Equipments (P) Limited	INDIA	
5.58.2	FCG Flamproof Control Gears P. Ltd	INDIA	
5.58.3	FCG Power Industries Pvt Ltd	INDIA	
5.58.4	Flameproof Equipments Pvt.Ltd	INDIA	
5.58.5	Flexpro Electricals Pvt Ltd	INDIA	
5.58.6	Kaysons Techno Equipment P Ltd.	INDIA	
5.58.7	Sudhir Switchgears Pvt Ltd	INDIA	
<b>5.59</b>	<b>PLUGS/SOCKETS/HANDLAMPS (FLAME PROOF)</b>		
<b>A</b>	<b>Indian Bidders</b>		

5.59.1	Baliga Lighting Equipments (P) Limited	INDIA	
5.59.2	Cooper Crouse-Hinds	INDIA	
5.59.3	FCG Flameproof Control Gears P. Ltd	INDIA	
5.59.4	FCG Power Industries Pvt Ltd	INDIA	
5.59.5	Flameproof Equipments Pvt.Ltd	INDIA	
5.59.6	Flexpro Electricals Pvt Ltd	INDIA	
5.59.7	Kaysons Techno Equipment P Ltd.	INDIA	
5.59.8	PEPPERL & FUCHS MANUFACTURING (INDIA) PRIVATE LIMITED / OEM Authorised bidder: M/s. Pepperl & Fuchs (India) Pvt Ltd. – INDIA	INDIA	Rev.1: Name Change
5.59.9	Sudhir Switchgears Pvt Ltd	INDIA	
<b>5.60</b>	<b>HIGH MAST LIGHTING SYSTEM</b>		
<b>A</b>	<b>Indian Bidders</b>		
5.60.1	Bajaj Electricals Ltd	INDIA	
5.60.2	CG Power and Industrial Solutions Ltd	INDIA	
5.60.3	Philips Electronics India Limited	INDIA	
<b>5.61</b>	<b>LIGHTING FIXTURES (SAFE AREA)</b>		
<b>A</b>	<b>Indian Bidders</b>		
5.61.1	Bajaj Electricals	INDIA	
5.61.2	CG Power and Industrial Solutions Ltd	INDIA	
5.61.3	GE Lighting	INDIA	
5.61.4	Havells India	INDIA	
5.61.5	Philips Lighting	INDIA	
5.61.6	Surya Roshni India	INDIA	
5.61.7	Wipro India	INDIA	
<b>5.62</b>	<b>LIGHTING PANEL / POWER PANELS &amp; DISTRIBUTION BOARDS (SAFE AREA)</b>		
<b>A</b>	<b>Indian Bidders</b>		
5.62.1	ABB INDIA LIMITED	INDIA	Rev.2: Name Change
5.62.2	Advance Panels & Switchgear (P) Ltd	INDIA	
5.62.3	C & S Electric	INDIA	
5.62.4	Havells India Ltd	INDIA	
5.62.5	Indo Asian Fusegear	INDIA	
5.62.6	Indo Chem	INDIA	
5.62.7	Industrial Switchgear & Controls (Bombay) Pvt. Ltd	INDIA	
5.62.8	Intrelec	INDIA	
5.62.9	Legrand	INDIA	
5.62.10	M.K Engineers & Controls Pvt. Ltd	INDIA	
5.62.11	Md Switchgear Ltd	INDIA	
5.62.12	Novateur Electrical & Digital Systems Pvt Ltd	INDIA	
5.62.13	Standard Electricals	INDIA	
5.62.14	Zenith Engineering Corporation	INDIA	
<b>5.63</b>	<b>EXTRA HIGH VOLTAGE –XLPE CABLES</b>		
<b>A</b>	<b>Indian Bidders</b>		
5.63.1	Cable Corporation Of India	INDIA	
5.63.2	Finolex Cables Ltd.	INDIA	
5.63.3	KEC International Ltd	INDIA	
5.63.4	KEI Industries Limited	INDIA	
5.63.5	Polycab Wires Pvt Ltd	INDIA	
5.63.6	Sterlite Power Transmission Limited (under Sterlite Technologies Limited)	INDIA	
5.63.7	Torrent Cables Ltd	INDIA	
5.63.8	Universal Cables Limited	INDIA	
<b>5.64</b>	<b>CABLES-HIGH VOLTAGE-XLPE (FRLS)</b>		



<b>A</b>	<b>Indian Bidders</b>		
5.64.1	APAR Industries Ltd	INDIA	
5.64.2	Cable Corporation of India	INDIA	
5.64.3	Finolex Cables Ltd.	INDIA	
5.64.4	Gemscab Industries Ltd	INDIA	
5.64.5	Gupta Power Infrastructure	INDIA	
5.64.6	Havells India Ltd	INDIA	
5.64.7	Insucon Cable And Cond Pvt Ltd	INDIA	
5.64.8	KEC International Ltd	INDIA	
5.64.9	KEI Industries Ltd	INDIA	
5.64.10	Polycab Wires Pvt Ltd	INDIA	
5.64.11	Sterlite Technologies Limited	INDIA	
5.64.12	Suraj Cables	INDIA	
5.64.13	Torrent Cables Ltd	INDIA	
5.64.14	Universal Cables Ltd	INDIA	
<b>5.65</b>	<b>MV POWER CABLE - FIRE SURVIVAL (FRLS)</b>		
<b>A</b>	<b>Indian Bidders</b>		
5.65.1	Ajanta Electric	INDIA	
5.65.2	Associated Flexibles & Wires [P] Ltd	INDIA	
5.65.3	Cords Cable Industries Ltd	INDIA	
5.65.4	Gupta Power Infrastructure	INDIA	
5.65.5	Havells India Ltd	INDIA	
5.65.6	Insucon Cable And Cond Pvt Ltd	INDIA	
5.65.7	KEI Industries Limited	INDIA	
5.65.8	Polycab Wires Pvt Ltd	INDIA	
5.65.9	Suraj Cables	INDIA	
<b>5.66</b>	<b>CABLES-MEDIUM VOLTAGE-POWER-XLPE &amp; PVC</b>		
<b>A</b>	<b>Indian Bidders</b>		
5.66.1	Ajanta Electric	INDIA	
5.66.2	APAR Industries Ltd	INDIA	
5.66.3	Associated Flexibles & Wires [P] Ltd	INDIA	
5.66.4	Cable Corporation of India	INDIA	
5.66.5	Cords Cable Industries Ltd	INDIA	
5.66.6	Finolex Cables Ltd.	INDIA	
5.66.7	Gemscab Industries Ltd	INDIA	
5.66.8	Gupta Power Infrastructure	INDIA	
5.66.9	Havells India Ltd	INDIA	
5.66.10	Insucon Cable And Cond Pvt Ltd	INDIA	
5.66.11	KEC International Ltd	INDIA	
5.66.12	KEI Industries Limited	INDIA	
5.66.13	Polycab Wires Pvt Ltd	INDIA	
5.66.14	Rallison Electricals Pvt. Ltd.	INDIA	
5.66.15	Ravin Cables Pvt Ltd	INDIA	
5.66.16	Special Cables Pvt Ltd	INDIA	
5.66.17	Sriram Cables Pvt Ltd	INDIA	
5.66.18	Suraj Cables	INDIA	
5.66.19	Torrent Cables Ltd	INDIA	
5.66.20	Uniflex Cables Ltd	INDIA	
5.66.21	Universal Cables Ltd	INDIA	
<b>5.67</b>	<b>CABLES: CONTROL-XLPE &amp; PVC</b>		
<b>A</b>	<b>Indian Bidders</b>		
5.67.1	Ajanta Electric	INDIA	

5.67.2	Associated Cables Pvt Ltd	INDIA	
5.67.3	Associated Flexibles & Wires [P] Ltd	INDIA	
5.67.4	Cables Corporation of India	INDIA	
5.67.5	CMI Limited	INDIA	
5.67.6	Cords Cable Industries Ltd	INDIA	
5.67.7	Delton Cables Limited	INDIA	
5.67.8	Ecko Cables Pvt. Ltd.	INDIA	
5.67.9	Elkay Telelinks Ltd.	INDIA	
5.67.10	Finolex Cables Ltd.	INDIA	
5.67.11	Gemscab Industries Ltd	INDIA	
5.67.12	Havells India Ltd	INDIA	
5.67.13	Icon Cable Ltd.	INDIA	
5.67.14	Insucon Cables And Cond Pvt Ltd	INDIA	
5.67.15	KEC International Ltd	INDIA	
5.67.16	KEI Industries Limited	INDIA	
5.67.17	North Eastern Cables Pvt. Ltd.	INDIA	
5.67.18	Polycab Wires Pvt Ltd	INDIA	
5.67.19	Rallison Electricals Pvt. Ltd.	INDIA	
5.67.20	Ravin Cables Pvt. Ltd.	INDIA	
5.67.21	Reliance Engineers Ltd.	INDIA	
5.67.22	Scot Innovation Wires & Cables Pvt. Ltd.	INDIA	
5.67.23	Special Cables Pvt. Ltd.	INDIA	
5.67.24	Sriram Cables Pvt Ltd	INDIA	
5.67.25	Suraj Cables	INDIA	
5.67.26	Suyog Electricals	INDIA	
5.67.27	Thermo Cables Ltd.	INDIA	
5.67.28	Torrent Cables Ltd	INDIA	
5.67.29	Universal Cables Ltd	INDIA	
<b>5.68</b>	<b>CABLES-FIRE ALARM AND COMMN.</b>		
<b>A</b>	<b>Indian Bidders</b>		
5.68.1	CMI Limited	INDIA	
5.68.2	Cords Cable Industries Ltd	INDIA	
5.68.3	Delton Cables Limited	INDIA	
5.68.4	Elkay Telelinks Ltd.	INDIA	
5.68.5	KEI Industries Limited	INDIA	
5.68.6	Reliance Engineers Ltd	INDIA	
5.68.7	Vindhya Telelinks Ltd	INDIA	
<b>5.69</b>	<b>CONTROL CABLE - FIRE SURVIVAL (FRLS)</b>		
<b>A</b>	<b>Indian Bidders</b>		
5.69.1	Associated Flexibles & Wires [P] Ltd	INDIA	
5.69.2	Cords Cable Industries Ltd	INDIA	
5.69.3	Elkay Telelinks Ltd.	INDIA	
5.69.4	Havells India Ltd	INDIA	
5.69.5	Icon Cable Ltd.	INDIA	
5.69.6	KEI Industries Limited	INDIA	
5.69.7	Polycab Wires Pvt Ltd	INDIA	
5.69.8	Suyog Electricals Ltd	INDIA	
5.69.9	Thermo Cables Ltd	INDIA	
<b>5.70</b>	<b>CABLES COMMUNICATION (JELLY FIELD)</b>		
<b>A</b>	<b>Indian Bidders</b>		
5.70.1	Birla Cable Ltd (formerly Birla Ericsson Optical Ltd)	INDIA	
5.70.2	CMI Limited	INDIA	

5.70.3	Cords Cable Industries Ltd	INDIA	
5.70.4	Delton Cables Ltd	INDIA	
5.70.5	Elkay Telelinks Ltd	INDIA	
5.70.6	Finolex Cables Ltd	INDIA	
5.70.7	KEC International Ltd	INDIA	
5.70.8	KEI Industries Limited	INDIA	
5.70.9	Usha Beltron Ltd	INDIA	
5.70.10	Vindhya Telelinks Ltd	INDIA	
<b>5.71</b>	<b>PLANT COMMUNICATION SYSTEM (PA / PAGING)</b>		
<b>A</b>	<b>Indian Bidders</b>		
5.71.1	Armtel LLC	INDIA	
5.71.2	Siemens Enterprise Communications	INDIA	
<b>5.72</b>	<b>TELEPHONE (Instrument / EPABX)</b>		
<b>A</b>	<b>Indian Bidders</b>		
5.72.1	AGC	INDIA	
5.72.2	Aviva	INDIA	
5.72.3	Dee Em Systems	INDIA	
5.72.4	Fibcom India Limited	INDIA	
5.72.5	Laraon Engineers & Consultants Pvt. Ltd	INDIA	
5.72.6	Maxtel (Panasonic)	INDIA	
5.72.7	NEC	INDIA	
5.72.8	Philips	INDIA	
5.72.9	Progility	INDIA	
5.72.10	Siemens (Unify)	INDIA	
<b>5.73</b>	<b>TETRA SYSTEM</b>		
<b>A</b>	<b>Indian Bidders</b>		
5.73.1	EADS India Pvt Ltd	INDIA	
5.73.2	Rohde & Schwarz India Pvt Ltd	INDIA	
5.73.3	Selex Communications	INDIA	
5.73.4	Simoco Telecommunications (South Asia) Ltd	INDIA	
5.73.5	Motorola	INDIA	
<b>5.74</b>	<b>FIRE ALARM SYSTEM</b>		
<b>A</b>	<b>Indian Bidders</b>		
5.74.1	D.D. Electronic Equipment Pvt Ltd (D.D. Systems)	INDIA	
5.74.2	Dynamic Engineers Ltd	INDIA	
5.74.3	Edward International	INDIA	
5.74.4	Honeywell Automation India Ltd.	INDIA	
5.74.5	Mather & Platt India Ltd	INDIA	
5.74.6	New Fire Engineers (P) Ltd	INDIA	
5.74.7	Tyco Fire & Security India Pvt. Ltd	INDIA	
5.74.8	Vijay Fire Protection Sytem Ltd	INDIA	
<b>5.75</b>	<b>ELECTRICAL HEAT TRACING SYSTEM</b>		
<b>A</b>	<b>Indian Bidders</b>		
5.75.1	Bartec India	INDIA	
5.75.2	Pentair Thermal Systems	INDIA	
5.75.3	Raychem RPG	INDIA	
5.75.4	Thermon Heat Tracing	INDIA	
5.75.5	Thermopads Pvt Ltd	INDIA	
5.75.6	Tyco India Ltd	INDIA	
5.75.7	Xicon	INDIA	

5.75.8	Chromalux	INDIA	
<b>5.76</b>	<b>CATHODIC PROTECTION SYSTEM</b>		
<b>A</b>	<b>Indian Bidders</b>		
5.76.1	BSS Tech CP India Pvt. Ltd.	INDIA	
5.76.2	Cathodic Control Company	INDIA	
5.76.3	Consultants – Baroda	INDIA	
5.76.4	Consultech Cathodic Protection Engrs & India	INDIA	
5.76.5	Corrosion Control Services Pvt. Ltd.	INDIA	
5.76.6	Corrosion Technology Services	INDIA	
5.76.7	Corrtch International	INDIA	
5.76.8	Raychem RPG	INDIA	
5.76.9	Sark EPC Projects	INDIA	
5.76.10	Scientific Metal Engineers	INDIA	
<b>5.77</b>	<b>CABLE TRAYS GI /SS (Perforated /Ladder) &amp; CABLE DUCTS</b>		
<b>A</b>	<b>Indian Bidders</b>		
5.77.1	Elcon Cable Trays Pvt Ltd	INDIA	
5.77.2	Globe Elect. Industries Ltd. India	INDIA	
5.77.3	IDS Composites	INDIA	
5.77.4	Indiana Cable Trays	INDIA	
5.77.5	Metalemms Bombay Pvt. Ltd.	INDIA	
5.77.6	National Galvaniser	INDIA	

5.77.7	OBO Bettermann India Pvt Ltd	INDIA	
5.77.8	Patny Systems Pvt Ltd	INDIA	
5.77.9	Premier Power Products Cal Pvt. Ltd	INDIA	
5.77.10	Profab Engineers Pvt Ltd	INDIA	
5.77.11	Ratan Projects & Engineering Co. Pvt. Ltd.	INDIA	
5.77.12	Rukmani Electrical & Components	INDIA	
5.77.13	Steelite Engineering Limited	INDIA	
5.77.14	Vatco Elec Power Pvt Ltd	INDIA	
<b>5.78</b>	<b>CABLE TRAYS FRP</b>		
<b>A</b>	<b>Indian Bidders</b>		
5.78.1	Arvind Composites India	INDIA	
5.78.2	Ercon India	INDIA	
5.78.3	Sumip Composites India	INDIA	
5.78.4	Syntex India	INDIA	
<b>5.79</b>	<b>CABLE JOINTS &amp; TERMINATION KITS</b>		
<b>A</b>	<b>Indian Bidders</b>		
5.79.1	3M Electro & Communication India Pvt. Ltd. India	INDIA	
5.79.2	ABB india limited	INDIA	Rev.2: Name Change
5.79.3	Euromold (Nexans India)	INDIA	
5.79.4	Fischer	INDIA	
5.79.5	Heatshrink Technologies Ltd. India	INDIA	
5.79.6	Nkt	INDIA	
5.79.7	Raychem RPG	INDIA	
<b>5.80</b>	<b>CABLE GLANDS (FOR HAZARDOUS AREA)</b>		
<b>A</b>	<b>Indian Bidders</b>		
5.80.1	Baliga Lighting Eqpts Ltd	INDIA	
5.80.2	Comet Brass Products	INDIA	
5.80.3	FCG Flameproof Control Gears Pvt. Ltd Comet	INDIA	
5.80.4	FCG Power Ind Pvt Ltd	INDIA	
5.80.5	Flameproof Equipment Pvt. Ltd	INDIA	
5.80.6	Flexpro Electricals Pvt Ltd	INDIA	
5.80.7	Kaysons Techno Equipments P. Ltd.	INDIA	
5.80.8	Sudhir Switchgears Pvt Ltd	INDIA	
5.80.9	R Stahl	INDIA	
5.80.10	Standard Metal Industries	INDIA	
<b>5.81</b>	<b>LIGHTING POLES (GALVANISED)</b>		
<b>A</b>	<b>Indian Bidders</b>		
5.81.1	KI Industries	INDIA	
5.81.2	Shah Engg	INDIA	
5.81.3	India Electric Poles Mfg.Co	INDIA	
<b>5.82</b>	<b>NIFPS (NITROGEN INJECTED FIRE PROTECTION SYSTEM)</b>		
<b>A</b>	<b>Indian Bidders</b>		
5.82.1	CTR Manufacturing India Ltd	INDIA	
<b>5.83</b>	<b>DC MOTORS</b>		



<b>SECTION-D INSTRUMENTATION</b>		Doc. No.	IOCL-MSL-2020
<b>DOCUMENT TITLE :- PROJECT MASTER SUPPLIER LIST (PMSL)-IOCL-2020</b>		<b>REV :</b>	<b>2</b>
<b>M/s. INDIAN OIL CORPORATION LIMITED (IOCL)</b>		<b>Date :</b>	<b>31-Oct-20</b>
<b>COMMON PROJECTS MASTER SUPPLIER LIST-SECTION-D (INSTRUMENTATION)</b>			
<b>Sr.No</b>	<b>VENDOR NAME</b>	<b>COUNTRY</b>	<b>REMARK</b>
<b>6.1</b>	<b>TUBE FITTINGS</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
6.1.1	ARYA CRAFTS & ENGINEERING PVT LTD	INDIA	
6.1.2	ASTEC VALVES & FITTINGS PVT. LTD.	INDIA	
6.1.3	CIRCOR INSTR. TECHNOLOGIES INC-	INDIA	
6.1.4	COMFIT & VALVES PVT. LTD.	INDIA	
6.1.5	EXCEL HYDRO PNEUMATICS PVT LTD	INDIA	
6.1.6	EXCELSIOR ENGG. WORKS	INDIA	
6.1.7	FLUID CONTROLS PVT LTD	INDIA	
6.1.8	MULTIMETAL INDUSTRIES	INDIA	
6.1.9	PANAM ENGINEERS	INDIA	
6.1.10	PARKER HANNIFIN CORPORATION	INDIA	
6.1.11	PRIME ENGINEERS	INDIA	
6.1.12	RELIANCE ENGINEERING & ELECTRICALS CORPN	INDIA	
6.1.13	SEALEXCEL (INDIA) PVT. LTD.	INDIA	
6.1.14	SWAGELOK CO.	INDIA	
6.1.15	SWASTIK ENGINEERING WORKS	INDIA	
6.1.16	TK FUJIKIN CORPORATION	INDIA	
6.1.17	WESMEC ENGINEERING PVT. LTD	INDIA	
6.1.18	PRECISION ENGINEERING INDUSTRIES	INDIA	
<b>6.2</b>	<b>INSTRUMENT TUBING</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
6.2.1	HEAVY METALS & TUBES LIMITED	INDIA	
6.2.2	JINDAL SAW LTD	INDIA	
6.2.3	RATNAMANI METALS AND TUBES LTD	INDIA	
6.2.4	REMI EDELSTAHL TUBULARS LTD	INDIA	
6.2.5	TK FUJIKIN CORPORATION	INDIA	
6.2.6	NUCLEAR FUEL COMPLEX	INDIA	
<b>6.3</b>	<b>MACHINE MONITORING SYSTEMS</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
6.3.1	GE OIL & GAS INDIA PVT LTD	INDIA	Rev.2: Name Update
6.3.2	ROCKWELL AUTOMATION INDIA PVT LTD	INDIA	
6.3.3	PROGNOST SYSTEMS GmbH	INDIA	
<b>6.4</b>	<b>THERMO COUPLE EXTN.CABLES</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
6.4.1	ASSOCIATED CABLES PVT LTD	INDIA	
6.4.2	ASSOCIATED FLEXIBLES & WIRES [P] LTD	INDIA	
6.4.3	CORDS CABLE INDUSTRIESLTD	INDIA	
6.4.4	DELTON CABLES LIMITED	INDIA	
6.4.5	KEI INDUSTRIES LIMITED	INDIA	
6.4.6	T C COMMUNICATION PVT. LTD.	INDIA	
6.4.7	THERMO CABLES LTD	INDIA	
6.4.8	UDEY PYROCABLES PVT. LTD.	INDIA	

<b>6.5</b>	<b>SIGNAL CABLES</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
6.5.1	ASSOCIATED CABLES PVT LTD	INDIA	
6.5.2	ASSOCIATED FLEXIBLES & WIRESPRIVATE LTD	INDIA	
6.5.3	CMI LIMITED	INDIA	
6.5.4	CORDS CABLE INDUSTRIES LTD	INDIA	
6.5.5	DELTON CABLES LIMITED	INDIA	
6.5.6	ELKAY TELELINKS LTD.	INDIA	
6.5.7	KEC INETRATIONAL LIMITED	INDIA	
6.5.8	KEI INDUSTRIES LIMITED	INDIA	
6.5.9	LEONI CABLE SOLUTIONS (INDIA) PVT LTD.	INDIA	
6.5.10	POLYCAB WIRES PVT LTD	INDIA	
6.5.11	RALLISON ELECTRICALS PVT. LTD.	INDIA	
6.5.12	SUYOG ELECTRICALS LTD	INDIA	
6.5.13	T C COMMUNICATION PVT. LTD.	INDIA	
6.5.14	THERMO CABLES LTD	INDIA	
6.5.15	UDEY PYROCABLES PVT. LTD.	INDIA	
6.5.16	LAPP INDIA PVT LTD	INDIA	
<b>6.6</b>	<b>OPTICAL FIBRE CABLE &amp; ASSOC.ITEM</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
6.6.1	ABB INDIA LIMITED	INDIA	Rev.2: Name Change
6.6.2	AKSH OPTIFIBRE LIMITED	INDIA	
6.6.3	APAR INDUSTRIES LTD	INDIA	
6.6.4	BIRLA ERICSSON OPTICAL LIMITED	INDIA	
6.6.5	FINOLEX CABLES LTD.	INDIA	
6.6.6	HIMACHAL FUTIRISTIC COMMUNICATIONS LTD.	INDIA	
6.6.7	KEC INETRATIONAL - MYSORE	INDIA	
6.6.8	STERLITE OPTICAL TECHNOLOGIES LTD	INDIA	
6.6.9	SUDARSHAN TELECOM (A DIV. OF THE WCPML)	INDIA	
6.6.10	U M CABLES LTD	INDIA	
6.6.11	VINDHYA TELELINKS LIMITED	INDIA	
6.6.12	OPTEL TELECOMMUNICATIONS	INDIA	Rev.2: Deleted
6.6.13	ABB INDIA LIMITED	INDIA	Rev.2: Name Change
6.6.14	STERLITE TECHNOLOGIES LTD	INDIA	
<b>6.7</b>	<b>FIELD BUS SIGNAL CABLES</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
6.7.1	ASSOCIATED FLEXIBLES & WIRES [P] LTD	INDIA	
6.7.2	BELDEN INC	INDIA	
6.7.3	CORDS CABLE INDUSTRIES LTD	INDIA	
6.7.4	LAPP INDIA PVT LTD	INDIA	
<b>6.8</b>	<b>SIGNAL CABLE - FIRE RESISTANT</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
6.8.1	ASSOCIATED FLEXIBLES & WIRES [P] LTD	INDIA	
6.8.2	CORDS CABLE INDUSTRIES LTD	INDIA	
6.8.3	ELKAY TELELINKS LTD.	INDIA	
6.8.4	KEI INDUSTRIES LIMITED	INDIA	
6.8.5	POLYCAB WIRES PVT LTD	INDIA	
6.8.6	SUYOG ELECTRICALS LTD	INDIA	
6.8.7	THERMO CABLES LTD	INDIA	

6.8.8	ASSOCIATED CABLES LIMITED	INDIA	
6.8.9	UDEY PYROCABLES PVT LTD	INDIA	
6.8.10	TC COMMUNICATION PVT LTD	INDIA	
6.8.11	Lapp India Pvt Ltd	INDIA	
6.8.12	Leoni Cable Solutions (India) Pvt. Ltd.	INDIA	
<b>6.9</b>	<b>SPECIAL LEVEL INSTRUMENTS (TUNNING FORK)</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
6.9.1	ABB INDIA LIMITED	INDIA	Rev.2: Name Change
6.9.2	ENDRESS+HAUSER (INDIA) PRIVATE LIMITED	INDIA	Rev.2: Name Change
6.9.3	MOBREY LTD	INDIA	
6.9.4	NIVO CONTROLS PVT LTD	INDIA	
6.9.5	SAPCON INSTRUMENTS PVT LTD	INDIA	
6.9.6	VEGA INDIA LEVEL & PRESSURE MEASUREMENT PVT LTD	INDIA	
6.9.7	EMERSON PROCESS MANAGEMENT (INDIA) PRIVATE LIMITED.	INDIA	
<b>6.10</b>	<b>COPPER TUBES (COATED, BARE)</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
6.10.1	MEHTA TUBES LIMITED	INDIA	
6.10.2	MULTIMETALS LIMITED	INDIA	
6.10.3	RAJCO METAL INDUSTRIES P LTD	INDIA	
6.10.4	KAMANI TUBES	INDIA	
6.10.5	RELIANCE ENGINEERS LTD	INDIA	
6.10.6	ALCOBEX METALS PVT LTD	INDIA	
6.10.7	HIDUSTAN STEEL & METAL WORKS	INDIA	
6.10.8	INDUSTRIAL TUBES	INDIA	
<b>6.11</b>	<b>CORROSION MONITORS</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
6.11.1	PEPPERL + FUCHS GMBH	INDIA	
6.11.2	CHEMTREAT INDIA LIMITED	INDIA	
6.11.3	MANAN ENGINEERING CORPORATION	INDIA	
6.11.4	ALLWYN INDUSTRIES	INDIA	
<b>6.12</b>	<b>CONTROL VALVE POSITIONER / SMART POSITIONER</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
6.12.1	FLOWSERVE INDIA CONTROL PVT LTD- BANGALORE	INDIA	
6.12.2	SAMSON CONTROLS PVT LTD	INDIA	
6.12.3	EMERSON PROCESS MANAGEMENT (INDIA) PRIVATE LIMITED.	INDIA	
6.12.4	METSO AUTOMATION	INDIA	
6.12.5	DRESSER	INDIA	
<b>6.13</b>	<b>SOLENOID VALVES</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
6.13.1	ASCO NUMATICS (INDIA) P. LIMITED	INDIA	
6.13.2	AVCON CONTROLS PVT. LTD.	INDIA	
6.13.3	HERION WERKE	INDIA	
6.13.4	PRECISION INSTRUMENT COMPANY	INDIA	
6.13.5	ROTEX AUTOMATION LTD.	INDIA	
6.13.6	SCHRADER DUNCAN LIMITED	INDIA	
6.13.7	ASCO JOUCOMATIC LTD	INDIA	
<b>6.14</b>	<b>CONTROL VALVES</b>		



<b>A</b>	<b>INDIAN BIDDERS</b>		
6.14.1	ARCA REGLER GMBH	INDIA	
6.14.2	CCI VALVE TECHNOLOGY GMBH	INDIA	
6.14.3	EMERSON PROCESS MANAGEMENT CHENNAI PVT. LTD	INDIA	
6.14.4	FLOWSERVE INDIA CONTROL PVT LTD	INDIA	
6.14.5	FORBES MARSHALL ARCA P LTD.	INDIA	
6.14.6	GE OIL & GAS INDIA PVT LTD	INDIA	Rev.2: Name Update
6.14.7	INSTRUMENTATION LIMITED	INDIA	
6.14.8	KOSO INDIA PVT LTD	INDIA	
6.14.9	NELES INDIA PVT LTD	INDIA	Rev.1: Name Change
6.14.10	MIL CONTROLS LIMITED	INDIA	
6.14.11	SAMSON CONTROLS PVT LTD	INDIA	
6.14.12	SEVERN GLOCON INDIA PVT LTD	INDIA	
6.14.13	SPX VALVES & CONTROLS (FORMERLY DEZURIK)	INDIA	
6.14.14	WEIR VALVES & CONTROLS UK LTD	INDIA	
6.14.15	GE INDIA INDUSTRIAL PVT LTD (DRESSER)	INDIA	
6.14.16	KENT INTROL UK LTD	INDIA	
6.14.17	CONTROL COMPONENT INDIA PVT LTD.	INDIA	
6.14.18	DRESSER VALVE INDIA PVT LTD	INDIA	
6.14.19	BRAY CONTROLS (I) PVT LTD	INDIA	
<b>6.15</b>	<b>PRESSURE RELIEF VALVE</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
6.15.1	ANDERSON GREENWOOD CROSBY SANMAR Ltd.	INDIA	
6.15.2	BHARAT HEAVY ELECTRICALS LIMITED	INDIA	Rev.2: Name Change
6.15.3	BLISS ANAND PVT LTD	INDIA	
6.15.4	CURTISS WRIGHT FLOW CONTROL CORPORATION	INDIA	
6.15.5	DARLING MUESCO (INDIA) PVT. LTD	INDIA	
6.15.6	GE OIL & GAS INDIA PVT LTD	INDIA	Rev.2: Name Update
6.15.7	FAINGER LESER VALVES (P) LTD.	INDIA	
6.15.8	INSTRUMENTATION LIMITED	INDIA	Rev.1: Name Change
6.15.9	TRILLIUMFLOW TECHNOLOGIES INDIA PVT LTD	INDIA	Rev.1: Name Change
6.15.10	ANDERSON GREENWOOD CROSBY	INDIA	
6.15.11	DRESSER INC	INDIA	
6.15.12	TYCO SANMAR LTD	INDIA	
6.15.13	PENTAIR SAN MAR LTD	INDIA	
<b>6.16</b>	<b>INSTRUMENT VALVES &amp; MANIFOLDS</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
6.16.1	ANDERSON GREENWOOD CROSBY SANMAR Ltd.	INDIA	
6.16.2	ARYA CRAFTS & ENGINEERING PVT LTD	INDIA	
6.16.3	ASTEC VALVES & FITTINGS PVT. LTD.	INDIA	
6.16.4	BAUMER TECHNOLOGIES INDIA PVT.LTD	INDIA	
6.16.5	CIRCOR INSTR. TECHNOLOGIES INC	INDIA	
6.16.6	COMFIT & VALVES PVT. LTD.	INDIA	
6.16.7	EXCEL HYDRO PNEUMATICS PVT LTD	INDIA	
6.16.8	EXCELSIOR ENGG. WORKS	INDIA	
6.16.9	FLUID CONTROLS PVT LTD	INDIA	
6.16.10	MICRO PRECISION PRODUCTS PVT LTD	INDIA	
6.16.11	PANAM ENGINEERS	INDIA	
6.16.12	PARKER HANNIFIN CORPORATION	INDIA	
6.16.13	PRIME ENGINEERS	INDIA	
6.16.14	SWAGELOK CO.	INDIA	

6.16.15	SWASTIK ENGINEERING WORKS	INDIA	
6.16.16	TK FUJIKIN CORPORATION	INDIA	
6.16.17	WESMEC ENGINEERING PVT LTD.	INDIA	
6.16.18	CHEMTROLS INDUSTRIES LTD	INDIA	
6.16.19	PRECISION ENGINEERING INDUSTRIES	INDIA	
6.16.20	ANDERSON GREENWOOD CROSBY	INDIA	
6.16.21	TECNOMATIC INDIA PVT LTD	INDIA	
<b>6.17</b>	<b>TANK PR. PROTECT. DEVICES / FLAME ARRESSTER</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
6.17.1	ANDERSON GREENWOOD CROSBY SANMAR Ltd.	INDIA	
6.17.2	ANDERSON GREENWOOD VAREC	INDIA	
6.17.3	BRAUNSCHWEIGER FLAMMENFILTER	INDIA	
6.17.4	GROTH CORPORATION	INDIA	
6.17.5	PRESSURE & FLOW CONTROL INDUSTRIES	INDIA	
6.17.6	PROTEGO INDIA PVT LTD	INDIA	
<b>6.18</b>	<b>ON-OFF VALVES</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
6.18.1	BRAY CONTROLS INDIA PVT LTD	INDIA	
6.18.2	CAMERON LTD. (Group of Schlumberger Ltd)	INDIA	
6.18.3	EL-O-MATIC INDIA (PVT) LTD.	INDIA	
6.18.4	EMERSON PROCESS MANAGEMENT (INDIA) PRIVATE LIMITED.	INDIA	
6.18.5	FLOWSERVE INDIA CONTROLS PVT. LTD.	INDIA	
6.18.6	KITAMURA VALVE MANUFACTURING CO LTD	INDIA	
6.18.7	KOSO INDIA PVT. LIMITED	INDIA	
6.18.8	L&T VALVES LIMITED	INDIA	
6.18.9	NELES INDIA PVT LTD	INDIA	
6.18.10	MICROFINISH VALVES PVT LIMITED	INDIA	
6.18.11	SPX VALVES & CONTROLS (FORMERLY DEZURIK)	INDIA	
6.18.12	TRILLIUMFLOW TECHNOLOGIES INDIA PVT LTD	INDIA	Rev.1: Name Change
6.18.13	SAMSONS CONTROLS PVT LTD	INDIA	
6.18.14	TYCO VALVES & CONTROLS	INDIA	
6.18.15	VIRGO VALVES & CONTROLS PVT LTD	INDIA	
6.18.16	DELVAL FLOW CONTROLS PVT LIMITED	INDIA	
6.18.17	FOURESS ENGINEERING (INDIA) LTD.	INDIA	
<b>6.19</b>	<b>SELF ACTUATED PR. CONTROL VALVES</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
6.19.1	ELSTER-INSTROMET INDIA PVT LTD (HONEYWELL)	INDIA	
6.19.2	EMERSON PROCESS MANGMNT CHENNAI PVT. LTD	INDIA	
6.19.3	GE OIL & GAS INDIA PVT LTD	INDIA	Rev.2: Name Update
6.19.4	MIL CONTROLS LIMITED	INDIA	
6.19.5	NIRMAL INDUSTRIAL CONTROL PVT. LTD.	INDIA	
6.19.6	RMG REGEL+MESSTECHNIK GMBH	INDIA	
6.19.7	SAMSON CONTROLS PVT LTD	INDIA	
6.19.8	DRESSER VALVE INDIA PVT LTD	INDIA	
6.19.9	BRAY CONTROLS (I) PVT LTD	INDIA	
6.19.10	DELVAL FLOW CONTROLS PVT LIMITED	INDIA	
<b>6.20</b>	<b>SPECIAL CONTROL VALVES (BUTTERFLY)</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
6.20.1	EMERSON PROCESS MANAGEMENT (INDIA) PRIVATE LIMITED.	INDIA	

6.20.2	FLOWSERVE INDIA CONTROL PVT LTD- BANGALOR	INDIA	
6.20.3	GE OIL & GAS INDIA PVT LTD	INDIA	Rev.2: Name Update
6.20.4	NELES INDIA PVT LTD	INDIA	Rev.1: Name Change
6.20.5	SPX VALVES & CONTROLS (FORMERLY DEZURIK)	INDIA	
6.20.6	WEIR VALVES & CONTROLS UK LTD	INDIA	
6.20.7	SAMSONS CONTROLS PVT LTD	INDIA	
6.20.8	TYCO VALVES & CONTROLS	INDIA	
6.20.9	GE INDIA INDUSTRIAL PVT LTD (DRESSER)	INDIA	
6.20.10	BRAY CONTROLS (I) PVT LTD	INDIA	
6.20.11	DELVAL FLOW CONTROLS PVT LIMITED	INDIA	
6.20.12	FOURESS ENGINEERING (INDIA) LTD.	INDIA	
6.20.13	LARSEN & TOUBRO LIMITED	INDIA	Rev.2: Name Change
6.20.14	INTERVALVE POONAWALA	INDIA	
6.20.15	IPC INDIA LTD.	INDIA	
<b>6.21</b>	<b>DESUPERHEATERS &amp; PRDS</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
6.21.1	ARCA REGLER GMBH	INDIA	
6.21.2	BOMAFSA SPECIAL VALVE SOLUTIONS PVT. LTD.	INDIA	
6.21.3	CCI VALVE TECHNOLOGY AB	INDIA	
6.21.4	CIRCOR FLOW TECHNOLOGIES INDIA PVT LTD	INDIA	
6.21.5	FISHER SANMAR LTD (EMERSON PROCESS MANAGEMENT)	INDIA	
6.21.6	FORBES MARSHALL ARCA P LTD.	INDIA	
6.21.7	H.K. INDUSTRIES	INDIA	
6.21.8	LEPRETFLOW ENGINEERING PVT LTD	INDIA	
6.21.9	MAZDA LTD	INDIA	
6.21.10	TYCO VALVES & CONTROLS INDIA PVT LTD	INDIA	
6.21.11	VENTURI JET PUMPS LTD	INDIA	
6.21.12	YARWAY CORPORATION	INDIA	
6.21.13	INSTRUMENTATION LIMITED	INDIA	Rev.1: Name Change
6.21.14	CHEMROLS INDUSTRIES LTD	INDIA	
6.21.15	SAMSON AG MESS-UND REGELTECHNIK	INDIA	
6.21.16	INDITECH VALVES PVT LIMITED	INDIA	
<b>6.22</b>	<b>PR. REGULATOR &amp; SLAM SHUT VALVES</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
6.22.1	ELSTER-INSTROMET INDIA PVT LTD (HONEYWELL)	INDIA	
6.22.2	NIRMAL INDUSTRIAL CONTROL PVT. LTD.	INDIA	
6.22.3	RMG REGEL+MESSTECHNIK GMBH	INDIA	
<b>6.23</b>	<b>PILOT OPERATED SAFETY VALVES</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
6.23.1	ANDERSON GREENWOOD CROSBY SANMAR LTD	INDIA	
6.23.2	BLISS ANAND PVT LTD	INDIA	
6.23.3	CAMERON LTD. (Group of Schlumberger Ltd)	INDIA	
6.23.4	CURTISS WRIGHT FLOW CONTROL CORPORATION	INDIA	
6.23.5	GE OIL & GAS INDIA PVT LTD	INDIA	Rev.2: Name Update
6.23.6	FAINGER LESER VALVES (P) LTD.	INDIA	
6.23.7	DRESSER INC	INDIA	
6.23.8	ANDERSON GREENWOOD CROSBY	INDIA	
6.23.9	PENTAIR SANMAR LTD.	INDIA	
6.23.10	DARLING MUESCO INDIA PVT LTD	INDIA	

<b>6.24</b>	<b>PROCESS STREAM ANALYSERS (O2-ZIRCONIA)</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
6.24.1	ABB INDIA LIMITED	INDIA	Rev.2: Name Change
6.24.2	EMERSON PROCESS MANAGEMENT (INDIA) PRIVATE LIMITED.	INDIA	
6.24.3	SECO CONTROLS PVT LTD	INDIA	
6.24.4	SERVOMEX GROUP LTD.	INDIA	
6.24.5	YOKOGAWA INDIA LIMITED	INDIA	
6.24.6	GE SENSING EMEA	INDIA	
<b>6.25</b>	<b>GAS CHROMATOGRAPH (PROCESS)</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
6.25.1	ABB INDIA LIMITED	INDIA	Rev.2: Name Change
6.25.2	APPLIED INSTRUMENTS TECHNOLOGIES INC.	INDIA	
6.25.3	ELSTER-INSTROMET INDIA PVT LTD (HONEYWELL)	INDIA	
6.25.4	EMERSON PROCESS MANAGEMENT (INDIA) PRIVATE LIMITED.	INDIA	
6.25.5	YOKOGAWA INDIA LIMITED	INDIA	
6.25.6	SIEMENS AG	INDIA	
<b>6.26</b>	<b>STACK GAS ANALYSER SYSTEMS (EXTRACTIVE)</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
6.26.1	ABB INDIA LIMITED	INDIA	Rev.2: Name Change
6.26.2	EMERSON PROCESS MANAGEMENT (INDIA) PRIVATE LIMITED.	INDIA	
6.26.3	ENVIRONNEMENT S.A.	INDIA	
6.26.4	HORIBA LTD	INDIA	
6.26.5	SERVOMEX GROUP LTD.	INDIA	
6.26.6	THERMO FISHER SCIENTIFIC INDIA PVT. LTD.	INDIA	
6.26.7	YOKOGAWA INDIA LIMITED	INDIA	
6.26.8	CHEMTROLS INDUSTRIES LTD	INDIA	
<b>6.27</b>	<b>AMBIENT AIR ANALYSER SYSTEMS</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
6.27.1	ENVIRONNEMENT S.A.	INDIA	
6.27.2	THERMO FISHER SCIENTIFIC INDIA PVT. LTD.	INDIA	
6.27.3	CHEMTROLS INDUSTRIES LTD	INDIA	
<b>6.28</b>	<b>PROCESS STREAM ANALYSER (IR/UV)</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
6.28.1	ABB INDIA LIMITED	INDIA	Rev.2: Name Change
6.28.2	APPLIED INSTRUMENTS TECHNOLOGIES INC.	INDIA	
6.28.3	EMERSON PROCESS MANAGEMENT (INDIA) PRIVATE LIMITED.	INDIA	
6.28.4	HORIBA LTD	INDIA	
6.28.5	SERVOMEX GROUP LTD.	INDIA	
6.28.6	YOKOGAWA INDIA LIMITED	INDIA	
6.28.7	FORBES MARSHAL PVT LTD	INDIA	
<b>6.29</b>	<b>PROCESS STREAM ANALYSER (H.C.-TCD/FID)</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
6.29.1	ABB INDIA LIMITED	INDIA	Rev.2: Name Change
6.29.2	EMERSON PROCESS MANAGEMENT (INDIA) PRIVATE LIMITED.	INDIA	
6.29.3	FORBES MARSHAL PVT LTD	INDIA	
6.29.4	SIEMENS AG	INDIA	
6.29.5	SICK AG	INDIA	

<b>6.30</b>	<b>ANALYSER SYSTEMS</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
6.30.1	ABB INDIA LIMITED	INDIA	Rev.2: Name Change
6.30.2	APPLIED INSTRUMENTS TECHNOLOGIES INC.	INDIA	
6.30.3	EMERSON PROCESS MANAGEMENT (INDIA) PRIVATE LIMITED.	INDIA	
6.30.4	SERVOMEX GROUP LTD.	INDIA	
6.30.5	SIEMENS AG (ADAGE AUTOMATION PVT. LTD.)	INDIA	
6.30.6	YOKOGAWA INDIA LIMITED	INDIA	
6.30.7	CHEMTROLS INDUSTRIES LTD	INDIA	
6.30.8	FORBES MARSHAL PVT LTD	INDIA	
<b>6.31</b>	<b>STACK GAS ANALYSER SYSTEMS (INSITU)</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
6.31.1	ENVORNMENT SA	INDIA	
6.31.2	FORBES MARSHALL CODEL PVT. LTD.	INDIA	
6.31.3	SERVOMEX GROUP LTD.	INDIA	
6.31.4	TELEDYNE	INDIA	
6.31.5	THERMO FISHER SCIENTIFIC	INDIA	
6.31.6	CHEMTROLS INDUSTRIES LTD	INDIA	
6.31.7	SICK AG	INDIA	
<b>6.32</b>	<b>STACK GAS ANALYSERS (SPM)</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
6.32.1	ENVIRONNEMENT S.A.	INDIA	
6.32.2	FORBES MARSHALL CODEL PVT. LTD.	INDIA	
6.32.3	SERVOMEX GROUP LTD.	INDIA	
6.32.4	THERMO FISHER SCIENTIFIC	INDIA	
6.32.5	DURAG	INDIA	
6.32.6	SICK AG	INDIA	
6.32.7	AMETEK (LAND)	INDIA	
<b>6.33</b>	<b>ORIFICE PLATES &amp; FLANGES</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
6.33.1	BALIGA LIGHTING EQUIPMENTS (P) LIMITED	INDIA	
6.33.2	CAMERON LTD. (Group of Schlumberger Ltd)	INDIA	
6.33.3	COMFIT & VALVES PVT. LTD.	INDIA	
6.33.4	DANIEL MEASUREMENT SOLUTIONS PVT LTD (EMERSON)	INDIA	
6.33.5	EUREKA INDUSTRIAL EQUIPMENTS (P) LTD.	INDIA	
6.33.6	GAUGES BOURDON (I) PVT. LTD. (GEN.INST)	INDIA	
6.33.7	GURU NANAK ENGG WORKS	INDIA	
6.33.8	HYDROPNEUMATICS PVT. LTD.	INDIA	
6.33.9	INSTRUMENTATION LIMITED	INDIA	
6.33.10	MICRO PRECISION PRODUCTS PVT LTD	INDIA	
6.33.11	MINCO (INDIA) PVT LTD (GEN. INST.)	INDIA	
6.33.12	STAR-MECH CONTROLS (INDIA) PVT LTD	INDIA	
<b>6.34</b>	<b>FLOW ELEMENTS : (VENTURI, FLOW NOZZLES)</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
6.34.1	EMERSON PROCESS MANAGEMENT (INDIA) PRIVATE LIMITED.	INDIA	
6.34.2	GAUGES BOURDON (I) PVT. LTD. (GEN.INST)	INDIA	
6.34.3	HYDROPNEUMATICS PVT. LTD.	INDIA	
6.34.4	INSTRUMENTATION LIMITED	INDIA	
6.34.5	MICRO PRECISION PRODUCTS PVT LTD	INDIA	

6.34.6	MINCO (I) FLOW ELEMENT P. LTD. (GIC CO.)	INDIA	
6.34.7	STAR-MECH CONTROLS (INDIA) PVT LTD	INDIA	
6.34.8	MINCO (INDIA) PVT LTD	INDIA	
6.34.9	EUREKA INDUSTRIAL EQUIPMENTS PVT LTD.	INDIA	
<b>6.35</b>	<b>TEMP. ELEMENTS, THERMOWELLS</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
6.35.1	ALTOP INDUSTRIES LTD.	INDIA	
6.35.2	DETRIV INSTRUMENTATION & ELECTRONICS LTD	INDIA	
6.35.3	GAUGES BOURDON (I) PVT LTD (GEN. INST.)	INDIA	
6.35.4	GOA INSTRUMENTS INDUSTRIES PVT. LTD.	INDIA	
6.35.5	PYRO-ELECTRIC INSTRUMENTS GOA PVT LTD	INDIA	
6.35.6	TECHNO INSTRUMENTS	INDIA	
6.35.7	TEMPSENS INSTRUMENTS INDIA PVT LTD	INDIA	
6.35.8	TEMP-TECH	INDIA	
6.35.9	THERMO ELECTRIC CO. INC.	INDIA	
6.35.10	THERMO-COUPLE PRODUCTS CO	INDIA	
6.35.11	THERMAL INSTRUMENTS INDIA PVT. LTD	INDIA	
6.35.12	ABB INDIA LIMITED	INDIA	Rev.2: Name Change
6.35.13	WIKA	INDIA	
<b>6.36</b>	<b>SKIN THERMOCOUPLES</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
6.36.1	BAUMER GROUP	INDIA	
6.36.2	DETRIV INSTRUMENTATION & ELECTRONICS LTD	INDIA	
6.36.3	PYRO-ELECTRIC INSTRUMENTS GOA PVT LTD	INDIA	
6.36.4	TECHNO INSTRUMENTS	INDIA	
6.36.5	THERMO ELECTRIC CO. INC.	INDIA	
6.36.6	THERMO-COUPLE PRODUCTS CO	INDIA	
6.36.7	WIKA INSTRUMENTS INDIA PRIVATE LIMITED.	INDIA	
6.36.8	ABB INDIA LIMITED	INDIA	Rev.2: Name Change
<b>6.37</b>	<b>SPECIAL TEMPERATURE ELEMENTS</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
6.37.1	PYRO-ELECTRIC INSTRUMENTS GOA PVT LTD	INDIA	
6.37.2	THERMO ELECTRIC CO. INC.	INDIA	
6.37.3	THERMO-COUPLE PRODUCTS CO	INDIA	
6.37.4	BAUMER INDIA PVT LTD.	INDIA	
6.37.5	ABB INDIA LIMITED	INDIA	Rev.2: Name Change
<b>6.38</b>	<b>SURGE RELIEF VALVE</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
6.38.1	DANIEL MEASUREMENT SOLUTIONS PVT LTD (EMERSON)	INDIA	
<b>6.39</b>	<b>SPECIAL CONTROL VALVES (PLUG)</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
6.39.1	EMERSON PROCESS MANGMNT CHENNAI PVT. LTD	INDIA	
<b>6.40</b>	<b>SPECIAL CONTROL VALVE ( FLUSH BOTTOM)</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
6.40.1	MICRO PNEUMATICS PVT. LTD.	INDIA	
6.40.2	TECNIK VALVES PVT. LTD.	INDIA	

<b>6.41</b>	<b>WATER QUALITY ANALYSERS (SILICA)</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
6.41.1	FORBES MARSHALL PVT. LTD.- PUNE	INDIA	
6.41.2	HACH COMPANY	INDIA	
6.41.3	HONEYWELL AUTOMATION INDIA LTD.	INDIA	
6.41.4	ENDRESS+HAUSER (INDIA) PRIVATE LIMITED	INDIA	Rev.2: Name Change
6.41.5	ABB INDIA LIMITED	INDIA	Rev.2: Name Change
<b>6.42</b>	<b>WATER QUALITY ANALYSER-DISSOLVED OXYGEN</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
6.42.1	ABB INDIA LIMITED	INDIA	Rev.2: Name Change
6.42.2	EMERSON PROCESS MANAGEMENT (INDIA) PRIVATE LIMITED.	INDIA	
6.42.3	FORBES MARSHALL PVT. LTD.- PUNE	INDIA	
6.42.4	HACH COMPANY	INDIA	
6.42.5	HONEYWELL AUTOMATION INDIA LTD.	INDIA	
6.42.6	METTLER - TOLEDO AG	INDIA	
6.42.7	YOKOGAWA INDIA LIMITED	INDIA	
6.42.8	ENDRESS+HAUSER (INDIA) PRIVATE LIMITED	INDIA	Rev.2: Name Change
6.42.9	INVENSYS	INDIA	
<b>6.43</b>	<b>WATER QUALITY ANALYSER SYSTEMS</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
6.43.1	ABB INDIA LIMITED	INDIA	Rev.2: Name Change
6.43.2	EMERSON PROCESS MANAGEMENT (INDIA) PRIVATE LIMITED.	INDIA	
6.43.3	FORBES MARSHALL PVT. LTD.- PUNE	INDIA	
6.43.4	HONEYWELL AUTOMATION INDIA LTD.	INDIA	
6.43.5	METTLER - TOLEDO AG	INDIA	
6.43.6	YOKOGAWA INDIA LIMITED	INDIA	
6.43.7	ENDRESS+HAUSER (INDIA) PRIVATE LIMITED	INDIA	Rev.2: Name Change
<b>6.44</b>	<b>PROCESS STREAM ANALYSER-MOISTURE/ DEW PT</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
6.44.1	SERVOMEX GROUP LTD.	INDIA	
6.44.2	GE SENSING EMEA	INDIA	
<b>6.45</b>	<b>PROCESS STREAM ANALYSER(PARAMAGNETIC-O2)</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
6.45.1	ABB INDIA LIMITED	INDIA	Rev.2: Name Change
6.45.2	EMERSON PROCESS MANAGEMENT (INDIA) PRIVATE LIMITED.	INDIA	
6.45.3	HORIBA LTD	INDIA	
6.45.4	SERVOMEX GROUP LTD.	INDIA	
6.45.5	YOKOGAWA INDIA LIMITED	INDIA	
6.45.6	GE SENSING EMEA	INDIA	
6.45.7	SIEMENS AG	INDIA	
<b>6.46</b>	<b>WATER QUALITY ANALYSERS (PH)</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
6.46.1	ABB INDIA LIMITED	INDIA	Rev.2: Name Change
6.46.2	EMERSON PROCESS MANAGEMENT (INDIA) PRIVATE LIMITED.	INDIA	
6.46.3	ENDRESS+HAUSER (INDIA) PRIVATE LIMITED	INDIA	Rev.2: Name Change
6.46.4	FORBES MARSHALL PVT. LTD.- PUNE	INDIA	
6.46.5	HACH COMPANY	INDIA	
6.46.6	HONEYWELL AUTOMATION INDIA LTD.	INDIA	

6.46.7	INVENSYS INDIA PRIVATE LIMITED (SCHNEIDER)	INDIA	
6.46.8	METTLER - TOLEDO AG	INDIA	
6.46.9	YOKOGAWA INDIA LIMITED	INDIA	
<b>6.47</b>	<b>PROCESS STREAM ANALYSER(HYDROGEN-TCO)</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
6.47.1	ABB INDIA LIMITED	INDIA	Rev.2: Name Change
6.47.2	EMERSON PROCESS MANAGEMENT (INDIA) PRIVATE LIMITED.	INDIA	
6.47.3	HORIBA LTD	INDIA	
6.47.4	GE SENSING	INDIA	
<b>6.48</b>	<b>PRODUCT QUALITY ANALYSER SYSTEMS</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
6.48.1	ABB INDIA LIMITED	INDIA	Rev.2: Name Change
6.48.2	THERMO FISHER SCIENTIFIC	INDIA	
6.48.3	YOKOGAWA INDIA LIMITED	INDIA	
6.48.4	CHEMTROLS INDUSTRIES LTD	INDIA	
6.48.5	BARTEC GMBH	INDIA	
6.48.6	YOKOGAWA ELECTRIC CORPORATION	INDIA	
<b>6.49</b>	<b>WATER QUALITY ANALYSERS (TURBIDITY)</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
6.49.1	ABB INDIA LIMITED	INDIA	Rev.2: Name Change
6.49.2	EMERSON PROCESS MANAGEMENT (INDIA) PRIVATE LIMITED.	INDIA	
6.49.3	FORBES MARSHALL PVT. LTD.- PUNE	INDIA	
6.49.4	HACH COMPANY	INDIA	
6.49.5	METTLER - TOLEDO AG	INDIA	
6.49.6	YOKOGAWA INDIA LIMITED	INDIA	
6.49.7	ENDRESS+HAUSER (INDIA) PRIVATE LIMITED	INDIA	Rev.2: Name Change
<b>6.50</b>	<b>WATER QUALITY ANALYSERS (CONDUCTIVITY)</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
6.50.1	ABB INDIA LIMITED	INDIA	Rev.2: Name Change
6.50.2	EMERSON PROCESS MANAGEMENT (INDIA) PRIVATE LIMITED.	INDIA	
6.50.3	ENDRESS+HAUSER (INDIA) PRIVATE LIMITED	INDIA	Rev.2: Name Change
6.50.4	FORBES MARSHALL PVT. LTD.- PUNE	INDIA	
6.50.5	HACH COMPANY	INDIA	
6.50.6	HONEYWELL AUTOMATION INDIA LTD.	INDIA	
6.50.7	INVENSYS INDIA PRIVATE LIMITED (SCHNEIDER)	INDIA	
6.50.8	METTLER - TOLEDO AG	INDIA	
6.50.9	YOKOGAWA INDIA LIMITED	INDIA	
<b>6.51</b>	<b>PROCESS STREAM ANALYSER(IR/UV)</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
6.51.1	ABB INDIA LIMITED	INDIA	Rev.2: Name Change
6.51.2	APPLIED INSTRUMENTS TECHNOLOGIES INC.	INDIA	
6.51.3	EMERSON PROCESS MANAGEMENT (INDIA) PRIVATE LIMITED.	INDIA	
6.51.4	HORIBA LTD	INDIA	
6.51.5	SERVOMEX GROUP LTD.	INDIA	
6.51.6	YOKOGAWA INDIA LIMITED	INDIA	
<b>6.52</b>	<b>SO2 ANALYSER</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		



6.52.1	ABB INDIA LIMITED	INDIA	Rev.2: Name Change
6.52.2	YOKOGAWA	INDIA	
<b>6.53</b>	<b>WATER QUALITY ANALYSER-OIL IN H2O TOC/TC</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
6.53.1	ENVIRONMENT SA INDIA PVT LTD	INDIA	
6.53.2	FORBES MARSHALL PVT. LTD.(Old Name: FORBES MARSHALL STEAM SYSTEMS PVT. LTD.)	INDIA	
6.53.3	HACH COMPANY	INDIA	
6.53.4	LAR PROCESS ANALYSERS AG	INDIA	
<b>6.54</b>	<b>WATER QUALITY ANALYSER-OIL IN H2O DISLVD</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
6.54.1	FORBES MARSHALL PVT. LTD.- PUNE	INDIA	
<b>6.55</b>	<b>WATER QUALITY ANALYSERS(CHLORINE)</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
6.55.1	ABB INDIA LIMITED	INDIA	Rev.2: Name Change
6.55.2	EMERSON PROCESS MANAGEMENT (INDIA) PRIVATE LIMITED.	INDIA	
6.55.3	HACH COMPANY	INDIA	
6.55.4	YOKOGAWA INDIA LIMITED	INDIA	
6.55.5	ENDRESS+HAUSER (INDIA) PRIVATE LIMITED	INDIA	Rev.2: Name Change
<b>6.56</b>	<b>FLOW ELEMENTS-WEDGE TYPE</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
6.56.1	ABB INDIA LIMITED	INDIA	Rev.2: Name Change
6.56.2	MICRO PRECISION PRODUCTS PVT LTD	INDIA	
<b>6.57</b>	<b>GAS DETECTION SYSTEMS</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
6.57.1	DETECTOR ELECTRONICS CORP.(KIDDE CO.)	INDIA	
6.57.2	DRAGER SAFETY AG & CO.	INDIA	
6.57.3	EMERSON PROCESS MANAGEMENT (INDIA) PRIVATE LIMITED.	INDIA	
6.57.4	HONEYWELL ANALYTICS	INDIA	
6.57.5	INDUSTRIAL SCIENTIFIC OLDHAM	INDIA	
6.57.6	MINE SAFETY APPLIANCES COMPANY	INDIA	
6.57.7	NET SAFETY MONITORING INC	INDIA	
6.57.8	RESPO PRODUCTS	INDIA	
6.57.9	ESP SAFETY PVT. LTD.	INDIA	
6.57.10	CHEMTROLS INDUSTRIES LTD	INDIA	
6.57.11	DETECTION INSTRUMENTS INDIA	INDIA	
<b>6.58</b>	<b>FIRE &amp; GAS DETECTION SYSTEMS</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
6.58.1	DETECTOR ELECTRONICS CORP.(KIDDE CO.)	INDIA	
6.58.2	EMERSON PROCESS MANAGEMENT (INDIA) PRIVATE LIMITED.	INDIA	
6.58.3	HONEYWELL AUTOMATION INDIA LTD.	INDIA	
6.58.4	MINE SAFETY APPLIANCES COMPANY	INDIA	
6.58.5	NET SAFETY MONITORING INC	INDIA	
6.58.6	YOKOGAWA INDIA LIMITED	INDIA	
<b>6.59</b>	<b>PRODUCT QUALITY ANALYSERS (NIR)</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
6.59.1	ABB INDIA LIMITED	INDIA	Rev.2: Name Change

6.59.2	APPLIED INSTRUMENTS TECHNOLOGIES INC.	INDIA	
6.59.3	BARTEC GMBH	INDIA	
6.59.4	YOKOGAWA INDIA LIMITED	INDIA	
<b>6.60</b>	<b>PRODUCT QUALITY ANALYSERS (VISCOSITY)</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
6.60.1	ABB INDIA LIMITED	INDIA	Rev.2: Name Change
6.60.2	EMERSON PROCESS MANAGEMENT (INDIA) PRIVATE LIMITED.	INDIA	
<b>6.61</b>	<b>PRODUCT QUALITY ANALYSERS (DENSITY)</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
6.61.1	MOBREY LTD	INDIA	
6.61.2	THERMO FISHER SCIENTIFIC	INDIA	
<b>6.62</b>	<b>PRODUCT QUALITY ANALYSERS (FLASH POINT)</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
6.62.1	ABB INDIA LIMITED	INDIA	Rev.2: Name Change
6.62.2	EMERSON PROCESS MANAGEMENT (INDIA) PRIVATE LIMITED.	INDIA	
6.62.3	BARTEC GMBH	INDIA	
<b>6.63</b>	<b>PRODUCT QUALITY ANALYSERS (DISTILLATION)</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
6.63.1	ABB INDIA LIMITED	INDIA	Rev.2: Name Change
<b>6.64</b>	<b>PRODUCT QUALITY ANALYSER (SULPHUR)</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
6.64.1	ABB INDIA LIMITED	INDIA	Rev.2: Name Change
6.64.2	THERMO FISHER SCIENTIFIC INDIA PVT. LTD.	INDIA	
<b>6.65</b>	<b>STACK GAS ANALYSERS (O2-ZIRCONIA) + CO + CO2</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
6.65.1	ABB INDIA LIMITED	INDIA	Rev.2: Name Change
6.65.2	EMERSON PROCESS MANAGEMENT (INDIA) PRIVATE LIMITED.	INDIA	
6.65.3	SERVOMEX GROUP LTD.	INDIA	
6.65.4	YOKOGAWA INDIA LIMITED	INDIA	
6.65.5	GE SENSING EMEA	INDIA	
<b>6.66</b>	<b>ANALYSER-DENSITY/SP. GRAVITY (NUCLEONIC)</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
6.66.1	BERTHOLD TECHNOLOGIES GMBH & CO.KG	INDIA	
6.66.2	ENDRESS+HAUSER (INDIA) PRIVATE LIMITED	INDIA	Rev.2: Name Change
6.66.3	OHMART/VEGA CORPORATION	INDIA	
6.66.4	THERMO FISHER SCIENTIFIC	INDIA	
<b>6.67</b>	<b>ANALYSER-DENSITY/SP GRAVITY (VIB CYLINDR)</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
6.67.1	EMERSON PROCESS MANAGEMENT (INDIA) PRIVATE LIMITED.	INDIA	
6.67.2	MOBREY LTD	INDIA	
6.67.3	THERMO FISHER SCIENTIFIC	INDIA	
<b>6.68</b>	<b>ANALYSER-DENSITY/SP GRAVITY (CORIOLIS)</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
6.68.1	KROHNE MARSHALL PVT. LTD	INDIA	

6.68.2	YOKOGAWA INDIA LIMITED	INDIA	
6.68.3	ENDRESS+HAUSER (INDIA) PRIVATE LIMITED	INDIA	Rev.2: Name Change
6.68.4	EMERSON PROCESS MANAGEMENT (INDIA) PRIVATE LIMITED.	INDIA	
6.68.5	ENDRESS+HAUSER (INDIA) PRIVATE LIMITED	INDIA	Rev.2: Name Change
<b>6.69</b>	<b>AUTOMATIC LIQUID SAMPLER</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
6.69.1	CAMERON LTD. (Group of Schlumberger Ltd)	INDIA	
6.69.2	DOPAK ( SPIRARE ENERGY)	INDIA	
<b>6.70</b>	<b>WOBBE METERS</b>		
<b>6.71</b>	<b>PROGRAMMABLE LOGIC CONTROLLERS (DMR)</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
6.71.1	ABB INDIA LIMITED	INDIA	Rev.2: Name Change
6.71.2	GE INTELLIGENT PLATFORMS PVT LTD	INDIA	
6.71.3	HONEYWELL AUTOMATION INDIA LTD.	INDIA	
6.71.4	INVENSYS SOFTWARE SYSTEMS (S) PTE LTD (SCHNEIDER)	INDIA	
6.71.5	LARSEN & TOUBRO LIMITED	INDIA	Rev.2: Name Change
6.71.6	ROCKWELL AUTOMATION INDIA PVT LTD	INDIA	
6.71.7	SIEMENS LTD - NASHIK	INDIA	
6.71.8	YOKOGAWA INDIA LTD	INDIA	
6.71.9	GE-FANUC AUTOMATION	INDIA	
<b>6.72</b>	<b>PROGRAMMABLE LOGIC CONTROLLERS (TMR/QMR, SIL3 CERTIFIED)</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
6.72.1	ABB INDIA LIMITED	INDIA	Rev.2: Name Change
6.72.2	EMERSON PROCESS MANAGEMENT (INDIA) PRIVATE LIMITED.	INDIA	
6.72.3	HONEYWELL AUTOMATION INDIA LTD.	INDIA	
6.72.4	INVENSYS SOFTWARE SYSTEMS (S) PTE LTD (SCHNEIDER)	INDIA	
6.72.5	ROCKWELL AUTOMATION INDIA PVT LTD	INDIA	
6.72.6	YOKOGAWA INDIA LIMITED	INDIA	
6.72.7	ICS TRIPLEX (EMEA) PLC	INDIA	
<b>6.73</b>	<b>PRESSURE GAUGES</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
6.73.1	AN INSTRUMENTS PVT LTD	INDIA	
6.73.2	BAUMER TECHNOLOGIES INDIA PVT.LTD	INDIA	
6.73.3	GAUGES BOURDON (I) PVT. LTD. (GEN.INST)	INDIA	
6.73.4	GOA INSTRUMENTS INDUSTRIES PVT. LTD.	INDIA	
6.73.5	H GURU INSTRUMENTS(SOUTH INDIA)PVT. LTD	INDIA	
6.73.6	H.GURU INDUSTRIES	INDIA	
6.73.7	MANOMETER (INDIA) PVT. LTD.	INDIA	
6.73.8	Precision Mass Products Pvt. Ltd. (Old name: ASHCROFT INDIA PVT LTD)	INDIA	
6.73.9	WALCHANDNAGAR INDUSTRIES LTD(TIWAC DIVN)	INDIA	
6.73.10	WIKA INSTRUMENTS INDIA PVT LTD	INDIA	
6.73.11	BAUMER BOURDON HAENNI SAS	INDIA	
6.73.12	MASS PRODUCTS PVT. LTD	INDIA	
6.73.13	BAUMER INDIA PVT LTD.	INDIA	
<b>6.74</b>	<b>DRAFT GAUGES</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
6.74.1	AN INSTRUMENTS PVT LTD	INDIA	

6.74.2	GAUGES BOURDON (I) PVT. LTD. (GEN.INST)	INDIA	
6.74.3	SWITZER PROCESS INSTRUMENTS PVT. LTD.	INDIA	
6.74.4	WIKA	INDIA	
<b>6.75</b>	<b>DIFFERENTIAL PRESSURE GAUGES</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
6.75.1	AN INSTRUMENTS PVT LTD	INDIA	
6.75.2	BAUMER TECHNOLOGIES INDIA PVT.LTD	INDIA	
6.75.3	GAUGES BOURDON (I) PVT. LTD. (GEN.INST)	INDIA	
6.75.4	HIRLEKAR PRECISION ENGINEERING PVT LTD	INDIA	
6.75.5	SWITZER PROCESS INSTRUMENTS PVT. LTD.	INDIA	
6.75.6	WIKA INSTRUMENTS INDIA PVT LTD	INDIA	
6.75.7	HONEYWELL	INDIA	
6.75.8	SAMSONS CONTROLS PVT LTD	INDIA	
<b>6.76</b>	<b>TEMP.GAUGES(BI METALLIC,FILLED SYSTEM)</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
6.76.1	AN INSTRUMENTS PVT LTD	INDIA	
6.76.2	Precision Mass Products Pvt. Ltd. (Old name: ASHCROFT INDIA PVT LTD)	INDIA	
6.76.3	BAUMER TECHNOLOGIES INDIA PVT.LTD	INDIA	
6.76.4	GAUGES BOURDON (I) PVT. LTD. (GEN.INST)	INDIA	
6.76.5	GOA INSTRUMENTS INDUSTRIES PVT. LTD.	INDIA	
6.76.6	H GURU INSTRUMENTS(SOUTH INDIA)PVT. LTD	INDIA	
6.76.7	H.GURU INDUSTRIES	INDIA	
6.76.8	WALCHANDNAGAR INDUSTRIES LTD(TIWAC DIVN)	INDIA	
6.76.9	WIKA INSTRUMENTS INDIA PVT LTD	INDIA	
6.76.10	BAUMER BOURDON HAENNI SAS	INDIA	
6.76.11	THERMAL INSTRUMENTS INDIA PVT LTD	INDIA	
<b>6.77</b>	<b>VARIABLE AREA FLOW METERS(I,T)</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
6.77.1	ABB INDIA LIMITED	INDIA	Rev.2: Name Change
6.77.2	ALFLOW GLASS EQUIPMENTS	INDIA	
6.77.3	BROOKS INSTRUMENT	INDIA	
6.77.4	EUREKA INDUSTRIAL EQUIPMENTS (P) LTD.	INDIA	
6.77.5	HEINRICHS MESSTECHNIK GMBH	INDIA	
6.77.6	INSTRUMENTATION ENGINEERS PVT. LTD.	INDIA	
6.77.7	KROHNE MARSHALL PVT. LTD	INDIA	
6.77.8	PLACKA INSTRUMENTS INDIA P LTD	INDIA	
6.77.9	YOKOGAWA INDIA LIMITED	INDIA	
6.77.10	EMERSON PROCESS MANAGEMENT (INDIA) PRIVATE LIMITED.	INDIA	
6.77.11	ROTA YOKOGAWA GMBH & CO. KG	INDIA	Rev.2: Deleted
6.77.12	CHEMTROLS INDUSTRIES LTD	INDIA	
<b>6.78</b>	<b>MAGNETIC FLOW METERS</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
6.78.1	ABB INDIA LIMITED	INDIA	Rev.2: Name Change
6.78.2	EMERSON PROCESS MANAGEMENT (INDIA) PRIVATE LIMITED.	INDIA	
6.78.3	ENDRESS+HAUSER (INDIA) PRIVATE LIMITED	INDIA	Rev.2: Name Change
6.78.4	INSTRUMENTATION ENGINEERS PVT. LTD.	INDIA	
6.78.5	KROHNE MARSHALL PVT. LTD	INDIA	
6.78.6	YOKOGAWA INDIA LIMITED	INDIA	
6.78.7	ENDRESS+HAUSER (INDIA) PRIVATE LIMITED	INDIA	Rev.2: Name Change

<b>6.79</b>	<b>TERMINAL AUTOMATION SYSTEM</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
6.79.1	ADVANCED SYSTEK PVT LTD.	INDIA	
6.79.2	EMERSON PROCESS MANAGEMENT (INDIA) PRIVATE LIMITED.	INDIA	
6.79.3	HONEYWELL AUTOMATION INDIA LTD.	INDIA	
6.79.4	SCHNEIDER ELECTRIC INDIA PRIVATE LIMITED-MAHAPE	INDIA	Rev.2: Name Change
6.79.5	CHEMTROLS INDUSTRIES LTD	INDIA	
6.79.6	CHEMTROLS SAMIL (INDIA) PVT LTD (Old Name: CHEMTROLS INDUSTRIES LTD)	INDIA	
<b>6.80</b>	<b>POSITIVE DISPLACEMENT METERS</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
6.80.1	CAMERON LTD. (Group of Schlumberger Ltd)	INDIA	
6.80.2	IDEX FLUID & METERING P.LTD	INDIA	
6.80.3	TELTECH INSTRUMENTATION PVT.LTD.	INDIA	
6.80.4	TOSHNIWAL HYVAC PVT. LTD.	INDIA	
<b>6.81</b>	<b>ULTRASONIC FLOW METER</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
6.81.1	CAMERON LTD. (Group of Schlumberger Ltd)	INDIA	
6.81.2	DANIEL MEASUREMENT SOLUTIONS PVT LTD (EMERSON)	INDIA	
6.81.3	ELSTER-INSTROMET INDIA PVT LTD (HONEYWELL)	INDIA	
6.81.4	ENDRESS+HAUSER (INDIA) PRIVATE LIMITED	INDIA	Rev.2: Name Change
6.81.5	KROHNE MARSHALL PVT. LTD	INDIA	
6.81.6	RMG REGEL+MESSTECHNIK GMBH	INDIA	
6.81.7	SICK AG	INDIA	
6.81.8	THERMO FISHER SCIENTIFIC	INDIA	
6.81.9	GE INDIA INDUSTRIAL PVT LTD	INDIA	
6.81.10	ENDRESS+HAUSER (INDIA) PRIVATE LIMITED	INDIA	Rev.2: Name Change
<b>6.82</b>	<b>VORTEX FLOW METER</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
6.82.1	ABB INDIA LIMITED	INDIA	Rev.2: Name Change
6.82.2	EMERSON PROCESS MANAGEMENT (INDIA) PRIVATE LIMITED.	INDIA	
6.82.3	ENDRESS+HAUSER (INDIA) PRIVATE LIMITED	INDIA	Rev.2: Name Change
6.82.4	KROHNE MARSHALL PVT. LTD	INDIA	
6.82.5	RMG REGEL+MESSTECHNIK GMBH	INDIA	
6.82.6	ENDRESS+HAUSER (INDIA) PRIVATE LIMITED	INDIA	Rev.2: Name Change
6.82.7	YOKOGAWA INDIA LTD	INDIA	
<b>6.83</b>	<b>TURBINE FLOW METERS</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
6.83.1	CAMERON LTD. (Group of Schlumberger Ltd)	INDIA	
6.83.2	DANIEL MEASUREMENT SOLUTIONS PVT LTD (EMERSON)	INDIA	
6.83.3	ELSTER-INSTROMET INDIA PVT LTD (HONEYWELL)	INDIA	
6.83.4	RMG REGEL+MESSTECHNIK GMBH	INDIA	
6.83.5	ROCKWIN FLOWMETER INDIA (P) LTD	INDIA	
6.83.6	THERMO FISHER SCIENTIFIC	INDIA	
<b>6.84</b>	<b>MASS FLOW METERS</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
6.84.1	ABB INDIA LIMITED	INDIA	Rev.2: Name Change
6.84.2	BROOKS INSTRUMENT	INDIA	

6.84.3	EMERSON PROCESS MANAGEMENT (INDIA) PRIVATE LIMITED.	INDIA	
6.84.4	ENDRESS+HAUSER (INDIA) PRIVATE LIMITED	INDIA	Rev.2: Name Change
6.84.5	KROHNE MARSHALL PVT. LTD	INDIA	
6.84.6	KURZ INSTRUMENTS INC	INDIA	
6.84.7	LAMTECH SOLUTION LLP	INDIA	Rev.2: Name Change
6.84.8	ROCKWIN FLOWMETER INDIA PRIVATE LIMITED	INDIA	Rev.2: Name Change
6.84.9	YOKOGAWA INDIA LIMITED	INDIA	
6.84.10	ROTA YOKOGAWA GMBH & CO. KG	INDIA	Rev.2: Deleted
6.84.11	ENDRESS+HAUSER (INDIA) PRIVATE LIMITED	INDIA	Rev.2: Name Change
<b>6.85</b>	<b>GAUGE GLASSES &amp; COCKS</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
6.85.1	BLISS ANAND PVT LTD	INDIA	
6.85.2	CESARE BONNETTI S.P.A.	INDIA	
6.85.3	CHEMTROLS SAMIL (INDIA) PVT LTD	INDIA	
6.85.4	GAUGES BOURDON (I) PVT LTD (GEN. INST.)	INDIA	
6.85.5	LEVCON INSTRUMENTS PVT LTD	INDIA	
6.85.6	NISAN SCIENTIFIC PROCESS EQUIP. P LTD	INDIA	
6.85.7	PRATOLINA INSTRUMENTS PVT LTD	INDIA	
6.85.8	PUNE TECHTROL PVT LTD	INDIA	
6.85.9	SIGMA INSTRUMENTS CO	INDIA	
6.85.10	ASIAN INDUSTRIAL VALVES & INSTRUMENTS	INDIA	
6.85.11	TECHNOMATIC INDIA PVT LTD	INDIA	
<b>6.86</b>	<b>DRUM LEVEL INSTRUMENTS (ELECTRONIC)</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
6.86.1	CESARE BONNETTI S.P.A.	INDIA	
6.86.2	MOBREY LTD	INDIA	
6.86.3	YARWAY CORPORATION	INDIA	
6.86.4	CESARE BONNETTI INDIA PVT LTD	INDIA	
<b>6.87</b>	<b>DRUM LEVEL INSTRUMENTS (BI-COLOUR GAUGE)</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
6.87.1	CESARE BONNETTI S.P.A.	INDIA	
6.87.2	CESARE BONNETTI INDIA PVT LTD	INDIA	
<b>6.88</b>	<b>TANK LEVEL INSTRUMENTS (FLOAT OPERATED)</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
6.88.1	ENDRESS+HAUSER (INDIA) PRIVATE LIMITED	INDIA	Rev.2: Name Change
6.88.2	ENRAF B.V. (GR. COMPANY OF HONEYWELL)	INDIA	
6.88.3	NIVO CONTROLS PVT LTD	INDIA	
6.88.4	SBEM PVT LTD	INDIA	
6.88.5	SIGMA INSTRUMENTS CO	INDIA	
6.88.6	EMERSON PROCESS MANAGEMENT (INDIA) PRIVATE LIMITED.	INDIA	
<b>6.89</b>	<b>MAGNETIC LEVEL INSTRUMENTS</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
6.89.1	ABB INDIA LIMITED	INDIA	Rev.2: Name Change
6.89.2	BLISS ANAND PVT LTD	INDIA	
6.89.3	CESARE BONNETTI S.P.A.	INDIA	
6.89.4	GAUGES BOURDON (I) PVT LTD (GEN. INST.)	INDIA	
6.89.5	KROHNE MARSHALL PVT. LTD	INDIA	
6.89.6	LEVCON INSTRUMENTS PVT LTD	INDIA	

6.89.7	LAMTECH SOLUTION LLP	INDIA	Rev.2: Name Change
6.89.8	PRATOLINA INSTRUMENTS PVT LTD	INDIA	
6.89.9	PUNE TECHTROL PVT LTD	INDIA	
6.89.10	SHRIDHAN AUTOMATION PVT LTD	INDIA	
6.89.11	SIGMA INSTRUMENTS CO	INDIA	
6.89.12	CHEMTROLS INDUSTRIES LTD	INDIA	
6.89.13	CHEMTROLS SAMIL (INDIA) PVT LTD (Old Name: CHEMTROLS INDUSTRIES LTD)	INDIA	
6.89.14	TECHNOMATIC INDIA PVT LTD	INDIA	
6.89.15	VEGA GRIESHABER KG	INDIA	
6.89.16	CESARE BONNETTI INDIA PVT LTD	INDIA	
<b>6.90</b>	<b>SPL. LEVEL INSTRUMENTS-GUIDED WAVE RADAR</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
6.90.1	ABB INDIA LIMITED	INDIA	Rev.2: Name Change
6.90.2	EMERSON PROCESS MANAGEMENT (INDIA) PRIVATE LIMITED.	INDIA	
6.90.3	ENDRESS+HAUSER (INDIA) PRIVATE LIMITED	INDIA	Rev.2: Name Change
6.90.4	KROHNE MARSHALL PVT. LTD	INDIA	
6.90.5	LAMTECH SOLUTION LLP	INDIA	Rev.2: Name Change
6.90.6	VEGA GRIESHABER KG	INDIA	
<b>6.91</b>	<b>TANK FARM MANAGEMENT SYSTEM</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
6.91.1	ENDRESS+HAUSER (INDIA) PRIVATE LIMITED	INDIA	Rev.2: Name Change
6.91.2	ENRAF B.V. (GR. COMPANY OF HONEYWELL)	INDIA	
6.91.3	ROSEMOUNT TANK RADAR AB (EMERSON PROCESS MANAGEMENT)	INDIA	
6.91.4	SBEM PVT LTD	INDIA	
6.91.5	VEGA GRIESHABER KG	INDIA	
6.91.6	ENDRESS+HAUSER (INDIA) PRIVATE LIMITED	INDIA	Rev.2: Name Change
<b>6.92</b>	<b>TANK LEVEL INSTRUMENT (SERVO TYPE)</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
6.92.1	ENDRESS+HAUSER (INDIA) PRIVATE LIMITED	INDIA	Rev.2: Name Change
6.92.2	ENRAF B.V. (GR. COMPANY OF HONEYWELL)	INDIA	
6.92.3	SBEM PVT LTD	INDIA	
6.92.4	ENDRESS+HAUSER (INDIA) PRIVATE LIMITED	INDIA	Rev.2: Name Change
<b>6.93</b>	<b>SPECIAL LEVEL INSTRUMENTS (RF TYPE)</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
6.93.1	ABB INDIA LIMITED	INDIA	Rev.2: Name Change
6.93.2	AMETEK DREXELBROOK	INDIA	
6.93.3	ENDRESS+HAUSER (INDIA) PRIVATE LIMITED	INDIA	Rev.2: Name Change
6.93.4	LAMTECH SOLUTION LLP	INDIA	Rev.2: Name Change
6.93.5	MOBREY LTD	INDIA	
<b>6.94</b>	<b>SPECIAL LEVEL INSTRUMENTS (CAP.&amp; COND.)</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
6.94.1	AMETEK DREXELBROOK	INDIA	
6.94.2	ENDRESS+HAUSER (INDIA) PRIVATE LIMITED	INDIA	Rev.2: Name Change
6.94.3	LAMTECH SOLUTION LLP	INDIA	Rev.2: Name Change
6.94.4	MOBREY LTD	INDIA	
6.94.5	SBEM PVT LTD	INDIA	
6.94.6	VEGA GRIESHABER KG	INDIA	
6.94.7	YARWAY CORPORATION	INDIA	

6.94.8	SAPCON INSTRUMENTS PVT. LIMITED	INDIA	
<b>6.95</b>	<b>NUCLEONIC LEVEL INSTRUMENTS</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
6.95.1	ENDRESS+HAUSER (INDIA) PRIVATE LIMITED	INDIA	Rev.2: Name Change
6.95.2	THERMO FISHER SCIENTIFIC	INDIA	
6.95.3	TRACERCO LTD	INDIA	
<b>6.96</b>	<b>CLOSED CIRCUIT TV</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
6.96.1	COMMTEL NETWORKS PVT LTD	INDIA	
6.96.2	ELECTRONIC CORPORATION OF INDIA LTD.	INDIA	
6.96.3	HONEYWELL AUTOMATION INDIA LTD.	INDIA	
6.96.4	NELCO LTD	INDIA	
6.96.5	PELCO	INDIA	
6.96.6	PHILIPS	INDIA	
6.96.7	SECURITY VISION	INDIA	
6.96.8	TRANSIT ELECTRONICS PVT. LTD.	INDIA	
6.96.9	DATALESS INFORMATION TECHNOLOGIES LTD	INDIA	
<b>6.97</b>	<b>FIELD INSTRUMENTS/TRANSMITTERS (P,DP,F,L,T,TD)</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
6.97.1	ABB INDIA LIMITED	INDIA	Rev.2: Name Change
6.97.2	EMERSON PROCESS MANAGEMENT (INDIA) PRIVATE LIMITED.	INDIA	
6.97.3	ENDRESS+HAUSER (INDIA) PRIVATE LIMITED	INDIA	Rev.2: Name Change
6.97.4	FUJI ELECTRIC SYSTEMS CO. LTD/FUJI ELECTRIC INDIA PVT LTD	INDIA	
6.97.5	INVENSYS INDIA PRIVATE LIMITED	INDIA	
6.97.6	YOKOGAWA INDIA LIMITED	INDIA	
6.97.7	HONEYWELL AUTOMATION INDIA LIMITED	INDIA	
6.97.8	ENDRESS+HAUSER (INDIA) PRIVATE LIMITED	INDIA	Rev.2: Name Change
6.97.9	SCHNEIDER ELECTRIC SYSTEMS INDIA PRIVATE LIMITED	INDIA	
6.97.10	ABB INDIA LIMITED	INDIA	Rev.2: Deleted
<b>6.98</b>	<b>TANK LEVEL INSTRUMENT (RADAR,ULTRASONIC)</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
6.98.1	EMERSON PROCESS MANAGEMENT (INDIA) PRIVATE LIMITED.	INDIA	
6.98.2	ENDRESS+HAUSER (INDIA) PRIVATE LIMITED	INDIA	Rev.2: Name Change
6.98.3	ENRAF B.V. (GR. COMPANY OF HONEYWELL)	INDIA	
6.98.4	KROHNE MARSHALL PVT. LTD	INDIA	
6.98.5	LAMTECH SOLUTION LLP	INDIA	Rev.2: Name Change
6.98.6	MOBREY LTD	INDIA	
6.98.7	ROSEMOUNT TANK RADAR AB (EMERSON PROCESS MANAGEMENT)	INDIA	
6.98.8	SIEMENS AG	INDIA	
6.98.9	VEGA GRIESHABER KG	INDIA	
6.98.10	VEGA INDIA LEVEL AND PRESSURE MEASUREMENT PVT LTD	INDIA	
6.98.11	HONEYWELL AUTOMATION	INDIA	
<b>6.99</b>	<b>SPEED TANSMITTERS</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
6.99.1	ASEA BROWN BOVERY LTD (ABB LTD)	INDIA	
6.99.2	HANS TURCK GMBH & CO. KG	INDIA	
6.99.3	PEPPERL + FUCHS GMBH	INDIA	



<b>6.100</b>	<b>CONTROL PANEL &amp; ACCESSORIES</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
6.100.1	ACCUSONIC CONTROLS PVT LTD	INDIA	
6.100.2	CONTROL SYSTEMS ENGINEERS	INDIA	
6.100.3	ELECTRONIC CORPORATION OF INDIA LTD.	INDIA	
6.100.4	ELECTRONIC INSTRMNTATION & CONTROL P LTD	INDIA	
6.100.5	INDUSTRIAL CONTROLS & APPLIANCES PVT LTD	INDIA	
6.100.6	INSTRUMENTATION LIMITED	INDIA	
6.100.7	IRIS AUTOMATION PVT LTD	INDIA	
6.100.8	POSITRONICS PVT LTD	INDIA	
6.100.9	PRIMA AUTOMATION INDIA PVT LTD	INDIA	
6.100.10	PYROTECH ELECTRONICS PVT LTD	INDIA	
6.100.11	RADHA KRISHNA CONTROLS	INDIA	
<b>6.101</b>	<b>PREFABRICATED INSTRUMENT HOOKUPS</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
6.101.1	ASTEC VALVES & FITTINGS PVT. LTD.	INDIA	
6.101.2	COMFIT & VALVES PVT. LTD.	INDIA	
6.101.3	EMERSON PROCESS MANAGEMENT (INDIA) PRIVATE LIMITED.	INDIA	
6.101.4	FLUID CONTROLS PVT LTD	INDIA	
6.101.5	HONEYWELL AUTOMATION INDIA LTD.	INDIA	
<b>6.102</b>	<b>SP. CONTROL VALVE ( KNIFE GATE)</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
6.102.1	ORBINOX INDIA PVT. LTD	INDIA	
6.102.2	PENTAIR VALVES & CONTROLS INDIA PVT LTD	INDIA	
6.102.3	DRESSER VALVES	INDIA	
6.102.4	EMERSON PROCESS MANAGEMENT (INDIA) PRIVATE LIMITED.	INDIA	
6.102.5	VELAN ENGINEERING	INDIA	
<b>6.103</b>	<b>FIRE PROTECTION SYSTEM (VALVES &amp; ACC.)</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
6.103.1	MBM AUTOMATION AND ROBOTICS	INDIA	
6.103.2	SUMMIT TECHNODYNE PVT. LTD.	INDIA	
<b>6.104</b>	<b>ANALYSER-DENSITY/SP.GRAVITY(V.CYLNDR,CORLIS)</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
6.104.1	EMERSON PROCESS MANAGEMENT (INDIA) PRIVATE LIMITED.	INDIA	
6.104.2	ENDRESS+HAUSER (INDIA) PRIVATE LIMITED	INDIA	Rev.2: Name Change
6.104.3	KROHNE MARSHALL PVT. LTD	INDIA	
6.104.4	MOBREY LTD	INDIA	
6.104.5	THERMO FISHER SCIENTIFIC	INDIA	
6.104.6	YOKOGAWA INDIA LIMITED	INDIA	
<b>6.105</b>	<b>ANALYSER (AIR DEMAND/TOTAL SULPHUR)</b>		
<b>6.106</b>	<b>AVERAGING PITOT TUBES</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
6.106.1	EMERSON PROCESS MANAGEMENT (INDIA) PRIVATE LIMITED.	INDIA	
6.106.2	MICRO PRECISION PRODUCTS PVT LTD	INDIA	
6.106.3	MINCO (INDIA) PVT LTD (GEN. INST.)	INDIA	
6.106.4	STAR-MECH CONTROLS (INDIA) PVT LTD	INDIA	
6.106.5	THERMO FISHER SCIENTIFIC	INDIA	

6.106.6	VERIS INC.	INDIA	
<b>6.107</b>	<b>ANALYSERS (HYDROGEN SULPHIDE)</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
6.107.1	AMETEK	INDIA	
6.107.2	SICK AG	INDIA	
6.107.3	THERMO FISHER SCIENTIFIC	INDIA	
<b>6.108</b>	<b>VISCOSITY METER</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
6.108.1	MOBREY LTD	INDIA	
6.108.2	ABB INDIA LIMITED	INDIA	Rev.2: Name Change
6.108.3	EMERSON PROCESS MANAGEMENT (INDIA) PRIVATE LIMITED.	INDIA	
6.108.4	PAC LP	INDIA	
6.108.5	AMETEK INSTRUMENTS INDIA PVT. LTD.	INDIA	
<b>6.109</b>	<b>RUPTURE DISCS</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
6.109.1	BS & B SAFETY SYSTEMS (INDIA) LTD	INDIA	
6.109.2	FIKE CORPORATION-USA	INDIA	
<b>6.110</b>	<b>METER PROVERS</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
6.110.1	DANIEL MEASUREMENT SOLUTIONS PVT LTD (EMERSON)	INDIA	
6.110.2	EMC MEASUREMENT SOLUTION	INDIA	
<b>6.111</b>	<b>GAS PRESSURE REDUCING SKIDS</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
6.111.1	AUTOMETERS ENERGITEC LIMITED	INDIA	
6.111.2	DANIEL MEASUREMENT SOLUTIONS PVT LTD (EMERSON)	INDIA	
6.111.3	ELSTER-INSTROMET INDIA PVT LTD (HONEYWELL)	INDIA	
6.111.4	MULTITEX FILTRATION ENGINEERS LTD.	INDIA	
6.111.5	NIRMAL INDUSTRIAL CONTROL PVT. LTD.	INDIA	
6.111.6	RMG REGEL+MESSTECHNIK GMBH	INDIA	
6.111.7	ROCKWIN FLOWMETER INDIA (P) LTD	INDIA	
6.111.8	CHEMTROLS INDUSTRIES LTD	INDIA	
<b>6.112</b>	<b>GAS METERING SYSTEM (ULTRASONIC)</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
6.112.1	DANIEL MEASUREMENT SOLUTIONS PVT LTD (EMERSON)	INDIA	
6.112.2	ELSTER-INSTROMET INDIA PVT LTD (HONEYWELL)	INDIA	
6.112.3	NIRMAL INDUSTRIAL CONTROL PVT. LTD.	INDIA	
6.112.4	RMG REGEL+MESSTECHNIK GMBH	INDIA	
6.112.5	CHEMTROLS INDUSTRIES LTD	INDIA	
<b>6.113</b>	<b>GAS METERING SYSTEM (TURBINE)</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
6.113.1	AUTOMETERS ENERGITEC LIMITED	INDIA	
6.113.2	DANIEL MEASUREMENT SOLUTIONS PVT LTD (EMERSON)	INDIA	
6.113.3	ELSTER-INSTROMET INDIA PVT LTD (HONEYWELL)	INDIA	
6.113.4	NIRMAL INDUSTRIAL CONTROL PVT. LTD.	INDIA	
6.113.5	RMG REGEL+MESSTECHNIK GMBH	INDIA	
6.113.6	ROCKWIN FLOWMETER INDIA (P) LTD	INDIA	

6.113.7	CHEMTROLS INDUSTRIES LTD	INDIA	
<b>6.114</b>	<b>GAS METERING SYSTEM -DUAL CHAMBR ORIFICE</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
6.114.1	CAMERON LTD. (Group of Schlumberger Ltd)	INDIA	
6.114.2	DANIEL MEASUREMENT SOLUTIONS PVT LTD (EMERSON)	INDIA	
6.114.3	FMC MEASUREMENT	INDIA	
<b>6.115</b>	<b>LIQUID METERING SYSTEM (ULTRASONIC)</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
6.115.1	DANIEL MEASUREMENT SOLUTIONS PVT LTD (EMERSON)	INDIA	
6.115.2	KROHNE MARSHALL PVT. LTD	INDIA	
<b>6.116</b>	<b>LIQUID METERING SYSTEM (TURBINE)</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
6.116.1	CAMERON LTD. (Group of Schlumberger Ltd)	INDIA	
6.116.2	DANIEL MEASUREMENT SOLUTIONS PVT LTD (EMERSON)	INDIA	
6.116.3	ROCKWIN FLOWMETER INDIA (P) LTD	INDIA	
6.116.4	THERMO FISHER SCIENTIFIC	INDIA	
<b>6.117</b>	<b>LIQUID METERING SYSTEM (P D METERS)</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
6.117.1	CAMERON LTD. (Group of Schlumberger Ltd)	INDIA	
<b>6.118</b>	<b>LIQUID METERING SYSTEM (MASS FLOW METER)</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
6.118.1	ADVANCE SYSTEK	INDIA	
6.118.2	CHEMTROL INDUSTRIES LTD.	INDIA	
6.118.3	DANIEL MEASUREMENT SOLUTIONS PVT LTD (EMERSON)	INDIA	
6.118.4	FMC MEASUREMENT	INDIA	
6.118.5	HONEYWELL	INDIA	
6.118.6	ROCKWIN FLOWMETER INDIA PRIVATE LIMITED	INDIA	Rev.2: Name Change
<b>6.119</b>	<b>DISPLACER LEVEL INSTRUMENTS</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
6.119.1	GE OIL & GAS INDIA PVT LTD	INDIA	Rev.2: Name Update
6.119.2	EMERSON PROCESS MANAGEMENT (INDIA) PRIVATE LIMITED.	INDIA	
6.119.3	FOXBORO ECKARDT GMBH (SCHNEIDER)	INDIA	
6.119.4	INVENSYS INDIA PRIVATE LIMITED (SCHNEIDER ELECTRIC SYSTEMS INDIA PRIVATE LIMITED)	INDIA	
6.119.5	CHEMTROLS INDUSTRIES LTD	INDIA	
6.119.6	DRESSER PRODUITS INDUSTRIELS	INDIA	
6.119.7	DRESSER VALVE INDIA PVT LTD	INDIA	
<b>6.120</b>	<b>DISTRIBUTED CONTROL SYSTEMS</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
6.120.1	ABB INDIA LIMITED	INDIA	Rev.2: Name Change
6.120.2	BHARAT HEAVY ELECTRICALS LIMITED	INDIA	Rev.2: Name Change
6.120.3	EMERSON PROCESS MANAGEMENT (INDIA) PRIVATE LIMITED.	INDIA	
6.120.4	HONEYWELL AUTOMATION INDIA LTD.	INDIA	
6.120.5	INVENSYS INDIA PRIVATE LIMITED (SCHNEIDER)	INDIA	
6.120.6	SCHNEIDER ELECTRIC SYSTEMS INDIA PVT. LTD.	INDIA	
6.120.7	SIEMENS LTD (FOR NON FOUNDATION FIELD BUS SYSTEM)	INDIA	
6.120.8	YOKOGAWA INDIA LIMITED	INDIA	

<b>6.121</b>	<b>TELEPHONE AND PAGING SYSTEMS</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
6.121.1	ARMTTEL LIMITED	INDIA	
6.121.2	DEE EM SYSTEMS	INDIA	
6.121.3	FIBCOM INDIA LIMITED	INDIA	
6.121.4	INDUSTRONIC IND.-ELEC.GMBH&CO.KG	INDIA	
6.121.5	LARAON ENGINEERS & CONSULTANTS (NEUMAN)	INDIA	
6.121.6	PHILIPS	INDIA	
6.121.7	SIEMENS (UNIFY )	INDIA	
6.121.8	AVAYA GLOBAL CONNECT	INDIA	
6.121.9	AGC NETWORKS LTD	INDIA	
6.121.10	BPL SYSTEMS AND PROJECTS LTD	INDIA	
<b>6.122</b>	<b>FOUNDATION FIELD BUS (FF JB'S)</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
6.122.1	MTL INDIA	INDIA	
6.122.2	P&F	INDIA	
6.122.3	R STAHL	INDIA	
<b>6.123</b>	<b>JUNCTION BOXES (Flame Proof)</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
6.123.1	BALIGA LIGHTNING	INDIA	
6.123.2	FCG FLAME PROOF CONTROL GEARS	INDIA	
6.123.3	FCG POWER INDUSTRIES PVT LTD	INDIA	
6.123.4	FLAMEPROOF EQUIPMENTS PVT LTD	INDIA	
6.123.5	FLEXPRO ELECTRICALS	INDIA	
6.123.6	KAYSONS TECHNO EQUIPMENT P LTD.	INDIA	
6.123.7	PEPPERL & FUCHS MANUFACTURING (INDIA) PRIVATE LIMITED / OEM Authorised bidder: M/s. Pepperl & Fuchs (India) Pvt Ltd. – INDIA	INDIA	Rev.1: Name Change
6.123.8	SUDHIR SWITCHGEARS PVT LTD	INDIA	
<b>6.124</b>	<b>FLAME SCANNERS</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
6.124.1	DURAG	INDIA	
6.124.2	HONEYWELL	INDIA	
<b>6.125</b>	<b>PLC CABINETS / LOCAL CONTROL PANEL</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
6.125.1	BASE AUTOMATION INDIA	INDIA	
6.125.2	INDUSTRIAL CONTROL & APPLIANCES	INDIA	
6.125.3	MEGATECH CONTROLS	INDIA	
6.125.4	POSITRONICS PVT. LTD	INDIA	
6.125.5	PRIMA AUTOMATION INDIA PVT LTD	INDIA	
6.125.6	PYROTECH ELECTRONICS PVT LTD	INDIA	
6.125.7	RITTAL	INDIA	
<b>6.126</b>	<b>OPACITY ANALYSERS</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
6.126.1	CHEMTROLS INDUSTRIES LTD (SICK Germany)	INDIA	
<b>6.127</b>	<b>THERMAL MASS FLOWMETERS</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
6.127.1	EMERSON PROCESS MANAGEMENT (INDIA) PRIVATE LIMITED.	INDIA	

6.127.2	FLUID COMPONENTS INTL	INDIA	
6.127.3	GE SENSING	INDIA	
6.127.4	KURZ INSTRUMENTS INC	INDIA	
<b>6.128</b>	<b>MCT BLOCKS</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
6.128.1	MCT BRATTBERG	INDIA	
6.128.2	ROXTEC	INDIA	
6.128.3	HILTI INDIA	INDIA	
6.128.4	DELSEAL INDIA PVT. LTD.	INDIA	
<b>6.129</b>	<b>BARRIERS (IS) / BARRIERS (FF)</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
6.129.1	MTL	INDIA	
6.129.2	P & F	INDIA	
<b>6.130</b>	<b>BEACONS / HOOTERS/ MCP</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
6.130.1	BALIGA LIGHTING EQUIPMENT PVT LTD	INDIA	
6.130.2	CAEG FCG	INDIA	
6.130.3	EX PROTECTA	INDIA	
6.130.4	FLAMEPROOF EQUIPMENT PVT. LTD.	INDIA	
6.130.5	FLEXPRO ELECTRICALS	INDIA	
<b>6.131</b>	<b>AIR FILTER REGULATORS</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
6.131.1	DONALDSON (INDIA)	INDIA	
6.131.2	MARSH BELLOFRAM	INDIA	
6.131.3	PALL	INDIA	
6.131.4	PLACKA INSTRUMENTS INDIA P LTD	INDIA	
6.131.5	SCHRADER DUNCAN LIMITED	INDIA	
6.131.6	SHAVO NORNGREN (I) PVT LTD	INDIA	
6.131.7	DIVYA CONTROL ELEMENTS PVT LTD	INDIA	
6.131.8	JANATICS INDIA PVT LTD	INDIA	
6.131.9	SHAH PNEUMATICS	INDIA	
6.131.10	VELJAN HYDRAIR PVT LTD	INDIA	
6.131.11	JRU	INDIA	
6.131.12	ABB INDIA LIMITED	INDIA	Rev.2: Name Change
6.131.13	FISHER SANMAR LIMITED	INDIA	
<b>6.132</b>	<b>ACCESS CONTROL SYSTEM</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
6.132.1	ALE INDIA PVT. LTD.	INDIA	
6.132.2	ASCENT NETWORKS PRIVATE LIMITED	INDIA	
6.132.3	BOSCH LIMITED	INDIA	
6.132.4	COMMTTEL NETWORKS PVT. LIMITED	INDIA	
<b>6.133</b>	<b>ANALYSER SHELTER</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
6.133.1	ABB INDIA LIMITED	INDIA	Rev.2: Name Change
6.133.2	AXIS SOLUTIONS PVT. LTD.	INDIA	
6.133.3	EMERSON PROCESS MANAGEMENT (INDIA) PRIVATE LIMITED.	INDIA	
6.133.4	PYROTECH ELECTRONICS PVT LTD	INDIA	

6.133.5	BARTEC INDIA PRIVATE LIMITED (BETTEC BENKE GMBH)	INDIA	
6.133.6	ADAGE AUTOMATION PVT. LTD. (Siemens)	INDIA	
6.133.7	YOKOGAWA INDIA LIMITED	INDIA	
6.133.8	CHEMTROLS INDUSTRIES LTD	INDIA	
<b>6.134</b>	<b>LOOP POWERED INDICATORS</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
6.134.1	EMERSON PROCESS MANAGEMENT (INDIA) PRIVATE LIMITED.	INDIA	
6.134.2	ENDRESS+HAUSER (INDIA) PRIVATE LIMITED	INDIA	Rev.2: Name Change
6.134.3	HONEYWELL AUTOMATION INDIA LTD	INDIA	
6.134.4	INVENSYS INDIA PVT LTD (SCHNEIDER ELECTRIC INDIA PVT. LTD.)	INDIA	
6.134.5	MTL INSTRUMENTS PVT LTD	INDIA	
6.134.6	YOKOGAWA INDIA LIMITED	INDIA	
6.134.7	ABB INDIA LIMITED	INDIA	Rev.2: Name Change
<b>6.135</b>	<b>FIRE PROOFING FOR INSTRUMENT ITEMS (FOR CABLE TRAYS/DUCTS)</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
6.135.1	LOYDS INSULATION	INDIA	
6.135.2	THERMAL CERAMICS	INDIA	
6.135.3	UNIFRAX INDIA LTD	INDIA	
<b>6.136</b>	<b>SUNSHADE FOR FIELD INSTRUMENTS</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
6.136.1	FIBROCHEM INDUSTRIES	INDIA	
6.136.2	LOTUS FIBRE	INDIA	
<b>6.137</b>	<b>METER RUN ASSEMBLY (INTEGRAL ORIFICE)</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
6.137.1	EMERSON PROCESS MANAGEMENT (INDIA) PRIVATE LIMITED.	INDIA	
6.137.2	YOKOGAWA	INDIA	
<b>6.138</b>	<b>PROXIMITY TYPE LIMIT SWITCH</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
6.138.1	HONEYWELL INC	INDIA	
6.138.2	PEPPERL & FUCHS	INDIA	
<b>6.139</b>	<b>POSITION INDICATION SWITCHBOXES</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
6.139.1	FLOWSERVE	INDIA	
6.139.2	WESTLOCK	INDIA	
<b>6.140</b>	<b>TERMINAL BLOCKS</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
6.140.1	ELEMEX	INDIA	
6.140.2	PHONIX	INDIA	
6.140.3	CONNECTWELL	INDIA	
6.140.4	WEILDMULLER	INDIA	
<b>6.141</b>	<b>CABLE TRAY</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
6.141.1	METALLEMS	INDIA	
6.141.2	GLOBE ELECTRIC	INDIA	
6.141.3	INDIANA	INDIA	

6.141.4	RATAN ENGINEERING	INDIA	
6.141.5	IDS COMPOSITES	INDIA	
6.141.6	NATIONAL GALVANISER	INDIA	
6.141.7	VATCO	INDIA	
6.141.8	STEELITE	INDIA	
6.141.9	INDIANA GRATINGS	INDIA	
6.141.10	DECO ENTERPRISE	INDIA	
6.141.11	PREMIER POWER PRODUCT (CAL) PVT LTD	INDIA	
6.141.12	INDIA ELECTRICALS SYNDICATE	INDIA	
6.141.13	JAMUNA METALS	INDIA	
6.141.14	UNITECH FABRICATORS & ENGINEERS PVT LTD	INDIA	
<b>6.142</b>	<b>INSTRUMENT DB&amp;B BALL VALVES</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
6.142.1	ASTEC VALVES & FITTINGS PVT. LTD.	INDIA	
6.142.2	CIRCOR INSTR. TECHNOLOGIES INC	INDIA	
6.142.3	COMFIT & VALVES PVT. LTD.	INDIA	
6.142.4	PARKER HANNIFIN CORPORATION	INDIA	
6.142.5	SWAGELOK CO.	INDIA	
6.142.6	HAVI ENGINEERING	INDIA	
<b>6.143</b>	<b>MOTOR OPERATED VALVES</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
6.143.1	L&T VALVES LIMITED	INDIA	Rev.2: Name Change
6.143.2	CESARE BONETTI	INDIA	
6.143.3	XOMOX SANMAR LTD	INDIA	
6.143.4	ADAMS	INDIA	
6.143.5	AMPO POYAM	INDIA	
6.143.6	ADVANCE VALVES	INDIA	
6.143.7	FASANI SPA / PENTAIR	INDIA	
6.143.8	FLOWSERVE	INDIA	
<b>6.144</b>	<b>CORROSION COUPONS</b>		
<b>6.145</b>	<b>OPTICAL PYROMETERS</b>		
<b>6.146</b>	<b>SPECIAL CONTROL VALVES (AXIAL)</b>		
<b>6.147</b>	<b>SPECIAL CONTROL VALVES (PISTON)</b>		
<b>6.148</b>	<b>AUTOMATIC GAS SAMPLER</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
6.148.1	CAMERON LTD. (Group of Schlumberger Ltd)	INDIA	
<b>6.149</b>	<b>PRODUCT QUALITY ANALYSERS (RVP)</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
6.149.1	BARTEC GMBH	INDIA	
6.149.2	ATAC	INDIA	
<b>6.150</b>	<b>TARGET FLOWMETERS</b>		
<b>6.151</b>	<b>RECEIVER INSTRUMENTS</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		

6.151.1	YOKOGAWA INDIA LIMITED	INDIA	
<b>6.152</b>	<b>INFRARED TEMP MEASUREMENT SYSTEM</b>		
<b>6.153</b>	<b>ANTI SURGE CONTROL</b>		
<b>6.154</b>	<b>SPEED GOVERNOR FOR TURBINE</b>		
<b>6.155</b>	<b>PRESSURE SWITCHES</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
6.155.1	ASCO JOUCOMATIC LTD	INDIA	
6.155.2	BAUMER BOURDON HAENNI SAS	INDIA	
6.155.3	DAG PROCESS INSTRUMENTS PVT LTD	INDIA	
6.155.4	INDFOS INDUSTRIES LIMITED	INDIA	
6.155.5	KAUSTUBHA UDYOG	INDIA	
6.155.6	SWITZER PROCESS INSTRUMENTS PVT. LTD.	INDIA	
6.155.7	UNITED ELECTRIC CONTROLS CO	INDIA	
6.155.8	GAUGES BOURDON (I) PVT LTD (GEN. INST.)	INDIA	

<b>6.156</b>	<b>SPECIAL CONTROL VALVES ( ECC ROTARY PLUG)</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
6.156.1	DRESSER VALVES INDIA PVT. LIMITED (GE INDIA)	INDIA	
6.156.2	EMERSON PROCESS MANAGEMENT (INDIA) PRIVATE LIMITED.	INDIA	
6.156.3	FLOWSERVE INDIA CONTROLS PVT. LTD.	INDIA	
6.156.4	METSO AUTOMATION	INDIA	
6.156.5	SAMSON CONTROLS PVT. LIMITED	INDIA	
6.156.6	INSTRUMENTATION LIMITED	INDIA	

<b>6.157</b>	<b>BLENDING AUTOMATION SYSTEMS</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
6.157.1	ABB INDIA LIMITED	INDIA	Rev.2: Name Change
6.157.2	EMERSON PROCESS MANAGEMENT (INDIA) PRIVATE LIMITED.	INDIA	
6.157.3	HONEYWELL AUTOMATION INDIA LTD	INDIA	
6.157.4	INVENSYS	INDIA	
6.157.5	YOKOGAWA INDIA LIMITED	INDIA	

<b>6.158</b>	<b>GAUGE GLASSES &amp; COCKS (HIGH PRESSURE SERVICES 900# &amp; ABOVE)</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
6.158.1	CESARE BONNETTI S.P.A.	INDIA	
6.158.2	LEVCON INSTRUMENTS PVT LTD	INDIA	
6.158.3	NISAN SCIENTIFIC PROCESS EQUIP. P LTD	INDIA	
6.158.4	PUNE TECHTROL PVT LTD	INDIA	

<b>6.159</b>	<b>MAGNETIC LEVEL GAUGES (HIGH PRESSURE SERVICES 900# &amp; ABOVE)</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
6.159.1	BLISS ANAND PVT LTD	INDIA	
6.159.2	CHEMTROLS SAMIL	INDIA	

<b>6.160</b>	<b>PORTABLE NUCLEONIC SURVEY METER (BETA-GAMMA-NEUTRON)</b>		
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<b>6.161</b>	<b>SP CONTROL VALVES (ECCENTRIC DISC HI PERFORMANCE TYPE)</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
6.161.1	GE INDIA INDUSTRIAL PVT LTD (DRESSER)	INDIA	



6.161.2	EMERSON PROCESS MANAGEMENT (INDIA) PRIVATE LIMITED.	INDIA	
6.161.3	FLOWSERVE	INDIA	
6.161.4	METSO	INDIA	
6.161.5	TYCO VALVES & CONTROLS	INDIA	

<b>6.162</b>	<b>SPECIAL CONTROL VALVES (SEGMENTAL)</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
6.162.1	GE INDIA INDUSTRIAL PVT LTD (DRESSER)	INDIA	
6.162.2	EMERSON PROCESS MANAGEMENT (INDIA) PRIVATE LIMITED.	INDIA	
6.162.3	FLOWSERVE	INDIA	
6.162.4	METSO	INDIA	
6.162.5	SAMSON AG	INDIA	

<b>6.163</b>	<b>SPECIAL CONTROL VALVES (BALL CONTROL)</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
6.163.1	FLOWSERVE INDIA CONTROL PVT LTD-BANGALORE	INDIA	
6.163.2	METSO	INDIA	
6.163.3	EMERSON PROCESS MANAGEMENT (INDIA) PRIVATE LIMITED.	INDIA	Rev.1: Name Change
6.163.4	TYCO VALVES & CONTROLS	INDIA	

<b>6.164</b>	<b>SPECIAL CONTROL VALVES (VARIABLE CV)</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
6.164.1	GE INDIA INDUSTRIAL PVT LTD (DRESSER)	INDIA	
6.164.2	MIL CONTROLS LIMITED	INDIA	
6.164.3	INSTRUMENTATION LIMITED	INDIA	

<b>6.165</b>	<b>SPECIAL CONTROL VALVES (LOW CV)</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
6.165.1	GE INDIA INDUSTRIAL PVT LTD (DRESSER)	INDIA	
6.165.2	EMERSON PROCESS MANAGEMENT (INDIA) PRIVATE LIMITED.	INDIA	
6.165.3	FLOWSERVE	INDIA	
6.165.4	INSTRUMENTATION LIMITED	INDIA	
6.165.5	MIL CONTROLS LIMITED	INDIA	

<b>6.166</b>	<b>SAFETY VALVE BOILER SERVICE</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
6.166.1	BHARAT HEAVY ELECTRICALS LIMITED	INDIA	Rev.2: Name Change
6.166.2	INSTRUMENTATION LIMITED	INDIA	
6.166.3	TYCO SANMAR LTD	INDIA	

<b>6.167</b>	<b>INTERFACE DEVICES</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
6.167.1	MTL INSTRUMENTS	INDIA	
6.167.2	PEPPERL + FUCHS	INDIA	

<b>6.168</b>	<b>ACTUATORS-MOV</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
6.168.1	AUMA INDIA PRIVATE LTD	INDIA	
6.168.2	CAIR EUROMATIC AUTOMATION PVT LTD	INDIA	
6.168.3	FLOWSERVE LIMITORQUE	INDIA	
6.168.4	LIMITORQUE INDIA LIMITED	INDIA	
6.168.5	MARSH AUTOMATION PVT. LTD.	INDIA	
6.168.6	ROTORK CONTROLS (INDIA) LTD	INDIA	

<b>6.169</b>	<b>PROCESS STREAM ANALYSERS(ELECTROCHEM-02)</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
6.169.1	ABB INDIA LIMITED	INDIA	Rev.2: Name Change
6.169.2	EMERSON PROCESS MANAGEMENT (INDIA) PRIVATE LIMITED.	INDIA	
6.169.3	GE SENSING EMEA	INDIA	
6.169.4	METTLER - TOLEDO AG	INDIA	

<b>6.170</b>	<b>ALARM PANEL / ALARM ANNUNCIATOR</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
6.170.1	ELECTRONIC CORPORATION OF INDIA LTD	INDIA	
6.170.2	INSTALARM INSTRUMENTS PVT LTD	INDIA	
6.170.3	MINILEC (INDIA) PVT LTD	INDIA	
6.170.4	MTL INSTRUMENTS PVT LTD	INDIA	
6.170.5	PROCON INSTRUMENTATION PVT LTD	INDIA	
6.170.6	ICA	INDIA	
6.170.7	IIC	INDIA	

<b>6.171</b>	<b>PUSH BUTTON AND INDICATING LAMPS</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
6.171.1	C & S ELECTRIC LTD	INDIA	
6.171.2	ESSEN DEINKI	INDIA	
6.171.3	HOTLINE SWITCHGEAR & CONTROLS	INDIA	
6.171.4	LARSEN & TOUBRO LIMITED	INDIA	Rev.2: Name Change
6.171.5	PRECIFINE PRODUCTS PVT LTD	INDIA	
6.171.6	SCHNEIDER ELECTRIC INDIA PVT LTD	INDIA	
6.171.7	SHRI TULSI SWITCHGEARS PVT LTD	INDIA	
6.171.8	SIEMENS LIMITED	INDIA	
6.171.9	STANDARD ELECTRICALS LTD	INDIA	
6.171.10	IDEC-IZUMI	INDIA	
6.171.11	R. STAHL (P) LTD	INDIA	
6.171.12	TEKNIK	INDIA	

<b>6.172</b>	<b>TUBE FITTINGS (SEAL OIL, LUBE OIL, HYDROCARBON &amp; OTHER CRITICAL APPLICATIONS)</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
6.172.1	SWAGELOK CO.	INDIA	
6.172.2	ASTEC	INDIA	
6.172.3	EXCEL-HYDRO	INDIA	
6.172.4	ARYA CRAFTS & ENGINEERING PVT LTD	INDIA	
6.172.5	CIRCOR INSTR. TECHNOLOGIES INC- FORM.H608	INDIA	
6.172.6	COMFIT & VALVES PVT. LTD.	INDIA	
6.172.7	EXCELSIOR ENGG. WORKS	INDIA	
6.172.8	FLUID CONTROLS PVT LTD	INDIA	
6.172.9	MULTIMETAL INDUSTRIES	INDIA	
6.172.10	PANAM ENGINEERS	INDIA	
6.172.11	PRECISION ENGINEERING INDUSTRIES	INDIA	
6.172.12	PRIME ENGINEERS	INDIA	
6.172.13	RELIANCE ENGINEERING & ELECTRICALS CORPN	INDIA	
6.172.14	SEALEXCEL (INDIA) PVT. LTD.	INDIA	
6.172.15	SWASTIK ENGINEERING WORKS	INDIA	
6.172.16	TK FUJIKIN CORPORATION	INDIA	

<b>6.173</b>	<b>DIGITAL INDICATOR / DIGITAL MULTIPOINT INDICATOR</b>		
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<b>A</b>	<b>INDIAN BIDDERS</b>		
6.173.1	MTL (6000 SERIES)	INDIA	
6.173.2	PEPPERL & FUCHS	INDIA	

<b>6.174</b>	<b>CONTROL VALVE - ANGLE TYPE</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
6.174.1	METSO AUTOMATION PTE LTD	INDIA	

<b>6.175</b>	<b>I/P CONVERTER</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
6.175.1	EMERSON PROCESS MANAGEMENT (INDIA) PRIVATE LIMITED.	INDIA	
6.175.2	M.T.L INSTRUMENTS PVT. LTD.	INDIA	

<b>6.176</b>	<b>FLOW METER ULTRASONIC TYPE - For Flare Gas Application</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
6.176.1	GE SENSING	INDIA	
6.176.2	SICK AG	INDIA	

<b>6.177</b>	<b>CLAMP-ON ULTRASONIC FLOW TRANSMITTER</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
6.177.1	KROHNE MARSHALL PVT. LTD.	INDIA	

<b>6.178</b>	<b>INSTRUMENT VALVES &amp; MANIFOLDS FOR ANALYSERS / SAMPLING SYSTEMS</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
6.178.1	SWAGELOK CO.	INDIA	
6.178.2	PARKER HANNIFIN CORPORATION	INDIA	
6.178.3	HOKE	INDIA	

<b>6.179</b>	<b>PRESSURE REGULATOR FOR ANALYSERS / SAMPLING SYSTEMS</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
6.179.1	SWAGELOK CO	INDIA	
6.179.2	GO	INDIA	
6.179.3	TESCOM	INDIA	
6.179.4	PRESSURE TECH	INDIA	

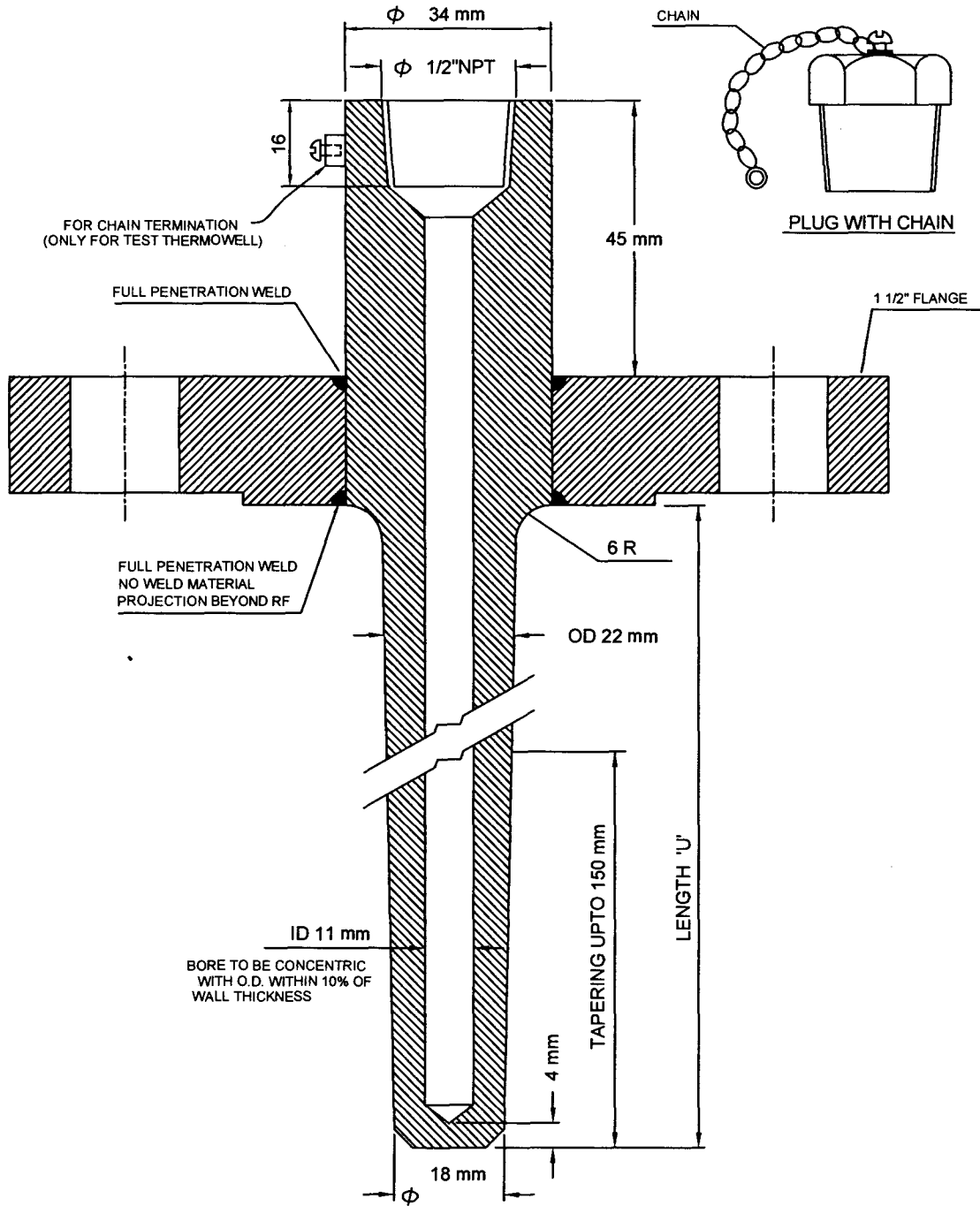
<b>6.180</b>	<b>GAS CYLINDER PRESSURE REGULATOR DUAL STAGE WITH PRESSURE GAUGE &amp; SAFETY VALVE FOR ANALYSERS / SAMPLING SYSTEMS</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
6.180.1	GO	INDIA	
6.180.2	GCE DRUVA	INDIA	
6.180.3	INOX	INDIA	
6.180.4	BALDOTA	INDIA	
6.180.5	CP ENGG	INDIA	

<b>6.181</b>	<b>PELTIER / COMPRESSOR COOLER FOR GAS SAMPLE FOR ANALYSERS / SAMPLING SYSTEMS</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
6.181.1	BUHLER	INDIA	
6.181.2	M&C	INDIA	
6.181.3	JCT	INDIA	

<b>6.182</b>	<b>DIAPHRAGM PUMP SINGLE / DOUBLE STAGE / HEAD PUMP FOR GAS SAMPLE FOR ANALYSERS / SAMPLING SYSTEMS</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
6.182.1	KNF	INDIA	
6.182.2	BUHLER	INDIA	

6.182.3	M&C	INDIA	
<b>6.183</b>	<b>PURGE CONTROLLER FOR PANEL FOR ANALYSERS / SAMPLING SYSTEMS</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
6.183.1	BARTEC	INDIA	
6.183.2	PEPPERL-FUCHS	INDIA	
<b>6.184</b>	<b>VORTEX COOLER FOR ANALYSERS FOR ANALYSERS / SAMPLING SYSTEMS</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
6.184.1	THERMOMEGATECH	INDIA	
<b>6.185</b>	<b>FILTERS FOR ANALYSERS / SAMPLING SYSTEMS</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
6.185.1	BLASTON	INDIA	
6.185.2	CLASSIC	INDIA	
6.185.3	HEADLINE FILTERS	INDIA	
6.185.4	GENIE MEMBRANE	INDIA	
<b>6.186</b>	<b>HOT EXTRACTION SAMPLE PROBE FOR ANALYSERS / SAMPLING SYSTEMS</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
6.186.1	JCT	INDIA	
6.186.2	BUHLER	INDIA	
<b>6.187</b>	<b>BULK POWER SUPPLY WITH SMPS (24 V DC) FOR ANALYSERS / SAMPLING SYSTEMS</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
6.187.1	PHOENIX CONTACT	INDIA	
6.187.2	SIEMENS	INDIA	
6.187.3	COSEL	INDIA	
<b>6.188</b>	<b>ETHERNET SWITCHES</b>		
<b>6.189</b>	<b>HMI SOFTWARE</b>		
<b>6.190</b>	<b>ELECTROMECHANICAL RELAY</b>		
<b>A</b>	<b>INDIAN BIDDERS</b>		
6.190.1	OEN	INDIA	
6.190.2	HONEYWELL	INDIA	
6.190.3	ABB INDIA LIMITED	INDIA	Rev.2: Name Change
6.190.4	ALSTOM T & D INDIA LTD (FORMLY A347)	INDIA	
6.190.5	DANISH PRIVATE LIMITED	INDIA	
6.190.6	EASUN REYROLLE LTD	INDIA	
6.190.7	ENPRO INDUSTRIAL AUTOMATION PVT LTD	INDIA	
6.190.8	GE INDIA INDUSTRIAL PVT LTD	INDIA	
6.190.9	SIEMENS LIMITED	INDIA	
<b>6.191</b>	<b>CONDITION MONITORING SYSTEM</b>		

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**NOTES -**

1. THIS STANDARD IS APPLICABLE FOR ;
  - a) TEMPERATURE GAUGES, BEADED TEMPERATURE ELEMENTS AND DUPLEX TEMPERATURE ELEMENTS.
  - b) THERMOWELL UP TO 1500 CLASS AS PER ASME OR EQUIVALENT.
2. TYPE OF FLANGE SHALL BE RTJ FOR RATING (AS PER ASME CLASS) > 600.
3. DP TEST SHALL BE CARRIED OUT FOR ALL WELD JOINTS.
4. CHAIN AND PLUG SHALL BE APPLICABLE ONLY FOR TEST THERMOWELLS.

4	25-04-18	REAFFIRMED & REISSUED	Manoj <i>Manoj</i>	MN <i>Manoj</i>	RG <i>Manoj</i>	RN <i>Manoj</i>
3	21-03-12	REVISED & REISSUED	Manoj	RG	RP/JMS	DM
Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convener	Stds. Bureau Chairman
						Approved by

**ANNEXURE A : SPECIAL REQUIREMENTS FOR HYDROGEN SERVICE**

These requirements are applicable in addition to the requirements specified in the Piping Material Specification.

**1.0 GENERAL**

Vendor's quality plan shall include the special quality checks and inspection requirements for these services.

For operating temperatures below 230 °C, materials shall be of carbon steel to the appropriate specifications

For operating temperatures of 230 °C and above, materials shall be selected on the basis of Nelson Curves of API Publication No. 941 (Steels for hydrogen service at elevated temperatures and pressures in petroleum refineries and petrochemical plants).

Impact test & normalizing of CS/AS materials shall be as mentioned in the code.

All flanged facing of flanges and valves shall have concentric serrations.

**1.1 PIPE, FLANGES AND FITTINGS****1.1.1 Method of manufacture****A. FOR CS LINES WITH HYDROGEN SERVICE UPTO 204 °C**

All CS pipes, fittings and flanges having wall thickness 9.53mm and above, shall be normalized. Cold drawn pipes and fittings shall be normalized after the final cold draw pass for all thickness. The normalizing heat treatment shall be a separate heating operation and not a part of hot forming operation.

**B FOR CS LINES WITH HYDROGEN SERVICE ABOVE 204 °C**

All CS pipes, fittings and flanges shall be normalized and tempered. Cold drawn pipes and fittings shall be normalized after the final cold draw pass for all thickness. The normalizing heat treatment shall be a separate heating operation and not a part of hot forming operation.

All Alloy Steel (Cr.-Mo) pipes, forgings and fittings shall be normalized and tempered. The normalizing and tempering shall be a separate heating operation and not a part of hot forming operation. The maximum room temperature tensile strength shall be 100,000 psi.

In addition, details given by process licensor's requirements shall be met.

**1.1.2 Post Weld Heat Treatment****A FOR CS LINES WITH HYDROGEN SERVICE UPTO 204 °C**

All carbon steel pipes and fittings having wall thickness 19 mm and above shall be post weld heat-treated.

**B FOR CS LINES WITH HYDROGEN SERVICE ABOVE 204 °C**

All carbon steel shall be post weld heat-treated.

All alloy steel (Cr-Mo) pipes and fittings shall be post weld heat treated irrespective of type or thickness of weld.

All austenitic stainless steel grades shall be solution annealed after welding. 100% radiography of welded joints shall be done both before and after PWHT

**1.1.3 Ferrite No. Test**

For all austenitic stainless steel, the weld deposit shall be checked for ferrite content. A ferrite No. (FN) not less than 3% and not more than 10% is required to avoid sigma phase embrittlement during heat treatment. FN shall be determined by Ferrite scope prior to post-to-post weld heat treatment.

**1.1.4 Impact Test**

For all carbon steel and alloy steel pipes, flanges and fittings with the wall thickness over 20 mm, Charpy-V Notch impact testing shall be carried out in accordance with paragraph UG-84 of ASME Section VIII, Div-1 for weld metal and base metal from the thickest item per heat of material and per heat treating batch. Impact test

specimen shall be in complete heat-treated condition and in accordance with ASTM A370. impact energies at 0°C shall be average greater than 27 J (20 ft-lb) per set of 3 specimens, with a minimum of 19J (15 ft-lb). If welding is used in manufacture, impact test of Heat Affected Zone (HAZ) and welds metal shall also be carried out.

In addition, details given by process licensor's requirements shall be met.

**1.1.5 Hardness**

For carbon steel pipes and fittings, hardness of weld and HAZ shall be limited to 200BHN(Max). For alloy pipes and fittings, hardness of weld and HAZ shall be limited to 225BHN(Max).

**1.1.6 Radiography**

All girth welded joints (longitudinal and circumferential) shall be 100% radiographed in accordance with UW-51 of ASME section VIII Div-1 and ASME Section V.

**1.1.7 Valves**

All valves castings shall be radiographic quality.

All cast valves flanges & bodies with flange rating of class 900 or greater shall be examined in accordance with paragraphs 7.2 through 7.5 of Appendix-7 of ASME SEC-VIII DIV-1, regardless of casting quality factor. Only Normalized and Tempered material shall be used in the following specifications:

**Castings** A216 Gr. WCB, A217 Gr.WC1, A217 Gr.WC4, A217 Gr.WC5, A217 Gr.WC6, A217 Gr.WC9, A217 Gr.C5, A217 Gr.C12

**Forgings** A105, A182 Gr. F11 Cl.2

Body / bonnet / cover joints & stuffing box of valves shall have low emission. One valve per metallurgy, per rating, per size shall be helium leak tested as per ASME Sec.V, Subsection A, Article 10 (Detector Probe Technique), Appendix IV at a minimum of 25% of the allowable (rated) cold working pressure. Selection of valves for helium leak test shall be at random.

**Test duration shall be as follows:**

Test Duration in Minutes					
NOMINAL SIZE	PRESSURE CLASS				
	UPTO 300	600	800 & 900	1500	2500
Upto 2.00"	3	6	9	12	12
3.00" to 6.00"	6	9	12	15	18
8.00" to 16.0"	9	9	12	15	18
18.0" to 24.0"	9	12	15	18	21

The valve shall show no leakage. No leakage is defined as a total leakage rate of less than 0.0001 ml/s of helium.

**CS & AS Valves :**

Bend test and Magnetic Particle inspection of the entire surface of body and bonnet casting shall be in accordance with ASTM A217. Supplementary requirement S3 & S4 evaluation of magnetic particle, inspection shall be in accordance with MSS-SP-53 except that no linear discontinuities shall be allowed.

The Brinell hardness of heat treated casting shall not exceed 200 BHN for carbon steel & 225 for alloy steel.

Repair of defective casting shall be outlined in writing to the purchaser before repair starts. Repair method to be approved prior to welding.

Casting shall be preheated to a minimum of 400°F prior to welding and all CS and Chromium-Molybdenum alloys shall be post weld heat treated after welding is complete. Stress relieving is essential for welds.

Carbon steel shall be normalised and alloy steels shall be normalised & tempered. Dye Penetrant test of welds shall be in accordance with ASTM B165 Procedure B-2. Interpretation as per Appendix-8 of ASME-VIII Div.1.

The tensile stress for AS shall be less than 100,000 psi.

Charpy V-notch impact testing is to be done for valve material (average 20 ft-lb for set of 3 [minimum value 15 ft-lb] at 30 F).

**SS Valves :**

Casting and test bar shall be heat treated together. Valve casting shall be in solution heat treated and pickled condition.

Critical body and bonnet casing section typically defined by ASME B16.34 shall be radiographed and shall meet ASTM E446 (up to 2" thick) Category A,B & CA Level 2, Category CB, OC & CD Level 3, Category D,B & F Level 0. For wall thickness 2" to 4.5" comparable plates of ASTM E186 shall be used. ASTM E94 and ASTM E142 shall be used for recommended practice & controlling quality of radiography as guide. The entire surface of all castings shall be dye-penetrant inspected after pickling.

Welds repair shall be 100% radiographed and evaluated in accordance with paragraph 344.5 of ASME B31.3 with a minimum casting quality factor of 0.95. Dye Penetration test shall be as per ASTM E165 Procedure B-2, Interpretation as per Appendix-8 of ASME-VIII Div.1.



**ANNEXURE B: SPECIAL REQUIREMENTS FOR OXYGEN SERVICE**

These requirements are applicable in addition to the requirements specified in the design basis.

**1.0 MATERIAL**

- i). Pipes shall be seamless, or mill welded.
- ii). All valves shall have Monel trims.
- iii). All pipes, fittings, flanges, gaskets and valves (and their components including packing, bonnet gasket, bolting etc.) shall be cleaned, degreased & packed for "OXYGEN SERVICE".
- iv). Valves stem packing shall consist of Braided OR Glass Filled Teflon.
- v). All Gaskets including valve bonnet gasket shall be SS Spirally wound with Teflon.
- vi). All Gaskets Spiral Wound SS 304 with Teflon shall be identified with metal tab.

**2.0 DESIGN**

- i). Piping shall be arranged to avoid abrupt change in direction and to minimize impingement or turbulence.
- ii). Reducing flanges shall not be used. where reduced size branches are required the branch line shall be equal to header size, and the reducer shall be located away from intersection.
- iii). Half Couplings shall be used for pressure connections, vents, drains, sample points & thermowells.
- iv). Oxygen lines shall be run away from other hydrocarbon lines in the plant and supported on shoe support for all sizes.
- v). All joints shall only be BW joints. No SW or threaded joints is permitted.

**3.0 CLEANING**

- i). Fabricated components shall be internally cleaned and degreased to completely remove grease, oil, scale, dirt and other foreign matter and thoroughly flushed and dried. Cleaning components and methods used shall be such as to result in a system suitable for safe handling of oxygen.
- ii). All oxygen lines shall be grounded.

### **ANNEXURE C : PROCEDURE FOR PICKLING**

These requirements are applicable in addition to the requirements specified in the Piping Material Specification. Vendor should follow the pickling procedure at their shop as per ASTM A380 (Latest) as a guideline. Brief sequence of operation as given below for SS pipes, fittings, flanges (segments) & valves for SS Gr.321 & SS Gr.316L.

- 1.0 The objective of chemical cleaning is to remove all extraneous matter, dirt, dust, grease, oil welding slag. Loose rust, oxide scales that may be present on the SS piping to avoid the contamination by way of iron pick up.

#### **2.0 SEQUENCE OF OPERATION**

Cleaning of segments shall be carried out in the following sequence.

- a. Flushing with the demineralised water to remove dirt, dust, loose rust and foreign matter.
- b. Degreasing
- c. Acid cleaning
- d. Final rinsing and drying

#### **3.0 CHEMICALS**

- 3.1 Caustic potash rayon grade or technical confirming to IS-6831 (latest edition).
- 3.2 Nitric acid technical grade conforming to IS:264 (latest edition).
- 3.3 Hydrofluoric acid conforming to ASTM or equivalent. In any case, purity should not be less than 50% HF by wt.
- 3.4 DM water/chloride free water (chloride level 50 ppm) should be used for flushing and rinsing operation.

#### **4.0 PICKLING OPERATION**

- 4.1 All the fittings, flanges and piping requiring pickling should be flushed with DM water/ chloride free water (chloride up to 50PPM) to remove all extraneous matter, dirt and dust etc.
- 4.2 After flushing, degreasing shall be carried out in a pickling bath to remove grease, oil and organic coating if any. Degreasing solution shall be potassium hydroxide of concentration 50 gm/litre (100% purity basis). Temperature of solution during pickling shall be 50-55 deg.C. for duration of about 1 hr.
- 4.3 After degreasing, above segments should be rinsed with above quality of water. Rinsing should be continued till the neutral PH is obtained.
- 4.4 After step 3, above segments shall be pickled with acid mixture of Nitric acid (HNO<sub>3</sub>) and Hydrofluoric acid (HF). Composition of pickling solution should be 10% concentrated HNO<sub>3</sub> by volume (On 100% purity basis) and 0.5% concentrated HF by volume (on 100% purity basis). Pickling solution can be prepared at room temperature and for a duration of 15-30 minutes. However exact concentration of acid mixture and duration shall depend on cleaning of the above segments based on visual inspection.
- 4.5 After pickling, above segments should be rinsed with chloride free water.
- 4.6 Finally dry all the segments by clean dry air.

#### **5.0 PRESERVATION**

After the pickling and drying, these segments should be preserved in clean and dry condition to prevent entry of moisture, dust or dirt.

#### **6.0 TEST COUPONS**

7.5 cm x 5.0 cm x 2 mm cleaned and dried test coupons (duplicate) of AISI-321 and 316L shall be exposed to the acid mixture cleaning solution in the tank for the duration of the cleaning operation and weight loss determined. The corrosion rate shall be less than 10 mpy. If excessive corrosion is experienced concentration of HF shall be reduced to get acceptable corrosion rate.

**NOTE:**

1. Pickling solution can be prepared in suitable bath & cleaning of above segments can be done by dipping or immersion method. Separate bath should be used for each operation.
2. After acid pickling above segments should be visually inspected and the surfaces should be clean, not over etched dry, free from rust and passivated. The visual observation shall be recorded. If the surfaces are not satisfactorily cleaned, then pickling solution concentration and duration shall be accordingly adjusted to obtain clean surface.

**DEPARTMENT:** FEG

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

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**1. MATERIAL REQUIREMENTS FOR SOUR SERVICE AND HIC RESISTANT STEEL**

**A SOUR SERVICE REQUIREMENTS (NACE MR 0175)**

**PLATES**

- Carbon steel plates conforming to SA-516 Gr. 60 shall be supplied in normalised condition
- Carbon content  $\leq 0.18\%$ , Carbon equivalent (Ceq)  $\leq 0.43\%$
- Hardness of plates shall be less than 200 BHN
- Cold deformation during forming / rolling shall be less than 5%

**FORGINGS**

- Carbon steel forging shall conform to SA-105 or equivalent
- Carbon content  $\leq 0.23\%$ , Carbon equivalent (Ceq)  $\leq 0.43\%$
- Hardness of forging shall be less than 187 BHN

**PIPES**

- Seamless carbon steel pipes shall conform to SA-106 Gr. B and hardness shall not exceed 190 BHN.
- Cold deformation  $< 5\%$ , Carbon content  $\leq 0.23\%$ , Carbon equivalent (Ceq)  $\leq 0.43\%$

**BOLTINGS**

- Internal bolting and bolting exposed to H<sub>2</sub>S environment shall conform to SA 193 B7M/SA-194 Gr. 2HM

**B SOUR SERVICE + HYDROGEN INDUCED CRACKING (HIC) RESISTANT REQUIREMENTS**

**PLATES**

- Carbon steel plates conforming to **SA-516 Gr. 60** shall be supplied in normalised condition. The steel shall be killed and shall conform to fine austenitic grain size as per SA-20. Carbon content  $\leq 0.2\%$ . Carbon equivalent (Ceq)  $\leq 0.42\%$  for  $t < 2''$  and  $0.45\%$  for  $t \geq 2''$
- Hardness of plates shall be less than 200 BHN (22HRC)
- Through thickness tension testing of plates 25mm thick and above shall be carried out as per SA-770, S-3 and minimum reduction area shall be 35%.
- Ultrasonic inspection of plates shall be carried out as follows:
  - a. Plates having thickness 16mm to 50mm (both inclusive) shall be examined ultrasonically as per SA 435
  - b. For thicknesses above 50mm ultrasonic examination shall be carried out as per SA 578 and shall have acceptance standard of Level – 1
  - c. For quenched and tempered steel plates, ultrasonic examination shall be done after the heat treatment of plates
  - d. Cold deformation during forming/rolling shall be less than 5%

**Chemical:**

These steels require the following composition control:

- Manganese content shall be less than 1.2%
- Nickel content shall be less than or equal to 0.5 % (target value 0.2%)
- Sulphur content shall be less than or equal to 0.002%. (target value 0.001%)
- Oxygen content shall be less than or equal to 0.0025%
- Phosphorus content shall be less than or equal to 0.01%

Materials shall pass the NACE standard TM 0284 but using the acidified test solution specified in NACE TM 0177 with:

Crack Length Ratio (CLR)	≤	5%
Crack Thickness Ratio (CTR)	≤	3%
Crack Sensitivity Ratio (CSR)	≤	0.5%

**The steel shall be specially produced as HIC resistant steel at the specified HIC resistant level, tested originally by the Steel Producer.** All requirements of Licensor, if any, shall also be met.

**PIPES**

- Seamless carbon steel pipes conforming to **SA-106 Gr. B** shall have following chemistry requirement on product
- Carbon content ≤ 0.23%, Carbon equivalent ( $C_{eq}$ ) ≤ 0.43%
- Hardness of pipes shall be limited to 190 BHN. Cold deformation < 5%

**FORGINGS**

- Carbon steel forging shall conform to **SA-105** or equivalent
- Hardness of forging shall be limited to less than 187 BHN
- Carbon content ≤ 0.23%, Carbon equivalent ( $C_{eq}$ ) ≤ 0.43%

**WELD METAL:** Welding consumables shall conform to ASME Section II Part C

**BOLTINGS**

Internal bolting and bolting exposed to H<sub>2</sub>S, shall conform to SA 193 B7M/SA-194 Gr. 2HM.

**2. MATERIAL SPECIFICATION FOR PARTS OF CS EQUIPMENT**

<i>MATERIAL SPECIFICATION FOR PARTS WHEN SHELL/DISHED HEAD IS SA 516 GR. 60/70</i>	
Reinforcement Pad/Pad for external attachment	Same as shell material
Nozzles & Pipes	SA 106 Gr. B (Seamless) < 12" NB "Same as shell material" for 12" NB and above (with full radiography of weld joints)
Flanges	SA 105
Forgings	SA 266
Fittings	SA 234 WPB
Couplings	SA 105
Gaskets	As per Piping Material Specification
External Bolts & Nuts	SA 193 Gr. B7/SA 194 Gr. 2H upto 343°C *SA 193 Gr. B16/SA 194 Gr. 4 for temp. > 343°C
Internal Bolts & Nuts	SS 304 / as specified in Process Data Sheet
Wrapper Plate	Same as shell material
Skirt support for min. top 1m (Top 2m in case of design temp. ≥ 400°C)	Same as shell material
Skirt / Base Plate	SA 283 Gr. C
Angle leg support / Pipe leg support / Bracket Support / Saddle support	SA 283 Gr. C / SA 53 upto 343°C Same as shell material for temp > 343°C
Welded internal parts	Same as shell material
Removable Internal parts	As specified in Process Data Sheet
External cleats (Directly welded to vessel)	Same as shell material
Stiffeners (External pressure)	Same as shell material
External cleats with pad (same as shell/head Material)	SA 283 Gr. C upto 343°C Same as shell material for temp > 343°C
Internal Gaskets	Non-asbestos
Tray support ring	Same as shell material
Demister support	Same as shell material
* MDS shall be referred for material of external bolts / nuts and in case of discrepancy between this material specification and PMS, the same shall be referred to CLIENT/Jacobs for clarification.	



**3. MATERIAL SPECIFICATION FOR PARTS OF CS (NACE/HIC) EQUIPMENT**

MATERIAL SPECIFICATION FOR PARTS WHEN SHELL/DISHED HEAD IS SA 516 GR. 60 WITH NACE/HIC REQUIREMENTS (See Note 1)	
Reinforcement Pad / Pad for external attachment	Same as shell material / use self reinforced nozzles if required as per design
Nozzles & Pipes	SA 106 Gr. B (Seamless) < 12" NB "Same as shell material" for 12" NB and above (with full radiography of weld joints)
Flanges	SA 105
Forgings	SA 266
Fittings	SA 234 WPB
Couplings	SA 105
Gaskets	As per Piping Material Specification
External Bolts & Nuts	SA 193 Gr. B7 / SA 194 Gr. 2H upto 343°C *SA 193 Gr. B16 / SA 194 Gr. 4 for temp. > 343°C
Internal Bolts & Nuts	SS 304 / as specified in Process Data Sheet
Wrapper Plate	SA 516 Gr. 60
Skirt support for min. top 1m (top 2m in case of design temp. ≥ 400°C)	Same as shell material
Skirt / Base Plate	SA 283 Gr. C
Angle leg support / Pipe leg support / Bracket Support / Saddle support	SA 283 Gr. C / SA 53 upto 343°C Same as shell material for temp > 343°C
Welded internal parts	Same as shell material
Removable Internal parts	As specified in Process Data Sheet
External cleats (Directly welded to vessel)	Same as shell material
External cleats with pad (pad same as shell/head Material)	SA 283 Gr. C upto 343°C Same as shell material for temp > 343°C
Internal Gaskets	Non-asbestos
Tray support ring	Same as shell material
Demister support	Same as shell material

\* MDS shall be referred for material of external bolts / nuts and in case of discrepancy between this material specification and PMS, the same shall be referred to CLIENT/Jacobs for clarification

Note 1: All materials shall comply with the requirement of Clause 1

**4. MATERIAL SPECIFICATION FOR PARTS OF SS316L CLAD EQUIPMENT**

MATERIAL SPECIFICATION FOR PARTS WHEN SHELL/DISHED HEAD IS SA 516 GR. 70 + SA 240 Gr. 316L CLAD (In case of a different SS cladding, the same shall be applicable)	
Reinforcement Pad/Pad for external attachment	SA 516 Gr. 70
Nozzles & Pipes	** SA 106 Gr. B (Seamless) + SS 316L Weld overlay < 8" NB "Same as shell material" for 8" NB and above (with full radiography of weld joints)
Flanges	SA 105 + SS 316L Weld overlay
Forgings	SA 266 + SS 316L Weld overlay
Fittings	SA 234 WPB + SS 316L Weld overlay
Couplings	SA 105 + SS 316L Weld overlay
Gaskets	As per Piping Material Specification
External Bolts & Nuts	SA 193 Gr. B7/SA 194 Gr. 2H upto 343°C *SA 193 GR. B16/SA 194 Gr. 4 for temp. > 343°C
Internal Bolts & Nuts	SS 316 / as specified in Process Data Sheet
Skirt support for min. top 1m (top 2m in case design temp. ≥ 400°C)	SA 516 Gr. 70
Skirt / Base Plate	SA 283 Gr. C
Angle leg support / Pipe leg support / Bracket support / Saddle support	SA 283 Gr. C / SA 53 upto 343°C Same as shell material for temp > 343°C
Internal parts (Removable & welded both)	Same as cladding alloy
External cleats (Directly welded to vessel)	SA 516 Gr. 70
Internal Gaskets	Non-asbestos
Tray support ring	Same as cladding alloy material
Demister support	Same as cladding alloy material
Stiffeners (External pressure)	SA 516 Gr. 70 with SS316L pad

\* MDS shall be referred for material of external bolts / nuts and in case of discrepancy between this material specification and PMS, the same shall be referred to CLIENT/Jacobs for clarification.

\*\* For smaller size if weld overlay is not possible in seamless pipe (3" NB & below) it shall be cut in two pieces and after weld overlay & proper finish these two pieces shall be welded and weld Seams shall be fully radiographed.

**5. MATERIAL SPECIFICATION FOR PARTS OF SS EQUIPMENT**

<i>MATERIAL SPECIFICATION FOR PARTS WHEN SHELL/DISHED HEAD IS SA 240Gr. 304 / 304L / 316L</i>	
Reinforcement Pad/Pad for external attachment	Same as shell material
Nozzles & Pipes	SA 312 Type 304/304L/316L (seamless) upto 6" NB "Same as shell material" for above 6" NB (with full radiography of weld joints)
Flanges	SA 182 F 304 / 304L / 316L
Fittings	SA 403 WP 304 / 304L / 316L (Seamless)
Couplings	SA 182 F 304 / 304L / 316L
Gaskets	As per Piping Material Specification
External Bolts & Nuts	SA 193 Gr. B7/SA 194 Gr. 2H upto 343°C *SA 193 Gr. B16/SA 194 Gr. 4 for temp. > 343°C
Internal Bolts & Nuts	SS 304
Wrapper Plate	Same as shell material
Skirt support for min. top 1m (top 2m in case of design temp. ≥ 400°C)	Same as shell material
Skirt / Base Plate	SA 283 Gr. C
Angle leg support / Pipe leg support / Bracket Support / Saddle support	SA 283 Gr. C / SA 53 upto 343°C Same as shell material for temp > 343°C
Internal parts	Same as shell material / As specified in Process Data Sheet
External cleats (Directly welded to vessel)	Same as shell material
Stiffeners (External pressure)	Same as shell material
External cleats (welded over pad)	SA 283 Gr. C for temp. <343°C Same as shell material for temp. ≥ 343°C
Internal Gaskets	Non-asbestos
Tray support ring	Same as shell material
Demister support	Same as shell material
* MDS shall be referred for material of external bolts / nuts and in case of discrepancy between this material specification and PMS, the same shall be referred to CLIENT/Jacobs for clarification.	

**6. MATERIAL SPECIFICATION FOR PARTS OF LOW ALLOY STEEL (1¼Cr-1/2 Mo) EQUIPMENT**

<i>MATERIAL SPECIFICATION FOR PARTS WHEN SHELL / DISHED HEAD IS SA 387GR. 11 Cl. 2</i>	
Reinforcement Pad/Pad for external attachment	SA 387 Gr. 11 Cl. 2
Nozzles & Pipes	SA 335 P 11 (seamless) < 16" NB "Same as shell material" for 16" NB and above (with full radiography of weld joints)
Flanges	SA 182 F 11 Cl. 2
Forgings	SA 336
Fittings	SA 234 WP 11 Cl. 2
Couplings	SA 182 F 11 Cl. 2
Gaskets	As per Piping Material Specification
External Bolts & Nuts	SA 193 Gr. B7/SA 194 Gr. 2H upto 343°C *SA 193 Gr. B16/SA 194 Gr. 4 for temp. > 343°C
Internal Bolts & Nuts	SS 304 / As per Process data sheet
Skirt support for min. top 1m (top 2m in case of design temp. ≥ 400°C)	Same as shell material
Skirt / Base Plate	SA 283 Gr. C
Saddle support	Same as shell material
Welded Internal parts	Same as shell material
Removable Internals	As specified in process data sheet
External cleats (Directly welded to vessel)	Same as shell material
Internal Gaskets	Non-asbestos
Tray support ring	Same as shell material
Stiffeners (External pressure)	Same as shell material
* MDS shall be referred for material of external bolts / nuts and in case of discrepancy between this material specification and MDS, the same shall be referred to CLIENT/Jacobs for clarification.	

**7. MATERIAL SPECIFICATION FOR PARTS OF LOW ALLOY STEEL (2¼Cr-1Mo) EQUIPMENT**

<i>MATERIAL SPECIFICATION FOR PARTS WHEN SHELL / DISHED HEAD IS SA 387 Gr. 22 Cl. 2</i>	
Reinforcement Pad / Pad for external attachment	SA 387 Gr. 22 Cl. 2
Nozzles & pipes	SA 335 P 22 (seamless) <12" NB. "Same as shell material" for 12" NB and above (with full radiography of weld joints)
Flanges	SA 182 F 22
Forgings	SA 336
Fittings	SA 234 WP 22
Couplings	SA 182 F 22
Gaskets	As per Piping Material Specification
External Bolts & Nuts	SA 193 Gr. B7 / SA 194 Gr. 2H upto 343 °C * SA 193 GR. B16/ SA 194 Gr.4 for temp. >343 °C
Internal Bolts & Nuts	SS 304 / as per Process Data Sheet
Skirt support for min. top 1m (top 2m in case design temp. ≥400 °C)	Same as shell material
Skirt / Base Plate	SA 283 Gr. C
Saddle support	Same as shell material
External cleats (Directly welded to Vessel)	Same as shell material
Welded internal parts	Same as shell material
Removable internals	As specified in Process Data Sheet
Internal Gaskets	Non-Asbestos.
Tray Support Rings	Same as shell material
Demister Support	Same as shell material
Stiffeners (External pressure)	Same as shell material
* MDS shall be referred for material of external bolts / nuts and in case of discrepancy between this material specification and MDS, the same shall be referred to CLIENT/Jacobs for clarification.	

**8. MATERIAL SPECIFICATION FOR PARTS OF TANKS**

<i>MATERIAL SPECIFICATION FOR PARTS WHEN SHELL / BOTTOM AND ROOF PLATE IS SA 36 / IS 2062 Gr. B / SA 516 Gr.70 / SA 516 Gr. 60</i>	
Reinforcement Pad / Pad for external attachment	Same as shell material
Nozzles Pipes upto 10" NB	SA 106 Gr. B
Nozzle $\geq$ 12" NB and Man way necks	Same as shell material
Nozzle Flanges	SA 105
Man way Flanges	Same as shell and roof material
Fittings	SA 234 WPB
Gaskets	As per Piping Material Specification
External Bolts & Nuts	* SA 193 GR B7 / SA 194 GR 2H
Internal Bolts & Nuts	SS 304
Bolting for structures	IS 1363 / IS 1367
Structures	IS 2062 Gr. B
Internal	Same as shell material or as specified in Process Data Sheet
Hand railing, Stairway, Platform	IS 1239 Cl.1 as per standard / SA 53/IS2062 Gr. A/B
External cleats	Same as shell material for temperature > 343deg.C
Heating coil	SA 106 Gr B / As per Process Data Sheet
Wind girder	Same as shell material
* MDS shall be referred for material of external bolts / nuts and in case of discrepancy between this material specification and MDS, the same shall be referred to CLIENT/Jacobs for clarification.	

**9. MATERIAL SPECIFICATION FOR PARTS OF MONEL400 CLAD EQUIPMENT**

<i>MATERIAL SPECIFICATION FOR PARTS WHEN SHELL / DISHED HEAD IS SA 516 Gr. 70 + MONEL 400 CLADDING / WELD OVERLAY</i>	
Reinforcement Pad / Pad for external attachment	SA 516 Gr. 70
Nozzles & pipes	** SA 106 Gr. B + Monel 400 Weld overlay <8" NB. "Same as shell material" for 8" NB and above (with full radiography of weld joints)
Flanges	SA 105 + Monel 400 Weld overlay
Forgings	SA 266 + Monel 400 Weld overlay
Fittings	SA 234 WPB + Monel 400 Weld overlay
Couplings	SA 105 + Monel 400 Weld overlay
Gaskets	As per Piping Material Specification
External Bolts & Nuts	SA 193 Gr. B7/SA 194 Gr. 2H upto 343°C *SA 193 Gr. B16/SA 194 Gr. 4 for temp. > 343°C
Internal Bolts & Nuts	MONEL 400
Skirt support for min. top 1m (top 2m in case of design temp. ≥400°C)	SA 516 Gr. 70
Skirt / Base Plate	SA 283 Gr. C
Saddle support	SA 516 Gr. 70
External cleats	SA 516 Gr. 70
Internal parts	Monel 400 / As specified in Process Data Sheet.
Internal Gaskets	Non-Asbestos.
Tray Support Rings	Monel 400
Demister Support	Monel 400
Stiffeners (External pressure)	SA 516 Gr. 70
<p>* MDS shall be referred for material of external bolts / nuts and in case of discrepancy between this material specification and MDS, the same shall be referred to CLIENT/Jacobs for clarification.</p> <p>** For small size if weld overlay is not possible in seamless pipe (3" NB &amp; below) it shall be cut in two pieces and after weld overlay and proper finish these two pieces shall be welded and weld seams shall be fully radiographed.</p> <p>Note: In case of Monel weld overlay ferrite content shall be checked and the same shall be limited to 2.5% at the depth of 3 mm cladding.</p>	

**10. PICKLING & PASSIVATION PROCEDURE FOR SURFACE CLEANING ON MONEL CLAD SURFACE**

SURFACE CLEANING OF MONEL (SB 127) 400 CLAD SURFACE

1.0 The following pickling procedure shall be adopted for cleaning the internal surfaces of the Monel cladding / weld overlay.

1.1 Swab with a solution made of

Water	:	1 gal.
Nitric acid (42 D Be)	:	1 gal.
Common Salt	:	2 lb.
Temperature	:	70-100 °F (ambient)
Time	:	5 Sec.

1.2 Rinse clean repeatedly with hot water (180°F)

1.3 Second swab with a solution with

Water	:	1 gal.
Nitric acid (42 D Be)	:	1 gal.
Temperature	:	70-100 °F (ambient)
Time	:	5 Sec.

1.4 Neutralisation by swabbing 1-2% soda ash followed by hot water rinse.

1.5 Cleaning with saw dust or dry cloth cleaning

The procedure shall be pre-qualified before being employed on the vessel.



**11. MATERIAL SPECIFICATION FOR PARTS OF LOW ALLOY STEEL (1¼ Cr-1/2Mo) EQUIPMENT WITH SS347 CLAD**

<i>MATERIAL SPECIFICATION FOR PARTS WHEN SHELL / DISHED HEAD IS SA 387 GR. 11CL.1 + SS 347 CLAD</i>	
Reinforcement Pad/Pad for external attachment	SA 387 Gr. 11 Cl. 1
Nozzles & Pipes	** SA 335 P 11 (seamless) + SS347 Weld overlay <12" NB
	"Same as shell material" for 12" NB and above (with full radiography of weld joints)
Flanges	SA 182 F 11 Cl. 2 + SS 347 Weld overlay
Forgings	SA 336 + SS 347 Weld overlay
Fittings	SA 234 WP 11 Cl. 1 + SS 347 Weld overlay
Couplings	SA 182 F 11 Cl. 2 + SS 347 Weld overlay
Gaskets	As per Piping Material Specification
External Bolts & Nuts	SA 193 Gr. B7/SA 194 Gr. 2H upto 343°C *SA 193 Gr. B16/SA 194 Gr. 4 for temp. > 343°C
Internal Bolts & Nuts	SS 304 / as per Process Data Sheet
Skirt support for min. top 1m (top 2m in case of design temp. ≥ 400°C)	Same as shell material
Skirt / Base Plate	SA 283 Gr. C
Saddle support	Same as shell material
Welded internal parts	Same as shell material
Removable Internal parts	As specified in Process Data Sheet
External cleats (Directly welded to vessel)	Same as shell material
Internal Gaskets	As specified in Process Data Sheet
Tray support ring	Same as shell material
Demister support	Same as shell material
Stiffeners (External pressure)	Same as shell material
<p>* MDS shall be referred for material of external bolts / nuts and in case of discrepancy between this material specification and MDS, the same shall be referred to CLIENT/Jacobs for clarification.</p> <p>** For smaller size if weld overlay is not possible in seamless pipe (3" NB &amp; below) it shall be cut in two pieces and after weld overlay and proper finish these two pieces shall be welded and weld seams shall be fully radiographed.</p>	

**12. MATERIAL SPECIFICATION FOR PARTS OF LOW ALLOY STEEL (2¼Cr-1Mo) EQUIPMENT WITH SS347 CLAD**

<i>MATERIAL SPECIFICATION FOR PARTS WHEN SHELL / DISHED HEAD IS SA 387 GR. 22 CL.2 + SS 347 CLAD</i>	
Reinforcement Pad / Pad for external attachment	SA 387 Gr. 22 Cl. 2
Nozzles & Pies	** SA 335 P 22 + SS 347 Weld Overlay (seamless) < 12" NB. "Same as shell material" for 12" NB and above (with full radiography of weld joints)
Flanges	SA 182 F 22 + SS 347 Weld Overlay
Forgings	SA 336 / SA 541 + SS 347 Weld overlay
Fittings	SA 234 WP 22+ SS 347 Weld Overlay
Gaskets	As per Piping Material Specification
External Bolts & Nuts	SA 193 Gr. B7/SA 194 Gr. 2H upto 343°C *SA 193 Gr. B16/SA 194 Gr. 4 for temp. > 343°C
Internal Bolts & Nuts	SS 304 / as specified in Process Data Sheet
Skirt support for min. top 1m (top 2m in case of design temp. ≥ 400°C)	Same as shell material
Skirt / Base Plate	SA 283 Gr. C
Saddle Support	Same as shell material
Welded internal parts	Same as shell material
Removable Internal parts	As specified in Process Data Sheet
External cleats (Directly welded to vessel)	Same as shell material
Internal Gaskets	Non-Asbestos
Tray supporting	Same as shell material
Demister Support	Same as shell material
Vacuum Stiffeners	Same as shell material
<p>* MDS shall be referred for material of external bolts / nuts and in case of discrepancy between this material specification and MDS, the same shall be referred to CLIENT/Jacobs for clarification.</p> <p>** For smaller size, if welded overlay is not possible in seamless pipe (3" NB &amp; below) it shall be cut in two pieces and after weld overlay and proper finish, these two pieces shall be welded and weld seams shall be fully radiographed.</p>	

**13. MATERIAL SPECIFICATION FOR PARTS OF HIGH THICK (>50 MM) C.S. EQUIPMENT**

<i>MATERIAL SPECIFICATION FOR PARTS WHEN SHELL / DISHED HEAD IS SA 516 Gr. 60 / 70 / SA 266 Gr.2</i>	
Pad for external attachment	Same as shell material / SA516 Gr. 70
Pipes (Except for nozzles directly welded to vessels)	SA 106 Gr. B (Seamless) < 12" NB. "Same as shell material" for 12" NB and above (with full radiography of weld joints)
Flanges & SR Nozzles including integral type flanges	SA 350 GR. LF2
Fittings	SA 234 WPB
Gaskets	As per Piping Material Specification
External Bolts & Nuts	* SA 193 GR. B7/SA 194 Gr. 2H upto 343 °C * SA 193 GR. B7/SA 194 Gr. 4 Temp. > 343 °C
Internal Bolts & Nuts	SS 304 / as specified in Process Data Sheet
Wrapper Plate	Same as Shell Material / SA516 Gr. 70
Skirt support for min. top 1m (top 2m in case of design temp. ≥ 400°C)	Same as shell material
Skirt / Base Plate	SA 283 Gr. C
Saddle Support	SA 283 Gr. C upto 343 °C Same as shell material for temp > 343 °C
Welded internal parts **	Same as shell material / SA516 Gr. 70
Removable Internal parts	As specified in Process Data Sheet
External cleats (Directly welded to vessel)	Same as shell material
External cleats with pad (same as shell / head material)	SA 283 Gr. C upto 343 °C Same as shell material / SA516 Gr.70 for temp > 343 °C
Internal Gaskets	Non-Asbestos
Tray support ring	Same as shell material / SA516 Gr. 70
Demister Support	Same as shell material / SA516 Gr. 70
* MDS shall be referred for material of external bolts / nuts and in case of discrepancy between this material specification and MDS, the same shall be referred to CLIENT/Jacobs for clarification.	
** For welded internal parts of clad portions of equipment, refer to respective material specifications / Mechanical Data sheet.	



**DEPARTMENT:** INSTRUMENTATION

**DOCUMENT NO:** 44AC9100-000-J.02-0001-A4

**DOCUMENT TITLE:** ENGINEERING DESIGN BASIS INSTRUMENTATION

**ITEM:**

**PROJECT NO:** 44AC9100

**PROJECT LOCATION:** DUMAD/IOCL-JR, Gujarat

**PROJECT TITLE:** EPCM/PMC SERVICES FOR ACRYLICS / OXO ALCOHOL PROJECT AT GUJARAT REFINERY AND DUMAD

**CLIENT:** INDIAN OIL CORPORATION LIMITED

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## 1.0 GENERAL

1.1 This design basis covers the general requirements for instrumentation design, fabrication and installation.

1.2 The following order of priority shall be governed when any contradictions are found between the various specifications, drawings, standards and statutory regulations or requirement.

- 1st priority : Statutory Regulation requirement
- 2nd priority : Process Licensor's documents
- 3rd priority : Job Specifications & Job Drawings
- 4th priority : Engineering Design Basis
- 5th priority : Standard Specifications, standard Drawings & Engineering standards

Note: In case of any conflicts most stringent requirements shall be followed, however it shall be obligatory on the contractor's part to bring such conflicts to the notice of owner/PMC, wherein owner/PMC decision shall be final.

This document specifies minimum requirement but not limited to only these, Instrumentation, Control system required for proper, safe and efficient operation and maintenance of the plant shall be considered.

## 1.3 LEGEND

Following marks shall be checked in the relevant square box wherever this type of check box used.

- : Applicable
- : Mostly applicable
- : Partially applicable
- : Not applicable
- : To be decided during Engineering

## 1.4 PROJECT TITLE

- Project Name : EPCM/PMC Services for Acrylics/ Oxo-Alcohol Project at Gujarat Refinery and Dumad
- Owner : Indian Oil Corporation Limited
- Location : Dumad & Vadodara, Gujarat, India

## 2.0 CODES, STANDARDS AND REGULATIONS

Applicable national / international standards

Design and terminology shall comply, as a minimum, with the latest edition prior to the date of purchaser's enquiry of following codes, standard practices and publications:

<b>AGA</b>	<b>(American Gas Association)</b>
AGA Report no.3.1	Orifice Metering of Natural Gas and other related hydrocarbon fluids. (General Equations & uncertainty guidelines), fourth edition (year-2012), 2nd printing-2013.
AGA Report no.3.2	Orifice metering of natural gas and other related hydrocarbon fluids part 2 Specification and Installation Requirements-Fifth Edition (year-2016)
AGA Report no.3.3	Orifice metering of natural gas and other related hydrocarbon fluids part 3 Natural gas application, Third Edition (year-2013)
AGA Report no.3.4	Orifice metering of natural gas and other related hydrocarbon fluids part 4 Background Development Implementation Procedure and Subroutine Documentation for Empirical Flange- Tapped Discharge Coefficient Equation, Third Edition (year-1992), Reprinting-2003
AGA Report no.7	Measurement of Gas by Turbine meters. (Year -2006)
AGA Report no.-9	Measurement of Gas by Multi-Path Ultrasonic meters. (Year – 2017)
<b>ASME</b>	<b>(American Society of Mechanical Engineers)</b>
ASME B 1.20.1	Pipe Threads General Purpose (inch) (Year - 2013)
ASME B 16.5	Steel Pipe Flanges and Flanged Fittings (Year- 2017)
ASME B 16.10	Face-to-Face and End-to-End Dimensions of Valves (Year- 2017)
ANSI B 16.20	Ring Joint Gaskets and Grooves for Steel Pipe Flanges (Year- 2012)
ASME B 16.34	Valves- Flanged, Threaded & Welding End (Year- 2017)
ANSI B 16.36	Orifice Flanges (Year- 2015)
ANSI B 16.37	Hydrostatic Testing of control Valve (Year 1980)
ANSI B 16.47	Large Diameter Steel Flanges (NPS 26 thru NPE 60) (Year 2017)
ANSI B40.100	Gauges and Pressure Indicating Dial Type, Elastic Element (Year 2013)
ANSI/FCI	(American National Standards Institute/Fluid Controls Institute)
FCI 70.2	Control Valve Seat Leakage Classification (Year-2013)
<b>ASME</b>	<b>(American Society of Mechanical Engineers)</b>
Section – VIII	Boiler and Pressure Vessel code rules for construction of pressure vessels (Year- 2017)
Section – I	Boiler and Pressure Vessel code. Section-1 'Power Boilers.' (Year- 2017)
ASME PTC 19.3	Thermowells- Performance Test Codes (Year – 2016)
ASME A-269	Standard Specification for Seamless and Welded Austenitic Stainless-Steel Tubing for General Service.
<b>API</b>	<b>(American Petroleum Institute)</b>
API RP520	Sizing, selection & installation of pressure relieving system in refineries.
Part I	-Sizing and selection, 9th edition (Year- July 2014)
Part II	-Installation 6th edition (Year- March 2015)
API RP521	Pressure relieving and depressurizing systems. 6th Edition April 2009
API RP526	Flanged steel safety relief valves. 6th edition Apr. 2009
API RP527	Seat tightness of pressure relief valves 4th Edition Nov 2014
API RP551	Process Measurement Instrumentation.



API RP552	Part -1 Process Control and Instrumentation, II Edition-2016
API RP553	Transmission Systems (Year - Feb 2017)
	Valves and Accessories for Control and Safety Instrumented Systems (Year - II Edition Oct 2012)
API RP554	Process Instrumentation and Control (Year- 1995)
	Part 1-Process Control Systems Functions and Functional Specification Development, Second Edition (Year-2007)
	Part 2-Process Control Systems Process Control System design, First Edition (Year-2008)
	Part 3-Process Control Systems Project Execution and Process Control System Ownership, First Edition (Year-2008)
API RP555	Process Analyzers (Year- 2001, Reaffirmed 2007)
API RP557	Guide to Advance Control systems (Year – 2013)
API 598	Valve Inspection and Testing (10th edition, October 2016)
API 609	Butterfly Valves: Double Flanged, Lug and Wafer Type (VII Edition - Feb 2016)
API 610	Centrifugal Pumps (latest Edition).
API 611	Steam Turbines
API 612	Steam Turbines
API 618	Reciprocating Compressor.
API 2540	Manual of Petroleum Measurement Standards
STD.2000	Venting Atmospheric and low-pressure storage tank (Year - 7th Edition March 2014)
STD. 670	Vibration, Axial-Position and Bearing-Temperature Monitoring Systems (Year-2010)
<b>BS</b>	<b>(British Standards)</b>
BS1042	Measurement of fluid flow in closed conduits
BSI BS 3463	Observation and Gauge Glasses for Pressure Vessels
BS-7244	Flame arrestors (Year- 1990)
BS-6364	Specification for valves for cryogenic service –(Year-1984)
EN-50288-7	Multi-element metallic cables used in analogue and digital communication and control. Sectional specification for instrumentation and control cables (Year-2005)
BS-6121	Mechanical Cable glands
BS 5308 PART-II	Instrumentation cables. Specification for PVC insulated cables
<b>CENELEC</b>	<b>Committee European de Normalization Electro technique</b>
<b>DIN</b>	<b>German Standards</b>
DIN 60947-5-6	Low Voltage switchgear & control gear (Year-2000-12)
DIN-10204	Inspection Documents for Metallic Products (year-2005)
DIN-19234	Measurement and control - electrical distance sensors - DC interface for distance sensor and signal converter
<b>IEC</b>	<b>(International Electro-Technical Commission.)</b>
IEC 60079	Electrical apparatus for Explosive Gas atmosphere (Year -2017)
IEC 60079-1	Explosive atmosphere equipment protection by flameproof enclosure 'D' (Year -20014 & 2018)
IEC 60079-11	Explosive atmospheres – Part 11: Equipment protection by intrinsic safety "i" (Year -2011 & 2014)
IEC60085	Thermal Evaluation and Classification of Electrical Insulation. (Year -2007)

IEC60227	PVC Insulated Cables.
IEC60331	Fire resisting characteristics of electrical cables (2018)
IEC60332	Tests for Electrical Cables Under Fire Conditions – Circuit Integrity.
IEC60332	Tests for Electrical Cables and Fiber Optic cables under Fire Conditions (Year – 2009)
EN 60529	Degrees of Protection Provided by Enclosures. (IP Code) – (Year- 2013)
IEC60534.1	Control valve terminology and general considerations
IEC60534-2-1	Industrial Process Control Valves-Flow capacity - Sizing equations for fluid flow under installed conditions (Year-2011)
IEC60534-2-3	Industrial Process Control Valves-Flow capacity – Test procedures (Year-1997)
IEC60534.8	Noise Prediction for Industrial Process Control Valves
IEC60584-2	Thermocouple – Tolerances (Year-2013)
IEC60751	Industrial Platinum Resistance Thermometer & Platinum Temperature Sensors. (Year-2008)
IEC60754	Test on Gases Evolved During Combustion of Materials from Cables – Part 1 Determination of the Amount of Halogen Acid Gas.
IEC60801	Electromagnetic compatibility for Industrial Process Measurement and Control equipment. (Year-1993)
IEC61000-4-1	Electromagnetic Compatibility-Part-4-1 Testing and measurement techniques - Overview of IEC 61000-4 series (Year-2016).
IEC61000-4-2	Electromagnetic Compatibility-Part-4-2 Testing and measurement techniques - Electrostatic discharge immunity test (Year-2009).
IEC61000-4-3	Electromagnetic Compatibility-Part-4-3 Testing and measurement techniques - Radiated, radio-frequency, electromagnetic field immunity test (Year-2010).
IEC61000-4-4	Testing and Measurement techniques – Electrical Fast Transient/burst Immunity Tests
IEC61000-4-5	Testing and Measurement techniques – Surge Immunity
IEC61034	Measurement of Smoke Density of Cables Burning Under Defined Conditions. Part 2 Test Procedures and Requirements
IEC 61508	Functional safety of Electrical/Electronic Programmable Electronic Safety Related System (Year-2010)
IEC 61511	Functional safety: safety Instrumented systems for the Process Industry sector (Year-2017)
IEC 61158	Digital data communications for measurement and control –. Fieldbus specification.
IEC A S-73-532	Standard for control, Thermocouple, Extension and instrumentation cable.
IEEE C37.90.1	Surge Withstand Capability (SWC) Tests for Protective Relays and Relay Systems Associated with Electric Power Apparatus (Year-2012)
<b>IS</b>	<b>(Indian Standards)</b>
IS-5	Colours for ready mixed paints (Year- 2007)
IS-319	Specification for free cutting Brass bars, rods and sections (Year -2007)
IS-1239-1	Mild steel tubes, tubular and other wrought steel fittings. (Year -2010)
IS-1239-2	Steel Tubes, Tubulars and Other Steel Fittings Part 2 Steel Pipe Fittings. (Year -2011)
IS-1271	Specification of Thermal Evaluation and Classification of Electrical Insulation. (Year -2012)
IS-1554 Part-1	PVC insulated (heavy-duty) electric cables working Voltage up to and including 1100V. (Year- 2010)
IS-2074	Ready mixed paints, air drying, and red oxide-zinc chrome. (Year 2006)
IS-2147	Degree of Protection provided by enclosures for low voltage switch gear and control gear
IS-2148	Flameproof enclosures for electrical apparatus for explosive Gas

IS-3624	Atmospheres – Flame proof Enclosures ‘d’. (Year- 2004)
IS-5608	Specification for pressure and vacuum gauges (year 1987)
	Specification for Low Frequency cables and wires with PVC Insulation and PVC Sheath
IS-5831	PVC insulation and sheath of electric cables. (Year -2016)
IS-7358	Specifications for Thermocouples (Year- 2015)
IS-8784	Thermocouple compensating cables. (Year- 2018)
IS-8130	Conductors for insulated electric cables and flexible cords (Year 2013)
IEEE C37.90.1	Surge Withstand Capability (SWC) Tests for Relays and Relay Systems Associated with Electric Power Apparatus.

**ISA**

**(Instrument Society of America)**

ISA 5.1	Instrument symbols and Identification (Year- 2009)
ISA 5.2	Binary logic diagrams for process operation (Year-1992)
ISA 5.3	Graphic symbols for Distributed Control/Shared Display Instrumentation Logic and Computer symbols (Year – 1983)
ISA 5.4	Instrument Loop Diagrams (Year – 1991)
ISA 7.3	Quality standards for instrument air. (Year-1996)
ISA 18.1	Annunciator sequences and Specifications (Year – 2004)
ISA 75.01	Flow equations for sizing control valves. (Year- 2012)
ISA 75.03 & 75.04	Face to Face Dimension for Control Valve Body
ISA S84.00.01P1/P2/P3	Application of Safety Instrumented Systems in the Process Industries
RP-75.08.01	Face to Face dimension of integral flanged globe control valve (Year-2007)
75.19.01	Hydrostatic Testing of Control Valve
ISA 71.01	Environmental Conditions for Process Management and Control System, Temperature and Humidity
ISA 71.04	Environmental Conditions for Process Measurement and Control Systems: Airborne Contaminants

**ISO**

**(International Organization for standardization)**

ISO 5167	Measurement of fluid flow by means of orifice plates, nozzles and venturi tubes inserted in circular cross-section conduits. -Year 2003
ISO 5208	Industrial valves - Pressure testing of metallic valves (Year – 2015)
ISO 4266:1994	Petroleum and liquid petroleum products– Measurement of temperature and level in storage tanks–Automatic Methods
ISO 10497	Testing of valves -- Fire type-testing requirements
ITU-T-G652	Characteristics of a Single Mode Optical Fibre Cable.

**Other standards:**

**NACE**

**National Association of Corrosion Engineers**

NACE MR0175	Petroleum & Natural Gas Industries - Material for Use H2S-Containing Environments in Oil & Gas Production (ISO15156)
MR-01-03	Sulphide stress cracking resistant metallic materials for oilfield equipment. (Year – 2015)
NEC	National Electric code.
NEMA	National Electrical Manufacturer’s Association
NFPA	National Fire Protection Association.
NFPA-496	Purged and pressurized enclosures for electrical equipment. (Year 2017)
OSHA	Occupational Safety and Health Authority.
MPMS	Manual of Petroleum measurement standards.
SAMA	Scientific Apparatus Maker’s Association.
OISD-STD-132	Inspection of Pressure Relieving Devices. (Year -1999)
OISD-STD-152	Safety System Instrumentation for process in HC Industry. (Year-2008)

OISD-STD-163

Process control room Safety. (Year- 2004)

IBR

Indian Boiler Regulations 1950 (Including Amendments in year 2017)

AG-181

FOUNDATION™ Fieldbus System Engineering Guidelines.

Apart from above listed OISD (Oil Industry Safety Directorate), the latest standards applicable as on date of enquiry for Instrumentation of Packages like Turbine, Compressor, Diesel Engines and Fire protection system etc.

### 3.0 GENERAL DESIGN REQUIREMENTS

#### 3.1 ENVIRONMENTAL CONDITIONS

All instruments shall be provided with adequate protective measures against the climatic condition at specified project sites of IOCL.

Table - 3.1.1: Meteorological design data/ Climatic data for Dumad

Sr. No.	Parameter	Minimum	Normal / Average	Maximum / Design						
<b>(A) METEOROLOGICAL DATA</b>										
1	Elevation above mean sea level, m		36.6							
2	Barometric pressure, kg/cm <sup>2</sup> (a)	1.020	1.028	1.033						
3	Ambient temperature, °C	t <sub>min</sub> = 4.4	t <sub>nor</sub> = 30.0	t <sub>max</sub> = 46.7						
4	Relative humidity, %	21		89						
5	Rainfall data: (a) for 1-hour period, mm (b) for 24-hours period, mm Rainy season from July to September			77 428						
6	Wind data (a) wind velocity, km/h (Note-1) (b) wind direction			44 m/s						
	Wind direction from	N	E	S	W	Calm	NE	SE	SW	NW
	%age of time	5	2	6	10	36	11	2	24	4

Table - 3.1.2: Meteorological design data/ Climatic data for Gujarat Refinery (JR)

Sr. No.	Parameter	Minimum	Normal / Average	Maximum / Design						
<b>(A) METEOROLOGICAL DATA</b>										
1	Elevation above mean sea level, m		36.6							
2	Barometric pressure, kg/cm <sup>2</sup> (a)	1.020	1.028	1.033						
3	Ambient temperature, °C	t <sub>min</sub> = 4.0	t <sub>nor</sub> = 30.0	t <sub>max</sub> = 46.7						
4	Relative humidity, %	21		89						
5	Rainfall data: (c) for 1-hour period, mm (d) for 24-hours period, mm Rainy season from July to September			77 428						
6	Wind data (c) wind velocity, km/h (Note-1) (d) wind direction			44 m/s						
	Wind direction from	N	E	S	W	Calm	NE	SE	SW	NW
	%age of time	5	2	6	10	36	11	2	24	4

Also refer process design basis (Doc No. 44AC9100-0000/P.06/0001/A4).

### 3.2 UTILITIES

Table - 3.2.1: Utility conditions at battery limit of a process unit in Dumad.  
(All B/L pressures are as measured at grade)

Sr. No.	Parameter	Minimum	Normal	Maximum	Mech Design
1	PLANT AIR				
	Pressure, kg/cm <sup>2</sup> (g)	3	4.5	7	10
	Temperature, °C	35	40		65
2	INSTRUMENT AIR				
	Pressure, kg/cm <sup>2</sup> (g)	3.5	5.2	7	10
	Temperature, °C	35	40		65
	Dew point @ atm. press. °C	(-) 40			

Table – 3.2.2: Utility conditions at Unit battery limit in Gujarat refinery (JR)  
(All B/L pressures are as measured at grade)

Sr. No.	Parameter	Minimum	Normal	Maximum	Mech Design
1	PLANT AIR				
	Pressure, kg/cm <sup>2</sup> (g)	3	4.5	7	10
	Temperature, °C	35	40		65
2	INSTRUMENT AIR				
	Pressure, kg/cm <sup>2</sup> (g)	3.5	5.2	7	10
	Temperature, °C	35	40		60
	Dew point @ 15 kg/cm <sup>2</sup> g; °C	(-) 15			

Also refer process design basis (Doc No. 44AC9100-0000/P.06/0001/A4).

### 3.3 INDOOR DESIGN CONDITION

The design condition for indoor or building Room's shall be as per ISA 71.01.

Sr. No.	Room	Temp °C	Relative humidity (%)
1	Control Room (Operator Room)	18 - 27	35-75

### 3.4 UNITS OF MEASUREMENT / INSTRUMENT SCALES / DISPLAY UNITS

Engineering Unit shall be in Metric.

- Liquid Flow                      Kg/hr (Mass) & m<sup>3</sup>/hr (Volume)
- Gas/Vapor Flow                  Nm<sup>3</sup>/hr
- Steam Flow                        Kg/hr / T/hr
- Level                                % / mm
- Pressure & Diff. Pressure      Kg/cm<sup>2</sup> (g) / mm of WC
- Vacuum Pressure                Kg/cm<sup>2</sup> (a) / mm of WC / mm of Hg

- Temperature °C
- Density Kg/m<sup>3</sup>
- Viscosity cP
- Kinematic Viscosity cSt
- Composition vol% or mol% (for Gas), wt% (for Liquid)
- Power kW
- Noise (Sound Level) dB(A)
- Conductivity S/cm, u/cm

Also refer process design basis (Doc No. 44AC9100-0000/P.06/0001/A4).

### 3.5 ACCURACY OF THE INSTRUMENTS

Type of Instrument	Accuracy
<b>Electronic Instruments</b>	
Differential pressure & Pressure transmitter – SMART (HART/ FF)	± 0.04% or better for more than 760 mmWC
Draft range Pressure transmitter – SMART (HART/ FF)	± 0.15% of span for below 760 mmWC
Diaphragm seal transmitter – SMART (HART/ FF)	± 0.25% of span for above 500 mmWC
	± 0.5% of span for below 500 mmWC
Displacement type level transmitter	± 0.2% FS (Smart)
Magnetic type flow meter	± 0.5% FS
Positive displacement flow meter, Raw material and Product, Others,	± 0.2% FS
	± 0.5% FS
Temperature Transmitter SMART (HART/ FF)	± 0.2% of calibrated span for RTD
	± 0.5% of calibrated span for Thermocouples
Turbine meter or Mass flow meter, Raw material and Product, Others,	± 0.2% FS
	± 0.5% FS
Ultrasonic type flow meter	± 1.5% FS (0.5 %)
Vortex flow meter	± 1.0% FS
Variable transmitter area type flow meter with Transmitter	± 2.0% FS
<b>Tank gauge</b>	
Servo type tank gauge	± 2 mm (up to 20 m height)
Radar type tank gauge	± 1 mm or better for custody transfer
	± 5 mm or better for normal application
<b>Local Instruments</b>	

Draft Pressure gauge	± 3.0% FS
Displacement type level indicator	± 1.0% FS
Filled system/Bimetallic Temp. gauge	± 1.0% FS
Pressure gauge	± 1.0% FS
Receiver Pressure gauge	± 1.5% FS
Small size pressure gauge	± 3.0% FS
Thermocouple & Resistance Temp. Element	Applicable Codes/Standards
Variable area type flow meter (Local Indicator)	Vendor's standard accuracy is applied.

- Accuracy of instrument and special articles except for the above-mentioned instrument shall be in accordance with the applicable codes/standards, or Vendor's standards as approved by Purchaser.
- FS: Full scale (Selected Span)
- Overall rangeability of transmitter except for draft range & wafer seal transmitters shall be 100:1. Draft range transmitter rangeability shall be 30:1 & wafer seal transmitters shall be 20:1 or better, for the accuracy indicated above.

### 3.6 STANDARDS FOR INSTRUMENT CONNECTIONS, MATERIAL & ENCLOSURE

Instrument connections, material of construction and type of enclosure protections shall be as per following codes & standards.

- Flange	ANSI	<input checked="" type="checkbox"/>	
- Thread	NPT	<input checked="" type="checkbox"/>	
- Material	ASTM	<input checked="" type="checkbox"/>	
- Area Classification	CENELEC	<input checked="" type="checkbox"/>	
- Explosion-proof	CENELEC	<input checked="" type="checkbox"/>	IS-2148 <input checked="" type="checkbox"/>

### 3.7 CLASSIFICATION OF HAZARDOUS AREAS

- Process area
  - Hazardous area, Refer hazardous area drawings
  - Non-hazardous area
- Utility / Offsite area
  - Hazardous area, Refer hazardous area drawings
  - Non-hazardous area, Refer hazardous area drawings
- Control room
  - Non-hazardous area
- Satellite Rack room (SRR):
  - Hazardous area, Refer hazardous area drawings
  - Non-hazardous area



### 3.8 EXPLOSION PROTECTION METHODS

- Flame proof  
 Used for field transmitters, Analyses requiring separate power supply  
  
 Used for Local Control Panels in Hazardous area  
(All internal components / instruments to be flame proof)
- Intrinsically safe  
 Used for Field Transmitters, FF instruments, I/P Converters, SMART Positioner, Proximity Switches, Solenoid Valves & analyzers if available
- Pressurized  
 Pressurized panels to be used only for vibration monitoring System display unit.

Instrumentation of all plants of Project shall be complete in all respects for the safe, efficient and easy operation, start up and shutdown of the units.

All instruments and equipment shall be suitable for use in a hot, humid and tropical industrial climate in which corrosive gases and/or chemicals may be present. As a minimum, all instruments and enclosures in field shall be dust proof, weather proof to IP65 or NEMA 4X and secure against the ingress of fumes, dampness, insects and vermin. All the field instruments and equipment's other than used for H2 service shall be suitable for Zone 1, Gas Grp. IIA & IIB, T3. Field instruments & for H2 service shall be suitable for Zone-1 Gas Grp. IIC, T3. as minimum.

All transmitters/instruments shall be certified for use in the specified hazardous area classification by any recognized authority like CMRS, FM, CENELEC, PTB, BASSEFA etc. All solenoid valves shall be of Low power, IS type with operating Voltage 24V DC and certified for use in specified hazardous area and shall be SIL-3 certified as minimum.

All intrinsically safe and explosion proof instruments and accessories shall in addition to the approvals by any of the above agencies have the certification of Petroleum & Explosives Safety Organization (PESO) / Chief Controller of Explosives (CCOE), Nagpur, India. This is a mandatory requirement.

Instrument systems shall be designed to avoid interaction between associated electrical circuits. Spurious signals that can cause interference shall be suppressed, preferably at source.

All instruments wetted parts shall be SS316 as minimum and Electronic housing material shall be of Epoxy coated die cast Aluminum.

### **3.9 ELECTROMAGNETIC COMPATIBILITY REQUIREMENTS**

All equipment shall meet the technical requirements as defined in the following specifications:

- IEC 61000 Sections 4.1 thru 4.5 - Electromagnetic Compatibility.
- IEC 61326 section 1 Electrical Equipment for Measurement, Control and Laboratory use -EMC requirements
- IEEE C37.90.1 Surge Withstand Capability (SWC) Tests for Protective Relays and Relay Systems

To demonstrate compliance with the above referenced specifications, the vendor shall submit a 'Technical Construction File' (TCF) or a 'Declaration of Compliance.

### **3.10 SELECTION OF MATERIALS**

The selection of materials for all in-line mounted instruments, including all their components connected to the line, e.g. instrument valves, flow meters etc., shall be in accordance with the associated piping material specification as a minimum. The selection of materials for all on vessel mounted instruments, including all their components connected to the vessel, e.g. level transmitter chambers, level gauges etc., shall be in accordance with the associated vessel trim material specification as a minimum.

Thermowells and orifice plates shall be 316 stainless steel as a minimum.

All remote mounted instruments, including instruments connected to lines or vessels by means of flush or remote mounted diaphragm seals, e.g. transmitters, switches etc., shall be 316 stainless steel as minimum unless process conditions require a more suitable material.

Positive Material Identification (PMI) shall be carried out on all items at Supplier's Works.

### **3.11 ACCESSIBILITY AND READABILITY**

All locally mounted gauges, e.g. level, pressure, temperature gauges etc., and all local electronic indicators shall be readable from grade or permanent platforms.

Locally mounted gauges, measuring elements, Transmitters and root valves at elevations  $\leq$  4 meters shall be considered accessible by a temporary ladder or portable platform. Above this height a permanent platform shall be provided. Instruments that are  $\leq$  0.5 meters from a permanent platform shall be considered accessible from that platform.

### 3.12 ELECTRICAL POWER SUPPLIES FOR INSTRUMENTATION DATA COLLECTION SYSTEMS AND COMPUTERS.

Following are the standard electrical supplies that shall be available for instrument service. However, the supplies may vary based on location of project, which shall be provided separately.

- 110V 50HZ 1 PHASE UPS

This supply is to be used for instrumentation and control system items only. It shall not be used for any other purpose. Two independent supplies will be provided; these shall be used in a dual redundant format, i.e. Instrument cubicles shall be dual fed and utilize redundant PSU's wired in hot standby mode.
- 240V 50HZ 1 PHASE NON- UPS

This supply shall be used for all other instrument services e.g. Cabinet lighting, level gauge illuminators etc.
- 24VDC INTRINSICALLY SAFE

This supply shall be derived in the ESD / DCS and shall be used for all SOV's and field instruments
- 415/240 50HZ

This supply shall be used for instrument loop accessories e.g. hydraulic power pack pumps, MOV.

Type	Tolerance	Back-up holding time	Remarks
<b>110 V AC UPS</b>	110v $\pm$ 10% 50Hz $\pm$ 3%	Refer Electrical Design Basis	
<b>24 V DC</b> (Bulk Power Supply)	24V $\pm$ 1V	N/A	(24 V DC derived from 110 V AC UPS supply)

Power supply redundancy shall be ensured from UPS feeders to all the downstream distribution feeders of DCS, PLC, MMS, F&G, etc. In case of one feeder power OFF from UPS, there should not be any disturbance in plant operation, monitoring and control. V / I / grounding Monitoring of feeders to be configured at DCS.

- 110 V AC, 50Hz UPS
  - Distributed Control System
  - Emergency Shutdown System
  - Package PLC's
  - Package unit's instruments
  - Alarm annunciator
  - Field instruments requiring power supply (4-wire) like mass flow meter ultrasonic flow meter, field analyzers etc.;
  - Fire Alarm Panel
  - Analyzers and analyzer system
  - Chromatographs
  - Local Panel
  - CCTV system
  - Clean Agent
  - Any other system as per process and project requirement.

## 4.0 FIELD INSTRUMENTS

### GENERAL

All Transmitters shall be intrinsically safe & SMART type with HART/ FF protocol (as applicable) with integral LCD indicator and be furnished with test terminals and bypass diode to facilitate field testing without disconnection of integral indicator. The transmitter electronics shall monitor their performance during normal operation. The transmitter diagnostics shall be able to detect both an input sensor failure and transmitter electronics failure. The sensor &/or electronics failure shall be transmitted to the host system (e.g. DCS / PLC). The stability shall be better than +/- 0.5% of upper range limit for 1 year. The transmitters shall have zero and range adjustable, and it shall be specified so that the normal operating value is within 40% to 70% of the calibrated range.

For SMART remote output meters / loop powered local indicators, repeat signal shall be provided from Analog Output card of the control system.

Diaphragm seal instruments with capillary shall be used for crystallizing and viscous fluid services where plugging of the element may occur or where suitable material is not available in highly corrosive services. In these cases, flange material shall be according to piping class, but minimum SS316 & the diaphragm material shall be minimum SS316 or better depending on process requirement. In case of pure H<sub>2</sub> service the transmitter diaphragm shall be gold plated. Flushing / Spacer rings wherever provided shall be from OEM, of minimum SS316 material & shall have seal welded vent & drain connections. Vent & drain valves shall be Gate valves. Capillary shall be of minimum SS316 material and shall have SS 304 armoring with PVC covering. Seal fluid shall be silicone oil only. Cable entry shall be 1/2" (NPTF).

For flow, level, pressure and DP, the body and other wetted parts material shall be SS 316 minimum. Other materials such as Hastelloy, Monel or tantalum may be used as per process requirement. The transmitters shall have over-range protection. Transmitters shall have minimum static pressure rating of 100 Kg/Cm<sup>2</sup>g except for very low range and wafer seal transmitters for which the static pressure shall be considered suitably based on the availability. All transmitters shall be provided with lightning & surge protections.

Transmitters shall be used in process application as level, pressure, temperature and flow measurement.

Field Transmitters shall be used in place of switches for all the PLC / ESD inputs used in process interlocks.

During HAZOP and SIL study/reviews, any requirement / addition of new instruments to meet the safe operation and SIL level achievement shall be provided / considered.

This document covers some of the type of instruments. Any other type that is specifically required and suitable for the application and service shall be considered by the contractor, package unit vendor.

### 4.1. FLOW INSTRUMENTS

The choice of primary differential producing devices will depend on service conditions and on the permanent pressure loss, which can be tolerated. A square edged concentric orifice plate is the usual selection if conditions permit. Quadrant edge or quarter circle orifice plates shall be used for viscous liquids and for pipe Reynolds number below 10,000. Conical entrance type of orifice plates shall preferably be used for very highly viscous liquids up to throat Reynolds number of 250. These shall be fabricated as per ISO 5167. Vent and drain holes shall be provided wherever necessary.

For hydrocarbon and high-pressure steam service, unused holes in orifice flange should be plugged and seal welded. Used holes from where the tapping is taken should also be welded.

Coriolis mass flow meters shall be used where greater accuracy is required like for custody transfer, blending, feed flow from battery limit, product flow, Heater fuel lines etc. and for highly viscous and fouling fluids like fuel oil etc. The mass flow meter shall be supplied with remote mounted Electronics and shall have provision for density measurement and compensation. Mass flow meters used in congealing services shall be with integral steam tracing jacket for sensor assembly. Master Meters shall be considered for accuracy checking of mass flow meters in case of custody transfer.

For critical application, mass flow meter multivariable signals (flow, density, temperature, totalizer value etc.) to be taken in control system.

Where Mass flow meter is not applicable Ultra sonic flow meter may be considered.

For the measurement of cooling water flow, Magnetic flow meter/Ultrasonic Flow meters shall be used. To avoid any problem of water ingress in electronics of the flow meters, installation of these flow meters shall be above ground. To achieve this, the portion of CW lines is to be brought above grade level. For extra ordinary cases, instrument with remote electronics and suitable IP class shall be used for installing in the pit with weatherproof canopy/covers and maintenance access.

Magnetic flow meters used for cooling water service. For large pipe line sizes insertion type shall be considered.

Venturi and flow nozzles may be selected where system requires low pressure drops.

Pitot tube should be an averaging pressure type, and may be selected for clean fluids, low- pressure loss and large quantity measurement.

Annubar shall not be used for bidirectional flow.

Vortex meter may be considered for clean liquids, gases and steam measuring application with higher turndown ratio.

Ultrasonic flow meter may be considered for the flow meter on large bore piping such as flare gas measurement.

Thermal mass flow meter to be used for stack flue gas measurement.

Variable area flow meters may be used where measurement with low accuracy is accepted.

Wherever remote display is required the cable between sensor and electronics shall be armoured preferably or it shall run in SS 304 Conduit for protection.

## **1. Orifice Plate**

Orifice plate shall be thin plate with square-edge concentric orifice. The plate shall be mounted between a pair of weld-neck flanges with flange taps to form orifice plate assembly.

- Design calculation of standard type orifice plates shall be as per ISO 5167 (Latest edition).

The flow range shall be selected such that normal flow rates are between 50% and 70% of the flow upper range value.

Beta ratio limits for orifice plates shall generally be between 0.3 and 0.7.

Material of construction of orifice plate shall be SS316 as minimum, except where this material is unsuitable for the service because of corrosion or erosion considerations, in which case an alloy shall

be chosen whose corrosion allowance is equal to or better than line material. Orifice plates dimensions, finishing, flatness, tolerances for dimensions and identification information shall be in accordance with ISO standard. Orifice plate shall be provided with tab handle, which is welded on the orifice plate and engraved with following information on the upstream of the tab handle.

UPSTREAM or UP

Instrument tag number

Orifice diameter

NPS (Nominal Pipe Size) and ANSI flange class rating, Material of the orifice plate

DP range & Meter (Flow) range

Supplier shall submit the sizing calculations for orifice plates for review.

- 1.1 Flange taps orifice shall generally be used for line sizes 2" to 14". Above 14" line size, D and D/2 taps shall be used. Integral Orifice assembly with transmitter shall be used for line size 1-1/2 "or below (as per standard BS-1042)

Orifice assembly shall be provided with two sets of "Flange Taps" located in accordance with the latest standards, in general. The orifice assembly shall be provided with jack screw for removal of orifice plate. Individual taps on the orifice flange shall be provided for individual transmitter (In case of 2 out of 3 logic requirements, three transmitters with independent taps on orifice shall be used. In such case six set of taps shall be provided in orifice assembly.)

Instrument tapping connections shall be 1/2" NPT(F) up to 600# pressure rating. For corrosive and congealing service and for services above 600#; instrument tapping connections shall be 3/4". Maximum schedule of impulse pipes and associated fittings to be used in general is schedule 160. Higher schedules may be used with the concurrence of PMC/ owner. For orifices used for critical flow measurement and for flows used for unit mass balance, the tapping should be drawn min 45 deg. upwards to avoid choking.

Dedicated orifice-tappings shall be used for each transmitter, for the installation of multiple transmitters from a common orifice (Separate tappings shall be provided in case of 2oo3 voting flow transmitters).

Closed-couple installation is preferred for high viscous services, or hydrocarbons contain water. The size (NB) of Impulse line shall be 3/4" in place of 1/2" for corrosive / congealing, and high-pressure service.

- 1.2 Orifice flanges

Orifice flanges shall be in accordance with the ANSI/ASME B16.36 and applicable piping specification. The minimum pressure rating of flanges shall be ANSI 300 lbs. Material shall be as per piping specification as minimum.

## 2. D/P Flow Transmitters

Flow transmitters for use with differential producing devices shall be smart Transmitter with minimum accuracy as mentioned in Table 3.5

The full scale of a differential pressure meter shall be chosen from the following:

- 1250 mm H2 O
- 2500 mm H2 O (preferred)
- 3750 mm H2 O
- 5000 mm H2 O

Piping hookup with three valve manifolds shall be considered for all HC and H2 services irrespective of piping class rating and for all services above 600# rating.

Hybrid hookup with pipes and tubes and not exceeding 2 ferrule tube fittings per impulse pipe may be considered for services below 600# (Non-HC and H2).

Closed coupled installation shall be considered for all services except steam.

Double isolation, double vent / drain valves shall be provided for all H2 / toxic services and for all services above 600# pipe class.

### 3. Rotameters

Rotameters may be required as indicators or transmitters. Accuracy of measurement shall be within 2% full scale. Rotameters shall be mounted in-line for pipe sizes less than 2 inches. / metal tube meters shall be used on hydrocarbon (liquid or gas) service, steam or other hazardous application. Rotameter Rangeability shall be more than 10:1. Flow damper shall be provided for pulsating flow. Cooling fins shall be provided for high temperature service (150 deg. C & above) & extension well shall be provided for low temperature service (0 deg. C and below). Jacket shall be provided for crystallizing fluid at ambient temperature.

## 4.2. LEVEL INSTRUMENTS

### 1. Selection

For most liquid level applications, normally Guided Wave Radar Type Smart level instruments shall be used for level measurement of liquids up to and including 2.4mtr. Side-side flanged connections are preferred when directly connected to the vessel or to stand pipe. The minimum flange rating shall be 300lbs. Transmitters that require heat tracing shall be supplied with the manufacturer standard integral steam tracing jacket. When mounted on still wells the same shall be manufactured from 80 mm NB pipe. Where these restrictions cannot be met differential transmitters shall be considered. All transmitters irrespective of type shall have integral local indicators. For slurries or other difficult services, Wafer / flush diaphragm seal type with extended capillary D/P cells shall be considered. Separate and independent tapping shall be provided for level gauges and level transmitters on the vessels. In case of constraint to provide many nozzles on vessel, stand pipe may be provided to accommodate installation of field transmitters and gauge.

All level instrument process hook-ups, in the services listed below, utilizing impulse piping shall include an excess flow check valve.

This shall be located as close as possible to the isolation "root" valve. Root valves for all high-pressure ( $> =60$  Kg/Cm<sup>2</sup>) applications shall be of double isolation type.

- In hydrogen and toxic services above 40 kg/ cm<sup>2</sup>
- In hydrocarbon and gas services above 70 kg/ cm<sup>2</sup>
- In services where the products are in liquid phase at process operating pressures and in the gas phase at atmospheric pressure, e.g. LPG
- In toxic product services with a threshold limit value (TLV) below 20 and where the gauges are in confined spaces.
- All auto ignition services
- Use of displacer type level instruments shall be avoided as far as possible; Guided wave radar type level instruments shall be used instead.
- Normally, Standpipe to be avoided and individual tapping to be considered. However, if at all standpipe is used, not more than two level instruments shall be installed on a standpipe.



Standpipe shall have isolation valves.

DM plant and all corrosive service shall have non-contact type level instrument.

## 2. Displacement Type Level Instruments

All displacer type level transmitters shall be torque tube type only with Inconel torque tube as a minimum.

For interface level measurements, guided wave type radar instrument shall be considered. However, where GWR is not suitable, displacer type instrument may be used.

Displacer type level instrument shall have external cage unit with 2-inch minimum flanged connections. Standard connections of external cage shall be side - side. Cage material shall be as per piping specification / minimum 316 SS. Displacer shall be minimum of 316 SS. Cooling fins or extension shall be provided where operating temperature is above 200 deg. C or below 0 deg. C.

The transmitter top unit should be rotatable type so that it can be positioned as required. Cable entry for transmitter shall be ½" NPT (F).

## 3. D/P Level Transmitters

Whenever Differential pressure transmitter is considered for level measurement, the element shall be preferably remote seal type with drip ring provision & with welded joint for vent & drain.

Diaphragm seal D/P Level transmitters wherever used shall have 3" ANSI RF process connection with minimum 300# rating. Process tapping shall also be 3" flange.

Where process conditions allow, the ERS type instrument shall be preferred for d/p level measurement.

## 4. Level Gauge

Liquid level gauges shall be used for local indication. Gauge glasses shall be made of borosilicate armoured / toughened glass. Gauge glass shall be a single piece forged construction.

The reflex/transparent gauge glass shall be used on all clean service application. The transparent gauge glass shall be provided with protective shield.

In case of service of crystallizing and viscous fluids, need steam tracing at ambient temperature, level gauge shall be provided with facility of tracing.

Magnetic level indicators may be considered in the place of gauge glasses for corrosive, hazardous or other difficult services.

Gauge cocks shall be provided for all gauges preferably quick operating lever operated forged offset ball type. All level gauges shall be supplied with ½" Drain valve with plug & ½" vent plug and excess flow check valve.

Transparent type glasses shall have integral illuminators operating at 240 V 50 Hz and suitable for the specified electrical area classification wherever required

Transparent type with mica or Kel-F shield shall be used for treated water, boiler and condensate services and corrosive liquids which will attack glass.

The visible range of level gauge shall be selected to cover the operating level, or the operating range of level instruments provided for the vessel.



The maximum visibility length of a single gauge shall not exceed 1500 mm. Generally, glass of 300 mm (approx.) section length shall be used.

On low temperature services with liquids having very high vapour pressure at ambient temperatures, safety valves shall be provided on the vent connection of the gauge glass.

Frost protection shall be considered for minus temperature fluid application. Bi-colour level gauges may be provided if indicated by Licensor.

For high pressure services no threaded joints shall be used.

#### **5. Other level instruments.**

Other special type of level instruments like radar, ultrasonic type, capacitance type, nucleonic type shall be used as necessitated by application requirements.

For the de-salter level, more than one numbers of RF-Capacitance type level transmitter shall be used.

#### **6. Steam Drum Level Measurement**

For high-pressure steam drum application, conductivity type ("Hydra step" or equivalent) level instrument is preferred, In addition to the continuous level measurement.

#### **7. Solid Level Measurement**

For solid level measurement, type of instrument shall be ultrasonic / radio frequency/ nucleonic. The actual type selection shall be carried out based on the proven track record of the selected type for the similar type of application.

### **4.3. PRESSURE INSTRUMENTS**

#### **1. General**

Gauge Pressure / DP transmitters shall be used for measurement & control of process pressure from DCS. Local indication shall be by means of pressure gauges (bourdon tube, diaphragm or other element) to suit the application.

#### **2. Pressure Transmitters**

Pressure transmitters shall have suitable pressure sensing element and normally be with integral indicator.

Transmitters in vacuum service shall be capable of withstanding full vacuum regardless of range, without damage or calibration shift.

Transmitter output, as specified, shall be linear, directly proportional to the applied pressure.

Flush type diaphragm seal element with capillary shall be used for congealing, corrosive and highly viscous services. The extended capillary shall be minimum 3-meter long. The process connection shall be as specified under clause 11.0. The material for the diaphragm shall be as per process requirement, but minimum 316 SS. The flange material and rating shall be as per piping specification /SS-316, 300# minimum.

Differential PGs not to be used instead DPT with local and DCS indication with alarm may use that is safer installation.

### 3. Pressure Gauges

Local indication shall be by means of pressure gauges utilizing a bourdon tube, diaphragm or other element to suit the application.

Local pressure gauges shall have 150mm dials and shall be quality gauges designed for the process industry.

Ranges of gauges shall be selected such that the normal operating pressure indication is approximately at mid-scale.

Accuracy of local pressure gauges shall be  $\pm 1.0\%$  of full scale. Pressure gauges shall be capable of withstanding intermittent overpressures of 1.3 times the maximum scale reading without damage or calibration shift of more than 1% of the scale reading. Blow out disc shall be provided for all ranges & solid front shall be provided for ranges above 100 Kg/cm<sup>2</sup>g.

Gauges connections size shall be 1/2" NPT(M). Connection location shall be bottom for local mounting with wrench flats or back for local panel board with mounting flange.

The standard measuring element shall be a bourdon tube of AISI 316 stainless steel, except where the process fluid requires the use of special material and movement of SS304 as a minimum. Case Material shall be SS as a minimum.

Bourdon tubes shall be welded to socket and tip and stress relieved as required.

Diaphragm type shall be used where necessary to protect gauges from corrosive fluid, crystallizing fluid, fluid including solids, high viscous fluid and high vibration services.

Diaphragm seals shall be of welded diaphragm type close coupled to the instrument or connected to it with capillary tubing.

The connection size for diaphragm type gauge shall be 1-1/2" flanged. The diaphragm material shall be minimum 316 SS & flange material and rating shall be as per piping specification / minimum SS 316.

In case, the diaphragm seal type instrument with extended capillary is used extended capillary tube shall be armoured with stainless steel, and length shall be as determined individually but minimum 3 meters. Silicone oil filled remote capillary gauges alone shall be considered.

Dial face shall be white with black graduations marked. Also, the operating range shall be marked with 'Green' band and above range shall be marked with 'Red' band and below range with yellow band.

The gauge pointer shall be adjustable without removing it from its shaft. All pressure gauges shall be provided with zero adjustment.

### 4. Auxiliary components for pressure gauge

Over range protector (gauge saver) shall be provided where a pressure gauge cannot withstand a protuberant pressure due to unavoidable operation. Over range protector whenever used shall be of SS316, as a minimum

Pulsation dampener shall be provided for all pulsating services e.g. Reciprocating pump discharge piping etc. Pulsation dampeners shall be of minimum SS 316 and have connection 1/2" NPT (F) on both ends. Dampener shall be provided with integral screw head needle valve to adjust aperture externally.

Pigtail type siphon shall be provided for steam service. Siphons shall be made of minimum SS 316 having connections 1/2" NPT (M) on both ends.

## 5. Draft Gauges

In general, the draft gauges shall be provided for each process heater to measure draft at burners, and in the stack, if required by process.

Direct connected gauges for indication of very low pressures and vacuum in the range of 0-0.5 m bar to 0-150 mbar shall be vertical scale gauges utilizing a slack diaphragm (rubberized nylon or equivalent) as the sensing element.

Draft gauges shall be designed for 2-inch pipe mounting.

Where draft gauges are used in the field, a suitable housing shall be provided.

The design of the draft gauge shall incorporate linearizing linkages where necessary to ensure a linear response of the indicating pointer.

Draft gauges shall be required to have an accuracy of +/-3% FS or better and shall be capable of withstanding pressures or vacuum equivalent to 100% over range.

Process connection shall be 1/4" NPT (F).

## 4.4. TEMPERATURE INSTRUMENTS

### 1. General

For transmission of individual temperature signals, thermocouples, RTDs shall be used in conjunction with field mounted temperature transmitters.

Resistance Temperature element (RTD) may be used as temperature primary elements where greater accuracy and better reproducibility are required than is afforded by thermocouples. RTD shall conform to standard IEC-751.

All temperature elements shall generally be protected by thermo-wells.

Class 'A' / Class '1' tolerance as per IEC 751 / 60584-2 shall be specified for RTD / thermocouple for all temperature measurement.

Temperature Switches shall not be used in general.

### 2. Thermocouples:

Thermocouples are the preferred means of Temperature measurements for centralized control and indication. Resistance thermometers may be used in selected cases.

For temperatures up to 1300°C, Type K (Chromel/Alumal) and Type E (Chromel/ Constantan) thermocouples shall be generally used.

For temperatures above 1300°C, or for H2 service above 750°C platinum/10% rhodium - platinum thermocouples shall be used (Type S).

Other types of thermocouples shall be used with the consent of owner on case to case basis.

In general, duplex thermocouples shall be used and this shall have two separate cable entries and shall be plugged with SS plugs.

All the temperature signals to control room (monitoring, control & shutdown) shall be through remote field mounted temperature transmitter.

Shutdown signals shall be discrete and shall not be connected to any other device. Electrical properties and tolerances shall be as per IEC-60584-2.

Thermocouples shall be spring loaded, magnesium oxide mineral-insulated un grounded metal sheathed. Other minimum specification shall be as below:

- Wire size shall be 18 AWG for simplex and 20 AWG for Duplex type.
- Sheath material shall be in stainless steel 316 as a minimum
- Outer diameter of sheath shall normally be 6 mm.
- Thermocouple extension wire if used shall be in accordance with & conform to ANSI MC 96.1

Furnace Tube Skin thermocouples shall be installed such as to provide accurate reliable temperature measurements of the furnace tubes. Skin thermocouples shall be Grounded type Xtracto pad type unless otherwise specified in the licensor's specification. Furnace tube skin thermocouples shall preferably be installed under supervision of OEM.

For Heater thermocouples, mineral insulated Inconel-600/SS-446 sheath may be considered suitably.

### 3. Resistance temperature elements

Resistance temperature detectors (RTD) shall only be used where the required measurement accuracy is greater than that obtainable with a thermocouple, subject to the operating range being between <minus>200°C to +200°C. They shall not be used where high frequent vibration is present, e.g. in high velocity steam or gas streams

- RTD shall conform to be PT-100, 3-wire type
- RTD shall be spring-loaded, mineral insulated and SS 316 metal sheath type
- The sheath diameter shall be 6 mm as a standard unless otherwise specified.

### 4. RTD/Thermocouple heads shall be as follows:

- The thermocouple head shall be connected with thermowell with 3-piece union to ensure proper contact of TC junction to thermowell.
- Head cover shall be screwed type, with SS retaining Chain fixed to body.
- Head cover shall be weather proof and ex proof suitable to specified hazardous area classification.
- Cable entry shall be 2 nos. 1/2" NPT(F) with one entry plugged with SS 304 plug.
- Terminals shall have separate screws for connecting element and extension cable.

### 5. Temperature Transmitters

Temperature transmitters shall be Remote mounted type (on 2" Pipe), dual channel and dual chamber, smart with HART / Foundation Field bus protocol (as applicable) and integral output meter.

Head mounted transmitters shall not be used.

Temperature transmitter used for control loops shall have provision of dual sensor with auto switch over facility.

Transmitter shall have universal input for thermocouple / RTD and output 4-20mA DC/ FF for 2 wire system.

Transmitter output signal shall be linear and directly proportional to the measured temperature with overall accuracy of +/- 0.1% FS

Transmitter shall have automatic cold junction compensation for thermocouples.

Burnout protection (selectable Up Scale / Down Scale) must be provided for temperature transmitters.

Instrument enclosure shall be designed with a dual compartment housing that provides isolation between the electronics and the terminal compartments.

Temperature transmitters shall be used for measurement of all the temperature parameters, except for the purpose of data acquisition system (DAS).

## 6. Filled system / bimetallic element local gauges

Only Bi-metallic elements shall be used. Where bimetallic gauges cannot be used, only gas filled gauges shall be considered. No liquid filled system to be used.

Filled system elements shall be as per gas-filled (as per SAMA) as required by temperature limit and span consideration. (Explosive, flammable or toxic liquid/gas and Mercury should not be used as the filling medium)

The thermal filled system shall be equipped with ambient temperature compensation, over range and/or under range protection.  
Accuracy shall be + / - 1% of span.

Element bulb extension shall be with armoured capillary in 316 SS having capillary length of 2.5 meter minimum.

Thermal element bulb shall be protected in thermowell.

½" NPTM adjustable bush & gland of SS shall be provided on element bulb stem to maintain the firm insertion of the bulb in thermowell.

Filled system instruments shall not be used if process contamination due to system failure is not acceptable.

Bimetallic thermometers shall be bimetallic actuated rigid element and dial every-angle type.

Dial size of the gauge shall be 150 mm diameter.

The stem and case material of the gauges shall be 316 SS.

Range shall be selected from manufacturer's standards such that normal operating temperature indication is approximately at midscale.

However, the following standard ranges are preferred: -

Minus 30	to	+ 70°C
0	to	+ 160°C
0	to	+ 250°C
0	to	+ 400°C

In vibrating services bimetallic thermometers shall not be used and only filled capillary type be used.

### 7. Special Thermometers

Infrared radiation thermometer, thermistor sensor etc. shall be used based on the process requirement.

### 8. Thermo-wells

Thermo-wells shall generally be provided for protection of the primary measuring element.

Thermowells for all services shall be in SS 316 minimum and drilled in a single piece from solid bar stock and tapered. Built-up thermowells may be considered in low pressure and low velocity services like in fired heaters and where longer thermowell immersion length is required (for greater than or equal to 500 mm).

Thermowells process connections shall be flanged 11/2" ANSI, 300# rating as minimum for pipes and for vessels / columns the flange connection shall be 2" ANSI, 300#. Well and flange material shall be SS 316 minimum.

In general, immersion length of thermowells shall be as follows:

Line Size	Immersion length (When nozzle height - 200mm)
From 4" to 6"	280 mm
From 8" onwards	320 mm
Vessels / columns	400 mm

The immersion length should be around two-third of the respective pipe diameter plus nozzle length. Other sizes and immersion lengths may be considered based on special condition / actual requirements.

The design of the wells shall be verified by means of stress analysis, resulting from stream velocity condition. The wake frequency calculation (WFC) shall not exceed 66% of the thermowell natural frequency. It will be designed to standard PTC 19.3 (latest edition).

If any Thermowell fails to meet the WFC then insertion length of Thermowell shall not be reduced instead other methods like increase in stem diameter, modification of nozzle size etc. shall be explored subject to approval of Consultant/Owner.

Pipe line below 4" nominal bore shall be blown to 4" NB size to install thermowell.

Only thermowell (test well) when specified, shall be provided with the element entry plugged with SS plug and SS chain.

All the thermowells shall be offered for hydrotesting at site to PMC/OWNER before installation.

## 4.5. CONTROL VALVES

### 1. General

The selection of materials for control valves shall follow the associated piping material specification as a minimum.

- Generally single seated globe bodied control valves are preferred with stem or cage guided trims. When large volumes at low DP or process condition dictate, other valve designs, such as butterfly valves, may be considered.
- Angle valves may be used where necessary to prevent the accumulation of solids (e.g. hydrocarbon services where coke may form), slurry service, or in piping schemes where space is at a premium, flashing service, and for unusually high differential pressures.
- Plug valves may be used for special applications such as throttling control in slurry service.
- All valves shall have the direction of the flow through the valve stamped or cast on the valve body.
- All flanges shall be in accordance with ANSI B16.5. The pressure ratings of globe and ball control valves shall be  $\geq$  Class 300. ESD Valves shall be Piping Class valves rated in accordance with the related piping class, with a minimum Class 300 rating. Control valves shall not be used for ESD service.
- Assembled valve ratings shall be to the full rating to the ANSI flange rating at the design temperature. Control valve bodies shall be NPS 1 as minimum, with reduced trim as necessary. Valve body sizes of NPS 1¼, 2½, 3½ and 5" shall not be used under any circumstances.
- The minimum nominal sizes of butterfly valves shall be 4" (100mm). Butterfly valves shall comply with API 609.
- Self-acting regulator valves shall be used for local, fixed gain control of utilities, such as fuel systems and Nitrogen blanketing, and where failure action and lower precision of such devices is acceptable. The maximum size shall be 1½" (40 mm)
- Notwithstanding the requirements above, the control valve body size shall not be less than half the nominal pipe size in which it is installed.
- All valves shall have removable seat rings and plugs

### 2. Valve Sizing

- Control valves size shall be calculated using the IEC formulae or Manufacturer's formulae. Valve sizing shall normally be based on the maximum flow x 1.3, at the coincident temperature, pressure and pressure drop conditions. Range-ability shall be checked for the anticipated minimum flow rate, which should be  $\geq$  20% of full stroke.
- The maximum flow shall be between 60 to 80% of full stroke for equal percent trims and 50 to 80% for linear trims.
- Butterfly valve sizing shall be based on a maximum opening of 60°, except where they are fitted with characterized vanes, in which case a 90° maximum opening shall be utilized.
- The effect of reduced inlet and outlet pipe sizes shall be considered when sizing control valves.

### 3. Valve Trim

- For each valve, the appropriate valve trim shall be selected to achieve the control



characteristic as specified on the relevant datasheet.

- When 50% or more of the system dynamic pressure drop is to be sustained by the control valve at normal flow conditions, the valve shall have a linear characteristic; otherwise it shall have equal percentage characteristic.
- Generally, each valve trim shall be constructed from 316 SS, unless stated otherwise on the datasheet. However, the use of trim materials such as Stellite faced 316 SS, 17- 4 PH or Tungsten Carbide etc. should be considered in the following applications:
  - Flashing service
  - Cavitating service
  - Erosive service
  - Slurry service
  - Wet Gas or Steam service
  - Pressure drops that exceed 10 kg/cm<sup>2</sup>
- Series/parallel labyrinth trims shall not be used on fluids that have solids in suspension with particle size > 3 microns. Where multistage trims are necessary in services where particle size is > 3 microns, a valve having a high resistance multistep axial flow trim shall be utilized. To avoid solids build-up the use of angle valves shall be given serious consideration.
- Where possible, the effects of cavitation shall be minimized by selection of suitable trim designs.
- Where cavitation cannot be avoided the valve trim and facing shall be selected to minimize damage. Butterfly valves shall not be used where cavitation is predicted.
- Valve maximum exit velocity shall be  $\leq$  Mach 0.33. Calculations shall be submitted to verify compliance.
- In flashing service, where necessary, the body size shall be increased to achieve this. In addition, valve trim and facing shall be selected to minimize damage.
- For ease of maintenance, all valve trims shall be of the quick-change type, with no internal components screwed or welded into the valve bodies or bonnets.
- Trim design shall provide equal pressurization around the plug-in order to minimize vibration and prevent the potential for binding.

#### 4. Valve Noise

- All control valves shall have their predicted aerodynamic / hydrodynamic noise level calculated. The calculations should be in accordance with IEC 534-8-3 for aerodynamic noise and IEC 534-8 – 4 for hydrodynamic noise. However, the Vendors Standard calculation based on construction and experience shall be considered paramount in line with good engineering practice.
- The predicted aerodynamic noise level at a 1m radius from the valve discharge flange shall not be greater than 85 dBA.
- Noise abatement shall in the first instance be achieved by judicious selection of the valve trim design. Where this cannot be achieved by trim design alone, path treatment e.g. heavy wall pipe / external insulation / silencers may be considered for localized abatement.
- Because noise is propagated over long distances via the fluid stream, effectiveness of path treatment ceases where treatment ends this method of abatement shall therefore be subject to IOCL approval.



## 5. Control valve leakage

- The degree of seat leakage shall be in accordance with IEC 60534.4 Class IV, unless specified on the valve data sheet to the contrary.
- For all the control / block and bleed valves connected to flare shall be of leakage class V or better.

## 6. End Connections

- Butterfly valves shall be double flanged. Not wafer design.
- All control valves shall be flanged. Valves up to NPS 600 mm shall be flanged to ANSI B16.5 and to ANSI B16.47 for valves larger than NPS 600 mm.
- All flanges shall be drilled for through bolting. Flanges which are drilled and tapped for studs are not acceptable.
- Gasket surface finish for raised face flanges shall be in accordance with ANSI B16.5 Para 6.4.4.

## 7. Valve Materials

### Body / Trim

- Materials for sour service shall conform to the requirements of NACE International Standard MR0103/ISO 15156.
- All butterfly valves shall, as a minimum, be fitted with stainless steel vanes and shafts in a precipitation hardened material (e.g. 17-4 PH).

### Bonnets and Packing

- Generally, stem seals shall have comprised a bolted packing box assembly, designed to allow the packing to be adjusted or completely removed without having to disturb any other components of the valve assembly.
- Low emission packing shall be utilized for all control valves. Valve packing containing asbestos in any form is strictly prohibited.
- Where process streams containing Toxic / Volatile Organic Compounds (VOCs) are specified the valve may require special low emission valve packing and / or bellows sealing. They shall be fitted with a monitor for bellows leakage, e.g. small pressure gauge and excess flow valve.
- The type of packing / sealing selected shall be compatible with the process and environmental conditions prevailing for each given application. Generally, the type of packing shall be selected in accordance with the following temperature limits:

Temperature Range	Packing Material
-40 to +230 C	PTFE V-Rings
Above +230 C	Graphite in pre-formed rings (non-asbestos)

- Extension bonnets shall be considered for design temperatures below 0 °C and above 230 °C.

## 8. Actuators, Valve Positioners & Accessories

- All accessories shall be fully piped/wired as part of the valve assembly and shall be suitably terminated. All instrument air tubing and fittings shall be 316 stainless steel. Compression fittings shall be double ferrule type. Tubing sizes shall be metric, 6mm OD minimum, and sized in accordance with the stroking times to be achieved.
- Actuator housing material shall be steel or anodized aluminium.
- All positioners shall be fitted with gauges for supply and output pressures.
- Limit switches shall be of Proximity type as per DIN 19234.
- All valves shall be provided with air filter regulators to prevent the actuator from maximum design pressure of Instrument air.
- All brackets, fixings and fittings shall be constructed from 316 SS.

### Diaphragm Actuators

- Spring Return Diaphragm actuators are preferred for modulating control valves. The normal operating range shall be 0.2 to 1.0 kg/cm<sup>2</sup> but shall not exceed 3.5 kg/cm<sup>2</sup>. Valve actuators shall be sized for the design pressure upstream of the valve with the downstream pressure taken as zero. Bench setting is unacceptable.

### Piston Actuators

- Pneumatic piston actuators shall be used on all ESD and Depressurization valves. They may also be used, where necessary on modulating control valves, to provide longer strokes or greater thrust than is available from spring diaphragm units. They shall preferably be the single acting spring return design and sized to operate at a minimum air supply of 3.5 kg/cm<sup>2</sup>.
- Double-acting piston actuators may only be used with owner's approval.

### Reserve Air Receivers

- For Depressurization valves which are designed to fail open and valves where approval has been given for double acting piston actuators, a stainless steel local air receiver shall be supplied. This shall be sized to provide at least three strokes over the full travel of the valve. They shall be supplied complete with double non-return valves, pressure gauge and relief valve. They shall comply with ASME VIII requirements.

### Control Valve Positioners

- All control valve actuators shall be provided with electro-pneumatic, SMART positioners, complete with air sets having 5-micron filters. All valve positioners shall be an intelligent design capable of transmitting full diagnostic and predictive maintenance data to the main DCS/ Asset Management System. Non-FF positioners shall have an input signal of 4-20 mA, 24V DC with super imposed HART protocol.

## 9. Solenoid valves

- Where solenoid valves are provided to override the modulating control; they shall be installed between the positioner and the actuator.
- The use of process line mounted solenoid valves should be avoided, and their use is subject

to owner's approval. Where their size prevents the use of intrinsically safe operating circuits, the hazardous area protection shall be EEx'd' as per the existing philosophy of the plant. Else the coils shall operate on 24Vdc.

- In case of UPS supply (110V ac) is used for SOV, an isolation transformer (1:1) is desirable to be used for powering the SOV, to arrest any "earth fault" generated in the field devices (SOV).
- The supply voltage of the SOV (for DC supply) shall be monitored on-line in DCS with trending and alarm configuration. This is to ensure that the voltage is not exceeding the recommended coil voltage.
- The cable entries in the JB and the SOV shall necessarily be routed from the bottom of the JB and the SOV. All the possibilities of the water ingress inside the JB and the SOV shall be prevented. (MP)
- For critical solenoid valves, which lead to complete plant shutdown, SIL3 SOV or Multiple SOV may be considered, so that failure of one SOV does not trip the plant.
- Vent port of all solenoid valves are to be provided with SS/ Brass bug screens, to prevent blockage of port because of bugs and to save the port from dust.
- Pilot operated solenoid valves are not permitted.

#### **10. Hand Wheels / Bypasses for Control Valves**

- Generally, hand wheels shall not be fitted. Hand operated bypass valves are preferred. Bypasses shall be piping class globe valves except for the following conditions, in which case a control valve body / trim, identical to the automatic control valve but with manual actuators shall be considered: -
  - Flow / pressure drop conditions are producing cavitation or flashing
  - Control valve is fitted with a noise control trim
  - Where a standard globe valve through-put would exceed the associated relief valve capacity
- Where a control valve is fitted with an override solenoid valve and has a fail closed action, a bypass valve shall not be fitted. "Balancing" and "warm-up" are excluded from this statement and must be considered on a case-by-case basis

## 4.6. PROTECTIVE SYSTEM VALVES

### 1. ESD and Emergency Depressurization Valves

All ESD and Depressurizing valves shall be pneumatically operated.

- Valves installed for emergency shutdown or depressurization duties shall be separate from other valves and shall not be used for other purposes. The SIL rating determined at the SIL review will determine whether 1 or 2 valves are required.
- Valves shall be piping class valves complying with API 6D, but with a minimum flange rating of 300#.
- All ESD and Depressurizing valves shall be metal seated Fire Safe Design. Valves having soft components (stem, seat or body seals) shall be of a fire type tested design in accordance with ISO 10497 and provided with appropriate certification.
- Leakage for soft-seated valves shall not exceed ISO 5208 Rate A (no visible leakage). For metal-seated valves the leakage rate shall not exceed ISO 5208:1993, Rate D.
- Ball valves are preferred but where process conditions dictate, other valve body design may be employed, subject to approval by IOCL.
- Ball support shall be by one of two methods, i.e. via trunnions or via the seats (floating). Generally, ball valves used on dirty services shall be trunnion mounted.
- In each instance, the Supplier shall select the method of ball support to suit the applicable piping classes and process conditions.
- When requested on the datasheets, the Supplier shall provide those actuators with a means to protect them against the effects of fire.
- Generally, protection can be provided using shields, casings or intumescent coatings (e.g. K-Mass).
- In each instance, the required means of protection shall be detailed on the relevant datasheet.
- It is the responsibility of the Supplier to ensure that access for maintenance and testing etc. is not compromised by the method of fire protection used.
- Actuators shall be pneumatically driven and where possible a single stroke spring return design. Sizing shall be based on an air supply of 3.5 kg/cm<sup>2</sup>g. The torque requirement calculation shall include a 1.5 safety factor, in addition to the basic valve torque, factors for seat material, fluid, and operational frequency. Hand wheels shall not be fitted. Unless stated otherwise in the requisition, valve closing speeds shall be:

15 – 65 mm-	2 seconds
80 – 150 mm -	3 – 6 seconds: dependent on size
200 – 600 mm -	8 – 24 seconds: dependent on size

- Depressurization valve actuators shall normally be designed to fail open, be fitted with two IS solenoid valves piped and wired to be “fault tolerant” and have discrete local reserve air cylinders.

### 2. Actuator Torque

- Actuators shall be sized for providing the required torque to operate the ball valve at minimum air supply pressure. Vendor shall ensure that the actuator torque produced at maximum air supply pressure (MAWP) does not exceed the shear torque of the valve stem/shaft. As a guideline, actuator torque values shall be in accordance with the following:

- Minimum actuator torque of 1.5 x required highest starting torque to commence movement of the ball in the case of maximum differential across the valve.
- Shear torque of stem/shaft greater than 1.5 x maximum torque produced by actuator at maximum air supply pressure

### 3. Partial Valve Stroke Testing

- For ESD Valves of SIL 2 or higher, proprietary partial valve stroke testing mechanisms shall be provided. This mechanism shall include the use of an intelligent valve positioner and shall enable the valve to be stroked partially (adjustable set point) without upsetting normal process operation.
- Partial stroke initiation shall be from the DCS and shall also be capable of transmitting full valve diagnostics and predictive maintenance data to the DCS Asset Management System. All necessary licenses / bolt on software shall be supplied. They shall be supplied with air filter regulators having 5-micron filters
- Air Capacity Tanks shall be used on valves where there is a requirement to provide a driven failure action. Valves on critical service shall be supplemented with air capacity tanks as specified in the pneumatic scheme (Refer standard specification for On-Off valve). Air capacity tanks shall be sized to provide adequate air storage such that three valve operations may be obtained between available minimum air supply pressure. Fabrication of this tank shall be in accordance with ASME Section VIII Unfired Pressure Vessels.
- The tanks shall be manufactured from carbon steel, painted and shall be to the pressure vessel code applicable to the project. The accumulators shall be provided with drain facilities. Non-return valve, Pressure Gauge & Safety valve shall be in the EPCC 1 scope & to be delivered along with buffer tank in completely mounted conditions. Safety valve shall be provided with Test certificate. All the accessories (tubing, fittings, Non-return valves) used for air capacity tanks shall be 316 Stainless Steel.

### 4. Position Switches and Indication

- All ESD and Depressurization valves shall also be fitted with a junction box type housing containing two (open & closed) proximity status switches. All valves shall be supplied with a high visibility mechanical position indicator for easy verification of the valve position status.

### 5. Solenoid Valves

- SIL 3 approved solenoid valves shall be considered for all applications. Atmospheric vents shall be fitted with bug screens. IS Solenoid shall be preferred, however Ex d solenoid valves may be considered, subject to owner's approval, where IS solenoids are not suitable.
- Dual SOVs to be considered for all ESD application where production loss in event of trip actuation. Each of these dual SOVs are to be configured in different card, use different marshaling cabinet cable & Junction boxes.
- ESD SOVs for trip of critical equipment's is concern, a TMR SOVs are (may be hydraulic oil as operating medium case of SOVs) to be considered like for MAB, RGC & WGC. Each of these TMR SOVs are to be configured in different card, use different marshaling cabinet cable & Junction boxes.

## 6. Local Manual Reset

- Local manual trip and reset buttons shall be specified for ESD and Depressurization valves.

## 4.7. PROTECTIVE COATING AND END PROTECTION

- Machined or threaded surfaces subject to atmospheric corrosion during shipment or subsequent storage shall be coated with an easily removable rust preventative.
- All valves shall be provided with Plastic end caps at both end flanges and that plastic cap shall be tied with valve flange so that it does not come out during transport or storage.
- Steel Valve bodies and top works shall be painted. The top works shall be painted in the following colours:

Red	–	Air Failure Closed
Green	–	Air Failure Open
Orange	–	Air Failure Locked

Austenitic stainless steel and non-ferrous valves shall not be painted.

## 4.8. VALVE NDE & NDT REQUIREMENTS

All valves shall be subject to NDE/NDT in accordance with ASME B16.34

## 4.9. VALVE TESTING

### 1. Hydrostatic Test

All control, ESD & Depressurizing valves shall be subject to the following tests as a minimum:

- 100% hydrostatically tested with water not exceeding 50 degrees C in accordance with ANSI B16.5.
- Pneumatic piping bubble tested for leaks
- 100% full functionally checked.
- Seat leakage 10% of each type of Control Valves shall be leak tested against the FCI 70-2 rating as specified on the valve data sheet. Should any valve fail in this initial test then 100% of the valves shall be tested.
- All ESD valve shall be seat leak tested against standard ISO 5208 grade 'A'.

## 4.10. GAS DETECTION

- Gas detectors shall be Infrared (IR) type & open path for hydrocarbons and catalytic combustion/ metal oxide semiconductor type with IS protection for hydrogen and toxic gas respectively shall be considered.
- The sensor shall be easily replaceable. The life span of IR type sensor shall be minimum 5 years and for others 3 years may be considered. All detectors shall be SIL certified.
- The gas detectors shall be directly connected to the DCS/ESD system. Separate gas detection panel is not to be used.
- All the mounting accessories, splash guards, junction box etc. shall be included in the scope of supply. Calibration cylinders for 6 months of operation shall be supplied.
- The enclosure shall be of SS316 and shall be weatherproof and certified by CENELEC/ FM/ UL. PESO/CCOE approval is must for use in hazardous area.

The transmitter of gas detector shall be smart type with self-diagnostic & auto-calibration features with 4-20 mA output signal.

#### 4.11. ANALYZERS AND GAS CHROMATOGRAPH

##### 1. General Requirement

- The vendor shall supply Analyzers as a complete mechanical, electrical, instrument package which receives samples from the analyzer process probe, transports and conditions the sample, performs the measurements and transmits the process variable signals and associated status and alarm signals to the analyzer data system and hence to the process control system. It also includes the supply of Analyzer Shelters, Local Cabinets and other ancillary equipment associated with the analyzer installations and operation.
- Analyzers enclosure shall be weather proof to NEMA 4X. Analyzers shall be suitable for the area classification as detailed on the analyzer data sheet, and otherwise should be suitable for IEC Class 1 Zone 1 minimum as being compliant with IEC 60079. Analyzer systems shall preferably be intrinsically safe with EEx(ia) Gr-II A/B, T3 certification. If intrinsically safe is not available, explosion proof with EEx(d) certification shall be considered. Besides that, all instrument signal circuits wherever possible shall be certified by the PESO / Chief Controller of Explosives (CCOE), Nagpur, India.
- Certification from statutory authority like BASEFFA, FM, PTB, CENELEC etc. for items of foreign origin and from CMRI, ERTL etc. for items of Indian origin are only acceptable.
- Analyzer Systems shall comply with IEC 61000-4. The Analyzers shall also meet, wherever applicable, Environmental Protection Agency (EPA) USA regulations or shall be TUV approved
- All Analyzers shall be microprocessor based with 4-20mA output for DCS and shall have automatic calibration facility, self-diagnostic facility with local indication. The Analyzer systems shall be supplied in fully assembled condition and shall generally consist of the following items: -
  - Sample tap
  - Sample transport system (piping to transport the sample)
  - Sample conditioning system (filters, vaporizers, separators, etc.)
  - Programmer (for chromatographs only)
  - Readout device
  - Analyzer
  - Analyzer cabinet (if required)
  - Analyzer shelter/shed

The design used shall provide maximum reliability, maximum on-line performance and minimum maintenance. Instrument shall be field proven. No prototype instrument shall be offered.

- In all cases, where measured values are used for process control, the relevant measured values shall be transmitted directly to the DCS via a 24V DC, 4-20mA signal.
- Where analyzers are used for safety or other critical regulatory function then the signals mentioned above shall be first routed to the appropriate system and then repeated to the DCS.
- The analyzer "Common Fault Alarm" shall be hardwired direct to the DCS as SPDT volt-free



contacts. A Low Sample Flow Alarm for each stream shall also be provided.

- All the GC (gas chromatographs), FTIR and other complex analyzers used for monitoring and process alarms, shall, subject to technical limitations and required volume of data, have serial communication with the DCS.
- Redundant UPS power to be considered for all GCs/ Analyzers inside the shelter. There should be dedicated power cable from each UPS feeder up to Analyzer shelter. This is required to ensure the reliability & availability of critical Analyzers & GCs for the process monitoring & control.
- For the shelter analyzers, provision for monitoring the shelter temperature with high temperature alarm in the control room to be provided.
- Any PLC/controller supplied for HVAC/system control shall be of minimum DMR configuration at processor, power supply and I/O level.
- The on-line data of all the critical analyzers to be made available in a centralized location (Inst W/Shop / LAN / respective control room) for better monitoring. The possibility shall be explored in the installed analyzers. However, this must be considered in the new projects. For all Stack & ETP pollution analyzer necessary infrastructure i.e. PC's, Servers, Software's etc. to be made for data transfer to SPCB & CPCB

## 2. Sample Acquisition / Conditioning System

### Sample Acquisition

The functions performed by the Sample Acquisition / Conditioning System are the interfaces between the process and the process analyzer.

These shall include the following:

- Taking and delivering a representative sample from the process.
- Transporting the sample from the sample tap to the analyzer and from the analyzer to the waste disposal and / or process return point.
- Sample-stream switching and calibration switching into the analyzer.
- Design incorporates capability for ease of maintenance, cleaning, or (when needed) flushing the entire system.

Unless stated to the contrary in the analyzer data sheet, the sampling system, inclusive of sample probe, transport system and sample conditioning system, etc., shall be designed to deliver a representative sample with a time lag  $\leq 90$  seconds. The sample system design and site hook-up shall be coordinated to achieve this, including calculations to verify the lag time.

The preferred method for extracting samples for Continuous Emissions Monitoring System (CEMS) applications is by dilution using a sample probe with an integral Venturi to dilute the sample and provide the motive force to transport it to the analyzer. Dilution method should not be used for extractive oxygen measurements, and these should use hot- extraction instead.

## 3. Sample Conditioning

Samples shall be returned to a relatively low pressure return point where available such as process pump suction, the low-pressure side of pressure controlled static equipment, to closed or atmospheric drain (where suitable or environmentally acceptable), or from the point of origin using a sample pump.



Where the analyzer or related sample system components cannot be rated for the return pressure then the sample should be recovered using a sample recovery system.

#### **4. Local Analyzer System**

In case of local analyzer, the complete assembly shall be mounted on a free-standing easel type frame, complete with overhead rain / sun protection canopy, large enough to provide protection for the equipment and technician during maintenance. The canopies shall have at least 50 mm clearance between the top of the cabinet / panel and the canopy. The equipment shall be mounted on back plate or in a cabinet as required by the analyzer.

The support framework and canopy shall be constructed from unpainted type 316 or 304 stainless steel or epoxy painted galvanized steel. Cabinets including all fittings e.g. hinges, screws, bolts, nuts, washers, supports etc. and components in contact with the atmosphere shall be manufactured from stainless steel. Doors shall have a fixed open devise or be a lift off design.

Where a local cabinet contains a sample with 500 ppm H<sub>2</sub>S or more, an H<sub>2</sub>S detector shall be installed inside the cabinet.

Where it is not possible to prevent the internal temperature rising above 30°C by natural means, suitable arrangements shall be provided.

#### **5. Analyzer Shelter**

Analyzer system shall be installed in the shelter of SS material and insulated as per applicable standard. No RCC room is acceptable. Air conditioning system (redundant HVAC system) shall be suitable to specified hazardous area classification with chemical filters in the suction of each HVAC duct for removing any toxic gases entering the shelter.

Analyzer shelter and analyzer location shall be designed to minimize sampling time and easy maintenance. Provision shall be made for keeping all the fast loop devices outside the shed. Gas Chromatographs and stack monitoring analyzers shall be generally installed only in a shelter.

Cable entry to analyzer shed / shelter shall be through MCT blocks only.

#### **6. Gas chromatograph**

Gas chromatograph (GC) system shall consist of complete set of analyzers (s) including sampling system, sample-conditioning system, internal power supplies, inter cabling, inter piping and other components required to provide a fully integrated and functional system. GC shall always be put inside shelter.

Gas chromatograph shall be of TCD type as far as possible

The GC shall be provided with a dedicated microprocessor controller which shall be stand alone and incorporate control, safety, diagnostic and highway interface systems.

The system software and a copy of the application shall be stored in non-volatile memory. There shall be a simple and secure facility to store or retrieve the application. The application programs may additionally be stored in battery backup RAM where required. The analyzer shall automatically

recover after a power failure, restore the application, and resume analysis.

On power failure of the electronics controller, all switching valve outputs and analytical valves shall be failed to a safe position.

GC shall be provided with redundant RS 485 serial interface for communicating with DCS.

### **7. Selection of Gas Chromatograph/ Analyzer**

Following points shall be considered when selecting the operating principle of GC/Analyzer:

- For GC the linearity of the detectors should be better than +/-1% of the full-scale value across the whole measured range. So Thermal conductivity detectors (TCDs) should be preferred as far as possible.
- When the dilution method is used for CEMS applications, the dilution ratio shall be considered to determine if the analyzer is suitably sensitive for the application.
- Paramagnetic, Zirconia oxide, or electrochemical measurement techniques, may be selected to best suit the application. However, for furnace efficiency application, Zirconia analyzer shall be used.
- Flame Ionization analyzers shall be supplied as appropriate in applications where continuous gas analysis of hydrocarbon and organic samples is required
- The preferred technique for normal moisture analysis is the aluminium oxide cell type, subject to compatibility with the process sample. Where the analyzer is required to monitor extremely low levels of moisture the quartz-crystal oscillator technique shall be considered
- The recommended analyzer type to be used for determination of molecular weight is a direct density or SG measurement with pressure and temperature compensation as required
- The recommended analyzer type to be used for determination of Sulphur compounds in Process gas and for Tail gas measurements is a UV Photometer.
- The recommended analyzer type to be used for determination of Oxygen in Tail gas measurements is a paramagnetic analyzer.
- The recommended form of analyzer to be used for these measurements is a glass electrode type measuring cell (pH), appropriate capacitance probe (Conductivity), and electrochemical sensor (Dissolved O<sub>2</sub>) together with a loop powered transmitter.

### **8. FAT, Warranty & Post warranty maintenance**

A factory acceptance test (FAT) is required on all analyzer shelters including their associated analyzer systems and all local analyzer system assemblies. The factory test shall be an operating test, and to support the FAT it is a minimum requirement to provide all equipment / facilities, including calibration, carrier and sample gases, required to demonstrate the system in accordance with this Specification and the Analyzer Data sheets.

The warranty shall be 36 months from the date of commissioning (site acceptance test) for Analyzer system with air conditioning equipment.

Supplier shall also propose 5 years maintenance contract of analyzer /GC after warranty which shall exclusively mention the service to be provided, methodology, scope of work, and vendor's responsibility with year wise break up.

#### 4.12. LOCAL CONTROL PANELS

1. Field panels shall be intrinsically safe (IS) for hazardous areas. Where ever intrinsically safe panel is not feasible, Ex-Proof panels may consider subject to approval of owner/PMC.
2. Only IS Indication lamps/ Push Buttons / alarm panels in intrinsically safe enclosure shall be installed in local panels.
3. No Bulk Power Supply /Regulated Power Supply /Barriers to be installed in field panels.
4. Local control panels, in general, shall be of free standing, totally enclosed construction, fabricated from 3.2 mm thick CRCA steel plate.  
Maximum dimensions shall be 2100 mm (H) x 1200 mm (W) x 800 mm (D).

The panels shall be pickled / phosphate and shall undergo a seven-tank process before primer is applied. The panels shall be provided with 2 coats of red oxide primer and 2 coats of final stove enameled paint. Paint colour shall be any of the following (to be confirmed).

Opaline green	IS 275
Light admiralty gray	IS 697
Sky blue	IS 101
As approved by the OWNER.	

5. Panel doors shall cover the total width and height of a panel section. All doors shall have continuous stainless-steel plane hinges. Panels over 1200mm wide shall have double rear doors with heavy duty T-bar latches. Panels less than 1200mm wide shall have single rear door with heavy duty T-bar latch.
6. Panels shall be provided with 4 lifting lugs at the top. The panels shall be well sealed against ingress of dust and moisture. IP 51 as per IEC 529 for indoor applications and IP 54 for outdoor service.
7. Local control panel for the package units shall be installed within the battery limit of the package considering operational and maintenance requirements and accessibility. In case of skid mounted package; panel shall be located away from the skid.
8. In case local control panel is housed outdoor i.e. not in a local control room, it shall be designed to meet IP-55 requirements. In addition, panel must be provided with a rain cum sun shade canopy /shed
9. It shall be possible to switch off incoming power to panel from panel front. All such power on/off switches shall be flameproof type.
10. All lamps, status as well as alarm, shall be provided with lamp test facility. One single lamp test push button shall be used for each panel.
11. Engraved identification plates shall be provided for all instruments on rear of the panel face. Instruments shall have integral nameplate on the panel front. Markers for wires, tubes, terminals, connectors, switches, circuit breakers, panel numbers etc. shall be permanently affixed on them
12. The panels shall normally be floor mounted on channel base. Channel base and suitable bolts shall be included in the scope of panel supply.
13. Cable entry to the panel shall be only from the bottom through MCT blocks only.
14. All panels shall be equipped with an earth bus securely fixed along the inside base of the panels. Provision shall be made for future extension of the earth bus, if need arises.
15. The control panel shall be subjected to the following tests and checks:
  - I. Check of panel alignment and mechanical operation check
  - II. Verification of degree of protection as per IS 2147.
  - III. High Voltage Test (2000V for 1 minute)
  - IV. Verification of wiring as per approved drawings
  - V. Routine tests and checks on all panel accessories

16. CONTRACTOR shall supply the following drawings during engineering:

- I. Mechanical details of panel construction.
- II. Panel drawing showing layout of instruments, plans, inside view, foundation details etc.
- III. Schematic wiring drawing, wiring layout of panel and other accessory equipment's.

#### 4.13. LOCAL GAUGE BOARD

1. Local gauge board shall be used to install skid mounted instruments like pressure gauges, temperature gauges and transmitters.
2. Local gauge boards, when provided shall have easy access at the rear and front for all instruments and accessories for maintenance and operation.
3. Gauge board shall be constructed from 3 mm cold rolled cold annealed steel sheet with other necessary steel supporting structure and shall be painted as per Mfr. Standard.
4. Local gauge board shall be supplied with all instruments installed and completely in tubed/wired condition before shipment.
5. All pressure gauges shall be provided with block and bleed valves securely fastened. Identification tags shall be securely fastened for easy identification both at the front and rear.

#### 4.14. CABLE

##### 1. General

This standard defines requirements for cabling between field instruments, junction boxes or local panels and Control room. It also specifies requirements for cabling used inside Control Buildings except the internal wiring of control panels or equipment cabinets and vendor supplied cabling for interconnecting system cabinets. Use of cable types described will ensure that Cable Vendor supplied cabling conforms to overall Project Standards.

Cables included in this standard are suitable for use in an industrial process plant with a hazardous atmosphere, for installation above or below ground.

The installation will take place in areas defined by the Institute of Petroleum Code (I.P. Code) as: -

- Zone 0
- Zone 1
- Zone 2
- Non-hazardous

##### 2. Technical

2.1 All cables shall be resistant to:

- Water
- Oil, in accordance with ICEA S-73-532
- Sunlight (UV), in accordance with UL 1581 section 1200.

2.2 All instrument cables shall be constructed to be gas/vapour tight and shall prevent transmission along length of cable.

All cables shall have XLPE as primary insulation primary insulation of 85°C PVC as per IS-5831 type C and inner and outer jacket shall be 90°C PVC to IS-5831 type ST-2. Oxygen index of PVC shall be over 30% and temperature index shall be over 250.°C.

The insulation grade shall be 600 V/1100 V as a minimum and shall meet insulation resistance, voltage and spark test requirements as per BS-5308 Part-II

2.3 All instrument cables shall be flame retardant as a minimum in accordance with the applicable tests in IEC 60332 or equivalent. Fire resistant cables shall be used for Safety Systems (ESD) and Gas Detection System (GDS) related instruments.

Where cables are designated to be fire resistant, in addition to the requirements stated above:

- They shall retain circuit integrity for 3 hours at 750°C in accordance with IEC 60331.
- They shall be low smoke, zero halogen type in accordance with IEC 60754 and IEC 61034.
- They shall be LSZH (Low smoke zero halogen) sheathed.

2.4 All field cables (including communication cable) shall be armoured with galvanized steel wire/flat as per IS-1554 part-I.

Inter panel Prefabricated Cables and network cables installed within Control Buildings/Instrument Buildings shall be un-armoured. However, power cable and signal cables shall be armoured even if they are installed inside building.

The drain wire resistance including shield shall not exceed 30 ohms / km.

A pair of communication wire shall be provided for multi-pair cables. Each wire shall be 0.5 mm<sup>2</sup> of plain annealed single or multi-strand copper conductor with 0.4 mm thick 85 Deg.C PVC insulation. Insulation shall be green and red colour coded.

2.5 Conductors shall be stranded electrolytic annealed copper except for T/C extension cables. Maximum dc resistance of the conductor of the cable shall be as per IS-8130

2.6 Pairs and triads within multi-pair/triad cable shall be identified by the pair/triad number being printed continuously along the length of one core of the pair/triad.

Run length of the cable shall be printed at least at every 5-meter interval.

2.7 Signal cable and thermocouple cable shall be shielded. Shield shall be aluminium backed by mylar/polyester tape bonded together helically applied with the metallic side down with either side having 25% overlap and 100 % surface. Minimum shield thickness shall be 0.05 mm for single pair and 0.075 mm for multi pair cable. Drain wire shall be 0.5-mm<sup>2</sup> multi-strand bare tinned annealed copper conductor. The drain wire shall be in continuous contact with the aluminium side of the shield.

2.8 Where instrument cables are required to be run in areas that may be contaminated by oil or chemicals they shall have an additional protective multi-layer sheath consisting of Aluminium foil/HDPE/Polyamide.

2.9 Where cables are to be used for intrinsically safe signals they shall have the following characteristics:

- Mutual capacitance shall be maximum 200nF/km.
- Inductance shall be maximum 1mH/km.
- L/R shall be maximum 30μH/Ω.

### 3. Signal cables

All signal cables shall be twisted pair with a conductor size of 1.5 mm<sup>2</sup> minimum. Minimum conductor size of solenoid valve field cable shall be 1.5 mm<sup>2</sup> or 2.5 mm<sup>2</sup> as required. Single pair, shielded signal cables shall be used between field instruments and junction boxes/local control panels.

Multi pair individually and overall shielded signal cables shall be used between junction boxes/local control panels and main control room, in general.

All multi pair cables shall have 6 pair/12 pairs only while multi triad cable shall have 6 triads/8 triads only. Conductor size shall be 0.75 mm<sup>2</sup> as minimum or higher cable conductor sizes can be selected

based on voltage drop calculations.

For solenoid valve, multi-pair cable size shall be 1.5 mm<sup>2</sup> or higher cable conductor sizes can be selected based on voltage drop calculations.

#### 4. Control/ Alarm Cables

All control/ alarm cables shall be twisted pair with a conductor size of 1.5 mm<sup>2</sup> minimum. Single pair, shielded cables shall be used between field instruments (on-off switches/ solenoid valves) and junction boxes/local control panels.

Multi core (12 or 24 core) control cables shall be used between junction boxes local control panel and main control room mounted devices in general. These cables shall have only overall shielding and minimum conductor size shall be 1.5 mm<sup>2</sup>.

#### 5. Thermocouple extension cables

- Single pair shielded thermocouple extension cables shall be used between thermocouple head and transmitters, junction boxes (only where Temperature transmitter can't be used) or local control panel mounted instruments.
- Multi-pair individually and overall shielded thermocouple extension cables shall be used between junction boxes and main control room mounted devices.
- The type of thermocouple extension cables shall be compatible with thermocouple used.
- The cable shall have 16 AWG and 18 AWG solid conductors for single and multi-pairs respectively as minimum.
- All thermocouple extension cable shall be matched and calibrated in accordance with MC-96.1 or equivalent.

#### 6. Power supply cables

All power supply cables shall be as per IS-1554 Part I and shall have copper conductors. Minimum conductor size shall be 2.5 mm<sup>2</sup>. The cables shall be PVC/ LSZH insulated and armoured. The higher size conductors shall be used in case of long distance power cable where voltage drops more than 3 volts.

7. Any other type of cable (may be special cables), which is not specifically listed in this document but is required to make the instrument/ equipment work shall also be supplied.

8. The following table may be followed while selecting cables for various applications:

**TABLE FOR INSTRUMENT CABLE**

SERVICE	OUTER COLOUR	TYPE	CONDUCTOR		Overall Jacket
			Minimum Size (mm <sup>2</sup> )	Type	
<b>Electronic Signal from Field Instruments</b>					
4-20 mA DC	Blue	IS	1.5	Pair/ Triad	Each pair/ triad & Overall Shield. PVC/ LSZH sheath.
4-20 mA DC	Black	Non-IS	1.5	Pair/ Triad	Each pair/ triad & Overall Shield. PVC/ LSZH sheath.
Pulse Signal	Blue	IS	1.5	Pair	Each pair & Overall Shield. PVC/ LSZH sheath
Pulse Signal	Black	Non-IS	1.5	Pair	Each pair & Overall Shield. PVC/ LSZH sheath
On-Off Contacts	Blue	IS	1.5	Pair	Overall Shield. PVC/ LSZH Sheath
	Black	Non-IS			
SOV	Blue	IS	1.5 / 2.5	Pair	Overall Shield. PVC/ LSZH Sheath
	Black	Non-IS			
RTD	Black		1.5	3-wire/ 4-wire	Overall Shield. PVC/ LSZH Sheath
Thermocouple			16 AWG for Single 18 AWG for Multi-pair	Pair	Each pair & Overall Shield. PVC/ LSZH sheath. (Ext. cable for K and compensating cable for S)
K Type	Yellow				
S Type	Orange				
FF Spur	Orange with Blue longitudinal stripes	IS	18 AWG	Single Pair	Shielded, armoured. PVC/ LSZH sheath.
FF Trunk	Orange with Black longitudinal stripes	Non-IS	16 AWG	2 Pair	Each pair & Overall Shielded, armoured. PVC/ LSZH sheath.
<b>Power Cable</b>					
AC Power	Black	Non-IS	2.5	Core	Armoured for field. Non-armoured for Control Room. PVC/ LSZH sheath
DC Power	Black	Non-IS	2.5	Core	Armoured for field. Non-armoured for Control Room. PVC/ LSZH sheath
<b>Other Type of Cables</b>					
Earthing	Green	Non-IS	2.5	1 Core	Non-armoured



Fibre Optic	Purple	Non-IS	6 Fiber	Single Mode	Armoured, PVC sheath
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## 9. Testing

Factory tests on completed wire and cable shall be in accordance with the standards listed for each cable type. A cable test certificate for each manufactured cable shall be provided by the Cable Vendor. The following additional information shall be included in the certificate when specified in the requisition: -

- Resistance of each copper conductor in ohms/1000 meter at 20°C.
- Maximum mutual capacitance values in pf/meter.
- Maximum L/R Ratio for adjacent cores in uH/ohm.

After testing, the ends of cable shall be sealed by approved method, to prevent the ingress of moisture.

### 4.15. CABLE GLANDS

- CONTRACTOR shall supply all cable glands required for glanding cables both at field instrument and local control panel, junction boxes and at main control room.
- All cables glands shall be of type 304 SS; double compression type, flame proof with Ex(d) certificate suitable for armoured cables with PVC shrouds.

### 4.16. JUNCTION BOXES

Separate junction boxes shall be used for IS and Non-IS signals. Further it shall be segregated based on signal types given below;

- Analogue input/Analogue output
- Thermocouple
- Digital input
- Digital output
- Power cable
- RTD
- Vibration signals
- Gas detectors

NOTE: Direct cable shall be considered for pulse signals.

The junction boxes shall be of die cast aluminium alloy (LM-6) body, flameproof with Ex(d) certification and weather proof as a minimum. Junction Box shall be PESO/CCOE approved, for specified hazardous area class based on gas group service. For Fieldbus cables, junction boxes shall be of SS with Increased safety (EExe) type.

Junction boxes shall have terminals suitable for the cable sizes to be terminated but shall be minimum suitable for 2.5 mm<sup>2</sup> cable. 20% spare terminals shall be supplied in each junction box. The terminals shall be mounted on rails in the junction box. Cross ferruling philosophy to be followed for wiring. Blue junction box terminals shall be preferred for IS circuits. Grey JB terminals shall be preferred for



Non-IS circuits.

Telephone sockets and plugs shall be provided in junction boxes.

Each junction box shall have minimum of 10% or 2 Nos. minimum spare entries. All spare entries shall be provided with SS plugs. All the cable entries shall be from bottom only. Junction boxes shall be earthed to dedicated earth-pit.

#### **4.17. INSTRUMENT VALVES AND MANIFOLDS**

CONTRACTOR shall supply instrument valves and valve manifolds wherever required. All isolation, vent and drain valves shall be gate valves. Equalizing valves shall be globe valves.

Root valves for all high-pressure ( $> =60$  Kg/Cm<sup>2</sup>) applications shall be of double isolation type.

Body rating and material shall be as per piping class or better and trim material shall be SS 316. All valves and manifolds shall be forged type only and of minimum 800 LBS rating.

Superior body and trim material shall be selected if required by process conditions. Packing material in general shall be of PTFE or better.

#### **4.18. IMPULSE PIPING/TUBING**

In general transmitters for hydrocarbon service shall be installed close coupled or with minimum length of impulse tubing.

Closed coupled instrument hook ups fabrication shall be by pipe and pipe items, minimum as per PMS to consider for all the Hydrocarbon services. SS tube and associated tube fittings are not to be used as an instrument impulse pipe for any HC services.

CONTRACTOR shall supply ½ in. NB impulse lines as per piping specification, however final connection to instrument of impulse piping shall be made using ½" OD X 1.2 mm thick ASTM A -269 TP 316 stainless seamless tubes and SS 316 compression fittings. Maximum SCH 160 seamless pipe with at least 3000 lb. rating fittings should be used as minimum for impulse piping.

Steam tracing shall be 10 mm OD copper tubes of electrolytic grade copper. For critical services, dual steam tracing with individual supply from header shall be provided. Steam tracing of instruments shall be provided as per process requirement (e.g. congealing, highly viscous, highly corrosive e.g. crude oil, fuel gas, etc.)

Proper accessibility to be provided to installed field devices by providing ladder or platforms, for maintenance.

#### **4.19. PIPES AND TUBE FITTINGS**

CONTRACTOR shall supply SS316 flare less compression tube fitting of three-piece construction of Swagelok / Parker make only. The tube fittings shall be of minimum 3000 LBS rating.

The fitting/ferrule hardness shall be in the range of RB 85-90 to ensure a minimum hardness difference of 5 to 10 between tube and fittings. The ferrule shall be of stainless-steel material, in

general.

Socket-weld type forged pipe fittings of suitable material and rating shall be supplied for pipe fittings. The minimum rating shall be 800 lbs. Weld neck fittings shall be used where socket weld types are not allowed by piping class.

All threaded fittings shall have NPT threads as per ANSI/ASME B16.11 only. All the pipe fittings shall be of 800 LBS minimum rating.

All tubing shall be properly clamped as per international standard and good engineering practice.

#### **4.20. PNEUMATIC SIGNAL TUBES**

CONTRACTOR shall supply 8mm OD x 1mm thick SS 316L tubes as per ASTM A 269 seamless type.

CONTRACTOR shall avoid use of intermediate connectors and shall estimate single run length for each instrument location.

Air supply to individual instruments shall be provided with SS 304 full bore ball valves.

#### **4.21. INSTRUMENT AIR MANIFOLDS, FITTINGS AND VALVES**

Instrument air manifolds made from 1-inch Seamless SS pipe. Air distribution main header and all instrument air piping line shall be of minimum SS304. In case of use of Instrument air manifold, the length of the air header tubing from manifold to individual valve shall be limited to 12 meters. only. In case of length more than 12 meters, supply piping from header to proximity of instrument shall be provided.

Number of tapping shall be provided on one instrument air manifold as per API standard. Double compression type Stainless steel fittings made from solid bar stock of 3000 lbs rating shall be used.

Isolation valves on instrument air service shall be pack less gland type full-bore ball valves and body material shall be SS 304.

For corrosive services air tube shall be SS 304 with PVC coating.

#### **4.22. AIR FILTER REGULATORS**

Instrument air filter regulator of suitable size, range and capacity shall be supplied for each pneumatic instrument. The body of the filter shall be SS316.

The filter shall have 5-micron sintered bronze/ceramic filter element and shall be provided with manual drain and 2" nominal size pressure gauge.

#### **4.23. CABLE TRAYS AND CABLE DUCTS**

- All cables on the main pipe rack shall be laid in cable duct. Cable ducts shall be made of G.I. sheets and shall be covered. Cable duct shall be epoxy painted.
- All cables to/ from the cable duct shall run on cable trays with cover. Tray shall be made of

anodized aluminium as per IS 737. Anodized Aluminium perforated cable tray shall be used up to 300 mm size.

- For DM plant/SRU plant and corrosive services FRP cable tray shall be used for all sizes.
- Thickness of tray shall be minimum 2.0 mm for 50 mm wide tray, 3.0 mm for 100 to 400 mm wide and 4.0 mm for 500 mm wide tray.
- Suitable cable clamps shall be supplied for binding the cables/tubes at every 500 mm.
- The width shall be so selected that 50% of tray space is available for future use.
- Structural angles used for cable dropping to Junction Box or to field device shall be preferably galvanized.
- All cable trays and ducts shall be fire proofed.

#### 4.24. PAINTING & PROTECTION

This protection method of any instruments shall be chosen to ensure their correct operation against the following:

- Undesirable condensation, separation or freezing of fluids
- Interference with the proper operation of an instrument by a viscous fluid
- Damage to an instrument by corrosive or hot fluids
- Damage due to corrosive environment
- Entrance of solids into impulse lines and instruments
- Change in chemical composition of measured fluid
- Risk of Exposure to personnel from hazardous/toxic materials, and or systems containing hot/cold fluids
- Flashing of low boiling point of liquids

In general, following methods of protection of instruments shall be followed:

- Insulation of the Instrument and/or Instrument Piping to prevent heat loss or gain
- Tracing the instrument manifold and/or the instrument piping
- Steam trace heating of instrumentation shall be generally used. Care shall be taken to ensure that overheating of the process fluid does not occur, by use of soft tracing if required.
- Where process monitoring requirements dictate more accurate control of temperature (e.g. analyzer sample lines) then electric trace heating may be used.

All tracing of instruments shall account for Manufacturer's recommendation regarding maximum temperature of operation.

- Purging or flushing the instrument and/or the instrument piping to prevent undesirable liquids, solids, or gases from entering the instruments.
- Isolating the instrument from the process fluid by using a diaphragm seal.
- Isolating the instrument and the instrument piping from the process fluid with a sealing liquid
- Sealing liquids shall be immiscible/compatible with the process fluid
- Isolating the instrument and piping from entrained fluids using knock out pots.
- Special consideration shall be given to protection method (s) used where hazardous/toxic fluids are handled. Protection philosophy in these cases shall be to contain the process fluid as close to the process (e.g. piping/vessels) as possible, even when the instrument system materials do not necessarily require protection.
- In some cases, a suitable means of flushing or purging may be required (either continuous or

intermittent).

- Enclosing the instruments in an insulated housing (Where possible equipment shall be specified for the appropriate climatic conditions).
- Providing canopy for all electronic instruments including positioner/ junction box which could be exposed to direct sunlight/weather. Canopies for all electronic instruments/junction boxes shall be of FRP (min. 3 mm thick). Canopies made of GI are not acceptable.
- Besides above, all the outdoor items shall be tropicalized, and epoxy painted. All carbon steel bolting shall be hot dip galvanized or Cadmium plated and bi-chromated

Monitoring system shall be provided to monitor electrical tracing systems and report status and alarms to the control room. Consideration shall be given to the grouping of critical loops.

#### **4.25. IDENTIFICATION AND MARKING**

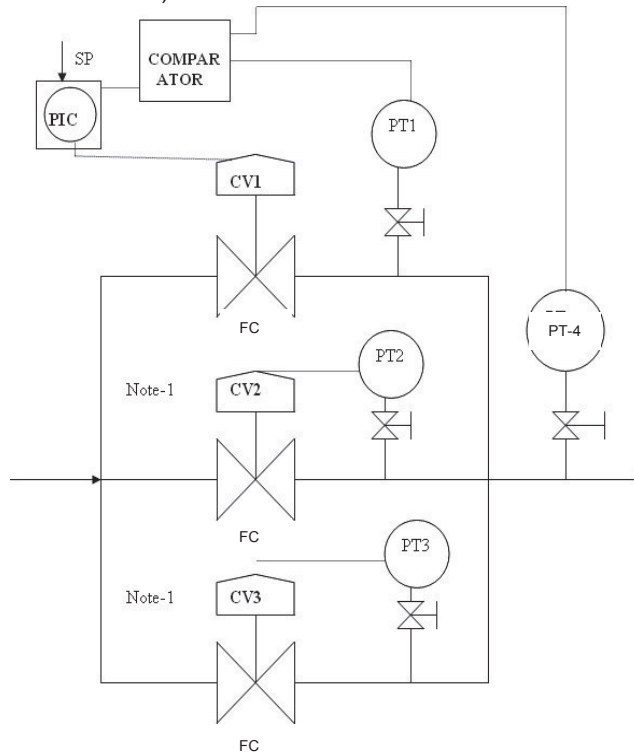
Each device shall be identified with the following information.

Manufacturer's name or identity  
Manufacturer's model and /or serial number Input range  
Tag no.  
Power Supply  
Area Class & IP Class  
IS / Non-IS  
ID no. for 'FF' field devices.

The above information shall be in a permanent form on a metal nameplate, permanently attached to the device/equipment.

## 4.26. PRDS / GAS PRESSURE CONTROL VALVES

“Parallel-redundant” philosophy for the critical PRDS / gas pressure control valves to Gas Turbines etc. for improved reliability / availability, is to be examined by TS for implementation. (A proposed scheme is enclosed).



### Note 1: -

The Control scheme for CV2 & CV3 will be exactly similar as that of CV1. There will be three independent controllers for the three control valves. Set Point for all the three controllers will be same.

### CONDITIONS FOR ACHIEVING UNINTERRUPTED PRESSURE CONTROL THROUGH REDUNDANT FAULT TOLERANT INSTRUMENTATION

The pressure on individual streams are being controlled by the Pressure Control Valves CV1, CV2 & CV3 based on the pressure indications provided by PT1, PT2, PT3 & PT4 in common line.

1. The Pressure, PT4, measured at the common downstream line is compared with all the three pressure indications, PT1, PT2 & PT3 individually and the Pressure, which is close to the Set Point, is used for controlling the respective Control Valve. The difference of the two pressure indications is considered good for control only when the difference is within a band, which will be set as per requirement.
2. Set point for all the three controllers is set at the same value.
3. Pressure indication, PT4, at the downstream header is provided to ensure redundancy of Pressure Indications & commonality of Set point.
4. All control valves are considered Air Fail to close, for safety reasons.
5. Since, the behavior of Control Valves when I/P fails is unpredictable, following three conditions are considered.

- a. Failed Control valve remains full open.  
In this case, other two Control Valves will close partially to control the downstream pressure.
  - b. Failed Control valve remains full close.  
In this case, other two Control Valves will open more to maintain the downstream pressure.
  - c. Failed Control Valve maintains the last open position. No control is possible.  
In this case, the two operating pressure control valves will control the downstream pressure.
6. The Pressure Control Valves CV1, CV2 & CV3 are therefore to be sized in such a way that when one valve is fully open, the minimum downstream pressure requirement is met. If two Control Valve fails (closes fully), the remaining one Control Valve will fully open to meet the pressure requirement.
  7. The scheme is conceived to take care of a single failure in any component / Control valve. Double failure like, two Control valves getting fully opened together cannot be taken care.

#### 4.27. CONTROL ROOM AMBIENCE

- A control room with double doors and air curtain is desirable for ensuring healthy and dust-free environment.
- Control room environment temperature should be configured in the DCS for alarm and monitoring of the trends of this parameter.
- Instruments for continuous monitoring of various parameters related to the control room environment, to be installed for monitoring / recording the control room environmental parameters.
- Air curtain is to be installed at the first entry to the control room. All entries to control/ rack rooms shall be with double doors.
- Continuous corrosion monitoring systems shall be provided in each control room.
- LEL & H2S detectors are to be provided in Control Rooms near Sulphur Recovery Units/ ARU/ SWS units or any other unit where such leakages are expected.

#### 4.28. GENERAL CONSIDERATIONS

- I. Smart positioners to be considered for all control valves along with smart positioner diagnostics software for enabling advanced diagnostics with valve signature. The control valve position feedback shall be configured in the DCS with trend recording.
- II. All extra / unused entries of Junction Boxes, transmitters, thermocouples heads shall be plugged by SS plug of suitable size.
- III. For all furnaces, arch pressure transmitters to be provided above the tapping point.
- IV. For reliability and safety high quality fittings and tubes like Swage lock / Parker make may be used for all hydrocarbon lines.
- V. Impulse lines with SS fittings shall be avoided for hydrocarbon lines. Wherever, impulse lines are done with tube fittings, the same is to be replaced with impulse piping. Maximum two Nos. of ferrule fittings shall be used.
- VI. Instrument Air Quality

- Instrument air tapping for sub headers are to be taken from the top of main header.
- Instruments and accessories required for Instrument air quality measurement shall be provided as shown on P&ID.

#### VII. Power supply

Power supply for all subsystems, where facility is available for accepting redundant supplies, shall be from redundant power source. for the systems like:

- Machine Monitoring System
- Governor Control System.
- TMR Over-speed trip system (e.g. Woodward protect system).
- Where Over-speed trip is generated by using any other method (Like using Frequency to current converter & fed to PLC as AI or through trip amplifier) – Ensure that power supply is not common.
- Package PLCs, wherever used (Like Compressor PLCs, PSA PLC etc.).

## 12.0 INSTRUMENT INTERFACE AND INSTALLATION DETAILS

### 1. GENERAL

This specification provides general guidelines for the following:

1. Interface of Instrument Systems to Mechanical Systems (piping, vessels, tanks, standpipes, heaters)
2. Interface of Instrument Systems to Electrical Systems.
3. Practices/ Standards of Workmanship for Installation of Instrumentation.

### 2. INTERFACE OF INSTRUMENT SYSTEMS TO MECHANICAL SYSTEMS

The basic interfaces to piping, vessels, stand pipes, tanks and heaters are as per the tables on next pages.

However, following general philosophy to be followed:

- i. First isolation valve(s) (Root valve by Piping/Mechanical) for instruments shall be of gate type only.
- ii. Not more than two level instruments shall be installed on a standpipe. Standpipe shall have isolation valves.



## 2.1 INSTRUMENT CONNECTION ON VESSELS, STANDPIPES AND TANKS

SR. NO	TYPE OF INSTRUMENTS	UNCLADDED EQUIPMENTS		CLADDED EQUIPMENTS		INSTRUMENT CONNECTION
		FIRST BLOCK VALVE	EQUIPMENT/ STANDPIPE CONNECTION	FIRST BLOCK VALVE	EQUIPMENT/ STANDPIPE CONNECTION	
1	EXTERNAL DISPLACER LEVEL INSTRUMENT ON EQUIPMENT	2" FLGD.	2" FLGD.	3" FLGD.	3" FLGD.	2" FLGD.
2	EXTERNAL DISPLACER LEVEL INSTRUMENT ON STANDPIPE	2" FLGD.	2" FLGD.	2" FLGD.	2" FLGD.	2" FLGD.
3	EXTERNAL GUIDED WAVE LEVEL INSTRUMENT ON EQUIPMENT	2" FLGD.	2" FLGD.	3" FLGD.	3" FLGD.	2" FLGD.
4	EXTERNAL GUIDED WAVE LEVEL INSTRUMENT ON STANDPIPE	2" FLGD.	2" FLGD.	2" FLGD.	2" FLGD.	2" FLGD.
5	EXTERNAL MAGNETIC LEVEL INSTRUMENT/ GAUGE ON EQUIPMENT	2" FLGD.	2" FLGD.	3" FLGD.	3" FLGD.	2" FLGD.
6	EXTERNAL MAGNETIC LEVEL INSTRUMENT/ GAUGE ON STANDPIPE	2" FLGD.	2" FLGD.	2" FLGD.	2" FLGD.	2" FLGD.
7	EXTERNAL BALL FLOAT LEVEL INSTRUMENT ON VESSEL	2" FLGD.	2" FLGD.	3" FLGD.	3" FLGD.	1" SW
8	EXTERNAL BALL FLOAT LEVEL INSTRUMENT ON STANDPIPE	2" FLGD.	2" FLGD.	3" FLGD.	3" FLGD.	1" SW
9	INTERNAL DISPLACER / FLOAT LEVEL INSTRUMENTS	-	4" FLGD	-	4" FLGD	4" FLGD.
10	INTERNAL GUIDED WAVE LEVEL INSTRUMENT ON EQUIPMENT	-	4" FLGD.	-	4" FLGD.	4" FLGD.
11	MAGNETIC LEVEL INSTRUMENT/ GAUGE (INTERNAL - TOP MOUNTED)	-	4" FLGD.	-	4" FLGD.	4" FLGD.
12	LEVEL GAUGE ON VESSEL	2" FLGD.	2" FLGD.	3" FLGD.	3" FLGD.	2" FLGD.

SR. NO	TYPE OF INSTRUMENTS	UNCLADDED EQUIPMENTS		CLADDED EQUIPMENTS		INSTRUMENT CONNECTION
		FIRST BLOCK VALVE	EQUIPMENT/ STANDPIPE	FIRST BLOCK VALVE	EQUIPMENT/ STANDPIPE	
13	LEVEL GAUGE ON STANDPIPE	2" FLGD.	2" FLGD.	3" FLGD.	3" FLGD.	3/4" FLGD.
14	SPECIAL LEVEL INSTRUMENT ON EQUIPMENT (CAPACITANCE /ULTRASONIC /R.F. PROBE)	-	2" FLGD.	-	3" FLGD.	2" FLGD.
15	D.P. INSTRUMENT/ GAUGES ON VESSEL	1 1/2" SW/BW/FLGD#	1 1/2" FLGD.	3" FLGD.	3" FLGD.	1/2" SCRDR.
16	D.P. INSTRUMENT/ GAUGES ON STANDPIPE	1 1/2" SW/BW/FLGD#	1 1/2" FLGD.	3" FLGD.	3" FLGD.	1/2" SCRDR.
17	DIAPHRAGM SEAL D.P. INSTRUMENT/ GAUGES ON VESSEL	3" FLGD.	3" FLGD.	3" FLGD.	3" FLGD.	3" FLGD.
18	EXTENDED DIAPHRAGM SEAL D.P. INSTR/ GAUGE ON VESSEL	-	4" FLGD. (NOTE-1)	-	4" FLGD. (NOTE-1)	4" FLGD.
19	DIP TUBE LEVEL INSTRUMENT	1/2" SW (BY INST)	1 1/2" FLGD.	1/2" SW (BY INST)	3" FLGD.	1/2" SCRDR
20	TANK LEVEL INSTRUMENT (MECHANICAL)	1 1/2" FLGD (BY INST)	1 1/2" FLGD	-	-	1/2" SCRDR
21	TANK LEVEL INSTRUMENT (SERVO) ON ATMOSPHERIC	6" FLGD. (BY INST)	6" FLGD.	-	-	6" FLGD
22	TANK LEVEL INSTRUMENT (SERVO) FOR PRESSURISED	6" FLGD. (BY INST)	6" FLGD.	6" FLGD. (BY INST)	6" FLGD.	6" FLGD
23	TANK LEVEL INSTRUMENT (RADAR) ON ATMOSPHERIC TANK	-	8" FLGD.	-	-	8" FLGD.
24	TANK LEVEL INSTRUMENT (RADAR) ON ATMOSPHERIC TANK	-	24" FLGD.	-	-	24" FLGD.

SR. NO	TYPE OF INSTRUMENTS	UNCLADDED EQUIPMENTS		CLADDED EQUIPMENTS		INSTRUMENT CONNECTION
		FIRST BLOCK VALVE	EQUIPMENT/ STANDPIPE CONNECTION	FIRST BLOCK VALVE	EQUIPMENT/ STANDPIPE CONNECTION	
25	TANK LEVEL INSTRUMENT (RADAR) FOR PRESSURISED EQUIPMENTS	-	8" FLGD.	-	8" FLGD.	8" FLGD.
26	TANK LEVEL INSTRUMENT - CAPITANCE/ULTRASONIC/RF TYPE ON ATMOSPHERIC TANKS/PRESSURISED	-	2" FLGD.	-	3" FLGD.	2" FLGD.
27	TANK LEVEL INSTRUMENT - TUNING FORK	-	3" FLGD.	-	-	3" FLGD.
28	PRESSURE INSTRUMENT/ GAUGE ON VESSEL	1 1/2" FLGD #	1 1/2" FLGD	3" FLGD.	3" FLGD.	1/2" SCRD
29	PRESSURE INSTRUMENT/ GAUGE ON STANDPIPE	3/4" SW/BW/ FLGD #	3/4" SW/BW/ FLGD #	3/4" SW/BW/ FLGD #	3/4" SW/BW/ FLGD #	1/2" SCRD
30	CHEMICAL SEAL PRESSURE INSTRUMENT/ GAUGE ON VESSEL	3" FLGD	3" FLGD	3" FLGD.	3" FLGD.	3" FLGD.
31	DIAPHRAGM SEAL PRESSURE INSTRUMENT/GAUGE ON VESSEL	3" FLGD	3" FLGD	3" FLGD.	3" FLGD.	3" FLGD.
32	THERMOWELL ON EQUIPMENT	-	2" FLGD	-	3" FLGD.	2" FLGD/3" FLGD
33	MULTI-POINT TEMPERATURE ELEMENTS FOR TANKS	-	3FLGD."	-	3" FLGD.	3" FLGD
34	STANDPIPE (RATING UP TO 600#)	-	3FLGD."	-	3" FLGD.	-
35	STANDPIPE (RATING > 600#)	-	3FLGD."	-	3" FLGD.	-
Notes	1. NOZZLE I.D. ON EQUIPMENT SHALL BE SELECTED TO SUIT O.D. OF EXTENDED DIAPHRAGM OF INSTRUMENT. 2. ALL FLANGES/SW RATING SHALL BE AS PER PIPING SPECIFICATION. FLANGE MINIMUM RATING SHALL BE 300#. HIGHER RATING SHALL BE AS PER PIPERATING. 3. IN CASE OF DIRECT MOUNTED INSTRUMENTS AND WHERE FLANGED TYPE FIRST ISOLATION VALVE ARE PROVIDED, BOLTING AND GASKETS SHALL BE IN PIPING SCOPE. 4. INSTALLATION OF TANK LEVEL INSTRUMENTS (SERVO, MECHANICAL AND MULTIPOINT TEMPERATURE ELEMENT) ON TANKS ARE IN TANK VENDOR SCOPE. 5. FOR ANY OTHER INSTRUMENTS NOT REFERRED ABOVE THE CONNECTION DETAILS SHALL BE AS PER INDIVIDUAL REQUIREMENT AS INDICATED IN PAID. 6. NOZZLE SIZES / RATINGS SPECIFIED BY LICENSOR IN VESSEL DATASHEETS SHALL HAVE PRECEDENCE OVER SIZES / RATINGS GIVEN IN THIS DOCUMENT. # AS PER PIPING SPECIFICATION/PROJECT PHILOSOPHY.					

2.2 INSTRUMENT CONNECTION ON PIPES

(A) BARE PIPES															
S.NO	TYPE OF INSTRUMENTS	WHERE PIPING CLASS RECOMMENDS SCRD CONNECTION				WHERE PIPING CLASS RECOMMENDS SW/BW #				WHERE PIPING CLASS RECOMMENDS FLGD CONNECTION					
		PROCESS CONNECTION	FIRST BLOCK VALVE	INSTRUMENTS CONNECTION	INSTRUMENTS CONNECTION	PROCESS CONNECTION	FIRST BLOCK VALVE	INSTRUMENTS CONNECTION	INSTRUMENTS CONNECTION	PROCESS CONNECTION	FIRST BLOCK VALVE	INSTRUMENTS CONNECTION			
1	FLOW METER ORIFICE	1/2"SCRD*	1/2"SCRD*	1/2"SCRD	1/2"SCRD	1/2"SCRD*	1/2"SW/BW#	1/2"SCRD	1/2"SCRD	1/2"SCRD*	1/2"SW/BW#	1/2"SCRD	1/2"SCRD	1/2"SCRD	1/2"SCRD
		-	-	-	-	3/4"SCRD**	3/4"SW/BW#	3/4"SCRD	3/4"SCRD	3/4"SCRD**	3/4"SW/BW#	3/4"SCRD	3/4"SCRD	3/4"SCRD	1/2"SCRD
2	FLOWMETER VENTURI/ NOZZLE	1/2"SCRD*	1/2"SW/BW#	1/2"SCRD	1/2"SCRD	1/2"SCRD*	1/2"SW/BW#	1/2"SCRD	1/2"SCRD	1/2"SCRD*	1/2"SW/BW#	1/2"SCRD	1/2"SCRD	1/2"SCRD	1/2"SCRD
		3/4"SCRD**	3/4"SW/BW#	1/2"SCRD	1/2"SCRD	3/4"SCRD**	3/4"SW/BW#	1/2"SCRD	1/2"SCRD	3/4"SCRD*	3/4"SW/BW#	1/2"SCRD	3/4"SCRD	3/4"SCRD	1/2"SCRD
3	FLOW METER ORIFICE (DIAPH. SEAL)	1/2"SCRD*	1/2"SCRD*	3" FLGD	3" FLGD	1/2"SCRD*	1/2"SW/BW#	3" FLGD	3" FLGD	1/2"SCRD*	1/2"SW/BW#	3" FLGD	3" FLGD	3" FLGD	3" FLGD
		-	-	-	-	3/4"SCRD**	3/4"SW/BW#	-	-	3/4"SCRD**	3/4"SW/BW#	3" FLGD	3" FLGD	3" FLGD	3" FLGD
4	FLOW METER VENTURI/ NOZZLE (DIAPH. SEAL)	1/2"SCRD*	1/2"SW/BW#	3" FLGD	3" FLGD	1/2"SCRD*	1/2"SW/BW#	3" FLGD	3" FLGD	1/2"SCRD*	1/2"SW/BW#	3" FLGD	3" FLGD	3" FLGD	3" FLGD
		-	-	-	-	3/4"SCRD**	3/4"SW/BW#	-	-	3/4"SCRD**	3/4"SW/BW#	3" FLGD	3" FLGD	3" FLGD	3" FLGD

S.NO	TYPE OF INSTRUMENTS	WHERE PIPING CLASS RECOMMENDS SCRD CONNECTION			WHERE PIPING CLASS RECOMMENDS SW/BW #			WHERE PIPING CLASS RECOMMENDS FLGD CONNECTION		
		PROCESS CONNECTION	FIRST BLOCK VALVE	INSTRUMENTS CONNECTION	PROCESS CONNECTION	FIRST BLOCK VALVE	INSTRUMENTS CONNECTION	PROCESS CONNECTION	FIRST BLOCK VALVE	INSTRUMENTS CONNECTION
5	FLOW METER AVERAGING PITOT	3"FLGD	3"FLGD (BY INST)	3"FLGD+	3"FLGD	3"FLGD (BY INST)	3"FLGD	3"FLGD	3"FLGD (BY INST)	3"FLGD+
6	DIFFERENTIAL PRESSURE (DP) INSTRUMENTS	3/4"SCRD*	3/4"SCRD*	1/2"SCRD.	3/4"SW/BW#	3/4"SW/BW#	1/2"SCRD	3/4"SW/BW#	3/4"SW/BW#	1/2"SCRD
7	DIAPHRAGM SEAL D.P. INSTRUMENTS	3"FLGD.	3"FLGD.	3"FLGD.	3"FLGD.	3"FLGD.	3"FLGD	3"FLGD.	3"FLGD.	3"FLGD.
8	PRESSURE INSTRUMENTS	3/4"SCRD*	3/4"SCRD*	1/2"SCRD.	3/4"SW/BW#	3/4"SW/BW#	1/2"SCRD	3/4"SW/BW#	3/4"SW/BW#	1/2"SCRD
9	DIAPH. (CHEMICAL) SEAL PRESSURE INSTRUMENT (SCRD.)	3/4"SCRD*	3/4"SCRD*	1/2"SCRD.	3/4"SW/BW#	3/4"SW/BW#	1/2"SCRD	3/4"SW/BW#	3/4"SW/BW#	1/2"SCRD
10	DIAPHRAGM SEAL PRESSURE INSTRUMENTS (FLGD.)	1 1/2"FLGD.	1 1/2"FLGD.	1 1/2"FLGD.	1 1/2"FLGD.	1 1/2"FLGD.	1 1/2"FLGD.	1 1/2"FLGD.	1 1/2"FLGD.	1 1/2"FLGD.
11	THERMOWELL	1 1/2"FLGD.	-	1 1/2"FLGD.	1 1/2"FLGD.	-	1 1/2"FLGD.	1 1/2"FLGD.	-	1 1/2"FLGD

(B) CLADDED/CEMENTED/LINED PIPES											
S.NO	TYPE OF INSTRUMENTS	WHERE PIPING CLASS SPECIFIES CLADDED PIPES			WHERE PIPING CLASS SPECIFIES CEMENT LINED PIPES			WHERE PIPING CLASS SPECIFIES RUBBER/TEFLON LINED PIPES			
		PROCESS	FIRST BLOCK VALVE	INSTRUMENT CONNECTION	PROCESS CONNECTION	FIRST BLOCK VALVE	INSTRUMENT CONNECTION	PROCESS CONNECTION	FIRST BLOCK VALVE	INSTRUMENT CONNECTION	
1	FLOW METER ORIFICE	≤ 600#	1/2"SCRD*	1/2"SCRD	1/2"SCRD*	1/2"SW/BW	1/2"SCRD	1" FLGD	1" FLGD	1/2"SCRD	
		> 600#	3/4"SCRD**	1/2"SCRD	-	-	-	-	-	-	
2	FLOW METER ORIFICE (DIAPHRAGM SEAL)	≤ 600#	1/2"SCRD*	3"FLGD	1/2"SCRD*	1/2"SW/BW	3"FLGD	1" FLGD	1" FLGD	3"FLGD	
		> 600#	3/4"SCRD**	3"FLGD	-	-	-	-	-	-	
3	FLOW METER AVERAGING PITOT TUBE	3"FLGD	3"FLGD (BY INST)	3"FLGD+	3"FLGD	3"FLGD (BY INST)	3"FLGD+	3"FLGD (BY INST)	3"FLGD (BY INST)	3"FLGD+	
4	DP INSTRUMENTS	3/4"SW/BW#	3/4"SW/BW#	1/2"SCRD.	3"FLGD	3/4"FLGD	1/2"SCRD	11/2"FLGD	1 1/2" FLGD	1/2"SCRD	
5	DIAPHRAGM SEAL D.P. INSTRUMENTS	3"FLGD.	3"FLGD.	3"FLGD	3"FLGD	3"FLGD	3"FLGD	3"FLGD.	3"FLGD.	3"FLGD.	
6	PRESSURE INSTRUMENTS	3/4"SW/BW#	3/4"SW/BW#	1/2"SCRD.	3"FLGD	3/4"SW/BW	1/2"SCRD	1" FLGD	1" FLGD	1/2"SCRD	
7	DIAPHRAGM (CHEMICAL) SEAL PRESSURE INSTRUMENTS (SCRD.)	3/4"SW/BW#	3/4"SW/BW#	1/2"SCRD.	3"FLGD	1 1/2"SW/BW	1/2"SCRD	1" FLGD	1" FLGD	1/2"SCRD	
8	DIAPHRAGM SEAL PRESSURE INSTRUMENTS (FLGD)	1 1/2"FLGD.	1 1/2"FLGD.	1 1/2"FLGD.	3"FLGD	1 1/2"FLGD	1 1/2"FLGD	1 1/2"FLGD	1 1/2"FLGD	1 1/2" FLGD	

S. NO	TYPE OF INSTRUMENTS	WHERE PIPING CLASS SPECIFIES CLADDED PIPES			WHERE PIPING CLASS SPECIFIES CEMENT LINED PIPES			WHERE PIPING CLASS SPECIFIES RUBBER/TEFLON LINED PIPES			
		PROCESS CONNECTION	FIRST BLOCK VALVE	INSTRUMENTS CONNECTION	PROCESS CONNECTION	FIRST BLOCK VALVE	INSTRUMENTS CONNECTION	PROCESS CONNECTION	FIRST BLOCK VALVE	INSTRUMENT CONNECTION	
9	THERMOWELL	1 1/2"FLGD.	-	1 1/2"FLGD.	3"FLGD	-	3"FLGD	3"FLGD	-	3"FLGD	
<b>NOTES:</b>	1	FOR ANY OTHER INSTRUMENTS NOT REFERRED ABOVE THE CONNECTION DETAILS SHALL BE AS PER INDIVIDUAL REQUIREMENT.									
	2	ALL FLANGES/SW RATING SHALL BE AS PER PIPING SPECIFICATION. FLANGE MINIMUM RATING SHALL BE 300#. HIGHER RATING SHALL BE AS PER PIPE RATING.									
	3	IN CASE OF DIRECT MOUNTED FLANGED INSTRUMENTS AND WHERE FLANGED FIRST ISOLATION VALVE ARE PROVIDED, BOLTING AND GASKETS SHALL BE IN PIPING SCOPE.									
	4	INSTALLATION OF ALL IN-LINE INSTRUMENTS SHALL BE IN PIPING SCOPE.									
	5	PRESSURE INSTRUMENTS INCLUDE PRESSURE TRANSMITTERS AND PRESSURE GAUGES.									
	6	NOZZLE SIZES / RATINGS SPECIFIED BY LICENSOR SHALL HAVE PRECEDENCE OVER SIZES / RATINGS GIVEN IN THIS DOCUMENT.									
	*	SEAL WELDING REQUIRED.									
	#	AS PER PIPING SPECIFICATION.									
	**	STRENGTH WELD									
	+	CONNECTIONS FOR D.P. INSTRUMENT 1/2" SCR D									

### 2.3 INSTRUMENT CONNECTION ON FIRED HEATERS

S. NO.	TYPE OF INSTRUMENTS	HEATER/DUCT/LINE CONNECTION	FIRST BLOCK VALVE	INSTRUMENT CONNECTION
1	FLOW ELEMENT - AVG PITOT TUBE	3" FLANGED	-	3" FLANGED (NOTE-3)
2	FLOW ELEMENT - VENTURI TUBE	1/2" FLANGED	1/2" FLANGED	1/2" NPT (F)
3	FLOW ELEMENT - THERMAL MASS	1 1/2" FLANGED	-	1 1/2" FLANGED
4	PRESSURE INSTRUMENT	1 1/2" FLANGED	1 1/2" FLANGED	1/2" NPT (F)
5	PRESSURE INSTRUMENT (COIL)	1 1/2" FLANGED	1 1/2" FLANGED	1/2" NPT (F)
6	DRAFT GAUGE	1 1/2" FLANGED	-	1/2" NPT (F)
7	TEMPERATURE INSTRUMENT (THERMOWELL)	1 1/2" FLANGED	-	1 1/2" FLANGED
8	TEMPERATURE INSTRUMENT (COIL) - THERMOWELL	1 1/2" FLANGED	-	1 1/2" FLANGED
9	SKIN THERMOCOUPLE	1" PIPE	-	-
10	FLUE GAS ANALYZER (SOX, NOX, O2, HC, CO)	4" FLANGED	-	4" FLANGED
11	FLUE GAS ANALYZER (SPM)	6" FLANGED	-	6" FLANGED
	<b>NOTE</b>			
1	PRESSURE RATING OF FLANGED CONNECTION SHALL BE 300# INSTRUMENT MOUNTED DIRECTLY ON HEATER			
2	PRESSURE RATING OF FLANGED CONNECTION ON THE TUBE SIDE SHALL BE AS PER PIPING CLASS.			
3	TRANSMITTER CONNECTION SHALL BE 1/2" NPT (F)			

- Flange ratings shall be 300 lb minimum or as per piping or vessel specification whichever is the greater. Orifice flange taps connection size shall be 1/2" internal diameter.
- Temperature connections should be installed in a minimum of a 4" line. Smaller lines sizes shall be swaged up locally to accommodate this. Where connection is on stream axis, in a bend or tee, line size may be 3".
- Where nonstandard connections are required, e.g. analyzer sample points, diaphragm seals, hazardous services, these will be detailed on P&ID's.
- Where instruments require flushing or purging, this shall be indicated on PIDs.
- Where there is a requirement to connect an instrument to a closed drain system, Instrumentation Group will be responsible for the installation to a suitable connection,



- provided by Piping Group, on the drain header.
- For level gauges, level displacers and level switches the mechanical installation shall be by Piping Group.
  - Instrument Air Headers and take off valves shall be as detailed on P&ID's.

### 3. FLOW METERS

This Standard provides the requirements for: -

- a) Orifice Plates
- b) Venturi Tubes
- c) Averaging Pitot Tubes (Annubars)
- d) Magnetic Flow Meters
- e) Variable Area Meters
- f) Turbine Meters

This Standard does not cover the design and installation of the transmitters or electronics associated with these primary devices.

This Standard does not cover the selection of the individual primary devices.

This Standard does not cover the detail requirements for fiscal or custody transfer metering.

#### 3.1 Installation Definition & Requirements

To achieve the stated instrument accuracy, each type of primary device must be installed correctly. Correct installation will require the following to be considered:

- a) Upstream straight pipe
- b) Downstream straight pipe
- c) Vertical flow - up or down
- d) Insertion plane with respect to upstream disturbances.

All dimensions are from the last weld line of the fitting preceding the flow device (not the center-line of the pipe).

All straight lengths shall be based on pipe inside diameters.

#### 3.2 Orifice Plates

Straight length requirements are based on ISO 5167 for 0.5% additional uncertainty. Lengths are based on a Beta ratio of 0.75.

(See copy extract of table from ISO 5167 part 2 on following page.)

**Required straight lengths between orifice plate and fittings without flow conditioners**

Table taken from BS5767 pt.2 – Values expressed in multiples of internal D

Diameter Ratio β	Upstream (inlet) side of orifice plate											Downstream (outlet) side of orifice plate	
	Single 90° bend or two 90° bends in any plane (S > 30D) <sup>a</sup>	Two 90° bends in the same plane; S-configuration (30D ≥ S > 10D) <sup>a</sup>	Two 90° bends in perpendicular planes (30D ≥ S ≥ 5D) <sup>a</sup>	Two 90° bends in perpendicular planes (5D > S) <sup>a</sup>	Single 90° tee with or without an extension; Mitre 90° bend	Single 45° bend; Two 45° bends in the same plane; S-configuration (S ≥ 2D) <sup>a</sup>	Concentric reducer 2D to D over a length of 1.5D to 3D	Concentric expander 0.5D to D over a length of D to 2D	Full bore ball valve or gate valve fully open	Abrupt symmetrical reduction	Thermometer pocket or well of diameter ≤ 0.03D <sup>d</sup>		Fittings (columns 2 to 11) and the densitometer pocket
1	2	3	4	5	6	7	8	9	10	11	12	13	14
-	A <sup>b</sup> B <sup>c</sup>	A <sup>b</sup> B <sup>c</sup>	A <sup>b</sup> B <sup>c</sup>	A <sup>b</sup> B <sup>c</sup>	A <sup>b</sup> B <sup>c</sup>	A <sup>b</sup> B <sup>c</sup>	A <sup>b</sup> B <sup>c</sup>	A <sup>b</sup> B <sup>c</sup>	A <sup>b</sup> B <sup>c</sup>	A <sup>b</sup> B <sup>c</sup>	A <sup>b</sup> B <sup>c</sup>	A <sup>b</sup> B <sup>c</sup>	A <sup>b</sup> B <sup>c</sup>
≤ 0.20	6 3	10 9	10 9	19 18	34 17	3 9	7 9	5 9	6 9	12 6	30 15	5 3	4 2
0.40	16 3	10 9	10 9	44 18	50 25	9 3	30 9	5 9	12 8	12 6	30 15	5 3	6 3
0.50	22 9	16 10	22 10	44 16	75 34	19 9	30 18	8 5	20 9	12 6	30 15	5 3	6 3
0.60	42 13	30 18	42 18	44 18	65 <sup>e</sup> 25	29 18	30 18	9 5	26 11	14 7	30 15	5 3	7 3.5
0.67	44 20	44 18	44 20	44 20	60 18	36 18	44 18	12 6	28 14	16 9	30 15	5 3	7 3.5
0.75	44 20	44 18	44 22	44 20	75 18	44 18	44 18	13 8	36 18	24 12	30 15	5 3	8 4

NOTE 1 The minimum straight lengths required are the lengths between various fittings located upstream or downstream of the orifice plate and the orifice plate itself. Straight lengths shall be measured from the downstream end of the curved portion of the nearest (or only) bend or tee or the downstream end of the curved or conical portion of the reducer or the expander.

NOTE 2 Bends on which the lengths in this table are based had a radius of curvature equal to 1.5D.

a - S is the separation between the two bends measured from the downstream end of the curved portion of the upstream bend to the upstream end of the curved portion of the downstream bend.

b - This is not a good upstream installation; a flow conditioner should be used where possible.

c - The installation of thermometer pockets or wells will not alter the required minimum upstream straight lengths for the other fittings.

d - A thermometer pocket or well of diameter between 0.03D and 0.13D may be installed provided that the values in columns A & B are increased to 20 & 10 respectively. Such an installation is not, however recommended.

e - Column A for each fitting gives lengths corresponding to 'zero additional uncertainty' values.

f - Column B for each fitting gives lengths corresponding to '0.5% additional uncertainty' values.

g - The straight lengths in column A zero additional uncertainty; data are not available for shorter straight lengths which could be used to give the required straight lengths for column B.

h - 95D is required for ReD × 10<sup>6</sup> if S < 2D.

Notes:

1. When the valve is preceded by a fitting, the straight run must be sufficient to cover their requirements.

2. Double entry fittings may be considered as single bends when the line is normally blocked off, such as a spare pump.
3. Fittings include elbows, tees, crosses, drums, tanks, pressure taps, thermowells, and other such fittings.
4. Metering orifice shall be installed in horizontal lines where possible, if installed in vertical lines, flow shall be upwards for liquids and downwards for gases.
5. Straightening vanes shall not be used.

### 3.3 Venturi Tubes

Straight length requirements are based on ISO 5167 (BS1042) for 0.5% additional uncertainty, and a Beta ratio of 0.7.

#### Upstream

**Table 2**

Single 90° bend	2 or more 90° bends in the same or different planes	Reducer 1,33D to D over a length of 2,3D	Expander 0,67D to D over a length of 2.5D	Reducer 3D to D over a length of 3.5D	Expander 0.75D to D over a length of D	Full Bore ball or gate valve fully open
3	3	4*	5	2.5	3.5	3.5

*\*Data is not available for shorter lengths which could be used to give the required straight lengths for 0.5% uncertainty. Therefore, the length given is that for 0% uncertainty.*

All lengths measured from the upstream tapping.

If several fittings are placed in series upstream from the primary device, the following rule shall be applied: between the fitting (1) closest to the primary device and the primary device itself, there shall be a minimum straight length such as is indicated for the fitting (1) in question. But, in addition, between this fitting (1) and the proceeding one (2) there shall be a straight length equal to one-half of the value given in Table 2 for fitting (2).

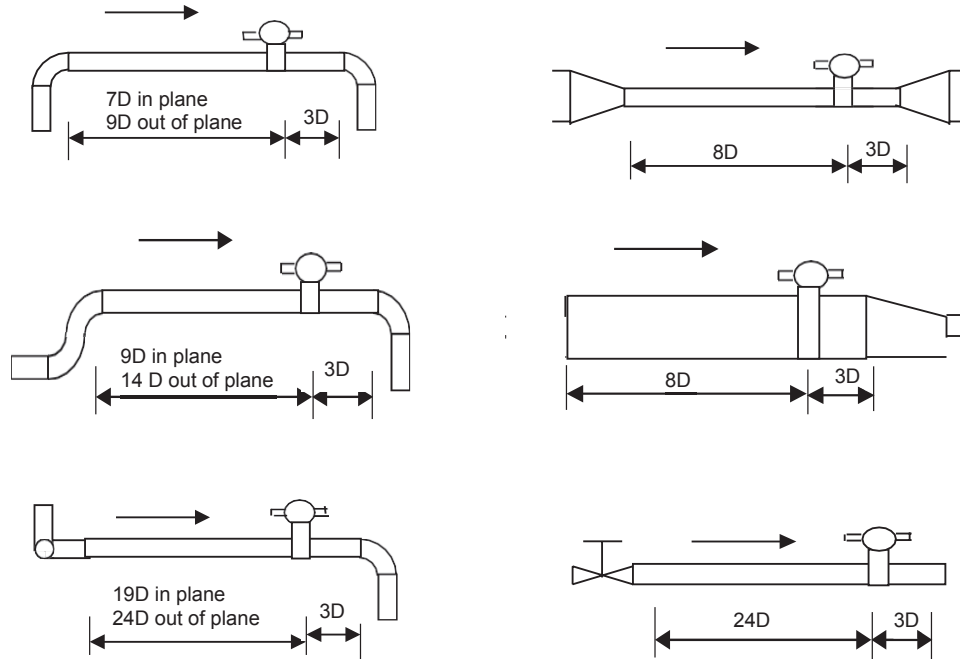
#### Downstream

3D for all fittings.

### 3.4 Averaging Pitot Tubes (Annubars)

Install across the diameter of the pipe.

Upstream and downstream straight pipe lengths are shown for 6 piping configurations based on typical manufacturer's recommendations.



### 3.5 Magnetic Flow Meters

In horizontal pipe runs, electrode axis must be horizontal. Locate in pipe run that is always full of liquid.

Provide a minimum of 7D upstream and 2D downstream (measured from the electrode axis), based on typical manufacturers recommendations.

### 3.6 Variable Area Meter

Must be installed in a vertical line with the flow upward. Provide a minimum of 10D upstream and 2D downstream.

### 3.7 Turbine Meters

Minimum upstream straight pipe is 15D. If flow straighteners are used upstream straight pipe is 10D. These requirements are based on typical manufacturer recommendations.

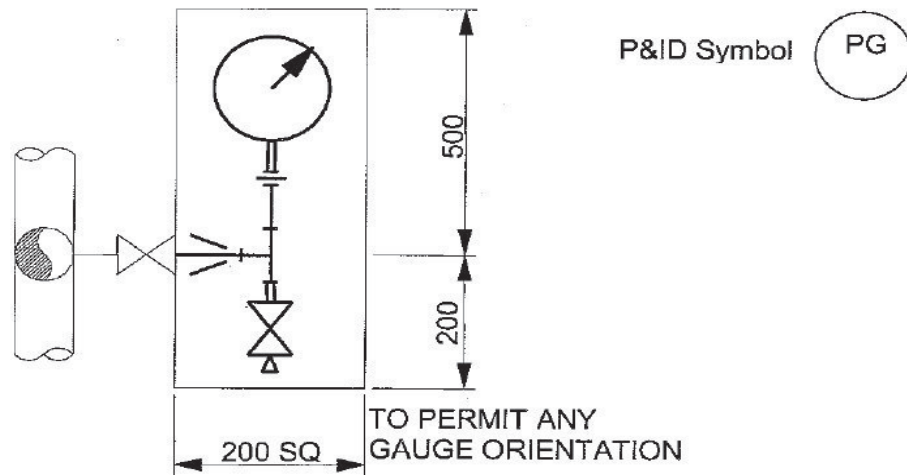
Minimum downstream straight pipe is 5D.

## 4. INSTRUMENT INSTALLATION SPACE REQUIREMENTS

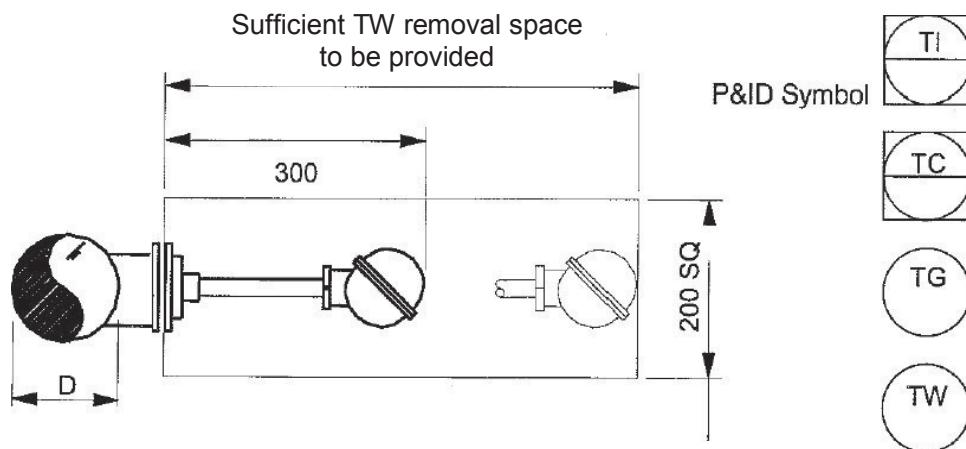
### Outline

This guide outlines the clearance envelope required for the installation of assembly as a minimum.

#### 1. Pressure Gauge

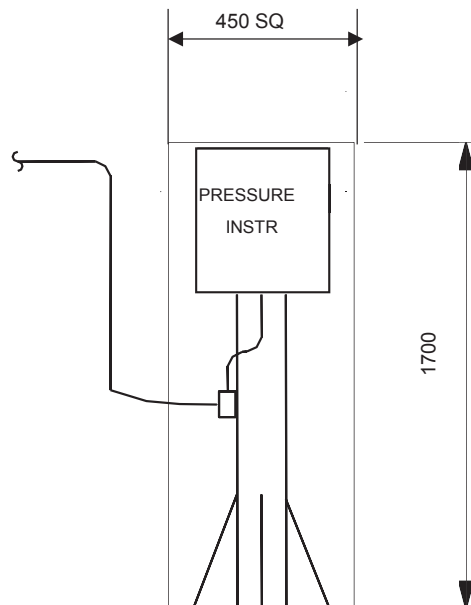
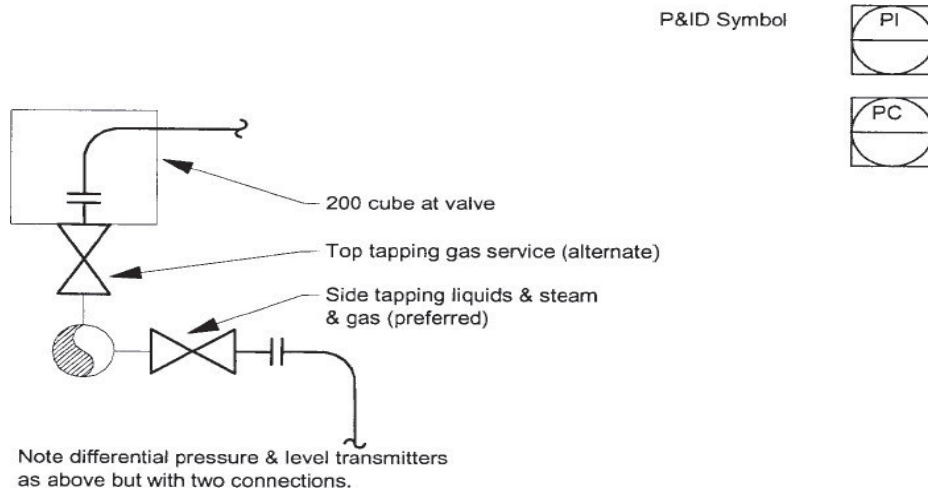


#### 2. Temperature Instruments

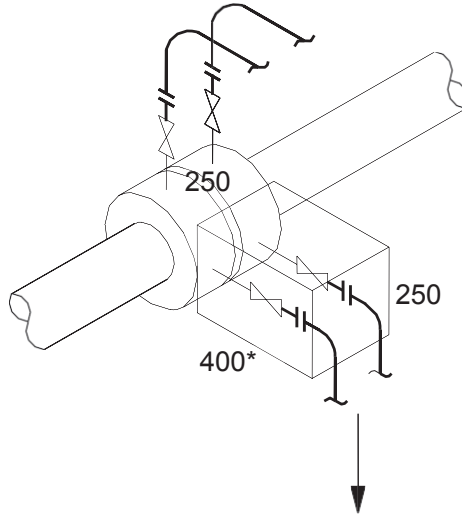


### 3. Pressure transmitter (remote mounted)

Note. Preferred installation is line mounted.



#### 4. Flow transmitters (orifice type).



P&ID  
Symbol



Envelop at instrument as per  
pressure (450 sq. x 1700 high)

Horizontal lines (preferred installation).

Gas service - Side taps

Liquid & steam service - Side taps.

Horizontal lines (alternate installation).

Gas service - top tapping down to 45 degrees either side of vertical. Liquid service-horizontal tapping down to 45 degrees either side of the horizontal.

Vertical lines

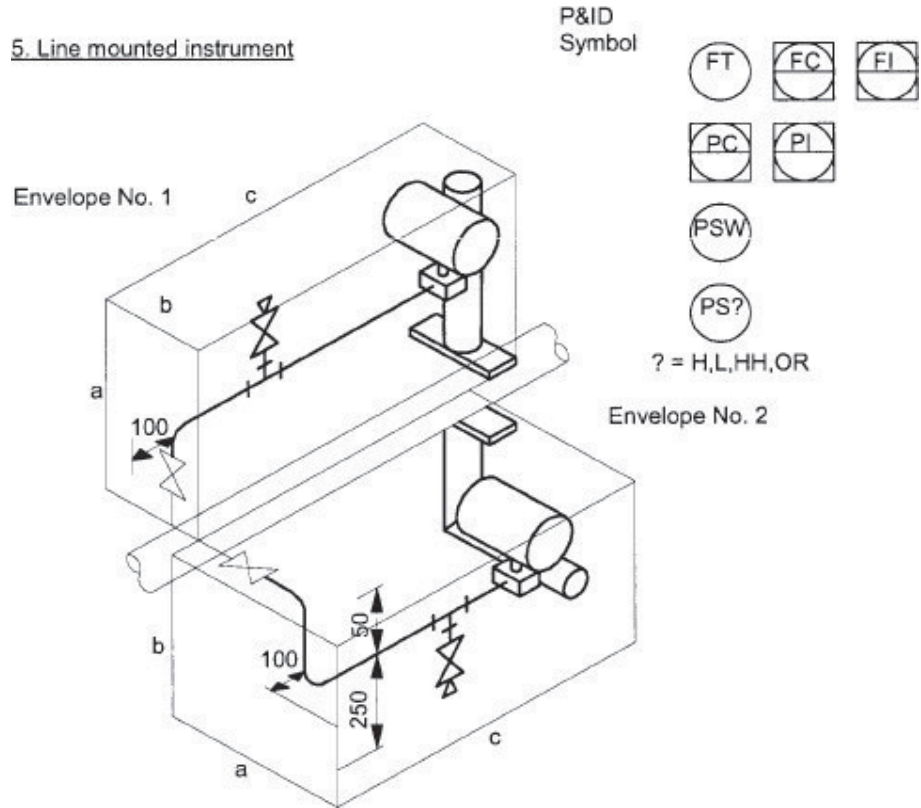
Flow upwards - liquid.

Flow downwards - gas & steam

Note \*Dimension relative to outside of orifice flange.

On liquid and water filled steam service impulse lines must go up to the same

5. Line mounted instrument



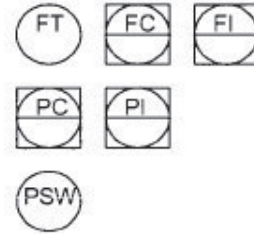
Envelope No. 1				
Dimension			Service	Instrument
a	b	c		
700	450	1000	Gas	PT, PS
900	650	1100	Gas	FT

Envelope No. 2				
Dimension			Service	Instrument
a	b	c		
700	400	1000	Liquid, Steam	PT, PS
900	450	1100	Liquid, Steam	FT

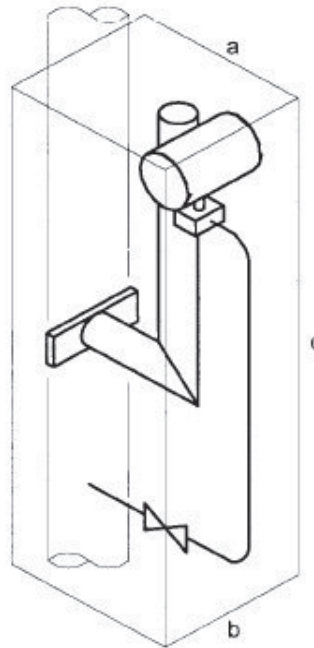


6. Line mounted instrument

P&ID



Envelope No.3



Envelope No. 3			Service	Instrument
Dimension				
a	b	c		
700	450	1000	Gas (Note 2)	PT, PS
900	650	1100	Gas (Note 2)	FT

Notes:

1. Dimension 'a' relative to outside of pipe.
2. For Liquid & Steam service as above but instrument below connection(s)

**5. INSTRUMENT / ELECTRICAL CONTROL INTERFACE**

A guideline which may be followed for Instrument/ electrical interface is provided in this section. These are the minimum requirements and may vary from project to project.

- All hardwired signal /cable interfaces between electrical control equipment and RR, except serial interface to Motor Control System, shall take place at an Instrument/Electrical Interface Cabinet (also termed as IRP -Interposing Relay Panel). The signal type designation will be detailed in the Instrument Database and included Motor Control and Indication Schedule (Electrical Database).
- The Interface Cabinet shall be located in the Instrument RR.
- Sufficient terminals shall be provided in the interface cabinet to allow the termination of all cores of cables entering the cabinet. This shall include a minimum of 10% spare cables and cores. Signal content and connection details of Instrument cables shall be included in the respective Cabinet Interconnection Diagrams.

**5.1 SIGNALS FROM INSTRUMENT TO ELECTRICAL**

Refer to Attachment – I, for diagrammatic representation of interface signal requirements.

SIGNAL TYPE	CONNECTION TYPE (Refer Attachment I)
DCS/ESD CONTROL START / START PERMISSIVE (All motors)	A
DCS/ESD CONTROL STOP / TRIP (All 415V drives)	B
DCS/ESD CONTROL STOP / TRIP (HV motors)	I
CONTROL – ANALOGUE	E

All IRP relays shall be fitted with diode suppression circuits. IRP relays to be rated at 5A to prevent burnout / sticking.

All relay contacts shall be suitable for the Electrical control voltage.

All relays shall have LED indication. All interposing relays at Instrument end shall be dual contact type only.

**5.2 SIGNALS FROM ELECTRICAL TO INSTRUMENT**

Refer to Attachment - I, for diagrammatic representation of interface signal requirements.

SIGNAL TYPE	CONNECTION TYPE (Refer Attachment I)
MCC STATUS TO DCS/ESD	C
NON MCC STATUS TO DCS/ESD	D
UPS INDICATION - ANALOGUE	H

### 5.3 CONTROL SIGNALS

All signals between DCS/ESD and motor starters and vice versa shall be hardwired via Interposing Relay Panel (IRP). IRP shall be located in MCC/ Substation room and shall be supplied by DCS vendor as complete assembled and prewired panel ready to install. Required signals (both MCC and DCS side) details shall be provided by LSTK/DEC as per MCC signal segregation philosophy. Relays are to be segregated based on the voltage level.

There shall not be any remote start command from DCS/ESD unless specifically required by process and shown in P&ID. However, in case of auto-start applications based on interlocks, control signals shall be sent from DCS / ESD to MCC.

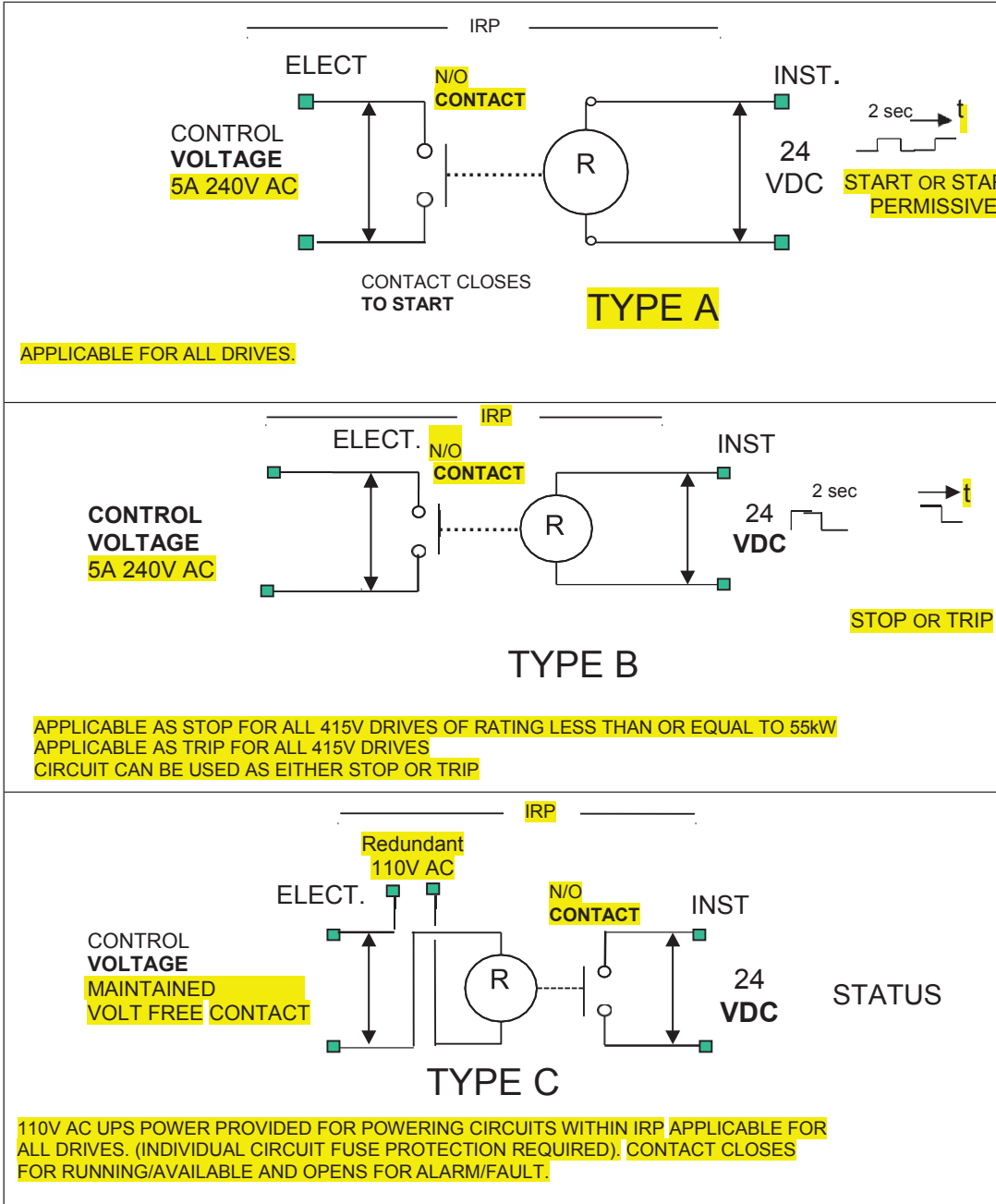
Remote stop (manual, and automatic if necessary) shall be provided for each motor/load.

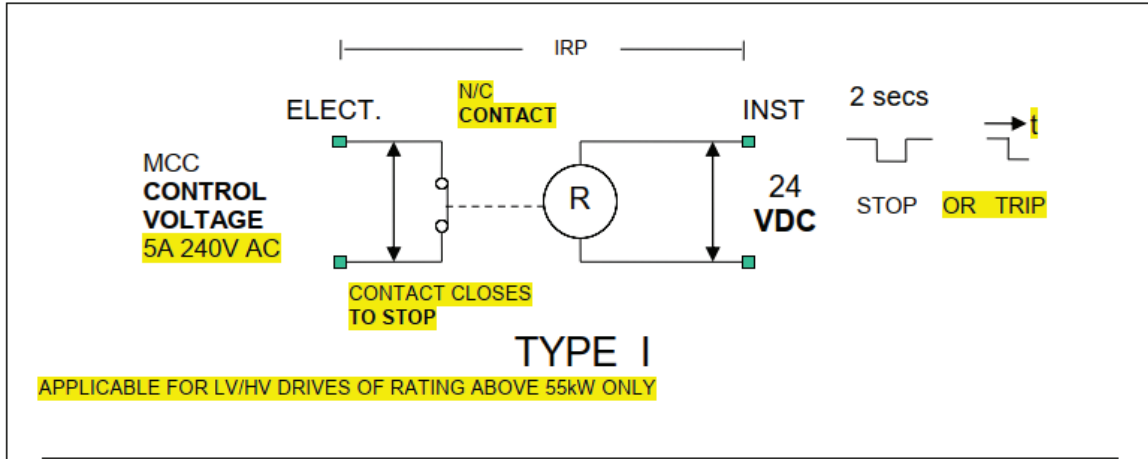
### 5.4 UPS diagnostics

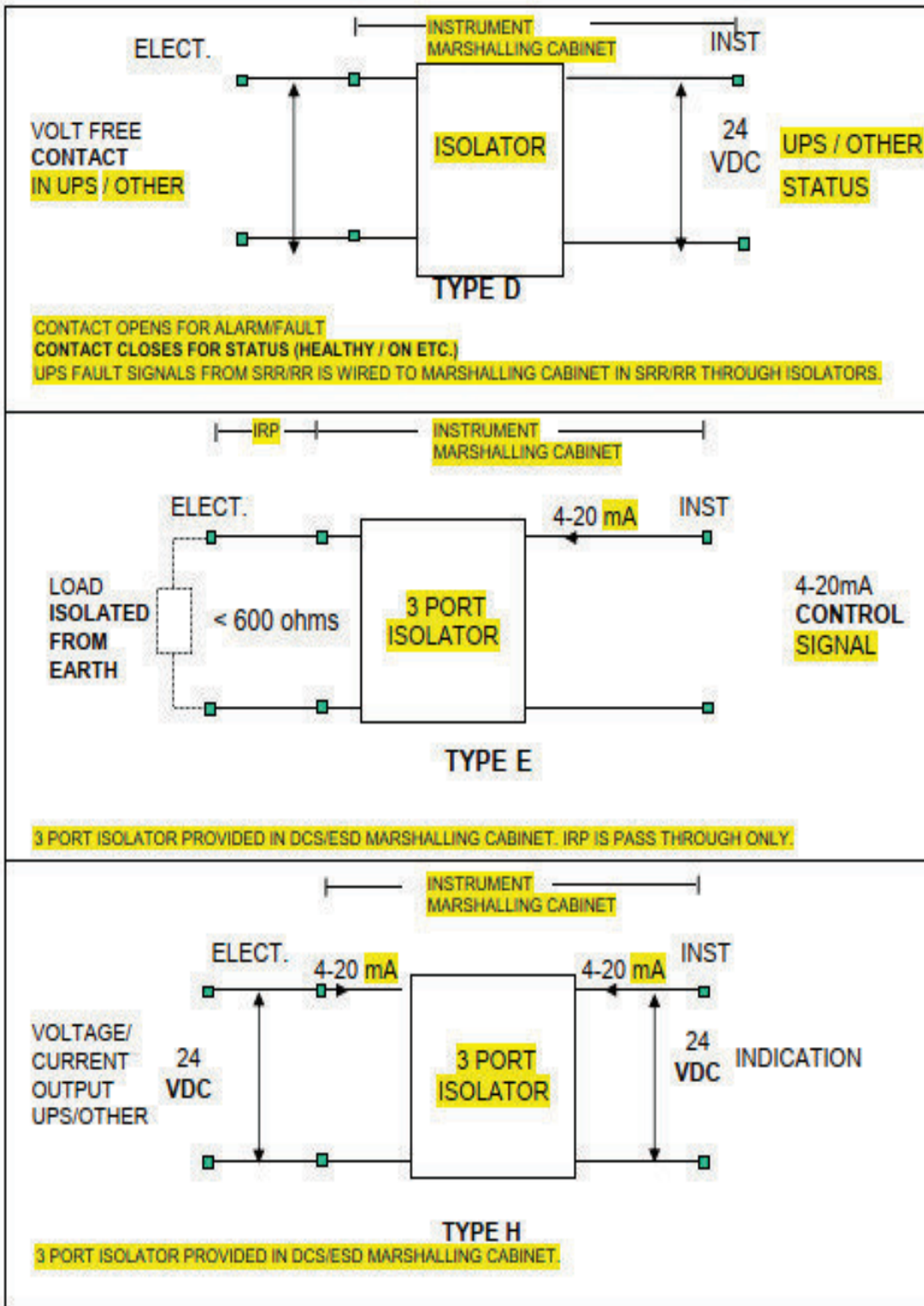
UPS current and voltage indications and failure alarms shall be connected to DCS and made available to operator in control rooms.

**5.5 ATTACHMENT I**

**Electrical / Instrument Interface Schematics**







## 6. INSTALLATION STANDARDS

Practices/ Standards of Workmanship for Installation of Instrumentation has been described in this section.

### 6.1 INSTRUMENT LOCATION AND SUPPORT

#### General

- Instruments shall be located in accordance with the detail drawings and with due regard to accessibility and maintenance activities. Vents, drains and filling points shall be sited away from access ways and to minimize the impingement of process fluids on instrument equipment and cables.
- Care shall be taken to ensure that no passageways or accesses to equipment are obstructed. Instruments shall be clear of drainage points for condensate, water and process fluids from adjacent equipment. Instruments shall be located away from potential fire risks, spillage areas, hot environments, and sources of radiation. Indicating instruments shall be orientated to be readable from walkways or platforms. Instruments shall be accessible for adjustment or maintenance.
- Generally, instruments shall be line mounted. Instruments may be accessed from a portable ladder up to an elevation of 4000 above grade. Instruments line mounted above 4000 shall be accessed from a permanent platform or fixed ladder.
- Remote mounted Instrumentation requiring operator access shall be mounted at a height of 1400mm from grade or platform. Other instrumentation shall also be mounted at 1400mm from grade or platform.
- The only permitted exceptions are for DP level transmitters, level switches, displacers, thermowells, etc., where their elevations are determined by their respective process connections.
- Where field indicators are specified in association with transmitters, the field indicator shall be located to be readable from the associated control valve or final element, unless otherwise noted on the P & I diagram or instrument location plans.
- When installing instruments, allowance shall be made where necessary for any tracing, insulation and housings that may be required.
- A clearance of not less than 300mm is required between any hot surface (temperature more than 65°C) and any instrument tubing systems.
- No instrument support shall be welded to a vessel, pipe or any other equipment containing process fluids. The only exception to this shall be for instrument supports/brackets installed by vessel fabricator at his works as part of the vessel dressing.
- Except for pressure gauges no instrument shall be installed such that it depends for support or rigidity on the impulse piping.
- Pressure gauges shall be installed such that their blowout protectors are not obstructed. Protectors shall face away from the operator access area. The minimum clearance between blowout disc and a nearby obstruction should be 25mm.
- Handrails shall not be used for mounting or supporting instruments, nor shall any instrument or support be located within 150mm of the top handrail.
- Special attention shall be paid to the mounting of instruments with filled systems and capillaries. Capillary tubing shall be continuously supported throughout its length supported and protected against mechanical damage and shall be run independently of all other lines. Extra lengths of capillary shall be coiled up at the instrument end, with a minimum bending radius of 125mm.

- Instruments fitted with direct mounted manifolds shall be supported by the manifold.
- Instrument field supports, JB frames, etc. shall be prepared and finished in accordance with detail drawings.
- All instrument equipment shall be mounted and supported such that it is free from vibration and misalignment.
- All local panels, JB frames, etc. shall be levelled using shims as required. Where equipment is mounted at grade, the supports shall be grouted such that any water is shed.
- All junction boxes, transmitters, gas detectors, local panels etc. need to be provided with sunshield / canopies.

## 6.2 Instrument Accessibility

### General

All instrument equipment shall be accessible for servicing from floor level, walkways, permanent ladders or platforms. Orifice plates, thermocouples and other in-line devices may be accessed by temporary means.

### Access from a Platform

To be accessible from a platform the location must satisfy the following:

- a) The equipment shall be located on, next to, or above a platform.
- b) When the equipment is located next to a platform, the center of the operating mechanism shall be not more than 0.5m outside the handrail and neither more than 1.5m nor less than 150mm above the platform.
- c) When the equipment is located above a platform, the top of the mechanism shall be neither more than 3m nor less than 150mm above the platform.

### Access from a permanent ladder

To be accessible from a permanent ladder the equipment shall be not more than 1m from the centerline of the ladder.

## 6.3 INSTRUMENT PROCESS PIPING AND TUBING

### General

The Instrument Piping Material Standard, shall apply after the first process block valve.

- The instrument PMS shall be developed based on total material requirements for approved Instrument hook ups. only 1/2" / 3/4" SW and BW valves are to be considered for impulse piping fabrication for instrument hook ups. Flange valves shall not be used.
- Schedule 80 seamless pipe, as a minimum, should be used for impulse piping.
- Impulse pipes and associated fittings used shall be of schedule 160 maximum. Higher schedules may be used if warranted only with the concurrence of consultant/ owner.
- A close coupled piping installation should be used for all flammable, hydrocarbon, hydrogen gas and high-pressure services (900 lb. and over).
- For water, N<sub>2</sub>, air and LP/MP steam services a tubing installation can be followed, however for steam services a remote mounted installation is allowed with a hybrid installation of piping and tube, the tubing portion shall connect to the transmitter and shall be kept to a minimum. Not more than 2 compression fittings per impulse pipe is allowed in such cases.
- Impulse lines for lube oil and seal oil skids connected to rotary equipment, e.g.



compressor, may be tubing, however in this case only compression fittings manufactured by Swagelok or Parker are acceptable.

- Root isolation valve shall be provided for skid mounted instruments where tubing is extended to remote installation of instrument.
- All impulse lines shall be run with a slope of not less than 1:12 except where otherwise stated. The slope shall be down from the tapping point for liquid, steam and any condensable medium, and up from the tapping point for gases in accordance with detail drawings.
- Vents shall be sited at the highest point of the installation and drains at the lowest. For all sour services/inflammable gases, instrument drain and vent points shall be connected to flare header and CBD by way of providing separate isolation valves, NRVs and break flanges in between instrument hook up assembly and CBD & flare for maintenance purpose.
- Impulse lines shall be kept as short as possible consistent with good practice and accessibility.
- Joints made in adjoining tubing lines shall be located such that the joints are not adjacent at the same level.
- Impulse lines shall not sag. Adequate support shall be provided.
- Impulse lines and piping shall not be supported from handrails.
- Impulse lines shall not be supported from process lines except by agreement with the owner.
- Double isolation valves, double drain and vent valves shall be used for all services above 600# and on all hydrogen services irrespective of piping class.
- In close coupled installations only, flange joints and no unions should be used in impulse lines. Unions may be used in branching of instrumentation air lines only. Couplings may be used with impulse piping used in pressure gauge installations only.
- Impulse lines are to be supported independently of the instrument to which they are connected so that no strain is imparted to the instrument.
- Due regard shall be given to hot service installation that is subject to contraction, to ensure that sufficient flexibility is allowed.
- Stainless steel pipes or tubes shall not be located where, in the event of a fire, there is a possibility of molten zinc falling onto the stainless steel from associated galvanized structures, zinc chromate paint, etc. This is necessary to eliminate the dangers caused by zinc embrittlement of stainless steel.
- Where stainless steel tubing with compression fittings is installed, the correct procedures, as specified by the fittings manufacturer, shall be followed. This shall include, but not be limited to, the following: -
  - Proper cutting of the tube. Only proprietary cutting tools shall be used to ensure a clean square cut without burrs, hacksaws shall not be used. The cutting tool shall be suitable for the tube material being cut.
  - Proper installation of the ferrules.
  - Checking that the tube is round and free from burrs and distortions. Minimum straight lengths into fittings before bending shall be as per fitting manufacturer's instructions. Tube fitting assembly shall be checked using fitting manufacturer's gap inspection gauges.
  - All tube fitting installers shall have proof of having completed the tube fitting manufacturers training programmed.
- The 'Wet' leg of DP level transmitters in non-freezing services shall be filled with the

process fluid.

## 6.4 INSTRUMENT AIR PIPING

### General

- The location of the main instrument air headers and the take-off points shall be as shown on the drawings.
- Instrument air manifolds will normally be used in areas of high user density. Where instrument density is low, spider type air header should be used.
- Air supply headers shall be sized as follows based on an operating pressure of 7 Kg/cm<sup>2</sup>:

1-5 users - ½" NB  
6-20 users - 1" NB

- All branch take-offs shall be from the top of the header.
- All take-offs from the main air header shall have an isolation valve (by piping group).
- An isolation valve shall be installed local to each air user.
- The detailed routing of all sub header pipework shall be responsibility of the Installation CONTRACTOR.
- CONTRACTOR shall ensure that drain legs are supplied at each low point of the installation.

### 6.4.1 INSTRUMENT AIR SIGNAL TUBING

#### General

- Tubing shall be jointed only with approved compression fittings compatible with the tube material, i.e. Stainless-steel tubing requires Stainless steel fittings.
- All tubing shall be cleaned by blowing through with filtered air before connecting to instruments.
- Sufficient slack shall be allowed in all air tubing to avoid strain on the instrument connections. Connections to instruments shall have sufficient flexibility to facilitate disconnection. All control valves and vessel mounted transmitters shall have an extra 150 mm diameter loop in their air tubing for maximum flexibility.

### 6.4.2 PIPING AND TUBING SUPPORTS

#### General

- Instrument pipes or tubes may be supported by fastening to existing structural steel or pipe stands, provided the ambient temperature is not excessive and tubing does not interfere with other equipment. Tubing shall not be fastened directly to process lines or other process equipment. Vibrating structures and equipment shall be avoided.
- One or two single pipes or tubes may be supported by dedicated heavy duty channel section if other support is not available.
- The length of unsupported tubing to destination (such as control valve or transmitter) for single tubes shall not exceed 0.5m.
- Tubing shall be fastened to support at regular intervals with non-corrosive fixings to prevent sagging, or misalignment.

- Where three or more single tubes are run parallel to each other, galvanized steel cable tray, as used for instrument cables, shall be used for support.
- Care shall be taken to avoid stainless steel tubing coming into direct contact with galvanized supports using proprietary tube clamps or insulating strip between the tubing and the support.

## 6.5 INSTRUMENT CABLING

### General

Instrument cabling shall be installed in such a manner that the design requirements for the contract in terms of safety, reliability, access, etc. are realized. The main points of the design philosophy are given below, and all installation methods shall take account of this philosophy.

#### 6.5.1 Design Philosophy

- This specification gives details of cable type numbers, cable construction, signal categories, signal groups and service applications.
- Multicore cables shall be sized such that they contain a minimum of 20% spare conductors at the completion of contract design, with a matching terminal spare age in the relevant junction boxes.
- Junction boxes shall be dedicated to one signal category only.
- Junction boxes located in Zone 1 or 2 areas that contain signals from instruments certified Ex-d and IS instruments shall be fabricated from Aluminium (LM6 alloy), suitably painted for a coastal environment, and shall be certified EEx'd'.
- Junction boxes located in a Zone 1 or 2 area and containing intrinsically safe Foundation Fieldbus signals and a high-powered trunk shall be fabricated from 316 stainless steel and shall be certified Exe.
- Intrinsically safe circuits and non-intrinsically safe circuits shall not be contained within the same cable or marshalled in the same junction box.

### Earthing

- All equipment containing an electrical signal or power supply shall be earthed for personnel safety reasons and for minimizing electrical interference. This includes enclosures, cable armour, cable glands, cable tray and conduit.
- Cable screens shall be electrically continuous throughout the cable run and shall be earthed at one point only. This point is the panel reference bar of the panel or cabinet to which the cable is connected. It is always shown on the detailed wiring drawings.
- The design of the earthing system shall avoid the creation of earth loops caused by duplication of earthing paths. Attention shall be paid to the isolation of panel reference bars within panels and cabinets and their final earthing to a point of zero potential.
- All cabling shall be protected against mechanical damage, chemicals and heat. In general, underground cabling and cabling run on ladder rack and tray will meet these requirements if installed in accordance with the Contract drawings and provided attention is paid to detail routing.

### 6.5.2 Cable Separation

- Main cable routes are shown on detail drawings and these take account of the segregation requirements. These requirements are given below and must be adhered to for all cable routes not detailed elsewhere.
- Instrument cables shall be routed separately from electrical power cables. The physical separation of signal and power cables on parallel runs shall be as below:

<u>Power Wiring</u> <u>Capacity</u>	<u>Minimum</u> <u>Separation (mm)</u>
125V or 10A	250
250V or 50A	500
440V or 200A	750
3.3KV or 500A	1250
11KV up or 800A	4000

- Crossovers that bring signal and power cables into proximity shall be made at right angles. The minimum separation at the point of crossover is 250mm.
- The requirements described above may be relaxed at entries to instruments and panels.
- Instrument cables carrying more than 10 amps shall be treated as power cables.
- Instrument power cables, above 115VAC should be run as far as possible with Electrical power cables.
- On tray routes instrument power cables shall be run on separate tray
- I.S. and non-I.S. cables may be run together in the same tray/duct or trench but must be separated into different bundles as far apart as possible.

### 6.5.3 Cable Installation

Primary cables from junction box shall be run on tray to cable duct/trunking run in the pipe rack. The duct/trunking shall be run on the pipe rack as far as possible to the process unit boundary where it will drop down to grade and cables will continue their route in a preformed reinforced concrete trench to Control Building.

### 6.5.4 Underground Cable Installation

- Cables routed underground shall be run in pre-formed reinforced concrete trenches. Crossings beneath roads or access ways shall be by means of ducts encased in concrete. The routes of all main trenches are shown on the applicable detail drawings.
- Preformed reinforced concrete trenches shall have a minimum width of 600mm and shall be 1000mm deep and be fitted with removable reinforced concrete covers, these shall be coloured red for route identification.
- Reinforced concrete trenches shall be sized to consider future expansion and to cater for this space shall be allowed to accommodate 40% of additional cables at completion of detailed design using the largest cable diameter to calculate the required spare space.
- Cables in pre-formed trenches shall be laid on a bed of sand 100mm deep. After installation cables to be covered with a layer of sand, 150mm deep, followed by a layer

of concrete tiles, finally trench shall be back-filled with stone-free material and removable reinforced concrete covers fitted.

- Markers shall be located at every point where the trench changes direction and at regular intervals along straight lengths. (every 15m within battery limits and every 45m outside battery limits). For trenches over 1m in width, markers shall be provided on both sides. For trenches under 1m in width, marker shall be provided at one side only.
- Markers shall consist of a 90mm sq. plate of non-corrosive material, engraved with the legend "Instrument Cables", together with a large arrow indicating the direction of run of the cable route. These plates shall be set flush with the ground.
- The following general requirements are applicable to all underground cable installations:
- Cables should be laid in multiple layers. The highest cable shall be 500mm minimum below finished grade. This may be increased but no cable should be buried more than 900mm deep.
- Route should be chosen to avoid obstructions and maintain access to buried cables. A minimum clearance of 300mm shall be maintained between cables and parallel runs of underground piping. Trenches shall not be located close to parallel runs of grade level piping.
- All crossings under roads, railways, access ways or load bearing surfaces shall be by means of 12 inch or higher pipes encased in concrete. The detail design of these crossings shall ensure that cables will not be damaged by vertical loads (including those experienced during construction of the plant).
- Where instrument and electrical cables cross, separation shall be maintained by permanent means e.g. cable tiles or ducts enclosed in concrete.
- Draw wires are to be installed in all ducts. Ducts shall be sealed at both ends after installation of cables. Duct banks shall be designed to provide 20% spare ducts after completion of contract.
- Where cables emerge from under the ground they shall be protected by UPVC ducts set in concrete. Ducts shall extend a minimum of 150mm above and below grade. Ducts shall be sealed after installation of cable.

### 6.5.5 Above Ground Cable Installation

- Cables routed above ground shall be supported in duct/trunking, tray, angle iron, channel or conduit. The main routes and some of the secondary routes are shown on the applicable detail drawings.
- Overhead ducts/trunking shall be used for routing of multicore cables within Process Units. The duct/trunking shall be routed within the pipe rack in a suitable accessible location, it shall be suitably supported to ensure when duct/trunking is fully loaded there is no sagging or distortion. The duct/trunking shall be designed such that it is filled to a maximum of 65% of its overall capacity at the completion of detailed design. The duct/trunking shall be fabricated in accordance with detailed design and fabrication drawings. The duct/trunking shall have removable covers to allow for new cables to be installed and pulled.
- Walkways along with overhead cable duct shall be provided for maintenance accessibility.
- All Instrument cable laying and dressing shall only be through conduit/box enclosure in the skid.
- Cable tray shall be heavy duty, galvanized steel. They should incorporate return flanges for personnel and cable protection and additional strength. They should be

equally suitable for use in the field or in buildings.

- Tray shall be capable of spanning a 2-meter length unsupported. Longer lengths of tray may be braced using longitudinal channel section.
- Supports for main cable tray shall be provided by EPCC contractor and for branch cable tray support shall be provided by instrument site contractor.
- Supports for and tray shall be fixed to suitable structural steel or concrete, before the application of any fireproofing. Welding is the preferred method of fixing to structural steel. Galvanizing shall be repaired after welding. Supports shall not be welded to vessels or pipe work.
- Where site fabricated bends are used, they shall conform to the minimum bending radius recommended by the cable manufacturer.
- Cables may be stacked 2 layers high (max) on tray installations. Spare capacity should be provided on all installations (1 additional cable or 20% of total number, whichever is greater).
- Routes shall avoid obstructions, hot surfaces, vibrations and areas of high ambient temperature. Minimum clearance from hot surface (above 65°C) shall be 300mm. The route shall not run beneath parallel runs of process piping and shall not block walkways or access to equipment.
- Routes which cross walkways shall provide minimum headroom of 2 meters. Routes which cross roads or areas requiring vehicular access shall provide minimum headroom of 5.5 meters.
- Where routes pass through the floor of a structure, mechanical protection in the form of a metal sleeve or kick plate shall be provided. This shall project a minimum of 75mm above floor level.
- Cable tray should only be cut along a line of metal i.e. not through the perforations. Holes cut in tray for the passage of cables shall be bushed or lined to avoid cable damage.
- Individual cable runs near to the final termination point, such as an individual instrument, should be run in adequately supported galvanized mild steel angle or proprietary channel section, however all cable routing from proximity sensors (vibration monitoring) to junction box should be routed through conduits. All cables shall be suitably clamped on their supports.
- Cable separation shall be maintained in above ground cable installations. This may require the use of separate trays for different signal groups. Instrument power cables shall not be run on the same tray as signal cables.
- All cable trays and ducts shall be with covers.
- All main cable tray, duct/ trunking routes are to be fully fireproofed. The fireproofing shall be openable for access to the cables and shall consist of a minimum of two layers (25mm thick) non fumable, ceramic mattress which is asbestos free and nontoxic and covered with aluminium cladding. The cladding shall be fixed with Stainless Steel (type 304) removable, reusable clamps. The installation shall be designed to avoid dust and water ingress into the mattress.
- The fireproofing shall provide a minimum protection of ½ hour in a hydrocarbon fire without damage to the cables.
- The fireproofing system shall have been tested as per ASTM E-119/BS-476/IS-3809 for a hydrocarbon fire test at 1100 Deg. C for at least 30 minutes.

### 6.5.6 Cable Installation Inside Buildings

- Cables within control rooms will normally be routed under floor. Where cables are routed above the floor they may be in trunking or conduit. The main routes are shown on the detail drawings.

The following general requirements are applicable to cable routes inside buildings.

- Under floor cables shall be installed on cable tray. The general requirements for above ground installations in the field are applicable.
- Above floor routes of cable tray should also be installed in accordance with these general requirements. Flexible conduit may be used for runs from main trunking to final termination point.
- Conduit shall be free from burrs and shall be fitted with locknuts, bushes and ferrules at termination points. Conduit shall be neatly run and adequately supported. PVC conduit shall avoid equipment operating at elevated temperatures.

### 6.5.7 Fire Hazards

Cable routes shall avoid fire risk areas wherever possible. The extent of required protection shall be shown on the detail drawings.

### 6.5.8 Cable Entry to Buildings

Cable entry to all buildings shall be via MCTs, cable transit system as shown on the detail drawings. The transit frames shall be sealed by each cable using multi diameter sealing modules consisting of two halves with removable layers that enable accurate fit to cable diameter. After installation of the cables the penetrations shall be fully sealed using the sealing modules complete with center core.

### 6.5.9 Cable Installation – General

- Cables shall only be terminated in instruments, junction boxes or other approved equipment. No intermediate cable joints are permitted.
- Where underground cables are pulled prior to installation of package units, modules, etc., care shall be taken to ensure that cables are adequately protected.
- When installing cables, the radius of all bends shall exceed the minimum bending radius specified by the cable manufacturer.
- Instrument cables shall not be run on the same tray as instrument piping and tubing.
- Installation, terminating, jointing and testing of fibre-optic and co-axial cabling shall be strictly in accordance with the manufacturer's instructions.
- Above ground cables shall be fixed using pre-formed saddles or PVC covered stainless steel strapping. PVC cable ties shall not be used. Cables shall be fixed at approximately 250mm intervals in vertical runs and 500mm intervals on horizontal runs.
- Cables connected to instruments shall be installed with a loop of cable to provide sufficient slack for re-making the cable connection if the instrument is removed and to allow for removing the instrument without electrical disconnection.

### 6.5.10 Cable Glanding

- All cables in the field and control room shall be glanded.



- The following general requirements are applicable to all gland installations: -
- Cable glands shall comply with BS6121 part 1.
- All instrument cable glands shall be dual certified Exe/ Ex-d (As applicable).
- All gland installations shall maintain the IP rating of the associated equipment.
- The gland thread shall match that of the associated equipment wherever possible. The use of thread adaptors shall be minimized.
- Cable glands in the field shall be protected by fitting plastic shrouds with silicon grease; shrouds to be zero halogen and oil resistant.
- All glands shall be fitted in the bottom of equipment located in the field. Side entry shall only be permitted if necessary and shall be subject to prior approval. Top gland plates shall not be used.
- Any unused cable entries shall be sealed using a certified proprietary plug, to suit the equipment.

#### 6.5.11 Cable Marking and JB colours

- Every instrument cable and junction box are allocated a number. All these numbers are shown on the detail drawings and shall be marked on the cables and junction boxes.
- Cables shall be marked as follows: -
  - i) On both sides of transit entries into buildings.
  - ii) At 30-meter intervals along the length.
  - iii) On one side of every duct crossing.
- Cables shall be marked as above using a suitable metal marker attached to the cable using a stainless-steel cable tie.
- For junction boxes on shutdown service the background colour shall be red and a further label shall be fitted stating "This box contains trip circuits".
- For intrinsically safe junction boxes the background colour shall be blue and a further label shall be fitted stating "This box contains I.S. circuits".
- Labels shall be attached to junction boxes using stainless steel screws and shall not affect the certification or ingress protection of the box.

#### 6.5.12 Wiring Terminations

- All wiring terminations are shown on detail drawings. These drawings take account of the wiring methods used for terminating individual conductors.
- Wiring terminations shall be in accordance with the following general requirements:
- All terminals shall be screw clamp type where the screw is not in direct contact with the wire. Terminals may incorporate test sockets if necessary. Power supply terminals and all terminals with voltages over 50V shall be fitted with protective covers and warning labels. Power supply terminals shall be fitted with partitions between adjacent terminals.
- Solid conductors shall not be fitted with crimped connections. Stranded conductors shall be crimped using a crimp which also grips the insulation of the conductor. The termination end of the crimp shall be suitable for the terminal to which it is connected. Crimp metallurgy should be the same as that of the cable conductor to avoid differential expansion when heated. All crimping shall be carried out using the crimp manufacturer's approved tool.



- Normally only one conductor shall be terminated in each terminal. Common connections shall be made as far as possible using the terminal manufacturer's standard bridging arrangement. Where connection of 2 wires into one terminal is unavoidable, two flat-bladed crimps shall be used. Two wires shall not be crimped in one crimp sleeve and two round-pin type crimps shall not be screwed into one terminal.
- Sufficient slack wire shall be left looped at terminals to allow for re-making of terminations.
- All spare cores in multicore cables shall be terminated. Sufficient terminals shall be fitted in all equipment to facilitate this.

### 6.6 Labels

- Every item of instrument equipment for which a tag or identification is allocated shall be provided with an engraved label. This label will be in addition to any manufacturer's wired-on tags or maker's nameplates.
- Labels for individual instruments shall be fitted to the instrument support such that the label remains in place if the instrument is removed. Labels for other equipment will normally be fitted on the equipment.
- Tag numbers for individual instruments shall be painted on canopies where these are provided, however where they are not provided tag numbers shall be painted on the nearest suitable location.
- The body and canopy of trip related instruments shall be coloured red.

## 13.0 INSTRUMENT SYMBOL AND IDENTIFICATION

### 1. GENERAL

Instruments shall be identified on P&IDs by a system of letters and sequential numbers (Tag Numbers) in accordance with this standard.

This standard has been, in general, based on ISA 5.1 and 5.3 The following shall not be shown on P&IDs:

- Symbols for valve positioners
- Balloons for field mounted I/P or P/I transducers.
- Balloons identifying flow, temperature, level and pressure primary elements.
- Local process variable indicators integral with transmitters. Where local indicators using the transmitter, signal are required away from the transmitter, they shall be shown on the P&IDs with a note detailing their required location.

### 2. REFERENCE DOCUMENTS

ISA. 5.1 Instrumentation Symbols and Identification

ISA..5.3 Graphic Symbols for Distributed Control/Shared Display Instrumentation, Logic and Computer Systems.

### 3. INSTRUMENT IDENTIFICATION

#### 3.1 General

All instrument components shall be uniquely tagged.

All instrument components, except for purely local devices, shall be associated with an instrument loop.

Apart from purely local devices, tagging shall take the hierarchy that the Loop Tag shall be defined first, the associated Component Tags shall follow on from this.

All alphabet letter characters shall be uppercase.

#### 3.2 Loop Tag Structure

The format for the numbering of instrument loops shall be as follows:

#### UUU-EE-NNNNMM

Where:

Character	Type	Name	Description
UUU a	Char	Unit Code	A three-character (numeric) code that identifies a process, utility or offsite unit.
- m	Separator		
EE l e	Letter	Loop Measured Variable	Two alpha characters, coded to identify the function of the loop, refer to attachment 5.1
- :	Separator		
NNNN	Number	Loop Number	A four-digit numeric group "Serial Number"

0 4 0 - F C			coded to identify the unique identification number within the unit. The first two digits of the serial number (NNNN) shall be the last two digits of the corresponding P&ID number.
<b>MM-</b> 1	Letter	Suffix	Two alpha characters. The use of suffixes shall be kept to a minimum.

### 3.3 Component Tag Structure

Except for purely local devices, each instrument component tag shall be associated to a loop number, as defined in section 5.1

### 3.3.1 Instrument Tags

Instrument depiction shall be as per ISA. The relevant table for the alphabetic depiction of instrument type is included in drawing No. 44AC9100-000/P.01/0001/A1 and 0002/A1. For details follow Process design basis guidelines.

### 3.4 Fieldbus Segment

The FF Segment shall follow the following naming convention:

#### UUU-BBB-NNN

Where:

Character	Type	Name	Description
<b>UUU</b>	Char	Unit Code	A three-character (alpha or numeric) code that identifies a process, utility or offsite unit.
-	Separator		
<b>BBB</b>	Char	Building Code	A three-character (numeric) code that identifies the building where the cabinet is located
-	Separator		
<b>NNN</b>	Number	Segment Sequence Number	A three-digit sequential number that is derived from the connecting Fieldbus junction box sequence number.

### 3.5 Motor Control Signals

Motor drive signal tags shall have a similar structure to the instrument tagging structure described above.

### 3.6 Cabinet Alarm Signals

Cabinet Alarm contacts tags shall have a similar structure to the instrument tagging structure described in section 5.3, with suffixes depicted as follows:

Tag & Suffix	Function
UUU-XS-NNNNA	Cabinet Temperature Alarm
UUU-XS-NNNNB	24VDC Power Supply Alarm
UUU-XS-NNNNC	Redundant Power Supply Alarm
UUU-XS-NNNND	Common Alarm
UUU-XS-NNNNE	Proximity Failure
UUU-XS-NNNNF	Fan Failure
UUU-XS-NNNNG	Control room Temperature High Alarm
UUU-XS-NNNNH	Control room Poor Ambience Alarm (More than G2/P2)
UUU-XS-NNNNI	UPS trouble Alarm

Table – Cabinet Alarm Tag Suffix

Further suffixes to be defined as cabinet/card requirements are identified.

### 3.7 Fire and Gas Devices

Fire and Gas loop and tagging convention shall follow the standard instrument tagging convention as per sections 5.2 and 5.3, but will be identified with process function AF for Fire Detection and AG for Gas Detection as per Attachment 5.2 and shall be as follows:

#### 3.7.1 Loop Structure

##### UUU-EE-ZZNNMM

Where:

Character	Type	Name	Description
<b>UUU</b>	Char	Unit Code	A three-character (numeric) code that identifies a process, utility or offsite unit.
-	Separator		
<b>EE</b>	Letter	Loop Measured Variable	Two alpha characters, coded to identify the function of the loop, refer to attachment 5.1 AG = Gas Detection loops AF = Fire Detection loops
-	Separator		
<b>ZZNN</b>	Number	Loop Number	A four-digit numeric group "Serial Number" coded to identify the unique identification number within the unit, broken in two parts as follows. ZZ = Serial number section depicting the Fire/Gas Zone NN = unique sequence number for a defined zone
<b>MM</b>	Letter	Suffix	Two alpha characters. The use of suffixes shall be kept to a minimum.

Example: 040-AG-0101, 040-AF-0101

### 3.7.2 Tags structure

#### UUU-LLFFFF-ZZNNMM

Where:

Character	Type	Name	Description
<b>UUU</b>	Char	Unit Code	A three-character (numeric) code that identifies a process, utility or offsite unit.
-	Separator		
<b>LLFFFF</b>	Letter	Instrument Type	Up to six-character code depicting the measured variable and function of the instrument, refer to attachment 5.1 where LL = Loop measured variable (AG or AF) FFFF = Instrument function
-	Separator		
<b>ZZNN</b>	Number	Component Number	A four-digit numeric group "Serial Number" coded to identify the unique identification number within the unit, derived from the loop number where ZZ = Serial number section depicting the Fire/Gas Zone NN = unique sequence number for a defined zone
<b>MM</b>	Letter	Component Suffix	Up to two alpha character that may be used to identify the position of functional items of the loop that provides duplicate functions.

Example: 040-AGE-0134A, 040-AFHS-0212

### 3.8 ESD and Interlocks

ESD and interlock symbols shall be shown on the P&IDs.

## 4. INSTRUMENT EQUIPMENT IDENTIFICATION

### 4.1 Cable Numbering

#### 4.1.1 Single Pair Cable (Instrument to Junction Box)

Single pair cable (Instrument to Junction Box) shall have the format:

**C- “Field Instrument Tag Number”** i.e. the actual tag number of the instrument with a prefix C to identify as a cable.

e.g. C-040-PT-0001

Auxiliary cables (e.g. cables from local terminal box to transmitter and local indicator or transmitter to thermocouple head) shall follow the same convention as above where the tag number is derived from the source of the cable

If the instrument is a 4-wire system with 24V DC external power supply, the power supply cable shall be named as:

**PD- “Field Instrument Tag Number”** i.e. the actual tag number of the instrument with a prefix PD to identify as DC power.

e.g. PD-040-PT-0021

**PA- “Field Instrument Tag Number”** i.e. the actual tag number of the instrument with a prefix PA to identify as AC power cable.

For an instrument requiring AC power, it shall be fed from Instrument UPS distribution board.

e.g. J-040-FT-2001

#### 4.1.2 Multi Cables (Junction Box to Rack Room Panel)

These Multi Cables shall contain both the origin and destination and have the following format:

**UUU-JB-SSS-NNN/AAA-MC-BBB-XX**

Where:



Character	Type	Name	Description
<b>UUU</b>	Char	Unit Code	A three-character (numeric) code that identifies a process, utility or offsite unit.
<b>JB</b>			Junction Box code
-	Separator		
<b>SSS</b>	Letter	Signal Category	Up to three-character code that identifies the signal category, for approved categories refer to Attachment 5.2.
-	Separator		
<b>NNN</b>	Number	JB Number	A three-digit sequential number that is derived from the connecting junction box sequence number.
/	Separator		
<b>AAA</b>	Char	Unit Code	A three-character (numeric) code that identifies a process, utility or offsite unit. Only applicable where this differs from UUU depicted above.
-	Separator		Only applicable where AAA is required
<b>CCCC</b>	Letter	Cabinet Type	Cabinet Code identifying the type of cabinet the cable is connected from, for approved categories refer to Attachment 5.3.
-	Separator		
<b>BBB</b>	Char	Building Code	A three-character (numeric) code that identifies the building where the cabinet is located.
-	Separator		
<b>XX</b>	Number	Cabinet Number	A two-digit sequential number that is derived from the connecting cabinet sequence number.

Examples:

010-JB-L-001/MC-801-01

010-JB-L-002/MC-801-01

010-JB-L-010/020-MC-802-01

etc....

#### 4.1.3 Multi Cables (Local Panel to Rack Room Panel)

Local panels shall contain junction boxes within each panel and the multi cables shall be numbered according to section 4.1.2 above.

**4.1.4** Secondary Multi Cables (Secondary Junction Box to Main Junction Box) These Multi Cables shall have the following format:

### UUU-JB-SSS-NNNM/JB-SSS-XXX

Where:

Character	Type	Name	Description
<b>UUU</b>	Char	Unit Code	A three-character (numeric) code that identifies a process, utility or offsite unit.
-	Separator		
<b>JB</b>			Secondary Junction Box code
-	Separator		
<b>SSS</b>	Letter	Signal Category	Up to three-character code that identifies the signal category, for approved categories refer to Attachment 5.2.
-	Separator		
<b>NNN</b>	Number	JB Number	A three-digit sequential number that is derived from the secondary junction box sequence number.
<b>M</b>	Letter	JB Number Suffix	A one letter suffix identifying the secondary junction box number, subsequent JB's are identified with suffix 'A', 'B', 'C', etc.
/	Separator		
<b>JB</b>			Main Junction Cabinet code
-	Separator		
<b>SSS</b>	Letter	Signal Category	Up to three-character code that identifies the signal category, for approved categories refer to Attachment 5.2.
-	Separator		
<b>XXX</b>	Number	JB Number	A three-digit sequential number that is derived from the main junction box sequence number.

Examples:

010-JB-L-001A/JB-L-001 (for 1st Junction Box)

010-JB-L-001B/JB-L-001 (for 2nd Junction Box) etc....

### 4.1.5 Cabinet Interconnecting Cables

Inter connecting cables between the cabinets within the same building or between different buildings (including Fibre Optic Cables) use the cabinet number at each end followed by consecutive sequential numbers and shall have the format:

**CCCC-BBB-XX/DDDD-YYY-ZZ-NNN**

Where:

Character	Type	Name	Description
<b>CCCC</b>	Letter	Cabinet Type	Cabinet Code identifying the type of cabinet the cable is connected from, for approved categories refer to Attachment 5.3.
-	Separator		
<b>BBB</b>	Char	Building Code	A three-character (numeric) code that identifies the building where the cabinet is located.
-	Separator		
<b>XX</b>	Number	Cabinet Number	A two-digit sequential number that is derived from the connecting cabinet sequence number.
/	Separator		
<b>DDDD</b>	Letter	Cabinet Type	Cabinet Code identifying the type of cabinet the cable is connected to, for approved categories refer to Attachment 5.3.
-	Separator		
<b>YYY</b>	Char	Building Code	A three-character (numeric) code that identifies the building.
-	Separator		
<b>ZZ</b>	Number	Cabinet Number	A two-digit sequential number that is derived from the connecting cabinet sequence number.
-	Separator		
<b>NNN</b>	Number	Cable Number	A three-digit cable sequential number.

Examples:

MC-802-01/DCS-802-01-001 (for 1st cable)

MC-802-01/DCS-802-01-002 (for 2nd cable)

etc.

**4.2 Cable Core Numbering**

**4.2.1 Cable Core Numbering at Instrument**

Cable Core Numbering shall have the following format:

**qqqrr/UUUJBSSNNNMxxxxyy**

Where:

Character	Type	Name	Description
<b>qqqq</b>	Number and/or Letter	Instrument Terminal Strip/Rail	Rail number of terminal row to which the cable core is connected. Omitted if the Terminal Strip is not identified.
<b>rr</b>	Number and/or Letter	Instrument Terminal Number	Terminal number to which the cable core is connected.
<b>/</b>	Symbol	Separator	
<b>UUU</b>	See Wiring Equipment Numbering (where destination termination other than JB, then this section to reflect accordingly)		
<b>JB</b>			
<b>SSS</b>			
<b>NNN</b>			
<b>M</b>			
<b>xxxx</b>	Number and/or Letter	JB Terminal Strip/Rail	Rail number of terminal row to which the cable core is connected at JB end. Omitted if the Terminal Strip is not identified.
<b>yy</b>	Number and/or Letter	JB Terminal Number	Terminal number to which the cable core is connected at JB end.

Example: +/010-JB-L-001-TBA-1 (instrument end)

#### 4.2.2 Cable Core Numbering at Junction Box (Instrument side)

Junction Box Cable Core Numbering (Instrument side) shall have the following format:

**“Field Instrument Tag Number” qqqr/xxxxyy**

Where:

Character	Type	Name	Description
UUU			See Component Tag Structure section 5.3
FFFFFF			
NNNN			
M			
qqqq	Number and/or Letter	Instrument Terminal Strip/Rail	Rail number of terminal row to which the cable core is connected at instrument end. Omitted if the Terminal Strip is not identified.
rr	Number and/or Letter	Instrument Terminal Number	Terminal number to which the cable core is connected at instrument end.
/	Symbol	Separator	
xxxx	Number and/or Letter	JB Terminal Strip/Rail	Rail number of terminal row to which the cable core is connected. Omitted if the Terminal Strip is not identified.
yy	Number and/or Letter	JB Terminal Number	Terminal number to which the cable core is connected.

Example: 010-PT-0001+/TBA-1 (at Junction Box)

#### 4.2.3 Cable Core Numbering at Junction Box (Multi-core side)

Junction Box Cable Core Numbering (Multi-core side) shall have the following format:

**qqqr/UUCCCCSSxxxxyy**

Where:

Character	Type	Name	Description
qqqq	Number and/or Letter	JB Terminal Strip/Rail	Rail number of terminal row to which the cable core is connected. Omitted if the Terminal Strip is not identified.
rr	Number and/or Letter	JB Terminal Number	Terminal number to which the cable core is connected.
/	Symbol	Separator	
UUU			See Cabinet Numbering section 5.3
CCCC			
SS			

<b>xxxx</b>	Number and/or Letter	MC Terminal Strip/Rail	Rail number of terminal row to which the cable core is connected at MC end. Omitted if the Terminal Strip is not identified.
<b>yy</b>	Number and/or Letter	MC Terminal Number	Terminal number to which the cable core is connected at MC end.

Example TBA-1/010-MC-01-TBA-1 (at Junction Box)

#### 4.2.4 Cable Core Numbering at Marshalling Cabinet (Field multi-core side)

Marshalling Cable Core Numbering (Field multi-core side) shall have the following format:

**UUUJBSSSNMxxxxyy/qqqrr**

Where:

Character	Type	Name	Description
<b>UUU</b>		See Wiring Equipment Numbering section 5.3 (where destination termination other than JB, then this section to reflect accordingly)	
<b>JB</b>			
<b>SSS</b>			
<b>NNN</b>			
<b>xxxx</b>	Number and/or Letter	JB Terminal Strip/Rail	Rail number of terminal row to which the cable core is connected at JB end. Omitted if the Terminal Strip is not identified.
<b>yy</b>	Number and/or Letter	JB Terminal Number	Terminal number to which the cable core is connected at JB end.
<b>/</b>	Symbol	Separator	
<b>qqqq</b>	Number and/or Letter	MC Terminal Strip/Rail	Rail number of terminal row to which the cable core is connected. Omitted if the Terminal Strip is not identified.
<b>rr</b>	Number and/or Letter	MC Terminal Number	Terminal number to which the cable core is connected.

Example 010-JB-L-001-TBA-1/TBB-51 (at Marshalling)

#### 4.2.5 Cable Core Numbering at Marshalling Cabinet (Marshalling to Marshalling)

Marshalling Cable Core Numbering (Marshalling to Marshalling) shall have the following format:

**CCCCNNSSxxxxyy/qqqrr**

Where:

Character	Type	Name	Description
<b>UUU</b>		See Wiring Equipment Numbering section 5.3	
<b>CCCC</b>			
<b>SS</b>			
<b>xxxx</b>	Number and/or Letter	MC Terminal Strip/Rail	Rail number of terminal row to which the cable core is connected at MC end. Omitted if the Terminal Strip is not identified.
<b>yy</b>	Number and/or Letter	MC Terminal Number	Terminal number to which the cable core is connected at MC end.
<b>/</b>	Symbol	Separator	
<b>qqqq</b>	Number and/or Letter	MC Terminal Strip/Rail	Rail number of terminal row to which the cable core is connected. Omitted if the Terminal Strip is not identified.
<b>rr</b>	Number and/or Letter	MC Terminal Number	Terminal number to which the cable core is connected.

Example 010-MC-01-TBA-1/TBB-51 (at Marshalling)

#### 4.3 Wiring Equipment Numbering

##### 4.3.1 Junction Box Numbering

Junction Box Numbering shall have the format:

**UUU-JB-SSS-NNNM**

Where:

Character	Type	Name	Description
<b>UUU</b>	Char	Unit Code	A three-character (numeric) code that identifies a process, utility or offsite unit.
<b>-</b>	Separator		
<b>JB</b>	Letter	Junction Box	Junction Box abbreviation
<b>-</b>	Separator		
<b>SSS</b>	Letter	Signal Category	Up to three-character code that identifies the signal category, for approved categories refer to Attachment 5.2.
<b>-</b>	Separator		
<b>NNN</b>	Number	JB Sequence	A three-digit sequential number.

Character	Type	Name	Description
		Number	
<b>M</b>	Letter	JB Suffix	A one letter suffix identifying the secondary junction box number, subsequent JB's are identified with suffix 'A', 'B', 'C', etc.

Example: 010-JB-L-101, 040-JB-HF-001

### 4.3.2 Local Panel Numbering

Local Panel Numbering shall have the format:

**UUU-LP-NNN**

Where:

Character	Type	Name	Description
<b>UUU</b>	Char	Unit Code	A three-character (numeric) code that identifies a process, utility or offsite unit.
-	Separator		
<b>LP</b>	Letter	Local Panel	Local Panel abbreviation
-	Separator		
<b>NNN</b>	Number	LP Sequence Number	A three-digit sequential number.

Example: 010-LP-101

### 4.3.3 Cabinet Numbering

Cabinet Numbers shall have unique equipment numbers in the following format:

**UUU-CCCC-SS**

Where:

Character	Type	Name	Description
<b>UUU</b>	Char	Unit Code	A three-character (numeric) code that identifies a process, utility or offsite unit.
-	Symbol	Separator	Dash
<b>CCCC</b>	Letter	Cabinet Type	Cabinet Code identifying the type of cabinet, for approved categories refer to Attachment 5.3.
-	Symbol	Separator	Dash
<b>SS</b>	Number	Sequence Number	Two-digit sequential number to identify the cabinets.

Example: 010-DCS-01, 010-ESD-01, 010-HVAC-01, 010-MC-01, etc.



#### 4.4 Pneumatic Equipment Numbering

Pneumatic Equipment Numbering shall be used to identify instrument air manifolds and shall have the format:

#### UUU-PPP-NNNN

Where:

Character	Type	Name	Description
<b>UUU</b>	Char	Unit Code	A three-character (numeric) code that identifies a process, utility or offsite unit.
-	Separator		
<b>PPP</b>	Letter	Equipment Identifier	Abbreviation depicting equipment as follows: IAT = Instrument air take-off for direct air take off from the main air header IAM = Instrument air manifold
-	Separator		
<b>NNNN</b>	Number	Sequence Number	A four-digit sequential number unique to each process, utility or offsite unit. The first two digits of the serial number (NNNN) shall be the last two digits of the corresponding P&ID number.

Example: 010-IAT-0001, 040-IAM-0001

## 5. ATTACHMENTS

### 5.1 Instrument or Loop Tag Identification Letters

Instrument depiction shall be as per ISA. The relevant table for the alphabetic depiction of instrument type is included in drawing No. 44AC9100-000/P.01/0001/A1 and 0002/A1 (Refer Annexure 2 of Process design Basis).

### 5.2 Cabinet Types

Code	Cabinet Type
ACS	Advanced Control System
AMADAS	Analyzer Management & Data Acquisition System
BMS	Burner Management System
CCS	Compressor Control System
CMS	Conditioning Monitoring System
CTMS	Custody Transfer Metering System
DAHS	Data Acquisition and Historian System
DCS	Distributed Control System
EIIF	Electrical/Instrument Interface Cabinet
ESD	Emergency Shutdown System
FAP	Fire Alarm Panel
FDS	Fire Detection System
FP	Fibre Optics Patch Panel
GDS	Gas Detection System
HVAC	HVAC Cabinet
MC	Marshalling Cabinet
MCC	Comms. module of MCC for Winding Temp
MMS	Machinery Monitoring System
PLC	Programmable Logic Controller
TCC	Telecomms
TGS	Tank Gauging System
UPS	Uninterrupted Power Supply
WS	Workstation

### 5.3 Examples

Function Identification Examples

MEASURED VARIABLE	FUNCTION IDENTIFICATION EXAMPLES							
	ANALYSIS	FLOW	LEVEL	PRESS	PRESS	SPEED	TEMP	TEMP
INSTRUMENT FUNCTION								
ELEMENT	AE	FE	LE	PE	PDE	SE	TE	TDE
INDICATOR (MOUNTED)	AI	FI	LI	PI	PDI	SI	TI	TDI
INDICATOR (LOCAL)	-	-	LG	PG	PDG	-	TG	TDG
TRANSMITTER	AT	FT	LT	PT	PDT	ST	TT	TDT
INDICATING CONTROLLER	AIC	FIC	LIC	PIC	PDIC	SIC	TIC	TDIC
RECORDING CONTROLLER (2)	ARC	FRC	LRC	PRC	PDRC	SRC	TRC	TDRC
CONTROL VALVE	AV	FV	LV	PV	PDV	SV	TV	TDV



CONTROL VALVE SELF ACTING	-	-	LCV	PCV	PDCV	-	TCV	-
SWITCH (1)	AS	FS	LS	PS	PDS	SS	TS	TDS
ALARM (1)	AA	FA	LA	PA	PDA	SA	TA	TDA

- BE - BURNER FLAME DETECTOR
- BS - FLAME DETECTION SWITCH
- EI - ELECTRICAL INDICATOR (P&ID TO SPECIFY VARIABLE)
- FQ - INDICATION OF INTEGRATED FLO

- FQS - INDICATION OF INTEGRATED FLOW AND SWITCH ACTUATED BY INTEGRATED FLOW
- FY - FLOW RELAY (EG RATIO, LINEARIZING)
- HCV - HAND CONTROL VALVE
- HIC - MANUAL LOADING STATION WITH OUTPUT GAUGE
- HS - HAND SWITCH
- HLS - HAND SWITCH WITH INDICATING LIGHT
- LG - LEVEL GAUGE
- PSE - RUPTURE DISC
- PSV - RELIEF VALVE
- PVV - PRESSURE AND VACUUM RELIEF VALVE
- FO - RESTRICTION ORIFICE

**NOTE:1.**

Designation of alarm or switch, i.e. High, high-high, low, Low-low, to appear outside a tagging balloon as H, HH, L & LL for software generated alarms.

**NOTE: 2.**

Any hardwired recording requirements shall be shown by a specific balloon on the P&ID as a non-DCS instrument.

## 14.0 SPARE PART REQUIREMENT

### 1. PURPOSE

The purpose of this document is to define the minimum requirements of spare parts and related documentation for a project.

This Specification covers the selection and quantities of the following:

**Mandatory Spare Parts** - Parts of Instruments, Instrument items, systems or complete items /Instrument that will be required for replacement where failure of which will be critical for continuous safe operation of the plant.

The Material Requisitions shall include all Mandatory Spare Parts and clearly indicate the quantity required. These mandatory spares shall be procured as along with main instrument/system.

Philosophy of mandatory spares shall be in line with the table mentioned in Section 2.

**Commissioning Spares** - Spare parts needed to adequately cover the requirements of day to day maintenance and any premature failures for the period of start-up, commissioning and trial run operations.

Commissioning spares are recommended by Vendors or requested in Material Requisitions as per experience of owner/ consultant. The Material Requisitions shall include requirement of Commissioning Spares and the same shall be procured as along with main instrument/system.

**Two Years Operation and Maintenance Spares** - Parts or assemblies normally used or consumed based on scheduled maintenance, overhauls, inspections, wear, corrosion, erosion or deterioration in normal service for a period of TWO years after start-up.

Vendors will be requested to quote for their recommended two years operation and maintenance spares, but these spares will not be considered for price evaluation.

These will be selected and ordered by IOCL separately. Broad Guidelines for selection of the same include:

- Key operation and safety functions of the equipment.
- Current delivery time and transportation time to site of items not stocked.
- Possibility of damage during installation and commissioning.
- Expected normal wear and tear during first TWO years of operation.
- Service interval stated by Manufacturers maintenance policy.
- Possible repair/exchange items.

**Special Tools** - These are the tools, jigs and fixtures, including hand held and portable spot measurement instruments which are necessary to carry out maintenance activities.

Special Tools that are recommended by Vendors or requested in Material Requisitions as per experience of owner/ consultant, will be procured along with main Instrument / systems.



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## **2. PHILOSOPHY FOR IDENTIFYING MANDATORY SPARES- GENERAL INSTRUMENTS**

Mandatory spares philosophy for general instruments is attached with tender document elsewhere.



**DEPARTMENT:** INSTRUMENTATION  
**DOCUMENT NO:** 44AC9100-000-J.SS-0104-A4  
**DOCUMENT TITLE:** STANDARD SPECIFICATION FOR FLOW INSTRUMENT  
**ITEM:**  
**PROJECT NO:** 44AC9100  
**PROJECT LOCATION:** DUMAD/IOCL-JR, Gujarat  
**PROJECT TITLE:** EPCM/PMC SERVICES FOR ACRYLICS / OXO ALCOHOL PROJECT AT GUJARAT REFINERY AND DUMAD  
**CLIENT:** INDIAN OIL CORPORATION LIMITED  
**CLIENT PROJECT NO:**  
**CLIENT AUTHORIZATION:** MR. GAURAV DOLEY (DGM-PJ)  
**PM AUTHORIZATION:** MR. PAWAN GUPTA

				APPROVALS		
Rev. No.	Issue Date	Pages	Revision Description	Prepared	Checked	Approved
A	26-12-2018	20	ISSUED FOR BID	ARG	PV	PV
<input checked="" type="checkbox"/> Entire Document Issued this Revision		DOCUMENT ISSUED FOR: (please <input checked="" type="checkbox"/> as applicable)				
<input type="checkbox"/> Revised Pages Only Issued this Revision		<input type="checkbox"/> In-house Review	<input type="checkbox"/> Purchase			
		<input type="checkbox"/> Client Approval	<input type="checkbox"/> Construction			
		<input type="checkbox"/> Design				

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**1.0 GENERAL**

- 1.1 This specification, together with the datasheets, MR and special requirements (If any) covers the general requirements for instrumentation design, materials, name plate marking, inspection, testing and shipping of all Flow instruments along with their accessories.
- 1.2 The All flow elements, flow meters and its accessories shall be supplied in fully assembled condition.
- 1.3 In the event of any conflict between this standard specification, datasheet, statutory regulations, related codes, standards etc., the following order of priority shall govern:

1st priority	: Statutory Regulation requirement
2nd priority	: Process Licensor's documents
3rd priority	: Job Specifications & Job Drawings
4th priority	: Engineering Design Basis
5th priority	: Standard Specifications, standard Drawings & Engineering standards

Note: In case of any conflicts most stringent requirements shall be followed, however it shall be obligatory on the contractor's part to bring such conflicts to the notice of owner/PMC, wherein owner/PMC decision shall be final.

- 1.4 Individual flow meter data sheets specify the material for wetted parts and flanges. Unless specifically indicated otherwise, alternate superior material of construction shall also be acceptable provided vendor assumes complete responsibility for the selected materials for their compatibility with the specified fluid and its operating conditions.

**1.5 PROJECT TITLE**

Project Name	:	EPCM/PMC Services for Acrylics/ Oxo-Alcohol Project at Gujarat Refinery and Dumad
Owner	:	Indian Oil Corporation Limited
Location	:	Dumad & Vadodara, Gujarat, India

## 2.0 CODES, STANDARDS AND REGULATIONS

Applicable national / international standards

Design and terminology shall comply, as a minimum, with the latest edition prior to the date of purchaser's enquiry of following codes, standard practices and publications:

<b>AGA</b>	<b>(American Gas Association)</b>
AGA Report no.3.1	Orifice Metering of Natural Gas and other related hydrocarbon fluids. (General Equations & uncertainty guidelines), fourth edition (year-2012), 2nd printing-2013
AGA Report no.3.2	Orifice metering of natural gas and other related hydrocarbon fluids part 2 Specification and Installation Requirements-Fifth Edition (year-2016)
AGA Report no.3.3	Orifice metering of natural gas and other related hydrocarbon fluids part 3 Natural gas application, Third Edition (year-2013)
AGA Report no.3.4	Orifice metering of natural gas and other related hydrocarbon fluids part 4 Background Development Implementation Procedure and Subroutine Documentation for Empirical Flange- Tapped Discharge Coefficient Equation, Third Edition (year-1992), Reprinting-2003
AGA Report no.7	Measurement of Gas by Turbine meters. (Year -2006)
AGA Report no.-9	Measurement of Gas by Multi-Path Ultrasonic meters. (Year – 2017)
<b>ASME</b>	<b>(American Society of Mechanical Engineers)</b>
ASME B 1.20.1	Pipe Threads General Purpose (inch) (Year - 2013)
ASME B 16.5	Steel Pipe Flanges and Flanged Fittings (Year- 2017)
ANSI B 16.20	Ring Joint Gaskets and Grooves for Steel Pipe Flanges (Year- 2012)
ASME B 16.34	Valves- Flanged, Threaded & Welding End (Year- 2017)
ANSI B 16.36	Orifice Flanges (Year- 2015)
ANSI B 16.47	Large Diameter Steel Flanges (NPS 26 thru NPE 60) (Year 2017)
ASME PTC 19.3 TW	Performance Test Code-Temperature measurement (Year 2010)
MFC 14M	Measurement of Fluid Flow using Small Bore Precision Orifice Meters
<b>API</b>	<b>(American Petroleum Institute)</b>
API 2540	Manual of Petroleum Measurement Standards
<b>EN</b>	<b>European standards</b>
10204	Inspection Documents for Metallic Products
<b>IEC</b>	<b>(International Electro-Technical Commission.)</b>
IEC 60079	Electrical apparatus for Explosive Gas atmosphere (Year -2017)
IEC 60079-1	Explosive atmosphere equipment protection by flameproof enclosure 'D' (Year -20014 & 2018)
IEC61000-4-3	Electromagnetic Compatibility-Part-4-3 Testing and measurement techniques - Radiated, radio-frequency, electromagnetic field immunity test (Year-2010).
IEC61000-4-4	Testing and Measurement techniques – Electrical Fast Transient/burst Immunity Tests
IEC61000-4-5	Testing and Measurement techniques – Surge Immunity
IEC 61508	Functional safety of Electrical/Electronic Programmable Electronic Safety

IEC 61511	Related System (Year-2010) Functional safety: safety Instrumented systems for the Process Industry sector (Year-2017)
IEC 61158	Digital data communications for measurement and control –. Fieldbus specification.
IEC 60529	Degrees of Protection Provided by Enclosures (IP Code) - (Year- 2015)
IEC 61804	Function blocks (FB) for process control - Electronic Device Description (Year-2018).
IEC 61518	Mating dimensions between differential pressure (type) measuring instruments and flanged-on shut-off devices up to 41.3 bar (41,3 MPa)
<b>IS</b>	<b>(Indian Standards)</b>
IS-1271	Specification of Thermal Evaluation and Classification of Electrical Insulation. (Year -2012)
<b>ISA</b>	<b>(Instrument Society of America)</b>
ISA 5.1	Instrument symbols and Identification (Year- 2009)
ISA 5.2	Binary logic diagrams for process operation (Year-1992)
ISA 5.3	Graphic symbols for Distributed Control/Shared Display Instrumentation Logic and Computer symbols (Year – 1983)
ISA 5.4	Instrument Loop Diagrams (Year – 1991)
ISA 71.01	Environmental Conditions for Process Management and Control System, Temperature and Humidity
ISA 71.04	Environmental Conditions for Process Measurement and Control Systems: Airborne Contaminants
<b>ISO</b>	<b>(International Organization for standardization)</b>
ISO 5167	Measurement of fluid flow by means of orifice plates, nozzles and venturi tubes inserted in circular cross-section conduits. -Year 2003
ISO 6817	Measurement of Conductive liquid flow in closed Conduit - Method using electromagnetic flow meters
ISO 9104	Measurement of fluid flow in closed conduits -Methods of evaluating the performance of electromagnetic flow meters for liquids.

**Other standards:**

NEC	National Electric code.
NEMA	National Electrical Manufacturer's Association
NFPA	National Fire Protection Association.
NFPA-496	Purged and pressurized enclosures for electrical equipment. (Year 2017)
OSHA	Occupational Safety and Health Authority.
MPMS	Manual of Petroleum measurement standards.
IBR	Indian Boiler Regulations 1950 (Including Amendments in year 2017)
AG-181	FOUNDATION™ Fieldbus System Engineering Guidelines
ITK	Interoperability Test Kit (6.3.0 or the latest version)

Flow Measurements Engineering Handbook by R.W. Miller

Principles and Practice of Flow Meter Engineering by L.K. Spink

Apart from above listed OISD, the latest standards applicable as on date of enquiry for Instrumentation of Packages like Turbine, Compressor, Diesel Engines and Fire protection system etc.

### 3.0 GENERAL DESIGN REQUIREMENTS

All flow transmitters shall be intrinsically safe & 4-20mA SMART type with HART/ FF protocol with integral LCD indicator and be furnished with test terminals and bypass diode to facilitate field testing without disconnection of integral indicator. The transmitter electronics shall monitor their performance during normal operation. The transmitter diagnostics shall be able to detect both an input sensor failure and transmitter electronics failure. The sensor &/or electronics failure shall be transmitted to the host system (e.g. DCS / PLC). The stability shall be better than +/- 0.5% of upper range limit for 1 year. The transmitters shall have zero and range adjustable.

### 3.1 ORIFICE PLATE

- Orifice Plate shall be of SS316 material as a minimum.
- Flow measurement shall generally be by orifice plates, sized and installed in accordance with ISO 5167-2. The values of 'beta' shall be between 0.3 and 0.7. For high accuracy measurement a Beta ratio of 0.56 is preferred.
- The thickness of orifice plates shall be as specified in purchaser's data sheets, as a minimum. However, wherever Quadrant edge type of orifice plate is specified, the thickness of the orifice shall be equal to the radius of curvature of the orifice, as a minimum.
- The fluid outlet surface of the plate should be flat and smooth and shall not have roughness and scores that can be ascertained by touch or sight.
- Orifice plates in oxygen and chlorine service shall be thoroughly degreased using reagents like trichloro-ethylene or carbon tetrachloride and all connections shall be plugged after degreasing process to avoid entrance of grease or oil particles.
- General Orifice assemblies having ring-type joint flanges (RTJ) shall be supplied with a plate-carrying holder. Even when only the orifice plate has been ordered, vendor shall supply the plate with the holder for use with ring type joint flanges. Plate holder hardness shall meet the requirements specified in the data sheet.
- Orifice flanges shall be to ANSI/ASME B16.36.
- Flange bore diameter shall be the same as pipe's internal diameter.
- They shall be supplied with two pair of flange taps complete with plugs as a minimum. The tap design shall be in accordance with ISO 5167. The minimum rating shall be 300lb. For pressure classes  $\geq$  900lb the flange facing shall be RTJ and the orifice plate shall be installed on API carrier ring.
- For line sizes  $<$  2" (50 mm) NB: prefabricated meter runs shall be used. The associated orifice shall be installed in a carrier ring utilizing corner taps. The meter run, plate and carrier ring shall be manufactured from 316 stainless steel unless compatibility with the flowing medium requires a higher alloy and purchased as an entity. For extremely small flows, integral orifice transmitters shall be used.
- Unless otherwise specified, the following shall govern: -
  1. Threaded end connections shall conform to NPT as per ASME B 1.20.1.
  2. Flanged end connections shall be as per ASME B 16.5.
  3. Grooves of the ring type joint flanges shall be octagonal as per ASME B16.20.
  4. Flange face finish shall be as per ASME B 16.5. The face finish as specified in the data shall be as follows:
    - 125 AARH: 125 to 250 micro inch AARH
    - 63 AARH: 32 to 63 micro inch AARH
- Where flange taps have been specified, the Centre lines of the tap-holes shall be at 25.4 millimeters from the nearest face of the orifice plate, considering the gasket thickness mentioned in the specification sheets.
- Where conical entrance type of orifice plates has been specified in purchaser's datasheet, only corner taps shall be offered. Flange taps shall not be permitted.
- The reference conditions for standardized flows shall be:

Liquids: 15°C and 760mm Hg  
Gas/ Vapours: 0°C and 760mm Hg

### 3.2 VENTURIS/ NOZZLES

- Flow elements shall be designed and fabricated as specified in ISO 5167 the latest edition.
- The flow elements shall be sized so that the maximum pressure drop after full recovery shall not exceed the maximum allowable pressure drop indicated in purchaser's data sheet.
- Vendor shall follow the proper welding procedures for welding of dissimilar materials.
- The flow element shall be suitable for horizontal & vertical mounting and flow direction shall be clearly stamped or cast on the body.
- All weld joints shall undergo 100% radiography.
- All welding projections inside the pipe shall be flush grinded.
- For all flow elements, minimum two pairs of pressure taps shall be provided for purchaser's impulse piping. Orientation of these taps shall be at least 45 degrees from vertical. One set of pressure taps shall be provided with blind flanged plugs for each Flow element.
- Flow elements (Venturi/Flow Nozzles) shall have flanged end connections; unless otherwise specified. Weld joints, if any, shall be of radiographic quality. End connection for flanges shall be as per ASME B-16.5 up to 24" size and as per ASME B-16.47-B for sizes greater than or equal to 26".
- All flanges shall be weld neck type unless otherwise specified.
- Unless otherwise mentioned, end connection details shall be as below:
  1. Threaded end connections shall be to NPT as per ASME B 1.20.1.
  2. Flanged end connections shall be as per ASME B 16.5.
  3. Grooves of ring type joint flanges shall be octagonal as per ASME B 16.20 and groove finish shall be 63 AARH: 32 to 63 micro inch AARH
  4. When Flanges are Raised Face (RF) type, the face finish shall be as per ASME B16.5 and shall be 125 AARH: 125 to 250 micro inch AARH
- The material of construction of flow element shall be provided as specified in the respective data sheets.
- Meter Sizing: All calculations and units of measurement shall be in metric standard only. Sizing calculations indicating the sizing differential pressure and max pressure loss at all operating flow conditions specified in the purchaser's data sheet as well as at meter maximum shall be submitted.
- The flow elements shall be designed to have minimum measurable DP of 25 mmWC. Accordingly, the DP at meter maximum shall be selected and calculated based on the allowable DP indicated in the purchaser's data sheet. The DP below 25 mmWC shall not be considered at operating flow conditions.
- 
- Vendor data sheet for each Flow elements (Venturi/ Flow Nozzles), shall also indicate the following:
  - a) Calculated differential pressure at specified maximum, normal, minimum flow rates.
  - b) Maximum pressure loss through the flow element at maximum flow rate
  - c) Upstream and downstream straight pipe length requirement for installation.
- Each flow meter and accessories shall be subjected to successful hydrostatic testing. The hydrostatic test pressure shall be 1.5 times the design pressure.
- The design, sizing and construction of Venturi Flow element shall conform to ISO5167 standard (latest version) and shall be classical, machined, non-truncated type unless otherwise specified.
- Impulse piping connection for venturi tubes shall be provided with 1/2" NPTF connection, unless otherwise specified in the data sheet.

- Venturi tube shall be forged/ cast construction in general. However fabricated construction shall also be acceptable, wherever allowed as per ISO-5167.
- Venturi tube shall be provided with Annular chamber/ Piezo-metric Ring. Material of construction of Annular chamber/ Piezo-metric Ring shall be same as material of Venturi tube.
- Material of construction of Venturi tube shall be SS316 as a minimum. Material of construction for Throat, Divergent section and Convergent section shall also be SS316 as a minimum. Flanges shall be provided as per the material specified in the datasheet.
- The design, sizing and construction of Flow nozzle shall conform to ISO5167 standard (latest version) and shall be ISA 1932 type, unless otherwise specified.
- Flow nozzle shall be supplied in spool piece construction with flanged end construction. Nozzle itself shall also be mounted within flanges with similar specification. The spool piece length shall be 5D upstream and 5D downstream.
- Material of construction of nozzle shall be SS316 as a minimum. The material of Spool piece and flange shall be considered as per the material indicated in the datasheet.
- Impulse piping connection for flow nozzle shall be with 1/2" flanged end connection, unless otherwise specified in the datasheet.

### 3.3 AVERAGING PITOT TUBE / ANNUBAR

The general requirements for Averaging Pitot tubes/ Annubar shall be as follows:

- The flow sensor shall be a continuous averaging velocity head producing type of pitot tube with four or more equal annubar sensing ports or continuous slots to suit line velocity profile. The sensor shall also incorporate a rear port for the measurement of line static pressure.
- The sensor shall be designed to provide a non-clog design and shall be able to provide a uniform flow pattern around the sensor to ensure accurate differential pressure consistently.
- Unless otherwise specified, averaging pitot tube shall be of flanged construction. The process flange connection shall be of 3" size with material and rating as specified in the datasheet.
- Vendor shall also supply a special weldolet along with weld neck flange with inner diameter to suit the outer diameter of averaging pitot tube. The material and rating of weldolet and flange shall be as specified in purchaser's data sheet.
- High pressure and low-pressure connections for differential pressure transmitter connection shall be 1/2" NPTF. The isolation valves with 316 Stainless Steel construction shall be provided for each pressure tap.
- Clean out plugs shall be provided as standard with all averaging pitot tubes.
- Vendor shall perform vibration analysis for each averaging pitot tube element for the indicated flow conditions as per ASME PTC 19.3 TW 2010 to ensure that the quoted averaging pitot tube is of sufficient thickness and strength to withstand the vibration effects created due to Karman vortex shedding in the fluid stream.
- Unless second support is specifically recommended by vendor, based on vibration analysis, the free end of the averaging pitot tube shall be pressure supported at the pipe wall
- Unless otherwise specified, the offered averaging pitot tubes shall meet the following performance requirements:
  1. Accuracy inclusive of repeatability and hysteresis shall be +1% of actual value.
  2. Repeatability of averaging pitot tube shall be + 0.1 % of actual value.
- Averaging pitot tubes in oxygen and chlorine service shall be thoroughly degreased using reagents like trichloro-ethylene or carbon tetrachloride and end connections shall be



plugged after degreasing process to avoid entrance of grease or oil particles.

- Vendor shall follow the proper welding procedures for welding of dissimilar materials.
- Unless otherwise mentioned, end connection details shall be as below:
  - a) Threaded end connections shall be to NPT as per ASME B 1.20.1.
  - b) Flanged end connections shall be as per ASME B 16.5.
  - c) Grooves of ring type joint flanges shall be octagonal as per ASME B 16.20
  - d) When Flanges are Raised Face (RF) type, the face finish shall be as per ASME B16.5 and shall be
    - 125 AARH: 125 to 250 micro inch AARH
    - 63 AARH: 32 to 63 micro inch AARH
- Vendor data sheet for each Averaging Pitot tube/ Annubar, shall also indicate the following:
  - a) Calculated differential pressure at specified maximum, normal, minimum flow rates.
  - b) Maximum pressure loss through the flow element at maximum flow rate
  - c) Upstream and downstream straight pipe length requirement for installation.
  - d) Expected accuracy at minimum, normal and maximum flow.
  - e) Permanent pressure loss that will be created by the averaging Pitot tube.
  - f) Material of Construction
  - g) Calculations of vibration analysis and its recommendation
  - h) Minimum clearance requirement for removal of pitot tube.

### 3.4 MASS FLOW METER

The general design, construction, terminal Housing, meter Sizing and performance requirements for Mass flow meter shall be as follows:

- Flow meter shall be of in-line mounting design with flow direction clearly marked on the flow meter body to ensure correct installation.
- Flow meter design shall ensure that the location and / or orientation of installation of mass flow meter in the line shall not affect the calibration, accuracy of the meter.
- The material of construction of mass flow internals and body shall be as specified in the respective data sheets, as a minimum.
- The mass flow meter shall be provided with the external flow tube housing wherever specifically indicated in the data sheet. In all such cases, the flow tube housing shall have provision to monitor housing pressure continuously.
- The mass flow meter shall have high vibration immunity. The meter output shall not be affected by the pipeline vibration where the meter is installed.
- Unless otherwise mentioned, end connection details shall be as below:
  - 1. Threaded end connections shall be to NPT as per ASME B 1.20.1.
  - 2. Flanged end connections shall be as per ASME B 16.5.
  - 3. Flange face finish shall be as per ASME B 16.5. The face finish as specified in the data shall be as follows:
    - 125 AARH: 125 to 250 micro inch AARH
    - 63 AARH: 32 to 63 micro inch AARH
- Following shall apply for both integral as well as for remote meter electronics:
  - a) All connections shall be terminated on the terminals brought out in the terminal housing located on the flow meter body. Flying leads shall not be provided.
  - b) All intrinsically safe terminals shall be properly identified and shall be separate from the non-intrinsically safe terminals.



- c) Separate cable entry shall be provided in the terminal housing for power and intrinsically safe signals.
- d) The flow meter enclosure, housing the electrical parts shall be suitable for the area classification indicated in the data sheets. Unless otherwise specified, the enclosure shall conform to the following standards, as a minimum:
- Weatherproof housing - IP 65 to IS/IEC-60529
  - Flame proof housing - Flame proof / Ex (d) as per IS/ IEC-60079
- Flameproof housing shall also be made weatherproof.
- Flow meter electronics shall be microprocessor based and shall include pre-amplifier, converter, transmitter electronics and integral output meter. The indication on the output meter shall be digital with engineering units.
  - The mass flow meter transmitter shall be smart type and shall provide 4-20mA analog output superimposed with digital signal for meter diagnostics (HART Output). When specified, flow meter shall provide field-bus output conforming to the standard specified in the specification sheets.
  - The mass flow meter shall be capable of computing field density and shall incorporate temperature sensor flow fluid temperature measurement. Whenever specified in the data sheets, the flow meter electronics shall have capability to compute volumetric flow rates.
  - The meter electronics shall be protected against transients induced by lightning and power supply surges. Transient protection electronics shall preferably be provided in the terminal block. The transient protection shall meet the requirements specified in IEC-60587.
  - The configurational data of the instrument shall be stored in a non-volatile memory such that this remains unchanged because of power fluctuations or power off condition. In case, vendor standard instrument has battery backed RAM vendor to ensure that battery drain alarm is provided as diagnostic maintenance message.
  - In addition to the requirements specified above, field bus-based transmitter shall meet the requirements;
    - a) All instruments must satisfy the requirements of the field bus registration laboratory with applicable checkmark like foundation field bus or as specified in the data sheets.
    - b) All instruments shall have two analog input blocks and a PID controller block, as a minimum.
    - c) All instruments must be interoperable and shall have valid interoperability test clearance like ITK 4.6 for foundation field bus or as applicable.
    - d) The field bus instruments shall support peer-to-peer communication.
    - e) Field bus instruments as offered shall not be polarity sensitive.
    - f) The field bus instruments in hazardous area shall be certified as per entity concept or shall be FISCO approved as per the requirements specified in the Material requisition/datasheet.
  - Meter electronics shall also be provided with security lockout feature to disable access to configuration modification features.
  - Flow meter electronics shall be either integral to flow meter or shall be remote mounted type. Where remote mounted electronics is offered a minimum of 10 meters of interconnecting cable shall be included.
  - Flow meter electronics shall have enclosures suitable for the hazardous area classification indicated in data sheets. When area classification is specified as electrically hazardous flow meter shall have flameproof enclosure with intrinsically safe circuitry for sensor connectivity. Safety barrier if required for the sensors shall be supplied by vendor and shall be part of transmitter enclosure.
  - The meter electronics along with flow meter shall be pre-calibrated at vendor's works with calibration factor duly established for the flow meter.

- The meter electronics shall be immune to RFI and EMI radiation and shall comply with the electromagnetic compatibility requirement as per IEC 61 000-4.
- Following shall be applicable for power supply to instrument:
  - a) Transmitters shall generally be two wire transmitters. However, in case of four wire transmitters, Instrument shall be suitable for use in voltage ranges of 110V AC and 220VAC, 50 Hz.
  - b) Supply voltage fluctuation of  $\pm 10$  percent and supply frequency fluctuation of  $\pm 3$  Hz shall not affect the instrument performance.
- The meter shall be sized considering the following guidelines;
  - a) Min. flow, max. flow and meter maximum as specified in the data sheet.
  - b) Flow accuracy between the minimum and maximum flow specified in the data sheet. Where only normal flow is specified, the maximum and minimum flows considered for sizing shall be;
    - Maximum flow = 1.4 times the normal flow
    - Minimum flow = 0.4 times the normal flow

When only maximum flow is specified, minimum flow shall be considered as 0.2 times the maximum flow for sizing the meter.

  - c) The maximum pressure drop at meter maximum shall not exceed the allowable pressure drop across the meter specified in the data sheet.
  - d) The meter shall be selected such that both accuracy and allowable pressure differential across the meter are complied.
- Unless specified otherwise in the data sheets, the performance requirements for the mass flow meter shall be as follows;
  - a) Flow meter accuracy:  $\pm 0.2\%$  of mass flow rate for liquid service.  
 $\pm 0.5\%$  of mass flow rate for gas / vapour service
  - b) Flow meter repeatability:  $\pm 0.1\%$  of mass flow rate for liquid service  
 $\pm 0.25\%$  of mass flow rate for gas service

The performance requirements specified above excludes the effect of zero stability of the flow meter on these parameters.

- Mass flow meter accessories as follows:
- Hand held configurator for Smart Instruments: Hand Held configurator shall be universal type and shall be able to communicate with all make and models of smart instruments with HART output like transmitters, smart positioners etc., and shall carry out all engineering like calibration, configuration and diagnostics. The hand-held configurator shall be certified intrinsically safe. Carrying case shall be supplied with each configurator.
- Field bus hand held tester: The field bus hand held tester shall be able to communicate with the specified field bus instrument and shall be capable of calibrating and configuring field bus devices. The field bus hand held tester shall be certified intrinsically safe. Carrying case shall be supplied with each tester.
- Battery charger: Both field bus hand held tester and hand-held configurator for smart instruments with HART output shall be supplied with battery charger for battery charging of hand held configurator / field bus tester. Unless otherwise specified, battery charger shall operate at 240V 50Hz supply.

### 3.5 ELECTROMAGNETIC FLOW METER

The general design, construction, terminal Housing, meter Sizing and performance requirements for Magnetic flow meter shall be as follows:

- Unless otherwise specified, flow meter shall be of in-line mounting design. Insertion type of magnetic flow meter shall not be offered.
- Flow direction should be clearly marked on the magnetic tube to ensure correct installation of the flow meter.
- Vendor to note, that the location and orientation of installation of electromagnetic flow meter in the line, shall not affect the calibration, accuracy and performance of the meter.
- Flow meter shall be of flanged body construction with material of construction as specified in data sheet. In case of welded end connection design, the weld joints shall be of radiography quality.
- Unless otherwise specified, the following shall govern: -
  1. Threaded end connections shall be to NPT as per ASME B 1.20.1.
  2. Flanged end connections shall be as per ASME B 16.5.
  3. Flange face finish shall be as per ASME B 16.5. The face finish as specified in the data shall be as follows:
    - 125 AARH: 125 to 250 micro inch AARH
    - 63 AARH: 32 to 63 micro inch AARH
- Unless specified otherwise, the flow meter tube shall have PTFE liner. The liner shall hold tightly and rigidly against the flow meter tube without any air gap.
- The field coils shall operate on an alternating supply voltage as indicated in the data sheets. The performance of the flow meter shall not be affected by the following variations in the supply voltage;
  - a) Voltage variation of +/- 10% of nominal value.
  - b) Frequency variation of +/- 3% of nominal value.
- Coil insulation should be class F suitable for high temperature as per IEC 60085/IS 1271.
- Unless otherwise specified, the coil housing shall be of carbon steel construction fully welded to the meter body to avoid ingress of moisture, dust and corrosive gases.
- Coil excitation technique shall be pulsed DC type or dual frequency type. In case of slurry applications, the meters shall have high coil current and high frequency excitation. In case of slurry applications, grounding ring shall act as lining protector.
- Electrodes shall have good corrosion resistance and shall be welded to meter body. Field replaceable electrode construction shall be offered only when specifically indicated in the data sheet.
- Vendor shall offer on line removable electrodes where cleaning of electrodes, is necessary due to coating characteristics of the process fluid.
- The vendor shall ensure that for potential equalization between sensor and liquid, the flow meter shall be provided with integral earthing reference electrode when installed in non-lined pipe and an earthing plate / ring when installed in lined pipe. Vendor's scope of supply shall also include earthing cables and cable accessories like earthing lugs for interconnection with meter electronics. Unless specifically indicated, earthing electrode shall not be acceptable in place of earthing ring.
- The electrodes including earthing ring shall be connected in the intrinsically safe circuit for flow meter handling electrically hazardous fluids.
- Meter shall be capable of measuring process fluid of conductivity 5 micromhos /micro siemens per centimeter unless specified otherwise in the data sheet.
- Following velocity limits shall be considered for meter sizing, unless otherwise specified.
  - a) For slurries and viscous flow: 4 to 5 m/s.
  - b) For all other services: 2 to 3 m/s

Velocity beyond these limits shall not be considered for sizing.

- Following shall apply for both integral as well as for remote meter electronics:
  - a) All connections shall be terminated on the terminals brought out in the terminal housing located on the flow meter body. Flying leads shall not be provided.
  - b) All intrinsically safe terminals shall be properly identified and shall be separate from the non-intrinsically safe terminals.
  - c) Separate cable entry shall be provided in the terminal housing for power and intrinsically safe signals.
  - d) The flow meter enclosure, housing the electrical parts shall be suitable for the area classification indicated in the data sheets. Unless otherwise specified, the enclosure shall conform to the following standards, as a minimum:
    - Weatherproof housing - IP 65 to IS / IEC-60529
    - Flame proof housing - Flame proof / Ex (d) as per IS / IEC-60079
    - Flameproof housing shall also be made weatherproof.
- Proper terminal blocks shall be provided in the transmitter unit for the termination of cables. Separate terminal blocks shall be provided for power and signal connections.
- Meter electronics includes all the associated electronics like pre-amplifiers, transmitter/converters etc. Where the vendor is supplying the complete meter electronics, vendor shall ensure that the input/output signals and performance characteristics of individual item are compatible with each other.
- When meter electronics is specified for installation in electrically classified area, the transmitter shall be flameproof with intrinsically safe sensor. Safety barrier as required for the sensor shall be provided by the vendor and shall be part of transmitter enclosure.
- The electronic transmitter shall be two (2) wire micro-process based and shall provide 4 to 20 mA analog output superimposed with diagnostic data in digital mode (i.e. HART output). When specified, flow meter shall provide field-bus output conforming to the standard specified in the Material specification/Datasheet.
- For smart transmitters with HART output or for field-bus based transmitter the following features must be ensured;
  - a) It shall allow multi-master (primary and secondary) for configuration, calibration, diagnosis and maintenance. The primary could be the control system or host computer, and the secondary could be the hand-held communicator.
  - b) It should be capable to implement universal commands.
- In addition to the requirements specified above, field-bus based transmitter shall meet the following requirements;
  - a) All instruments must satisfy the requirements of the field bus registration laboratory with applicable checkmark like foundation field bus or as specified in the data sheets.
  - b) All instruments shall have two analog input blocks and a PID controller block, as a minimum.
  - c) All instruments must be interoperable and shall have valid interoperability test clearance for foundation field bus, as applicable.
  - d) The field bus instruments shall support peer-to-peer communication.
  - e) Field bus instruments as offered shall not be polarity sensitive.

The field bus instruments in hazardous area shall be certified as per entity concept or shall be FISCO approved as per the requirements specified in the specification Datasheet.

- Field mounted converters/transmitters shall have an integral output LCD meter. Local indication of the output meter shall be digital with engineering units.
- The span of the transmitter shall be field adjustable. In case separate device is required, to make such a change, the same shall be included.
- The configurational data for the instrument shall be stored in a non- volatile memory such that the data remains unchanged because of power fluctuations or power off condition.
- When data sheets indicate the presence of permeable solids in the stream (e.g. slurries containing magnetic materials like iron) vendor shall offer a flow meter system whose circuitry compensates for signal changes induced by the presence of permeable solids.
- When specified, the meter electronics shall be protected against transients induced by lightning and power supply surges. Transient protection electronics shall preferably be provided in the terminal block.
- Where remote mounted converter/ transmitter is offered a minimum of 10 meter of interconnecting cable shall be included for both, measuring electrode and earthing electrode / plate, unless specified otherwise.
- Unless specified otherwise in the data sheets, the performance requirements for the Magnetic flow meter shall be as follows;
  - a) Flow meter accuracy, inclusive of linearity, repeatability and hysteresis shall be better than +/- 0.5% of flow rate.
  - b) Flow meter repeatability: shall be better than +/-0.1 % of flow rate

### 3.6 DIFFERENTIAL PRESSURE TYPE FLOW METER

Differential Pressure type flow transmitters shall be as per the requirements specified in Standard Specification for Pressure Instruments (Doc. No. 44AC-9100-00-J. SS-0106).

The above flow transmitters shall be provided with integral 3 way or 5-way manifold valves.

### 3.7 VARIABLE AREA FLOW METER

- Variable Area Flowmeters or rotameters shall be as per ISA-RP 16.1, 16.2, 16.3, 16.4, 16.5 and 16.6 and shall be used for viscous or corrosive services or where rangeability in flow precludes the use of an orifice. Metal tube rotameters shall be used for all process fluids. External devices for indicating or transmitting shall be magnetically coupled to the float or extension. Magnetic coupling shall be glandless type. The tube and flanges shall be SS316 as a minimum.
- Glass tube rotameters shall be used for low pressure utility services for local indication and where line size is 1-1/2" (40 mm) or less. Glass tube rotameters shall not be used if outlet line is connected to a line or vessel containing hazardous or toxic fluid unless a check valve is installed at the downstream side of rotameter. Glass tube meters shall be mechanically protected and may only be used on non-hazardous fluid services, with temperatures up to 130°C, and on fluids always above freezing.
- Linearity should be better than 5% for indication-only rotameters and better than 1% for rotameter transmitter. Accuracy shall be 2% (or better) of full scale for general purpose and metal tube rotameters.
- Variable Area Flowmeters (purge rotameters) fitted with a constant flow regulator shall only be used for fixed rate flows such as flushing or purging.
- For low cost measurement of high flow rates generally 2" and larger sizes, bypass

rotameters shall be used.

### 3.8 TURBINE & POSITIVE DISPLACEMENT TYPE FLOW METER

- These flow meters shall be used for highly accurate volumetric flow measurement. These meters can be applied in custody transfer operation or in batch-transfers.
- Turbine / PD flow meters shall be used for relatively clean liquid services. Strainers and vapour Accuracy / Repeatability to be indicated, eliminators shall be used with these meters.
- As a minimum, the rotor shall be of 316 SS material. Turbine meter shall have tungsten carbide bearings and shall be designed with hydraulic balance to keep the rotor in place. Designs using thrust bearings are not advisable.
- Whenever PD meter is selected, these shall be of double casing type with inner casing of 316 SS as a minimum.
- Transmitter signal shall be of pulse type. Pulser and the transmitter selected shall be compatible and should have a proven combination reference.
- While selecting turbine flow meters, due considerations to be given to the fluid viscosity. Viscosity affects the linearity of turbine meter, so on high viscosity line it is advisable to size the meter so that its maximum permitted flowrate is as close as possible to the application maximum flowrate.

### 3.9 THERMAL MASS FLOW METER

Thermal mass flow meters shall be considered as a special application device:

- For high reliability flow switching, no-flow detection, reverse-flow detection.
- For measuring very low flow rates.
- For measuring flow rates of highly corrosive fluids or difficult-to-meter fluids.
- Flue gas measurement.

### 3.10 TARGET METERS

Target meters shall be considered for highly viscous hydrocarbon streams such as asphalt, tar, polymers, etc.

### 3.11 VORTEX FLOW METER

The Vortex flow meter shall be considered for following applications:

- Where higher rangeability is required
- Where high accuracy is required
- Where no maintenance spare is expected
- Where process is a clean service
- Where mechanical vibrations are not existent in pipe and sufficient straight lengths can be provided.

Vortex flowmeter shall not be used for the following services:

- High viscous and slurry service.
- Liquids having large concentration of solids and two-phase flow or pulsating flow service.

Meter shall be selected such that cavitation does not occur for given line pressure.

### **3.12 ULTRASONIC FLOW METER**

Ultrasonic flow measurement shall be considered where non-intrusive flow measuring is required. This type of flow meter shall normally be used for flare gas flow measurement.



#### 4.0 DOCUMENTATION

Post Order Documents to be submitted by the bidder for review/ approval.

<b>DOCUMENTATION REQUIREMENTS</b>	<b>REVIEW / APPROVAL</b>
QUALITY ASSURANCE PLAN (QAP)	For Approval
PRODUCTION SCHEDULE	For Review
INSTRUMENT DATA SHEETS	For Approval
INSTRUMENT G.A. / INSTALLATION DRAWINGS	For Approval
BILL OF MATERIALS INCLUDING SPARES	For Review

Note: Schedule of submission of the above documents shall be aligned to meet the delivery requirements.

Final documentation consisting of design data, installation manual, operation and maintenance manual etc., submitted by the vendor after placement of purchase order shall include the following, as a minimum;

- a) Specification sheet/ Data sheet/ Sizing Sheet for the applicable Flow Meter.
- b) As- built drawings for each Mass Flow Meter, providing details (dimensional), constructional details, Weight and material of construction.
- c) Copy of test certificates for all the tests as per MR and Documents along with TPI IRN.
- d) Installation procedure for each orifice plate and flanges.
- e) BOM including spares (if applicable)
- f) Product Catalogs of Main equipment and accessories/ bought outs.
- g) Curves for flow measurement vs. accuracy and rangeability.
- h) Maximum and minimum supply voltage required for the instrument to function within the stated performance characteristics.
- i) Clearance required for maintenance work
- j) Calibration procedures for flow meter

Three hard copies in bound format and one soft copy in CD/ DVD of the above shall be submitted as final document.



## 5.0 NAME PLATE

Each electromagnetic flow meter and its accessories shall have a stainless-steel nameplate attached firmly to it at a visible place, furnishing the following information:

- a) Tag number as per data sheet.
- b) Manufacturers serial number and model number.
- c) Manufacturer's name/trademark.
- d) Nominal end connection size and rating.
- e) Tube, tube liner and electrode materials.
- f) Calibrated range of flow.
- g) Area classification for which the equipment is certified for installation.
- h) Hazardous area certification number and marking
- i) Operating power supply voltage and frequency.
- j) Specified range and units of measurement for flow.

## 6.0 SHIPPING

All threaded and flanged openings shall be suitably protected to prevent entry of foreign material.

The flow transmitter and its accessories shall be packed separately.

The consignment shall be packed and suitably labelled clearly indicating the following as minimum:

- a) Project Name and Location
- b) PO Number
- c) Packing List inside consignment (indicating Main Equipment Tag nos, Accessories and Spares as applicable)
- d) Vendor Name and location of dispatch



**DEPARTMENT:** INSTRUMENTATION  
**DOCUMENT NO:** 44AC9100-000-J.SS-0105-A4  
**DOCUMENT TITLE:** STANDARD SPECIFICATION FOR LEVEL INSTRUMENT  
**ITEM:**  
**PROJECT NO:** 44AC9100  
**PROJECT LOCATION:** DUMAD/IOCL-JR, Gujarat  
**PROJECT TITLE:** EPCM/PMC SERVICES FOR ACRYLICS / OXO ALCOHOL PROJECT AT GUJARAT REFINERY AND DUMAD  
**CLIENT:** INDIAN OIL CORPORATION LIMITED  
**CLIENT PROJECT NO:**  
**CLIENT AUTHORIZATION:** MR. GAURAV DOLEY (DGM-PJ)  
**PM AUTHORIZATION:** MR. PAWAN GUPTA

				APPROVALS		
Rev. No.	Issue Date	Pages	Revision Description	Prepared	Checked	Approved
A	27-12-2018	13	ISSUED FOR BID	ARG	PV	PV
<input checked="" type="checkbox"/> Entire Document Issued this Revision		DOCUMENT ISSUED FOR: (please <input checked="" type="checkbox"/> as applicable)				
<input type="checkbox"/> Revised Pages Only Issued this Revision		<input type="checkbox"/> In-house Review	<input type="checkbox"/> Purchase			
		<input type="checkbox"/> Client Approval	<input type="checkbox"/> Construction			
		<input type="checkbox"/> Design				

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**1.0 GENERAL**

1.1 This specification, together with the datasheets, MR and special requirements (If any) covers the general requirements for instrumentation design, materials, name plate marking, inspection, testing and shipping of all Level instruments along with their accessories.

1.2 The All Level Instruments and its accessories shall be supplied in fully assembled condition.

1.3 In the event of any conflict between this standard specification, datasheet, statutory regulations, related codes, standards etc., the following order of priority shall govern:

- 1st priority : Statutory Regulation requirement
- 2nd priority : Process Licensor's documents
- 3rd priority : Job Specifications & Job Drawings
- 4th priority : Engineering Design Basis
- 5th priority : Standard Specifications, standard Drawings & Engineering standards

Note: In case of any conflicts most stringent requirements shall be followed, however it shall be obligatory on the contractor's part to bring such conflicts to the notice of owner/PMC, wherein owner/PMC decision shall be final.

1.4 Individual level instrument data sheets specify the material for wetted parts and flanges. Unless specifically indicated otherwise, alternate superior material of construction shall also be acceptable provided vendor assumes complete responsibility for the selected materials for their compatibility with the specified fluid and its operating conditions.

**1.5 PROJECT TITLE**

- Project Name : EPCM/PMC Services for Acrylics/ Oxo-Alcohol Project at Gujarat Refinery and Dumad
- Owner : Indian Oil Corporation Limited
- Location : Dumad & Vadodara, Gujarat, India

## 2.0 CODES, STANDARDS AND REGULATIONS

Applicable national / international standards Design, and terminology shall comply, as a minimum, with the latest edition prior to the date of purchaser's enquiry of following codes, standard practices and publications:

**ASME****(American Society of Mechanical Engineers)**

ASME B 1.20.1 Pipe Threads General Purpose (inch) (Year - 2013)  
ASME B 16.5 Steel Pipe Flanges and Flanged Fittings (Year- 2017)  
ANSI B 16.20 Ring Joint Gaskets and Grooves for Steel Pipe Flanges (Year- 2012)

**BS****British standards**

3463 Observation and Gauge Glasses for Pressure Vessels.

**EN****European standards**

10204 Inspection Documents for Metallic Products

**IEC****(International Electro-Technical Commission.)**

IEC 60079 Electrical apparatus for Explosive Gas atmosphere (Year -2017)  
IEC 60079-1 Explosive atmosphere equipment protection by flameproof enclosure 'D' (Year -20014 & 2018)

IEC61000-4-3 Electromagnetic Compatibility-Part-4-3 Testing and measurement techniques - Radiated, radio-frequency, electromagnetic field immunity test (Year-2010).

IEC61000-4-4 Testing and Measurement techniques – Electrical Fast Transient/burst Immunity Tests

IEC61000-4-5 Testing and Measurement techniques – Surge Immunity

IEC 60587 Electrical Insulating Materials under severe ambient conditions- Test methods for evaluating resistance to tracking and erosion (Year-2010)

IEC 61158 Digital data communications for measurement and control –. Fieldbus specification.

IEC 60529 Degrees of Protection Provided by Enclosures (IP Code) - (Year- 2015)

IEC/ TS 60079 FISCO technical specification (Year-2006).

IEC 61518 Mating dimensions between differential pressure (type) measuring instruments and flanged-on shut-off devices up to413 bar (41,3 MPa)

**IS****Indian standards**

5428 Part I Tubular glasses for Level gauges  
Part II Protector glasses for Tubular Gauge glasses.  
Part III Through-vision and Reflex Glasses.

**Other standards:**

NEC National Electric code.  
NEMA National Electrical Manufacturer's Association  
NFPA National Fire Protection Association.  
NFPA-496 Purged and pressurized enclosures for electrical equipment. (Year 2017)  
OSHA Occupational Safety and Health Authority.

IBR  
AG-181  
ITK

Indian Boiler Regulations 1950 (Including Amendments in year 2017)  
FOUNDATION™ Fieldbus System Engineering Guidelines  
Interoperability Test Kit (6.3.0 or the latest version)

Apart from above listed OISD, the latest standards applicable as on date of enquiry for Instrumentation of Packages like Turbine, Compressor, Diesel Engines and Fire protection system etc.

### 3.0 GENERAL DESIGN REQUIREMENTS

All Level transmitters shall be intrinsically safe & SMART type with HART/ FF protocol with integral LCD indicator and be furnished with test terminals and bypass diode to facilitate field testing without disconnection of integral indicator. The transmitter electronics shall monitor their performance during normal operation. The transmitter diagnostics shall be able to detect both an input sensor failure and transmitter electronics failure. The sensor &/or electronics failure shall be transmitted to the host system (e.g. DCS / PLC). The transmitters shall have zero and range adjustable.

#### 3.1 LEVEL GAUGES

The general design requirements for various level gauges shall be as follows:

- Gauge glasses and cocks shall be suitable for the designed pressure and temperature related to the corresponding ASME rating specified for each item.
- Unless otherwise specified, the following shall govern: -
  1. Threaded end connections shall conform to NPT as per ASME B 1.20.1.
  2. Flanged end connections shall be as per ASME B 16.5.
  3. Grooves of the ring type joint flanges shall be octagonal as per ASME B16.20.
  4. Flange face finish shall be as per ASME B 16.5. The face finish as specified in the data shall be as follows:
    - 125 AARH: 125 to 250 micro inch AARH
    - 63 AARH: 32 to 63 micro inch AARH

#### 3.2 TUBULAR TYPE GAUGE GLASSES

The general design requirements for tubular type gauge glasses shall be as follows:

- Tubular type gauge glasses shall have a minimum of 3/4 "(19mm) tempered glass tube with steel guard rods.
- All gauge glasses shall have SS graduated scale along the length of gauge glass fixed external to the glass tube.
- Tubular type gauge glasses shall have side-side connections (as per datasheet) with 1/2" threaded vent and drain connections. Vent and drain connection shall be plugged.
- The length of individual tubular gauge glass shall not exceed 1000 mm.

#### 3.3 ARMoured TYPE LEVEL GAUGE

Design requirements for armoured type level gauge shall be as follows:

- Gauge glasses shall be of the mechanical and thermal shock resistant type. Glass material shall be toughened borosilicate, for all types of gauges.
- Cover bolts and nuts shall correspond to ASTM A-193 Gr. B7/A-194 Gr. 2H, unless otherwise specified.
- Where side-side connections are specified, the gauge shall have two entries, 180 degrees apart at each end with one side plugged.
- Unless otherwise specified, vent and drain connections shall be 1/2 " threaded which shall be suitably plugged.
- Gauge glasses in corrosive service shall be supplied with glass protective shield/liners of minimum 1/16" (1.5 mm) thickness suitable for the process fluid being handled. Mica shield shall be provided for all steam and /or condensate services.
- All Level gauges shall be provided with excess flow check valves. Excess Flow Check valves shall



be of the quick-closing type. Unless otherwise specified, all moving and wetted internals shall be 316 Stainless Steel, as a minimum. The stem packing shall be of PTFE or better suited for process conditions

- The gauge glasses shall be of heavy armour design and shall meet the following test pressures as a minimum:

Type of Chamber	Model	Type	Test Pressure (Kg/ cm <sup>2</sup> g)
Standard	Reflex	1 (up to 300 Class flange rating)	165
		2 (up to 600 Class flange rating)	210
	Transparent	3 (up to 300 Class flange rating)	84
		4 (up to 600 Class flange rating)	210
Large	Reflex	5 (up to 300 Class flange rating)	50
	Transparent	6 (up to 150 Class flange rating)	40

- Illuminator wherever specified, shall be supplied complete with mounting brackets and lighting fixtures. Unless otherwise specified, illuminator lamps shall operate on 240 V, 50 Hz single phase supply. The illuminator housing shall be constructed to the following standards:
  - Weather proof housing shall be IP 65 as per IS/IEC-60529 and
  - Flame proof housing- flame proof Ex(d) as per IS/ IEC 60079.
  - Multiple illuminators in gauge shall be wired internally using armoured cables and suitable glands. The incoming power terminals shall be suitable for cable connection up to 4.0 mm<sup>2</sup> size.

**3.4 SENSOR / PROBE**

The minimum design requirements for Mass flow meter shall be as follows:

- Vendor shall select the probe length and diameter based on the application and process parameters. The type and material of construction of level instrument shall be as specified in the datasheet.
- Probe shall be of flanged construction with material of construction of flange as specified in data sheet. In case of welded flanged connection design, the weld joint shall be of radiography quality.
- Probe shall be of rugged construction without any mechanical moving part and shall not be affected by abrasion because of fluid turbulence. The probe design shall ensure that the deposits, dust, noise, foam or turbulence in the fluid shall not affect the performance of the level instruments.
- The mass flow meter shall have high vibration immunity. The meter output shall not be affected by the pipeline vibration where the meter is installed.
- Unless otherwise mentioned, the following shall govern:
  - Threaded end connections shall be to NPT as per ASME B 1.20.1.
  - Flanged end connections shall be as per ASME B 16.5.
  - Flange face finish shall be as per ASME B 16.5. The face finish data shall be as follows:
    - 125 AARH: 125 to 250 micro inch AARH
    - 63 AARH: 32 to 63 micro inch AARH
  - Grooves of ring type joint flanges shall be octagonal as per ASME B 16.20.
- Following Sensor/Probes installed in oxygen and chlorine service shall be thoroughly degreased

using reagents like tri-chloro-ethylene or carbon tetrachloride. End connection shall be blinded/plugged after the degreasing process, to avoid entrance of grease or oil particles.

### 3.5 INSTRUMENT ELECTRONICS

- Level Instrument electronics shall be compatible with the associated level probe and shall comprise of pre-amplifier, converter, transmitter, switching amplifier etc. as applicable for the specified application. Vendor shall ensure that the input/output signals and performance characteristics of individual item supplied as a part of each level instrument are compatible with each other.
- The instrument electronics shall be integral with the probe. Where remote mounted converter/transmitter is offered in place of integral electronics a minimum of 10 meters of interconnecting cable shall be included.
- Instrument electronics shall be of microprocessor based state-of-the-art technology, which shall be capable of being configured locally and through a universal hand-held configurator.
- The meter electronics shall be provided with in-built lightning and power supply surge protectors. The transient protection shall meet the requirements specified in IEC 60587.

#### Power Supply:

1. Transmitters shall generally be two wire transmitters. However, in case of four wire transmitters, Instrument shall be suitable for use in voltage ranges of 110V AC and 220VAC, 50 Hz.
2. Supply voltage fluctuation of  $\pm 10$  percent and supply frequency fluctuation of  $\pm 3$  Hz shall not affect the instrument performance.

#### Terminals and Enclosure:

- Proper terminal blocks shall be provided in the transmitter unit for the termination of cables. Flying leads shall not be provided. Separate terminal blocks shall be provided for power and signal connections.
- All terminals shall be clearly identified, and polarity shall be permanently marked.
- Separate cable entries shall be provided for signal and power cables. The cable entry sizes shall be 1/2" NPT (F) for signal and 3/4" NPT (F) for power.
- The instrument enclosure, housing the electrical parts shall be certified for the area classification indicated in the data sheets. Unless otherwise specified, the enclosure shall conform to the following standards, as a minimum:
  - Weatherproof housing to IP 65 as per IS / IEC-60529.
  - Flame proof housing - Flame proof / Ex (d) as per IS / IEC-60079
  - Flameproof housing shall also be made weatherproof.

#### Converter / Transmitter:

- Electronic transmitter shall generally operate at nominal voltage of 24V DC and shall be protected against short circuit and reverse voltage.
- Electronic transmitters with two-wire system shall be suitable for delivering rated current to an external loop resistance of at least 600ohm when powered with 24 V DC.
- The span of the transmitter shall be field adjustable.
- Field mounted converters/transmitters shall have an integral output meter. Local indication of the output meter must be digital and in engineering units.
- For smart transmitters with HART output or for field-bus based transmitter the following features must be ensured;
  - a) Smart and field-bus based transmitters shall be two wire microprocessor-based type. All necessary signal conversions and output generation with the required protocol shall be carried out in the transmitter electronics. Integral output meter with LCD display shall be provided for all transmitters.

- b) The configurational data of the instruments and complete sensor characterization which is stored in a non-volatile memory shall remain unaffected because of power fluctuations or power-off condition.
  - c) Transmitter shall also run complete diagnostic subroutines and shall provide diagnostic alarm messages for sensor as well as transmitter healthiness.
  - d) Transmitter protocol shall ensure the following features:
    - It shall allow multi masters (two for example, primary and secondary) for configuration, calibration, diagnostics and maintenance. The primary could be the control system or host computer and the secondary could be the hand- held communicator or integral facia.
    - It shall be capable of implementing universal commands from either of these locations.
- In addition to the requirements specified above, field-bus based transmitter shall meet the following requirements;
    - a) All instruments must satisfy the requirements of the field bus registration laboratory with applicable checkmark like foundation field bus or as specified in the data sheets.
    - b) All instruments shall have two analog input blocks and a PID controller block, as a minimum.
    - c) All instruments must be interoperable and shall have valid interoperability test clearance for foundation field bus, as applicable.
    - d) The field bus instruments shall support peer-to-peer communication.
    - e) Field bus instruments as offered shall not be polarity sensitive.
    - f) The field bus instruments in hazardous area shall be certified as per entity concept or shall be FISCO approved as per the requirements specified in the specification Datasheet.

### 3.6 GUIDED WAVE RADAR TYPE LEVEL INSTRUMENT

- The instrument shall work on TDR principle and shall be capable of measuring level of process fluid of dielectric constant as low as 1.9.
- The type of wave guide i.e. coaxial/twin rod/single rod shall be selected by the vendor based on the specified application.
- The instrument probe length shall be selected based on the minimum and maximum levels indicated in the data sheet.
- External type guided wave radar instrument shall have external chamber/cage with 2" flanged end connections. The chamber/cage shall also have 3/4" NPT vent and drain connection. Internal type guided wave radar instrument shall have 4" flanged end connection.
- The instrument shall meet the following performance requirement:
  - a) Accuracy inclusive of linearity, repeatability and hysteresis shall be better than  $\pm 3\text{mm}$ .
  - b) Repeatability of level instrument shall be better than  $\pm 3.0\text{ mm}$ .
  - c) Response time (i.e. 63.2% response) shall be better than 1 second.

### 3.7 ULTRASONIC TYPE LEVEL INSTRUMENT

- Ultrasonic probe shall be selected based on the level measurement range specified in the data sheet.
- The instrument probe shall have 2" flanged end connection.

- The instrument shall have an accuracy (inclusive of linearity, repeatability and hysteresis) better than  $\pm 0.25\%$  of measuring range.

### 3.8 RADIO FREQUENCY TYPE LEVEL INSTRUMENT

- The type of probe i.e. rod, or rope type shall be selected by vendor based on the specified application.
- The instrument probe length shall be selected by vendor based on the specified level measurement range.
- The instrument probe shall have 2" flanged and connection.
- The instrument shall have an accuracy (inclusive of linearity, repeatability and hysteresis) better than  $\pm 0.5\%$  of measuring range.

### 3.9 CAPACITANCE TYPE LEVEL INSTRUMENT

- The type of instrument probe rod or rope shall be selected by vendor based on the specified level range.
- The material of construction of the probe shall be stainless steel 316/ 316L with insulation of PTFE.
- For non-metallic equipment or equipment's lined internally with insulation material, probe having suitable ground reference shall be provided.
- The instrument probe shall have 2" flanged end connection.
- The instrument shall have an accuracy (inclusive of linearity, repeatability and hysteresis) better than  $\pm 0.5\%$  of measuring range.

### 3.10 MISCELLANEOUS

Other special type of level instruments like radar, ultrasonic type, capacitance type, nucleonic type shall be used as necessitated by application requirements.

For the de-salter level, more than one numbers of RF-Capacitance type level transmitter shall be used.

The For high-pressure steam drum application, conductivity type ("Hydra step" or equivalent) level instrument is preferred, In addition to the continuous level measurement

For solid level measurement, type of instrument shall be ultrasonic / radio frequency/ nucleonic. The actual type selection shall be carried out based on the proven track record of the selected type for the similar type of application.

#### 4.0 DOCUMENTATION

Post Order Documents to be submitted by the bidder for review/ approval.

<b>DOCUMENTATION REQUIREMENTS</b>	<b>REVIEW / APPROVAL</b>
QUALITY ASSURANCE PLAN (QAP)	For Approval
PRODUCTION SCHEDULE	For Review
INSTRUMENT DATA SHEETS	For Approval
INSTRUMENT G.A./INSTALLATION DRAWINGS	For Approval
CERTIFIED VALUES OF FAILURE RATES, PROBABILITY OF FAILURE ON DEMAND (PFD) AND TEST INTERVALS FOR OFFERED ITEMS FOR SAFETY INTEGRITY LEVEL (SIL) ANALYSIS	For Review
BILL OF MATERIALS INCLUDING SPARES	For Review

Note: Schedule of submission of the above documents shall be aligned to meet the delivery requirements.

Final documentation consisting of design data, installation manual, operation and maintenance manual etc., submitted by the vendor after placement of purchase order shall include the following, as a minimum;

- a) Specification sheet/ Data sheet/ Sizing Sheet for each Level Instrument with accessories.
- b) As built drawings for each Level Instrument with accessories, providing dimensional details, constructional details, connection details and material of construction.
- c) Copy of test certificates for all the tests as per MR and Documents along with TPI/ IRN.
- d) Installation procedure for each Level Instrument along with their accessories.
- e) Calibration, Configuration and Maintenance procedures
- f) Device Descriptor (DD) Files/EDDL file/DTM files for configuring the device parameters (Soft Copy)
- g) Common File Format (CFF) files for integrating the device into the system (Soft Copy).
- h) DD/ITK/CFF Revision number
- i) BOM including spares (if applicable)
- j) SIL data
- k) Product Catalogs of Main equipment and accessories/ bought-outs

Three hard copies in bound format and one soft copy in CD/ DVD of the above shall be submitted as final document.

## 5.0 NAME PLATE

Each level instrument and its accessories shall have a stainless-steel nameplate attached firmly to it at a visible place, furnishing the following information:

- a) Tag number as per data sheet.
- b) Manufacturers serial number and model number.
- c) Manufacturer's name/trademark.
- d) Nominal end connection size and rating.
- e) Range of measurement.
- f) Calibrated range of level
- g) Area classification for which the instrument is certified for installation.
- h) Hazardous area certification number and marking
- i) Operating power supply voltage and frequency.
- j) Specified range and units of measurement for level

## 6.0 SHIPPING

All threaded and flanged openings shall be suitably protected to prevent entry of foreign material.

The instrument shall be supplied individually, in suitably sealed packing.

Proper care shall be taken in shipping the instruments to avoid damage.

The consignment shall be packed and suitably labelled clearly indicating the following as minimum:

- a) Project Name and Location
- b) PO Number
- c) Packing List inside consignment (indicating Main Equipment Tag nos, Accessories and Spares as applicable)
- d) Vendor Name and location of dispatch



**DEPARTMENT:** INSTRUMENTATION  
**DOCUMENT NO:** 44AC9100-000-J.SS-0106-A4  
**DOCUMENT TITLE:** STANDARD SPECIFICATION FOR PRESSURE INSTRUMENT  
**ITEM:**  
**PROJECT NO:** 44AC9100  
**PROJECT LOCATION:** DUMAD/IOCL-JR, Gujarat  
**PROJECT TITLE:** EPCM/PMC SERVICES FOR ACRYLICS / OXO ALCOHOL PROJECT AT GUJARAT REFINERY AND DUMAD  
**CLIENT:** INDIAN OIL CORPORATION LIMITED  
**CLIENT PROJECT NO:**  
**CLIENT AUTHORIZATION:** MR. GAURAV DOLEY (DGM-PJ)  
**PM AUTHORIZATION:** MR. PAWAN GUPTA

				APPROVALS		
Rev. No.	Issue Date	Pages	Revision Description	Prepared	Checked	Approved
A	28-12-2018	12	ISSUED FOR BID	ARG	PV	PV
<input checked="" type="checkbox"/>	Entire Document Issued this Revision	DOCUMENT ISSUED FOR: (please ✓ as applicable)				
<input type="checkbox"/>	Revised Pages Only Issued this Revision	<input type="checkbox"/> In-house Review	<input type="checkbox"/> Purchase			
		<input type="checkbox"/> Client Approval	<input type="checkbox"/> Construction			
		<input type="checkbox"/> Design				



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**1.0 GENERAL**

- 1.1 This specification, together with the datasheets, MR and special requirements (If any) covers the general requirements for instrumentation design, materials, name plate marking, inspection, testing and shipping of all Flow instruments along with their accessories.
- 1.2 The pressure instruments and its accessories shall be supplied in fully assembled condition.
- 1.3 In the event of any conflict between this standard specification, datasheet, statutory regulations, related codes, standards etc., the following order of priority shall govern:

1st priority	: Statutory Regulation requirement
2nd priority	: Process Licensor's documents
3rd priority	: Job Specifications & Job Drawings
4th priority	: Engineering Design Basis
5th priority	: Standard Specifications, standard Drawings & Engineering standards

Note: In case of any conflicts most stringent requirements shall be followed, however it shall be obligatory on the contractor's part to bring such conflicts to the notice of owner/PMC, wherein owner/PMC decision shall be final.

- 1.4 Individual pressure Instrument data sheets specify the material for wetted parts and flanges. Unless specifically indicated otherwise, alternate superior material of construction shall also be acceptable provided vendor assumes complete responsibility for the selected materials for their compatibility with the specified fluid and its operating conditions.

**1.5 PROJECT TITLE**

Project Name	:	EPCM/PMC Services for Acrylics/ Oxo-Alcohol Project at Gujarat Refinery and Dumad
Owner	:	Indian Oil Corporation Limited
Location	:	Dumad & Vadodara, Gujarat, India

## 2.0 CODES, STANDARDS AND REGULATIONS

Applicable national / international standards

Design and terminology shall comply, as a minimum, with the latest edition prior to the date of purchaser's enquiry of following codes, standard practices and publications:

### ASME

#### (American Society of Mechanical Engineers)

ASME B 1.20.1	Pipe Threads General Purpose (inch) (Year - 2013)
ASME B 16.5	Steel Pipe Flanges and Flanged Fittings (Year- 2017)
ANSI B 16.20	Ring Joint Gaskets and Grooves for Steel Pipe Flanges (Year- 2012)
ASME B 40.100	Pressure Gauges and gauge attachments (the latest)

### EN

#### European standards

10204	Inspection Documents for Metallic Products
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### IEC

#### (International Electro-Technical Commission.)

IEC 60079	Electrical apparatus for Explosive Gas atmosphere (Year -2017)
IEC 60079-1	Explosive atmosphere equipment protection by flameproof enclosure 'D' (Year -20014 & 2018)
IEC61000-4-3	Electromagnetic Compatibility-Part-4-3 Testing and measurement techniques - Radiated, radio-frequency, electromagnetic field immunity test (Year-2010).
IEC 60529	Degrees of Protection Provided by Enclosures (IP Code) - (Year- 2015)
IEC 61804	Function blocks (FB) for process control - Electronic Device Description (Year-2018).
IEC 61158	Digital data communications for measurement and control – Fieldbus specification
IEC 61508	Functional safety of Electrical/Electronic Programmable Electronic Safety, Related System (Year-2010)
IEC 61511	Functional safety: safety Instrumented systems for the Process Industry sector (Year-2017)
IEC 61518	Mating dimensions between differential pressure (type) measuring instruments and flanged-on shut-off devices up to 413 bar (41,3 MPa)

### IS

#### (Indian Standards)

IS-3624	Specification for Pressure and Vacuum gauges
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### ISA

#### (Instrument Society of America)

ISA 5.1	Instrument symbols and Identification (Year- 2009)
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#### Other standards:

NEC	National Electric code.
NEMA	National Electrical Manufacturer's Association
NFPA	National Fire Protection Association.
NFPA-496	Purged and pressurized enclosures for electrical equipment. (Year 2017)
OSHA	Occupational Safety and Health Authority.
IBR	Indian Boiler Regulations 1950 (Including Amendments in year 2017)

AG-181  
ITK

FOUNDATION™ Fieldbus System Engineering Guidelines  
Interoperability Test Kit (6.3.0 or the latest version)

Apart from above listed OISD, the latest standards applicable as on date of enquiry for Instrumentation of Packages like Turbine, Compressor, Diesel Engines and Fire protection system etc.

### 3.0 GENERAL DESIGN REQUIREMENTS

All pressure transmitters shall be intrinsically safe & SMART type with HART/ FF protocol with integral LCD indicator and be furnished with test terminals and bypass diode to facilitate field testing without disconnection of integral indicator. The transmitter electronics shall monitor their performance during normal operation. The transmitter diagnostics shall be able to detect both an input sensor failure and transmitter electronics failure. The sensor &/or electronics failure shall be transmitted to the host system (e.g. DCS / PLC). The stability shall be better than +/- 0.5% of upper range limit for 1 year. The transmitters shall have zero and range adjustable.

### 3.1 PRESSURE ELEMENTS

The design requirements for pressure elements shall be as follows:

- The pressure element shall be an elastic element like bourdon tube, bellow, diaphragm etc. with material as specified in the data sheet.
- In case of bourdon type of gauges, the size of the bourdon tube shall not be less than 75% of the nominal diameter of the dial size.
- The gauge socket shall be in one piece and shall also serve as element anchorage in case of bourdon tube type element, which shall be directly connected to the socket, without any capillary or tube in between. For other types of elements, the anchorage may be integral with the socket or connected with the socket using capillary tube with minimum bore of 3 millimeters.
- Any joint in the process wetted system including joint between the element and the anchorage/socket shall be welded type only.
- Unless specified otherwise, the pressure gauges shall have an over-range protection of at least 130% of maximum working pressure, as a minimum. Data sheet indicates the minimum requirement of material of construction.
- The gauge movement material shall be of stainless steel unless specified otherwise in the data sheet. It shall be adjustable for calibration without dismantling the sensor unit.
- Pressure gauges with range as 0 to 100kg/cm<sup>2</sup>g and above shall have safety type solid front case.
- All gauges in oxygen and chlorine service shall be thoroughly degreased using reagents like trichloro-ethylene or carbon tetrachloride. All connections shall be plugged after degreasing process to avoid entrance of grease or oil particles.

### 3.2 CASING AND DIAL

The design requirements for pressure casings and dials shall be as follows:

- The gauges shall be weather proof to IP 55 as per IS/IEC 60529.
- In general, dial markings and dial colour shall be as per IS 3624. Dials of gauges in oxygen service shall additionally have the word 'OXYGEN' or 'CHLORINE' written in black and 'USE NO OIL' written in red.
- The pointer stops shall be provided at both ends of the scale to restrict the pointer motion beyond 5% above the maximum of scale and less than 5% below the minimum of the scale.
- The dial cover shall be made from shatter proof glass sheet of thickness 1.5 to 3mm for gauges with dial size less than 100 mm while minimum 3.0mm for gauges with dial size 100 mm or greater.
- All gauges shall be provided with a blowout device i.e. blow out disc of aperture not less than 25mm for gauges with dial size 100 mm and above, while 20mm for gauges with dial size less than 100mm.
- When safety type solid front type of gauges is required, they shall consist of a solid

partition isolating the pressure element from the dial. In such gauges the total solid partition disc area shall not be less than 75% of the cross-sectional area of the inside of the case surrounding the pressure element.

- The bezel ring shall be Screwed or Bayonet type.
- The dials shall be colour coded in circular arc along with the pressure marking with clear visibility. The details of colour coding shall be as below:
  - 0-30% of Range : Yellow
  - 30-75% of Range : Green
  - 75-100% of Range : Red

### 3.3 DIAPHRAGMS

The general requirements for diaphragms shall be as follows:

- Unless otherwise indicated in purchaser's data sheets, gauges specified with diaphragm seals shall have their diaphragms integral with the gauges.
- Whenever diaphragm seal gauges are specified with capillary, the size of the capillary shall be selected to ensure response time of the gauge better than 5 seconds.
- The sealing liquid for diaphragm seal gauges shall be an inert liquid, compatible with the process fluid and its temperature. For gauges in oxygen and chlorine service, the sealing liquid shall be fluoro lube or equivalent compatible with the specified service.
- For diaphragm seal pressure gauges with flanged ends, the diaphragm shall be rated for the maximum allowable pressure of the associated flange.

### 3.4 END CONNECTIONS

Unless otherwise mentioned, end connection details shall be as below:

- a) Threaded end connections shall be to NPT as per ASME B 1.20.1.
- b) Flanged end connections shall be as per ASME B 16.5.
- c) RTJ flanges shall be with octagonal grooves as per ASME B 16.20
- d) When Flanges are Raised Face (RF) type, the face finish shall be as per ASME B16.5 and shall be
  - 125 AARH: 125 to 250 micro inch AARH
  - 63 AARH: 32 to 63 micro inch AARH

### 3.5 ELECTRONIC TRANSMITTERS

The general design, construction, terminal Housing and performance requirements for electronic transmitters shall be as follows:

- All instruments shall be of state-of-the-art technology and shall comply with the electromagnetic compatibility requirements specified in IEC-61000-4 standard.
- Plug-in circuit boards shall be designed and manufactured such that reverse insertion or insertion of the wrong card is prevented.
- Electronic instruments shall generally operate on nominal voltage of 24 VDC and shall be protected against short circuit and reverse voltage. Transmission and output signal shall generally be 4 to 20 mA DC for Analog and Smart transmitters.
- The display of integral output meter shall be in engineering units for pressure, differential pressure, flow & Temperature and 100% linear for level.
- Electronic transmitters with two-wire system shall be suitable for delivering rated current to an external loop resistance of at least 600ohm when powered with 24 V DC.
- Terminals for electrical connections shall be clearly identified, and polarity shall be permanently marked.

The minimum design requirements for Smart and Fieldbus transmitters shall be as below:

- Smart and fieldbus-based transmitters shall be two wire microprocessor-based type. These shall have a non-volatile memory, storing, complete sensor characterization and configuration data of the transmitter. All necessary signal conversions and output generation with the required protocol shall be carried out in the transmitter electronics. Integral output meter with LCD display shall be provided for all transmitters.
- Transmitter shall also run complete diagnostic subroutines and shall provide diagnostic alarm messages for sensor as well as transmitter healthiness. Fieldbus based transmitter in addition shall have facility to detect plugged impulse lines, whenever specifically indicated in purchaser's data sheets. In the event of detection failure, the output shall be driven to a predefined value, which shall be field configurable.
- The transmitters with field bus connectivity shall have built in control algorithm like proportional, proportional-integral and proportional-integral-differential.
- The meter electronics shall be provided with in-built lightning and power supply surges. The transient protection shall meet the requirements specified in IEC-61000-4.
- The configuration data of the instruments shall be stored in a non-volatile memory such that this remains unchanged because of power fluctuations or power off condition.
- The stability of the transmitters shall be equal to or better than +0.1% of span for a period of minimum 6 months, as a minimum.
- In the transmitter, the 'WRITE' option shall be protected through password.
- Following features must be ensured for Smart HART transmitters;
  - a) It shall allow multi masters (two for example, primary and secondary) for configuration, calibration, diagnostics and maintenance. The primary could be the control system or host computer and the secondary could be the hand-held communicator.
  - b) It shall be capable of implementing universal commands from either of these locations.

The exclusive design requirements for Fieldbus transmitters shall be as below:

In addition to the requirements mentioned elsewhere in the specification, fieldbus-based transmitter shall meet the following requirements;

- All instruments must satisfy the requirements of the field bus registration laboratory with applicable checkmark like foundation field bus, profibus NutZer organization e.g. (PNO), or as specified in the Data sheets.
- All instruments shall be polarity insensitive. Also, transmitter shall be LAS capable and provided with line plugging detection, whenever specified in data sheet.
- All instruments shall have one no. of Analog Input (AI) block and One no. of Proportional, Integration and Differential (PID) control block, as a minimum. All function blocks supplied with the device shall be instantiated by the device manufacturer. AI block execution time shall be better than 45ms and PID block execution time shall be better than 60msec.
- All instruments must be interoperable including maximizing of the associated advanced diagnostic features coupled to asset management capabilities within DCS System and shall have valid interoperability test clearance like ITK latest version for foundation field bus.
- The field bus instruments shall support peer to peer communication.
- The field bus instruments in hazardous area shall be certified as per entity concept or shall be FISCO approved as per the requirements specified in the purchaser's specification.
- All instruments shall support EDDL or FDT/DTM requirements, as specified in data sheets.

- Internal Software shall be configured by the vendor including the following information.
- Serial Number
  - Device Tag (TagNo.)
  - Process Description
  -
- All instruments shall be support incremental Device Descriptor (DD) for extra functionality and/or software revisions in Device Memory.



#### 4.0 DOCUMENTATION

Post Order Documents to be submitted by the bidder for review/ approval.

<b>DOCUMENTATION REQUIREMENTS</b>	<b>REVIEW / APPROVAL</b>
QUALITY ASSURANCE PLAN (QAP)	For Approval
PRODUCTION SCHEDULE	For Review
INSTRUMENT DATA SHEETS	For Approval
INSTRUMENT G.A. / INSTALLATION DRAWINGS	For Approval
Certified values of failure rates, probability of failure on demand (PFD) and test intervals for offered items for Safety Integrity Level (SIL) analysis	For Review
BILL OF MATERIALS INCLUDING SPARES	For Review

Note: Schedule of submission of the above documents shall be aligned to meet the delivery requirements.

Final documentation consisting of design data, installation manual, operation and maintenance manual etc., submitted by the vendor after placement of purchase order shall include the following, as a minimum;

- a) Specification sheet/ Data sheet for the applicable pressure instrument.
- b) As- built drawings for each pressure instruments, providing details(dimensional), constructional details, Weight and material of construction.
- c) Copy of test certificates for all the tests as per MR and Documents along with TPI IRN.
- d) Installation procedure for each electronic transmitter along with its accessories.
- e) Calibration, Configuration and Maintenance procedures
- f) Device Descriptor (DD) Files/EDDL file/DTM files for configuring the device parameters (Soft Copy)
- g) Common File Format (CFF) files for integrating the device into the system (Soft COPY).
- h) DD/ITK/CFF Revision number
- i) BOM including spares (if applicable)
- j) Product Catalogs of Main equipment and accessories/ bought outs.
- k) SIL data (As applicable)

Three hard copies in bound format and one soft copy in CD/ DVD of the above shall be submitted as final document.

## 5.0 NAME PLATE

Each pressure instrument and its accessories shall have a stainless-steel nameplate attached firmly to it at a visible place, furnishing the following information:

- a) Tag number as per data sheet.
- b) Manufacturers serial number and model number.
- c) Manufacturer's name/ trademark.
- d) Nominal end connection size and rating.
- e) MAWP and maximum vacuum rating of the element.
- f) Calibration/ Instrument range.
- g) Hazardous area certification of the instrument

## 6.0 SHIPPING

All threaded and flanged openings shall be suitably protected to prevent entry of foreign material.

Instrument shall be supplied individually, in suitably sealed packing.

Proper care shall be taken in shipping gauges with diaphragm seals to ensure safety of the diaphragm seals, extensions, capillaries, where specified.

The consignment shall be packed and suitably labelled clearly indicating the following as minimum:

- a) Project Name and Location
- b) PO Number
- c) Packing List inside consignment (indicating Main Equipment Tag no, Accessories and Spares as applicable)
- d) Vendor Name and location of dispatch



**DEPARTMENT:** INSTRUMENTATION  
**DOCUMENT NO:** 44AC9100-000-J.SS-0107-A4  
**DOCUMENT TITLE:** STANDARD SPECIFICATION FOR TEMPERATURE INSTRUMENT  
**ITEM:**  
**PROJECT NO:** 44AC9100  
**PROJECT LOCATION:** DUMAD/IOCL-JR, Gujarat  
**PROJECT TITLE:** EPCM/PMC SERVICES FOR ACRYLICS / OXO ALCOHOL PROJECT AT GUJARAT REFINERY AND DUMAD  
**CLIENT:** INDIAN OIL CORPORATION LIMITED  
**CLIENT PROJECT NO:**  
**CLIENT AUTHORIZATION:** MR. GAURAV DOLEY (DGM-PJ)  
**PM AUTHORIZATION:** MR. PAWAN GUPTA

				APPROVALS		
Rev. No.	Issue Date	Pages	Revision Description	Prepared	Checked	Approved
A	28-12-2018	15	ISSUED FOR BID	ARG	PV	PV
<input checked="" type="checkbox"/>	Entire Document Issued this Revision	DOCUMENT ISSUED FOR: (please ✓ as applicable)				
<input type="checkbox"/>	Revised Pages Only Issued this Revision	<input type="checkbox"/> In-house Review	<input type="checkbox"/> Purchase			
		<input type="checkbox"/> Client Approval	<input type="checkbox"/> Construction			
		<input type="checkbox"/> Design				

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**1.0 GENERAL**

- 1.1 This specification, together with the datasheets, MR and special requirements (If any) covers the general requirements for instrumentation design, materials, name plate marking, inspection, testing and shipping of all temperature instruments along with their accessories.
- 1.2 The All Temperature Instruments and its accessories shall be supplied in fully assembled condition.
- 1.3 In the event of any conflict between this standard specification, datasheet, statutory regulations, related codes, standards etc., the following order of priority shall govern:

1st priority	: Statutory Regulation requirement
2nd priority	: Process Licensor's documents
3rd priority	: Job Specifications & Job Drawings
4th priority	: Engineering Design Basis
5th priority	: Standard Specifications, standard Drawings & Engineering standards

Note: In case of any conflicts most stringent requirements shall be followed, however it shall be obligatory on the contractor's part to bring such conflicts to the notice of owner/PMC, wherein owner/PMC decision shall be final.

- 1.4 Individual temperature instrument data sheets specify the material for wetted parts and flanges. Unless specifically indicated otherwise, alternate superior material of construction shall also be acceptable provided vendor assumes complete responsibility for the selected materials for their compatibility with the specified fluid and its operating conditions.

**1.5 PROJECT TITLE**

Project Name	:	EPCM/PMC Services for Acrylics/ Oxo-Alcohol Project at Gujarat Refinery and Dumad
Owner	:	Indian Oil Corporation Limited
Location	:	Dumad & Vadodara, Gujarat, India

## 2.0 CODES, STANDARDS AND REGULATIONS

Applicable national / international standards Design, and terminology shall comply, as a minimum, with the latest edition prior to the date of purchaser's enquiry of following codes, standard practices and publications:

<b>ASME</b>	<b>(American Society of Mechanical Engineers)</b>
B 1.20.1	Pipe Threads General Purpose (inch) (Year - 2013)
B 16.5	Steel Pipe Flanges and Flanged Fittings (Year- 2017)
B 16.20	Ring Joint Gaskets and Grooves for Steel Pipe Flanges (Year- 2012)
B 40.200	Thermometers - Direct Reading and Remote Reading (latest edition)
D 2863	Test method for measuring the minimum oxygen concentration to support candle like combustion of plastics (oxygen index).
PTC 19.3	Performance Test Code-Temperature measurement (latest edition)
<b>API</b>	<b>American Petroleum Institute</b>
RP 551	Process Measurement Instrumentation.
<b>BS</b>	<b>British standards</b>
5308 Part II	Specification for PVC insulated cables.
<b>EN</b>	<b>European standards</b>
10204	Inspection Documents for Metallic Products
<b>IEC</b>	<b>(International Electro-Technical Commission.)</b>
IEC 60079	Electrical apparatus for Explosive Gas atmosphere (Year -2017)
IEC 60079-1	Explosive atmosphere equipment protection by flameproof enclosure 'D' (Year -20014 & 2018)
IEC 60332	Tests on bunched wires and cables
IEC61000-4-3	Electromagnetic Compatibility-Part-4-3 Testing and measurement techniques - Radiated, radio-frequency, electromagnetic field immunity test (Year-2010).
IEC61000-4-4	Testing and Measurement techniques – Electrical Fast Transient/burst Immunity Tests
IEC61000-4-5	Testing and Measurement techniques – Surge Immunity
IEC 60529	Degrees of Protection Provided by Enclosures (IP Code) - (Year- 2015)
IEC 60584-2	Thermocouple Tolerances (Latest edition)
IEC 60584-3	Extension and compensating cables - Tolerances and identification system
IEC 60751	Industrial Platinum Resistance Thermometer Sensor.
SAMA	Scientific Apparatus Maker's Association
<b>IS</b>	<b>Indian standards</b>
IS 7358	Specifications for Thermocouples.
1554 Part I	PVC insulated (heavy duty) electric cables-working voltage up to and including 1100V
3975	Mild steel wires, formed wires and tapes for armouring of cables
5831	PVC insulation and sheath of electric cables.
10810	Method of test for cables.

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8784	Thermocouple Extension and compensating cables.
Part 40	Method for testing uniformity of coating on zinc coated articles.
Part 41	Mass of zinc coating on steel armour
Part 58	Oxygen Index test
Part 61	Flame Retardant test
Part 62	Flame Retardance test for bunched cables

**Other standards:**

NEC	National Electric code.
NEMA	National Electrical Manufacturer's Association
NFPA	National Fire Protection Association.
NFPA-496	Purged and pressurized enclosures for electrical equipment. (Year 2017)
OSHA	Occupational Safety and Health Authority.
IBR	Indian Boiler Regulations 1950 (Including Amendments in year 2017)
AG-181	FOUNDATION™ Fieldbus System Engineering Guidelines
ITK	Interoperability Test Kit (6.3.0 or the latest version)

Apart from above listed OISD, the latest standards applicable as on date of enquiry for Instrumentation of Packages like Turbine, Compressor, Diesel Engines and Fire protection system etc.



### 3.0 GENERAL DESIGN REQUIREMENTS

All Temperature transmitters shall be intrinsically safe & SMART type with HART/ FF protocol with integral LCD indicator and be furnished with test terminals and bypass diode to facilitate field testing without disconnection of integral indicator. The transmitter electronics shall monitor their performance during normal operation. The transmitter diagnostics shall be able to detect both an input sensor failure and transmitter electronics failure. The sensor &/or electronics failure shall be transmitted to the host system (e.g. DCS / PLC). The transmitters shall have zero and range adjustable.

### 3.1 TEMPERATURE GAUGES

The general design requirements for various temperature gauges shall be as follows:

- Gauge Temperature gauges shall be of the separate socket type suitable for well installation. Upon assembly of components, the temperature gauge element shall firmly contact the bottom of the well. The gauge stem shall fit the well so that maximum heat-transfer rate results.
- Unless otherwise specified, the temperature gauges shall be of bimetallic type.
- Whenever filled system type temperature gauges are specified, the following SAMA Classifications shall be referred:

SAMA Class	Filling Fluid
I	Liquid
II	Vapour
III	Gas

Mercury filled type of temperature gauges shall not be offered.

- Vendor shall ensure that the operating temperature falls in 30% to 60% of the offered range.
- Unless otherwise specified, the temperature gauges shall have an over range protection of at least 130% of specified range or maximum working temperature, whichever is higher.
- Whenever temperature gauges are specified with capillary extension for remote installation, the capillary shall be of 304 Stainless Steel protected by stainless steel flexible armour. Preferred lengths are 3m (minimum) to 10m (maximum).
- The Gauge movement material shall be of stainless steel, as a minimum, unless specified otherwise in the data sheet. It shall be adjustable for calibration without dismantling the sensor unit.
- Unless otherwise specified, the accuracy of temperature gauge shall be +/- 1 % of set range, which is inclusive of repeatability and hysteresis.

Design requirements for Casing and Dials shall be as follows:

- Unless specified otherwise, the case of bimetallic type of gauges shall be all angles rotatable type, 130 mm diameter.
- Unless specified otherwise, the gauges shall be weatherproof to IP55 as per IS/IEC 60529 as a minimum.
- The gauge dial shall be made of a suitable metallic material so that the finished dial can withstand a dry heat of 85°C for 10 hours and immersion in water at 85°C for 1 hour without cracking, blistering, warping or discoloration of the dial or paint on the dial.
- The pointer stops shall be provided at both ends of the scale to restrict the pointer motion beyond 5% above the maximum scale and less than 5% below the minimum of the scale.
- The dial cover shall be made from shatter proof glass sheet of thickness of minimum 3 mm.

- In general, dial markings and dial colour shall be as per IS 3624.
- The dials shall be colour coded in circular arc along with the temperature marking with clear visibility. The details of colour coding shall be as below:
  - a) 0-30% of Range : Yellow
  - b) 30-75% of Range : Green
  - c) 75-100% of Range : Red

### 3.2 THERMOCOUPLE

The general design requirements for thermocouples shall be as follows:

- The type of thermocouple shall be ISA- K Type, unless otherwise mentioned in datasheets. The thermocouple element shall be 18 AWG for all thermocouples, unless otherwise specified in purchaser's data sheet.
- Thermocouple assemblies shall be furnished with threaded heads.
- Unless otherwise specified, the assembly shall conform to the following standards:
  - a) The heads shall be weatherproof to IP 65 as per IS/IEC-60529
  - b) In case of flameproof construction, heads shall be flame proof as per IS/IEC-60079 and weather proof to IP 65 as per IS/IEC-60529.
- The heads shall consist of a case, screwed on cover and terminal block. The thermocouple shall be screwed to the terminal block. Separate screw shall be provided on the terminal block for terminating the extension / compensating cables. There shall be an extra terminal in the terminal block connected to the head for grounding the shield.
- The case shall be suitable for mounting terminal blocks for single or duplex type thermocouple element assemblies. Duplex element sensors, if used, shall have two separate cable entries and shall be plugged with SS plugs only.
- A heat resistant and moisture proof gasket shall be fitted between the case and cover. Head support chain (between case and cover) material shall be stainless steel.
- The terminals shall be permanently and legibly identified for their polarity. The terminal block shall be permanently and legibly marked with the IEC letter code to designate the type of thermocouple. There shall be an extra terminal connected to the head for grounding.
- The thermocouple assemblies shall be spring loaded.
- The thermocouple properties and limits of error shall be as per IEC-60584-2.
- Thermocouple shall be 316 Stainless Steel sheathed magnesium oxide insulated, ungrounded type, unless otherwise specified.
- The design of thermocouple assemblies shall be such that on-line replacement is possible.

### 3.3 RESISTANCE TEMPERATURE DETECTORS (RTD)

Design requirements for RTDs shall be as follows:

- Gauge glasses shall be of the mechanical and thermal shock resistant type. Glass material shall be toughened borosilicate, for all types of gauges.
- The type of RTD shall be 3 wire type with platinum element having 100 ohms resistance at 0°C, unless otherwise mentioned in Data sheet.
- RTD shall be the element shall be of highly refined material of reference grade and shall have been stress relieved. RTD calibration shall be as per IEC-60751.

- The wire shall be wound on a ceramic core and immobilized against strain or damage. The winding shall be of bifilar type. The leads shall be copper up to terminal block.
- The element shall be within a metal sheath, in a manner which provides good thermal transfer and protection against moisture. The sheath material shall be 316 Stainless Steel, unless otherwise specified.
- The RTD assemblies shall be furnished with threaded heads. The heads shall consist of a case, screwed on cover and terminal block. The RTD shall be screwed to the terminal block. Separate screw shall be provided on the terminal block for terminating the incoming cable. There shall be an extra terminal in the terminal block connected to the head for grounding the shield.
- The case shall be suitable for mounting terminal blocks for single or duplex type RTD element assemblies. The connecting terminals shall be properly numbered and shall be permanently and legibly identified.
- The RTD assemblies shall be spring loaded.
- A heat resistant and moisture proof gasket shall be fitted between the case and cover. The head support chain (between case and cover) shall be of stainless steel.
- Unless otherwise specified, the assembly shall confirm to the following standards:
  - a) The heads shall be weatherproof to IP 65 as per IS/IEC-60529
  - b) In case of flameproof construction, heads shall be flame proof as per IS/IEC-60079 and weather proof to IP 65 as per IS/IEC-60529.

### 3.4 THERMOCOUPLE EXTENSION CABLES

The minimum constructional requirements for thermocouple extension cables shall be as follows:

- Vendor shall select the probe length and diameter based on the application and process parameters. The type and material of construction of temperature instrument shall be as specified in the datasheet.
- Type and material of extension cable core shall be as per IS 8784 and IEC 60584-3 as applicable.
- Primary insulation for PVC insulated cables, shall be 85°C polyvinyl chloride Type C as per IS583 1. Thickness of primary insulation shall be 0.5 mm as a minimum.
- Unless specified otherwise, insulation, inner sheath and outer sheath colour shall be as per IEC60584. However, it is vendor's responsibility to re-confirm insulation and sheath colour with purchaser prior to manufacturing. The thickness of the sheath shall be as per IS 1554 part 1.
- Inner and outer sheath of cable shall be flame retardant made of extruded PVC Type ST2 (90°C) as per IS 583 1 and shall meet the following requirements:
  - a) Minimum Oxygen index of PVC shall be 30 at 27 deg C +/- 2 deg C.
  - b) Temperature index shall be over 250 deg C.
  - c) Inner and Outer sheath shall meet flame retardant requirements for bunched cables as per IS 108 10 (Part 62) category AF or IEC 60332 category A.
  - d) A rip cord shall be provided for inner sheath.
  - e) Outer sheath shall be suitable for protecting the cable against rodent and termite attack.
- Armour over inner sheath shall be of galvanised steel wire/flat. The dimensions of armour shall be as per IS 1554 (Part 1). Requirement and methods of tests for armour material and uniformity of galvanisation shall be as per IS 3975 and IS 10810 (Part 40) respectively.
- Each pair shall be shielded. Shield shall be of aluminium backed by mylar / polyester tape bonded together helically applied with metallic side down having 25% overlap on either side and 100% coverage. Minimum shield thickness shall be 0.05 mm. Drain wire shall be 0.5 mm<sup>2</sup> multi-strand bare tinned annealed copper conductor. The drain wire shall be in

continuous contact with aluminium side of the shield.

- The cores of a pair shall be twisted with a minimum of 10 twists per metre of cable.
- Sequential marking of the length of the cable in meters shall be provided on the outer sheath at every one meter. The embossing /engraving shall be legible and indelible.
- Tolerance in overall diameter of cable shall be within +/- 2 mm over offered value.

#### Drum length and length Tolerance

The length of the cables in each drum (drum length) shall be as specified in the purchaser's data sheets. Where no drum length is indicated in the data sheet /material requisition, the following shall be apply:

- a) Drum length for single pair cable: 500 metres
  - b) Drum length for multi-pair cable: 1000 metres.
- Actual produced drum length shall not vary by more than +/- 5% from drum length.
  - Tolerance over the total ordered length for a type of cable shall be as follows;
    - a) +/- 5% for total length less than 5 km.
    - b) +/- 2% for total length more than 5 km

#### Electrical Characteristics

- Thermoelectric specifications and limits of error shall be as per IEC 60584-3.
- Mutual capacitance of the pairs or adjacent cores shall not exceed 250 pF / m at a frequency of 1 KHz.
- Capacitance shall not exceed 400 pF / m between any core and screen at a frequency of 1 KHz.
- Core inductance shall not exceed 4 mH / km
- The drain wire resistance including shield shall not exceed 30 ohm / km
- Electrostatic noise rejection ratio shall be over 76 dBA.

#### Type I (Single pair/Triad shielded)

- Each core shall be made of 16 AWG solid conductor.
- Other requirements of this specification shall be complied.

#### Type-II (Multi-pair/ Multi-triad cable with individual pair/triad shield and overall shield)

- Each core shall be made of 20 AWG solid conductor.
- Overall twist of all pair shall be as per vendor's standard.
- In addition to individual pair shield overall shield shall be provided. Overall shield shall be of aluminium backed up by mylar/polyester tape helically applied with metallic side down either side 25% overlap and 100% coverage. Minimum shield thickness shall be 0.075 mm. Drain wire shall be similar to individual pair drain wire and shall be in continuous contact with the aluminium side of the overall shield.
- A pair of communication wire shall be provided for multipair cables. Each wire shall be 0.5 mm<sup>2</sup> of plain annealed single or multi-strand copper conductor with 0.4 mm thick 85°C PVC insulation. Insulation shall be green and red colour coded.
- A pair identification shall be with numbers at interval of not more than 250 mm. Other requirements of this specification shall be complied.

Type-III (Multi-pair/ Multi-triad cable with individual pair/triad shield and overall shield)

- The cable shall be same as type-II cable, except conductor size shall be 16 AWG.

### 3.5 HEATER TUBE SKIN THERMOCOUPLES

The minimum design requirements for heater tube skin thermocouple shall be as follows:

- The type of heater tube skin thermocouple assembly shall be either welded type or extraction type. The type of assembly shall be offered as specified in Material requisition/datasheet.
- Each heater tube skin thermocouple shall be supplied as a complete assembly consisting of:
  - a) Magnesium oxide insulated sheathed thermocouple element with stainless steel compression fitting and terminal head. The total length of the thermocouple shall be determined by the vendor based on data sheets and Material requisition.
  - b) Retaining clips required for each assembly as per the quantity indicated in the datasheets or as recommended in installation drawings.
  - c) Welding rods of suitable material required for welding of offered skin thermocouple sheath to the heater tube.
  - d) Any other item, not specifically indicated, but required to make installation of heater tube skin thermocouples complete.

#### Element:

Unless specified otherwise, the thermocouple element shall meet the following requirements:

- a) The thermocouple element shall be type "K" as per ISA/IS-7358 or IEC 60584. The thermocouple properties and limits of error shall be as per IEC 60584-2.
- b) The element wire diameter shall correspond to 16 AWG as a minimum.

#### Sheath:

Unless specified otherwise, the thermocouple sheath shall meet the following requirements:

- c) The sheath material shall be AISI type 446 Stainless Steel.
- d) The outside diameter of the sheath shall be 6mm and 9.5mm (minimum) and the sheath wall thickness shall be minimum 1.0mm and 2.2mm for pad type Simplex and Duplex thermocouples respectively. The outside diameter of the sheath shall be 12.7 mm and the sheath wall thickness shall be minimum 3.18 mm for knife edge type.

#### Sensing Section:

- The sensing section shall be either pad type or knife-edge type. Vendor shall supply the type of element as specified in the purchaser's data sheet.
- The extreme end of the sheath (in the direction opposite to the terminal head) shall be formed to achieve a 'Wedge' shape/pad shape in the lower half section. This formed section shall extend to a length of 50mm.
- The thermocouple junction shall be grounded and shall be in the middle of this formed section. The junction shall be located at the tip of the wedge/pad.

- The formed section shall be straight or curved to suit the heater tube outer diameter as per the data sheets.
- The formed section shall be welded to the heater tube on the circumferential periphery for obtaining the skin temperature of the tube, as per manufacturer's recommendation.
- Protection shield shall be provided to cover the thermocouple at heater tube side.
- The weld pad and the protective shield shall have a minimum thickness of 5mm and shall be of AISI type 446 Stainless Steel.
- When specified design requires extraction of temperature element, it shall meet the following requirements:
  - a) The sensing element is designed to fit into a pad, which is welded to the heater tube.
  - b) The element, if required, can be pulled out of welded pad and can be reinserted.
  - c) The protection shield shall be welded from three sides.

### Retaining Clips

Unless otherwise specified, retaining clips shall meet the following requirements:

- a) Retaining clips shall be 63 mm long, 12 mm wide and 3 mm thick. These shall be used for holding thermocouple sheath to the heater tube.
- b) The material of retaining clips shall be AISI type 446 Stainless Steel.

### Terminal Head

- The terminal head shall consist of a cast aluminium case, screwed on cover and terminal block. The terminals shall be clearly identified for their polarity.
- The terminal block shall be clearly marked with the IS/IEC calibration letters to designate the type of thermocouple. An extra terminal shall be provided and connected to the head for grounding the shield.
- The thermocouple sheath shall be fixed to the terminal head by a stainless-steel compression fitting. The cover shall be fastened to the case by a stainless-steel chain with a swivel. It shall be provided with a screwdriver slot. A heat resistant and moisture proof gasket shall be placed between the case and the cover.
- Unless otherwise specified, the assembly shall conform to the following standards:
  - a) The heads shall be weatherproof to IP 65 as per IS/IEC-60529
  - b) In case of flameproof construction, heads shall be flame proof as per IS/IEC-60079 and weather proof to IP 65 as per IS/IEC-60529.

## 3.6 THERMOWELLS

Vendor shall carryout the vibration analysis of the thermo-wells as per ASME PTC 19.3 TW 2010 or the latest standard. The thermowell shall be supplied with collars wherever required as per wake frequency calculations. The wake frequency calculations shall be reviewed as a part of vendor document review & actual requirement of collar shall be indicated on vendor drawing.

The minimum design requirements for thermowells shall be as follows:

- Unless otherwise specified, the thermowell material shall be 316 Stainless Steel, as a minimum.
- Thermowells with immersion length up to 500mm shall be mechanized out of forged barstock.

- Built-up thermowell with welded well construction shall be considered for immersion length of greater than 500mm, unless specified otherwise in the datasheet.
- All thermowell weld joints shall be full penetration weld type only.
- Thermowell immersion length shall be as specified in data sheets. Where immersion length is not specified in the purchaser's data sheet, following shall govern;

Line Size	Immersion Length
Up to 6"	280 mm
8" and above	320 mm
Equipment's	400 mm

### End Connections

Unless otherwise mentioned, end connection details shall be as below:

- a) Threaded end connections shall be to NPT as per ASME B 1.20.1.
- b) Flanged end connections shall be as per ASME B 16.5.
- c) RTJ flanges shall be with octagonal Grooves as per ASME B 16.20
- d) When Flanges are Raised Face (RF) type, the face finish shall be as per ASME B16.5 and shall be:  
125 RH: 125 to 250 micro inch AARH  
63 AARH: 32 to 63 micro inch AARH



#### 4.0 DOCUMENTATION

Post Order Documents to be submitted by the bidder for review/ approval.

<b>DOCUMENTATION REQUIREMENTS</b>	<b>REVIEW / APPROVAL</b>
QUALITY ASSURANCE PLAN (QAP)	For Approval
PRODUCTION SCHEDULE	For Review
INSTRUMENT DATA SHEETS	For Approval
INSTRUMENT G.A. / INSTALLATION DRAWINGS	For Approval
CERTIFIED VALUES OF FAILURE RATES, PROBABILITY OF FAILURE ON DEMAND (PFD) AND TEST INTERVALS FOR OFFERED ITEMS FOR SAFETY INTEGRITY TEMPERATURE (SIL) ANALYSIS	For Review
BILL OF MATERIALS INCLUDING SPARES	For Review

Note: Schedule of submission of the above documents shall be aligned to meet the delivery requirements.

Final documentation consisting of design data, installation manual, operation and maintenance manual etc., submitted by the vendor after placement of purchase order shall include the following, as a minimum;

- a) Specification sheet/ Data sheet/ Sizing Sheet (TW) for each Temperature Instrument with accessories.
- b) As built drawings for each Temperature Instrument with accessories, providing dimensional details, constructional details, connection details and material of construction.
- c) Copy of test certificates for all the tests as per MR and Documents along with TPI/ IRN.
- d) Installation procedure for each thermowells.
- e) Calibration, Configuration and Maintenance procedures
- f) Device Descriptor (DD) Files/EDDL file/DTM files for configuring the device parameters (Soft Copy)
- g) Common File Format (CFF) files for integrating the device into the system (Soft Copy).
- h) DD/ITK/CFF Revision number
- i) BOM including spares (if applicable)
- j) SIL data
- k) Product Catalogs of Main equipment and accessories/ bought-outs

Three hard copies in bound format and one soft copy in CD/ DVD of the above shall be submitted as final document.





## 5.0 NAME PLATE

Each temperature instrument and its accessories shall have a stainless-steel nameplate attached firmly to it at a visible place, furnishing the following information:

- a) Tag number as per data sheet.
- b) Manufacturers serial number and model number.
- c) Manufacturer's name/ trademark.
- d) Thermocouple type/RTD element type.
- e) Grounded or Ungrounded
- f) Nominal end connection size and rating.
- g) Thermowell and Flange material
- h) Thermowell immersion length 'U'
- i) Range of instrument and units of measurement
- j) Area classification for which the instrument is certified for installation.

## 6.0 SHIPPING

All threaded and flanged openings shall be suitably protected to prevent entry of foreign material.

The instrument shall be supplied individually, in suitably sealed packing.

Proper care shall be taken in shipping the instruments to avoid damage.

The consignment shall be packed and suitably labelled clearly indicating the following as minimum:

- a) Project Name and Location
- b) PO Number
- c) Packing List inside consignment (indicating Main Equipment Tag nos, Accessories and Spares as applicable)
- d) Vendor Name and location of dispatch
- e)



**DEPARTMENT:** INSTRUMENTATION  
**DOCUMENT NO:** 44AC9100-000-J.SS-0108-A4  
**DOCUMENT TITLE:** STANDARD SPECIFICATION FOR CONTROL VALVES  
**ITEM:**  
**PROJECT NO:** 44AC9100  
**PROJECT LOCATION:** DUMAD/IOCL-JR, Gujarat  
**PROJECT TITLE:** EPCM/PMC SERVICES FOR ACRYLICS / OXO ALCOHOL PROJECT AT GUJARAT REFINERY AND DUMAD  
**CLIENT:** INDIAN OIL CORPORATION LIMITED  
**CLIENT PROJECT NO:**  
**CLIENT AUTHORIZATION:** MR. GAURAV DOLEY (DGM-PJ)  
**PM AUTHORIZATION:** MR. PAWAN GUPTA

				APPROVALS		
Rev. No.	Issue Date	Pages	Revision Description	Prepared	Checked	Approved
A	26-12-2018	20	ISSUED FOR BID	ARG	PV	PV
<input checked="" type="checkbox"/>	Entire Document Issued this Revision		DOCUMENT ISSUED FOR: (please ✓ as applicable)			
<input type="checkbox"/>	Revised Pages Only Issued this Revision		<input type="checkbox"/> In-house Review	<input type="checkbox"/> Purchase		
			<input type="checkbox"/> Client Approval	<input type="checkbox"/> Construction		
			<input type="checkbox"/> Design			

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**1.0 GENERAL**

1.1 This specification, together with the datasheets, MR and special requirements (If any) covers the general requirements for instrumentation design, materials, name plate marking, inspection, testing and shipping of all Control valves along with their accessories.

1.2 The control valves and its accessories shall be supplied in fully assembled condition.

1.3 In the event of any conflict between this standard specification, datasheet, statutory regulations, related codes, standards etc., the following order of priority shall govern:

1st priority	: Statutory Regulation requirement
2nd priority	: Process Licensor's documents
3rd priority	: Job Specifications & Job Drawings
4th priority	: Engineering Design Basis
5th priority	: Standard Specifications, standard Drawings & Engineering standards

Note: In case of any conflicts most stringent requirements shall be followed, however it shall be obligatory on the contractor's part to bring such conflicts to the notice of Owner / PMC, wherein Owner / PMC decision shall be final.

1.4 Individual control valve data sheets specify the material for wetted parts and flanges. Unless specifically indicated otherwise, alternate superior material of construction shall also be acceptable provided vendor assumes complete responsibility for the selected materials for their compatibility with the specified fluid and its operating conditions.

**1.5 PROJECT TITLE**

Project Name	:	EPCM/PMC Services for Acrylics/ Oxo-Alcohol Project at Gujarat Refinery and Dumad
Owner	:	Indian Oil Corporation Limited
Location	:	Dumad & Vadodara, Gujarat, India

## 2.0 CODES, STANDARDS AND REGULATIONS

Applicable national / international standards

Design and terminology shall comply, as a minimum, with the latest edition prior to the date of purchaser's enquiry of following codes, standard practices and publications:

<b>ASME</b>	<b>(American Society of Mechanical Engineers)</b>
ASME B 1.20.1	Pipe Threads General Purpose (inch) (Year - 2013)
ASME B 16.5	Steel Pipe Flanges and Flanged Fittings (Year- 2017)
ANSI B 16.20	Ring Joint Gaskets and Grooves for Steel Pipe Flanges (Year- 2012)
ASME B 16.34	Valves- Flanged, Threaded & Welding End (Year- 2017)
ANSI B 16.47	Large Diameter Steel Flanges (NPS 26 thru NPE 60) (Year 2017)
<b>ANSI / FCI</b>	<b>American National Standard Institute/Fluid Control Institute</b>
ANSI FCI 70-2	Control Valve Seat Leakage
<b>API</b>	<b>(American Petroleum Institute)</b>
API 6D	Pipelines valves (Gate valve, Plug, Ball and Check valves)
API 598	Inspection Requirements
API 609	Lug and wafer type, Butterfly valves
<b>AWWA</b>	<b>American Water Works Association</b>
C207 CL. D	Steel Pipe Flanges for Water work services
<b>BS</b>	<b>British Standards</b>
BS 6364	Valves in cryogenic service European Standards
<b>EN</b>	<b>European standards</b>
10204	Inspection Documents for Metallic Products
61056-1	Specification for performance, design and construction of valve,
regulated sealed	type.
<b>IS / IEC</b>	<b>Indian Standards / International Electro-Technical Commission.</b>
IS / IEC 60079	Electrical apparatus for Explosive Gas atmosphere (Year -2017)
IEC 60079-1	Explosive atmosphere equipment protection by flameproof enclosure 'D' (Year -20014 & 2018)
IEC 61000-4-3	Electromagnetic Compatibility-Part-4-3 Testing and measurement techniques - Radiated, radio-frequency, electromagnetic field immunity test (Year-2010).
IEC 61000-4-4	Testing and Measurement techniques – Electrical Fast Transient/burst Immunity Tests
IEC 61000-4-5	Testing and Measurement techniques – Surge Immunity
IEC 61508	Functional safety of Electrical/Electronic Programmable Electronic Safety Related System (Year-2010)
IEC 61511	Functional safety: safety Instrumented systems for the Process Industry sector (Year-2017)

IEC 61158	Digital data communications for measurement and control –. Fieldbus specification.
IS/IEC 60529	Degrees of Protection Provided by Enclosures (IP Code) - (Year- 2015)
IEC 61804	Function blocks (FB) for process control - Electronic Device Description (Year-2018).
IEC 60534-3-2	Face to Face dimension of rotary valves except butterfly valves.
IEC 60534-4	Seat leakage
IEC 60534-8.3	Industrial process control valves, noise consideration, control valve Aerodynamic noise prediction method
IEC 60534-8.4	Industrial process control valves, noise consideration, prediction of noise generated by hydrodynamic flow
FF 890/1/2/3/4	Function Block Application Process Part 1/ Part 2/ Part 3/ Part 4/ Part 5.

## ISA

### (Instrument Society of America)

ISA 75.01.01	Flow equation for sizing control valves.
ISA 75.02	Control valve capacity test procedure.
ISA 75.04	Control Valve positioner stability
ISA 75.05.01	Control Valve terminology
ISA 75.07	Laboratory measurement of aerodynamic noise generated by control valves
ISA 75.08.01	Face to face dimensions for integral flanged Globe-style control valve Bodies ASME Class 125,150,300 and 600)
ISA 75.11.01	Inherent flow characteristic and Rangeability of control valves.
ISA 75.19.01	Hydrostatic testing of control valves.
ISA 75.22	Face to centre-line dimensions for flanged Globe-style Angle control valve bodies (ASME Class 150,300 and 600)
ISA 75.25.01	Test Procedure for Control valve response measurement for step inputs
TR75.25.02	Control valve response measurement for step inputs
ISA 75.25.13	Method of evaluating the performance of positioners with analog input signals and pneumatic output.
ISA 75.17	Control valve aerodynamic noise prediction.
RP75.23	Considerations for evaluating control valve Cavitation

### Other standards:

NEC	National Electric code.
NEMA	National Electrical Manufacturer's Association
NFPA	National Fire Protection Association.
NACE MR-0103	Materials Resistant to Sulphide stress cracking in Corrosive Petroleum. Refinery Environments.
OSHA	Occupational Safety and Health Authority.
MPMS	Manual of Petroleum measurement standards.
IBR	Indian Boiler Regulations 1950 (Including Amendments in year 2017)
AG-181	FOUNDATION™ Fieldbus System Engineering Guidelines
ITK	Interoperability Test Kit (6.3.0 or the latest version)
MSS SP 25	Standard Markings System for Valves, Fittings, Flanges and Unions

Apart from above listed OISD, the latest standards applicable as on date of enquiry for Instrumentation of Packages like Turbine, Compressor, Diesel Engines and Fire protection system etc.



### 3.0 DESIGN REQUIREMENTS

#### 3.1 GENERAL REQUIREMENTS FOR CONTROL VALVE

- Vendor shall be responsible for selecting their standard valve flow coefficient suitable for the specified service and process conditions specified in the Data sheets.
- Vendor shall be responsible for checking for cavitation, flashing and noise generated and to provide suitable trim and treatment to limit these within appropriate limits.
- Vendor must furnish certified values of failure rates, probability of failure on demand (PFD) and test intervals for the safety integrity level (SIL) analysis wherever specified.
- Vendor shall furnish sizing calculation for each tag number clearly highlighting the standard used for calculation, noise level, Cavitation or flashing, Cv selected, percentage opening at minimum, normal and maximum flow, inlet and outlet velocity etc.
- Catalogues giving detailed technical specifications, model decoding details and other information for each type of control valve and accessories covered in the bid. For fieldbus positioners, information shall include, but not limited to, product certification, power supply, current drawn, Standard/Advanced/Enhanced function blocks available and the execution time for each block, device type, number of link objects, Virtual Communication Relationships, Basic and advanced diagnostic features, failure mode etc.
- Self-actuating regulators for flow, pressure and temperature shall be used where loads are constant, and requirements of precision and accurate controls are not stringent.
- For valves in cryogenic service, vendor shall meet the following acceptance criteria:
  1. Vendor shall furnish, along with the offer, type test certificate, duly witnessed by Third Party Inspection agency like MIS LRIS, DNV BV, TUV, CEIL etc. of having successfully conducted the cryogenic test as per BS 6364 on the offered valves (same model, size, rating and material) in cryogenic service. Further vendor to note the following:
    - a) Test temperature shall be -45°C for LTCS and -196°C for all grades of austenitic Stainless Steel.
    - b) 63 Test carried out on a particular size of one type of valve, pressure rating and material shall qualify all sizes equal to and below the test valve size for the same type, pressure rating and material. In case of austenitic Stainless Steel any one grade would qualify for other grades of austenitic Stainless Steel.
  2. In case vendor does not have cryogenic type test certificate for the offered valves as mentioned above, vendor shall confirm to conduct the cryogenic test on the offered valves and furnish type test report meeting requirements specified above.

#### 3.2 CONTROL VALVE BODY

- Control valves shall have flanged end connections integral to the valve body. Split body type valve design shall not be offered unless specifically indicated in the Data sheets. Whenever flangeless control valve body design is specified in the Data sheet, following shall apply:
  - a) Wafer type or lug type body design for control valves body size up to 6 inches.
  - b) Lug type body design for butterfly type of control valve body size more than 6 inches.

- The valve body rating should be equal to or higher than the flange rating specified in the data sheets. As a minimum, control valve body shall be rated for ASME Class 300. However, end connection shall be as specified in Data sheet.
- The control valves shall be suitable for installation in horizontal as well as in vertical lines. For all applications, where full port valves are specified, following shall apply:
  - a) Port size shall be equal to line size for rating up to ASME Class 1500.
  - b) Port size shall not be smaller than one size lower than that of the line size for body rating ASME Class 1500 and above.

### 3.2.1 Flow Direction:

- In general, flow direction shall be as below:
  - a) Flow tending to open for single seated unbalanced valve design.
  - b) Flow entering between the seats for double seated valves.
  - c) Flow entering at the side and leaving at the bottom for angle valves.
- For valves design other than those specified above, flow direction shall be as per manufacturer standard.
- Flow direction shall be clearly marked on the control valve body.
- For 3-way control valves, service like mixing or diverting, shall be clearly identified with inlet and outlet end connection clearly marked on the control valve body.

### 3.2.2 Material of Construction

- a) The material of construction of control valves shall be as specified in the data sheet.
- b) Control valve body, bonnet, flanges and other pressure containing assemblies shall be of the same material of construction as specified for valve body in the data sheets.
- c) The bonnet flange and bottom flange shall have metallic spiral wound gaskets suitable for the specified service.
- d) Vendor shall be responsible for selecting proper material for the internal parts of control valve. All such materials shall have the same or better specification than specified in the data sheets.
- e) The material of construction of silencers, diffuser plates, diffuser plate assembly etc shall be as per the body material specified in the data sheets, as a minimum.

## 3.3 CONTROL VALVE TRIM

- The term 'trim' covers those parts of valve assembly (excluding the body, bonnet and bottom flange) which are exposed to and are in contact with the line medium consisting of but not limited to the seat ring, valve stem, valve plug, valve plug guide, guide bushing and cage. In case of rotary type of control valves like butterfly, ball, segmental ball, rotary plug, eccentric disc and rotary disc, the term trim covers disc/ball, seat ring, shaft and bearing.

### 3.3.1 Guiding:

- a) Single seated globe (unbalanced) and angle type control valves shall have heavy top plug guiding. Stem guided control valve design shall not be acceptable unless specifically indicated in datasheets.
- b) Single seated globe (balanced) control valves shall be of cage guided design. The cage shall provide a continuous plug guiding.

- c) Double seated valves shall have top and bottom or cage guiding and shall be of the pressure balanced type.
- d) Whenever cage type control valves are specified, top guided or top and bottom guided control valves can be offered provided it meets all other process and functional requirements. But whenever top or top and bottom type of guiding is specified, cage type control valves shall not be offered.
- e) 3-way control valves of either diverting or mixing type shall have top guiding.
- f) Rotary control valves like butterfly, segmental ball, eccentric rotary plug etc. shall have blowout proof shaft guiding design.
- g) Guide bushings shall be of a sufficiently hard material to resist side thrust on the plug.

### 3.3.2 Trim Design:

- Control valve manufacturer/vendor shall be responsible for trim selection and trim design of the control valve. However, it must meet the following minimum requirements:
  - a) Control valve trim design shall suit the type of guiding specified in the data sheet.
  - b) The trim design and material of construction shall be selected to minimize the risk of galling particularly in case of cage guided valves. Vendor shall select proper material pairs, surface finish, hardness and clearances wherever possibility of galling exist.
  - c) Under extreme temperature conditions, vendor shall consider increased clearances at room temperature and seal welding of threaded seat rings etc. Hard facing of trim shall be used in high temperatures. For very low temperature application, material used shall have adequate cold impact strength.
  - d) For Globe/Angle/3-way type of control valves, Stem and Plug shall be detachable and shall be attached together by suitable threaded design secured with a pin to avoid plug rotation during operation.
  - e) For top and bottom guided control valves with sizes above 8", post and guide bushing design shall be used to prevent rotation of plug and stem.
  - f) Whenever Cavitation conditions are expected, vendor shall select a special anti- Cavitation trim design and shall use trim material of sufficiently high hardness.
  - g) Whenever the possibility of aerodynamic noise in a control valve exists under any operating condition specified in data sheet, vendor shall select a special low noise trim for that application.
- The plug inherent characteristics shall be as indicated in the Data sheet. However, following shall be followed unless otherwise specified:
  - a) Control valves with low noise and anti-cavitation trim design shall have modified equal percentage or linear characteristics.
  - b) Rotary type control valves shall have modified equal percentage or equal percentage characteristics.
  - c) Control valves with flow co-efficient less than 0.4 shall have equal percentage or linear characteristics.
  - d) All other control valves shall have equal percentage characteristics. Whenever linear or modified equal percentage characteristics are specified, equal percentage characteristics shall also be acceptable. Characterized positioner cam design to meet specified inherent control valve characteristics shall not be offered.

### 3.3.3 TRIM Material:

- Whenever stellite trim is specified in the data sheets following material of construction for the trim parts shall be acceptable.
  - a) Plug and seat : Stellite sheathing/hard alloy coating or solid stellite
  - b) Cage : Nitrided or stellite sheathing/hard alloy coating or solid stellite.
  - c) Guide bushing : Stellite coating/sheathing or solid stellite
  - d) Valve stem : Hardened SS /Inconel X-760.

Special material requirements, if specified in the datasheets, shall supercede the above mentioned requirements.

Whenever hardened SS trim is specified in the Data sheet, following material of construction for the trim parts shall be acceptable provided same are compatible with the specified process conditions;

- a) Plug and seat : Stellite sheath/hard alloy coating or 17-4PH SS or 440C
- b) Cage : Nitrided or stellite sheathing/coating, solid stellite, ENC coating, 17-4 PH SS
- c) Guide bushing : 440C, 3 16SS stellite, 17-4 PH SS or solid stellite
- d) Valve stem : 17-4 PH SS

### 3.3.4 Leakage Class:

- Leakage class shall be as per ANSI FCI 70.2 and shall be as per Data sheet for each control valve. Where no leakage class is specified, the same shall be considered as Class IV.
- For control valves specified with Class VI leakage class, vendor shall select the soft seat (elastomer) material suitable for the process conditions i.e., shut off pressure, maximum temperature and process fluid.
- In case vendor's calculation show occurrence of cavitation , flashing or noise under any of the specified process condition, vendor shall select proper type of valve trim to suit such process conditions.

## 3.4 CONTROL VALVE SIZING

Data sheet indicates calculated flow co-efficient values at minimum, normal and maximum operating conditions. Vendor shall calculate this co-efficient as per the offered control valve and select the size considering valve openings as under:

At maximum flow:	Less than 90% open
At normal flow:	Typically 75% open
At minimum flow:	More than 10% open

Conventional Butterfly valves shall be sized assuming a 600 opening at maximum flow. Wherever high-performance butterfly valves are specified, these shall be sized considering maximum opening of 900 at maximum flow.

### 3.5 CONTROL VALVE NOISE

- Vendor shall examine each control valve for noise generation possibilities. The noise level shall be calculated as per ISA 75.17.
- Noise generated by control valve during operation shall be limited to OSHA specified levels i.e. the maximum allowable noise shall be less than 85 dBA, when measured at a distance governed by ISA 75.17.
- If the predicted noise level is found to exceed 85 dBA SPL, control valve shall be treated for noise. Source treatment for noise shall be resorted to. When source treatment for noise is not sufficient to reduce the noise level below 85 dBA, vendor shall provide path treatment like diffuser plate/silencer etc in addition to source treatment so as to reduce the level below 85dBA. Whenever additional path treatment is recommended, the maximum differential pressure across the silencer/diffuser plate shall not exceed 40% of the specified differential pressure.
- Vendor shall also furnish noise calculations with and without the use of these devices and the noise abatement achieved in individual components.
- Diffuser plate shall be inserted between control valve body and pipe flanges. In cases where the diffuser plate size is higher than the valve body size or there is a need of multiple diffuser plates, vendor shall supply the complete diffuser assembly with flanged end connections.
- The silencer whenever offered for noise abatement shall always be supplied with flanged end connections.

### 3.6 CONTROL VALVE ACTUATOR

#### 3.6.1 Pneumatic Actuator:

- a) Actuator shall be sized for the shut-off differential pressure indicated in Data sheets. However, for 3-way type control valve, the actuator shall be sized for maximum differential pressure, unless specifically indicated otherwise.
- b) The actuator shall be designed to move the valve to the failure position specified in the Data sheet. For failure position specified as 'fail-locked', vendor shall provide fail-lock relays to meet the requirement.
- c) Actuator casing shall be made of pressed steel or anodised aluminium. Non-metallic actuator casings shall not be offered.
- d) Springs shall be corrosion-resistant and shall be cadmium or nickel-plated. Alternately vendor standard coating shall also be acceptable. These shall be of the enclosed type. The compression of the springs shall be adjustable.
- e) In general, an actuator operating range of 0.2-to 1.0 kg/cm<sup>2</sup>g is preferred. However, when vendor standard actuator model is not able to meet the specified shutoff pressure, higher actuator operating range may be offered.
- f) In general, spring opposed diaphragms type actuators shall be used. Only when this type of actuator becomes extremely unwieldy, based on the data specified in the Datasheet, should a piston and cylinder type of actuator be considered.
- g) Whenever piston and cylinder actuator is considered, single acting spring return type shall be used.
- h) Whenever double acting springless type of actuator is unavoidable, all accessories like pilot valves, booster relays, non-return valve, pressure gauge, volume tank etc. shall be provided to ensure desired action on air failure. The volume tank shall be sized considering full stroking of the valve for two complete cycles. The volume tank shall be of carbon steel construction and sized as per ASME Section VIII with design pressure of 10kg/cm<sup>2</sup> g as a minimum. Accessories like pressure relief valves and tubing

shall be of 316 Stainless steel constructions. Other accessories can be of Cast Aluminium.

- i) The actuator casings and diaphragms shall be designed for minimum twice the maximum pneumatic operating pressure of the control valve.
- j) Valve stem position indicator shall be provided for every control valve. The position indicator scale shall be marked from 0 to 100% in steps of 10%.
- k) In general, side-mounted handwheels will be used. Hand wheels shall provide manual control in both opening and closing directions independent of spring action. Hand- wheels shall be of non-rising type suitable for accurate valve positioning .The hand- wheel actuator shall be sized to provide the required thrust for valve positioning with 178N force applied to the hand-wheel.
- l) Actuator orientation shall be as per purchaser's requirements, in general. When, no requirements are indicated by purchaser, vendor shall provide recommended actuator orientation. It shall be possible to change this orientation at site for the offered valve- actuator combination in case it is found necessary.

### 3.6.2 Actuator Sizing:

- Vendor shall be fully responsible for the sizing and selection of the correct actuator for the specified control valve. While sizing the actuator, vendor shall ensure that the actuator is able to develop sufficient thrust to properly seat the control valve plug/disc at the actuator air pressure (lowest specified pressure) and shut-off conditions specified in the purchaser's data sheets.
- While sizing the actuator, vendor must ensure that the sizing factor indicated below is fully complied. Higher sizing factor may be considered if found necessary by vendor.
  - a) For control valves with leakage class IV and below, the actuator shall be sized considering actuator thrust more than 1.3 times the total force induced by shut-off conditions specified in the data sheet and the force required to overcome packing friction. Vendor shall utilize this factor as 1.5 in case the control valve is operating between 80% to 90% or 10% to 20% in any of the specified conditions
  - b) For control valves with leakage class V and above, the actuator shall be sized considering actual thrust more than 1.7 times the total force induced by specified shut-off conditions in the Data sheet and the force required to overcome packing friction.

## 3.7 CONTROL VALVE PACKING BOX, BONNET & STEM

### 3.7.1 Packing Box

- a) The packing box shall be flanged bolted to the bonnet and shall meet the requirements specified in Data sheet.
- b) Generally low friction type packing like braided teflon will be used wherever operating conditions permit. For high temperature application (>200°C), Grafoil or equivalent gasket suitable for the specified service shall be selected.
- c) Where specifically indicated, control valve shall have its packing box drilled and tapped to 1/4" NPT (F) for connecting external lubricator. When external lubricator is not provided, this hole shall be plugged.
- d) An isolating valve shall be provided with all valves having external lubrication



provision. Vendor shall specify the lubricator stick material used in each case.

- e) For application in vacuum service, vendor to provide inverted packing design suitable for vacuum service. For pressure-cum-vacuum service, the control valve shall have dual packing design suitable for the application. Dual packing design shall also be provided for control valves in toxic service.
- f) Wherever environmental packing design is specified vendor shall supply special packing design suitable to minimize fugitive emission.

### 3.7.2 Bonnet

- a) The bonnet shall be flanged bolted to the body. Threaded bonnets are not permitted.
- b) Wherever the operating temperature of the fluid is above 200°C, extension or radiation finned bonnet shall be provided. Vendor standard bonnet design shall also be acceptable if these are suitable for higher temperatures.
- c) For temperature below 0°C, vendor shall provide extended bonnet design. For valves in cryogenic application bonnet extension shall be as per BS-6364 as a minimum.

### 3.7.3 Stem

- a) The stem surface finish shall be fine. Extra fine surface finish shall be provided wherever the packing material is PTFE.
- b) The stem/shaft shall be designed for the maximum thrust of the actuator without any measurable deflection.
- c) The valve stem/shaft shall be connected to the actuator stem/shaft by suitable arrangement to avoid backlash problem.

## 3.8 CONTROL VALVE ACCESSORIES

### 3.8.1 Positioner

- a) Positioners shall be of force-balance type or smart digital type or field bus type as specified in the Datasheet. They shall be direct acting, with an adjustable gain unless otherwise specified.
- b) The Positioner shall be provided with an integral by-pass switch whenever the operating range of the actuator is the same as that of the control signal.
- c) Every positioner shall have two pressure gauges mounted on it, one each for air supply and for positioner output to actuator.
- d) In addition, pneumatic positioner shall have third pressure gauge for control signal.
- e) Pneumatic connections shall be 1/4" NPT (F) and cable entry shall be 1/2 " NPTF. If connection for cable entry is different than that specified, suitable adapters shall be provided.
- f) Positioners shall be side-mounted on the control valve and shall have corrosion resistant linkages and rugged brackets.

### 3.8.2 Smart type and field bus type positioners

Digital smart positioners or field bus type of positioners with diagnostic capabilities shall be supplied whenever specified in the purchaser's data sheets. These shall meet the following minimum requirements:

- a) The positioner sensor and sensing mechanism shall be rugged and shall not

- be affected by the line/valve vibration. The performance of the positioners shall be immune to above vibration.
- b) The positioner's output and input range shall be field adjustable without any hardware modification. The output from the positioners shall be available for both single acting as well as double acting actuator.
  - c) Each positioner shall be operable, configurable and accessible through HART compatible hand-held configurator/field bus configurator as applicable.
  - d) Unless otherwise specified, vendor shall offer smart positioner for control valves in critical applications such as split range, high pressure drop (>50kg/cm<sup>2</sup>) high temperature (>250°C), low temperature (<-29°C), tight shut off leakage (leakage class ANSI class V and VI) and where vendor's calculations indicate phenomenon like cavitation, flashing and high noise level (>85 dBA) irrespective of requirements specified in Data sheet for such control valves.
  - e) The positioner shall be a two-wire device, which shall operate on two-way digital communication mode. All engineering, configuration, diagnostic and maintenance related data shall be provided by the positioner.
  - f) The smart positioner shall provide HART protocol of latest version and shall be capable of implementing commands from Instrument Asset Management System / hand-held HART configurator.
  - a) Positioners with field bus output shall meet the following requirements:
    - I) All positioners must satisfy the requirements of the field bus registration laboratory with applicable checkmark like FieldBus foundation, Profibus Nutzerorganisation e.v (PNO) or as specified in the Data sheets.
    - II) All positioners shall have analog output (AO) and controller blocks (PID).
    - III) All positioners must be interoperable and shall have valid interoperability test clearance like ITK latest version for foundation field bus or equivalent for profibus PA, as applicable.
    - IV) The field bus positioners shall support peer-to-peer communication with two wire communicator and bus powered supply.
    - V) Field bus positioners as offered shall not be polarity sensitive. The field bus positioners shall be certified as per entity concept or shall be FISCO approved.
    - VI) Internal software shall be configured by the vendor including the following information:
      - Serial Number
      - Device tag (Tag No.)
      - Process Description/service
    - VII) Positioners shall be capable of supporting incremental Device Description (DD) for extra functionality and/or software revisions in Device memory.
  - b) The positioners shall be suitable to operate with commercially available asset management software and shall support the following features, as a minimum:
    - I) It shall allow multi-master for configuration, calibration, diagnosis and maintenance. The primary could be a host computer and secondary could be a hand-held communicator.



- II) It shall be capable of implementing universal commands. It shall be possible to communicate all commands of commercially available asset management system to/ from smart positioner.
- c) The offered positioners shall meet the following performance characteristics:
  - Overall control accuracy shall be better than  $\pm 0.5\%$  of span.
  - Repeatability shall be less than  $\pm 0.25\%$  of span.
  - Hysteresis shall be less than  $\pm 0.5\%$  of span.
  - Vendor shall supply the valve's operating signatures in the form of hard copy and soft copy for each control valve supplied with smart positioners.
- d) All positioners shall have metallic casing and cover either of stainless steel or of anodized aluminium.
- e) Fieldbus positioners shall support EDDL requirements as per IEC 61804/FDT/DTM requirements.

### 3.8.3 Electro-Pneumatic converter

- a) Electro-pneumatic converter shall be of electronic feedback type unless specified otherwise and shall be yoke mounted.
- b) It shall have an integral terminal housing. Electro pneumatic converter with flying leads shall not be acceptable.
- c) Unless otherwise mentioned, it shall be intrinsically safe.
- d) Pneumatic connections shall be 1/4" NPT (F). The electrical connections shall be 1/2" NPT (F). If they are different, suitable adapters shall be provided.
- e) The overall accuracy of the electro-pneumatic converter shall be better than  $\pm 0.3\%$ .

### 3.8.4 Air Filter Regulator

- a) Vendor shall supply air filter regulator with each positioner complete with an integral output gauge
- b) Air filter Regulator shall be sized considering the air supply pressure and flow required to meet the requirement mentioned in datasheet.
- c) Filter material shall be sintered bronze. Filter size shall be maximum 5 micron. However, lower filter mesh size shall be considered to suit the electro-pneumatic converter vendor's requirement.

### 3.8.5 Valve Jacketing

- a) Jacketed valves shall have inlet/outlet steam connection shall be flanged.
- b) Valve end connection shall be one size higher than the normal valve connection for jacketed valve.

### 3.8.6 Hand held communicator/configurator

- a) It shall be possible to perform routine configuration / calibration, display process variable, diagnostics etc. from Hand Held Communicator, which can be connected at any location in the loop. It shall be possible to perform all the above functions on line and the loop function shall remain unaffected.
- b) There should be no interruption on the output while communicating with the positioner.
- c) Hand held communicator shall be universal type and shall be compatible with all make and models of HART transmitters and smart Positioners with all engineering capability like calibration, diagnostics, configuration, inhibition of HART signal etc. Similarly, Fieldbus Hand Held communicator shall also be universal type and shall be suitable for all make and models of FF transmitters and positioners.
- d) It shall be possible to connect the communicator at any location at the following locations for the purpose of digital communication:
  - Marshalling cabinet serving the transmitter, in safe area
  - Junction box serving the transmitter in hazardous area
  - Directly at the transmitter/positioner in hazardous area

Plug in type connections shall be provided with field communicator.  
Necessary interconnection accessories shall be supplied by the vendor.

- e) Offered communicator shall be dustproof, certified intrinsically safe and suitable for outdoor location. Carrying case shall be supplied with each communicator. The software shall also be capable of configuring the other makes of transmitters / positioners.
- f) They shall be powered with replaceable and rechargeable battery suitable for recharging with 240 V AC 50 HZ. Replaceable battery and battery charger shall be supplied with each Hand-held communicator. In case vendor standard doesn't permit rechargeable battery, vendor shall supply two sets of additional batteries.

### 3.9 VALVE FINISH

Valve body shall be painted as below:

- |    |                       |                               |
|----|-----------------------|-------------------------------|
| a) | Carbon steel body:    | Light grey                    |
| b) | Alloy steel body:     | Canary yellow                 |
| c) | Stainless steel body: | Natural                       |
| d) | Above 150 Deg C:      | Aluminium paint(White colour) |

Items like silencers, diffuser plate assemblies etc. shall be painted as per respective control valve body requirement

Actuator shall be painted as below: -

- |    |   |        |
|----|---|--------|
| a) | Direct Action Valve (Open on-air failure) -   | Green  |
| b) | Reverse Action Valve (Close on-air failure) - | Yellow |
| c) | Actuators for shutdown valves-                | Red    |

Items like air volume tanks etc. shall be painted as per corresponding Actuator.

### 3.10 END CONNECTIONS

- Unless otherwise mentioned, end connection details shall be as below:
  - a) Threaded end connections shall be to NPT as per ASME B 1.20.1.
  - b) Flanged end connections shall be as per ASME B 16.5/ B 16.47B/ AWWA C207 CL.D.
  - c) RTJ flanges shall be with octagonal Grooves as per ASME B 16.20
  - d) Flange face finish shall be as per ASME B16.5 and shall be
    - 125 AARH: 125 to 250 micro inch AARH
    - 63 AARH: 32 to 63 micro inch AARH
- Face-to-face dimensions of globe type control valves shall be in accordance with ISA 75.08.
- Where provided, control valve bottom drains shall be plugged off or blind flanged. Where a plug is used, threads shall correspond to ASME B 1.20.1 (NPT). Where a flange is used, its dimensions and rating shall correspond to ASME B 16.5.

#### 4.0 DOCUMENTATION

Post Order Documents to be submitted by the bidder for review/ approval.

<b>DOCUMENTATION REQUIREMENTS</b>	<b>REVIEW / APPROVAL</b>
QUALITY ASSURANCE PLAN (QAP)	For Approval
PRODUCTION SCHEDULE	For Review
INSTRUMENT DATA SHEETS	For Approval
INSTRUMENT G.A. / SIZING / INSTALLATION DRAWINGS	For Approval
certified values of failure rates, probability of failure on demand (PFD) and test intervals for offered items for Safety Integrity Level (SIL) analysis	For Review
SIL data	For Review
DTM/EDDL file etc.	For Review
BILL OF MATERIALS INCLUDING SPARES	For Review

Note: Schedule of submission of the above documents shall be aligned to meet the delivery requirements.

Final documentation consisting of design data, installation manual, operation and maintenance manual etc., submitted by the vendor after placement of purchase order shall include the following, as a minimum;

- a) Data sheet/ Sizing Sheet for each control valve with accessories.
- b) As- built drawings for each control valve with accessories, providing dimensional details(face to face and height of completely assembled valve), Dimensions of clearance space for maintenance work, weight of completely assembled valve , constructional details, connection details, orientation with respect to flow direction marked on the body and material of construction.
- c) Type test certificates
- d) Copy of test certificates for all the tests as per MR and documents along with TPI- IRN.
- e) Installation procedure for each control valve with accessories
- f) Curves for flow measurement vs. accuracy and rangeability.
- g) Calibration, configuration and maintenance procedures including replacement of its parts / internals wherever applicable.
- h) Control valve operating signatures whenever smart positioners or field bus based positioners are specified.
- i) Device Descriptor (DD) Files for configuring the device parameters (Smart positioner /Fieldbus parameters)
- j) Common File Format (CFF) files for integrating the device into the system

- (soft copy).
- k) BOM including spares (if applicable)
  - l) Product Catalogs of Main equipment and accessories/ bought outs.

Three hard copies in bound format and one soft copy in CD/ DVD of the above shall be submitted as final document.

## 5.0 NAME PLATE

Each control valve and its accessories shall have a stainless-steel nameplate attached firmly to it at a visible place, furnishing the following information:

- a) Tag number as per data sheet.
- b) Body size, port size in inches
- c) Valve flow coefficient(Cv)
- d) Stem travel in millimetres
- e) Action on Air failure
- f) Spring range
- g) Air supply pressure
- h) Manufacturers serial number and model number for Valve body, Actuator and positioner.
- i) Manufacturer's name/ trademark.
- j) Nominal end connection size and rating.
- k) Hazardous area certification number and marking
- l) Operating power supply voltage and frequency.
- m) Specified range and units of measurement for flow.

## 6.0 SHIPPING

All threaded and flanged openings shall be suitably protected to prevent entry of foreign material.

The Control valve and its accessories shall be supplied preassembled and pre-tubed.

Control valves with external lubricators shall be lubricated before shipment.

Instrument shall be supplied individually, in suitably sealed packing.

The consignment shall be packed and suitably labelled clearly indicating the following as minimum:

- a) Project Name and Location
- b) PO Number
- c) Packing List inside consignment (indicating Main Equipment Tag nos, Accessories and Spares as applicable)
- d) Vendor Name and location of dispatch.



**DEPARTMENT:** INSTRUMENTATION  
**DOCUMENT NO:** 44AC9100-000-J.SS-0109-A4  
**DOCUMENT TITLE:** STANDARD SPECIFICATION FOR ON-OFF VALVE  
**ITEM:**  
**PROJECT NO:** 44AC9100  
**PROJECT LOCATION:** DUMAD/IOCL-JR, Gujarat  
**PROJECT TITLE:** EPCM/PMC SERVICES FOR ACRYLICS / OXO ALCOHOL PROJECT AT GUJARAT REFINERY AND DUMAD  
**CLIENT:** INDIAN OIL CORPORATION LIMITED  
**CLIENT PROJECT NO:**  
**CLIENT AUTHORIZATION:** MR. GAURAV DOLEY (DGM-PJ)  
**PM AUTHORIZATION:** MR. PAWAN GUPTA

				APPROVALS		
Rev. No.	Issue Date	Pages	Revision Description	Prepared	Checked	Approved
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**1.0 GENERAL**

1.1 This specification, together with the datasheets, MR and special requirements (If any) covers the general requirements for instrumentation design, materials, name plate marking, inspection, testing and shipping of all On-Off valves along with their accessories.

1.2 The On-Off valves and its accessories shall be supplied in fully assembled condition.

1.3 In the event of any conflict between this standard specification, datasheet, statutory regulations, related codes, standards etc., the following order of priority shall govern:

1st priority	: Statutory Regulation requirement
2nd priority	: Process Licensor's documents
3rd priority	: Job Specifications & Job Drawings
4th priority	: Engineering Design Basis
5th priority	: Standard Specifications, standard Drawings & Engineering standards

Note: In case of any conflicts most stringent requirements shall be followed, however it shall be obligatory on the contractor's part to bring such conflicts to the notice of owner/PMC, wherein owner/PMC decision shall be final.

1.4 Individual On-Off valve data sheets specify the material for wetted parts and flanges. Unless specifically indicated otherwise, alternate superior material of construction shall also be acceptable provided vendor assumes complete responsibility for the selected materials for their compatibility with the specified fluid and its operating conditions.

**1.5 PROJECT TITLE**

Project Name	:	EPCM/PMC Services for Acrylics/ Oxo-Alcohol Project at Gujarat Refinery and Dumad
Owner	:	Indian Oil Corporation Limited
Location	:	Dumad & Vadodara, Gujarat, India

## 2.0 CODES, STANDARDS AND REGULATIONS

Applicable national / international standards

Design and terminology shall comply, as a minimum, with the latest edition prior to the date of purchaser's enquiry of following codes, standard practices and publications:

<b>ASME</b>	<b>(American Society of Mechanical Engineers)</b>
B 1.20.1	Pipe Threads General Purpose (inch) (Year - 2013)
B 16.5	Steel Pipe Flanges and Flanged Fittings (Year- 2017)
B16.10	Face to face dimension and grooves
B 16.20	Metallic gaskets for Pipe flanges- Ring joint, Spiral wound and jacketed. (Year- 2012)
B 16.34	Valves- Flanged, Threaded & Welding End (Year- 2017)
B 16.47	Large Diameter Steel Flanges (NPS 26 thru NPE 60) (Year 2017)
<b>ANSI / FCI</b>	<b>American National Standard Institute/Fluid Control Institute</b>
ANSI FCI 70-2	Control Valve Seat Leakage
<b>API</b>	<b>(American Petroleum Institute)</b>
API 6D	Pipelines valves (Gate valve, Plug, Ball and Check valves)
API 598	Inspection Requirements
API 609	Lug and wafer type, Butterfly valves
API 6FA	Specification for Fire Test of Valves
API 598	Fire test for soft seated valves
API 609	Metal Ball Valves - Flanged, Threaded and welding end
<b>AWWA</b>	<b>American Water Works Association</b>
C207 CL. D	Steel Pipe Flanges for Water works services
<b>BS</b>	<b>British Standards</b>
BS 6364	Valves in cryogenic service European Standards
BS 6755 Part II	Testing of Valves - Specification for Fire type - testing requirements
<b>EN</b>	<b>European standards</b>
10204	Inspection Documents for Metallic Products
61056-1	Specification for performance, design and construction of valve, regulated sealed type.
<b>IS / IEC</b>	<b>Indian Standard / International Electro-Technical Commission.</b>
IS / IEC 60079	Electrical apparatus for Explosive Gas atmosphere (Year -2017)
IEC 60079-1	Explosive atmosphere equipment protection by flameproof enclosure 'D' (Year -20014 & 2018)
IEC 61000-4-3	Electromagnetic Compatibility-Part-4-3 Testing and measurement techniques - Radiated, radio-frequency, electromagnetic field immunity test (Year-2010).
IEC 61000-4-4	Testing and Measurement techniques – Electrical Fast Transient/burst

	<b>Immunity Tests</b>
IEC 61000-4-5	Testing and Measurement techniques – Surge Immunity
IEC 61508	Functional safety of Electrical/Electronic Programmable Electronic Safety Related System (Year-2010)
IEC 61511	Functional safety: safety Instrumented systems for the Process Industry sector (Year-2017)
IEC 61158	Digital data communications for measurement and control –. Fieldbus specification.
IS/IEC 60529	Degrees of Protection Provided by Enclosures (IP Code) - (Year- 2015)
IEC 61804	Function blocks (FB) for process control - Electronic Device Description (Year-2018).
IEC 60534-3-2	Face to Face dimension of rotary valves except butterfly valves.
IEC 60534-4	Seat leakage
IEC 60534-8.3	Industrial process control valves, noise consideration, control valve Aerodynamic noise prediction method

**ISA****(Instrument Society of America)**

ISA 75.01.01	Flow equation for sizing control valves.
ISA 75.02	Control valve capacity test procedure.
ISA 75.04	Control Valve positioner stability
ISA 75.05.01	Control Valve terminology
ISA 75.07	Laboratory measurement of aerodynamic noise generated by control valves
ISA 75.08.01	Face to face dimensions for integral flanged Globe-style control valve Bodies ASME Class 125,150,300 and 600)
ISA 75.11.01	Inherent flow characteristic and Rangeability of control valves.
ISA 75.19.01	Hydrostatic testing of control valves.
ISA 75.22	Face to center-line dimensions for flanged Globe-style Angle control valve bodies (ASME Class 150,300 and 600)
ISA 75.25.01	Test Procedure for Control valve response measurement for step inputs
TR75.25.02	Control valve response measurement for step inputs
ISA 75.25.13	Method of evaluating the performance of positioners with analog input signals and pneumatic output.
ISO 5208	Industrial Valves-Pressure testing of metallic valves

**MSS****Manufacturer's Standardization Society**

SP 25	Standard Markings System for Valves, Fittings, Flanges and Unions
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**Other standards:**

NEC	National Electric code.
NEMA	National Electrical Manufacturer's Association
NFPA	National Fire Protection Association.
NACE MR-0103	Materials Resistant to Sulphide stress cracking in Corrosive Petroleum. Refinery Environments.
OSHA	Occupational Safety and Health Authority.
MPMS	Manual of Petroleum measurement standards.
IBR	Indian Boiler Regulations 1950 (Including Amendments in year 2017)
AG-181	FOUNDATION™ Fieldbus System Engineering Guidelines
ITK	Interoperability Test Kit (6.3.0 or the latest version)

Apart from above listed OISD, the latest standards applicable as on date of enquiry for Instrumentation of Packages like Turbine, Compressor, Diesel Engines and Fire protection system etc.

### 3.0 DESIGN REQUIREMENTS

#### 3.1 GENERAL REQUIREMENTS FOR ON-OFF VALVE

- For valves in cryogenic service, vendor shall meet the following acceptance criteria:
  1. Vendor shall furnish, along with the offer, type test certificate, duly witnessed by Third Party Inspection agency like MIS LRIS, DNV BV, TUV, CEIL etc. of having successfully conducted the cryogenic test as per BS 6364 on the offered valves (same model, size, rating and material) in cryogenic service. Further vendor to note the following:
    - a) Test temperature shall be -45 Deg. C for LTCS and -196 Deg. C for all grades of austenitic Stainless Steel.
    - b) Test carried out on a particular size of one type of valve, pressure rating and material shall qualify all sizes equal to and below the test valve size for the same type, pressure rating and material. In case of austenitic Stainless Steel any one grade would qualify for other grades of austenitic Stainless Steel.
  2. In case vendor does not have cryogenic type test certificate for the offered valves as mentioned above, vendor shall confirm to conduct the cryogenic test on the offered valves and furnish type test report meeting requirements specified above.

#### 3.2 ON-OFF VALVE BODY

- On-off valves shall have flanged end connections integral to the valve body. Top entry valve design shall not be offered unless specifically indicated in the Data sheets.
  - a) Wafer type or lug type body design for On-Off valves body size up to 6 inches.
  - b) Lug type body design for butterfly type of On-Off valve body size more than 6 inches.
- The valve body rating should be equal to or higher than the flange rating specified in the data sheets. As a minimum, On-Off valve body shall be rated for ASME Class 300. However, end connection shall be as specified in Data sheet.
- The On-Off valves shall be suitable for installation in horizontal as well as in vertical lines. For all applications, where full port valves are specified, following shall apply:
  - a) Port size shall be equal to line size for rating up to ASME Class 1500.
  - b) Port size shall not be smaller than one size lower than that of the line size for body rating ASME Class 1500 and above.
- For steam jacketed valves, the body and port size shall be one size lower than the on-off valve end connection.

##### 3.2.1 Flow Direction:

- Flow direction shall be clearly marked on the on-off valve body.
- For 3-way on-off valves, service like mixing or diverting, shall be clearly identified with inlet and outlet end connection clearly marked on the on-off valve body.

##### 3.2.2 Material of Construction

- a) The material of construction of on-off valves shall be as specified in the data sheet.
- b) On-off valve body, bonnet, flanges and other pressure containing assemblies shall be of the same material of construction as specified for valve body in the data sheets.
- c) The bonnet flange and bottom flange shall have metallic spiral wound gaskets suitable for the specified service.
- d) Vendor shall be responsible for selecting proper material for the internal parts of on-off valve. All such materials shall have the same or better specification than specified in the data sheets.

### 3.3 DESIGN REQUIREMENTS TRIM

- The term 'trim' covers those parts of valve assembly (excluding the body, bonnet and bottom flange) which are exposed to and are in contact with the line medium consisting of but not limited to the seat ring, valve stem, valve plug/disc/ ball, valve plug guide, guide bushing and cage etc.
- In case of ball type of on-off valves:
  - a) The valve design shall ensure valve seat and body protection against thermal expansion of the entrapped fluid when the on-off valve is fully close.
  - b) In case of ball-type of on-off valves for size up to 4" and rating up to ASME Class 300, the on-off valve shall have floating ball design. For ratings ASME Class 600 and above, floating ball is acceptable for sizes less than 2". For higher sizes trunnion mounted ball design shall be provided.

#### 3.3.1 Guiding:

- a) Single seated globe (unbalanced) and angle type on-off valves shall have heavy top plug guiding. Stem guided control valve design shall not be acceptable.
- b) Rotary type on-off valves like ball, butterfly valves etc. shall have blowout proof shaft guiding design.
- c) Guide bushings shall be of a sufficiently hard material to resist side thrust on the plug or shaft.

#### 3.3.2 Trim Design:

- Valve manufacturer/vendor shall be responsible for trim selection and trim design of the on-off valve. However, it must meet the following minimum requirements:
  - a) Valve characteristics shall be quick opening (on-off) type unless otherwise specifically mentioned in datasheet.
  - b) The trim design and material of construction shall be selected to minimize the risk of galling. Vendor shall select proper material pairs, surface finish, hardness and clearances wherever possibility of galling exist.
  - c) Under extreme temperature conditions, vendor shall consider increased clearances at room temperature and seal welding of threaded seat rings etc. Hard facing of trim shall be used in high temperatures (above 200 deg C). For very low temperature application, material used shall have adequate cold impact strength.
  - d) For all on off valve including 3-way type of valves, Stem and Plug shall be detachable and shall be attached together by suitable threaded design secured with a pin to avoid plug rotation during operation.

### 3.3.3 TRIM Material:

Whenever stellite trim or hardened SS trim is specified in the data sheets following material of construction for the trim parts shall be acceptable provided same are compatible with the specified process conditions;

- a) Ball/ Disc/ Plug : Stellite sheathing/hard alloy coating or solid stellite  
And seat 17-4 PH SS or SS 440C
- B) Guide : Stellite sheath/hard alloy coating or solid stellite, 17-4  
PH SS or SS 440C
- C) Valve stem : 17-4 PH SS, Hastelloy

Special material requirements, if specified in the datasheets, shall supersede the above-mentioned requirements.

- In case of rotary valves, vendor shall select the stem bearing type and material as per the process conditions. Material of construction shall be as per the wetted part material specified in Datasheet, as a minimum.

### 3.3.4 Leakage Class:

- Leakage class shall be as per ANSI FCI 70.2 and shall be as per Data sheet for each valve. Where no leakage class is specified, the same shall be considered as Class IV.
- For valves specified with Class VI leakage class, vendor shall select the soft seat (elastomer) material suitable for the process conditions i.e., shut off pressure, maximum temperature and process fluid. Metal seated on-off valves meeting the leakage class shall also be acceptable.

## 3.4 ON-OFF VALVE SIZING

- Body size of on-off valve shall be same as the line size. Valve sizing shall be carried out only for those on-off valves where Datasheet specify the same.

## 3.5 DESIGN REQUIREMENTS OF VALVE ACTUATOR

### 3.5.1 Pneumatic Actuator:

- a) Actuator shall be sized for the shut-off differential pressure indicated in Data sheets. However, for 3-way valve, the actuator shall be sized for maximum differential pressure, unless specifically indicated otherwise.
- b) The actuator shall be designed to move the valve to the failure position specified in the Data sheet. For failure position specified as 'fail-locked', vendor shall provide Air reservoir with all the accessories to meet the requirement. Air reservoir shall be designed considering full stroking of the valve for one complete cycle. Air reservoir shall be carbon construction and sized as per ASME section VIII with design pressure 10Kg/Cm<sup>2</sup>g as a minimum. All accessories and tubing shall be SS316.
- c) Actuator casing shall be made of pressed steel or anodized aluminium. Non-metallic actuator casings shall not be offered.
- d) Springs shall be corrosion-resistant and shall be cadmium or nickel-plated. These shall be of the enclosed type. The compression of the springs shall be adjustable.



- e) The actuators shall be sized for maximum air pressure of 3.5 Kg/ cm<sup>2</sup>, unless otherwise specified in the datasheet.
- d) In general, spring opposed diaphragms type actuators shall be used. Only when this type of actuator becomes extremely unwieldy, based on the data specified in the Datasheet, should a piston and cylinder type of actuator be considered.
- e) Whenever piston and cylinder actuator is considered, single acting spring return type shall be used.
- f) Whenever double acting springless type of actuator is unavoidable, all accessories like pilot valves, booster relays, non-return valve, pressure gauge, volume tank etc. shall be provided to ensure desired action on air failure. The volume tank shall be sized considering full stroking of the valve for three complete cycles. The volume tank shall be of carbon steel construction and sized as per ASME Section VIII with design pressure of 10kg/cm<sup>2</sup> g as a minimum. Accessories like pressure relief valves and tubing shall be of 316 Stainless steel constructions. Other accessories can be of Cast Aluminium.
- g) The actuator casings and diaphragms shall be designed for minimum twice the maximum pneumatic operating pressure of the valve.
- h) Valve stem position indicator shall be provided for each valve. The position indicator scale shall be marked from 0 to 100% in steps of 10%.
- i) In general, side-mounted handwheels will be used. Hand wheels shall provide manual on-off in both opening and closing directions independent of spring action. Hand-wheels shall be of non-rising type suitable for accurate valve positioning. The hand-wheel actuator shall be sized to provide the required thrust for valve positioning with 178N force applied to the hand-wheel.
- j) Actuator orientation shall be as per purchaser's requirements, in general. When, no requirements are indicated by purchaser, vendor shall provide recommended actuator orientation. It shall be possible to change this orientation at site for the offered valve-actuator combination in case it is found necessary.
- k) For the on off valve where operating time is specified in Datasheet/MR, vendor shall design the actuator and its accessories to meet these requirements.

### 3.5.2 Actuator Sizing:

- Vendor shall be fully responsible for the sizing and selection of the correct actuator for the specified valve. While sizing the actuator, vendor shall ensure that the actuator is able to develop sufficient thrust to properly seat the on off valve at the actuator air pressure (lowest specified pressure) and shut-off conditions specified in the data sheets.
- While sizing the actuator, vendor shall consider actuator thrust equal to two times the total force induced by shut off condition specified in the Datasheet and the force required to overcome packing friction.

## 3.6 DESIGN REQUIREMENTS FOR PACKING BOX, BONNET & STEM

### 3.6.1 Packing Box

- a) The packing box shall be flanged bolted to the bonnet and shall meet the requirements specified in Data sheet.
- b) Generally low friction type packing like braided Teflon will be used wherever

operating conditions permit. For high temperature application (>200°C), Grafoil or equivalent gasket suitable for the specified service shall be selected.

- c) Wherever on off valve is offered with external lubricator, it shall have its packing box drilled and tapped to 1/4" NPT (F) as per ASME B 1.20.1 for connecting external lubricator.
- d) An isolating valve shall be provided with all valves having external lubrication provision. Vendor shall supply the lubricator stick in each case.
- e) For application in vacuum service, vendor to provide inverted packing design suitable for vacuum service. For pressure-cum-vacuum service, the valve shall have dual packing design suitable for the application. Dual packing design shall also be provided for valves in toxic service with facility to connect inert fluid between packings.
- f) Wherever environmental packing design is specified vendor shall supply special packing design suitable to minimize fugitive emission.
- g) 3-way on off valve of either diverting or mixing type shall have PTFE box rings.

### 3.6.2 Bonnet

- a) The bonnet shall be flanged bolted to the body. Threaded bonnets are not permitted.
- b) Wherever the operating temperature of the fluid is above 200°C, extension or radiation finned bonnet shall be provided. Vendor standard bonnet design shall also be acceptable if these are suitable for higher temperatures.
- c) For temperature below 0°C, vendor shall provide extended bonnet design. For valves in cryogenic application bonnet extension shall be as per BS-6364 as a minimum.

### 3.6.3 Stem

- a) The stem surface finish shall be fine. Extra fine surface finish shall be provided wherever the packing material is PTFE.
- b) The stem/shaft shall be designed for the maximum thrust of the actuator without any measurable deflection.
- c) The valve stem/shaft shall be connected to the actuator stem/shaft by suitable arrangement to avoid backlash problem.

## 3.7 ON-OFF VALVE ACCESSORIES

### 3.7.1 Positioner

- a) Positioners shall be of force-balance type or smart digital type or field bus type as specified in the Datasheet. They shall be direct acting, with an adjustable gain unless otherwise specified.
- b) The Positioner shall be provided with an integral by-pass switch whenever the operating range of the actuator is the same as that of the control signal.
- c) Every positioner shall have two pressure gauges mounted on it, one each for air supply and for positioner output to actuator.
- d) Cable entry shall be 1/2 " NPTF. If connection for cable entry is different than that specified, suitable adapters shall be provided.
- e) Positioners shall be side-mounted on the on-off valve and shall have corrosion resistant linkages and rugged brackets.

### 3.7.2 Smart type and field bus type positioners

Digital smart positioners or field bus type of positioners with diagnostic capabilities shall be supplied whenever specified in the purchaser's data sheets. These shall meet the following minimum requirements:

- a) The positioner sensor and sensing mechanism shall be rugged and shall not be affected by the line/valve vibration. The performance of the positioners shall be immune to above vibration.
- b) The positioner's output and input range shall be field adjustable without any hardware modification. The output from the positioners shall be available for both single acting as well as double acting actuator.
- c) Each positioner shall be operable, configurable and accessible through HART compatible hand-held configurator/field bus configurator as applicable.
- d) The positioner shall be a two-wire device, which shall operate on two-way digital communication mode. All engineering, configuration, diagnostic and maintenance related data shall be provided by the positioner.
- e) The smart positioner shall provide HART protocol of latest version and shall be capable of implementing commands from Instrument Asset Management System / hand-held HART configurator.
- f) The positioners shall be suitable to operate with commercially available asset management software and shall support the following features, as a minimum:
  - I) It shall allow multi-master for configuration, calibration, diagnosis and maintenance. The primary could be a host computer and secondary could be a hand-held communicator.
  - II) It shall be capable of implementing universal commands. It shall be possible to communicate all commands of commercially available asset management system to/ from smart positioner.
- a) The offered positioners shall meet the following performance characteristics:
  - i) Overall control accuracy shall be better than  $\pm 0.5\%$  of span.
  - ii) Repeatability shall be less than  $\pm 0.25\%$  of span.
  - iii) Hysteresis shall be less than  $\pm 0.5\%$  of span.
  - iv) Vendor shall supply the valve's operating signatures in the form of hard copy and soft copy for each on-off valve supplied with smart positioners.
- b) All positioners shall have metallic casing and cover either of stainless steel or of anodized aluminium.

### 3.7.3 Air Filter Regulator

- a) Vendor shall supply air filter regulator with each positioner complete with an integral output gauge.
- b) Air filter Regulator shall be sized considering the air supply pressure and flow required to meet the requirement mentioned in datasheet.
- c) Filter material shall be sintered bronze. Filter size shall be maximum 5 micron.

### 3.7.4 Valve Jacketing

- a) Jacketed valves shall have inlet/outlet steam connection shall be flanged.
- b) Valve end connection shall be one size higher than the normal valve connection for jacketed valve.

### 3.7.5 Limit Switches

Limit switches shall be provided for open and close positions suitably mounted in a Limit Switch Box. The limit switches shall be proximity type switches unless otherwise specified.

### 3.7.6 Hand held communicator/configurator

- a) It shall be possible to perform routine configuration / calibration, display process variable, diagnostics etc. from Hand Held Communicator, which can be connected at any location in the loop. It shall be possible to perform all the above functions on line and the loop function shall remain unaffected.
- b) There should be no interruption on the output while communicating with the positioner.
- c) Hand held communicator shall be universal type and shall be compatible with all make and models of HART transmitters and smart Positioners with all engineering capability like calibration, diagnostics, configuration, inhibition of HART signal etc. Similarly, Fieldbus Hand Held communicator shall also be universal type and shall be suitable for all make and models of FF transmitters and positioners.
- d) It shall be possible to connect the communicator at any location at the following locations for digital communication:
  - Marshalling cabinet serving the transmitter, in safe area
  - Junction box serving the transmitter in hazardous area
  - Directly at the transmitter/positioner in hazardous area

Plug in type connections shall be provided with field communicator. Necessary interconnection accessories shall be supplied by the vendor.

- e) Offered communicator shall be dustproof, certified intrinsically safe and suitable for outdoor location. Carrying case shall be supplied with each communicator. The software shall also be capable of configuring the other makes of transmitters / positioners.
- f) They shall be powered with replaceable and rechargeable battery suitable for recharging with 240 V AC 50 HZ. Replaceable battery and battery charger shall be supplied with each Hand-held communicator. In case vendor standard doesn't permit rechargeable battery, vendor shall supply two sets of additional batteries.

## 3.8 VALVE FINISH

Valve body shall be painted as below:

- a) Carbon steel body: Light grey
- b) Alloy steel body: Canary yellow

- c) Stainless steel body: Natural
- d) Above 150 Deg. C: Aluminium paint (White colour)

Items like silencers, diffuser plate assemblies etc. shall be painted as per respective on-off valve body requirement.

Actuator shall be painted as below: -

- a) Direct Action Valve (Open on-air failure) - Green
- b) Reverse Action Valve (Close on-air failure) - Yellow
- c) Actuators for shutdown valves- Red

Items like air volume tanks etc. shall be painted as per corresponding Actuator.

### 3.9 END CONNECTIONS

- Unless otherwise mentioned, end connection details shall be as below:
  - a) Threaded end connections shall be to NPT as per ASME B 1.20.1.
  - b) Flanged end connections shall be as per ASME B 16.5
  - c) RTJ flanges shall be with octagonal Grooves as per ASME B 16.20
  - d) Flange face finish shall be as per ASME B16.5 and shall be
    - 125 AARH: 125 to 250 micro inch AARH
    - 63 AARH: 32 to 63 micro inch AARH
- Face-to-face dimensions of globe type on off valves shall be in accordance with standard specified in this specification.
- Where provided, on-off valve bottom drains shall be plugged off or blind flanged. Where a plug is used, threads shall correspond to ASME B 1.20.1 (NPT). Where a flange is used, its dimensions and rating shall correspond to ASME B 16.5.

### 3.10 SPECIAL REQUIREMENTS

#### On-Off Valve Stroke testing

Whenever specified in the data sheet / specifications, the operational integrity of the on-off valves shall be verified at regular intervals by performing physical testing without upsetting the process / operation. The methodology of testing adopted shall also be indicated in the data sheets. The testing scheme shall be designed by the vendor to meet specified operational functional and safety requirements specified below.

#### Manual Valve Testing (MVT)

Manual valve testing scheme shall be designed by the vendor to ensure operational integrity of actuating components i.e. solenoid valves etc. without stroking the on-off valve. The test hardware shall meet the following requirements;

The manual valve testing scheme shall be designed and supplied complete with minimum two solenoid valves, a two position (normal test) manual switch (with lock) and a pressure gauge (50mm dial). The scheme shall meet the following functional requirements;

- a) There shall be no upset or disturbance in the process while carrying out MVT. The solenoid valves, therefore shall be pneumatically tubed in 2 out of 2 configurations.

- b) While in test mode, the switch shall supply air supply to actuator bypassing the accessories. The solenoid valves are manually actuated one by one with their operational status indicated by pressure gauge.
- c) No software for MVT is in vendor's scope, however, an electrical contact rated for 110V, 0.5 A DC shall be provided to purchaser for audit trail when in test position.

### **Partial Stroke Testing (PST)**

Partial stroke testing shall be performed to ensure satisfactory operation of on-off valve including all accessories on demand. The test shall be performed automatically by partially (around 10%) stroking the valve while these valves are in service. The test hardware and software shall meet the following minimum requirements;

- a) Partial stroke test scheme shall be complete with all hardware and software which shall include solenoid valves, valve positioner and logic solver. All components used in PST shall be fail safe and shall not affect the on-off valve performance under any circumstances.
- b) The PST design shall ensure:
  - The testing shall be carried out automatically at pre-defined intervals which shall be adjustable.
  - The shutdown demand shall always over-ride if PST is in operation at that time.
  - The valve shall not operate beyond a predefined maximum allowable stroke valve under any condition or failure. When valve positioner is used to realize PST, the positioner output shall be limited beyond the allowable value in case of valve struck condition.
  - Audit trail shall be available to indicate time and date of PST, test results (OK 1 fail), reason of failure, changes made etc. as a minimum.
  - Upward connectivity to purchaser's Host system.
  - Vendor shall supply the complete testing assembly duly tubed / piped / wired on a SS mounting plate of thickness 3.2mm suitable for 2" pipe stanchion mounting. Standard pre-designed rigidly mounted components shall also be acceptable for PST assembly.

### **Volume tank**

Air Capacity Tanks shall be used on valves where there is a requirement to provide a driven failure action. Valves on critical service shall be supplemented with air capacity tanks as specified in the pneumatic scheme (Attachment 01). Air capacity tanks shall be sized to provide adequate air storage such that three valve operations may be obtained between available minimum air supply pressure. Fabrication of this tank shall be in accordance with ASME Section VIII Unfired Pressure Vessels.

The tanks shall be manufactured from carbon steel, painted and shall be to the pressure vessel code applicable to the project. The accumulators shall be provided with drain facilities. Non-return valve, Pressure Gauge & Safety valve shall be in the EPCC 1 scope & to be delivered along with buffer tank in completely mounted conditions. Safety valve shall be provided with Test certificate. All the accessories (tubing, fittings, Non-return valves) used for air capacity tanks shall be 316 Stainless Steel.

### Fire Safe Design Requirements

Wherever the valves are indicated as fire safe on the data sheets they shall be tested for fire safe as per BS 6755 (Part-2) when the valves are supplied with metal-to-metal seats and shall be tested as per API 607 latest edition when the valves are provided with soft seats. In case soft-seated valves with fire safe design are offered, vendor's design shall be such that soft seat is not damaged while closing/opening of the valve.

Wherever fire safe actuator and controls have been asked for, actuators and all accessories such as solenoid valves, air volume bottles etc. shall meet the fire proof requirement to ensure normal valve operation even during and after exposure to fire. Vendor shall clearly define the schemes they propose to achieve the above requirements and ensure that the proposed schemes shall meet the requirement in terms of type of exposure and exposure time of the testing procedure given in BS 6755/ API 607. Vendor must note that all items i.e. actuators, its accessories and interconnecting tubing including Volume bottles is required to be protected under fire exposure conditions. The fire protection methodologies like fully enclosed fireboxes or special material coverage are acceptable provided fire safe certification is provided for complete assembly as indicated above

Vendor shall furnish type test certificate duly witnessed by third party inspection agency like MIS LRIS, BV, DNV, TUV etc. for fire safe testing of valve, actuator and controls for the offered models along with the offer. Vendor to note that fire safe box up to maximum twice the surface area of fire box already satisfactorily fire safe type tested is acceptable provided the clearance inside the fire box with all accessories duly mounted are maintained equal to or greater than those maintained in fire safe box successfully type tested. In case, earlier fire safe test carried out by vendor is not applicable for quoted size hating of the valve, fire safe box, then vendor shall carry out the test for fire safe design for the offered valves / actuators & controls.

Backup volume bottles for the valve operation shall be designed in line with ASME Sec. VIII requirement. Each volume bottle shall be sized for a minimum of 3 valve strokes. Backup bottles shall also meet the requirement of fireproofing in case fireproof actuators and controls have been asked for.



#### 4.0 DOCUMENTATION

Post Order Documents to be submitted by the bidder for review/ approval.

<b>DOCUMENTATION REQUIREMENTS</b>	<b>REVIEW / APPROVAL</b>
Quality Assurance plan (QAP)	For Approval
Production schedule	For Review
Instrument datasheets	For Approval
Instrument G.A. / sizing sheets /Installation drawings	For Approval
Certified values of failure rates, probability of failure on demand (PFD) and test intervals for offered items for Safety Integrity Level (SIL) analysis	For Review
SIL data	For Review
DTM/EDDL file etc.	For Review
Bill of materials including spares	For Review

Note: Schedule of submission of the above documents shall be aligned to meet the delivery requirements.

Final documentation consisting of design data, installation manual, operation and maintenance manual etc., submitted by the vendor after placement of purchase order shall include the following, as a minimum;

- a) Data sheet/ Sizing Sheet for each On-Off valve with accessories.
- b) As- built drawings for each On-Off valve with accessories, providing dimensional details (face to face and height of completely assembled valve), Dimensions of clearance space for maintenance work, weight of completely assembled valve, constructional details, connection details, orientation with respect to flow direction marked on the body and material of construction.
- c) Type test certificates
- d) Copy of test certificates for all the tests as per MR and documents along with TPI- IRN.
- e) Installation procedure for each On-Off valve with accessories
- f) Calibration, configuration and maintenance procedures including replacement of its parts / internals wherever applicable.
- g) Valve operating signatures whenever smart positioners or field bus-based positioners are specified with On-Off valve.
- h) Device Descriptor (DD) Files for configuring the device parameters (Smart positioner /Fieldbus parameters)
- i) Common File Format (CFF) files for integrating the device into the system (soft copy).



- j) BOM including spares (if applicable)
- k) Product Catalogs of Main equipment and accessories/ bought outs.

Three hard copies in bound format and one soft copy in CD/ DVD of the above shall be submitted as final document.

## 5.0 NAME PLATE

Each On-Off valve and its accessories shall have a stainless-steel nameplate attached firmly to it at a visible place, furnishing the following information:

- a) Tag number as per data sheet.
- b) Body size, port size in inches
- c) Stem travel in milli-meters
- d) Action on Air failure
- e) Spring range
- f) Air supply pressure
- g) Manufacturers serial number and model number for Valve body, Actuator and positioner.
- h) Manufacturer's name/ trademark.

Other details as per MR shall also be suitably indicated on the Valve/ Actuator.

## 6.0 SHIPPING

All threaded and flanged openings shall be suitably protected to prevent entry of foreign material.

On-Off valve and its accessories shall be supplied preassembled and pre-tubed.

On-Off valves with external lubricators shall be lubricated before shipment.

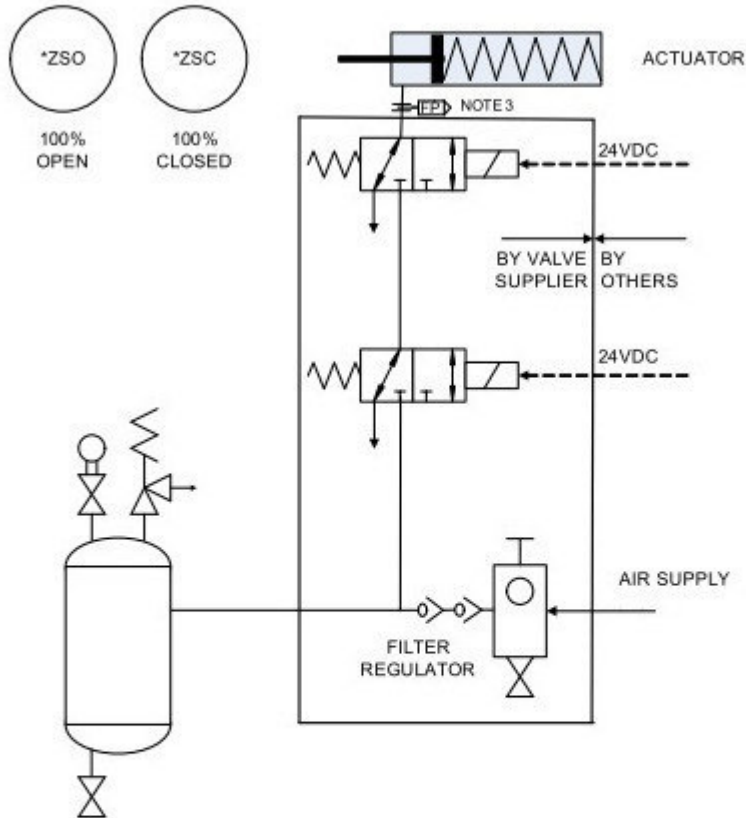
Instrument shall be supplied individually, in suitably sealed packing.

The consignment shall be packed and suitably labelled clearly indicating the following as minimum:

- a) Project Name and Location
- b) PO Number
- c) Packing List inside consignment (indicating Main Equipment Tag no, Accessories and Spares as applicable)
- d) Vendor Name and location of dispatch.

## 7.0 ATTACHMENT – 01

### SINGLE ACTING PNEUMATIC ACTUATOR WITH TWO SOLENOID VALVES AIR FAIL OPEN/CLOSE, VOLUME TANK FOR ACTUATION ON AIR FAILURE



CIRCUIT SHOWN DE-ENERGIZED, NO AIR OR ELECTRICAL POWER

**NOTES:**

1. PILOT VALVE TO BE PROVIDED TO PERMIT FAST VENTING OF ACTUATORS WHEN REQUIRED
2. VOLUME TANK SHALL BE SIZED FOR 3 STROKES.
3. FUSIBLE PLUG (FP) SHALL BE SUPPLIED & INSTALLED BY OTHERS, WHERE SPECIFIED ON THE DATASHEET



**DEPARTMENT:** INSTRUMENTATION  
**DOCUMENT NO:** 44AC9100-000-J.SS-0110-A4  
**DOCUMENT TITLE:** STANDARD SPECIFICATION FOR SAFETY / THERMAL RELIEF VALVES, RUPTURE DISCS AND BREATHER VALVES  
**ITEM:**  
**PROJECT NO:** 44AC9100  
**PROJECT LOCATION:** DUMAD/IOCL-JR, Gujarat  
**PROJECT TITLE:** EPCM/PMC SERVICES FOR ACRYLICS / OXO ALCOHOL PROJECT AT GUJARAT REFINERY AND DUMAD  
**CLIENT:** INDIAN OIL CORPORATION LIMITED  
**CLIENT PROJECT NO:**  
**CLIENT AUTHORIZATION:** MR. GAURAV DOLEY (DGM-PJ)  
**PM AUTHORIZATION:** MR. PAWAN GUPTA

				APPROVALS		
Rev. No.	Issue Date	Pages	Revision Description	Prepared	Checked	Approved
A	31-12-2018	12	ISSUED FOR BID	ARG	PV	PV
<input checked="" type="checkbox"/> Entire Document Issued this Revision <input type="checkbox"/> Revised Pages Only Issued this Revision			DOCUMENT ISSUED FOR: (please ✓ as applicable) <input type="checkbox"/> In-house Review <input type="checkbox"/> Purchase <input checked="" type="checkbox"/> Client Approval <input type="checkbox"/> Construction <input type="checkbox"/> Design			

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**1.0 GENERAL**

1.1 This specification, together with the datasheets, MR and special requirements (If any) covers the general requirements for design, manufacture, testing and supply of Safety / Thermal Relief Valves, Rupture discs and Breather valves and any other hardware as necessary.

1.2 In the event of any conflict between this standard specification, datasheet, statutory regulations, related codes, standards etc., the following order of priority shall govern:

1st priority	: Statutory Regulation requirement
2nd priority	: Process Licensor's documents
3rd priority	: Job Specifications & Job Drawings
4th priority	: Engineering Design Basis
5th priority	: Standard Specifications, standard Drawings & Engineering standards

Note: In case of any conflicts most stringent requirements shall be followed, however it shall be obligatory on the contractor's part to bring such conflicts to the notice of owner / PMC, wherein owner / PMC decision shall be final.

1.4 Individual Safety/Thermal relief valves, Rupture discs and Breather valves data sheets specify the material for wetted parts and flanges. Unless specifically indicated otherwise, alternate superior material of construction shall also be acceptable provided vendor assumes complete responsibility for the selected materials for their compatibility with the specified fluid and its operating conditions.

**1.5 PROJECT TITLE**

Project Name	:	EPCM/PMC Services for Acrylics/ Oxo-Alcohol Project at Gujarat Refinery and Dumad
Owner	:	Indian Oil Corporation Limited
Location	:	Dumad & Vadodara, Gujarat, India

## 2.0 CODES, STANDARDS AND REGULATIONS

Applicable national / international standards

Design and terminology shall comply, as a minimum, with the latest edition prior to the date of purchaser's enquiry of following codes, standard practices and publications:

<b>ASME</b>	<b>(American Society of Mechanical Engineers)</b>
Section – VIII	Boiler and Pressure Vessel code rules for construction of pressure vessels (Year- 2017)
<b>API</b>	<b>(American Petroleum Institute)</b>
API RP520	Sizing, selection & installation of pressure relieving system in refineries. Part I -Sizing and selection, 9 <sup>th</sup> edition (Year- July 2014) Part II-Installation 6 <sup>th</sup> edition (Year- March 2015)
API RP521	Pressure relieving and depressurizing systems. 6th Edition April 2009
API RP526	Flanged steel safety relief valves. 6th edition Apr. 2009
API RP527	Seat tightness of pressure relief valves 4th Edition Nov 2014
API 598	Valve Inspection and Testing (10th edition, October 2016)
API 2000	Venting Atmospheric and Low-Pressure Storage Tanks (Year-2014)
<b>IEC</b>	<b>(International Electro-Technical Commission.)</b>
EN 60529	Degrees of Protection Provided by Enclosures. (IP Code) -(Year- 2013)
<b>ISA</b>	<b>(Instrument Society of America)</b>
ISA 5.1	Instrument symbols and Identification (Year- 2009)
ISA 5.3	Graphic symbols for Distributed Control/Shared Display Instrumentation Logic and Computer symbols (Year – 1983)
<b>ISO</b>	<b>(International Organization for standardization)</b>
ISO 10497	Testing of valves - Fire type-testing requirements
<b>Other standards:</b>	
NEC	National Electric code.
NEMA	National Electrical Manufacturer's Association
NFPA	National Fire Protection Association.
NFPA-496	Purged and pressurized enclosures for electrical equipment (Year 2017)
OSHA	Occupational Safety and Health Authority.
IBR	Indian Boiler Regulations 1950 (Including Amendments in year 2017)



### 3.0 TECHNICAL REQUIREMENTS

#### 3.1 RELIEF VALVE AND DESIGN

The vendor shall be responsible for the selection and sizing of the safety relief valves in accordance with the supplied process data.

Safety relief valves shall be designed, manufactured and sized in accordance with the recommendations of API RP526, API 527, API 520, API 521, ASME code for 'Boilers and Pressure Vessels' and Indian Boiler Regulations.

The calculated result should be used to select a relief valve whose effective flow area is the nearest size larger than the calculated area, as limited by the standard orifice areas available.

The calculated orifice areas, if given, in respective data sheets are indicative only. Vendor shall calculate the orifice areas as per the process data furnished and select the safety relief valves accordingly. Vendor shall furnish sizing calculations to Owner/ PMC for approval.

For two phase liquid / vapour relief application, the total orifice area shall be the sum of the orifice areas calculated individually for liquid and vapour.

Where Safety relief valves are provided on ASME coded boiler and pressure vessels, they shall be manufactured in accordance with ASME VIII and shall carry the ASME VIII code stamp.

Body drain with a plug shall be provided as a standard feature on every pressure relief valve.

Wherever stelling of disc and nozzle has been specified, it stands for stelling of the seat joint and the entire disc contour, unless otherwise specified.

Lifting levers shall be provided for valves used for steam service.

Bonnet shall be of the enclosed type in general. Open bonnet shall be used only for steam service.

Whenever the specified set pressure exceeds 70 kg /cm<sup>2</sup>g, vendor shall submit the leakage rate of valves for approval of purchaser.

Where bubble tightness is specified, there shall be no leakage or bubbles of air at the specified percentages of set pressure.

The percentage accumulation in case of pressure relief / safety valves shall be as follows for Steam Service.

- ASME SEC I	3%
- IBR (Before steam let-down station)	5%
- IBR (Distribution & Utilities) and ASME Section VIII	10%
- Gas, Vapour or liquid	10%
- Liquid for thermal Relief	20% or less
- Fire exposure on unfired pressure vessels with vapour	21%

### 3.2 VALVE CONSTRUCTION

In general, the material of construction shall be cast carbon steel (ASTM A216 Gr WCB) for body, SS316 (forged) for trim and cadmium plated CS for spring, unless otherwise specified on the datasheets. Tungsten alloy steel springs shall be used for temperature above 230 deg. C.

For safety relief valves in sour service:

- a) Carbon steel/Duplex SS /Incoloy 825 shall meet the requirements of NACE MR-01-75 latest edition and other job specific requirements as mentioned in datasheets.
- b) Materials other than CS/Duplex SS / Incoloy 825 shall meet the requirements of NACE MR-01-75 latest edition and all the castings and welding shall be 100% radiographed.

Normally full nozzle, full lift type valves shall be supplied for sizes 1" and larger/ the nozzle bushing shall extend through and beyond the inlet flange base and shall form the gasket bearing surface for the inlet flange.

Flanged safety relief valves shall have enclosed spring bolted bonnet, screwed cap with a tapped and plugged vent for easy conversion to balanced bellows type valves. Bellows safety valves shall be considered wherever back pressure exceeds 10% of the set pressure. Bellows material shall be same as trim material as a minimum.

Open bonnet type safety valves along with lifting lever shall be used for water above 60°C, air and steam services.

Flanged connections shall be as per ANSI B16.5 and the rating shall be as per the piping material specifications as indicated in the data sheets. However, vendor shall confirm the flange ratings as per his sizing calculations.

Centre to center dimensions shall be as per the latest edition of API Std 526.

Testing for seat tightness shall be accordance with the latest edition of API Std.527. Soft seating (coring) shall be provided wherever tight shutoff is called for.

Safety relief valves for set pressure of 17.5 kg/sq.cm. (250 psig) or less shall have springs suitable for a range of adjustment of plus or minus 10% of the set pressure.

Safety relief valves set at pressures higher than 17.5 Kg/Sq.cm.g(250 psig) shall have springs suitable for range of adjustment of plus or minus 5% of the set pressure. Range identification shall be provided on the spring.

The allowable tolerance in set pressures are as below:

- a) + 0.14 kg/cm<sup>2</sup>g for set pressure upto and including 5 kg/cm<sup>2</sup>g.
- b) + 3% for set pressure above 5 kg/cm<sup>2</sup>g.

Safety relief valves shall be provided with tamper proof seals after factory set calibration.

#### Pilot Operated Safety / Relief Valves

Pilot operated safety/relief valves use the process pressure acting on the topside of the disk as the closing force. The pilot valve, which is a spring-loaded valve, connects the cavity above the disk either to the process or to the atmosphere, or a low-pressure system. Internal sensing for pilot shall be avoided as far as possible by providing remote pilot sense ports. The pilot

operated safety/relief valve can operate at process pressure close to the set pressure because of the high positive closing force which increases with the process pressure. Normally pilot operated valves should be provided with soft seals, which give a better valve tightness. The design features of a pilot operated valve allow for larger orifice sizes than the maximum 8T10 size for spring loaded valves. A field connection for checking the set pressure shall be provided.

#### Mechanical requirements

The design shall incorporate guiding arrangements necessary to ensure consistent operation and tightness.

The spring shall be designed so that the full lift spring compression shall be no greater than 80% of the nominal solid deflection. The permanent set of the spring (defined as the difference between the free height and height measured 10 mins. after the spring has been compressed solid three additional times after presetting at room temperature) shall not exceed 0.5% of the free height.

The valve seat shall be fastened to the valve body such that the valve seat shall not lift. test gag shall be provided for all pressure relief valves.

Valves shall be provided with provision for sealing of all external adjustments.

On valves where the design allows liquid to collect on the discharge side of the disk, the valve shall be provided with a drain at the lowest point.

Stems shall be of AISI 416 except if the body is austenitic stainless steel, when it shall be of 18.8% Cr.Ni.

#### Steam service

Pressure Relief Valves on steam service shall be provided with a lifting device to ensure the valve is free. Pressure tight packing shall be provided around the lifting lever assembly, so that leakage will not occur when the valve is opened or under back pressure.

The lifting device shall not hold the valve disk in the open position when the exterior lifting force is released.

Safety Relief Valves on steam service shall meet the requirements of the Indian Boiler Regulations.

Valves for steam service shall be flanged to ANSI B16.5. Serrated R.F. and shall have an open bonnet i.e. only with a yoke in place of a closed bonnet. They shall be provided with a weather hood \ when used in outdoor service.

Steam services above (750°F) 399°C shall be provided with a cooling spool between the body and bonnet to minimize conduction of heat to the spring.

Vendor shall furnish sizing calculations based on IBR formula. In this connection, vendor shall indicate the 'C' value as accepted by IBR.

### Thermal Expansion Relief Valves

Relief valves without blow down ring shall be used for liquid thermal expansion purposes.

3/4" x 1" threaded (NPT) modified nozzle type valves with typically 0.38 cm<sup>2</sup> orifice size shall be specified for thermal relief. If the piping material specification does not allow screwed connection, then flange connection shall be used.

### Relief Valve Installation

Safety and Safety Relief Valves shall always be mounted in a vertical position directly on nozzles having a well-rounded approach that provides smooth, unobstructed flow from the vessel or line to the valve.

Safety valves shall not be mounted on nozzles having an inside diameter smaller than the inlet connection to the valve, or on excessively long nozzles.

Discharge pipe work shall be piped upwards such that vapours or liquids are discharged vertically.

For optimum safety valve performance, discharge piping shall be supported independently of the valve.

For steam service slip joint drip pan elbows should be used, with the drip pan drain piped away to a safe location.

The installation of safety and safety relief valves shall be in accordance with the recommendations of API RP 520 Part II.

### Relief Valve Testing

Steam service valves shall be tested with steam. Where this facility is not available air may be used. When steam valves are tested with air all necessary corrections for differential in popping pressure between steam and air shall be determined by the vendor and submitted to the purchaser for approval.

For steam service valves not covered by API Std. 527, when leak tested there shall be no visible or audible leakage from the valve outlet when the inlet pressure is held at 95% of the set pressure after popping and reseating.

Valves marked for general service may be tested with air.

Liquid service valves shall preferably be tested with water but may be tested with air.

Valves shall be tested to demonstrate the popping point and tightness.

Pressure relief valves shall be type tested for capacity with 5% blowdown as per ASME Sec VIII UG 131 and actual blowdown of the individual valves shall meet the process requirement. All Valves shall be provided with such type test certificates.

For all relief valves test records and test certificates to fully cover component materials and the valve test details shall be provided.

#### Relief Valve Marking

The marks shall be placed on the valve or on a plate securely fastened to the valve. The marks shall be made in such a way that they will not be obliterated in service.

### 3.3 BREATHER VALVE SIZING & DESIGN

The breather valves shall have follow the listed specifications as a minimum during design. There shall be sufficient margin between the set pressure of breather valve and tank's design pressure / vacuum. Also, there should be sufficient difference between the set pressure of N2 blanketing system and breather valve.

Breather valves shall generally be soft seated, dead weight type and shall have self-draining body construction. The seating surfaces shall be shielded from condensates and the design shall prevent tendency of pallet to stick to the seat.

Vacuum breakers shall, in general, be sized and designed as per API 2000.

### 3.4 RUPTURE DISC DESIGN

Rupture discs shall be reverse buckling type, in general and shall be supplied in pre-torqued holder assembly which shall fit inside the inner diameter of the bolt circle of standard flanges. Disc and holder material shall be compatible with the process fluid. Inconel discs shall be used above 100°C if compatible with the process fluid.

When rupture disc is used upstream of a pressure relief valve, a pressure gauge shall be provided on the downstream of the disc to indicate any rupture of the disc in addition to an excess flow check valve. In addition, combination capacity factor of 0.9 shall be used for sizing unless the combination has been tested and approved for any other combination capacity factor. For such discs, a zero-manufacturing tolerance shall be considered.

The total tolerance of the rupture disc shall be  $\pm 5\%$  of the specified bursting pressure or less, unless otherwise specified. This shall include both the manufacturing tolerance and burst tolerance of the disc. All rupture discs shall be with 'J' bolt and tell-tale assembly consisting of pressure indicator, pressure switch and excess flow check valve.

Rupture discs on ASME coded pressure vessels shall carry the ASME UD stamp.

#### Rupture Disc Testing

All discs shall be tested by bursting 2 discs of every batch with a 'batch' being defined as a set of discs having the same size, material and set pressure.

All rupture discs and holders shall be provided with test records and test certificates to fully cover component materials and the disc test details.

#### Rupture Disc & Breather Valve Marking

The marks shall be placed on a plate securely fastened to the disc and disc holder. The marks shall be made in such a way that they will not be obliterated in service.

#### 4.0 DOCUMENTATION

Post Order Documents to be submitted by the bidder for review/ approval.

<b>DOCUMENTATION REQUIREMENTS</b>	<b>REVIEW / APPROVAL</b>
QUALITY ASSURANCE PLAN (QAP)	For Approval
PRODUCTION SCHEDULE	For Review
Safety Valve Datasheets	For Approval
Safety Valve G.A. / Installation drawings.	For Approval
Sizing calculations	For Approval
Bill of Materials including Spares	For Approval

Note: Schedule of submission of the above documents shall be aligned to meet the delivery requirements.

Final documentation consisting of design data, installation manual, operation and maintenance manual etc., submitted by the vendor after placement of purchase order shall include the following, as a minimum;

- c) Data sheet/ sizing calculation Sheet for Safety / Thermal Relief Valves / Rupture Discs / Breather Valves with accessories.
- d) General Arrangement Drawing of pipe connections
- e) Detailed installation instructions,
- f) Calibration procedure,
- g) Bill of materials showing manufacturer's catalogue numbers for all major components,
- h) Recommended spare parts for two years operation & commissioning
- i) A copy of the factory inspection sheet,
- j) Hazardous Area classification certificates for specified hazardous atmospheres.

Three hard copies in bound format and one soft copy in CD/ DVD of the above shall be submitted as final document.

## 5.0 NAME PLATE

Each Safety / Thermal Relief Valves / Rupture Discs / Breather Valves and its accessories shall have a stainless-steel nameplate attached firmly to it at a visible place, furnishing the following information:

- Tag number
- Vendors name
- Vendors design or type number (Model Number)
- Size (mm)
- Set Pressure (Set pressure for Vacuum / Gauge Pressure for Breather valves)
- Set Pressure at room temperature (Not applicable for Breather valves)
- Back pressure (constant or variable) (Not applicable for Breather valves)
- Capacity at overpressure (Not applicable for Breather valves)
- Orifice (standard letter designations)
- Cold setting
- Year of manufacture
- ASME or IBR symbol as required/ applicable.

## 6.0 SHIPPING

All threaded and flanged openings shall be suitably protected to prevent entry of foreign material.

Safety / Thermal Relief Valves / Rupture Discs / Breather Valves shall be supplied, in suitably sealed packing.

Proper care shall be taken in shipping Safety / Thermal Relief Valves / Rupture Discs / Breather Valves to ensure safety of the process analysers and system, where specified.

The consignment shall be packed and suitably labelled clearly indicating the following as minimum:

- a) Project Name and Location
- b) PO Number
- c) Packing List inside consignment (indicating Main Equipment Tag no, Accessories and Spares as applicable)
- d) Vendor Name and location of dispatch.





**DEPARTMENT:** INSTRUMENTATION  
**DOCUMENT NO:** 44AC9100-000-J.SS-0112-A4  
**DOCUMENT TITLE:** STANDARD SPECIFICATION FOR ELECTRONIC TRANSMITTERS  
**ITEM:**  
**PROJECT NO:** 44AC9100  
**PROJECT LOCATION:** DUMAD/IOCL-JR, Gujarat  
**PROJECT TITLE:** EPCM/PMC SERVICES FOR ACRYLICS / OXO ALCOHOL PROJECT AT GUJARAT REFINERY AND DUMAD  
**CLIENT:** INDIAN OIL CORPORATION LIMITED  
**CLIENT PROJECT NO:**  
**CLIENT AUTHORIZATION:** MR. GAURAV DOLEY (DGM-PJ)  
**PM AUTHORIZATION:** MR. PAWAN GUPTA

				APPROVALS		
Rev. No.	Issue Date	Pages	Revision Description	Prepared	Checked	Approved
A	29-12-2018	13	ISSUED FOR BID	ARG	PV	PV
<input checked="" type="checkbox"/> Entire Document Issued this Revision			DOCUMENT ISSUED FOR: (please <input checked="" type="checkbox"/> as applicable)			
<input type="checkbox"/> Revised Pages Only Issued this Revision			<input type="checkbox"/> In-house Review	<input type="checkbox"/> Purchase		
			<input type="checkbox"/> Client Approval	<input type="checkbox"/> Construction		
			<input type="checkbox"/> Design			

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**1.0 GENERAL**

1.1 This specification, together with the datasheets, MR and special requirements (If any) covers the general requirements for instrumentation design, materials, name plate marking, inspection, testing and shipping of Electronic Transmitters along with their accessories.

1.2 The Electronic Transmitters and its accessories shall be supplied in fully assembled condition.

1.3 In the event of any conflict between this standard specification, datasheet, statutory regulations, related codes, standards etc., the following order of priority shall govern:

- 1st priority : Statutory Regulation requirement
- 2nd priority : Process Licensor's documents
- 3rd priority : Job Specifications & Job Drawings
- 4th priority : Engineering Design Basis
- 5th priority : Standard Specifications, standard Drawings & Engineering standards

Note: In case of any conflicts most stringent requirements shall be followed, however it shall be obligatory on the contractor's part to bring such conflicts to the notice of owner/PMC, wherein owner/PMC decision shall be final.

1.4 Individual Electronic Transmitters data sheets specify the material for wetted parts and flanges. Unless specifically indicated otherwise, alternate superior material of construction shall also be acceptable provided vendor assumes complete responsibility for the selected materials for their compatibility with the specified fluid and its operating conditions.

**1.5 PROJECT TITLE**

- Project Name : EPCM/PMC Services for Acrylics/ Oxo-Alcohol Project at Gujarat Refinery and Dumad
- Owner : Indian Oil Corporation Limited
- Location : Dumad & Vadodara, Gujarat, India

## 2.0 CODES, STANDARDS AND REGULATIONS

Applicable national / international standards

Design and terminology shall comply, as a minimum, with the latest edition prior to the date of purchaser's enquiry of following codes, standard practices and publications:

<b>ASME</b>	<b>(American Society of Mechanical Engineers)</b>
B 1.20.1	Pipe Threads General Purpose (inch) (Year - 2013)
B 16.5	Steel Pipe Flanges and Flanged Fittings (Year- 2017)
B 16.20	Metallic Gaskets for Pipe Flanges-Ring joint, spiral wound and jacketed (Year- 2012)
<b>EN</b>	<b>European standards</b>
10204	Inspection Documents for Metallic Products
<b>IS / IEC</b>	<b>Indian Standards / International Electro-Technical Commission.</b>
IS / IEC 60079	Electrical apparatus for Explosive Gas atmosphere (Year -2017)
IEC 60079-1	Explosive atmosphere equipment protection by flameproof enclosure 'D' (Year -20014 & 2018)
IEC 61000-4-3	Electromagnetic Compatibility-Part-4-3 Testing and measurement techniques - Radiated, radio-frequency, electromagnetic field immunity test (Year-2010).
IEC 61000-4-4	Testing and Measurement techniques – Electrical Fast Transient/burst Immunity Tests
IEC 61000-4-5	Testing and Measurement techniques – Surge Immunity
IEC 61508	Functional safety of Electrical/Electronic Programmable Electronic Safety Related System (Year-2010)
IEC 61511	Functional safety: safety Instrumented systems for the Process Industry sector (Year-2017)
IEC 61158	Digital data communications for measurement and control –. Fieldbus specification.
IS/IEC 60529	Degrees of Protection Provided by Enclosures (IP Code) - (Year- 2015)
IEC 61804	Function blocks (FB) for process control - Electronic Device Description (Year- 2018).
IEC 61518	Mating dimensions between differential pressure (type) measuring instruments and flanged-on shut-off devices up to 413 bar (41,3 MPa)
<b>ISA</b>	<b>(Instrument Society of America)</b>
ISA S 7.3	Quality Standard for Instrument Air
ISA S 50.1	Compatibility of Analog Signals for Electronic Industrial Process Instruments.
<b>Other standards:</b>	
NEC	National Electric code.
NACE MR-0103	Materials Resistant to Sulphide stress cracking in Corrosive Petroleum. Refinery Environments.
IBR	Indian Boiler Regulations 1950 (Including Amendments in year 2017)
AG-181	FOUNDATION™ Fieldbus System Engineering Guidelines
ITK	Interoperability Test Kit (6.3.0 or the latest version)

### 3.0 DESIGN REQUIREMENTS

#### 3.1 GENERAL REQUIREMENTS FOR ELECTRONIC TRANSMITTER

- The range of instruments shall be selected by vendor based on the set range indicated in the data sheet. Where no set range is indicated, vendor to select the same as per the following guidelines:
  - a) The set range shall be 1.1 times the maximum process value or 1.4 times the operating process value whichever is higher rounded to the nearest ten.
  - b) The set range shall preferably be in the middle third of the selected instrument range.
- Measuring element in vacuum service shall have under range protection down to full vacuum, without undergoing a change in calibration or permanent set.
- Unless otherwise specified, diaphragm seal instrument shall meet the following requirements:
  - a) Instruments shall have its diaphragm seal (flanged type) integral with the instrument. In case wafer type diaphragm seal is provided, it shall be supplied with companion flange.
  - b) When Data sheets specify wafer seal type of instrument, vendor shall include supply of studs, nuts and gasket as per the materials specified in the Data sheet.
  - c) The sealant shall be an inert liquid, compatible with the process fluid and process temperature indicated in the Data sheets. In general, sealant shall be:
    - I. DC 704 or equivalent for all diaphragm seal instruments except for oxygen and chlorine.
    - II. Fluoro-lube or equivalent for all diaphragm seal instruments in oxygen and chlorine.
  - d) The requirement of spacer ring shall be as specified in Data sheet. The material of construction of spacer ring shall be 316 Stainless Steel, as a minimum unless otherwise specified in the Data sheets.
  - e) The span of the offered model shall be selected to ensure zero elevation/zero suppression equal to the head created by the fill fluid for the specified capillary length in the data sheet.
- Wherever Data sheet specifies integral flow transmitter, vendor shall supply complete assembly consisting of integral orifice, upstream and downstream meter runs with end flanges. Unless otherwise specified, material of construction shall be 316 Stainless Steel for integral orifice and meter run with flanges.
- The instrument enclosure shall be suitable for the area classification indicated in the Data sheets. Unless otherwise specified, the enclosure shall be Weatherproof housing IP-65 to IS/IEC- 60529 as well as Flameproof/ Ex (d) as per IS/IEC-60079. Unless otherwise specified, the finish shall be as per manufacturer's standard and shall be suitable for sulphurous, salt laden environmental conditions.
- Unless otherwise specified, the electronic transmitters shall be certified intrinsically safe.
- Electrical cable entries shall have ½" NPT threaded connection. Process connections on instruments other than analysers shall be 1/2" NPT female. Mounting accessories and brackets shall be supplied along with transmitters.
- All electronic instruments in oxygen and chlorine service shall be thoroughly degreased using reagents like trichloro-ethylene or carbon tetrachloride. End connection shall be blinded / plugged

after the degreasing process to avoid entrance of grease or oil particles. PMS shall be followed for details of procedure for Oxygen service instruments.

- Measurement linearization shall be accomplished in the transmitter, e.g.: square root extraction of differential pressure flow measurement.
- Unless otherwise specified, Accuracy/ Rangeability of transmitters, smart as well as field bus Based, shall be as follows:

Type of Transmitter	Accuracy/Rangeability
Direct Standard Transmitters	<p><b>Static Pressure:</b> 100 kg/cm<sup>2</sup> minimum</p> <p><b>Overall rangeability:</b> 1:100</p> <p><b>Accuracy:</b> Equal to or better than <math>\pm 0.075\%</math> of span within a turndown ratio of 1:10</p>
Diaphragm seal	<p><b>Static Pressure:</b> As per flange rating</p> <p><b>Overall rangeability:</b> 1:30</p> <p><b>Accuracy:</b> Equal to or better than <math>\pm 0.25\%</math> of span within a turndown ratio of 1:10</p>
Draft range transmitters	<p><b>Static Pressure:</b> As required</p> <p><b>Overall rangeability:</b> 1:30</p> <p><b>Accuracy:</b> Equal to or better than <math>\pm 0.15\%</math> of span within a turndown ratio of 1:10</p>

- The accuracy is defined as the combined effect of repeatability, linearity and hysteresis.

### 3.2 DESIGN REQUIREMENTS FOR ELECTRONIC TRANSMITTER

- All instruments shall be of state-of-the-art technology and shall comply with the electromagnetic compatibility requirements specified in IEC-61000-4 standard.
- Plug-in circuit boards shall be designed and manufactured such that reverse insertion or insertion of the wrong card is prevented.
- Electronic instruments shall generally operate on nominal voltage of 24 VDC and shall be protected against short circuit and reverse voltage. Transmission and output signal shall generally be 4 to 20 mA DC for Analog and Smart transmitters.
- The display of integral output meter shall be in engineering units for pressure, differential pressure, flow & Temperature and 100% linear for level.
- Electronic transmitters with two-wire system shall be suitable for delivering rated current to an external loop resistance of at least 600ohm when powered with 24 V DC.
- Terminals for electrical connections shall be clearly identified, and polarity shall be permanently

marked.

### 3.3 DESIGN REQUIREMENTS FOR SMART AND FIELDBUS BASED TRANSMITTER

- Smart and field-bus based transmitters shall be two-wire microprocessor-based type. These shall have a non-volatile memory, storing, complete sensor characterization and configuration data of the transmitter. All necessary signal conversions and output generation with the required protocol shall be carried out in the transmitter electronics. Integral output meter with LCD display shall be provided for all transmitters.
- Transmitter shall also run complete diagnostic subroutines and shall provide diagnostic alarm messages for sensor as well as transmitter healthiness. Field-bus based transmitter in addition shall have facility to detect plugged impulse lines, whenever specifically indicated in purchaser's data sheets. In the event of detection failure, the output shall be driven to a predefined value, which shall be field configurable.
- The transmitters with field bus connectivity shall have built in control algorithm like proportional, proportional-integral and proportional-integral-differential.
- The meter electronics shall be provided with in-built lightning and power supply surges. The transient protection shall meet the requirements specified in IEC-61000-4.
- The configuration data of the instruments shall be stored in a non-volatile memory such that this remains unchanged because of power fluctuations or power off condition.
- The stability of the transmitters shall be equal to or better than +0.1% of span for a period of minimum 6 months, as a minimum.
- In the transmitter, the 'WRITE' option shall be protected through password.
- Following features must be ensured for Smart HART transmitters;
  - a) It shall allow multi masters (two for example, primary and secondary) for configuration, calibration, diagnostics and maintenance. The primary could be the control system or host computer and secondary could be the hand-held communicator.
  - b) It shall be capable to implement universal commands from either of these locations.

### 3.4 EXCLUSIVE DESIGN REQUIREMENTS FOR FIELDBUS TRANSMITTER

In addition to the requirements mentioned elsewhere in the specification, field-bus based transmitter shall meet the following requirements:

- Data sheet indicates calculated flow co-efficient values at minimum, normal and maximum operating conditions. Vendor shall calculate this co-efficient as per the offered control valve and All instruments must satisfy the requirements of the field bus registration laboratory with applicable checkmark like foundation field bus, profibus NutZer organisation e.v (PNO), or as specified in the Data sheets.
- All instruments shall be polarity insensitive. Also, transmitter shall be LAS capable and provided with line plugging detection, whenever specified in data sheet.
- All instruments shall have one no. of Analog Input (AI) block and One no. of Proportional, Integration and Differential (PID) control block, as a minimum. All function blocks supplied with the device shall be instantiated by the device manufacturer. AI block execution time shall be better than 45ms and

PID block execution time shall be better than 60msec.

- All instruments must be interoperable including maximizing of the associated advanced diagnostic features coupled to asset management capabilities within DCS System and shall have valid interoperability test clearance like ITK latest version for foundation field bus.
- The field bus instruments shall support peer to peer communication.
- The field bus instruments in hazardous area shall be certified as per entity concept or shall be FISCO approved as per the requirements specified in the purchaser's specification.
- All instruments shall support EDDL or FDT/DTM requirements, as specified in data sheets.
- Internal Software shall be configured by the vendor including the following information.
  - Serial Number
  - Device Tag (TagNo.)
  - Process Description
  -
- All instruments shall support incremental Device Descriptor (DD) for extra functionality and/or software revisions in Device Memory.

### 3.5 EXCLUSIVE DESIGN REQUIREMENTS FOR TEMPERATURE TRANSMITTER

In addition to the requirements mentioned elsewhere in the specification, Temperature transmitter shall meet the following requirements:

- Temperature transmitter shall be universal type and shall be able to accept input from resistance temperature detector (RTD) or thermocouple (T/C) of any type and range.
- Temperature transmitters shall be freely programmable i.e. element type and range shall be programmable without any change in hardware / software.
- Temperature transmitter shall be remote mounted type, in general. Head mounted transmitters shall be supplied when specifically indicated in Data sheets.
- The accuracy of the temperature transmitter with RTD element shall be as follows:
  - a) For temperature range above 350 deg. C, the accuracy shall be equal to or better than  $\pm 0.075\%$  of range.
  - b) For temperature range with ranges between 350 deg. C to 150 deg. C, the accuracy shall be equal to or better than  $\pm 0.15\%$  of range.
  - c) For temperature range below 150 deg. C, the accuracy shall be equal to or better than  $+0.25\%$  of range.
- The accuracy of temperature transmitter with cold junction compensation for Thermocouple element shall be as follows;
  - a) For temperature above 350 deg. C, accuracy shall be  $\pm 0.25\%$  of range.
  - b) For temperature between 150 deg. C to 350 deg. C. accuracy shall be  $\pm 0.5\%$  of range
  - c) For temperature below 150 deg. C, accuracy shall be  $\pm 0.75\%$  of range.



### 3.6 DESIGN REQUIREMENTS FOR TRANSMITTER ACCESSORIES

#### 3.6.1 Field universal communicator

Hand held communicator for field bus and HART transmitters shall have minimum following features: -

- a) It shall be possible to perform routine configuration / calibration, display process variable, diagnostics etc. from Hand Held Communicator, which can be connected at any location in the transmitter loop. It shall be possible to perform all the above functions on line and the loop function shall remain unaffected.
  - b) There should be no interruption on the output while communicating with the transmitter.
  - c) Hand held communicator shall be universal type and shall be compatible with all make and models of HART transmitters and smart Positioners with all engineering capability like calibration, diagnostics, configuration, inhibition of HART signal etc. Similarly, Fieldbus Hand Held communicator shall also be universal type and shall be suitable for all make and models of FF transmitters and positioners.
  - d) It shall be possible to connect the communicator at any location at the following locations for digital communication:
    - i. Marshalling cabinet serving the transmitter, in safe area
    - ii. Junction box serving the transmitter in hazardous area
    - iii. Directly at the transmitter in hazardous area
- Plug in type connections shall be provided with field communicator. Necessary interconnection accessories shall be supplied by the vendor.
- e) Offered communicator shall be dustproof, certified intrinsically safe and suitable for outdoor location. Carrying case shall be supplied with each communicator. The software shall also be capable to configure the other makes of transmitters
  - f) They shall be powered with replaceable and rechargeable battery suitable for recharging with 240 V AC 50 HZ. In case vendor standard doesn't permit rechargeable battery, vendor shall supply two sets of additional batteries

#### 3.6.2 Remote Output meter

- a) Remote output meter shall be electronics with LCD display.
- b) The display shall be in actual engineering units
- c) Offered output meter shall be suitable for Intrinsically safe/FISCO when used in Hazardous as specified in datasheet.
- d) The field-bus based field indicator shall be 2 wire segments powered and shall be able to indicate minimum of 8 signals available in the field bus segment selectively
- e) Yoke mounted instruments shall be supplied with universal mounting brackets, U bolt and nuts suitable for mounting the instrument on 50 mm (nominal bore) pipe stanchion (horizontal or vertical)

#### 3.6.3 Battery Charger

Battery charger shall be supplied with all the necessary accessories and shall be suitable for 240 VAC +/- 10% 50HZ +/- 3 Hz unless otherwise specified.

### 3.7 END CONNECTIONS

Unless otherwise mentioned, end connection details shall be as below:

- a) Threaded end connections shall be to NPT as per ASME B 1.20.1.
- b) Flanged end connections shall be as per ASME B 16.5.
- c) RTJ flanges shall be with octagonal Grooves as per ASME B 16.20
- d) When Flanges are Raised Face type, the face finish shall be as per ASME B16.5 and shall be:
  - 125 AARH: 125 to 250 micro inch AARH
  - 63 AARH: 32 to 63 micro inch AARH

**4.0 DOCUMENTATION**

Post Order Documents to be submitted by the bidder for review/ approval.

<b>DOCUMENTATION REQUIREMENTS</b>	<b>REVIEW / APPROVAL</b>
QUALITY ASSURANCE PLAN (QAP)	For Approval
PRODUCTION SCHEDULE	For Review
INSTRUMENT DATA SHEETS	For Approval
INSTRUMENT G.A. / INSTALLATION DRAWINGS	For Approval
certified values of failure rates, probability of failure on demand (PFD) and test intervals for offered items for Safety Integrity Level (SIL) analysis	For Review
SIL data	For Review
DTM/EDDL file etc.	For Review
Bill of Materials including Spares	For Review

Note: Schedule of submission of the above documents shall be aligned to meet the delivery requirements.

Final documentation consisting of design data, installation manual, operation and maintenance manual etc., submitted by the vendor after placement of purchase order shall include the following, as a minimum;

- a) Data sheet/ Sizing Sheet for each Electronic transmitter with accessories.
- b) As- built drawings for each Electronic transmitter with accessories, providing dimensional details, constructional details, connection details and material of construction.
- c) Copy of test certificates for all the tests as per MR and documents along with TPI / IRN.
- d) Installation procedure for each Electronic transmitter with their accessories.
- e) Calibration, configuration and maintenance procedures including replacement of its parts / internals wherever applicable.
- f) Device Descriptor (DD) Files/EDDL file/DTM files for configuring the device parameters (Soft Copy)
- g) Common File Format (CFF) files for integrating the device into the system (Soft COPY).
- h) DD/ITK/CFF Revision number
- i) Calculations for integral orifice
- j) BOM including spares (if applicable)
- k) SIL data
- l) Product Catalogs of Main equipment and accessories/ bought-outs.

Three hard copies in bound format and one soft copy in CD/ DVD of the above shall be submitted as final document.

## 5.0 NAME PLATE

Each Electronic transmitter and its accessories shall have a stainless-steel nameplate attached firmly to it at a visible place, furnishing the following information:

- a) Tag number as per data sheet.
- b) Manufacturers serial number and model number.
- c) Manufacturer's name/ trademark.
- d) Hazardous area certification number and marking
- e) Operating power supply voltage and frequency.
- f) Specified range and units of measurements.

## 6.0 SHIPPING

All threaded and flanged openings shall be suitably protected to prevent entry of foreign material.

Instrument shall be supplied individually, in suitably sealed packing.

Proper care shall be taken in shipping gauges with diaphragm seals to ensure safety of the diaphragm seals, extensions, capillaries, where specified.

The consignment shall be packed and suitably labelled clearly indicating the following as minimum:

- a) Project Name and Location
- b) PO Number
- c) Packing List inside consignment (indicating Main Equipment Tag no, Accessories and Spares as applicable)
- d) Vendor Name and location of dispatch.



**DEPARTMENT:** INSTRUMENTATION  
**DOCUMENT NO:** 44AC9100-000-J.SS-0113-A4  
**DOCUMENT TITLE:** STANDARD SPECIFICATION FOR CABLES AND RELATED ACCESSORIES  
**ITEM:**  
**PROJECT NO:** 44AC9100  
**PROJECT LOCATION:** DUMAD/IOCL-JR, Gujarat  
**PROJECT TITLE:** EPCM/PMC SERVICES FOR ACRYLICS / OXO ALCOHOL PROJECT AT GUJARAT REFINERY AND DUMAD  
**CLIENT:** INDIAN OIL CORPORATION LIMITED  
**CLIENT PROJECT NO:**  
**CLIENT AUTHORIZATION:** MR. GAURAV DOLEY (DGM-PJ)  
**PM AUTHORIZATION:** MR. PAWAN GUPTA

				APPROVALS		
Rev. No.	Issue Date	Pages	Revision Description	Prepared	Checked	Approved
A	26-12-2018	14	ISSUED FOR BID	ARG	PV	PV
<input checked="" type="checkbox"/> Entire Document Issued this Revision			DOCUMENT ISSUED FOR: (please <input checked="" type="checkbox"/> as applicable)			
<input type="checkbox"/> Revised Pages Only Issued this Revision			<input type="checkbox"/> In-house Review	<input type="checkbox"/> Purchase		
			<input type="checkbox"/> Client Approval	<input type="checkbox"/> Construction		
			<input type="checkbox"/> Design			

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**1.0 GENERAL**

1.1 This specification, together with the datasheets, MR and special requirements (If any) covers the general requirements for design, materials, name plate marking, inspection, testing and shipping of all signal & control cables and related accessories.

1.2 In the event of any conflict between this standard specification, datasheet, statutory regulations, related codes, standards etc., the following order of priority shall govern:

- 1st priority : Statutory Regulation requirement
- 2nd priority : Process Licensor's documents
- 3rd priority : Job Specifications & Job Drawings
- 4th priority : Engineering Design Basis
- 5th priority : Standard Specifications, standard Drawings & Engineering standards

Note: In case of any conflicts most stringent requirements shall be followed, however it shall be obligatory on the contractor's part to bring such conflicts to the notice of owner / PMC, wherein owner / PMC decision shall be final.

**1.4 PROJECT TITLE**

- Project Name : EPCM/PMC Services for Acrylics/ Oxo-Alcohol Project at Gujarat Refinery and Dumad
- Owner : Indian Oil Corporation Limited
- Location : Dumad & Vadodara, Gujarat, India



## 2.0 CODES, STANDARDS AND REGULATIONS

Applicable national / international standards

Design and terminology shall comply, as a minimum, with the latest edition prior to the date of purchaser's enquiry of following codes, standard practices and publications:

### **ASTM**

#### **American Society for Testing and Materials**

- D 2843 Standard Test Method for Density of Smoke from the Burning or Decomposition of Plastics)
- D 2863 Test method for measuring the minimum oxygen concentration to support candle like combustion of plastics (oxygen index)

### **BS**

#### **British Standards**

- BS 5308 Part I Specification for Polyethylene insulated cables.  
BS 5308 Part II Specification for PVC insulated cables

### **EN**

#### **European standards**

- 10204 Inspection Documents for Metallic Products  
61056-1 Specification for performance, design and construction of valve, regulated sealed type.

### **IEC**

#### **International Electro-Technical Commission.**

- IEC 540 & 540A Test methods for insulation and sheaths of electric cables.  
IEC 60331 Testing of Fire Resistant cables.  
IEC 60332 Tests on bunched wires and cables  
IEC 60092 Electrical Installations of Cables  
IEC 60754 Test on Gases Evolved during Combustion of materials from Cables - Part 1,2.

### **IS**

#### **Indian Standards**

- 1554 Part 1 PVC insulated (heavy duty) electric cables-working voltage up to 1100 V  
3975 Mild steel wires, formed wires and tapes for armouring of cables.  
5831 PVC insulation and sheath of electric cables  
6380 Elastomeric insulation and sheath of electric cables  
6474 Polyethylene Insulation and sheath of electric cables  
10810 Methods of test for cables  
Part 40 Method for testing uniformity of coating on zinc coated articles.  
Part 41 Mass of zinc coating on steel armour  
Part 58 Oxygen Index test  
Part 59 Determination of halogen acid gas evolved during combustion of polymeric material taken from cables  
Part 61 Flame Retardant test  
Part 62 Flame Retardance test for bunched cables  
Part 63 Smoke density of electric cables under fire conditions

### 3.0 TECHNICAL REQUIREMENTS

- All cables shall be resistant to:
  - Water
  - Oil, in accordance with ICEA S-73-532
  - Sunlight (UV), in accordance with UL 1581 section 1200.
  
- All instrument cables shall be constructed to be gas/vapour tight and shall prevent transmission along length of cable.  
All cables shall have XLPE as primary insulation primary insulation of 850C PVC as per IS-5831 type C and inner and outer jacket shall be 900C PVC to IS-5831 type ST-2. Oxygen index of PVC shall be over 30% and temperature index shall be over 250 Deg.C.  
The insulation grade shall be 600 V/1100 V as a minimum and shall meet insulation resistance, voltage and spark test requirements as per BS-5308 Part-II
  
- All instrument cables shall be flame retardant as a minimum in accordance with the applicable tests in IEC 60332 or equivalent. Fire resistant cables shall be used for Safety Systems (ESD) and Gas Detection System (GDS) related instruments.  
Where cables are designated to be fire resistant, in addition to the requirements stated above:
  - They shall retain circuit integrity for 3 hours at 750°C in accordance with IEC 60331.
  - They shall be low smoke, zero halogen type in accordance with IEC 60754 and IEC 61034.
  - They shall be LSZH (Low smoke zero halogen) sheathed.
  
- All field cables (including communication cable) shall be armoured with galvanized steel wire/flat as per IS-1554 part-I.  
Inter panel Prefabricated Cables and network cables installed within Control Buildings/Satellite Rack Rooms/Instrument Buildings shall be un-armoured. However, power cable and signal cables shall be armoured even if they are installed inside building.  
The drain wire resistance including shield shall not exceed 30 ohms / km. A pair of communication wire shall be provided for multi-pair cables. Each wire shall be 0.5 mm<sup>2</sup> of plain annealed single or multi-strand copper conductor with 0.4 mm thick 85 Deg.C PVC insulation. Insulation shall be green and red colour coded.
  
- Conductors shall be stranded electrolytic annealed copper except for T/C extension cables  
Maximum dc resistance of the conductor of the cable shall be as per IS-8130
  
- Pairs and triads within multi-pair/triad cable shall be identified by the pair/triad number being printed continuously along the length of one core of the pair/triad.  
Run length of the cable shall be printed at least at every 5-meter interval.
  
- Signal cable and thermocouple cable shall be shielded. Shield shall be aluminium backed by mylar/polyester tape bonded together helically applied with the metallic side down with either side having 25% overlap and 100 % surface. Minimum shield thickness shall be 0.05 mm for single pair and 0.075 mm for multi pair cable. Drain wire shall be 0.5-mm<sup>2</sup> multi-strand bare tinned annealed copper conductor. The drain wire shall be in continuous contact with the aluminium side of the shield.
  
- Where instrument cables are required to be run in areas that may be contaminated by oil or chemicals they shall have an additional protective multi-layer sheath consisting of Aluminium foil/HDPE/Polyamide.

- Where cables are to be used for intrinsically safe signals they shall have the following characteristics:
  - Mutual capacitance shall be maximum 200nF/km.
  - Inductance shall be maximum 1mH/km.
  - L/R shall be maximum 30 $\mu$ H/ $\Omega$ .

### 1. Signal cables

All signal cables shall be twisted pair with a conductor size of 1.5 mm<sup>2</sup> minimum. Minimum conductor size of solenoid valve field cable shall be 1.5 mm<sup>2</sup> or 2.5 mm<sup>2</sup> as required. Single pair, shielded signal cables shall be used between field instruments and junction boxes/local control panels.

Multi pair individually and overall shielded signal cables shall be used between junction boxes/local control panels and SRR/ main control room, in general.

All multi pair cables shall have 6 pair/12 pairs only while multi triad cable shall have 6 triads/8 triads only. Conductor size shall be 0.75 mm<sup>2</sup> as minimum or higher cable conductor sizes can be selected based on voltage drop calculations.

For solenoid valve, multi-pair cable size shall be 1.5 mm<sup>2</sup> or higher cable conductor sizes can be selected based on voltage drop calculations.

### 2. Control/ Alarm Cables

All control/ alarm cables shall be twisted pair with a conductor size of 1.5 mm<sup>2</sup> minimum. Single pair, shielded cables shall be used between field instruments (on-off switches/ solenoid valves) and junction boxes/local control panels.

Multi core (12 or 24 core) control cables shall be used between junction boxes local control panel and SRR/ main control room mounted devices in general. These cables shall have only overall shielding and minimum conductor size shall be 1.5 mm<sup>2</sup>.

### 3. Thermocouple extension cables

- Single pair shielded thermocouple extension cables shall be used between thermocouple head and transmitters, junction boxes (only where Temperature transmitter can't be used) or local control panel mounted instruments.
- Multi-pair individually and overall shielded thermocouple extension cables shall be used between junction boxes and main control room mounted devices.
- The type of thermocouple extension cables shall be compatible with thermocouple used.
- The cable shall have 16 AWG and 18 AWG solid conductors for single and multi-pairs respectively as minimum.
- All thermocouple extension cable shall be matched and calibrated in accordance with MC-96.1 or equivalent.

### 4. Power supply cables

All power supply cables shall be as per IS-1554 Part I and shall have copper conductors. Minimum conductor size shall be 2.5 mm<sup>2</sup>. The cables shall be PVC/ LSZH insulated and armoured. The higher size conductors shall be used in case of long distance power cable where voltage drops more than 3 volts.

Any other type of cable (may be special cables), which is not specifically listed in this document but is required to make the instrument/ equipment work shall also be supplied.

### 3.1 CABLE CONSTRUCTIONAL REQUIREMENTS

- Primary insulation for PVC insulated cables, shall be 85°C polyvinyl chloride Type C as per IS 5831. Thickness of primary insulation shall be 0.5 mm as a minimum. For PE insulated cables, primary insulation shall be of 70 deg. C Polyethylene.
- Inner sheath colour of signal cables shall be black. Outer sheath colour shall also be black except for cables used in intrinsically safe systems. The outer sheath colour for all such cables used in intrinsically safe application shall be light blue. The thickness of the sheath shall be as per IS 1554 part 1.
- Inner and outer sheath of cable shall be flame retardant made of extruded PVC Type ST2 (90°C) as per IS 583 1 and shall meet the following requirements:
  - a) Minimum Oxygen index of PVC shall be 30 at 27 deg. C +/- 2 deg. C.
  - b) Temperature index shall be over 250 deg. C.
  - c) Inner and Outer sheath shall meet flame retardant requirements for bunched cables as per IS 108 10 (Part 62) category AF or IEC 60332 category A.
  - d) A rip cord shall be provided for inner sheath.
  - e) Outer sheath shall be suitable for protecting the cable against rodent and termite attack.
- Armour over inner sheath shall be of galvanised steel wire/flat. The dimensions of armour shall be as per IS 1554 (Part 1). Requirement and methods of tests for amour material and uniformity of galvanisation shall be as per IS 3975 and IS 10810 (Part 40) respectively.
- Each pair/triad shall be shielded. Shield shall be of aluminium backed by mylar / polyester tape bonded together helically applied with metallic side down having 25% overlap on either side and 100% coverage. Minimum shield thickness shall be 0.05 mm. Drain wire shall be 0.5 mm<sup>2</sup> multi-strand bare tinned annealed copper conductor. The drain wire shall be in continuous contact with aluminium side of the shield.
- Overall shield shall be of aluminium backed up by mylar /polyester tape helically applied with the metallic side down with either side having 25% overlap and 100% coverage. Minimum shield thickness shall be 0.075 mm. Drain wire shall be like individual pair/triad drain wire and shall be over the overall shield.
- The cores of a pair triad shall be twisted with a minimum of 10 twists per metre of cable.
- Sequential marking of the length of the cable in meters shall be provided on the outer sheath at every one meter. The embossing /engraving shall be legible and indelible.
- Tolerance in overall diameter of cable shall be within +/- 2 mm over offered value.
- The cables used in installations under the jurisdiction of Director General of Mines and Safety (DGMS) shall meet all requirements of DGMS. The word "Mining Cable" shall be embossed on the cable outer sheath as per IS 1554 (Part 1).

### 3.2 DRUM LENGTH AND LENGTH TOLERANCE

- The length of the cables in each drum (drum length) shall be as specified in the purchaser data sheets. Where no drum length is indicated in the data sheet /material requisition, the following shall be applied:
  - a) Drum length for single pair/ single triad cable: 500 metres
  - b) Drum length for multi-pair/ multi- triad cable: 1000 metres

#### 3.2.1 Specific requirements for Fire Resistant cables:

- The cables shall have circuit integrity as per IEC 60331.
- Primary insulation shall be heat resisting elastomeric which can withstand temperature up to 90°C such as silicon rubber/mica glass tape/EPR (medium grade) as per IS 6380. Insulation thickness shall be 1.0 mm minimum and shall confirm to IEC 60092.
- A wrapping of tape made of PETP (polyethylene terephthalate)/woven glass shall be provided over core insulation.
- Individual pair triad shall be shielded. The shield shall be aluminium backed by glass mica/PETP tape with the metallic side down helically applied with 25% overlap on either side and 100% coverage. Minimum shield thickness shall be as per IEC 60092. Drain wire shall be 0.5mm<sup>2</sup> (7/0.3mm dia) multi-stranded bare tinned annealed copper conductor. Drain wire shall be in continuous contact with aluminium side of the shield.
- Inner and outer sheath shall be made of low smoke, heat resistant, oil resistant and flame-retardant material with oxygen index over 30, temperature index shall be over 250°C. Acid generation shall be maximum 20% by weight as per IEC 60754. Smoke density rating not to exceed 60% as per ASTM D 2843.
- The thickness of the sheath shall be as per IEC 60092. Inner and outer sheath colour shall be orange. A rip cord shall be provided for inner sheath.
- Armour bedding over inner sheath shall be of special high oxygen index, low smoke halogen free fire resisting compound.

### 3.3 ELECTRICAL CHARACTERISTICS

- Maximum DC resistance of the conductor of the finished cable shall not exceed 12.3 Q / km at 20°C for cables with 1.5 mm<sup>2</sup> conductors and 39.7 Q / km at 20°C for cables with 0.5 mm<sup>2</sup> conductors.
- Mutual Capacitance for PVC Insulated cables: The mutual capacitance of between pairs/triads or adjacent cores shall not exceed of 250 pF / metre at a frequency of 1 KHz.
- Mutual Capacitance for PE Insulated cables: The mutual capacitance between the pairs/triads shall not exceed of 100 pF / metre at a frequency of 1 KHz.
- Capacitance between any core or screen: The capacitance between any core and screen shall not exceed a maximum of 400 pF / metre at a frequency of 1 KHz.
- L/R ratio of adjacent core shall not exceed 40 μH/Ω for cables with 1.5 mm<sup>2</sup> conductors and 25

- $\mu\text{H}/\Omega$  for cables with 0.5 mm conductors.
- The drain Wire resistance including shield shall not exceed 30  $\Omega$ / km.
- Electrostatic noise rejection ratio of the finished cable shall be over 76 dBA.

**3.4 TYPE I (SINGLE PAIR/ TRIAD SHIELDED)**

- Each core shall be 1.5 mm<sup>2</sup> made of 7 stranded annealed electrolytic copper conductors. Each strand shall be 0.53mm diameter.
- Colour of core insulation shall be black and blue in pair and black, blue and brown in a triad. Other requirements of this specifications shall be complied.

**3.5 TYPE-II (MULTI-PAIR/ TRIAD CABLE WITH INDIVIDUAL PAIR/TRIAD SHIELD AND OVERALL SHIELD)**

- Conductor sizes shall be 0.5mm<sup>2</sup> made up of 7 strands of annealed electrolytic copper conductor. Each strand shall be of 0.3 mm diameter.
- Overall twist of all pair/triads shall be as per vendor's standard.
- A pair of communication wire shall be provided for multipair/ multi-triad cables. Each wire shall be 0.5 mm<sup>2</sup> of plain annealed single or multi-strand copper conductor with 0.4 mm thick 85°C PVC insulation. Insulation shall be green and red colour coded.
- A pair identification shall be with numbers at interval of not more than 250 mm. Other requirements of this specifications shall be complied.

**3.6 TYPE-III (MULTI-PAIR / MULTI-TRIAD CABLE WITH ONLY OVERALL SHIELD)**

- The cable shall be same as type-II cable, except that the individual pair/triad shall not have shielding.

**3.7 TYPE-IV (MULTI-PAIR /MULTI-TRIAD CABLE WITH INDIVIDUAL PAIR SHIELD AND OVERALL SHIELD)**

- The cable shall be same as Type II, except conductor size shall be 1.5 mm<sup>2</sup> made of 7 stranded annealed electrolytic copper conductors. Each strand shall be of 0.53 mm dia.

**3.8 TYPE-V (MULTI-PAIR / MULTI-TRIAD CABLE WITH OVERALL SHIELD ONLY)**

- The cable shall be same as type IV except that the individual pair/triad shall not have the shielding.

**3.9 FIBRE OPTIC CABLE**

- The cable shall be single mode, 6 fibres or 12 fibres. Cable construction shall be Single Mode loose Buffer Fiber Optic cable, Flame Retardant Low Smoke (FRLS) Zero Halogen, armoured.
- For multi-mode fibre optic cable shall be either 12 fibres or 24 fibres. Cable construction shall be Multi Mode loose Buffer Fiber Optic cable, Flame Retardant Low Smoke (FRLS) Zero Halogen, armoured

#### 4.0 CABLE GLANDS

- CONTRACTOR shall supply all cable glands required for glanding cables both at field instrument and local control panel, junction boxes and at main control room / SRR.  
All cables glands shall be of type 304 SS; double compression type, flame proof with Ex(d) certificate suitable for armoured cables with PVC shrouds.

## 5.0 CABLE TRAYS AND CABLE DUCTS

- All cables on the main pipe rack shall be laid in cable duct. Cable ducts shall be made of G.I. sheets and shall be covered. Cable duct shall be epoxy painted.
- All cables to/ from the cable duct shall run on cable trays with cover. Tray shall be made of anodized aluminium as per IS 737. Anodized Aluminium perforated cable tray shall be used up to 300 mm size.
- For DM plant/SRU plant and corrosive services FRP cable tray shall be used for all sizes.
- Thickness of tray shall be minimum 2.0 mm for 50 mm wide tray, 3.0 mm for 100 to 400 mm wide and 4.0 mm for 500 mm wide tray.
- Suitable cable clamps shall be supplied for binding the cables/tubes at every 500 mm.
- The width shall be so selected that 50% of tray space is available for future use.
- Structural angles used for cable dropping to Junction Box or to field device shall be preferably galvanized.
- All cable trays and ducts shall be fire proofed.



**6.0 DOCUMENTATION**

Post Order Documents to be submitted by the bidder for review/ approval.

<b>DOCUMENTATION REQUIREMENTS</b>	<b>REVIEW / APPROVAL</b>
Quality Assurance plan (QAP)	For Approval
Production schedule	For Review
Datasheets	For Approval
Drum Schedule	For Approval
Spares	For Review

Note: Schedule of submission of the above documents shall be aligned to meet the delivery requirements.

Final documentation consisting of design data, installation manual, operation and maintenance manual etc., submitted by the vendor after placement of purchase order shall include the following, as a minimum;

- a) Specification sheet/ Data sheet for each type of cable.
- b) As- Cable details giving electrical characteristics, overall diameter, diameter under armour and diameter over armour.

Three hard copies in bound format and one soft copy in CD/ DVD of the above shall be submitted as final document.

**7.0 NAME PLATE**

- a) Manufacturer's name
- b) Type and size of cable with cable indicated in material requisition.
- c) Length of the cable in metres contained in the drum.
- d) Gross weight
- e) Drum Number
- f) Direction of rotation of drum for unwinding by means of an arrow
- g) Purchase order number.
- g) Manufacturers serial number for each cable.

Above details shall be marked on each drum. Other details as per MR shall also be suitably indicated.

## 8.0 SHIPPING

Cables shall be dispatched in wooden drums securely battened, with takeoff end fully protected against damage. Minimum number of eight PVC rubber end caps shall be shipped with each drum.

Each drum of the consignment shall be packed and suitably labelled clearly indicating the following as minimum:

- a) Project Name and Location
- b) PO Number
- c) Packing List inside consignment (Other details as per Nameplate details)
- d) Vendor Name and location of dispatch.



**DEPARTMENT:** INSTRUMENTATION  
**DOCUMENT NO:** 44AC9100-000-J.SS-0114-A4  
**DOCUMENT TITLE:** STANDARD SPECIFICATION FOR INSTRUMENT VALVES AND ACCESSORIES  
**ITEM:**  
**PROJECT NO:** 44AC9100  
**PROJECT LOCATION:** DUMAD/IOCL-JR, Gujarat  
**PROJECT TITLE:** EPCM/PMC SERVICES FOR ACRYLICS / OXO ALCOHOL PROJECT AT GUJARAT REFINERY AND DUMAD  
**CLIENT:** INDIAN OIL CORPORATION LIMITED  
**CLIENT PROJECT NO:**  
**CLIENT AUTHORIZATION:** MR. GAURAV DOLEY (DGM-PJ)  
**PM AUTHORIZATION:** MR. PAWAN GUPTA

				APPROVALS		
Rev. No.	Issue Date	Pages	Revision Description	Prepared	Checked	Approved
A	29-12-2018	10	ISSUED FOR BID	ARG	PV	PV
<input checked="" type="checkbox"/>	Entire Document Issued this Revision		DOCUMENT ISSUED FOR: (please ✓ as applicable)			
<input type="checkbox"/>	Revised Pages Only Issued this Revision		<input type="checkbox"/> In-house Review	<input type="checkbox"/> Purchase		
			<input type="checkbox"/> Client Approval	<input type="checkbox"/> Construction		
			<input type="checkbox"/> Design			

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**1.0 GENERAL**

1.1 This specification, together with the datasheets, MR and special requirements (If any) covers the general requirements for design, materials, name plate marking, inspection, testing and shipping of:

- a) Miniature Instrument Valve
- b) Instrument Valve Manifolds
- c) Instrument Air Valves

1.2 In the event of any conflict between this standard specification, datasheet, statutory regulations, related codes, standards etc., the following order of priority shall govern:

- 1st priority : Statutory Regulation requirement
- 2nd priority : Process Licensor's documents
- 3rd priority : Job Specifications & Job Drawings
- 4th priority : Engineering Design Basis
- 5th priority : Standard Specifications, standard Drawings & Engineering standards

Note: In case of any conflicts most stringent requirements shall be followed, however it shall be obligatory on the contractor's part to bring such conflicts to the notice of owner / PMC, wherein owner / PMC decision shall be final.

Enclosed data sheets specify the material for Instrument valves and Manifolds and its accessories. Unless specifically indicated otherwise, alternate superior material of construction shall also be acceptable provided vendor assumes complete responsibility for the selected materials for their compatibility with the specified fluid and its operating conditions.

**1.4 PROJECT TITLE**

Project Name : EPCM/PMC Services for Acrylics/ Oxo-Alcohol Project at Gujarat Refinery and Dumad  
Owner : Indian Oil Corporation Limited  
Location : Dumad & Vadodara, Gujarat, India

## 2.0 CODES, STANDARDS AND REGULATIONS

Applicable national / international standards

Design and terminology shall comply, as a minimum, with the latest edition prior to the date of purchaser's enquiry of following codes, standard practices and publications:

### **ASME**

#### **(American Society of Mechanical Engineers)**

ASME B 1.20.1	Pipe Threads General Purpose (inch) (Year - 2013)
ASME B 16.9	Factory made wrought steel Butt welding fitting
ASME B 16.11	Forged steel fittings-socket welding and threaded
ASME B 16.34	Valves- Flanged, Threaded & Welding End (Year- 2017)

### **API**

#### **(American Petroleum Institute)**

API 598	Valve Inspection and Testing
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### **EN**

#### **European standards**

10204	Inspection Documents for Metallic Products
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### **IBR**

**Indian Boiler Regulations** 1950 (Including Amendments in year 2017)

### **MSS**

**Manufacturers Standardization Society of the valve and Fitting Industry**

SP99	Instrument Valves
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### 3.0 DESIGN REQUIREMENTS

#### 3.1 GENERAL REQUIREMENTS

- Qualification test (Hydrostatic proof and burst test) as per MSS SP-99 shall be conducted by vendor for each design and size of the valve to establish the cold working pressure(CWP) rating.
- For all valves and manifolds with body material of Carbon steel/Stainless steel, the valve trim material shall be 316SS or superior. Whenever body material is other, trim material shall be same as body material or superior.
- Unless otherwise specified, valve packing material for all valves and manifolds shall be PTFE only. O ring material whenever used shall also be of PTFE.
- Finishing and tolerance of parts like stem, piston, stem threading etc. of the offered valves and manifolds shall be properly machined to avoid problems like galling.
- Hand wheel material for all valves and manifolds shall be Zinc/nickel plated carbon steel. Any other material, if provided as per standard vendor design shall also be acceptable.
- Minimum cold working pressure (CWP) rating of manifolds shall be as per the table below:

Sr. No.	Item	Line Pressure Class	Minimum Cold Working Pressure (CWP)	Hydrostatic Test Pressure for	
				Seat Leakage Test	Shell Leakage Test
1	Instrument Valves (Miniature)	≤ Class 600	102kg/cm <sup>2</sup> g	112kg/cm <sup>2</sup> g	153kg/cm <sup>2</sup> g
		≥ Class 900 to ≤ Class 1500	253kg/cm <sup>2</sup> g	278kg/cm <sup>2</sup> g	383kg/cm <sup>2</sup> g
2	Instrument Valve Manifolds	≤ Class 600	102kg/cm <sup>2</sup> g	112kg/cm <sup>2</sup> g	153kg/cm <sup>2</sup> g
		≥ Class 900 to ≤ Class 1500	253kg/cm <sup>2</sup> g	278kg/cm <sup>2</sup> g	383kg/cm <sup>2</sup> g
3	Instrument Air Isolation Valves	≤ Class 600	27kg/cm <sup>2</sup> g	30kg/cm <sup>2</sup> g	41kg/cm <sup>2</sup> g
4	Instrument Air Needle Valves	≤ Class 600	27kg/cm <sup>2</sup> g	30kg/cm <sup>2</sup> g	41kg/cm <sup>2</sup> g

#### 3.2 INSTRUMENT VALVE (MINIATURE)

- The instrument valve shall be of globe pattern needle valve forged/bar stock with inside screwed bonnet with back seated blow out proof system.
- Body Material shall be SS 316, unless specified otherwise.
- End connection shall be 1/2" NPTF to ASME B 1.20.1, unless specified otherwise.
- Flow direction shall be marked on the body.
- Valve dimension shall be as follows: -
  - a) End to End dimension: 76 mm approx.



- b) Height in fully open condition-135 mm max.

These dimensions are indicative only.

### 3.3 VALVE MANIFOLDS

#### 3.3.1 General requirements for Valve manifolds:

- The flanges shall be integral part of manifold block.
- Material of construction shall be SS 316 unless specified otherwise.
- Process connection shall be 1/2" NPTF to ASME B 1.20.1, unless specified otherwise.
- Wherever the manifolds are specified for stanchion mounting, these shall be supplied along with mounting accessories. The bolts and nuts shall be alloy steel as per ASTM A 193 Gr B7 and ASTM A194 Gr. 2H (Hot dip galvanised or Zinc plated) respectively. Other accessories shall be Zinc plated.

#### 3.3.2 3-way Valve manifold:

- 3-way valve manifold shall be designed for direct coupling to differential pressure transmitters having 2 bolt flanges with 54mm (2-1/8 ") center to center connections and 41.3 mm (1-5/8") bolt to bolt distance.
- 3-way valve manifold shall contain two main line block valves and equalising bypass valve. The valves shall be needle type. They shall use self-aligning 316 SS ball seats, unless specified otherwise.

#### 3.3.3 5-way Valve manifold:

- 5-way valve manifold shall be designed for direct coupling to differential pressure transmitters having 2 bolt flanges with 54 mm (2-1/8 ") center to center connections and 41.3 mm (1-5/8") bolt to bolt distance.
- 5-way valve manifold shall contain two main line block valves and a combination of double block and bleed for the bypass line. The valves shall be needle type or special ball with bleed hole.

#### 3.3.4 3-way/ 2-way Valve manifold for Pressure Gauges:

- Manifold shall be designed for use with Pressure gauge with block and bleed valves. The manifold body shall be either straight or angle type as specified in the datasheet.
- The valve shall be a needle type.
- Material of construction shall be SS 316 unless specified otherwise.
- Manifold shall have the following connections:
  - a) The inlet connection shall be 3/4" plain ends with a minimum of 100mm nipple extension suitable for socket weld or butt or butt weld as per B16.11/B16.9.
  - b) The gauge connection shall be with union nut and tail piece threaded to 1/2" NPTF.
  - c) The drain connection shall be 1/2" NPTF.

### 3.4 INSTRUMENT AIR VALVES

- Instrument Air Isolation valves (Miniature)
  - i. The valves shall be full bore ball type with forged body
  - ii. Material of construction shall be SS 316.
  - iii. End connection shall be 1/2" NPTF to ASME B 1.20.1, unless specified otherwise.
  - iv. End to end dimension shall be 70mm(approx.)
  
- Instrument Air needle valve (Miniature)
  - a) The instrument valves shall be globe pattern needle valve forged/bar stock with inside screwed bonnet.
  - b) Material of construction shall be SS 316.
  - c) End connection shall be 1/2" NPTF to ASME B 1.20.1, unless specified otherwise.
  - d) Flow direction shall be marked on the body
  - e) Valve dimension shall be as follows: -
    - i. End to end dimension shall be 54 mm(Approx.)
    - ii. Height in fully open condition- 49 mm (Approx.)

These dimensions are indicative only.

- All valves and manifolds tubes in oxygen and chlorine service shall be thoroughly degreased using reagents like trichloro-ethylene or carbon tetrachloride and end connections shall be plugged after degreasing process to avoid entrance of grease or oil particles.

#### 4.0 DOCUMENTATION

Post Order Documents to be submitted by the bidder for review/ approval.

<b>DOCUMENTATION REQUIREMENTS</b>	<b>REVIEW / APPROVAL</b>
Quality Assurance plan (QAP)	For Approval
Production schedule	For Review
Instrument Datasheets	For Approval
Instrument G.A./ Installation drawings.	For Approval
Bill of material including Spares	For Review

Note: Schedule of submission of the above documents shall be aligned to meet the delivery requirements.

Final documentation consisting of design data, installation manual, operation and maintenance manual etc., submitted by the vendor after placement of purchase order shall include the following, as a minimum;

- a) Specification sheet/ Data sheet for each type of instrument valve and Manifold.
- b) As built drawings, providing dimensional details, constructional details and material of construction.
- c) Copy of test certificates for all the tests as per MR and Documents along with TPI/ IRN.
- d) Installation and maintenance procedure.
- e) BOM including spares (if applicable)
- f) Product Catalogs of Main equipment and accessories/ bought-outs.

Three hard copies in bound format and one soft copy in CD/ DVD of the above shall be submitted as final document.

**5.0 NAME PLATE**

- a) Material of construction
- b) Cold working pressure of each item
- c) Manufacturer's name
- d) Manufacturers serial number and Model no.
- e) Flow direction (As applicable)

Other details as per MR shall also be suitably indicated on the valve/ Manifold.

## 6.0 SHIPPING

All threaded and flanged openings shall be suitably protected to prevent entry of foreign material.

The consignment shall be packed and suitably labelled clearly indicating the following as minimum:

- a) Project Name and Location
- b) PO Number
- c) Packing List inside consignment (indicating Main Equipment Tag no, Accessories and spares as applicable)
- d) Vendor Name and location of dispatch.



**DEPARTMENT:** INSTRUMENTATION  
**DOCUMENT NO:** 44AC9100-000-J.SS-0115-A4  
**DOCUMENT TITLE:** STANDARD SPECIFICATION FOR JUNCTION BOXES AND ACCESSORIES  
**ITEM:**  
**PROJECT NO:** 44AC9100  
**PROJECT LOCATION:** DUMAD/IOCL-JR, Gujarat  
**PROJECT TITLE:** EPCM/PMC SERVICES FOR ACRYLICS / OXO ALCOHOL PROJECT AT GUJARAT REFINERY AND DUMAD  
**CLIENT:** INDIAN OIL CORPORATION LIMITED  
**CLIENT PROJECT NO:**  
**CLIENT AUTHORIZATION:** MR. GAURAV DOLEY (DGM-PJ)  
**PM AUTHORIZATION:** MR. PAWAN GUPTA

				APPROVALS		
Rev. No.	Issue Date	Pages	Revision Description	Prepared	Checked	Approved
A	29-12-2018	10	ISSUED FOR BID	ARG	PV	PV
<input checked="" type="checkbox"/> Entire Document Issued this Revision		DOCUMENT ISSUED FOR: (please ✓ as applicable)				
<input type="checkbox"/> Revised Pages Only Issued this Revision		<input type="checkbox"/> In-house Review	<input type="checkbox"/> Client Approval	<input type="checkbox"/> Purchase	<input type="checkbox"/> Construction	
		<input type="checkbox"/> Design				

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**1.0 GENERAL**

1.1 This specification, together with the datasheets, MR and special requirements (If any) covers the general requirements for design, materials, nameplate marking, inspection, testing and shipping of Junction boxes and related accessories.

1.2 In the event of any conflict between this standard specification, datasheet, statutory regulations, related codes, standards etc., the following order of priority shall govern:

- 1st priority : Statutory Regulation requirement
- 2nd priority : Process Licensor's documents
- 3rd priority : Job Specifications & Job Drawings
- 4th priority : Engineering Design Basis
- 5th priority : Standard Specifications, standard Drawings & Engineering standards

Note: In case of any conflicts most stringent requirements shall be followed, however it shall be obligatory on the contractor's part to bring such conflicts to the notice of owner / PMC, wherein owner / PMC decision shall be final.

Enclosed data sheets specify the material for Junction Boxes with their accessories including Cable Glands. Unless specifically indicated otherwise, alternate superior material of construction shall also be acceptable provided vendor assumes complete responsibility for the selected materials for their compatibility with the specified fluid and its operating conditions.

**1.4 PROJECT TITLE**

- Project Name : EPCM/PMC Services for Acrylics/ Oxo-Alcohol Project at Gujarat Refinery and Dumad
- Owner : Indian Oil Corporation Limited
- Location : Dumad & Vadodara, Gujarat, India



## 2.0 CODES, STANDARDS AND REGULATIONS

Applicable national / international standards

Design and terminology shall comply, as a minimum, with the latest edition prior to the date of purchaser's enquiry of following codes, standard practices and publications:

<b>ASME</b>	<b>American Society of Mechanical Engineers</b>
B 1.20.1	Pipe Threads General purpose (Inch)
<b>EN</b>	<b>European standards</b>
10204	Inspection Documents for Metallic Products
<b>IS / IEC</b>	<b>Indian Standards / International Electro-Technical Commission.</b>
IS / IEC 60529	Degree of Protection Provided by Enclosures (IP Code).
IS / IEC 60079	Electrical Apparatus for Explosive Gas Atmosphere.
IS-5	Colours for ready mixed paints and enamels.

### 3.0 DESIGN REQUIREMENTS

The minimum technical requirements for Junction boxes are as follows:

- Junction boxes, Cable Glands and Plugs shall be of the following type:
  - a) Weather proof and flameproof
- Unless otherwise specified, the Junction Box, Cable Glands and Plugs shall conform to the following standards:
  - a) Weatherproof housing: IP 65 to IS / IEC-60529 and
  - b) Flameproof housing: Flameproof / Ex (d) (to Zone-1 IIA/B as minimum) as per IS / IEC-60079.
- Number of entries and their location shall be as per data sheets. Junction boxes with top entries shall not be offered. The size of cable entries shall be as per the cable sizes / Cable gland sizes indicated in the data sheet.
- Junction boxes shall be provided with telephone sockets and plugs for connection of hand-powered telephone set.
- The material of construction of junction boxes shall be cast light metal alloy preferably die-cast aluminium (LM6).
- Flameproof junction box shall have detachable cover, which shall be fixed to the box by means of cadmium plated triangular head/ hexagonal head screws.
- Terminals shall be spring loaded, vibration proof, screw type, mounted on nickel plated steel rails complete with end cover and clamps for each row.
- All terminals used in the junction boxes shall be suitable for accepting cable sizes between 0.5 mm<sup>2</sup> and minimum 6mm<sup>2</sup>.
- Junction Boxes shall have 2 entries for Multi pair/ triad cables and 12 entries for single pair/ triad cables. The junction boxes shall be supplied with cable glands with PVC sleeves/ shrouds and plugs for all the entries.
- All Cable glands shall be double compression type for use with armoured cables. The cable glands shall be of nickel plated brass, as a minimum.
- Unless higher number of terminals are specified in the purchaser's data sheet, the number of terminals in the junction boxes shall be 48 Nos in two rows duly numbered. The colouring of the terminals shall be Blue/ Grey.
- Junction boxes shall be provided with external earthing lugs.
- Sizing shall be done with due consideration for accessibility and maintenance in accordance with the following guidelines:
  - a) 50 mm (minimum) gap shall be maintained between terminals/ terminal strip and sides/ top/ bottom of the Junction box.
  - b) 100 mm (minimum) gap shall be maintained between the terminal strips
- Surface shall be prepared for painting. It shall be smooth and devoid of rust and scale. Two coats of lead-free base primer and two final coats of lead free epoxy-based paint shall be applied both

for interior and exterior surfaces. The colour shall be Light Blue/ Light Gray.

- Junction Box shall be PESO/CCOE approved, for specified hazardous area class based on gas group service. For Fieldbus cables, junction boxes shall be of SS with Increased safety (EExe) type.
- Junction boxes shall have terminals suitable for the cable sizes to be terminated but shall be minimum suitable for 2.5 mm<sup>2</sup> cable. 20% spare terminals shall be supplied in each junction box. The terminals shall be mounted on rails in the junction box. Cross ferruling philosophy to be followed for wiring. Telephone sockets and plugs shall be provided in junction boxes.
- Each junction box shall have minimum of 10% or 2 Nos. minimum spare entries. All spare entries shall be provided with SS plugs. All the cable entries shall be from bottom only. Junction boxes shall be earthed to dedicated earth-pit.

#### 4.0 CABLE GLANDS

- CONTRACTOR shall supply all cable glands required for glanding cables both at field instrument and local control panel, junction boxes and at main control room / SRR.
- All cables glands shall be of type 304 SS; double compression type, flame proof with Ex(d) certificate suitable for armoured cables with PVC shrouds.

## 5.0 DOCUMENTATION

Post Order Documents to be submitted by the bidder for review/ approval.

<b>DOCUMENTATION REQUIREMENTS</b>	<b>REVIEW / APPROVAL</b>
Quality Assurance plan (QAP)	For Approval
Production schedule	For Review
Datasheets	For Approval
G.A. / Installation drawings	For Approval
Bill of Materials including Spares	For Review

Note: Schedule of submission of the above documents shall be aligned to meet the delivery requirements.

Final documentation consisting of design data, installation manual, operation and maintenance manual etc., submitted by the vendor after placement of purchase order shall include the following, as a minimum;

- a) Specification sheet/ Data sheet / Sizing sheet for each Junction box and accessories.
- b) As built drawings for each Junction Box and Accessories, providing dimensional details, constructional details, cable entry details and material of construction.
- c) Copy of test certificates for all the tests as per MR and Documents along with TPI IRN.
- d) Installation procedure for each Junction Box with their accessories.
- e) BOM including spares (if applicable)
- f) Product Catalogs of Main equipment and accessories/ bought-outs.

Three hard copies in bound format and one soft copy in CD/ DVD of the above shall be submitted as final document.

**6.0 NAME PLATE**

- a) Tag Number as per purchaser's datasheet.
- b) Manufacturer's name
- c) Type of protection for use in hazardous area (This should be stamped on individual cable glands and plugs also)
- d) Manufacturers serial number and model no.

Other details as per MR shall also be suitably indicated on the junction box.

## 7.0 SHIPPING

All threaded openings shall be suitably protected to prevent entry of foreign material and avoid damage to threads.

The consignment shall be packed and suitably labelled clearly indicating the following as minimum

- a) Project Name and Location
- b) PO Number
- c) Packing List inside consignment (Including main tag number, accessories and spares as applicable)
- d) Vendor Name and location of dispatch.

**DEPARTMENT:** FEG

**DOCUMENT NO:** 44AC9100-000/V.02/0104/A4




**DOCUMENT TITLE:** GENERAL SPECIFICATION FOR PMI AT VENDOR SHOP

**PROJECT NO:** 44AC9100

**PROJECT LOCATION:** DUMAD/IOCL-JR, Gujarat

**PROJECT TITLE:** EPCM/PMC Services for Acrylics/Oxo-Alcohol Project at Gujarat Refinery & Dumad Complex

**CLIENT:** Indian Oil Corporation Limited

				APPROVALS		
Rev No.	Issue Date	Page	Revision Description	Prepared	Checked	Approved
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- 8.1 TYPICAL POSITIVE MATERIAL IDENTIFICATION REPORT FORM – ALLOY STEEL BULK MATERIAL**

**1.0 SCOPE**

- 1.1 This specification applies to the requirements for Positive Material Identification (PMI) to be performed at vendor's works on Metallic Alloy Materials procured either directly by Vendor or indirectly through their sub-vendors. Any deviations from this specification must be approved by Purchaser in the deviation / Waiver permit format. This specification shall also be read in conjunction with positive material identification at site.
- 1.2 This Specification covers the procedures and methodology to be adopted to assure that the chemical composition of alloy material is consistent with the material specification as specified in purchase documents using alloy analyser at the time of final inspection before despatch.
- 1.3 The scope of this specification shall include but not limited to Positive Material identification (PMI) to be performed on Alloy Piping Materials listed below :

However all grades of materials including stainless steel are subjected to PMI verification / test after receipt at site.

- Alloy Steel Pipes
- Alloy steel plates
- Alloy steel large forgings
- Alloy Steel nozzle Flanges & Forgings
- Alloy Steel Fittings
- Alloy Steel Fasteners
- Alloy Cast & Forged Steel Valves
- Alloy Steel Instrumentation items (Control Valve, Safety Valves etc.)
- Equipment plates, Pipe, Fittings & Welds.
- Gaskets (Ring Type Joints)

Following items shall be excluded from scope of PMI examination

- Gasket other than Ring Type Joints
- Valve internal Components

**2.0 DEFINITIONS**

- 2.1 **Vendor** : Any supplier or manufacturers on whom an order is placed for supply of referred piping items. This definition shall also include any sub-vendor or manufacturers on whom a sub-order is placed by the vendor.
- 2.2 **Inspection Lot** : A group of items offered for Inspection covered under same size, heat and heat treatment lot.
- 2.3 **Alloy Material** : Any metallic material (including welding filler materials) that contains alloying elements such as chromium, nickel, molybdenum, vanadium, etc which are intentionally added to enhance mechanical or physical properties and/or corrosion resistance.

**3.0 PMI EXAMINATION**

- 3.1 The Vendor shall submit a procedure of PMI to comply with the requirements of this Specification. Approval of PMI procedure shall be obtained from Purchaser prior to commencing manufacturer / inspection of product.
- 3.2 PMI examination of alloy materials is independent of any certification, markings of colour coding that may exist and is aimed at verifying that the alloy used are as per specified grades.
- 3.3 The Vendor shall identify all incoming alloy materials and maintain full traceability of all alloy materials, including all off-cuts. Transfer of identification marks shall be undertaken prior to cutting to ensure maintenance of identification on off-cuts.
- 3.4 The Vendor shall ensure that all materials are segregated and stored in separately identified locations to prevent the mix-up of materials of different alloy specifications or alloy material with carbon steel. Non-ferro-magnetic materials shall be segregated at all times from ferro – magnetic materials.
- 3.5 PMI examination is subject to surveillance inspection by Vendor / Third Party Inspection Agency / Client as specified in Quality Assurance Plan.

#### **4.0 ACCEPTABLE METHODS FOR PMI**

- 4.1 The Method used for PMI examination shall provide a quantitative determination of the alloying elements like Cr, Mo, Ni, V in Alloy Steel items. For Non-Ferrous alloys quantitative determination of appropriate alloying elements shall be verified.
- 4.2 Instruments or methods used for PMI examination shall be of those that will provide quantitative, recordable, elemental composition results for positive identification of alloying elements present.
- 4.3 The acceptable instrument for alloy analyser shall be either "Portable X-ray fluorescence" or "Optical Emission Spectro Analyser" type capable of verifying the percentage of alloy elements within specified range.
- 4.4 Chemical spot testing, magnets, alloy sorters and other methods using eddy current methods are not acceptable for PMI examination.
- 4.5 The PMI instrument used shall have the sensitivity to detect the alloying elements in the specified range.
- 4.6 Each analyser must be calibrated according to the manufacturer's specification at the beginning and end of each shift. Instrument must be checked against known standard for each alloy type to be inspected during the shift.
- 4.7 Certified samples with full traceability of "known" alloy materials shall be available for use as a random spot check on the instrument calibration.
- 4.8 The surface to be examined shall be prepared by light grinding or abrasive paper and solvent cleaner. Evidence of arc burn resulting from examination shall be removed by light grinding or abrasive paper.
- 4.9 Alloy steel type joint gaskets shall only be inspected by using portable X-ray fluorescence instrument.

- 4.10 Testing shall be done as per the procedures outlined by the manufactures of alloy analyser being used. Modification of these procedures if any, must be approved by Purchaser.
- 4.11 The persons performing PMI shall demonstrate their capabilities to the satisfaction of Client/Jacobs/Third Party Inspection Engineer. If the vendor has qualified operator in his rolls, he may perform the examination. Otherwise PMI examination shall be sub contracted to an independent testing agency.
- 4.12 Whenever materials, items and welds are identified as not meeting requirements by the visiting engineer a rejection note shall be issued. The above shall be marked with a red "R" pending resolution.

**5.0 EXTENT OF PMI EXAMINATION**

Following sampling plans shall be applicable for PMI examination of various alloy items.

- A. Flanges, Fittings, Valves, RTJ Gaskets : 100%
- B. Pipes, Plates, Forgings : 100% (for pipes, plates, Forgings procured from traders).  
10% random samples (minimum 2 Nos.) drawn from each size/Heat/Lot (for pipes, plates, Forgings procured directly from mills).
- C. Tubes for heat transfer service : 100% (for tubes procured from traders).  
Spot checking by sampling 1% of the tubes or 25 nos. whichever is less (for tubes procured directly from mills).
- D. Fasteners :  

<u>Lot Size</u>	<u>Sample Size</u>
Upto 100	2% (Min 2)
101 to 500	1% (Min 3)
501 and above	0.5% (min 5)

**6.0 RECORDING AND DOCUMENTATION**

The results of PMI examination shall be recorded in the PMI Report Form as enclosed with this specification.

**7.0 MARKING**

- 7.1 All alloy materials tested by PMI shall be identified using either of the following methods by indicating "AV"
  - a) Electro – etching
  - b) A low stress stamp marking
  - c) Hologram Sticker
  - d) Vibro – etching
  - e) Colour Coding

Location of markings will be near to vendor's monogram, material specification, heat number / cast number, welders stamp, etc as applicable.

**8.0 ATTACHMENTS**

As enclosed.

**PMI REPORT FORM – ALLOY BULK MATERIAL**

ATTACHMENT 8.1				
TYPICAL POSITIVE MATERIAL IDENTIFICATION REPORT : ALLOY STEEL BULK MATERIALS				Page ....of ....
Project :	Client :			Job No. :
PMI Report No. :	Vendor / Sub-Vendor :			
Purchase Order No. :	Testing Agency :			
Purchase Requisition No.	PMI Location :			
Bulk Item Type (as per Requisition)				
Material Specification / Grade :				
Number of items in Lot :				
Requisition Item No. Description :	Alloy Content Weight Percent			Remarks Accept/Reject
	Cr.	Mo	Ni	V
Instrument Type / ID			Source Age	
			Source dt.	
Last Service Date :	PMI Examination by :		Approved by Vendor	Witnessed by
Company				



**DEPARTMENT:** FEG

**DOCUMENT NO:** 44AC9100-000/V.02/0109/A4

**DOCUMENT TITLE:** GENERAL SPECIFICATION FOR PAINTING

**PROJECT NO:** 44AC9100

**PROJECT LOCATION:** DUMAD/IOCL-JR, Gujarat

**PROJECT TITLE:** EPCM/PMC Services for Acrylics/Oxo-Alcohol Project at Gujarat Refinery & Dumad Complex

**CLIENT:** Indian Oil Corporation Limited

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**1.0 General**

1.1 These technical specifications shall be applicable for the work covered by the contract and without prejudice to the various codes of practice, standard specifications, etc. It is understood that Contractor shall carry out the work in all respects with the best quality of materials and workmanship and in accordance with the best engineering practice and instructions of Engineer-in-Charge.

1.2 Wherever it is stated in the specification that a specific material is to be supplied or a specific work is to be done, it shall be deemed that the same shall be supplied or carried out by the contractor. Any deviation from this standard without written deviation permit from appropriate authority will result in rejection of job.

**2.0 Scope**

2.1 This specification outlines the general requirements for the protection against corrosion of the external surfaces of ferrous and low alloy (less than 12%Cr) steels using protective coating systems. This specification also addresses the requirements of protection against corrosion of insulated and uninsulated austenitic steels from corrosion.

2.2 The protective coating systems specified include surface preparation, paint materials selection, paint application, inspection requirements and acceptable nominal dry film thicknesses (DFT).

2.3 This specification defines the requirements for surface preparation, selection and application of paints on external surfaces of equipment, vessels, machinery, piping, ducts, steel structures, external & internal protection of storage tanks for all services. MS chimney without refractory lining and flare lines etc. The items listed in the heading of tables of paint systems is indicative only, however the contractor is fully responsible for carrying out all the necessary painting, coating and lining on external and internal surfaces as per the tender requirement.

2.4 Plant items covered by this specification include:

- a) All un-insulated C.S & A.S equipment like columns, vessels, drums, storage tanks, heat exchangers, pumps, compressors, electrical panels, motors, and tanks and equipment in ETP plant etc.
- b) All un-insulated carbon and low alloy piping fittings and valves (including painting of identification marks), furnace, ducts and stacks.
- c) Painting under insulation for carbon steel and stainless steel as specified.
- d) All items contained in a package unit as necessary.
- e) All structural steel work, pipe, structural steel supports, walkways, handrails, ladders, platforms, etc.
- f) Miscellaneous unprotected steel items
- g) External surfaces of furnace plating, Steel chimneys without refractory lining & flare lines.

- h) Identification color bands on all piping as required including insulated aluminum clad, galvanized, SS and nonferrous piping.
- i) Identification lettering / numbering on all painted surfaces of equipment / piping insulated aluminum clad, galvanized, SS and non-ferrous piping.
- j) Marking / identification signs on painted surfaces of equipment / piping hazardous service.
- k) Supply of all primers, paints and all other materials required for painting other than Owner's supply.
- l) Repair work of damaged / pre-erection / fabrication shop primer and weld joints at field.
- m) Internal surfaces of RCC tanks and structures in Effluent Treatment Plant.

2.5 This specification does not specify paint color schemes or high temperature resistant painting systems for operating temperatures above 600°C nor temperature indicating paints for refractory line equipment.

2.4 Changes and deviations required for any specific job due to client's requirements or otherwise shall be referred to Jacobs for deviation permit.

**3.0 Codes & Standards**

Without prejudice to the provision of Clause 1.1 above and the detailed specifications of the contract, the latest editions and revisions of following codes and standards shall be followed for the work covered by the contract.

BS 5493	(Previously CP 2008) Code of Practice for Protective Coating of Iron and Steel structures against Corrosion
BS 7079	Preparation of steel substrates before application of paints and related products
BS EN ISO 1461	Hot dip galvanized Coatings on Iron and Steel Articles
ISO 12944-1	Paints and Varnishes – Corrosion protection of steel structures by protective paint systems – Part 1: General introduction
IS-101	Methods of test for ready mixed paints and enamels.
SIS-05 5900-1967	Swedish Standard for surface preparation standards for painting steel surfaces

**4.0 General Requirements**

4.1 Surface required painting shall be prepared, primed and coated at specified venues as decided and designated by Jacobs. Main contractor shall state the SHOP / FIELD application venue philosophy to be adopted.

4.2 Shop applied coatings shall be dried and cured sufficiently to permit transport to the site of construction without excessive damage.

- 4.3 Field applied finishing coatings shall be subject to the requirements of this specification and shall include repair and touch-up of shop applied coatings
- 4.4 Shop and Field margins subject to Field testing shall be Shop surface prepared and taped for 50mm either side of the weld line. After successful primer application there should be a further 50mm taped margin applied for each subsequent coat to aid in coating thickness build up. The protective tape shall have sufficient quality to protect the achieved profile from deterioration. The remainder of the paint shall be chamfered back for approximately a further 100mm to 150mm.
- 4.5 Contractor shall remove slag spatter and flux residues from welded areas and grind out any sharp edges. Sharp edges, fillets, corners and weld seams shall be radiused or smoothed to a minimum of 3mm. All bolt holes shall be drilled and ground prior to blast cleaning. When grinding, weld or base metals shall not be ground below the surface. Prior to painting, the weld and surrounding area shall be prepared by chipping and /or blast-cleaning. Preparation shall include the cleaning of the chamfered paint edges and the removal of any burnt or scorched paint.
- 4.6 Particular attention shall be paid to the preparation and painting of comers, edges, welds, rivet heads, small brackets, nuts and interstices. Prior to applying each full coat of the coating system, these positions shall be pre-coated by brush. i.e. 'stripe coated' (using a contrasting shade to the main coat where possible) to ensure specified nominal dried film thicknesses are achieved.
- 4.7 Bare shall be taken to preserve the friction characteristics of faying surfaces of structural connections made with high strength friction - grip bolts and guidance given in B.S. 5493 Clause 25 shall be followed. However, as inorganic zinc primers offer a good slip coefficient, faying surfaces already primed with inorganic zinc shall only require surfaces to be cleaned and dried prior to bolting together. Zinc rich epoxy primers are not suitable for faying surfaces.
- 4.8 Aluminium paint shall not be applied to any steel or iron surfaces likely to attain a temperature greater than 100°C in any building where inflammable vapour may be present.
- 4.9 At the site of construction, the mechanical contractor shall be responsible for properly handling and storing the primed and painted items prior to erection to minimize damage to primed and painted surfaces.
- 4.10 The protective coating system applied by the Manufacturer to proprietary items such as motors, pumps, turbines, instrument panels etc. shall be suitable for the intended operational environmental conditions at the site of construction.
- 4.11 The selected protective paint systems take into consideration the corrosive environment, time delays between coating applications and specified maximum normal operational surface temperatures. Special consideration shall be given to items such as refractory lined piping and ducting, flare gas riser piping and protective heating tracing systems. In addition, anticipated conditions during start-up, shut-down and maintenance operations are considered.
- 4.12 Structural supports such as Vessel Skirts, legs, saddles etc., shall be considered as operating below 93°C unless otherwise specified.

- 4.13 All un-insulated portions of insulated equipment comprising vessel nozzles, man-way covers, brackets, clips, valves, relief valves, etc. shall be painted in accordance with the maximum normal operational surface temperatures involved. All un-insulated portions of piping, including pipe supports etc. shall be painted in accordance with the maximum normal operational surface temperatures involved.
- 4.14 The selected protective paint systems shall generally be based on the maximum normal operating temperatures of pipe-work or equipment items with the following exceptions:
- Items subjected to pre-commissioning steam out where the paint system employed shall take into account the designated steam out temperature and shall be suitable for that temperature.
- 4.15 The following surfaces and items shall not be painted unless specifically instructed otherwise:
- a) Hot dipped galvanized steel (unless for colour identification), plastic including plastic coated materials. Aluminium and other project nominated non-ferrous metals.
  - b) Asbestos free cement sheeting. slate, brick, tile. glass and similar weather resistant materials.
  - c) Insulation finishing materials.
  - d) Concrete or Mortar fireproofing.
  - e) Machined surfaces of machinery and gasket contact surfaces
  - f) Any equipment furnished completely primed and finish coated by the equipment manufacturer (pumps, motors and other machinery, instruments, instrument boards etc.)
  - g) Equipment name plates or any special instructions attached or included as part of an equipment unit.
  - h) Tripping mechanisms of Steam Turbines, Valve stems movable linage on equipment, grease fittings, compressor or pump shafts or any such surfaces on equipment that are normally lubricated or have close working tolerances.
- 4.16 The items listed below shall be shielded and protected to prevent damage during surface preparation and paint material application operations. All openings, including those that are flanged or threaded shall be sealed to prevent entry of blast abrasive or paint material. After completion of painting operations all material used for shielding and sealing shall be removed unless instructed otherwise.
- a) Nameplates
  - b) Packing glands and seals
  - c) Bearings
  - d) Rotating equipment couplings and shafts
  - e) Lubrication fittings
  - f) Pressure gauges

- g) Gauge and Flow Indicator glasses
- h) Motor starters
- i) Instrument dials
- j) Vents
- k) Exposed linkages
- l) Valve stems
- m) Light bulbs, enclosures and reflectors
- n) Air intakes
- o) Rubber parts and plastic

4.17 Surfaces requiring to be insulated for Personnel Protection reasons shall be fully painted in a similar manner to an un-insulated surface.

4.18 Equipment welds shall not be painted until all approved heat treatment, non-destructive testing, and pressure testing has been completed and approved.

4.19 Multi-pass shop welds for Piping designed in accordance with ASME S313 shall be prepared, primed and coated prior to pressure testing, unless stated otherwise in ASME B313. Single pass welds are not permitted. The release for painting shall only be approved after all heat treatment and non-destructive testing has been completed and approved.

4.20 Piping designed in accordance with piping codes other than those stated above shall not have - "SHOP" welds painted until all approved heat treatment, non-destructive testing, and pressure testing has been completed and approved.

4.21 The paint manufacturer's instructions shall be followed as far as practicable always. Attention shall be paid to the following:

- a) Instructions for storage to avoid exposure as well as extremes of temperature.
- b) Surface preparation prior to painting.
- c) Mixing and thinning.
- d) Application of paints and recommended limit on time intervals between coats.
- e) Suggested Quality assurance procedures.

**5.0 Equipment**

5.1 All tools, brushes, rollers, spray guns, blast material, hand power tools for cleaning, inspection instruments, e.g. surface profile gauges, holiday detectors, pin hole detectors, dry film thickness gauges, etc. and all equipment, scaffolding materials, shot blasting equipment & air compressors, etc., required to be used shall be suitable for the work and all in good order and shall be arranged by the Contractor at site and in sufficient quantity.

5.2 Mechanical mixing shall be used for paint mixing operations in case of two pack systems except that the Engineer-in-Charge may allow the hand mixing of small quantities at his discretion.

**6.0 Surface preparation**

**6.1 Shop Preparation**

- 6.1.1 Prior to commencement of surface preparation all surface defects likely to be detrimental to the protective painting system shall be removed. All fins at saw cuts, burrs and sharp edges shall be similarly removed. Where extensive grinding has been necessary the dressed areas shall be re-prepared to remove all rust and provide an adequate profile.
- 6.1.2 Prior to blast cleaning all grease and oil contamination shall be removed by wiping or scrubbing the surface with rags or brushes wetted with solvent followed by a wipe down with clean dry cloths. Alternatively, proprietary emulsifying agents may be used: where this method of cleansing is employed the surface shall be thoroughly washed with clean water and then dried before proceeding.
- 6.1.3 Blast cleaning shall not be carried out whilst the temperature of metal surfaces are less than 3°C above the dew point of the surrounding air or when the relative humidity of the air is greater than 85%.
- 6.1.4 All blast cleaned surfaces shall be primed before visible re-rusting occurs or within four hours of the commencement of blasting. If visible re-rusting occurs than the metal surfaces shall be lightly re-blasted and where necessary washed to remove rust blooming and accumulation of soluble salts. Spent blast abrasive shall be completely removed from the prepared surface by either vacuum cleaning or stiff-brush sweeping.
- 6.1.5 Soluble salt contamination tests shall be carried within 4 hours in accordance with ISO 3502-9. The maximum level of contamination shall be 5µg/cm<sup>2</sup>. Surfaces that do not meet these criteria shall be reprocessed.
- 6.1.6 When additional areas are blasted adjacent to newly primed areas, at least 50 mm of the previously primed area shall be re-blasted, with the abrasive directed away from the coated surface.
- 6.1.7 The maximum vertical distance between the summit of any peak and the depth of an immediate adjacent trough on blast cleaned surfaces shall be 80 microns and the minimum peak-to-valley height shall be 30 microns. Blast cleaned surfaces shall be in accordance with the MANUFACTURER's recommendations. In addition to visual examination, random measurements of blast I anchor profile shall be made at a minimum frequency of five (5) per shift per work area, or one per ten (10) square meters if greater, using Testex tape or other approved method. The surface profile measurements shall not be less than minimum value specified by the MANUFACTURER.
- 6.1.8 Regular measurement of the roughness of the blasted surface shall be carried out using one of the following methods:
1. The roughness of the blast cleaned surface is initially measured with a flat-ended calibrated micrometer. The surface is then ground until the bottoms of the deepest pits only are visible, and a further thickness measurement taken. (Suitable instruments are the Elcometer surface profile meter or Microtest).
  2. The roughness of the blast cleaned surface is visually compared with a reference surface. Suitable comparators are Rugotest or Keane-Tator Surface profile comparator.

- 6.1.9 Only dry blast cleaning techniques shall be employed, and abrasives shall be expendable copper slag or re-usable iron and steel grit. A non-metallic blast abrasive, i.e. Aluminium oxide or garnet shall be used when abrading stainless steel surfaces. Abrasives shall be in accordance with ISO B504-2. The use of silica sand, potentially silica containing material, and copper slag abrasives are not permitted and shall not be used under any circumstances.
- 6.1.10 Abrasive size shall be selected to best suit the type of priming material and to satisfy the paint manufacturers recommendation bearing in mind the restriction imposed above.
- 6.1.11 At the commencement of each application, sample metal panels shall be prepared to demonstrate the ability to comply with the specified level of cleanliness and, after approval, shall be used as the specification for the remainder of project work.
- At the commencement of each application, sample metal panels shall be prepared to demonstrate the ability to comply with the specified level of cleanliness and, after approval, shall be used as the specification for the remainder of project work.
- 6.1.12 Defects such as holes, crevices, voids and gaps that are not structurally detrimental, shall be filled with solvent-less epoxy filler as agreed by IOCL. The filler shall be applied after abrasive blasting and prime coating but before finishing coating.
- 6.1.13 Abrasive material for blast cleaning, consisting solely of steel shot shall not be used. A mixture consisting of steel shot and at least 25% by weight steel grit is acceptable.
- 6.1.14 Spent blast abrasive shall be completely removed from the prepared surface by either vacuum cleaning, blowing down with clean dry compressed air, or stiff brush sweeping.
- 6.1.15 Expendable abrasive used for blast-cleaning shall be free of contaminants such as chlorides and other soluble salts and shall not contain metallic copper, nor more than 2% by weight of copper oxide. Expendable abrasives shall not be recycled.
- 6.1.16 The abrasive used in installations such as wheel abators or manual blast rooms/cubicles in which the abrasive is recovered and re-used shall be a mixture of chilled iron or steel grit and steel shot able to produce the required surface profile. The abrasive mixture shall be replenished using new and worn abrasive so as to produce a consistent profile height and standard of surface cleanliness. The abrasive mixture shall be kept free of dust (including metallic particles) and debris.
- 6.1.17 Abrasive blast rooms/cubicles shall be fitted with approved reclamation and cleaning systems.
- 6.1.18 Blast cleaning shall not be carried out in the vicinity of painting works and/or where it can result in the contamination of wet paint. Care shall be taken protect adjacent areas and equipment from blasting by the erection of screens and barriers.
- 6.1.19 Acid washes and other cleaning solutions or solvents including inhibitive washes intended to prevent rusting shall not be used on metal surfaces after they are blasted.
- 6.1.20 A safety checklist is provided elsewhere in this specification.
- 6.1.21 Storage tanks shall be 100% blast cleaned in the FIELD after welding, prior to coating application.



- 6.1.22 The cleaning method(s) undertaken shall remove all weld flux slag and fume weld heat oxides and weld metal spatter in addition to all loose mill scale or loose paint if present after welding and testing has been completed.
- 6.1.23 The use of grinding discs may be included to achieve the removal of tightly adhering weld splatter, but great care shall be taken to ensure that surfaces shall not be polished nor left with a detrimental roughness or gouge marks.
- 6.1.24 The final action of surface preparation prior to the application of priming paint shall be a thorough washing with clean water to remove all soluble salts from the metal surface and a "drying" action which will not re-deposit contaminants on to the cleaned surfaces.
- 6.1.25 The initial coat of priming paint shall be carefully applied to ensure a thorough "wetting" of the prepared surfaces.
- 6.1.26 SHOP applied paint shall be feathered back to allow the correct application and buildup of required site applied paint coatings.
- 6.2 **Application Conditions**
- 6.2.1 Weather and Surface Conditions
- 6.2.2 Surface preparation and painting shall not be undertaken in conditions which are favorable to surface condensation or outside daylight hours on exterior locations.
- 6.2.3 Conventional solvent based paints shall not be applied to exterior surfaces in damp, humid weather when air temperature is below 5°C or when the metal surface temperature is less than 3°C above the dew-point temperature.
- 6.2.4 Chemically cured paints shall not be applied at air or metal surface temperature below 10°C or when relative humidity is above 05%.
- 6.2.5 Before the application of paint materials, the Applicator's paint procedure shall contain the MANUFACTURER's written recommendations regarding temperatures and ambient conditions of application.
- 6.2.6 Paint materials shall not be applied over metal surfaces having temperatures in excess of 45°C unless confirmed by MANUFACTURER datasheets and approved by IOCL.
- 6.2.7 When a metal surface to be coated exceeds 33°C, the use of sun screens/hades to maintain workable temperatures should be considered. Tarpaulins or monoflex sheeting type habitats could help. Paint manufacturers written advice to be sought.
- 6.2.8 Paint materials shall not be applied to steel when temperatures are expected to fall to 0°C before the paint has dried.
- 6.2.9 Paint materials shall not be applied in rain, snow, fog or mist, nor to wet or damp surfaces. Paint shall not be applied to frost or ice coated surfaces.
- 6.3 **Compressed Air**



- 6.3.1 Compressed air supply used for blast cleaning shall be free from water and oil. Adequate separators and traps shall be provided and installed in the coolest part of the system; they shall be regularly emptied to prevent carryover of water and oil. Accumulations of oil and moisture shall be removed from the air receiver by regular purging. Air compressor shall not deliver air at a temperature in excess of 110°C.

The dryness and cleanliness of the compressed air supply used for blast cleaning shall be verified by testing the air on a white blotter as per ASTM D 285. The testing shall be carried out at the start of each shift and every 4 hours thereafter and at the restart of compressor operation when off for more than 15 minutes. Compressed air pressure shall be tested at the start of each shift and every 4 hours thereafter in order to ensure an even blast profile.

- 6.3.2 Where air-operated equipment is used, the operator's hood or head gear shall be ventilated by clean cool air served through a regulator filter, to prevent blast cleaning residues from being inhaled.

#### 6.4 **Paint Mixing**

Paint material shall be thoroughly mixed immediately prior to application. Mixing shall be by means of mechanical stirrers, paddle mixers, can vibrators or can shakers only.

Constant mechanical agitation shall be maintained in the paint reservoir throughout paint spraying operations. Thinners shall only be added strictly in accordance with the paint manufacturers written instructions. The type of thinner shall comply with the paint manufacturers written instructions.

When thinners are permissible, they shall be added during the paint mixing process in accordance with the MANUFACTURER's datasheets.

#### 6.5 **Film Thickness**

The applied DFT of each coat and the total system shall not be less than the specified minimum stated in Table 2.

The OFT shall be measured in accordance with SSPC - PA2. The average of any five (5) spot readings on each 10m<sup>2</sup> area shall be equal to or greater than the specified minimum OFT and no single point reading shall be less than 30% of the specified minimum DFT. Each spot reading shall be made up of average of three (3) gauge readings that shall be taken in a 40mm diameter circle defining the spot.

DFT measurement shall be made of each coat and of the total system. The total minimum dry film thickness for a multi-coat system shall not be less than the added total specified minimum dry film thicknesses.

The dry film thickness of individual coats or system shall not exceed the MANUFACTURERs recommended maximum thickness, and shall not prove detrimental, i.e. wrinkling, mud cracking, general softness, poor adhesion, etc., to both the coating and for the total system.

Inadequate film thickness shall require the further application of an additional complete coat over the whole area until the dry film thickness is sufficient to meet the specified minimum. Excessive thick coats shall be removed completely by blast cleaning, and shall be re-coated according to this standard.

Film thickness measuring shall not include thickness of pre-fabricating primers. In the absence of pre-fabricating primer film thickness records, 25 microns shall be allowed for pre-fabrication primers whilst checking further film coat thicknesses.

## 6.6 Application

Shop paint shall be applied using spray guns ONLY. However, MANUFACTURER's recommended method in accordance with the paint datasheet may be accepted for inaccessible areas.

Spray guns shall be held perpendicular to the surface being coated at a maximum distance of 300 mm from the surface and no closer than 200 mm to the surface. Wet film thickness (comb) gauges shall be used by paint spray gun operatives to ensure an even and adequate DFT will be achieved.

Material and air pressure on the spray guns shall be regulated to achieve optimum atomization of the paint with the lowest possible pressures to avoid spray ricochet from the surface being painted.

Overlapping horizontal passes shall be made for each spray coat to obtain uniform application. Particular care shall be exercised to ensure that a uniform, complete wet coat is applied. Semi-dry spraying results in poor flow-out with excessive pin-holing and shall be avoided.

Coats of paint shall be uniformly applied without sags, runs, spots, damage or contamination; such irregularities shall be removed and the affected area recoated.

Each coat of paint shall be in a proper state of cure or dryness before the application of the succeeding coat. Attention shall be paid to the MANUFACTURER's datasheet for curing times between coats.

Damage to each coat of paint, whether shop or field applied, shall be repaired by abrasive paper cleaning and spot priming before succeeding coats of paint are applied. No succeeding coat of paint shall be applied before preceding coat of paint is thoroughly dry.

SHOP primed surfaces contaminated during transport and site storage shall be thoroughly washed down with fresh clean water [ $<30$  ppm chlorides] and allowed to dry before the application of further paint coatings. A soluble salt contamination test shall be carried out prior to paint application in accordance with 6.1.5.

Coatings which have weathered for more than six (5) months shall be thoroughly inspected prior to application of further coats to prevent inter-coat adhesion problems.

To minimize inter-coat contamination, succeeding coats shall be applied with a minimum time lapse consistent with proper drying time, work and erection schedules in accordance with the MANUFACTURER's datasheet.

Roller application of the first primer coat is not acceptable. However, the use of rollers shall be agreed with IOCL for inaccessible areas only. Rollers shall be manufactured from good quality 'carpet pile' or lamb's wool.

Paint brush application is not acceptable. However, the use of brush shall be agreed with IOCL for inaccessible areas only. When paints are applied by brushing, brushes shall be of good quality that allows proper application of the material. Brushing shall be done so that a smooth coat as nearly uniform in thickness as possible is obtained. There shall be no deep "detrimental" brush marks.

**6.7 Air Blast Cleaning**

The surfaces shall be blast cleaned using one of the abrasives Al<sub>2</sub>O<sub>3</sub> particles chilled cast iron or malleable iron and steel at pressure of 7 Kg /cm<sup>2</sup> at appropriate distance and angle depending of nozzle size maintaining constant velocity and pressure.

Chilled cast iron, malleable iron and steel shall be in the form of shot or grit of size not greater than 0.055" maximum in case of steel and malleable iron and 0.04" maximum in case of chilled iron. Compressed air shall be free from moisture and oil. The blasting nozzles should be venturi style with tungsten carbide or boron carbide as the materials for liners. Nozzles orifice may vary from 3/16" to 3/4".

On completion of blasting operation, the blasted surface shall be clean and free from any scale or rust and must show a grey white metallic luster. Primer or first coat of paint shall be applied within 4 hours of surface preparation. Blast cleaning shall not be done outdoors in bad weather without adequate protection or when there is dew on the metal, which is to be cleaned. Surface profile shall be uniform to provide good key to the paint adhesion (i.e. 35 to 50 microns). If possible, vacuum collector shall be installed for collecting the abrasives and recycling.

**6.8 Water Blast cleaning**

Environmental, health and safety problems associated with abrasive blast cleaning limit the application of Air Blast Cleaning in many installations. In such case water blast cleaning is resorted to.

Water Blast Cleaning can be applied with or without abrasive and high-pressure water blasting. The water used shall be inhibited with sodium chromate / phosphate. The blast-cleaned surface shall be washed thoroughly with detergents and wiped with solvent and dried with compressed air. For effective cleaning abrasives are used. The most commonly used pressure for high pressure water blast cleaning for maintenance surface preparation is 3000 to 6000 psi at 35-45 lit/minute water volume and pressures upto 1000 psi and water volume at 45 lit/minute provide maximum cleaning.

The water blast cleaned surface shall be comparable to SSPC-SP-12/NACE No. 5. The operation shall be carried out as per SSPC guidelines for water blast cleaning. The indicative values for sand injection is:

Air	:	300 to 400 Cu. Ft/min
Water	:	5-10 lit/min. with corrosion inhibitor
Sand	:	200-400 lbs/hr.
Nozzle	:	0.5 to 1" dia.

**6.9 Mechanical or Power Tool Cleaning**

Power tool cleaning shall be done by mechanical striking tools, Chipping hammers, grinding wheels or rotating steel wire brushes. Excessive burnish of surface shall be avoided as it can reduce paint adhesion. On completion of cleaning, the detached rust mill scale etc. shall be removed by clean rags and / or washed by water or stream and thoroughly dried with compressed air jet before application of paint.

#### 6.10 **Manual or hand tool cleaning**

Manual or hand tool cleaning is used only where safety problems limit the application of other surface preparation procedure and there is approach problem in certain areas and hence does not appear in the tables of paint systems.

Hand tool cleaning normally consists of the following:

- a. Hand descaling and / or hammering
- b. Hand scraping
- c. hand wire brushing

Rust, mill scale spatters, old coatings and other foreign matter, shall be removed by hammering, scrapping tools, emery paper cleaning, wire brushing or combination of the above methods. On completion of cleaning, loose material shall be removed from the surface by clean rags and the surface shall be brushed, swept, dusted and blow off with compressed air/steam to remove all loose matter. Finally, the surface may be washed with water and dried for effective cleaning.

#### 6.11 **Non-compatible shop coat primer**

The compatibility of finishing coat should be confirmed from the paint manufacturer. In the event of use of primer such as zinc rich epoxy, inorganic zinc silicate etc., as shop coat, the paint system shall depend on condition of shop coat. If the shop coat is in satisfactory condition showing no major defect, the shop coat shall not be removed. However, a non-compatible primer shall have to be removed before application of compatible paint system for the environment. The touch up primer and finishing coat(s) shall be identified for application by Engineer-in-Charge.

Shop coated (coated with primer & finishing coat) equipment should not be repainted unless paint is damaged.

Shop primed equipment and surfaces will only be 'spot cleaned' in damaged areas by means of power tool brush cleaning or hand tool cleaning and then spot primed before applying one coat of field primer unless otherwise specified. If shop primer is not compatible with field primer, then shop-coated primer should be completely removed before application of selected paint system for particular environment.

For Package units / equipment, shop primer should be as per the paint system given in this specification. However, manufacturer's standard can be followed review.

#### 6.12 **Coating Procedure and Application**

Surface shall not be coated in rain, wind or in environment where injurious airborne elements exists, when the steel surface temperature is less than 5°F above dew point when the relative humidity is greater than 85% or when the temperature is below 40°F.

Blast cleaned surface shall be coated with one complete application of primer as soon as practicable but in no case later than 4 hrs. the same day.

To the maximum extent practicable, each coat of material shall be applied as a continuous film uniform thickness free of probes. Any spots or areas missed in application shall be recoated and permitted to dry before the next coat is applied. Applied paint should have the desired wet film thickness.

Each coat shall be in proper state of cure or dryness before the application of succeeding coat. Material shall be considered dry for recoating when an additional coat can be applied without the development of any detrimental film irregularities, such as lifting or loss of adhesion of the under coat. Manufacturer instruction shall be followed for inter-coat interval.

When the successive coat of the same color has been specified, alternate coat shall be tinted, when practical, sufficiently to produce enough contrast to indicate complete coverage of the surface. The tinting material shall be compatible with the material and not detrimental to its service life.

Air spray application shall be in accordance with the following:

- a. The equipment used shall be suitable for the intended purpose, shall be capable of properly atomizing the paint to be applied and shall be equipped with suitable pressure regulators and gauges. The air caps, nozzles and needles shall be those recommended by the manufacturer of the equipment for the material being sprayed. The equipment shall be kept in satisfactory condition to permit proper paint application.
- b. Traps or separators shall be provided to remove oil and condensed water from the air. These traps or separators must be of adequate size and must be drained periodically during operations. The air from the spray gun impinging against the surface shall show no condensed water or oil.
- c. Ingredients shall be kept properly mixed in the spray pots or containers during application by continuous mechanical agitation.
- d. The pressure on the material in the pot and of the air at the gun shall be adjusted for optimum spraying effectiveness. The pressure on the material in the pot shall be adjusted when necessary for changes in elevation of the gun above the pot. The atomizing air pressure at the gun shall be high enough to properly atomize the paint but not so high as to cause excessive fogging of paint, excessive evaporation of solvent, or less by over spray.
- e. Spray equipment shall be kept sufficiently clean so that dirt, dried plant and other foreign materials are not deposited in the paint film.
- f. Any solvents left in the equipment shall be completely removed before applying paint to the surface being painted.
- g. Paint shall be applied in a uniform layer with overlapping at the edge of the spray pattern. The spray patterns shall be adjusted so that the paint is deposited uniformly. During application, the gun shall be held perpendicular to the surface and at a distance which will ensure that a wet layer of paint is deposited on the surface. The trigger of the gun should be released at the end of each stroke.

- h. All runs and sags shall be brushed out immediately or the paint shall be removed and the surface repainted.
- i. Areas inaccessible to the spray gun shall be painted by brush; if not accessible by brush, daubers or sheepskins shall be used.
- j. All nameplates, manufacturer's identification tags, machined surface, instrument glass, finished flange faces, control valve items and similar items shall be masked to prohibit coating deposition. If these surfaces are coated, the component shall be cleaned and restored to its original condition.
- k. Edges of structural shapes and irregular coated surfaces shall be coated first and an extra pass made later.
- l. If spray gun shows choking, immediately de-choking procedure shall be followed.

Airless spray application shall be in accordance with steel structure paint Manual Vol. 1 & Vol. 2 by SSPC, USA. Air less spray relies on hydraulic pressure rather than air atomization to produce the desired spray. An air compressor or electric motor is used to operate a pump to produce pressures of 1000 to 6000 psi, paint is delivered to the spray gun at this pressure through a single hose within the gun, a single paint stream is divided into separate streams, which are forced through a small orifice resulting in atomization of paint without the use of air. This results in more rapid coverage with less over spray. Airless spray usually is faster, cleaner, more economical and easier to use than conventional air spray.

Airless spray equipment is mounted on wheels, and paint is aspirated in a hose that sucks paint from any container, including drums. The unit shall have inbuilt agitator that keep the paint uniformly mixed during the spraying. The unit shall consist of inbuilt strainer. Usually very small quantity of thinning is required before spray. In case of high build epoxy coating (two pack), 30:1 pump ratio and 0.020-0.023" tip size will provide a good spray pattern. Ideally fluid hoses should not be less than 3/8" ID and not longer than 50 ft. to obtain optimum results.

In case of gun choking, de-choking steps shall be followed immediately.

Brush application of paint shall be in accordance with the following:

- Brushes shall be of a style and quality that will enable proper application of paint.
- Round or oval brushes are most suitable for rivets, bolts, irregular surface and rough or pitted steel. Wide flat brushes are suitable for large flat areas, but they shall not have width over five inches.
- Paint shall be applied into all corners.
- Any runs or sags shall be brushed out.
- There shall be a minimum of brush marks left in the applied paint.
- Surfaces not accessible to brushes shall be painted by spray or sheepskin.

Manual application by sling (where 6 o' clock position of pipe is not approachable)

A canvas strip (alternatively a tinplate strip) about 450mm wide and 1.5m long is held under the pipe by two men holding this sling move it up and down and walk slowly forward while fresh coating is poured on the pipe and they manipulate the sling so that an even coating is obtained all-round the bottom. This work shall be done very carefully and by experienced personnel. There shall not be any formation of "Whiskers" and holes in the coating. The coating film shall be inspected by mirror.

For each coat the painter should know the WFT corresponding to the specified DFT and standardize the paint application technique to achieve the desired WFT. This has to be ensured in the qualification trial.

#### Drying of coated surfaces

No coat shall be applied until the preceding coat has dried. The material shall be considered dry for re-coating when another coat can be applied without the development of any film irregularities such as lifting or loss of adhesion of undercoats. Drying time of the applied coat should not exceed maximum specified for it as a first coat; if it exceeds the paint material has possibly deteriorated or mixing is faulty.

No paint shall be force dried under conditions which will cause checking, wrinkling, blistering formation of pores, or detrimentally affect the conditions of the paint.

No drier shall be added to paint on the job unless specifically called for in the manufacturer's specification for the paint.

Paint shall be protected from rain, condensation, contamination, snow and freezing until dry fully practicable.

#### Paint Application

Shop priming / pre-erection priming with F9 or F12 shall be done only on blasted surface.

Shop priming / pre-erection priming with F9 shall be done only with airless spray.

For large flat surface field painting shall be done by airless spray otherwise brush can be used.

### 6.13 Repairs

SHOP prepared and primed surfaces shall normally be FIELD repaired after erection of primed plant, unless covered below.

Over areas considered to be inaccessible after erection SHOP applied primer repairs. FIELD applied primers, undercoats and finishing coats shall be applied, dried and cured before construction takes place. Care shall be taken to allow sufficient drying and curing time before moving, lifting or erecting newly painted surfaces.

Damage to each coat of paint, whether SHOP or FIELD applied, shall be repaired by abrasive paper cleaning and spot priming before succeeding coats of paint are applied. No succeeding coat of paint shall be applied before preceding coat of paint is thoroughly dry.

#### Repair of damaged paint surface



Where paint has been damaged in handling and in transportation, the repair of damaged coating of pre-erection / fabrication shall be as given below.

Repair of damaged inorganic zinc silicate primer after erection / welding.

Quickly remove the primer from damaged area by mechanical scrapping and emery paper to expose the white metal. Blast clean the surface if possible. Feather the primer over the intact adjacent surface surrounding the damaged area by emery paper.

Repair of damaged pre-erection and shop priming in the design temperature of  $-90^{\circ}\text{C}$  to  $400^{\circ}\text{C}$

- Surface preparation shall be done as per procedure 5.9.2
- One coat of F-9 shall be applied wherever damage was observed on pre-erection / pre-fabrication / shop primer of inorganic zinc silicate coating (F-9).

## 7.0 Application Responsibility

### 7.1 General

Certificates of release, confirming that successful completion of all appropriate tests and safety checks have been carried out to the released working areas, shall be obtained before the commencement of painting work.

All provisions of this Standard shall apply to both Shop and Field painting. All paint work shall be carried out in a neat, thorough and workmanlike manner. All cracks or crevices shall be filled with paint if practicable by the Painting Contractor / Contractor / Applicator. Wet paint shall be protected against damage by the Painting Contractor / Contractor / Applicator.

All shipping tags, wires, strings and other means of temporary or shipping identification on surfaces to be painted shall be removed only after checking with and receiving authorisation from the Main Contractor's Representative.

The Painting Contractor / Contractor / Applicator shall be responsible for protection against damage to abutting property, vehicles, pedestrians and other portions of the structure, due to the painting operations.

All instruments, gauge glasses, etc. to be protected from paint splatter by the painting contractor. The job site shall be maintained clean and neat during the paint application work.

Paints, thinners, solvents and rags, waste etc., soiled with these materials shall be kept in tightly closed containers whilst on the job site and not in use. IOCL / CONSULTANT or his designate shall have the right to stop the application of paint when in his opinion; conditions may result in injury to fl1e applied coatings.

The paint applicator shall provide a temporary shelter for storage and mixing of paint materials. During both application and drying, adequate ventilation shall be provided if the work area is enclosed.

### 7.2 Safety Requirements



The paint contractor shall be acquainted with safety and security requirements for equipment and materials used. The paint contractor shall observe and carry out all work in strict compliance with plant, local and national Health and Safety rules and shall obtain all necessary permits from the applicable authorities.

The paint contractor shall be responsible for earthing all his mechanical equipment to prevent build-up of static electricity. Before painters, blasters or general operatives are sent to work in any plant area: the working environment should be studied to detect hazards such as concentration of noxious fumes, presence of splash or spillage of harmful liquids, conditions of excessive heat, or areas where oxygen content of the air may be dangerously low.

Where these conditions exist, they must be corrected before painting personnel are permitted to enter the area, or painting personnel must be protected by materials or devices that will allow them to work without fear of injury or illness that might otherwise result from exposure.

The quantity of Volatile Organic Compound (VOC) in grams per liter, (pounds per gallon), shall follow the legal local, national and international values.

### 7.3 Inspection Requirements

All painting materials including primers and thinners brought to site by contractor for application shall be procured directly from manufactures as per specifications and shall be accompanied by manufacturer's test certificates. Paint formulations without certificates are not acceptable.

Engineer-In-Charge at his discretion, may call for tests for paint formulations. Contractor shall arrange to have such tests performed including batch-wise test of wet paints for physical & chemical analysis. All costs there shall be borne by the contractor.

The painting work shall be subject to inspection by Engineer-In-Charge always. Following stage-wise inspection will be performed and contractor shall offer the work for inspection and approval of every stage before proceeding with the next stage. The record of inspection shall be maintained in the registers.

- (a) Surface preparation
- (b) Primer application
- (c) Each coat of paint

In addition to above, record should include type of shop primer already applied on equipment e.g. Red oxide zinc chromate or zinc chromate or Red lead primer etc.

Any defect noticed during the various stages of inspection shall be rectified by the contractor to the entire satisfaction of Engineer-In-Charge before proceeding further. Irrespective of the inspection, repair and approval at intermediate stages of work, contractor shall be responsible for making good any defects found during final inspection/guarantee period/defect liability period as defined in general condition of contract. Dry film thickness (DFT) shall be checked and recorded after application of each coat and extra coat of paint should be applied to make-up the DFT specified without any extra cost to owner, the extra cost should have prior approval of Engineer-in-charge.

All phases of cleaning and painting and galvanizing operations of all shop and field painting shall be subject to spot check inspection by the Main Contractor's and IOCL appointed Representative.

This periodic inspection will be made to ensure that the paint applicator is accurately following the recommendations of this specification and the paint manufacturer's instructions.

The paint applicator is required to keep an accurate daily record of air temperature and humidity conditions and the times of commencement and cessation of all phases of the cleaning and painting operations. These records which shall be certified accurate by the paint applicator's painting supervisor shall be available for inspection by the MAIN CONTRACTOR always.

The responsibility for the total cleaning, painting and galvanizing operations remain entirely with the applicators who shall fully guarantee material and workmanship for the entire protective system. Inspection, approval or comments by THE MAIN CONTRACTOR, their agents or by independent inspectors shall not relieve the applicator of this responsibility.

The MANUFACTURER/CONTRACTOR shall provide a FIELD supervisor during the painting work. The supervisor shall hold a minimum qualification of NACE CIP Level 2 or ICORR / FROSIO equivalent.

It is the coating Applicator's responsibility to ensure that sufficient tests are carried out to show that the coatings comply with this standard. COMPANY reserves the right to carry out any additional tests at random to ensure compliance and the coating APPLICATOR shall have suitable test-equipment available for COMPANY use.

Prior to acceptance, COMPANY will carry out a final inspection. Representatives of the APPLICATOR and MANUFACTURER may be present. The coating APPLICATOR shall repair any defective areas at no additional cost to IOCL. Acceptable finish work must be free of abrasions and must be uniform in colour and appearance-

#### 7.4 Daily Inspection and Reporting

The APPLICATOR shall produce a daily report recording all relevant information appertaining to the surface preparation and coating activities. The report shall contain details on the items being coated, coating materials consumed by product number, description and batch number. The report shall include the names of operators who carried out blast cleaning and coating application, the time started and finished and the number of liters consumed. In the event of a coatings failure, it should be possible to retrieve the relevant surface preparation and coatings data for the item whose internal lining system has failed.

The coating APPLICATOR shall also keep a daily log of environmental conditions as follows:

- Air and steel temperatures
- Humidity

The above readings shall be recorded as follows:

- During blasting at each shift change
- During cleaning every four hours
- During application every shift change

- During drying / curing every shift change

**7.5 Inspection Tasks and Criteria**

All blast-cleaned internal surfaces shall be visually inspected to check for conformance to the standard of cleanliness, profile and roughness of the substrate as specified in this specification immediately prior to painting.

All painted surfaces shall be visually examined after application of each coat for deleterious film defects e.g. blisters, pinholes, dry spray, runs, sagging, wrinkling, mud-cracking, delamination, loss of adhesion, embedded particles, overspray and other contamination.

Wet film thickness measurements shall be made throughout the course of painting in order to ascertain the adequacy and uniformity of thickness. The readings shall be taken at least one every ten (10) square meters.

Dry film thickness {DFT} readings shall be taken using a non-destructive dry film thickness instrument capable of storing the readings. Sufficient readings shall be taken covering each coat prior to application of the following coat to ensure the correct required DFT.

The minimum measurement frequency shall be one (1) per two (2) square meters of item surface, with additional measurements taken at changes in section, corners or edges or a minimum of 5 readings per item whichever is the greatest. The recorded print-out of dry film thicknesses shall be retained with the inspection records together with marked up layout drawings clearly identifying the areas surveyed for future reference.

Defective work shall be corrected at the Applicator's cost.

Frequency of inspection and criteria for acceptance of painting work shall be in accordance with the following table:

Test	Standard	Frequency	Acceptance Criteria
Surface cleanliness	ISO 3501-1	one per ten (10) square meters	Sa2½
Surface profile	ISO 3503-2	one per ten (10) square meters	As per coating Procedure/datasheet
Soluble salt contamination	ISO 3502-2	one per ten (10) square meters	<5µg/cm <sup>2</sup>
Dust	ISO 3502-3	one per ten (10) square meters	Rating 2 or better
Adhesion	ISO 4524	one per test panel, per shift	5 MPa
Holiday Detection	NACE / RP0133	100% of surface	Zero defects
Dry Film Thickness	SS PC / PA-2	one per two (2) square meters	Max. and Min. dry film thickness not to be exceeded
Wet film Thickness	ISO 2302	one per ten (10) square meters	Consistent with providing required DFT.

Prior to final acceptance of the paint work, an inspection shall be made. The CONTRACTOR and IOCL shall both be represented, and they shall sign an inspection report agreed upon by all parties. The report shall consist, as a minimum, of the following:

- Names of the APPLICATOR and the responsible personnel
- Dates when work was carried out.
- Equipment and techniques used.
- Type and calibration of instruments used
- Weather and ambient conditions
- Painting periods
- Condition of surface before preparation.
- Tools and methods used to prepare surface
- Condition after preparation
- Information on systems being applied
- Mixing and testing prior to application
- Paint application techniques

## 7.6 Galvanized Items

### 7.6.1 Requirements

Galvanized items shall be coated using the hot dipped process in accordance with the latest revision of BS 1461. Articles specified to be galvanized shall be completely fabricated prior to the application of the hot dip galvanizing process.

Items shall not be hot dipped before surface preparation has been carried out in a full and correct manner. Surfaces shall be free of old paint, oil, grease, weld, slag deposits and laminations: and rolling fabrication defects eliminated prior to hot dipping. Coating weights shall comply with Table 1 of BS 1461.

### 7.6.2 Repairs

For touch-up of drilled and/or cut edge damage areas of galvanized steel, surfaces shall be hand tool cleaned and painted with one coat of zinc-rich epoxy to a nominal DFT of 60 microns. Major damage to be re-galvanized. The extent/definition of a damage area resulting in re-galvanizing shall be in accordance with EN ISO 1461, Section 6.3. Repair procedures shall be submitted as part of a painting procedure for review and approval.

### 7.6.3 For Minor Repairs:

All loose or damaged coating shall be removed by means of power driven or hand-held wire brushes to leave a feathered edge on the existing coating. At welds, the cleaning method shall remove all weld flux, spatter, slag and heat tint.

Following removal of all unwanted surface deposits, the repair area and surrounding areas shall be washed with a suitable organic solvent in accordance with SSPC-SP1 and then bristle brush washed with clean water.

When thoroughly dry, a minimum of two coats of two-pack zinc-rich epoxy paint shall be applied by brush to provide a zinc coating thickness that is a minimum of 30 microns more than the galvanized layer. The primer shall have a minimum of 30% metallic zinc in the dry film and all materials shall be applied strictly in accordance with the MANUFACTURER's recommendations. The primer shall overlap sound coating by at least 20mm.

#### 7.7 Equipment Manufacturers Standards

On standard production equipment e.g. Compressors coated with the Equipment Manufacturer's complete protective coating system it shall be the Manufacturers responsibility to ensure that their specification coating system is capable of protection within the anticipated service operating temperatures and environment, without break-down or failure.

The Equipment Manufacturer's coating system shall be suitable for a C5M environment defined as per ISO 12944-2 and shall comply with this specification unless they are able to demonstrate they are able to provide a coating system equal to, or better than that stated herein.

The protective coating system shall also be able to survive handling, transportation and storage prior to erection without incurring major damage.

The Equipment Manufacturer shall submit his surface preparation and protective coating system to the CONSULTANT/IOCL for approval prior to him carrying out any coatings related works.

### 8.0 MATERIALS

#### 8.1 General

Coating materials shall only be obtained from the MANUFACTURER's listed in Master Supplier List (MSL) approved vendors.

All material shall be supplied in the MANUFACTURER's original cans, durably and legibly marked with the description of the contents. This shall include the specification number, the colour reference number, the method of application for which it is intended, the batch number, date of manufacture and the MANUFACTURER's name, initials, or recognized trade mark. No intermixing of different brands or types of paints will be permitted.

No intermixing of different brands or types of paints will be permitted. Paint systems, i.e. primer, undercoat, finish coat, shall be from the same material MANUFACTURER to ensure compatibility. The MANUFACTURER's shall supply data sheets for each type of paint which shall include the recommended minimum and maximum over coating periods for the dry film thickness specified in this Specification. Paint Systems, i.e. primer, undercoat, finish coat, shall be from the same MANUFACTURER to ensure compatibility.

All coating materials used shall conform to the following generalized composition clauses. In meeting the composition clauses, the MANUFACTURER shall provide evidence of compliance and shall produce premium quality paint with the full performance required by this specification:

- Zinc rich primers shall be based on two pack epoxy media and shall contain a minimum of 35% metallic zinc by weight in the dry film.

- Zinc silicate primer shall be based on inorganic or ethyl silicate media and shall contain not less than 35% metallic zinc by weight in the dry film.
- Micaceous iron oxide pigmented paint shall contain a minimum of 50% natural laminar micaceous iron oxide by weight in the dry film.
- Glass Flake Epoxies shall contain a minimum of 20% glass flake by weight in the dry film. The applied painting system shall be compatible with cathodic protection systems and shall demonstrate excellent cathodic disbondment characteristics. When tested in accordance with ASTM G8 or similar, the maximum disbondment shall be less than 5mm.
- Epoxy phenolic system - "INS 1" where used for buried piping applications shall be compatible with cathodic protection systems and shall demonstrate excellent cathodic disbondment characteristics. When tested in accordance with ASTM GB or similar, the maximum disbondment shall be less than 5mm.

High temperature top coat paint shall be based on a one-pack formulation comprising leafing Aluminium pigment dispersed in silicone or two component inorganic silicate media. The paint shall be capable of withstanding continuous exposure to temperatures between 120°C and 400°C. Only ambient air curing heat resistant Aluminium paints shall be applied (post heat curing materials are not acceptable).

Materials containing the following components shall not be used:

- Cadmium, lead or any toxic material to environment/personnel shall not be used.
- Paints for use over stainless steels shall not contain free chlorides or other halides and zinc. Chlorides or other halides tied up within the cured resin's molecule may be acceptable. unless they are subject to release through aging within the temperature range specified.

## 8.2 Material Storage

Storage of paint materials at the site of usage shall be the responsibility of the APPLICATOR and the storage planning shall consider the geographical and meteorological conditions and make provisions for any abnormality such as temperatures.

Paint shall be stored in dry, well ventilated, temperature-controlled buildings out of direct sunlight in accordance with the MANUFACTURER's recommendations. Paint shall be used on a first in, first out basis and paint that has exceeded its shelf life shall not be used.

As a minimum all tins, bags, buckets, pails or other material storage containers for paints, thinners, abrasives or ancillary materials left on the job face shall be stacked in a safe, neat even manner off the ground and protected from the elements using a weather impervious sheet such as a tarpaulin. Fork lift truck pallets are generally acceptable for temporary stacking purposes. All items of material shall be stacked and marked indelibly for ease of identification.

The MANUFACTURER of the specified paint materials shall advise the APPLICATOR of the intended storage conditions and recommendations.

Records of paint material batch numbers together with dates of receipts of each batch shall be kept by the paint material applicator so that a sequence of storage can be arranged to ensure material is issued from store in the same sequence as received at painting venue. The Buyer reserves the right to inspect these records and check the issuing organization at any time during the execution of contract.

Storage shall consider and make provision for governing local safety regulations. adequate fire prevention equipment and its maintenance and the elimination of ignition risks (e.g. No smoking, use of flame proof equipment etc.).

Purposeful spillage shall be prohibited. but sufficient inert absorbing material shall always be available for the immediate clean-up of accidental spillage. The use of rags and wood dust for clean-up of inflammable materials is not permitted.

The disposal of waste and empty containers shall be subject to regulations laid down before the commencement of material deliveries. Empty and/or partially empty containers shall be collected and disposed of in accordance with the regulations.

Paint materials are potentially harmful to operatives and it shall be necessary to maintain a high standard of personnel hygiene. Paint Contractors shall advise the Main Contractor of details of precautions being taken to protect all working personnel in the vicinity of paint storage and handling.

### 8.3

#### **Documentation**

A written quality plan with procedure for qualification trials and for the actual work.

- Daily progress report with details of weather conditions of applications, no. of coats and type of materials applied, anomalies, progress of work versus program.
- Results of measurement of temperatures relative humidity, surface profile, film thickness, holiday detection, adhesion tests with signature of appropriate authority.
- Details of surface preparation and paint application during trials and during the work.
- Details of non-compliance, rejects and repairs.
- Type of testing equipment and calibration.
- Code and batch numbers of paint materials used.



9.0 PROTECTIVE COATING SYSTEMS

9.1 Coating Systems - Table 1

General protective coating requirements for structural steelwork and equipment:

Service / Item	Substrate	Max Operating temp °C	Coating System	Comments
Piping, Vessels, Equipment, Heat Exchangers, Structural steel	Carbon Steel	> 0 ≤ 120	CS 1	Tie-coat may be required between primer & build coat
Piping, Vessels, Equipment, Heat Exchangers, Structural steel	Carbon Steel	> 201 < 400	CS 2	For temperatures > 400°C contact Consultant
Piping, Vessels, Equipment, Heat Exchangers, Structural steel	Carbon Steel	> 121 < 200	CS 3	
Insulated Piping, Vessels, Heat Exchangers & Equipment	Carbon Steel	> 200 < 400	CS 4	Insulated stainless steel shall not be painted. For temperatures >400°C, contact Consultant
Insulated Piping, Vessels, Heat Exchangers & Equipment. Equipment skirts / supports that are to be fireproofed with dense concrete	Carbon Steel	≤ 200	INS 1	Care to be exercised not to apply epoxy phenolic coatings too thickly. Insulated stainless steel shall not be painted
Piping, Vessels, Equipment, Heat Exchangers, Structural steel Insulated & Uninsulated	Carbon Steel / Stainless Steel	Fluctuating upto 540°C	T.S.A.	Cyclic service to receive corrosion protection using Thermally Sprayed Aluminium
Immersed structures, below jetty deck supports and steel work in splash zone	Carbon Steel	≤ 70	CSJ 1	Above jetty deck protective coatings to be selected in accordance with other systems in this spec.
Un-insulated Piping, Vessels, Equipment, Heat Exchangers	Stainless Steel	> 0 ≤ 200	SS 1	If temperature is > 200°C, contact Consultant
Galvanized Steel	Carbon Steel	≤ 120	GAL 02	At Contractor request to be employed when coated for color purpose
Bulk Valves	Carbon Steel / Stainless Steel	≤ 565	CSA	if Valves are in a severe temperature cyclic situation, contact Consultant
External surfaces of uninsulated tanks	Carbon Steel	≤ 120	CS 1	
Tank bottoms, buried vessels, buried piping	Carbon Steel / Stainless Steel	≤ 70	UG01	
Tank bottoms, buried vessels, buried piping	Carbon Steel / Stainless Steel	> 70 ≤ 150	INS 1	Care to be exercised not to apply epoxy phenolic coatings too thickly.
Structural steel with concrete fireproofing	Carbon Steel	≤ 120	INS 1	Care to be exercised not to apply epoxy phenolic coatings too thickly.
Structural steel with light weight fireproofing	Carbon Steel	≤ 120	FP01	
External surfaces of pipeline Isolation Joints and above ground sections	Carbon Steel	≤ 120	IJ	



9.2 Make-up of Protective Coating Systems - Table 2

Coating system	Min Surface preparation	Coating System Make-Up			Min DFT $\mu\text{m}$
		Primer Coat	Build Coat	Top Coat	
CS 1	Abrasive Blast Clean to Sa 2½	Inorganic zinc silicate @ 75 $\mu\text{m}$	High build epoxy MIO @ 125 $\mu\text{m}$	Two pack acrylic polyurethane @50 $\mu\text{m}$	250
CS 2	Abrasive Blast Clean to Sa 2½	Inorganic zinc silicate @ 75 $\mu\text{m}$	High temperature top coat @ 125 $\mu\text{m}$ (Note 2)	High temperature top coat @125 $\mu\text{m}$ (Note 2)	125
CS 3	Abrasive Blast Clean to Sa 2½	Inorganic zinc silicate @ 75 $\mu\text{m}$	--	High temperature silicon acrylic @ 50 $\mu\text{m}$	125
CS 4	Abrasive Blast Clean to Sa 2½	Inorganic zinc silicate @ 75 $\mu\text{m}$	--	--	75
INS 1	Abrasive Blast Clean to Sa 2½	Two pack epoxy phenolic @ 150 $\mu\text{m}$	--	Two pack epoxy phenolic @ 150 $\mu\text{m}$	300
TSA	Abrasive Blast Clean to Sa 2½	Thermally Sprayed Aluminium shall be applied to carbon and Stainless Steel surfaces (insulated & non-insulated) when cyclic temperature conditions $\leq 540^{\circ}\text{C}$ apply.			250 (Note 3)
CSJ 1	Abrasive Blast Clean to Sa 2½	--	Glass Flake Epoxy @500 $\mu\text{m}$	Glass Flake Epoxy @500 $\mu\text{m}$	1000
SS1	Surface profile to 40-60 $\mu\text{m}$	Two pack epoxy phenolic @ 150 $\mu\text{m}$	--	Two pack epoxy phenolic @150 $\mu\text{m}$	300
GAL 02	Sweep blast (Note 1)	High build epoxy @75 $\mu\text{m}$		Two pack acrylic polyurethane @50 $\mu\text{m}$	125
UG 01	Abrasive Blast Clean to Sa 2½	--	Glass Flake Epoxy @500 $\mu\text{m}$	Glass Flake Epoxy @500 $\mu\text{m}$	1000
CSA	Abrasive Blast Clean to Sa 2½	--	Heat Resistant Cold Spray Aluminium @ 100 $\mu\text{m}$	Heat Resistant Cold Spray Aluminium @ 100 $\mu\text{m}$	250
IJ	Abrasive Blast Clean to Sa 2½	Glass Flake Epoxy @500 $\mu\text{m}$	Glass Flake Epoxy @500 $\mu\text{m}$	Two pack acrylic polyurethane @50 $\mu\text{m}$	1050
FP01	Abrasive Blast Clean to Sa 2½	Zinc Rich epoxy primer @ 75 $\mu\text{m}$	-	Epoxy Tie coat @ 25 $\mu\text{m}$	100



Notes:

1. Sweep blast stainless steel, galvanized steel surfaces using Aluminium oxide or garnet abrasive media
2. Only air curing heat resistant silicone Aluminium paints shall be applied, post heat curing materials are not acceptable.
3. The DFT for TSA is without sealer coats. where sealer coats are required the DFT must be increased accordingly. DFT for sealer coat shall be 25mm.

**10.0 Finish Color Schedule**

This section covers the general colour requirements for structural steel work and equipment with operating temperatures below 120°C:

Sr. No:	Service	Shade - Shade number
NA	Structural Steel work	Light Grey - RAL 7035
NA	Spheres and Storage tanks	White - RAL 9003
NA	Electrical Switch Boards, Cable Conduit Transformers and all other electrical equipment	Light Grey - RAL 7035
NA	Loading Arms (i) Structural Steel (ii) Arms	Light Grey - RAL 7035 Yellow - RAL 1023
NA	Valves	Signal Grey - RAL 7004 Or Aluminium - RAL 9006
96	Heater Structure	Aluminium - RAL 9006
97	Heater Casing	Aluminium - RAL 9006
98	Vessels and Columns	Aluminium - RAL 9006
99	Hydrogen Bullets	Antique Pink - RAL 3014
100	LPG Vessels	Oxide Red - RAL 3009
101	SO <sub>2</sub> Vessel	Yellow - RAL 1023
102	Heat Exchangers	Aluminium - RAL 9006
103	FO Tanks and Hot Tanks	Black - RAL 9017
104	All other Tanks	Aluminium - RAL 9006
105	Caustic/Amine/Acid Tanks	Gold/Yellow - RAL 1004
106	Sour Water	Sky Blue -RAL 5015
107	Outer Surface in Boiler House	Aluminium - RAL 9006
108	Steam Turbine	Aluminium - RAL 9006
109	Compressors and Blowers	Dk Grey BS 4800 18 B 25
110	Pumps (except Fire pumps)	Cobalt Blue - RAL 5013
111	Motors (except Fire motors)	Bluish Green RAL 5021
112	Hand Railing	Red - RAL 3001
113	Staircase, Ladders and Walkways	Black - RAL 9017
114	Load lifting equipment & mono rails etc.	Brown - RAL 8003
115	General Structure	Black - RAL 9017
116	Switchgear (incl. inside sub-station)	Light Grey - RAL 7035
117	Dangerous Obstruction	Alternate Black (RAL 9017) and Orange (RAL 2008) Diagonal Banding
118	Dangerous or Exposed parts of machinery	Orange - RAL 2008
119	Fire motors, Fire hydrants and equipment in fire fighting service	Signal Red - RAL 3001

**11.0 Pipe Colour Bands**

This section covers the requirements for a colour scheme identifying the contents of piping carrying products throughout IOCL refineries and petrochemical installations. The colour coding system is based on international specifications such as ASME, ANSI, BS and Indian Standards including IOCL's existing specification for colour coding.

The system of coding consists of a ground/base colour superimposed with secondary colour bands. The ground colour identifies the basic nature of the service and the secondary colour bands distinguish the service product contained. Ground colour shall be applied to the entire length of un-insulated piping.

The ground colours and secondary banding colours are defined in previous section.

The frequency of banding on un-insulated pipe shall be as follows:

- Unit Area - Bands at intervals of 5 meters
- Offsite Area - Bands at intervals of 10 meters

Each pipe segment will have a minimum of 1 identification band irrespective of length

Colour bands of the correct size shall be applied to the pipe at:

- Both sides of valves, tees and other fittings
- Where pipes enter and emerge through walls
- Where pipes enter and emerge from walkway overpasses and battery limits.
- At uniform intervals along long sections of pipe
- Adjacent to tanks, vessels and pumps.

Insulated piping shall receive ground coloring and colored (secondary) identification bands at a minimum of either side of valves, flanges and the like. At each change in flow direction and at no greater than 6-meter intervals. Ground colours should be 2 meters long.

Secondary colours are to be applied using adhesive plastic tapes to the specified colour.

Bands widths are shown below for different pipe diameters and are to be spaced 25mm apart when two bands (or more) are used:

<b>Outside diameter of pipe or covering (inches)</b>	<b>Width of color bands mm</b>
<b>&lt; 2"</b>	<b>200</b>
<b>2" – 4"</b>	<b>300</b>
<b>6" – 8"</b>	<b>600</b>
<b>≥ 10"</b>	<b>800</b>

Bands shall also be displayed conspicuously near walkways, both sides of culverts, tanks, dykes, vessels, suction and discharge of pumps/compressors, unit battery limit, near valves of line, etc.

**Identification Lettering**

Name of service and direction of flow, for all lines shall be positioned at the following locations:

- Offsite lines: Both sides of culverts, any one side of walkways, near tank dykes, at tank inlet/outlet points and suction/discharge Pumps/compressors.
- Unit lines: At the battery limit, suction/discharge of pumps/compressors, near vessels, columns, tanks, exchangers etc.

Identification/legend letter sizes on piping shall depend on the pipe diameter. Either white or black letters are to be selected so as to afford maximum contrast with the identification band colour.

<b>Outside diameter of pipe or covering (inches)</b>	<b>Size of legend letters (mm)</b>
<b>&lt; 2"</b>	<b>19</b>
<b>2" – 4"</b>	<b>32</b>
<b>6" – 8"</b>	<b>64</b>
<b>≥ 10"</b>	<b>89</b>

Pipe contents and direction of flow is to be identified using legend letters and arrows. any hazard must be identified clearly by the legend.

Size of letters (stenciled or pre-formed adhesive) for equipment shall be:

<b>Equipment</b>	<b>Size of legend letters (mm)</b>
<b>Column and vessel</b>	<b>150 mm height</b>
<b>Pump, compressor and other machinery</b>	<b>50 mm height</b>

Lettering shall be black on pipes painted with light shade colours and white on pipes painted with dark shade colours to give good contrast

**12.0 IOCL Paint Colour Code and Banding**

The following base/ground and secondary colour designation for identification of various important services shall be followed:

Sl. No:	Service	Base/Ground Colour	Secondary Colours	Band
<b>Hydrocarbon Lines – (Un-insulated)</b>				
1.	Crude Sour	Dk Grey BS4800 18 B 25	(x1) Orange – RAL 2008	
2.	Crude Sweet	Dk Grey BS4800 18 B 25	(x1) Red – RAL 3001	
3.	Lube Oils	Dk Grey BS4800 18 B 25	(x1) Green – RAL 6002	
4.	Flare Line	Aluminium – RAL 9006	Aluminium – RAL 9006	
5.	L.P.G.	Orange – RAL 2008	(x1) Oxide Red – RAL 3009	
6.	Propylene	Orange – RAL 2008	(x2) Oxford Blue – RAL 5003	
7.	Naphtha	Orange – RAL 2008	(x1) Green – RAL 6002	
8.	M.S.	Orange – RAL 2008	(x1) Dk Grey BS4800 18 B 25	
9.	AV. Gasoline (96 RON)	Orange – RAL 2008	(x1) Green – RAL 6002 + (x1) White – RAL 9003 + (x1) Red – RAL 3001	
10.	Gasoline (regular, leaded)	Orange – RAL 2008	(x1) Black – RAL 9017	
11.	Gasoline (premium, leaded)	Orange – RAL 2008	(x1) Blue – RAL 5017	
12.	Gasoline (white)	Orange – RAL 2008	(x1) White – RAL 9003	
13.	Gasoline (aviation 100/130)	Orange – RAL 2008	(x1) Red – RAL 3001	
14.	Gasoline (aviation 115/145)	Orange – RAL 2008	(x1) Purple – RAL 4006	
15.	N-Pentane	Orange – RAL 2008	(x2) Blue – RAL 5017	
16.	Diesel Oil (white)	Oxide Red – RAL 3009	(x1) White – RAL 9003	
17.	Diesel Oil (black)	Oxide Red – RAL 3009	(x1) Yellow – RAL 1023	
18.	Kerosene	Oxide Red – RAL 3009	(x1) Green – RAL 6002	
19.	HY. Kero	Oxide Red – RAL	(x2) Green – RAL 6002	

Sl. No:	Service	Base/Ground Colour	Secondary Colours	Band
		3009		
20.	Disulfide Oil (Ex-Merox)	Oxide Red – RAL 3009	(x1) Black – RAL 9017	
21.	M.T.O.	Oxide Red – RAL 3009	(x3) Green – RAL 6002	
22.	DHPPA	Oxide Red – RAL 3009	(x2) White – RAL 9003	
23.	Flushing Oil	Oxide Red – RAL 3009	(x2) Black – RAL 9017	
24.	Lab FS	Oxide Red – RAL 3009	(x2) Dk Grey BS4800 18 B 25	
25.	Lab RS	Oxide Red – RAL 3009	(x3) Dk Grey BS4800 18 B 25	
26.	Lab (Off. Spec.)	Oxide Red – RAL 3009	(x1) Lt Grey RAL 7036	
27.	N-Paraffin	Oxide Red – RAL 3009	(x1) Blue – RAL 5017	
28.	Heavy Alkylate	Oxide Red – RAL 3009	(x1) Red – RAL 3001	
29.	Blow Down, Vapour Line	Aluminium – RAL 9006	(x1) Brown – RAL 8003	
30.	Blow Down	Aluminium – RAL 9006	(x2) Brown – RAL 8003	
31.	A.T.F.	Brown – RAL 8003	(x1) White – RAL 9003	
32.	Toluene	Brown – RAL 8003	(x1) Yellow – RAL 1023	
33.	Benzene	Brown – RAL 8003	(x1) Green – RAL 6002	
34.	Lab Product	Brown – RAL 8003	(x1) Blue – RAL 5017	
35.	Fuel Oil	Black – RAL 9017	(x1) Yellow – RAL 1023	
36.	Fuel Oil (aromatic rich)	Black – RAL 9017	(x2) Yellow – RAL 1023	
37.	Asphalt	Black – RAL 9017	(x1) White – RAL 9003	
38.	Slop and Waste Oils	Black – RAL 9017	(x1) Orange – RAL 2008	
39.	Slop Aromatic	Black – RAL 9017	(x2) Orange – RAL 2008	



SI. No:	Service	Base/Ground Colour	Secondary Colours	Band
<b>Chemical Lines (Un-insulated)</b>				
40.	Tri-Sodium Phosphate	Yellow – RAL 1023	(x1) Violet – RAL 4008	
41.	Caustic Soda	Yellow – RAL 1023	(x1) Black – RAL 9017	
42.	Sodium Chloride	Yellow – RAL 1023	(x1) White – RAL 9003	
43.	Ammonia	Yellow – RAL 1023	(x1) Blue – RAL 5017	
44.	Corrosion Inhibitor	Yellow – RAL 1023	(x1) Aluminium – RAL 9006	
45.	Hexameta Phosphate	Yellow – RAL 1023	(x2) Black – RAL 9017	
46.	Acid Lines	Gold/Yellow – RAL 1004	(x1) Red – RAL 3001	
47.	Rich Amine	Yellow – RAL 1023	(x2) Blue – RAL 5017	
48.	Lean Amine	Yellow – RAL 1023	(x3) Blue – RAL 5017	
49.	Solvent	Yellow – RAL 1023	(x1) Green – RAL 6002	
50.	LCS	Yellow – RAL 1023	(x1) Grey – RAL 7001	
<b>Water Lines (Un-insulated)</b>				
51.	Raw Water	Sky Blue – RAL 5015	(x1) Black – RAL 9017	
52.	Industrial Water	Sky Blue – RAL 5015	(x2) Red – RAL 3001	
53.	Treated Water	Sky Blue – RAL 5015	(x1) Oxide Red – RAL 3009	
54.	Drinking Water	Sky Blue – RAL 5015	(x1) Green – RAL 6002	
55.	Cooling Water	Sky Blue – RAL 5015	(x1) Pale Brown – RAL 8025	
56.	Service Water	Sky Blue – RAL 5015	(x1) Red – RAL 3001	
57.	Tempered Water	Sky Blue – RAL 5015	(x2) Green – RAL 6002	
58.	DM Water	Sky Blue – RAL 5015	(x1) Aluminium – RAL 9006	
59.	DM Water above 150°F	Sky Blue – RAL 5015	(x2) Black – RAL 9017	
60.	Sour Water	Sky Blue – RAL 5015	(x2) Yellow – RAL 1023	
61.	Stripped Water	Sky Blue – RAL 5015	(x2) Blue – RAL 5017	
62.	ETP Treated Water	Sky Blue – RAL 5015	(x2) Oxide Red – RAL 3009	

Sl. No:	Service	Base/Ground Colour	Secondary Colours	Band
<b>Fire Protection System (Above Ground)</b>				
63.	Fire Water, Foam and Extinguishers	Red – RAL 3001	Red – RAL 3001	
<b>Air and Other Gas Lines (Un-insulated)</b>				
64.	Service Air	May Green – RAL 6017	(x1) Red – RAL 3001	
65.	Instrument Air	May Green – RAL 6017	(x1) Black – RAL 9017	
66.	Nitrogen	May Green – RAL 6017	(x1) Orange – RAL 2008	
67.	Freon	May Green – RAL 6017	(x1) Yellow – RAL 1023	
68.	Chlorine	Yellow – RAL 1023	(x1) Oxide Red – RAL 3009	
69.	SO <sub>2</sub>	Yellow – RAL 1023	(x2) White – RAL 9003	
70.	H <sub>2</sub> S	Orange – RAL 2008	(x2) Oxide Red – RAL 3009	
71.	Gas (fuel)	Orange – RAL 2008	(x1) Aluminium – RAL 9006	
72.	Gas (sour)	Orange – RAL 2008	(x2) Aluminium – RAL 9006	
73.	Gas (sweet)	Orange – RAL 2008	(x1) Red – RAL 3001	
74.	Hydrogen	Orange – RAL 2008	(x1) May Green – RAL 6017	
<b>Steam and Condensate Lines (Un-insulated)</b>				
75.	HP Steam & VHP Steam Line	Aluminium – RAL 9006	(x1) Yellow – RAL 1023	
76.	MP Steam	Aluminium – RAL 9006	(x1) Red – RAL 3001	
77.	MLP Steam	Aluminium – RAL 9006	(x1) Orange – RAL 2008	
78.	LP Steam	Aluminium – RAL 9006	(x1) Green – RAL 6002	



SI. No:	Service	Base/Ground Colour	Secondary Colours	Band
79.	Condensate	Sky Blue – RAL 5015	(x1) White – RAL 9003	
80.	Condensate above 150°F	Sky Blue – RAL 5015	(x3) Oxide Red – RAL 3009	
81.	BFW	Sky Blue – RAL 5015	(x2) Traffic Red – RAL 3020	
<b>Note:</b> For all insulated steam lines, the colour coding shall be followed as given for un-insulated lines with the specified length of colour bands				
<b>Insulated Hydrocarbon Lines</b>				
82.	IFO Supply	Black – RAL 9017	(x1) Yellow – RAL 1023	
83.	IFO Return	Black – RAL 9017	(x1) Green – RAL 6002	
84.	HPS	Black – RAL 9017	(x1) Red – RAL 3001	
85.	Bitumen	Black – RAL 9017	(x2) Red – RAL 3001	
86.	CLO	Black – RAL 9017	(x1) Brown – RAL 8003	
87.	VB Tar	Black – RAL 9017	(x2) Brown – RAL 8003	
88.	VR AM (Bitumen/VBU Feed)	Black – RAL 9017	(x1) Blue – RAL 5017	
89.	VR BH	Black – RAL 9017	(x2) Blue – RAL 5017	
90.	VAC. Slop	Black – RAL 9017	(x1) White – RAL 9003	
91.	Slop	Black – RAL 9017	(x1) Orange – RAL 2008	
92.	Crude Sweet	Dk Grey BS4800 18 B 25	(x1) Red – RAL 3001	
93.	Crude Sour	Dk Grey BS4800 18 B 25	(x1) Orange – RAL 2008	
94.	VGO/HCU Feed	Oxide Red – RAL 3009	(x1) Signal Grey – RAL 7004	
95.	OHCU Bottom/FCCU Feed	Oxide Red – RAL 3009	(x2) Signal Grey – RAL 7004	

**13.0 Guarantee**

The contractor shall guarantee that the chemical and physical properties of paint materials used are in accordance with the specifications contained herein/to be provided during execution of work.

The contractor shall produce test reports from manufacturer regarding the quality of the particular batch of paint supplied. The Engineer-in-Charge shall have the right to test wet samples of paint at random for quality of same, as per the paint materials specification. Batch test reports of the manufacturer for each batch of paints supplied shall be made available by the contractor. The contractor shall stand guarantee for carrying out the rectification/repair/re-painting of the defects/ failures of painting found during the execution of painting job and till the expiry of the defect liability period of total project as per the directions of the Engineer-in-Charge

**14.0 Qualification Criteria of Painting Contractor**

Painting contractor who is awarded the job under this standard must have necessary equipment, machinery, tools and tackles for surface preparation, paint application and inspection. The contractor must have qualified, trained and experienced surface preparator, paint applicator, inspector and supervisors. The contractor's supervisor, inspector, surface preparator and paint applicator must be conversant with the standards referred in this specification. The painting job shall be carried out by the approved agencies of paint manufacturers and supervised by the approved paint manufacturers own representative or paint manufacturer their scheme (supply and apply basis).

**15.0 Identification of stored pipe lines**

The part of the standard covers the method of identification of STORED piping material by color coding. This standard is applicable to storage during project Stage as well.

General guide lines of identification by color coding:

- a) Piping shall be painted with one color or a combination of colors as enclosed.
- b) Color identification is not required on galvanized material and mm ferrous material such as Copper. Aluminum etc. because of their peculiar color and character
- c) Special items like bellow, strainers, steam Imps etc. should be lagged and hence do not require a color identification.
- d) Color identification of Austenitic Stainless Steel is not desirable due to risk of contamination from paint material.
- e) Bends of piping to be welded shall not be painted. First color band shall start 2" from the pipe ends.
- f) Width of color strips shall be 25 mm for nominal pipe diameter and above. Secondary color strip where required, shall be half the size of primary strips. For less than 3" size color strip shall be 12 mm < 1/2") or maximum practical.

<b>Carbon Steels</b>		
API 5L Gr B	Pink	Seamless
API 5L Gr B	Pink / White	Welded
A 106 Gr B	Red	IBR
A 106 Gr B	Yellow	Non IBR
Welded and seamless fittings	Red	IBR
Welded and seamless fittings	Yellow	Non IBR
Welded fittings	Yellow / White	Normalized
Miters	Silver	
Class 22 fittings	Silver / Pink	Stress relieved at shop
IS 3589- IS 12239	No Paint	Non-critical
<b>Alloy Steels</b>		
P1, F1, WP1, WP1W etc.	Green / Red	
P12, F12, W12 etc.	Green / Yellow	
P22, F22, WP22 etc.	Green / Silver	
P11, F11, WP11 etc.	Green / Orange	
P5, F5, WP5 etc.	Green / Blue	
P9, F9, WR9 etc.	Green / Pink	

**16.0 Annexure-1 Painting in the Internal Floating Roof Tank**

Following painting requirements shall be followed for Internal Floating roof tanks.

**16.1 Recommendations pertaining to pontoon manhole**

- a) One manhole of minimum 20 NPS per pontoon floating roof tank is adequate as per clause C.3.5 of API 650 for new and existing floating roof tank as well. No additional manhole or opening is required.
- b) Painting inside tank pontoon is done in new tanks. In tanks under M&I, the painting is to be done where the same has been recommended by M&I.

**16.2 Procedure for Painting inside Tank Pontoon****I – Painting Procedure**

- a) Painting inside tank pontoon is not a routine job and is to be carried out only on recommendations of Inspection Department during M&I in case of existing tanks. In case of new tanks, also the same procedure of painting shall be applicable.
- b) Surface preparation only after tank is made gas free by hand tool cleaning/ scrappers / wire brush.
- c) Sufficient exhaust ventilation should be provided through either air hose or air operated blowers
- d) Confined Space Permit and Cold Permit specifying painting job to be issued and conditions of the permit to be complied with.
- e) Painting job to be undertaken only during day time with natural light. Use of lighting arrangement should be avoided. However, if required, it should be flame proof type and limited to 24 V DC.
- f) All electrical cables / wires should be joint free and in sound condition.
- g) Painting to be started as last activity after the preparation of the surface is complete and other above precautions taken. During painting job in pontoon, no hot work should be allowed in the vicinity. Also no job which has a potential to generate spark to be carried out.
- h) Two coats of high build (HB) red oxide zinc phosphate primer to be used
- i) Addition of thinner is prohibited
- j) Application of primers inside the pontoon must be done by brush / rollers only
- k) Ventilation should be continued even after completion of painting or coating applications to dissipate excess vapour concentrations till surface becomes dry and area is gas free.
- l) Continuous monitoring of concentration of flammable mixture through portable detector and stopping the work whenever concentration of vapours exceeds 10% of LEL. This aspect must be included in Tool Box Talk and Job Safety Analysis.
- m) Retest the atmosphere 10 minutes after ventilation has been discontinued to confirm that the area is gas free
- n) It should be ensured that empty / filled paint drums are not stored in the vicinity and stacked away from the working site.

- o) It should be ensured that rags /cotton/ tools paint etc. are not left out inside the pontoon.
- p) After completion of activity of painting of tank pontoon, it has to be ensured that the pontoon manholes are properly closed

**II- Painter Safety**

- a) Painter to come out from the tank pontoon for fresh air breathe after every 10-15 minutes and again re-start the job.
- b) Stand-by person(s) should always be available outside the confined area and should have regular communication with the painter inside the pontoon box to identify that the painter is not in any sort of discomfort.
- c) The persons involved in the painting job should wear requisite PPE as mentioned in Page No. 27-30 of Guidelines on Personal Protective Equipment issued by HSE, Corporate Office, which are uploaded on Corporate HSE intranet website also
- d) It is to be ensured that immediately after painting, painter will change his clothes and clothes used during the painting should be stored in a close container. After completion of job, these clothes should be disposed safely
- e) Painter should not move from the painting site without changing clothes not even for natural call

**III- Other Instructions**

- a) Job Safety Analysis for tank M&I jobs should be done separately for each sub-activity
- b) Tool box talk should include safety information / precaution related to specific jobs plan to carry out.

**DEPARTMENT:** FEG

**DOCUMENT NO:** 44AC9100-000/V.02/0110/A4




**DOCUMENT TITLE:** GENERAL SPECIFICATION FOR INSULATION

**PROJECT NO:** 44AC9100

**PROJECT LOCATION:** DUMAD/IOCL-JR, Gujarat

**PROJECT TITLE:** EPCM/PMC Services for Acrylics/Oxo-Alcohol Project at Gujarat Refinery & Dumad Complex

**CLIENT:** Indian Oil Corporation Limited

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**1.0 SCOPE**

**1.1 General**

This Specification covers the use of thermal insulation for above ground, external insulation of piping and equipment operating between Ambient Temperature and 600°C for the purpose of Heat Conservation, Process Stabilization, Temperature Maintenance, Acoustic Attenuation, Personnel and Fire Protection.

The insulation requirements of this Specification are suitable for use in both indoor and outdoor service with normal process plant atmospheres. Alternative designs and materials shall be considered if necessary for highly corrosive atmospheres or potential leaks and spills of chemicals.

This Specification is intended to cover Jacobs / IOCL / LSTK Contractor engineered piping, pressure vessels and circular ducting; Jacobs / IOCL / LSTK Contractor rated heat exchangers and mechanical equipment.

Cold service insulation shall be provided elsewhere in the contract document.

This Specification does not cover 'vendor designed insulation for Boiler or Fired Heater packages including Air heaters, Economizers, Gas Flues and Air Ducting. The Specification is intended to cover Jacobs / IOCL / LSTK Contractor supplied insulation for parts of such packages except for rectangular ducting.

Piping and equipment requiring insulation shall be specified on the following project documents:

- 1) Process St Instrumentation Diagrams (P&IDs) and Line Lists.
- 2) Piping General Arrangements and Isometrics
- 3) Instrument Piping Details
- 4) Project Specific Vessel and Exchanger Drawings
- 5) Equipment Suppliers General Arrangement Drawings for equipment items and Jacobs / IOCL insulated package plant.

**2.0 REFERENCE STANDARDS**

**International Standards**

API 521	:	Pressure-relieving and De-Pressuring Systems
ASTM B209		Standard Specification for Aluminium and Aluminium-Alloy Sheet and Plate
ASTM C547		Mineral Fibre Preformed Pipe Insulation
ASTM C612		Mineral Fibre Block and Board Thermal Insulation
ASTM C929		Handling, Transporting, Shipping, Storage, Receiving, and Application of Thermal Insulation Materials for use in Contact with Austenitic Stainless Steel
ASTM C692		Standard Test Method for Evaluating the Influence of Thermal insulations on External Stress Corrosion Cracking Tendency of Austenitic Stainless Steel
BS 2972		Methods of Test for inorganic Thermal Insulating Materials
BS 3533		Glossary of Thermal Insulation Terms
BS 3958		Thermal Insulating Materials
BS 476		Fire tests on building materials and structures



BS 5970	Code of Practice for Thermal Insulation of Pipework and Equipment in the Temperature Range -100°C to +870°C
BS 5422	Method for Specifying Thermal Insulating Materials for Pipes, Tanks, Vessels, Ductwork and Equipment Operating within the Temperature Range -40°C to +700°C
OISD-STD-177	Inspection and Maintenance of Thermal Insulation
OISD-STD-111	Process Design and Operating Philosophies on Fired Process Furnace
OISD 15665	Acoustics - Acoustic insulation for pipes, valves and flanges
NFPA 55	Liquefied Petroleum Gas Code

**3.0 DEFINITIONS**

'**APPLICATOR**' shall be defined as the party that is responsible for installation of insulating materials.

'**Manufacturer**' shall be defined as the party supplying the insulation, cladding or fixing materials.

'**IOCL**' shall be defined as Indian Oil Corporation Limited (Client).

'**Project**' shall be defined as the entire scope of work on the **Acrylic / Oxo Alcohol Project**, IOCL-Dumad.

'**Consultant**' shall be defined as Jacobs Engineering India Pvt. Limited

'**Contractor**' shall be defined as LSTK Contractor and his sub-contractor (if any)

**4.0 DESIGN - GENERAL**

4.1 General

4.1.1 In this Specification, insulation for the prevention of heat loss is designed to provide economic thicknesses such that resulting cold face surface temperatures do not exceed 60°C with ambient temperature in still air conditions min. 11°C max. 42°C

4.1.2 Insulation shall comprise a layer(s) of heat resisting fibre material enclosed within protective metal cladding sealed against the ingress of moisture and designed to allow differential expansion

4.1.3 Internal refractory lined piping and equipment shall not be insulated. Over these areas personnel protection shall be achieved by the use of stand-off metal guards

4.1.4 Personnel protection shall be achieved on surfaces having either a continuous operating temperature of 60°C to 200°C or is in intermittent service using stood off metal cages, guards, shields or railings. Design of personnel protection guards shall be agreed with Jacobs / IOCL

4.1.5 On surfaces with continuous operating temperatures greater than 200°C the use of insulation is acceptable. Insulation shall be designed to yield a cold face temperature of 60°C or less under ambient temperature and still air conditions.

4.1.6 Personnel protection for Fired Heaters based on OISD 111 requirement is covered elsewhere in the contract document.

4.1.7 The purpose for which insulation is required is identified by the applicable symbols in Table 1. Piping and Equipment to be insulated shall be identified by these symbols on P&ID and Line Lists.

4.1.8 Instruments and associated piping subject to operating flow and/or temperature conditions approximating those in the piping or equipment to which they are connected, shall be insulated to the same requirements as that piping or equipment. The insulation requirements shall be classified by symbols in accordance with Table 1.

- 4.1.9 Carbon steel and low alloy piping and equipment shall be protected against corrosion by painting in accordance with Project Specifications
- 4.1.10 All insulated austenitic stainless-steel piping and equipment shall be protected against external stress corrosion cracking by the application of a sacrificial aluminium foil system.
- 4.1.11 To assist corrosion prevention, insulation materials shall be of the correct chemical nature and shall include the following requirements
1. Carbon Steels - Insulation to be chemically neutral or slightly alkaline.
  2. Aluminium - Insulation to be chemically neutral or slightly acidic.
  3. Stainless Steels - Insulation shall be as free as possible of soluble chlorides (20 ppm maximum).

## 5.0 DESIGN - PIPING INSULATION

### 5.1 General

- 5.1.1 Insulated piping systems shall have straight pipe, bends, tees and non-flanged pipe fittings completely insulated
- 5.1.2 All valves and flanged joints shall be insulated only in the following services:
- Steam services
  - Trace heated or covered services
  - Closed Condensate services
- 5.1.3 Where insulation is used for Acoustic Attenuation, Class B and C, the system shall be completely insulated including equipment items, valves, flanged joints, pipe fittings and manways
- 5.1.4 "Bucket" and "Float type" steam traps shall be traced and insulated together with the inlet piping.
- 5.1.5 Insulation on inlet piping to Thermostatic and Thermodynamic steam traps shall terminate a minimum of 450mm from the trap leaving the remainder of piping and the trap un-insulated.
- 5.1.6 Steam trap outlet piping shall not be insulated except for Personnel Protection considerations
- 5.1.7 Insulation shall not be applied to the following unless otherwise specified for Acoustic Attenuation (Class B & C), Personnel Protection or other special reasons:
1. Piping which becomes hot intermittently, such as relief valves, vents, steam-out and snuffling steam systems, flare and blow down systems and by-passes at control valves.
  2. Supports for piping
  3. Steam Traps. (except as noted in paragraph 5.1.4 / 5.1.5).
  4. Valves, including control valves and flanges in process piping systems (except as noted in paragraph 5.1.2)
  5. Pipe union fittings
  6. Thermowell bosses and pressure tappings
  7. Expansion joints, hinged joints and hose assemblies
  8. Sight flow indicators
- 5.1.8 Piping shall be designed to provide an absolute minimum clearance of 25mm between the outside surface of any insulation finishing material and adjacent surfaces.
- 5.1.9 Where insulated horizontal piping is supported on steel shoes, the height of the shoe shall be such that the underside of the insulation finishing material is clear of the supporting structure

upon which the shoe rests by 25mm minimum.

- 5.1.10 Vertical piping insulation shall be supported by bolted collars at intervals. (see figure 1 detail]. Collars shall be supplied, fabricated and fitted by the APPLICATDR.

## 6.0 DESIGN - EQUIPMENT

### 6.1 General

- 6.1.1 Support skirts of insulated vertical vessels greater than 1200mm diameter shall be insulated both internally and externally for a minimum distance of 500mm below the bottom tangent line. On skirts which do not require fireproofing the insulation shall terminate not less than 300mm above the support concrete or steelwork. Where support skins are to be fireproofed the insulation shall extend to the top of the fireproofed areas and galvanized steel finishing material shall be used to protect the area of skin insulation below the bottom tangent line.
- 6.1.2 Support skirts of insulated vertical vessels of 1200mm diameter and less shall be insulated externally only, as described in paragraph 6.1.1 above
- 6.1.3 Bottom heads of insulated vertical vessels fully enclosed by a support skirt shall be insulated without weatherproof cladding finishing material and shall be insulated only when the vessel outside diameter is greater than 1200mm.
- 6.1.4 Liquid ends of positive displacement pumps and casings of centrifugal pumps shall be insulated only when heat traced or covered.
- 6.1.5 Insulation shall not be applied to the following equipment unless otherwise specified for Acoustic Attenuation (Class B&C), Personnel Protection, Fire Hazard Protection or other special reasons.
- Pumps with operating temperatures below 200°C unless pumped fluid has a pour point above minimum design ambient temperatures.
  - Fans, compressors, blowers or other rotating or reciprocating equipment.
  - Internally insulated or refractory lined equipment unless specially designed for metal temperature control
  - Heads of vessels fully enclosed by support skirts with vessel diameters 1200mm and less.
  - Internal surfaces of fully enclosing support skins of insulated vessels with vessel diameter 1200mm and less.
  - Exchanger channel covers.
  - Nozzles, manholes and hand holes, and flanges of equipment.
  - Surfaces of coolers and condensers.
  - Nameplates on all equipment items.
  - Thermowell bosses and pressure tappings

External Insulation for vessels and similar equipment shall be adequately supported or suspended, dependent on insulation material form, with clips and support lugs, welded on at internals around the equipment item and positioned in accordance with Project Specific Specifications. Contractor / Vendor shall supply all clips and supports required in order to attach insulation to the Equipment.

Vacuum stiffening rings on equipment shall be fully and independently insulated. The insulation finishing metal sheeting shall be sealed and allow for differential expansion. The sheeting shall be shaped to shed water.

7.0 DESIGN - TABLE 1 - INSULATION & PROTECTION SYMBOLS, CLASSIFICATION AND GENERAL CONDITIONS OF USE

Symbol	Classification	Insulation table thickness Table No. Reference	Insulation selection consideration	Notes
IH	Heat Conservation (Process lines) Where required for process reasons.	Table No. 3	Normal Operating temp. of process fluid and nominal pipe Size	Each section of the equipment having defined sections operating at differing temp. may be insulated to suit its individual temp. For Shell and Tube Exchangers Shells and Channels use the higher of the inlet and outlet temperatures
HS	Fleet Conservation (Steam and Condensate Lines)			
PS	Process Stabilisation to assist process control.	Special Consideration	Special Consideration	Piping and equipment subject to Special specific considerations to determine Insulation thickness and design which shall be clearly indicated on the P&IDs and Line lists.
IT	Steam tracing	Table No. 3	Normal operating temp. of process fluid and one pipe size greater than parent pipe.	Insulation where operating plant requires a protective heating system to protect piping, equipment and instruments against the effects of ambient temperatures (including hydrate formation, condensation, viscosity change and pour point suppression)
SS	IT with spaces			
SC	IT with heat transfer cement			
IE	Electric Tracing			
LT	Hot water or Solvent Tracing (liquid)			
OT	Hot Oil tracing			
W	Steam Covering	Table No. 3		
	Hot water or liquid covering			
	Hot oil covering			
FP	Fire hazard protection	Table No. 5 or special consideration but no greater Table No.3	Special consideration	Insulate to prevent fast boil-off of liquids. Galvanised steel / stainless steel protective cladding to be used over insulation in place of standard aluminium sheet metal cladding.
PP	Personal Protection (Insulation)	Table No. 4	Nominal pipe size and normal operating temp. Only applicable to operating Temp >200°C	Over unlined piping and equipment insulate or provide open mesh metal guards on operating plant would normally be left un-Insulated and which may be accessible during the performance of routine duties by operating not maintenance only} personnel. SEE NOTE*
PG	Personnel Protection [Stood-off metal-guard]	--	Operating Temp <200°C	
IA – A IA – B IA – C	Acoustic attenuation for noise control at various levels of requirement	Table No. 6	Acoustic Category attenuation subject to calculated insertion loss requirements.	The selected acoustic insulation symbol shall be added to any other thermal insulation symbol which applies e.g. HCA or STB or PPC etc. If no other insulation symbols are in use, Acoustic symbols A, B or C shall be used alone.
IC	Cold Insulation	Table No. 7	Normal Operating temp. of process fluid and nominal pipe Size	Equipment & piping having defined sections operating at differing temp. may be insulated to suit its individual temp. For Shell and Tube Exchangers use the lowest of the in / out temp.

NI	Not insulated	--		If no other symbol applies NI to be used for definition & clarity for MTO
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Notes:

The intent of P&IDs, Line Classification lists, Insulation Summaries etc. which designate insulation for types PP and PG is to call attention only to the eligibility of such service. The actual extent of such insulation shall be determined by Field Construction Personnel and/or operating personnel using the following criteria:

\* Pipe and Equipment designated for personnel protection ('PP' or 'PG') shall be fully painted in accordance with Project Specific Specification.

\*\* Exposed surfaces operating above 60°C and located with 600mm horizontally or 2100mm vertically of a normal access. walkway, or work area.

**8.0 DESIGN - TABLE 2 - INSULATION, CLADDING E SECURENIENT**

**INSULATION AND METAL CLADDING, FORM AND SECUFIEMENT METHOD**

Item	Nominal Size	Insulation Material form	Insulation securing method
Straight pipe	Upto 200mm (6")	Preformed Pipe Sections	12mm min. diameter stainless steel tie (lacing) wire
Straight pipe	250 (10") to 500 (20")	Preformed pipe section or multi-segments.	12mm wide stainless-steel bends.
Straight pipe	Above 500mm (20")	Multi-segments	20mm wide stainless-steel bends
Welded valves, butt-welded tees & reducers	All sizes	As per straight pipe cut and shaped to fit	As per straight pipe
Flanged Valves flanged joints	All sizes	Suitable preformed	Prongs. studs, rivet, Adhesive necessary to secure to removable cladding.
Bends & elbows	All sizes	As per straight pipe cut and shaped to fit	As per straight pipe
Equipment Heads (except bottom heads of vertical equipment)	All sizes	Preformed Blocks, Slabs cut and shaped to fit	20mm wide stainless-steel bends
Equipment shells	All sizes	Preformed pipe or multi-pipe segments or Slabs cut and shaped to fit	20mm wide stainless-steel bends
Vertical Equipment Bottom Heads without Skit	All sizes	As per equipment heads	20mm wide stainless-steel bends
Vertical Equipment Bottom Heads with Skit	All sizes over 1200mm (4ft)	As per equipment heads	Wire Netting and Lacing
Casing of pumps Turbines Compressor etc. Manholes and handholes and where required Exchanger channels	All sizes	Preformed slabs cut to suit lining	Prongs. studs, rivet, Adhesive necessary to secure to removable cladding.

Item	Insulation metal cladding	OD of thickness over insulation	Cladding thickness	Insulation securing method
Straight Pipe	Flat metal*	Upto 150mm	0.6 mm	12mm wide stainless-steel bands
Straight Pipe	Flat metal*	150 to 450mm	0.8 mm	12mm wide stainless-steel bands
Straight Pipe	Flat metal*	450 mm and above	1.0 mm	12mm wide stainless-steel bands
Welded valves, butt-welded tees & reducers	Flat metal*	All sizes	As per straight pipe	As per straight pipe
Flanged Valves flanged joints	Flat metal* Removable claddings	All sizes	1.0 mm	12mm wide stainless-steel bands and quick release toggle dips
Bends & elbows	Flat metal* straight pipe or pressed elbows	Upto 80mm	As per straight pipe	As per straight pipe
	Flat metal* fabricated mitre bends	80mm or larger	As per straight pipe	Screws & rivets
Equipment Heads (except bottom heads of vertical equipment)	Flat Metal* 'Orange Peel' Fabrication	All sizes	1.0 mm	Screws & rivets
Equipment shells	Flat metal*	All sizes	1.0 mm	20mm wide stainless-steel bands
Vertical Equipment Bottom Heads without Skit	Flat metal* fabricated to suit	All sizes	1.0 mm	Screws & rivets
Vertical Equipment Bottom Heads with Skit	Not required	All sizes	1.0 mm	--
Casing of pumps Turbines Compressor etc. Manholes and handholes and where required Exchanger channels	Flat metal* Removable claddings	All sizes	1.0 mm	20mm wide stainless-steel bands

Notes:

- For fire hazard protection galvanised steel cladding shall be used.
- All other areas to be clad in aluminium sheet

**9.0 DESIGN - TABLE 3 - HEAT CONSERVATION**

**INSULATION THICKNESS FOR HEAT CONSERVATION**

<b>NORMAL OPERATING TEMPERATURE (°C) AND THICKNESS (mm)</b>												
<i>Nominal Pipe size</i>	<i>Upto 100</i>	<i>101 to 150</i>	<i>151 to 200</i>	<i>201 to 250</i>	<i>250 to 300</i>	<i>301 to 350</i>	<i>351 to 400</i>	<i>401 to 450</i>	<i>451 to 500</i>	<i>501 to 550</i>	<i>551 to 600</i>	
<i>MM</i>	<i>THK</i>	<i>THK</i>	<i>THK</i>	<i>THK</i>	<i>THK</i>	<i>THK</i>	<i>THK</i>	<i>THK</i>	<i>THK</i>	<i>THK</i>	<i>THK</i>	
15	25	25	30	40	50	55	65	75	90	100	115	
20	25	25	30	40	50	60	70	85	95	110	125	
25	25	25	30	50	60	70	80	95	100	115	130	
40	25	25	40	50	60	70	85	100	110	125	140	
50	25	25	40	50	60	70	90	105	115	130	150	
65	25	25	40	50	60	75	95	110	120	140	160	
80	25	30	40	50	70	80	95	115	125	150	170	
100	25	30	40	60	70	80	100	125	140	160	180	
150	25	30	40	60	70	90	105	130	150	170	190	
200	25	30	50	60	80	95	110	140	160	180	200	
250	25	30	50	60	80	95	115	140	160	190	210	
300	25	40	50	70	80	100	120	150	170	190	215	
350	25	40	50	70	80	100	120	150	170	200	220	
400	25	40	50	70	90	100	125	150	170	200	225	
450	25	40	50	70	90	105	125	150	175	200	230	
500	25	40	50	70	90	105	130	150	190	205	240	
Over 500 and flat	25	40	50	70	100	125	160	190	230	270	320	
	<b>SINGLE LAYER</b>						<b>MULTI LAYER</b>					

**Design Basis:**

Maximum Heat Loss	=	150w/m <sup>2</sup>
Ambient Temp	=	31 °C
Wind speed	=	11.5 m/sec
Emissivity	=	0.15
Mineral wool preformed pipe section	=	140 kg/m <sup>3</sup>

9.1 **Multi-Layer Thickness Table**

<i>Thickness</i>	<i>1<sup>st</sup> layer</i>	<i>2<sup>nd</sup> layer</i>	<i>3<sup>rd</sup> layer</i>
55	30	25	--
60	30	30	--
65	40	25	--
70	40	30	--
75	50	25	--
80	40	40	--
85	60	25	--
90	60	30	--
95	70	25	--
100	50	50	--
105	80	25	--
110	80	30	--
115	90	25	--
120	90	30	--
125	100	25	--
130	100	30	--
135	100	35	--
140	100	40	--
145	100	45	--
150	100	50	--
160	100	30	30
170	100	40	30
175	100	50	25
180	100	50	30
185	100	60	25
190	100	60	30
195	100	70	25
200	100	50	50
205	100	80	25
210	100	80	30
215	100	90	25
220	100	90	30
225	100	100	25
230	100	100	30
240	100	100	40
250	100	100	50
260	100	100	60
270	100	100	70



**10.0 DESIGN - TABLE 4 - PERSONNEL PROTECTION**

**INSULATION THICKNESS OVER PROCESS PIPING AND EQUIPMENT FOR  
PERSONNEL PROTECTION PURPOSES**

Normal Operating temperatures (0°C) with still air at 31°C to give surface temp. not greater than 60°C						
Nominal Pipe size	60 to 200	201 to 300	301 to 400	401 to 500	501 to 550	550 and over
MM	THK	THK	THK	THK	THK	THK
15	Personnel protection shall be by guards	40	55	80	90	Personnel protection at elevated temperatures shall be subject to calculation and special consideration.
20		40	60	90	105	
25		50	65	95	110	
40		50	80	105	120	
50		50	85	110	130	
65		60	90	120	140	
80		60	95	125	150	
100		60	100	140	160	
150		70	105	150	175	
200		80	110	160	190	
250		80	120	180	200	
300		80	125	180	200	
350		90	130	180	200	
400		90	140	180	200	
450		90	140	180	205	
500		90	140	180	210	
Over 500 and flat	90	140	180	210		
<b>SINGLE LAYER</b>			<b>MULTI-LAYER</b>			

**Design Basis:**

Maximum cladding temp.	=	60 °C
Ambient Temp	=	31 °C
Wind speed	=	0 m/sec
Emissivity	=	0.15
Mineral wool preformed pipe section	=	140 kg/m <sup>3</sup>

Multi-Layer shall be constructed with layer thickness in accordance with the heat conservation layer thickness in section 9.1.

**11.0 DESIGN - TABLE 5 - PERSONNEL PROTECTION**

**MINIMUM INSULATION THICKNESS OVER EQUIPMENT FOR FIRE HAZARD PROTECTION PURPOSES**

Item	Minimum thickness mm	Insulation material	Protection finish	Notes
'FP' specified equipment	Refer to Table-3	Mineral Rock Fibre Fire Batts applied in two layers	Galvanized Steel / stainless steel sheeting with secured with stainless steel bands to be used in this service	For vertical steel vessels, i.e. towers, tall drums etc., that require fireproofing, the fireproofing insulation shall be applied to a height of 12m from grade or the nearest solid platform where a pool fire could form

When credit factors, per API RP 521, for the insulation in determining the minimum pressure relieving device sizes for fire exposure are to be considered, galvanized steel/stainless steel cladding shall be used. Insulation applied to bottom heads of vertical vessels in an enclosed skirt shall be fully clad with stainless steel jacketing

The Fire Proofing insulation system shall be capable of withstanding the force of fire hose stream impingement. Fire hose stream tests are described in NFPA SB. Appendix H-3.

**12.0 DESIGN - Table 6**

**MINIMUM THICKNESS OF ACOUSTIC INSULATION**

The level of acoustic attenuation is indicated by the Class Symbol below as required by Table 1. Where acoustic attenuation symbol A, B or C is combined with thermal insulation symbols the selected insulation thickness shall be the greater of the two requirements.

When the following acoustic insulation cladding thickness requirements differ from the thermal insulation protection sheeting requirements of the greater of the two thicknesses shall be selected.

CLASS	MINIMUM THICKNESS OF POROUS LAYER INSULATION (mm)	ACOUSTIC INSULATION CLADDING THICKNESS (mm)	CLADDING MATERIAL
A	50	0.7	Aluminium or Galvanized steel
B	100	0.7	galvanized steel only
C	100 (in two 50mm layers)	1.4 (in two 0.7mm layers)	Galvanized steel only

**13.0 DESIGN - Table 7**

**COLD INSULATION**

Insulation for Cold Insulation (IC) for operating temperatures below 10 °C and dual temperature (cold/hot) service where upper temperature limit is 120 °C shall be as given below:

**POLYURETHANE FOAM**

The physical requirement of bulk density, chloride content, thermal conductivity and pH value of the material shall be as follows:

Preformed pipe sections and radial lags (for higher diameter pipe) of polyurethane foam of self-extinguishing type in accordance with ASTM C591 TYPE –II Grade 2 shall be used as cold insulation material. PUF & PIR materials as per IS-12436 meeting the technical requirement specified is also acceptable.

High density polyurethane foam block of bulk density more than 300 Kg/m<sup>3</sup> shall be used for supports in cold lines.

Adhesive for bonding sections shall be Foster Fire Resistive Adhesive 81-33 or blown bitumen type 85/25 shall be used.

Vapor seal like Foster Fire Retardant Mastic 60-30 or equal shall be used.

Filler material shall be PUF dust or mineral wool mixed with specified adhesive shall be placed lightly so as to fill irregular voids and at flashing of insulation shall be Foster Foam Seal Sealer 30-45. Glass cloth to be used for vapor barrier reinforcement, shall be open weave 10 mesh having glass fibre thickness of 5 mils. Aluminium sheets shall be used for cladding of vapor barriers.

Bulk density	:	35.0 to 40.0 kg/m <sup>3</sup>
Chloride content	:	20ppm (max)
Thermal conductivity	:	0.221 Mw/cm °C at mean temp. 10°C
PH Value	:	Neutral
Closed cell content	:	95% (min)

High density polyurethane foam block of bulk density more than 300 Kg/m<sup>3</sup> shall be used for supports in cold lines.

Adhesive for bonding sections shall be Foster Fire Resistive Adhesive 81-33 or blown bitumen type 85/25 shall be used.

Vapor seal like Foster Fire Retardant Mastic 60-30 or equal shall be used.

Filler material shall be PUF dust or mineral wool mixed with specified adhesive shall be placed lightly so as to fill irregular voids and at flashing of insulation shall be Foster Foam Seal Sealer 30-45. Glass cloth to be used for vapor barrier reinforcement, shall be open weave 10 mesh having glass fibre thickness of 5 mils. Aluminum sheets shall be used for cladding of vapor barriers.

**POLYISOCYNAURATE (ASTM C 591 type II & III)**

Rigid Polyisocyanurate foam block pipe fittings insulation shall be manufactured with polyester or polyether resins, flammability retarding agents, special catalysts and fluorocarbon blowing agent. This is suitable for use upto 125 0C. Selection of samples for testing shall be as per ASTM C 390(Class IV frequency).

The physical requirement of bulk density, chloride content, thermal conductivity and pH value of the material shall be as follows:

Bulk density	:	40 to 64 kg/m <sup>3</sup> (Tested as per ASTM C303 and C302)
Chloride content	:	NIL
Thermal conductivity	:	0.238 mW/cm °C at mean temp. 10 °C 0.245 mW/cm °C at mean temp. 24 °C 0.252 mW/cm °C at mean temp. 38 °C
pH Value	:	Neutral

Other properties shall be as per applicable ASTM specification for the insulation

Proper expansion/contraction joints shall be provided to allow movement of pipe or vessel without producing random cracking of all the insulation.

Vapor barrier shall be applied on all the vessels and equipment in cold services and also for services upto 125°C.

Hot insulation over Stainless Steel surfaces shall be inhibited by Sodium Silicate.

**DESIGN - TABLE 7 – COLD INSULATIONON**

Nominal Dia (In)	Operating Temperatures, °C													
	>5	4 to-7	-8 to -18	-19 to -32	-33 to -45	-46 to -60	-61 to -75	-76 to -90	-91 to -100	-101 to -120	-121 to -130	-131 to -145	-146 to -155	-156 to -170
0.5	25	30	35	45	50	60	70	80	85	95	100	105	110	115
0.75	25	30	40	45	55	65	75	85	90	100	105	115	115	125
1	25	35	40	50	60	70	80	90	95	105	110	120	125	130
1.5	25	35	45	55	65	75	85	100	105	115	125	130	135	145
2	30	40	45	55	70	80	90	105	110	125	130	140	145	150
3	30	40	50	65	80	90	100	115	120	135	145	155	160	165
4	30	45	55	65	80	95	110	120	130	145	155	165	170	180
6	35	50	60	75	90	105	120	135	145	160	170	180	185	195
8	35	50	65	75	95	110	125	140	150	170	180	190	200	210
10	35	55	65	80	100	120	135	150	160	180	190	200	210	220
12	40	55	65	85	105	125	140	155	165	185	195	210	215	225
14	40	55	70	85	105	125	140	160	170	190	200	210	220	230
16	40	55	70	85	110	130	145	160	170	195	205	215	225	235
18	40	55	70	90	115	130	145	165	175	200	210	220	230	240
20	40	60	70	90	115	135	150	165	180	200	210	225	235	245
24	40	60	75	90	115	135	150	170	185	205	220	235	240	255
26	40	60	75	90	120	140	155	175	185	210	220	235	245	260
28	40	60	75	90	120	140	155	175	190	210	225	240	250	260
30 & >30	40	60	75	95	120	140	155	175	190	215	225	240	250	265

**14.0 MATERIALS**

All material shall be to the described form (Design Table 2) and the following and shall be of high quality and good appearance.

Insulation materials shall be of low chloride content, chemically inert, non-sulphurous, rot proof, vermin-proof, impervious to hot water and steam, non-injurious to health and non-corrosive to steel or aluminium. {even if soaked with water at ambient temperatures for extended periods}.

Insulation materials containing ASBESTOS in any form are not permitted

Insulation and cladding materials backed with paper or other flammable material are not acceptable.

Insulation materials shall be stored, transported, handled and applied as per ASTM C929.

**15.0 MATERIALS - THERMAL INSULATION**

**15.1 General**

insulating material shall be Fibrous Preformed {Mineral Fibre with resin binder} insulation and shall be of long fibred rock material processed from a molten state into fibrous form and bonded with a binder suitable for the intended operational temperature range

Preformed materials shall satisfy the minimum requirements of quality standard in accordance with BS 3958 (Parts 4 and 5), ASTM C547 and ASTM C612

The insulation material shall be supplied plain faced in Manufacturer's Standard sizes and the average measured length, width and thickness shall not differ from the standard dimensions specified by more than plus or minus 3mm.

Insulation shall conform to the following physical requirements:

- Density - minimum : 140 kg/m<sup>3</sup>
- Alkalinity (approx.) PH Between : 6 and 10
- Combustibility : Non-combustible
- Non-combustible minimum at 10% deformation : 100-320 kg/m<sup>2</sup>
- Hygroscopicity % volume : 0.20 maximum
- Linear shrinkage (av. max) : Below 2%
- Chloride content not to exceed 20 ppm : See Fig. 1 ASTM C795 wicking type of Insulation over Stainless Steel
- Sodium plus Silicate content : To exceed 40ppm

Mean temperature	Average 'K'
°C	W/m °C
50	0.043
100	0.052
200	0.064

250	0.078
250	0.093
300	0.110

\* Mean temperature = (Hot face temp + Cold face temp)/2

**15.2 Material - Weatherproof Cladding**

The selection of Aluminium material in both coil and flat sheeting form for use as the thermal insulation protective metal cladding shall take precedent over other metallic cladding with the exception of fire hazard protection where stainless steel/galvanized steel cladding shall be used.

Aluminium cladding shall be flat mill finished commercial grade of alloy AL-Mn which shall comply with BS 1470 or ASTM B209 under the following material designations: BS 1470 - NS 3 - H6 ASTM B209 Alloy 3003 - H14 or H16 Galvanized steel cladding required for fireproofing purposes shall be flat mill finished grade 2B of steel to comply with BS 1449 or ASTM A167, A40 Steels to be SS304 or SS316.

Aluminium metal cladding shall be supplied with factory applied reflective and protective barrier coating of polyethylene and aluminium foil which shall comply with BS 476 Class 1 (Surface Spread of Flame). The backing shall be directly laminated to the aluminium without use of adhesives or glue. Thicknesses shall be as indicated in Table 2.

**16.0 MATERIALS - ANCILLARIES**

**16.1 General**

16.1.1 Aluminium foil shall be 0.06 mm thick with a chemical composition of 98% minimum aluminium and shall not have an adhesive backing.

16.1.2 Binding and tie wire used where indicated to secure insulation materials and sacrificial foil over stainless steel surfaces shall be 18% Cr - 8% Ni stainless steel wire having a minimum diameter of 1.22mm. The wire shall be fully annealed.

16.1.3 Banding for use over insulation and over metallic finishing cladding shall be in hand able coils ready to be cut to required lengths at site. Bands shall be as shown in Table 2 of this standard 20mm or 12mm wide x 0.5mm thick - fully annealed 18% Cr - 8% Ni stainless steel.

- 16.1.4 Expansion sections of banding where required to cater for differential expansion shall be of the same size and material as the fiat bands and shall be of the 'Expand-R-Strap' type or 'Techalloy' Breather spring type or an approved equivalent.
- 16.1.5 Banding clips for use with securing bands shall be of the same stainless-steel material as the banding and shall be of the 'Butterfly' type similar to 'Band-it-Valstrap Clips'.
- 16.1.6 Rivets required for metal cladding fabrication shall be the expanding Monel 'pop' blind eye type, 9.5mm long x 5mm diameter
- 16.1.7 Screws required for metal cladding fabrication/securing shall be stainless steel slotted pan head self-tapping type A No. 8 dia. x 12mm long to BS 4174 complete with neoprene washers under the head
- 16.1.8 The material requirements of normal insulation accessories shall be as follows:
  - 1. 'S' and 'J' clips - Formed from 20mm wide stainless-steel banding.
  - 2. Removable cover fastenings - Shall be of the quick release, spring shackle lock type, material identical to the removable metal cladding.
  - 3. Metal cleats - Used as supporting angles on weatherproofing cladding shall be of similar material as described for the cladding material in paragraphs 8.2. 8.3 and 8.4. The size shall be 65mm high x 50mm wide with the returned angle toe 13mm less than the insulation thickness. The cleats shall be 6mm thick.
  - 4. Floating rings - Shall be 10mm dia. carbon steel rod conforming to BS 4360 Grade 43A.
  - 5. Sacrificial foil - Use as a barrier material between stainless steel piping and equipment surfaces and insulation material shall be 0.06mm thick aluminium foil for operating temperatures of 500°C and below. and stainless-steel foil at operating temperatures more than 500°C.
- 16.1.9 Sealing compound for use as metal sealant, sealing overlaps of metal cladding shall be a suitable flexible non-setting compound having properties which render materials waterproof, weatherproof, chemically resistant and fire resistant.

**17.0 MATERIAL - ACOUSTIC INSULATION**

- 17.1 Sound absorbent insulation material in use as the porous layer shall be preformed semi-rigid mineral fibre shapes as described for thermal insulation in Section 12.
- 17.2 The impermeable outer cover sound barrier material in use as the cladding is described for weatherproofing and protection in Section 12.2. Acoustic attenuation Classes B and C (See Table 6) shall use Steel cladding to the exclusion of aluminium.
- 17.3 The anti-vibration seals used to prevent metal-to-metal contact shall be a closed cell polyurethane foam strip with pressure sensitive adhesive backing. The strip shall be a minimum of 3mm thick by 50mm wide and possess the following characteristics:

Density	90 kg/m3
Water vapour Transmission	>0.167 metric-perms
Combustibility Self Extinguishing Service Temperature Range	From (-) 40°C to +32°C

17.4 Where anti-vibration seals are incompatible with operating temperature, such seals shall comprise of compressed porous layer material weatherproofed with a flexible mastic compound.

## 18.0 APPLICATION

### 18.1 General

18.1.1 The requirements of application, given in this specification in no way absolve the APPLICATOR from responsibilities of applying an insulating system that will give a satisfactory operational performance and the requirements given herein shall be regarded as directives and guidelines for the acceptable minimum. The APPLICATOR shall carry out the work in accordance with the best practices of insulation application with the minimum of waste and debris and the final job shall present a neat, efficient and workmanlike appearance.

18.1.2 All hydrostatic tests on piping and equipment, including steam tracing systems, shall be carried out before insulating material is applied. The APPLICATOR shall only insulate those sections of the plant that have been specifically released by an authorized agent of the IOCL for such work. If however, it has been planned and decided to insulate prior to other trades work and before tests have been completed, insulation shall terminate a suitable distance before and after welded and flanged joints and sealed against water ingress and protected from mechanical damage which may be caused by other trades and during subsequent testing.

18.1.3 Surfaces to be insulated shall be clean, dry and free from loose rust scale. It shall be the insulation Applicators responsibility to remove the loosely adhering scale and dirt by an appropriate method which does not scar, score or damage the metal surface.

18.1.4 Insulated carbon and low alloy steel piping and equipment require protective coatings as specified in Project Specification.

18.1.5 Where coatings are applied, repairs if necessary shall be carried out by the appointed Painting Applicator and the coatings shall be the subject of inspection by an authorized agent of the IOCL prior to the commencement of insulation application.

18.1.6 Insulated stainless steel piping and equipment shall be wrapped with sacrificial foil prior to insulation application. The foil shall be secured with stainless steel tie-wires at sufficient intervals to ensure the foil remains in place throughout the service life of the insulation- The supply and application of foil shall be the responsibility of the APPLICATOR.

18.1.7 The APPLICATOR shall NOT carry out any welding or drilling on piping or equipment, he shall however be responsible to carry out a check and confirm that all insulation supports, as indicated on fabrication drawings, have been installed and welded into position. The APPLICATOR shall also confirm that a sufficient and satisfactory number of supports have been provided in accordance with Figure 7 of this specification.

18.1.8 Insulation shall be finished, sealed and weatherproofed at all terminal points including either side of temporary shop supports, lifting lugs, testing points etc. At these positions on shop insulated items closure pieces shall be designed and fabricated, to fit exactly at a later date on site, without impairing the weatherproofing. The Insulation Applicator shall remain totally responsible for the finished insulation.



- 18.1.9 Equipment nameplates shall remain visible after insulation has been applied. The surrounding edges shall be efficiently sealed against water ingress.
- 18.1.10 The application of the insulation shall consider expansion movements of piping, and equipment at normal operating temperatures and include provision within the insulating system for any differential expansion anticipated.
- 18.1.11 Shop applied insulation shall consider not only thermal expansion and contraction movements but also movements of flexing and vibration created by on-off loading and transportation. The anticipated scope of these movements shall be outlined to the APPLICATOR by the item Fabricator.
- 18.1.12 Thermowell bosses, pressure tappings and weep hole nipples shall not be insulated but left accessible. The surrounding edges of insulation shall be positively sealed against water ingress.
- 18.1.13 Double layer construction shall be required when operating temperatures are over 316°C and/or the insulation thickness is greater than 100mm. Insulation installed in two or more layers shall be staggered joint construction and each layer shall be adequately secured in place.
- 18.1.14 Insulation shall be applied in large regular pieces cut to size where necessary and firmly butted together to minimize voids, and to keep edges of material under compression. Circumferential joints shall be staggered by one half sections.
- 18.1.15 Wet or damaged insulation shall not be used under any circumstances. Installed material awaiting its protective cover shall be adequately protected from damage, rain, and contamination by other trades such as oils, spent welding rods, paint etc.
- 18.1.16 A minimum clearance of 25mm between the outside surface of any insulation finish and adjacent equipment, pipe or structural members shall be maintained. Care shall be taken where insulation is shop applied to ensure this minimum clearance.
- 18.1.17 Where voids occur in the insulation they shall be filled with suitable fibrous loose fill material. Loose fill used for shop applications shall be protected from possible damage during subsequent lifting and transporting.
- 18.1.18 Where installed, expansion joints shall comprise of compressible mineral fibre of sufficient density and composition to operate efficiently as both insulant and expansion facility at the given operating temperatures.
- 18.1.19 Insulation supports shall not project proud of the insulation outer surface and shall be given sufficient coverage of insulating material to avoid hot spots on the insulation metallic weatherproof cladding at support positions.
- 18.1.20 Weather-proof cladding shall be designed and installed to shed water always. Flat horizontal surfaces are not acceptable. It shall be borne in mind throughout shop application that sloping planes in shop conditions may possibly become flat surfaces when finally positioned at site and continuous care shall be taken to ensure that final orientation is known by the Insulation Applicator.

**19.0 APPLICATION - PIPING - INSULATION**

## 19.1 General

- 19.1.1 Preformed insulation shall be applied, supported and secured to straight length single pipe runs using two half sections up to the maximum manufactured sizes, above this size piping shall be insulated with the minimum number of cut segments.
- 19.1.2 Insulating material shall be applied to fit snugly against the contours presented to the applicator and neatly cut and shaped only where necessary to achieve this requirement. The insulation shall be carried out with the least number of material pieces as possible and all unavoidable gaps, cavities, and voids shall be suitably filled with compatible loose fill material.
- 19.1.3 Shop fabricated piping shall be amply supported and positioned in such a manner that allows complete all-round uninterrupted access to the work piece. At temporary support points during shop fabrication, insulation shall be terminated and sealed, and closure pieces fabricated for later installation at site.
- 19.1.4 The insulation materials shall be secured to the pipes by means of circumferential tie wires or bands in accordance with Design - Table 2 of this Specification. Tie wires or bands shall be positioned sufficient to provide three ties or securing positions for each length of pipe insulation section. Ends of tie-wires shall be turned into the insulation material.
- 19.1.5 Each layer of insulation on piping requiring two or more layers shall be secured by the same method as required by paragraph 16.1.4 above. Joints of each layer shall be offset by staggering.
- 19.1.6 Where necessary the insulation on vertical or near vertical piping (i.e. greater than 45° angle from horizontal) shall be supported by bolted-on metal clips provided and installed by the Insulation Applicator who shall assume responsibility of adequate pipe insulation support.

**20.0 APPLICATION - PIPING - CLADDING**

## 20.1 General

- 20.1.1 The piping insulation protective metal cladding finish shall provide a weatherproofed and mechanical damage resistant cladding over the whole of the insulated areas and be applied and fitted in such a manner as to provide a close fitting assembly without gaps.
- 20.1.2 Straight pipe shall have metal cladding cut and machine rolled (approx. 1 metre long) wrapped around, with 50mm minimum overlaps on both longitudinal and circumferential overlaps. All laps shall be arranged to shed water
- 20.1.3 A single bead shall be made on all circumferential overlaps. Longitudinal overlaps shall be 'cracked' with a 45o angle inward turn of the overlapping edge to ensure a tight metal to metal contact
- 20.1.4 All the seams at overlap positions shall be rendered watertight using a metal seam sealer which shall be applied between overlapping metal edges in sufficient quantity and care to ensure that insulation remains dry and un wetted whether the possible water impingement is from rain, hose, or fire sprinklers.
- 20.1.5 The metal cladding shall be secured tightly around the insulated pipe and held in place with stainless steel bands on a maximum of 300mm centres. One band shall be located on each circumferential lap and the distance between laps divided at equal band spacing. The band securing seals shall be kept neatly in line and positioned away from viewing angles as much as is possible.
- 20.1.6 Vertical overlaps on vertical or near vertical piping shall be staggered to provide overlaps at 'North' and 'South' positions in alternate sections of cladding.
- 20.1.7 Each section of metal cladding on vertical piping with insulation OD's larger than 250mm shall be supported from the next lower section with two 'S' clips fabricated from banding material. The 'S' clips shall be of sufficient length to allow the minimum overlap of 50mm
- 20.1.8 On vertical piping with insulation OD of 600mm and larger, the securing bands shall be supported by 'J' clips fabricated from banding material. The 'J' clip spacing shall be a minimum of two per band. All 'J' clips shall be screwed into position and secured.
- 20.1.9 Insulated bends and elbows in piping 60mm and larger. shall be metallised with 'lobster back' segments using 10mm minimum ball swage to assist shaping. The metal bands shall be screwed with self-tapping screws and include metal sealants to provide a completely waterproofed arrangement.
- 20.1.10 Insulated bends and elbows in piping smaller than 60 mm may use complete pressed humped back flat metal elbows or fabricated 'stove pipe' elbows but these fitments shall be completely and positively waterproofed.

**21.0 APPLICATION - EQUIPMENT - INSULATION**

## 21.1 General

- 21.1.1 The insulation over equipment shall be supported by rings, bars, clips etc., welded and fitted to the metal surfaces by the equipment fabricators. Maximum use shall be made of these provisions by the Insulation Applicator.
- 21.1.2 Sections and slabs shall be cut and shaped to fit the equipment contours using the minimum number of insulating pieces.
- 21.1.3 Heads of equipment shall be insulated with preformed material of a form best suited to the curvature of the equipment.
- 21.1.4 Insulating material shall be secured to equipment items by means of 20mm wide stainless-steel bands at 300mm maximum centres. Bands shall be machine stretched and tensioned to take out slack only
- 21.1.5 Insulation securing bands on equipment larger than 2135mm outside diameter shall be provided with expansion sections at 1'-620mm maximum spacing.
- 21.1.6 On vertical equipment an expansion gap of approximately 25mm shall be allowed beneath each support or stiffener ring. Expansion gaps shall be filled with an even distribution of compressed mineral rock fibres.
- 21.1.7 Expansion gaps shall be provided on horizontal equipment with mineral fibre as described in paragraph 18.1.6 above being compressed between joints of the equipment insulation at 3660mm maximum intervals.
- 21.1.8 Where specified equipment flanges, nozzles, channel covers, manway and handhole flanged covers shall be insulated with lined removable prefabricated covers secured with bands or quick release toggle clips. Design to be approved by Jacobs / IOCL as in 16.1.13 above.
- 21.1.9 Insulation shall be stopped short of un-insulated flanges and nozzles etc., a sufficient distance to permit withdrawal of bolts without disturbing the remainder of the insulation. Insulation shall stop short by the bolt length + 50mm minimum. Insulation shall be weatherproofed and sealed at these positions.
- 21.1.10 Insulated bottom heads of shop insulated vertical equipment with fully enclosed support skirt, shall be provided with temporary weather resistant protection which shall efficiently prevent the ingress of water and weather during transportation, storage and lifting.
- 21.1.11 The insulation over pumps, compressors and turbines shall be in the form of lined removable metal covers. Design of the covers shall be submitted and approved Jacobs / IOCL prior to fabrication. Removable covers shall be fabricated by the Insulation Applicator and be made up in sizeable pieces designed to be quickly and easily taken apart and reassembled. In the fully assembled state lined covers shall represent an efficient, weatherproof, waterproof and sound resistant covering.

**22.0 APPLICATION - EQUIPMENT - CLADDING**

## 22.1 General

22.1.1 The protective metal weatherproof cladding over vertical vessel shells shall be constructed of rectangular sheet metal panels applied in a "wallpaper" pattern with the short width of panel in a circumferential direction parallel to the equipment insulation support rings and the longer length of panel in a parallel direction to the vessel centre line. The weight of the panel shall be taken on the equipment insulation support rings, via angle brackets bolted to the panel in accordance with Fig 3. There shall be a minimum of two brackets per panel. Shop applied insulation shall ensure that angle brackets remain in contact with support rings. The short width of panel shall be rolled to suit the outside curvature of the vessel insulation. The long side of panel shall be cut to suit the distance between insulation support rings.

22.1.2 The panels shall be applied commencing at the bottom of the vessel. Each circumferential ring of panels shall be tensioned by means of temporary tensioning bands until the final joint is screwed tight. 'S' clips shall be used as sheeting support at unscrewed circumferential overlaps. 'S' clips shall be riveted into position on shop applied systems, to prevent slippage during transportation.

22.1.3 The panels shall be held tight over the vessel insulation by means of circumferential bands and seals. The bands shall be positioned on all horizontal overlaps and at 450mm centres. Bands shall be held in their relative positions with 'J' clips and be machine stretched and sealed to remove slack only.

22.1.4 The panels shall have a minimum overlap of 60mm on both horizontal and vertical edges. The overlaps shall be arranged to shed water always.

22.1.5 The vertical and horizontal overlaps shall be secured with self-tapping screws at 75mm pitch except the horizontal overlaps pre-selected to act as expansion joints, these shall be constructed with a 150mm overlap and shall remain unscrewed and left free to permit expansion. All overlaps shall be rendered watertight by use of a metal sealant positioned between overlapping metal edges.

22.1.6 All equipment projections such as nozzles shall have the metal cladding sealed using a metal flashing cut to fit the projection and extend over the cladding by at least 75mm. The seal between the flashing and cladding shall be made water tight by use of self-tapping screws and metal sealing mastic.

22.1.7 Horizontal cylindrical equipment shall be finished with flat metal cladding arranged in circumferential bands with the edge of the sheets with the longer dimension applied around the circumference of the equipment insulation.

22.1.8 The panels shall have a minimum of 75mm overlap on both longitudinal and circumferential edges, both overlaps being finished with a simple ball swage and rendered water tight with a metal seam sealer applied between overlapping metal edges.

22.1.9 Horizontal overlaps shall be secured with No. 8 x 15mm long, self-tapping screws set in the overlap at 75mm intervals and shall be so arranged that staggered bands of panelling encircle the equipment. Vertical overlaps shall not be screwed.

22.1.10 The metal protective finish shall be banded and sealed at 450mm centres ensuring that one band is set over each vertical overlap.

22.1.11 The insulated heads of vertical and horizontal equipment shall be fabricated from flat metal in

an 'orange peel' construction with all radial seams overlapping a minimum of 50mm and secured with self-tapping screws at 75mm centres. All overlaps shall be ball swaged and be rendered water tight using metal seam sealer between metal overlaps.

- 22.1.12 Projections from the heads shall be sealed using metal flashings neatly cut to fit around the projections and extending over the cladding for a minimum of 75mm. The seal between flashing and cladding shall be weatherproofed with self-tapping screws and seam sealing mastics.
- 22.1.13 Insulation on bottom heads of fully skirted equipment does not require weatherproofing. (See para. 18.1.10 re-temporary shop insulated covering).
- 22.1.14 Heads of equipment 550mm DD and smaller shall be finished and waterproofed with square ended fabricated covers.
- 22.1.15 On shop insulated items at temporary shop supports, the insulating system shall be terminated and sealed, and closure pieces shall be designed and fabricated to fit the open positions. Designs of closure pieces shall consider the insulating requirements together with support and securement and the necessity of maintaining waterproofing and weatherproofing after closures are in place. Design proposals shall be approved by Jacobs / IOCL before fabrication of closures commences. Closure pieces shall be fitted at site by the site appointed Insulation Applicator.

## 23.0 ACOUSTIC INSULATION AND CLADDING

### 23.1 General

- 23.1.1 Acoustic Insulation (noise control] requirements and thicknesses shall be as indicated by classification symbols A, B or C shown in Table 1 and Table 6 of this specification
- 23.1.2 Application methods and materials shall be as described for thermal insulation with the following additions and exceptions.
- 23.1.3 For Class 'B' and 'C' acoustic insulation all flanges, valves, manways, fittings supports etc. shall be fully insulated.
- 23.1.4 The extent of acoustic insulation of shop insulated piping and equipment shall be identified to the APPLICATOR by the item Fabricator prior to the commencement of insulation.
- 23.1.5 At positions where metal-to-metal contact would normally occur, anti-vibration seals shall be applied. Seals shall have a minimum thickness of 3mm and a minimum width of 50mm. The edges of the cladding or end cap shall be folded where resting on the anti-vibration seals.
- 23.1.6 Gaps between the outer metallic insulation cladding and unavoidable projections shall be sealed with flexible, non-setting, impervious seals like mastic or rubber} where operating temperatures allow: otherwise metal projections shall be insulated for a minimum length of 300mm from the heat source allowing lower operating temperature seals to be used.
- 23.1.7 Shop fabricators shall inform the APPLICATOR of all operating temperatures where Acoustic insulation is required.
- 23.1.8 Complete cover of the system with insulating material shall be achieved and special attention shall be paid to ensure the prevention of noise leakage through gaps and voids in the insulating porous layer. Thicknesses of insulation shall never be reduced without approval by Jacobs /

## IOCL.

- 23.1.9 Removable acoustic enclosures {e.g. for valves, flanged joints. etc.) shall have an outer surface of cladding with a mass per unit area at least equal to that of the cladding of adjacent pipes and equipment. The lining of porous layer material shall be like that used on the piping and equipment and shall be retained by an inner surface layer of perforated metal sheeting with an open area of about 30%. It shall be at least 10mm away from the surfaces of flanges or valves
- 23.1.10 Where acoustic enclosures are installed they shall be of sufficient length to overlap the ends of the pipe and equipment cladding by at least 200mm.
- 23.1.11 If shop supports and/or access conditions, make it impossible to fit shop applied acoustic insulation completely in an uninterrupted application, then reference shall be made to Jacobs / IOCL via the piping or equipment shop fabricator for a decision of requirements.

**24.0 FIRE HAZARD PROTECTION - INSULATION - EQUIPMENT**

## 24.1 General

- 24.1.1 The method of application shall be in accordance with Sections 18 and 19 unless modified by specific requirements in the following paragraphs.
- 24.1.2 The insulation thickness shown in Table 5 shall be regarded as the minimum and shall be increased where necessary as in the case of elevated temperatures where there is an overriding requirement for thickness to suit heat conservation. tracing or other requirements.
- 24.1.3 The insulation cladding shall be secured with 25mm wide stainless-steel bands and screws.
- 24.1.4 The bands shall be positioned on horizontal overlaps for vertical items or vertical overlaps for horizontal equipment and at 150mm centres.
- 24.1.5 Bands on all equipment shall be held in their relative positions with 'J' clips which shall be riveted into permanent position.
- 24.1.6 Insulation applied to bottom heads of vertical vessels in an enclosed skirt shall be fully clad with stainless steel cladding.

**25.0 REMOVABLE INSPECTION PORTS (WINDOWS)**

## 25.1 General

- 25.1.1 Removable insulated inspection ports/windows will be required at strategic points on various piping arrangements and equipment/vessels throughout the refinery.
- 25.1.2 Inspection ports shall be of a proprietary type and approved by Jacobs / IOCL prior to purchase
- 25.1.3 Locations of any such removable inspection port/window will be initially indicated on {isometric} drawings. and subsequently physically marked with indelible ink/paint on piping or equipment prior to release by CONTRACTOR for insulation.
- 25.1.4 All inspection ports shall be rendered water tight using correct tooling and seating seals.



**26.0 DOCUMENTATION**

The APPLICATOR shall ensure that detailed method statements and quality plans are submitted for IOCL review and agreement, covering all insulation activities and shall include, but not be limited to, the following:

- Programme of work schedules in sufficient detail to allow inspection planning
- Safe storage and handling of materials, safe disposal of unwanted materials.
- Insulation system to be used
- Written information identifying selected materials and manufacturers. (see note 1)
- Copies of manufacturer's current data sheets for all materials
- Material delivery dates
- Documented experience list using the selected insulation system and materials (see note 1)
- Proposed insulation, cladding and fixing expansion details
- Stood off personnel protection guard details. {see note 1}
- Removable flange and valve cover details for both metal box and flexible types. (see note 1)
- OA/QC procedures for the work shall be as per approved
- Test and Inspection procedures and plans- (see note 1)
- Copy of proposed Inspection / Record Sheets.
- Written information regarding temporary protection arrangements in the event of
  - 1) Outdoor or partial outdoor application
  - 2) Application in the presence of other trades
  - 3) Site storage

Note 1: This information shall also be submitted by the APPLICATOR for Jacobs / IOCL review and agreement prior to contract award.

**27.0 INSPECTION****27.1 General**

27.1.1 CONTRACTOR and APPLICATOR are fully responsible for all quality assurance tasks related to the materials and application of the insulation systems and proper performance of the installed systems. Such tasks shall also include initiating, organizing and maintaining full documentation to verify compliance with this specification. The inspection requirements shall include, but not be limited to the tasks detailed below:

**27.1.2 Inspection Tasks**

The insulation shall be inspected during the following stages:

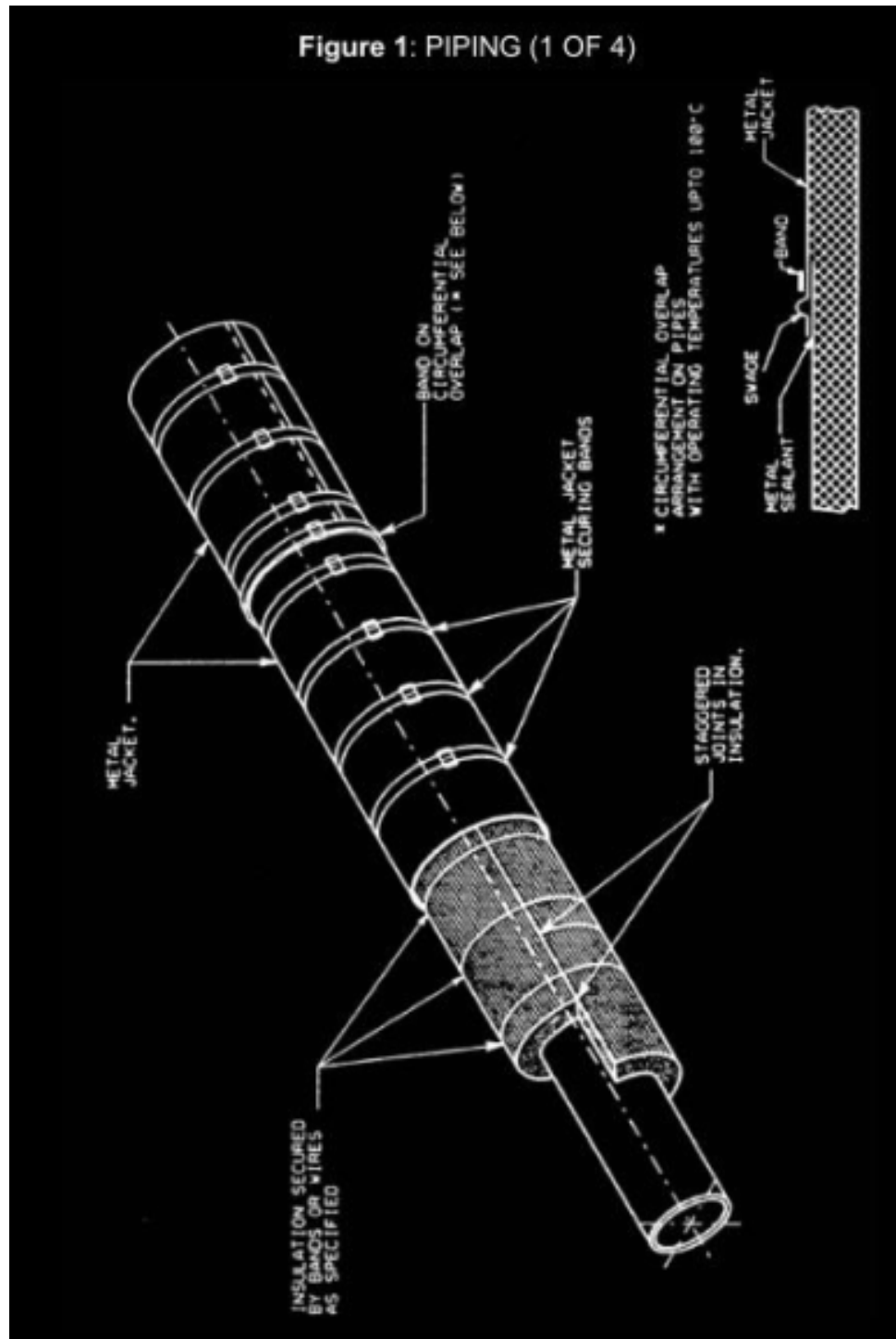
- At the time of material receipt
- Before applying the insulation
- During insulation application

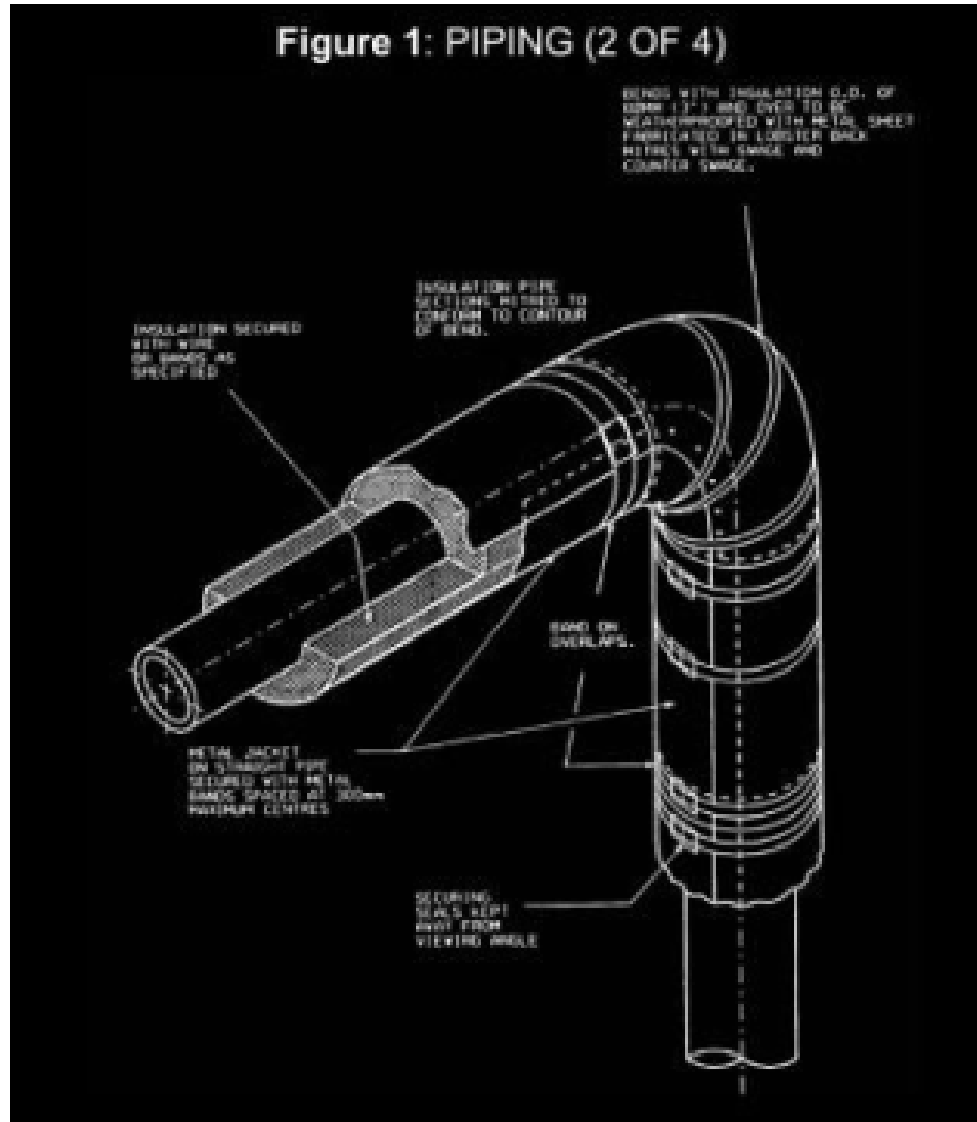


- Before and during application of weatherproofing
- 27.1.3 Inspection activities shall include at least the following activities at the time of receipt of the materials:
- Appropriate checks shall be made to verify materials received at the site are the same as the specified or approved materials. Such checks shall include verification of labels, material safety data sheets, delivery receipts, and thicknesses. Damaged, unspecified, or unapproved insulation materials shall be removed from the site.
  - Ensure materials are protected from being damaged by moisture, temperature, wind or any other atmospheric factors
- 27.1.4 Inspection activities shall include at least the following prior to insulation application:
- Verify that surfaces to be insulated are clean, dry, and coated as required
  - Verify that painting of protrusions through insulation has been carried out.
  - Ensure that aluminium foil has been applied over insulated stainless-steel surfaces.
- 27.1.5 Inspection activities shall include at least the following during insulation application
- Make sufficient checks to verify that the materials applied are the same as the specified or approved materials
  - Verify the insulated item and insulation code are the same as marked on the P&IDs and related drawings.
  - Inspect the insulation supports for correct location, type, width, and length. Verify that the insulation surface is uniform without gaps and voids
  - Inspect for tightness of joints and fasteners.
  - Verify that the joints of the insulation segments are properly staggered and tightly installed.
  - Verify the location, width, and installation of insulation expansion joints.
- 27.1.6 Inspection activities shall include at least the following prior to and during weatherproofing:
- Ensure that the insulation is clean, dry, and fit for its intended purpose before weatherproofing is applied.
  - Inspect size and direction of metal cladding overlaps
  - Ensure cladding is properly fabricated and installed.
  - Verify that the location of bands, screws, S-clips, and J-clips.
  - Ensure that moisture protection and weatherproofing at cut-outs, protrusions, and locations where moisture could enter the insulation has been appropriately installed.

28.0 FIGURES & DIAGRAMS

Following figures & diagrams shall form the part of this specification.





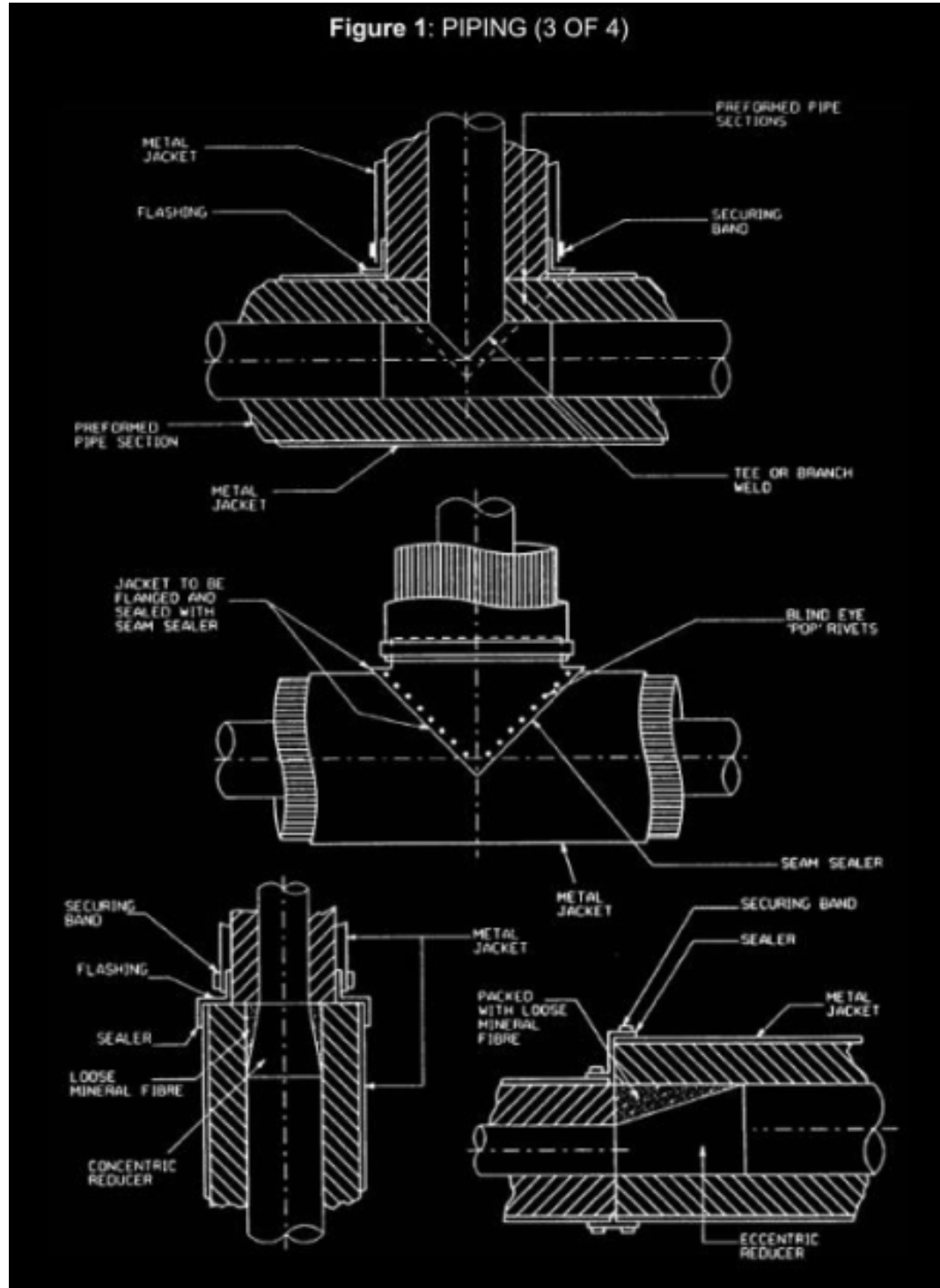


Figure 1: PIPING (4 OF 4)

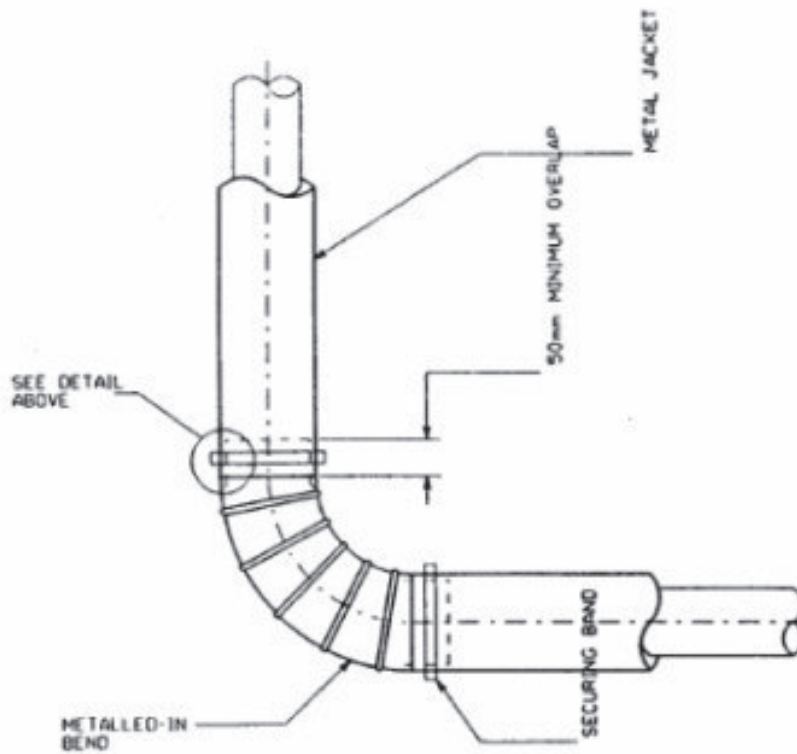
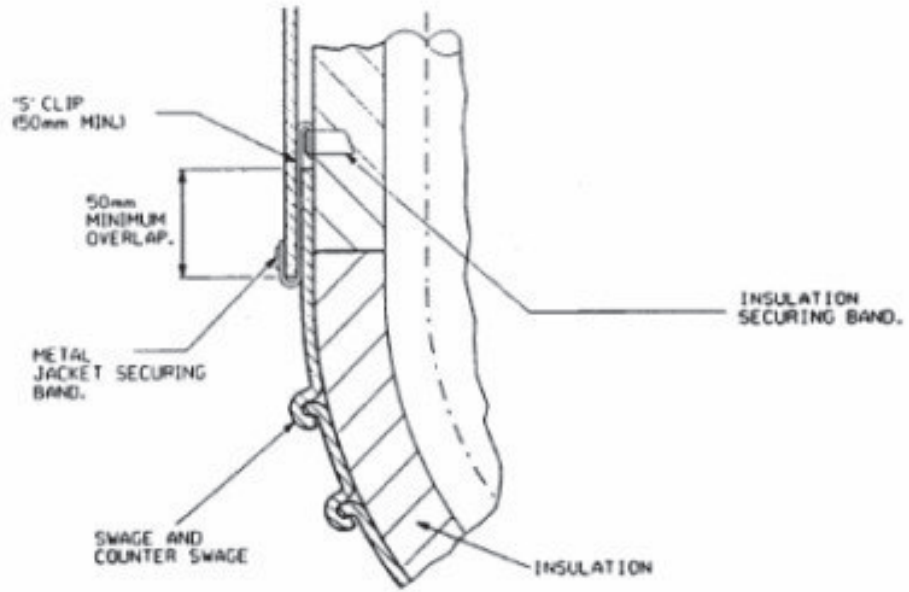
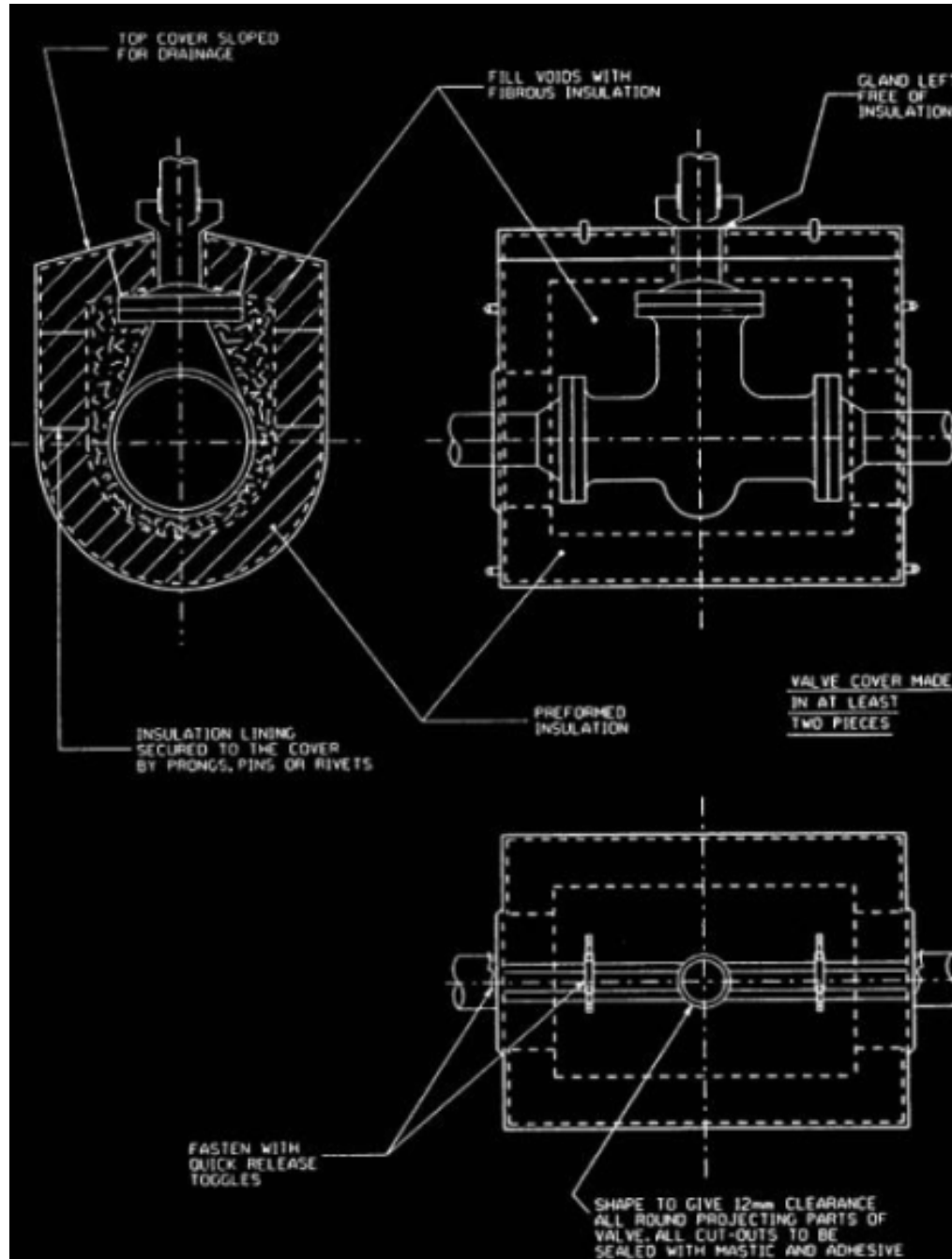


Figure 2: REMOVABLE COVERS (1 OF 4)



**Figure 2: REMOVABLE COVERS (2 OF 4)**

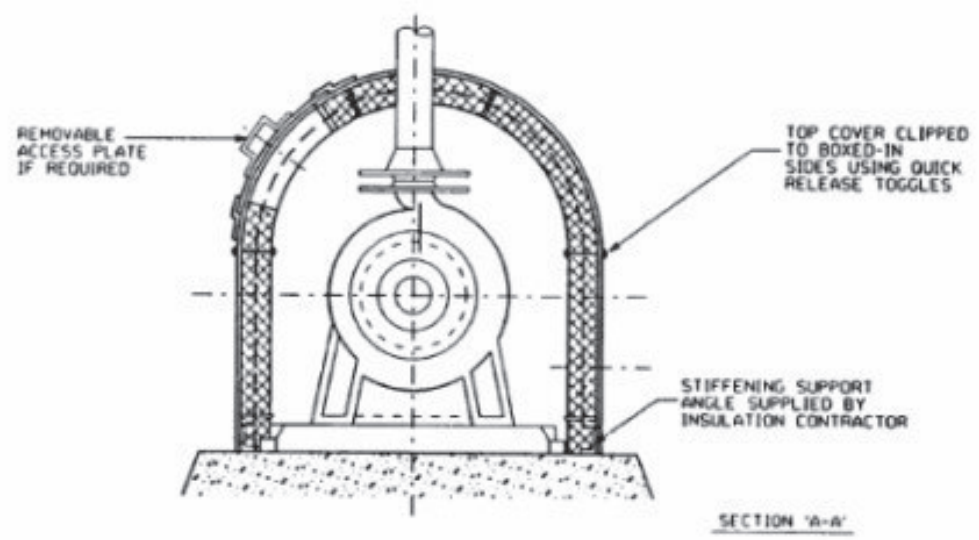
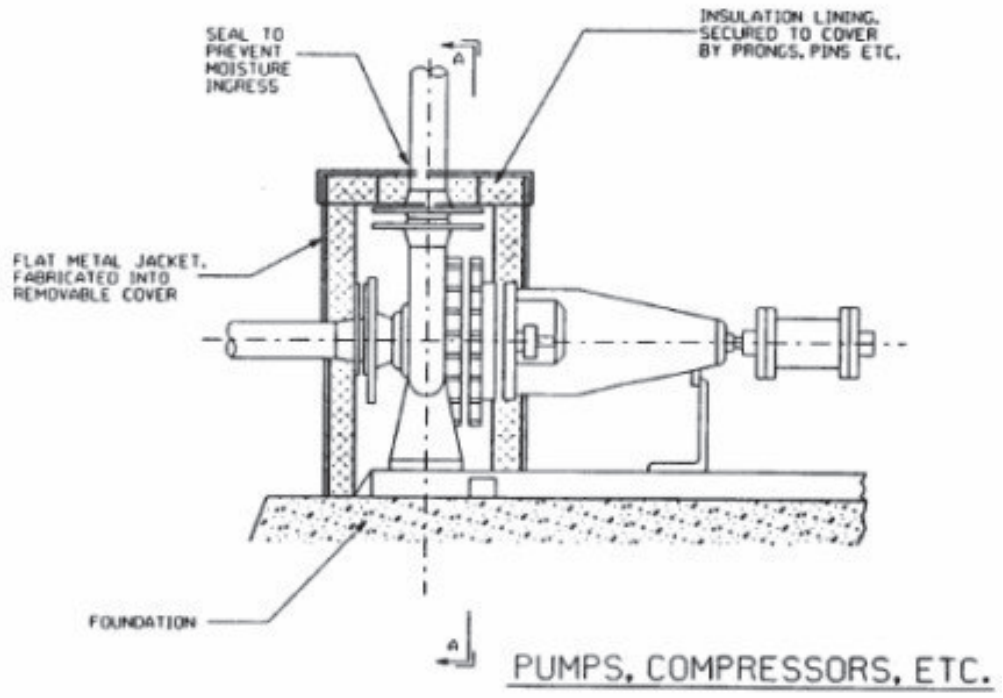


Figure 2: REMOVABLE COVERS (3 OF 4)

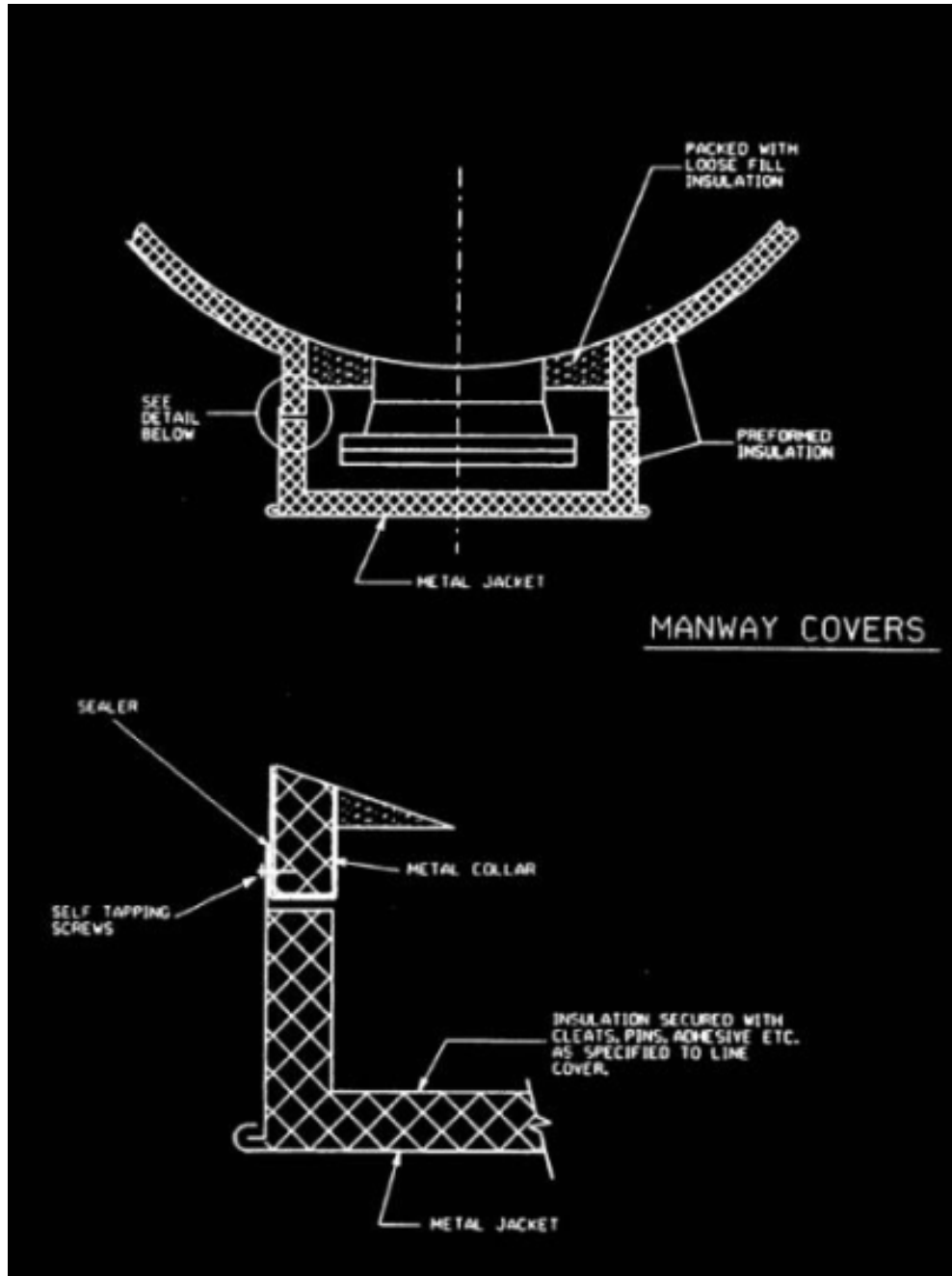




Figure 2: REMOVABLE COVERS (4 OF 4)

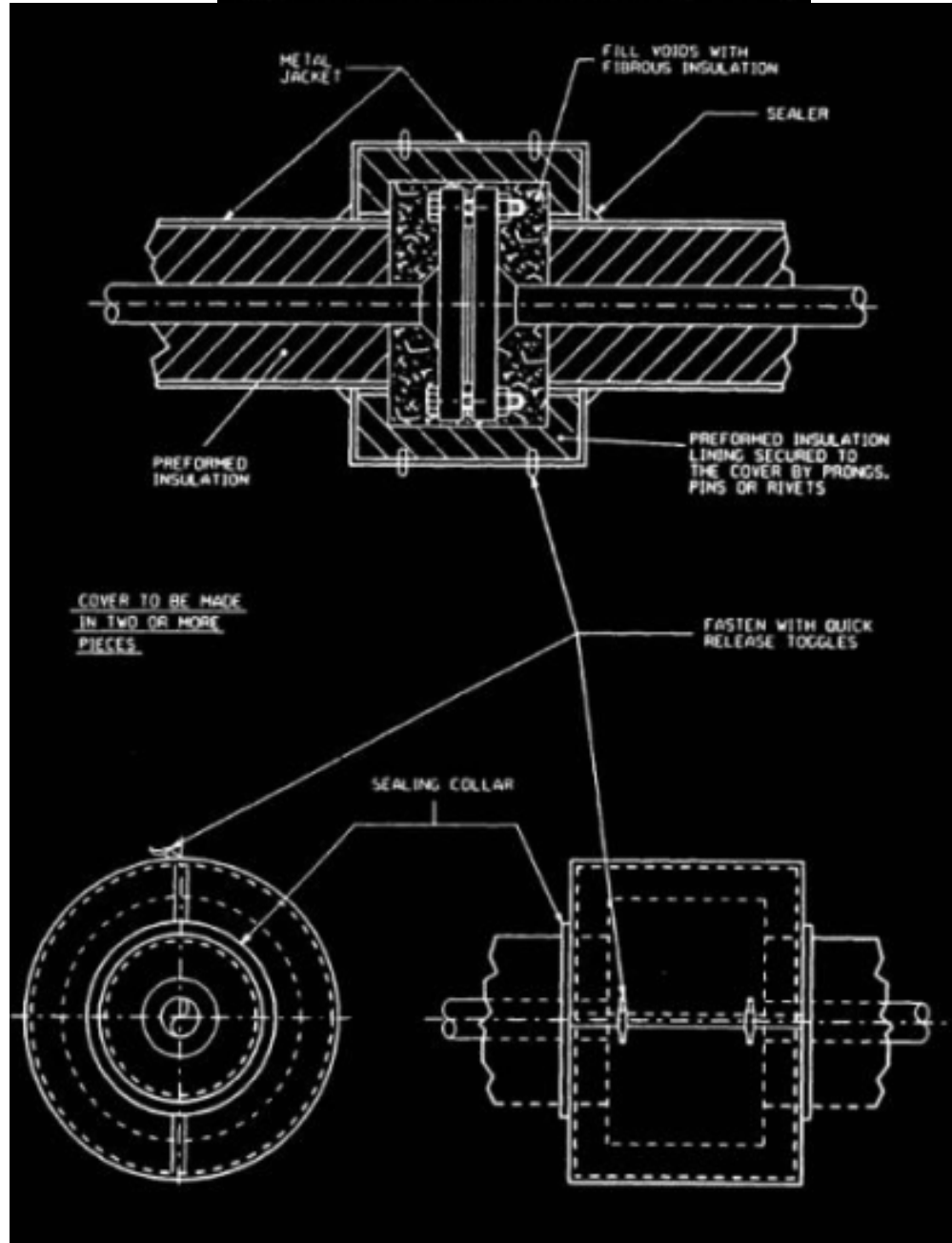


Figure 3: VERTICAL EQUIPMENT (1 OF 3)

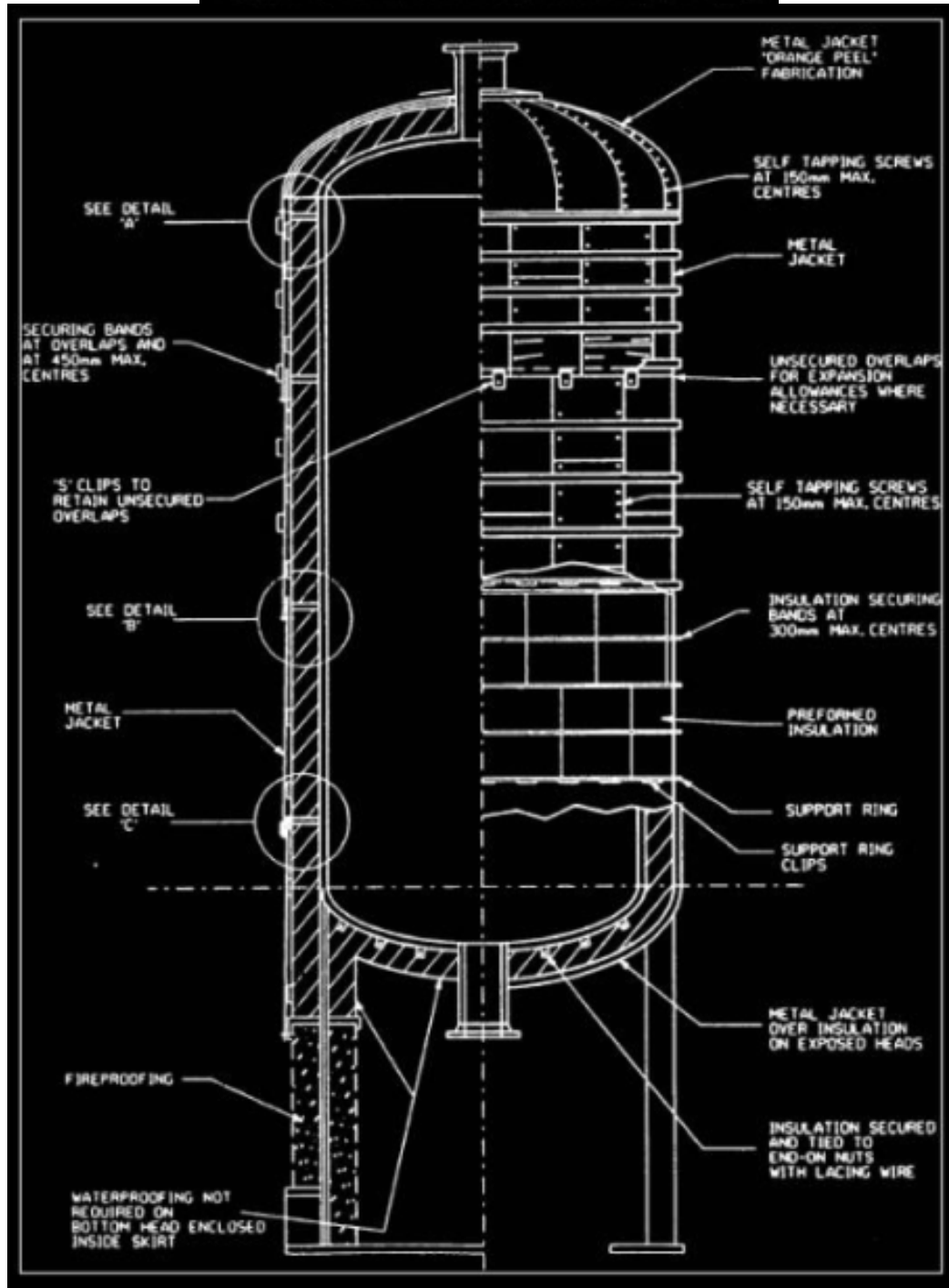
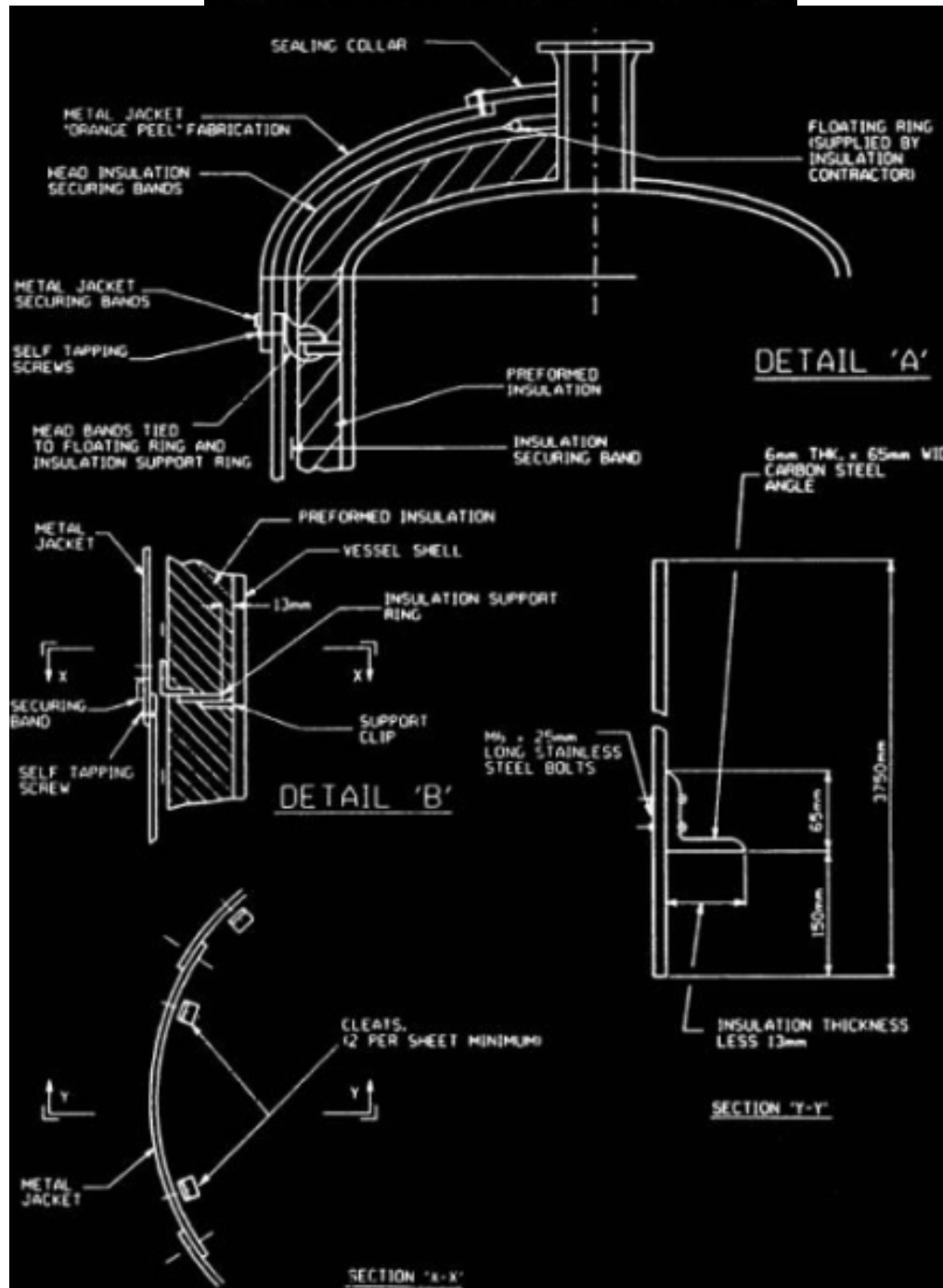


Figure 3: VERTICAL EQUIPMENT (2 OF 3)



**Figure 3: VERTICAL EQUIPMENT (3 OF 3)**

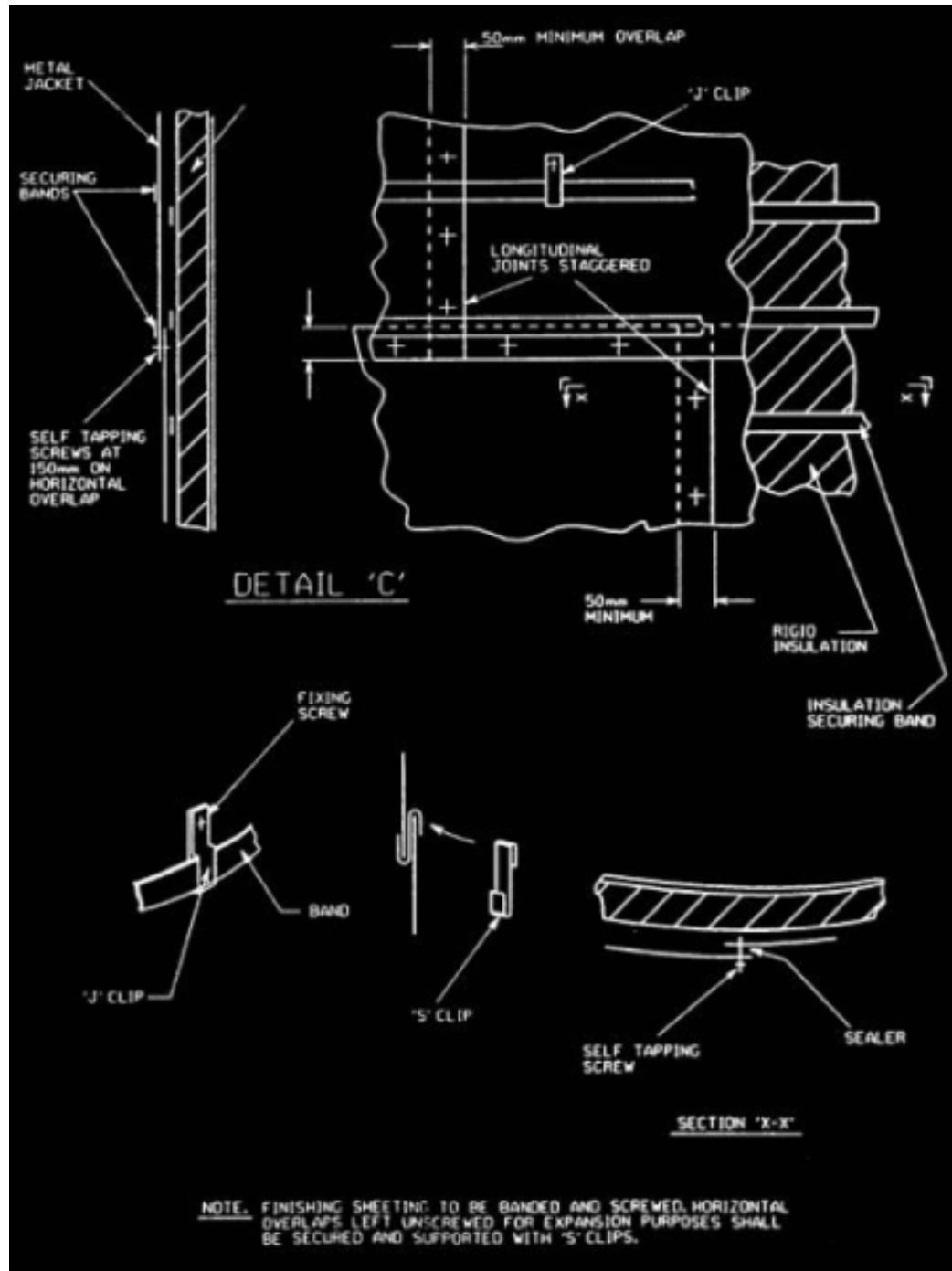
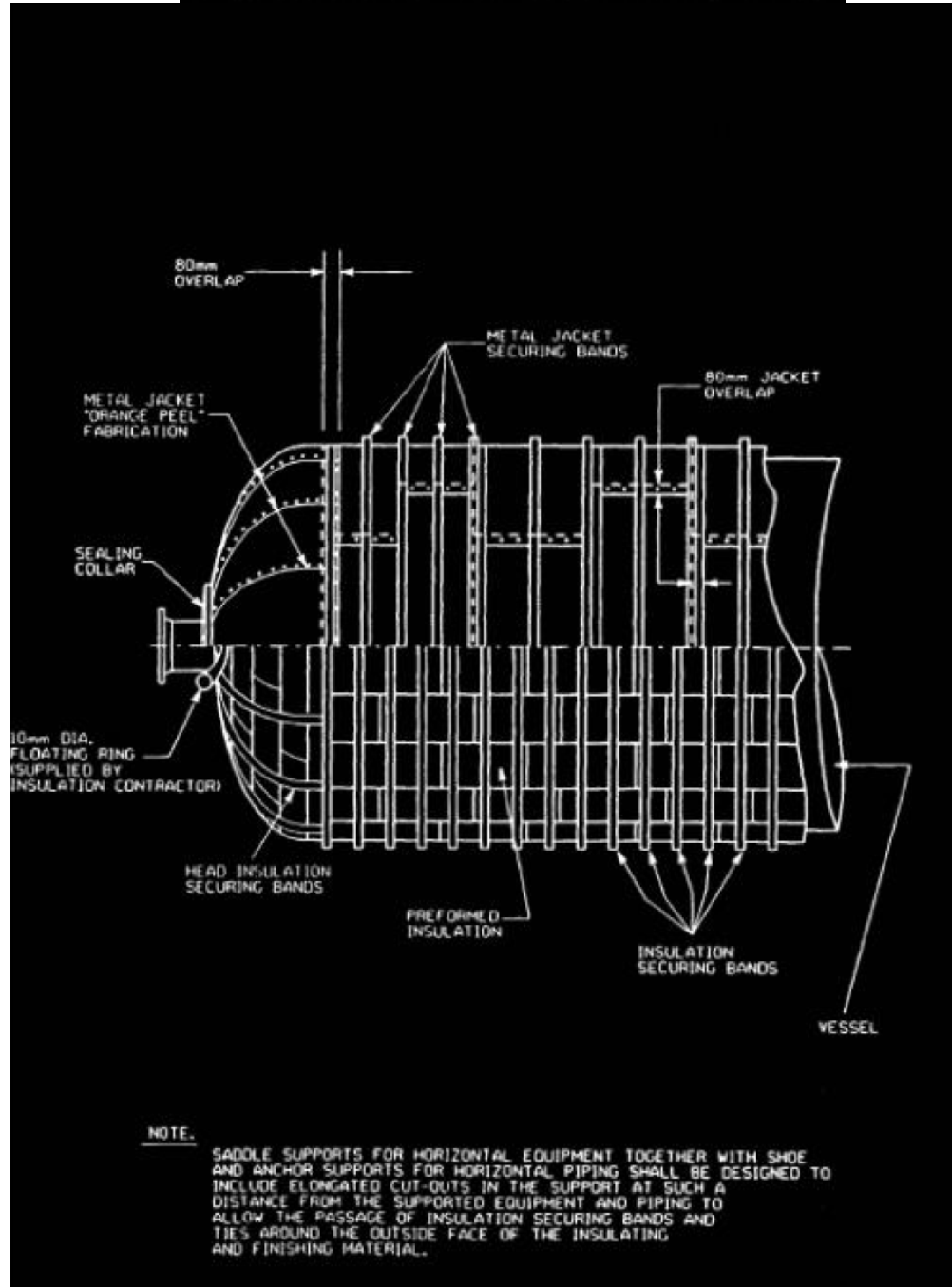


Figure 4: HORIZONTAL EQUIPMENT (1 OF 3)



**Figure 4: HORIZONTAL EQUIPMENT (2 OF 3)**

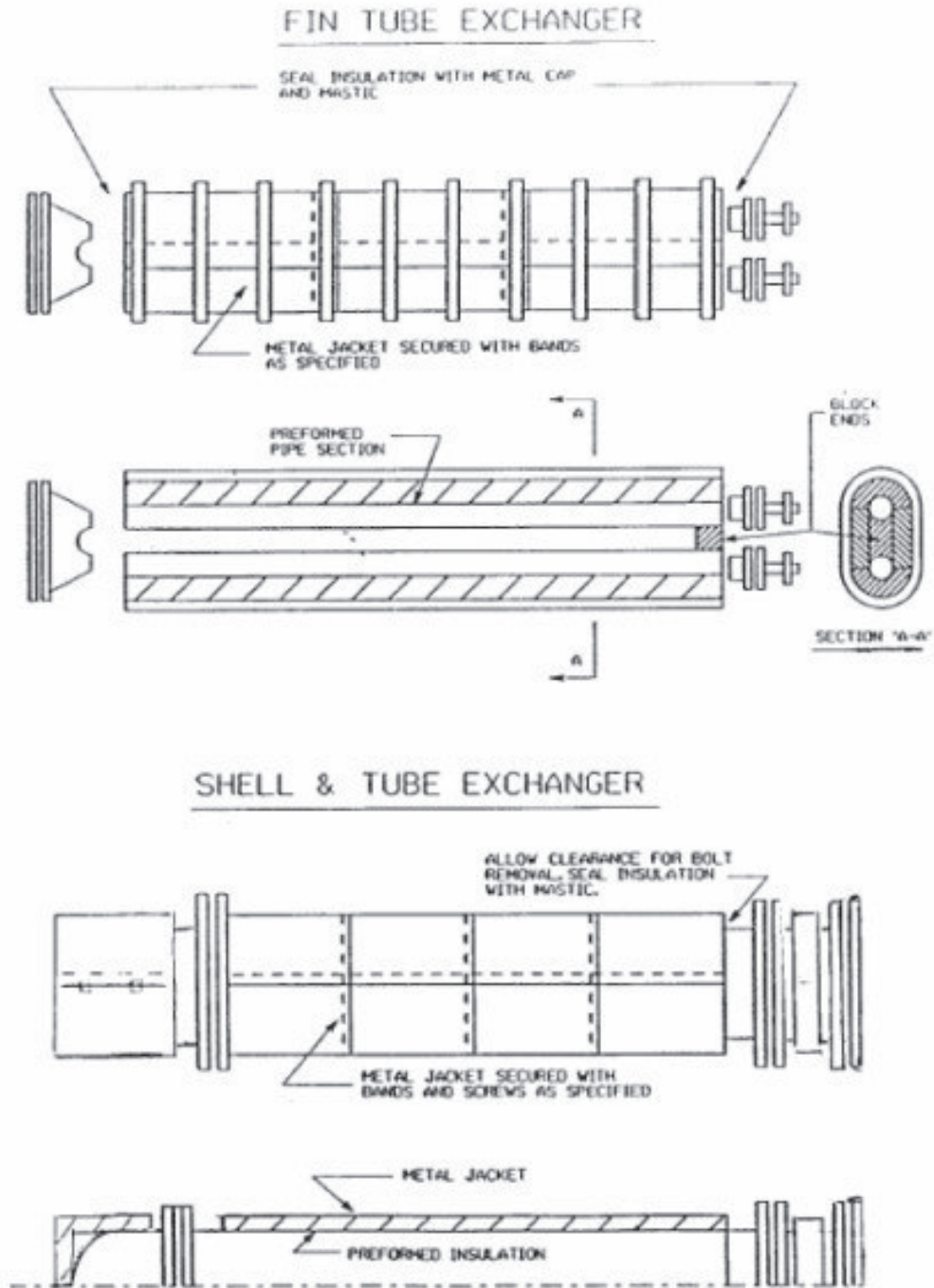




Figure 4: HORIZONTAL EQUIPMENT (3 OF 3)

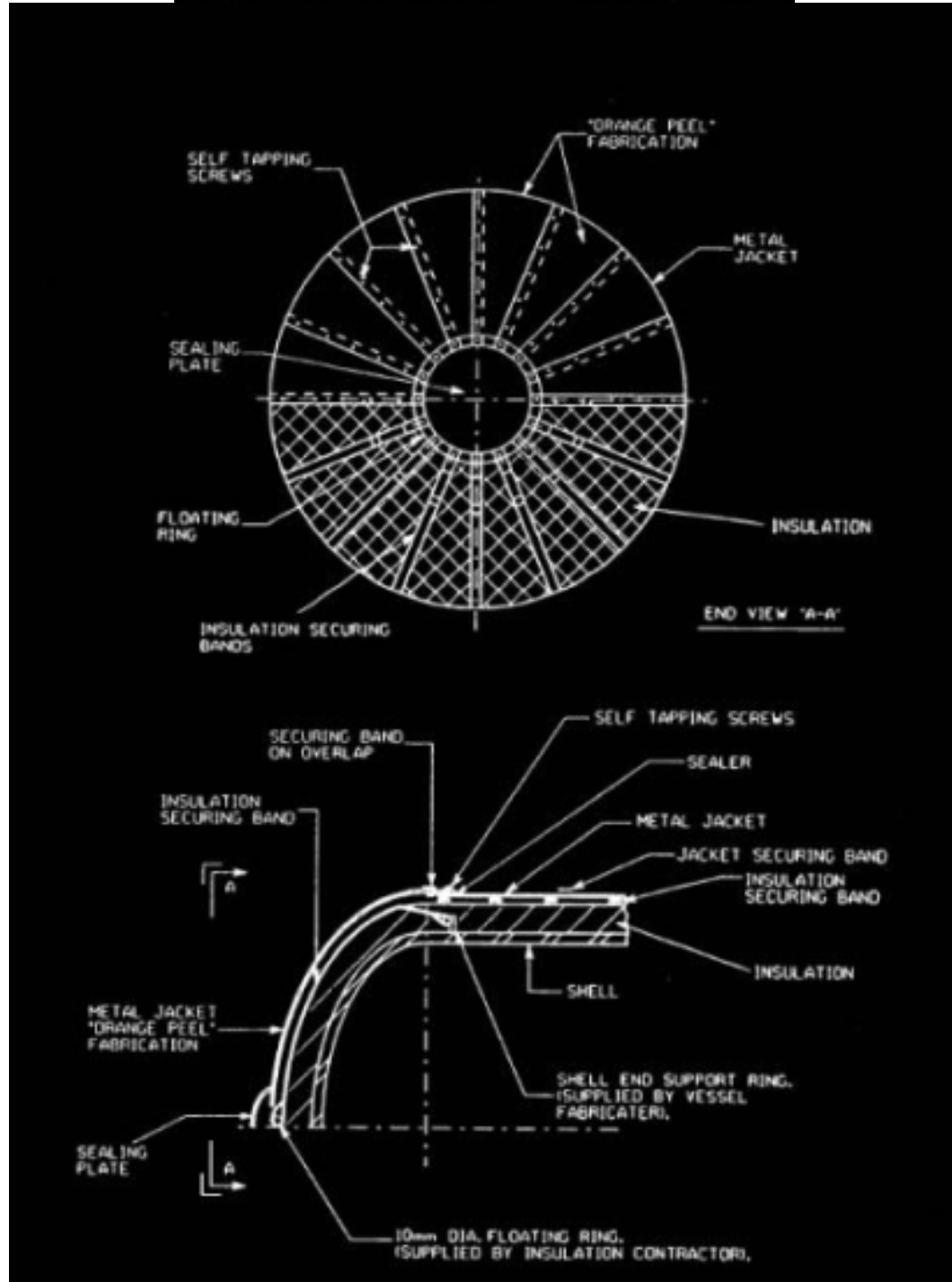
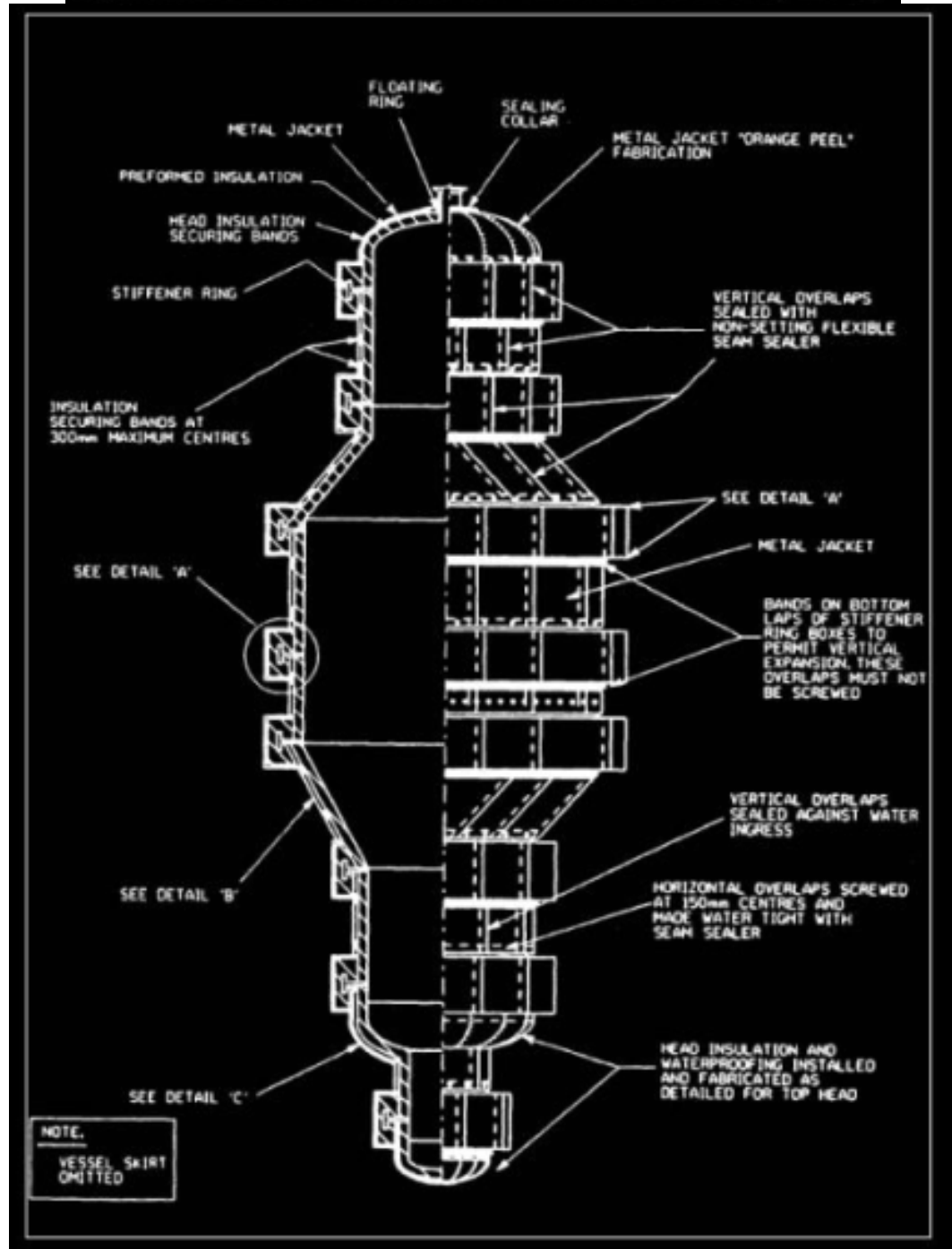
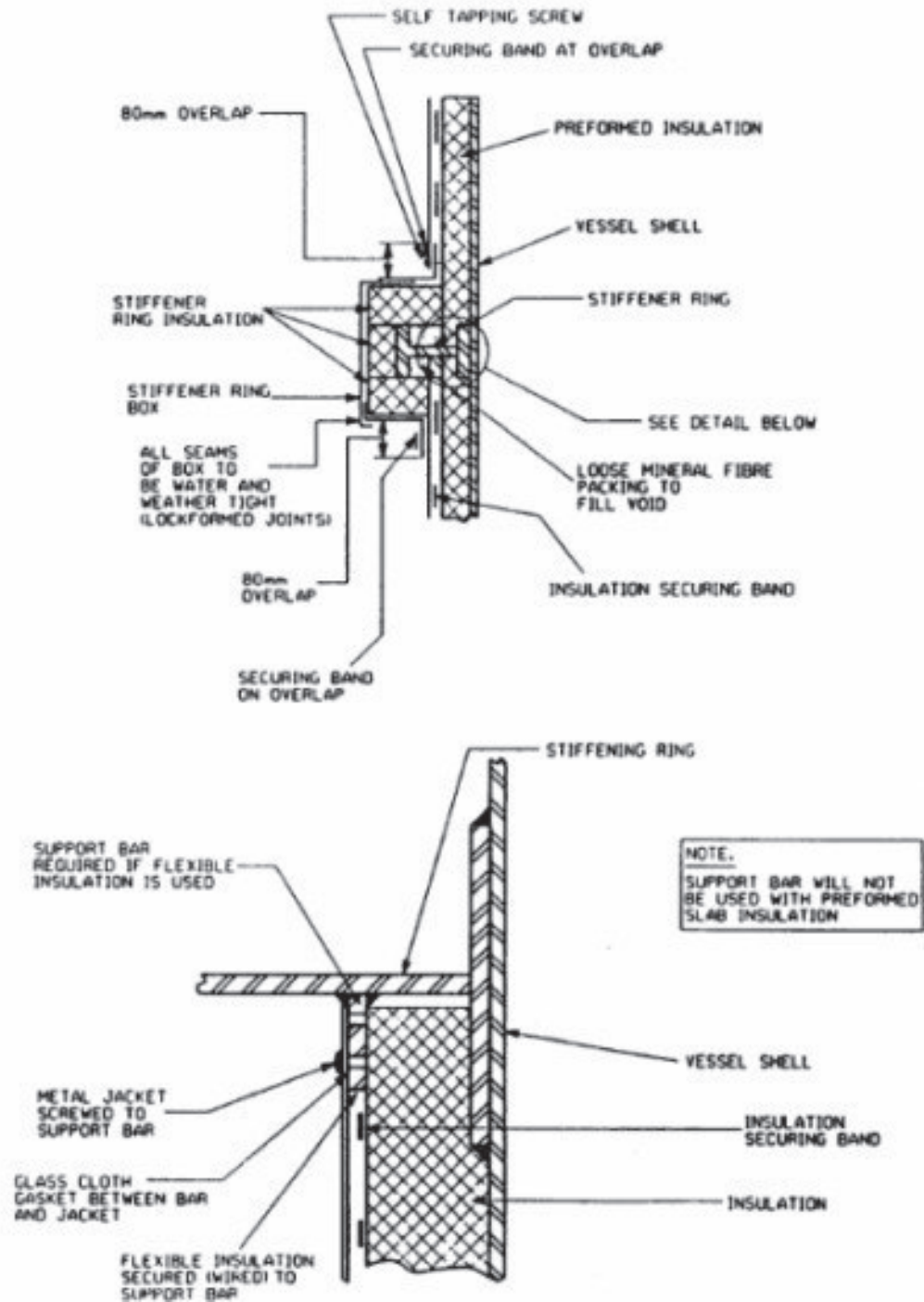




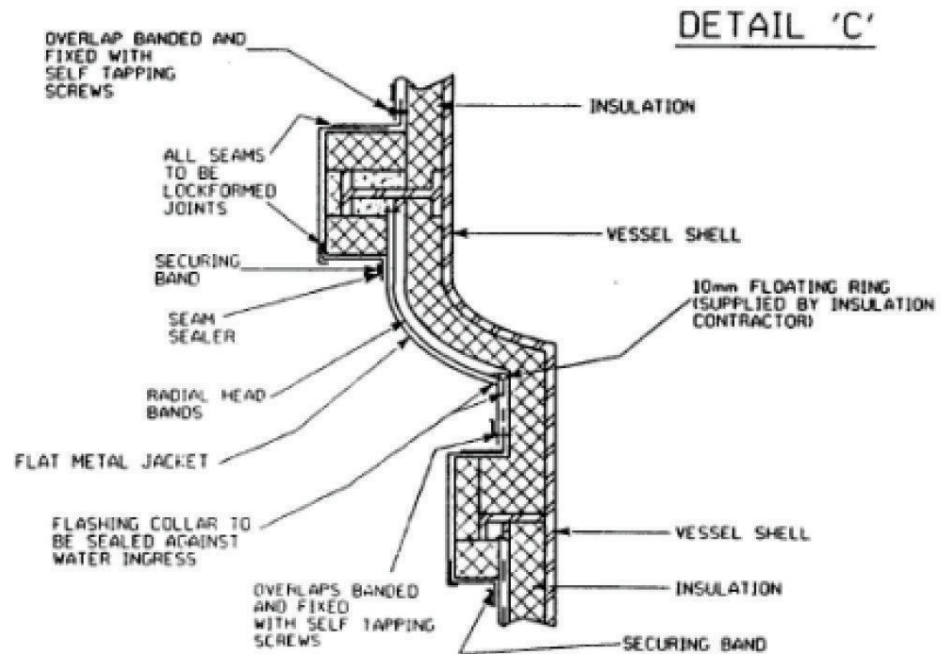
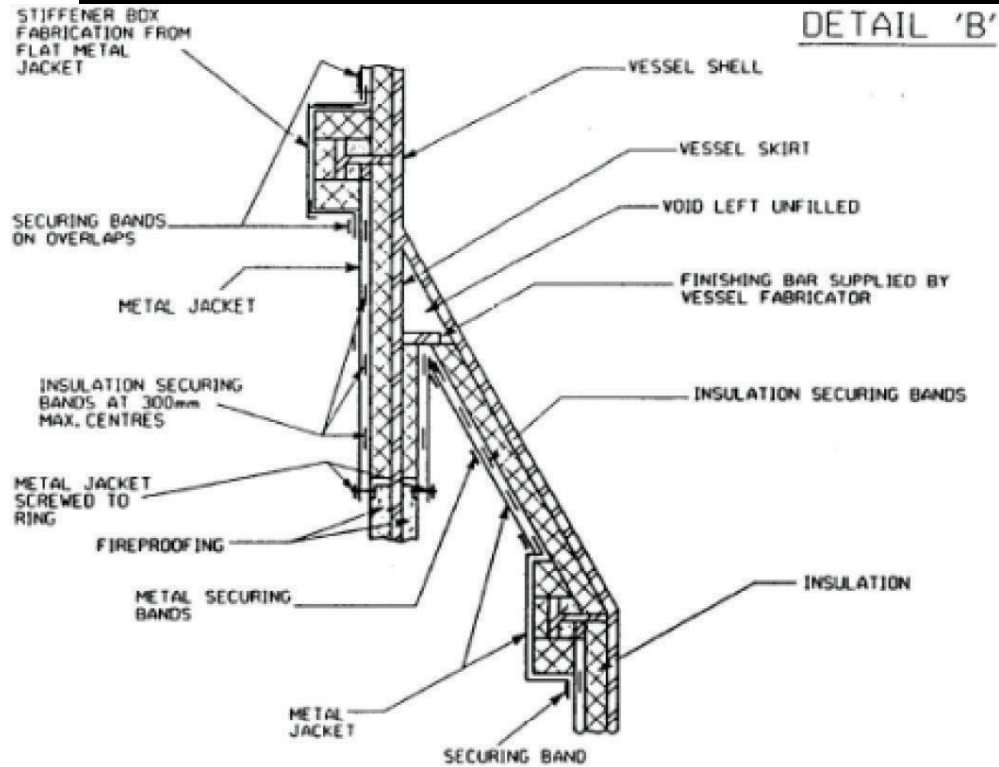
Figure 5: STIFFENER RINGS AND CONICAL SHAPES (1 OF 3)



**Figure 5: STIFFENER RINGS AND CONICAL SHAPES (2 OF 3)**  
**DETAIL 'A'**



**Figure 5: STIFFENER RINGS AND CONICAL SHAPES (3 OF 3)**



**Figure 6: ACOUSTIC INSULATION (1 OF 4)**

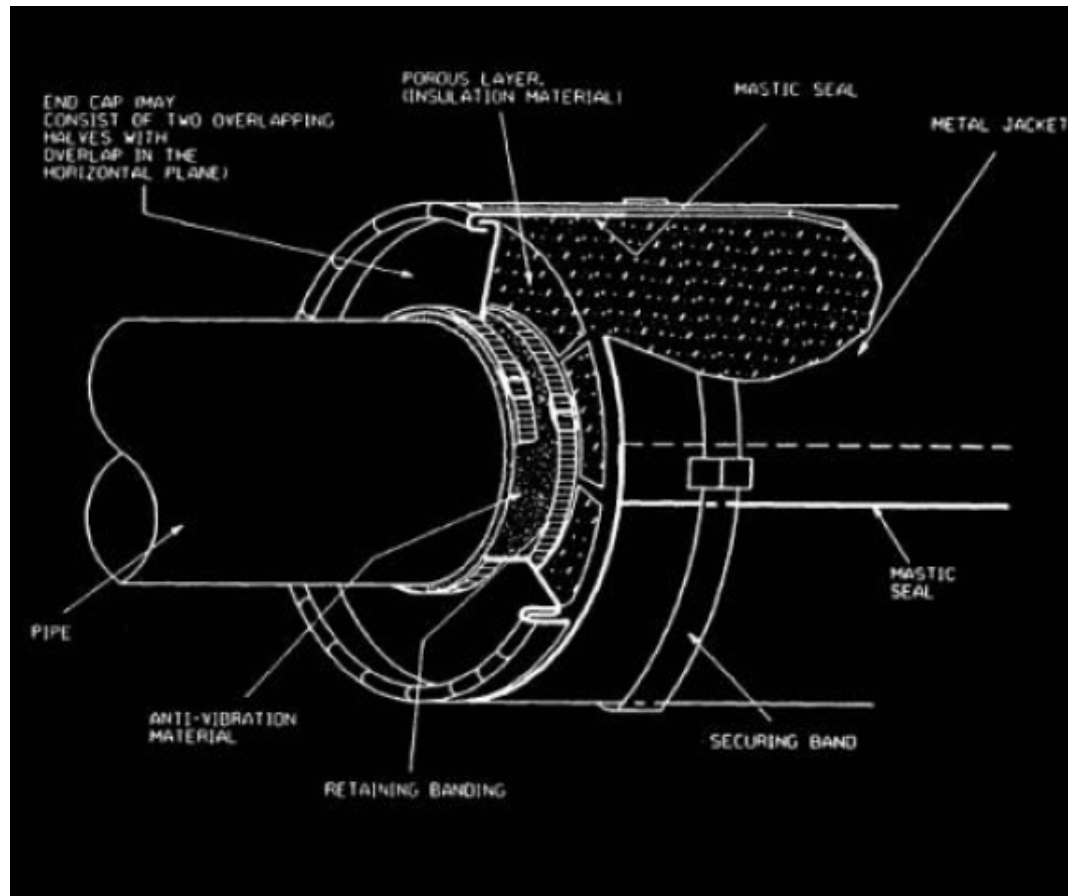
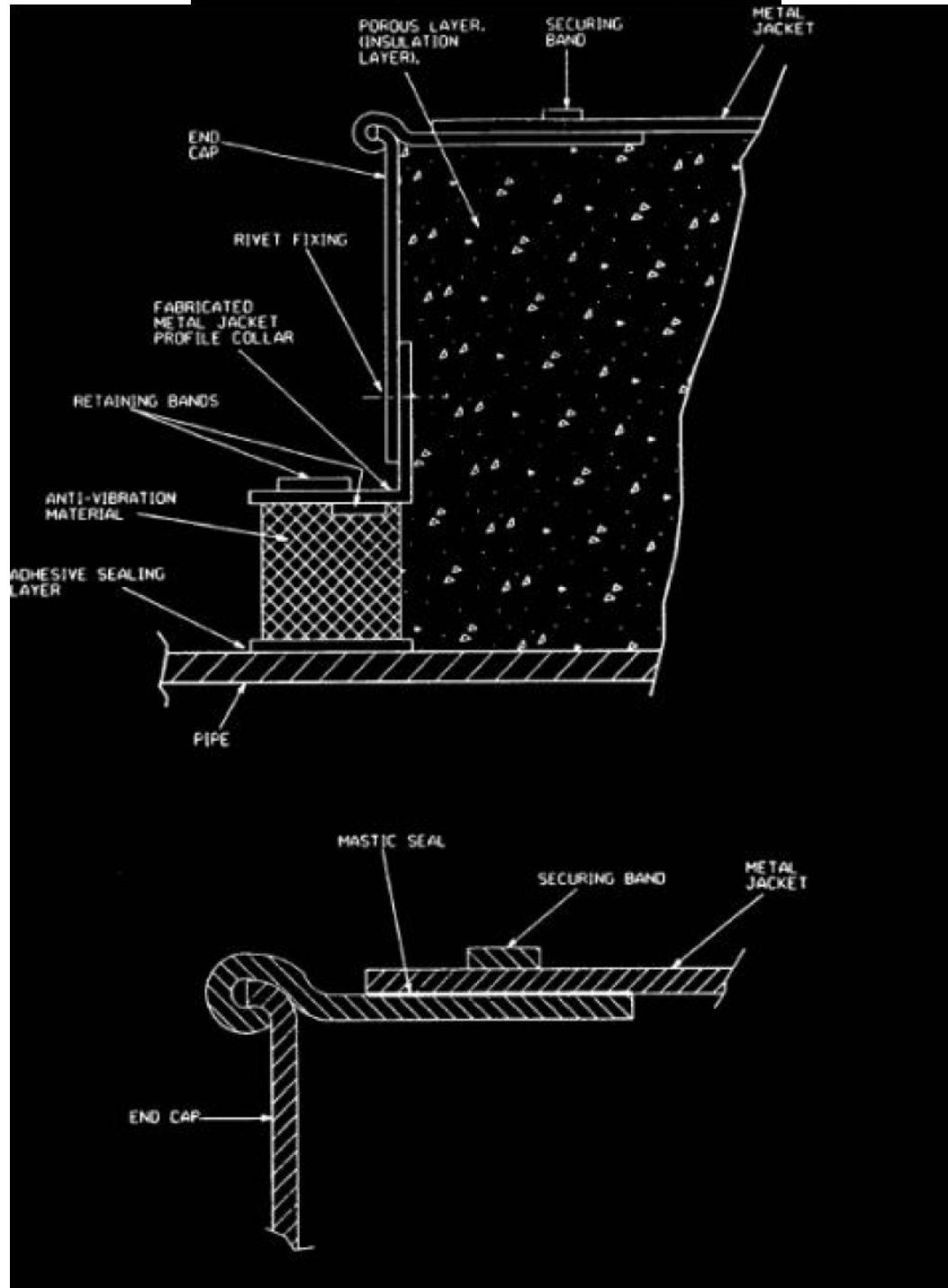
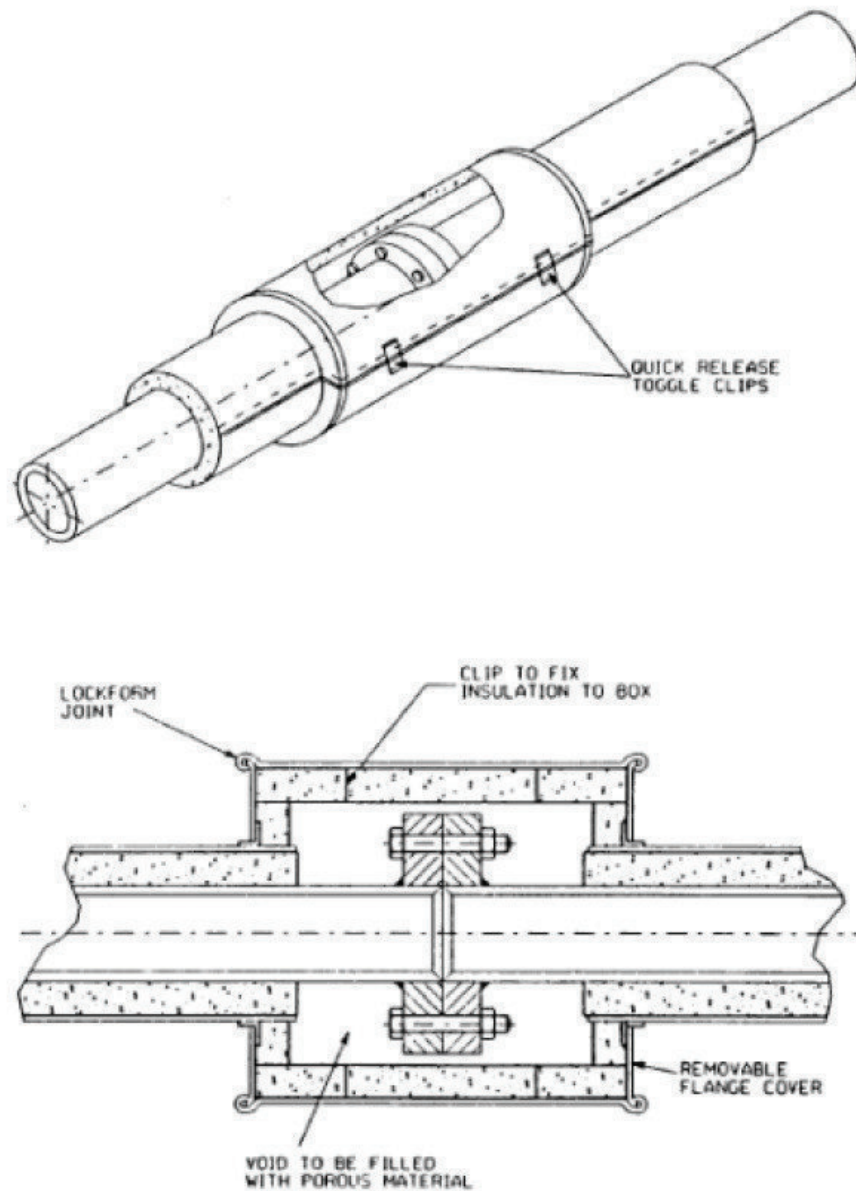


Figure 6: ACOUSTIC INSULATION (2 OF 4)



**Figure 6: ACOUSTIC INSULATION (3 OF 4)**





**Figure 6: ACOUSTIC INSULATION (4 OF 4)**

TYPICAL FOR SUPPORT IN CLASS B AND C.

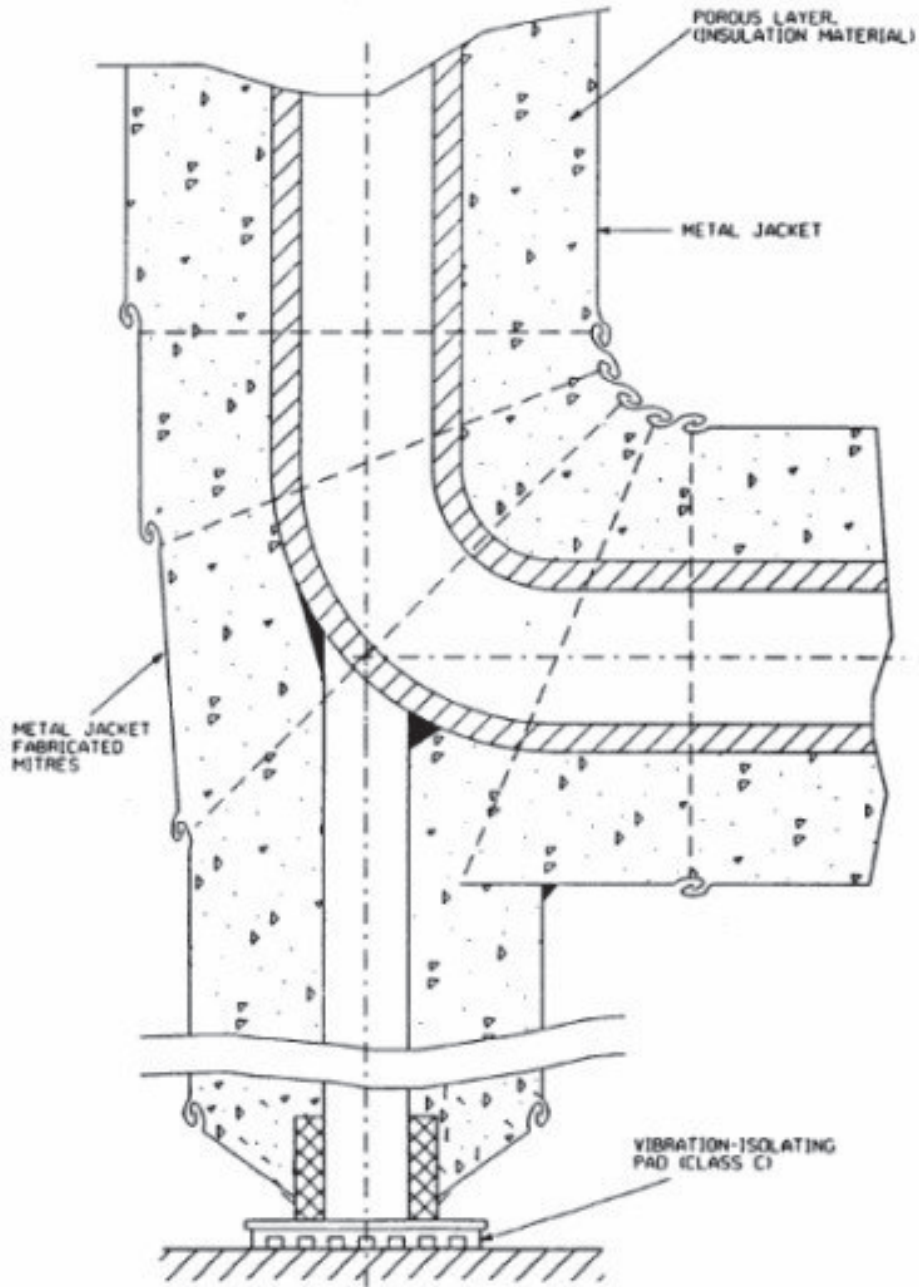
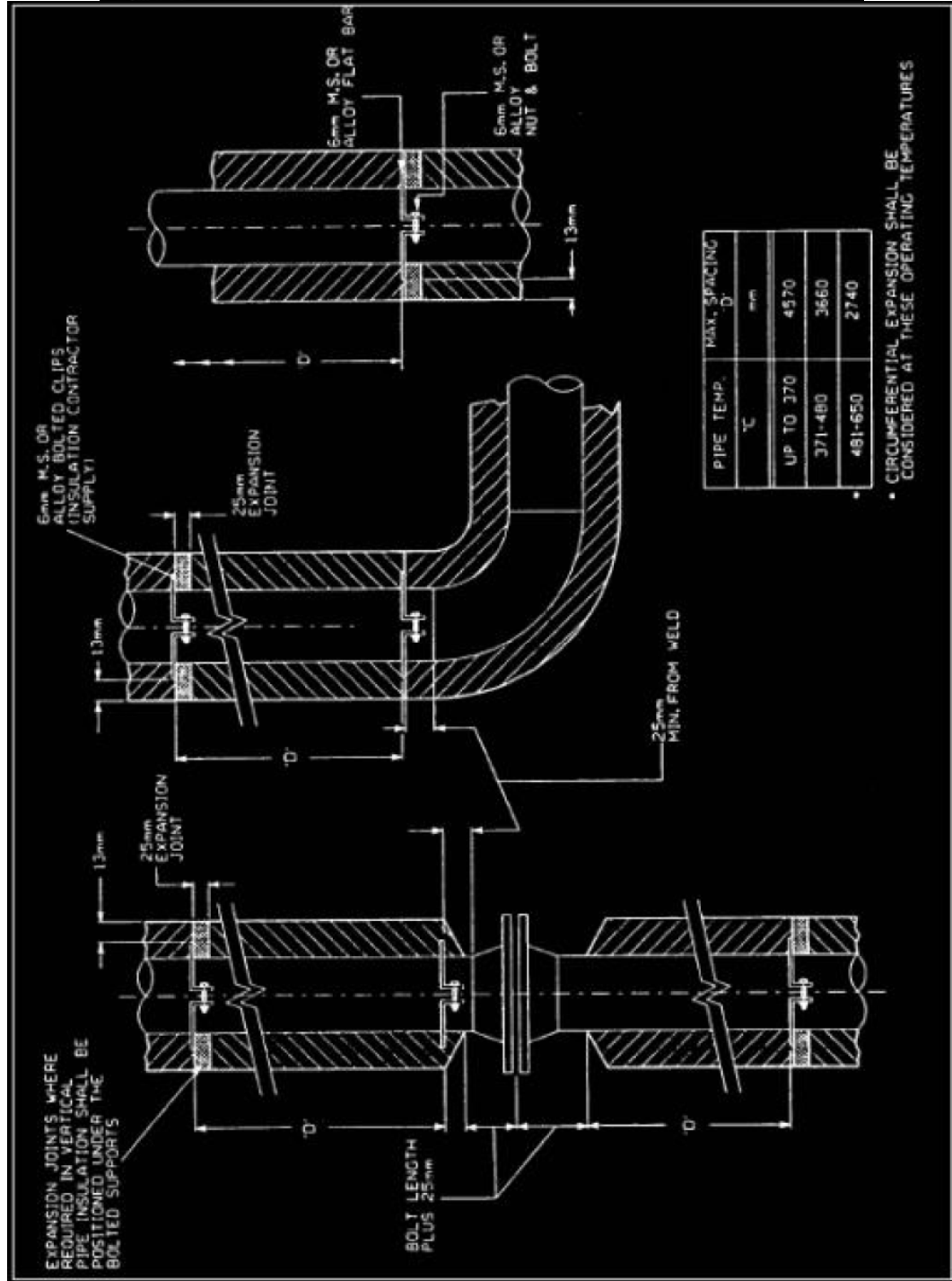


Figure 7: BOLTED ON INSULATION SUPPORT COLLARS







**DP Transmitter - Flow  
DATA SHEET**

Sheetspec\_shofspec\_sf    Rev:  
Data Sheet No:dwg\_name  
Req No:req\_no  
Po No:spec\_cmpnt\_po\_no

Rev	Description	Date	By	Ckd	Appr
	Client: udf_c61				
	Project: udf_c62				
	Project No: udf_c63				
	Location: udf_c64				
	Tag No: cmpnt_name				

G E N	1	Vendor	P&ID	udf_c65	pid_no
	2	Manufacturer	Model No	cmpnt_mfr_id	cmpnt_mod_id
	3	Line No	Equipment No	line_num	equip_id
	4	Enclosure Type	Electrical Area Class	spec_udf_c01	spec_udf_c02
	5	Approvals		spec_udf_c03	
P R O C E S S	6	Service		cmpnt_serv	
	7	Fluid	Phase	pd_fluid_name	pd_fluid_phase
	8	Corrosive	Erosive	pd_corrosive	pd_erosive
	9	Oper Flowrate	Max Flowrate	pd_flow_nor    if ( pd_flow_	pd_flow_max    if ( pd_flow_
	10	Oper Pressure	Max Pressure	pd_press_nor    if ( pd_press	pd_press_max    if ( pd_press
	11	Oper Temperature	Max Temperature	pd_temp_nor    pd_temp_ui	pd_temp_max    lookupdispl
	12	Design Pressure	Design Temperature	pd_press_des    if ( pd_press	pd_design to pd_design    lookupdispl
	13	Steady / Pulsating	%Solids	spec_udf_c10	spec_udf_c11
	14	spec_udf_c14		spec_udf_c15	
	15	spec_udf_c16		spec_udf_c17	
B O D Y & S E N S O R	16	Body Type		spec_udf_c21	
	17	Process Conn Size	Conn Type & Rating	spec_udf_c24    spec_udf_c	spec_udf_c25
	18	Body Material	Sensor Material	spec_udf_c26	spec_udf_c27
	19	Seal Ring Material		spec_udf_c28	
	20	Fill Fluid		spec_udf_c29	
	21	Design Pressure		spec_udf_c30    if ( pd_press	
	22	Design Temp		spec_udf_ to spec_udf_    lookupdispl	
	23	spec_udf_c36		spec_udf_c37	
	24	spec_udf_c38		spec_udf_c39	
T R A N S M I T T E R	25	Type		spec_udf_c40	
	26	Output	Power Supply	udf_c22	udf_c23
	27	Instrument Range		inst_range to inst_range    if ( pd_flow_	
	28	Calibrated Range		calib_rang to calib_rang    if ( pd_flow_	
	29	Accuracy	Response Time	spec_udf_c42	spec_udf_c43
	30	SQ. Root Extraction	Failure Mode Output	spec_udf_c44	spec_udf_c45
	31	Integral Indicator	Luminated ( Y/N )	spec_udf_c46	spec_udf_c47
	32	Ambient Temp Rating		spec_udf_ to spec_udf_    lookupdispl	
	33	Elevation / Supression		spec_udf_c50	
	34	Electrical Connection		spec_udf_c52	
	35	spec_udf_c58		spec_udf_c59	
S E A L	36	Seal Conn Size	Conn Type & Rating	spec_udf_c60    lookupdispl	spec_udf_c61
	37	Diaphragm Material	Seal Flange Material	spec_udf_c62	spec_udf_c63
	38	Capilliary Conn Size	Capilliary Conn Type	spec_udf_c64	spec_udf_c65
	39	Capilliary Material	Capilliary Length	spec_udf_c66	spec_udf_c67
	40	Fill Fluid		spec_udf_c68	
	41	Seal Design Pressure		spec_udf_c69    if ( pd_press	
	42	Seal Design Temperature		spec_udf_ to spec_udf_    lookupdispl	
	43	spec_udf_c78		spec_udf_c79	
M I S C	44	Manifold Type	Manifold Mounting	spec_udf_c82	spec_udf_c83
	45	Manifold Manufacturer	Manifold Model	spec_udf_c84	spec_udf_c85
	46	Lightning Protection		spec_udf_c86	
	47	Hydrostatic Test		spec_udf_c87	
	48	spec_udf_c88		spec_udf_c89	
N O T E S	spec_note				

Form: 0100    Manufacturer: LookUpDisplay(cmpnt\_mfr\_i)    Model: LookUpDisplay(cmpnt\_mod\_id)    Tag No.: cmpnt\_name



### Temperature Xmtr DATA SHEET

Sheetspec\_shofspec\_sr    Rev:  
 Data Sheet No:dwg\_name  
 Req No:req\_no  
 Po No:spec\_cmpnt\_po\_no

Rev	Description	Date	By	Ckd	Appr
	Client: udf_c61				
	Project: udf_c62				
	Project No: udf_c63				
	Location: udf_c64				
	Tag No: cmpnt_name				

G E N	1	Vendor	P&ID	udf_c65	pid_no
	2	Manufacturer	Model No	cmpnt_mfr_id	cmpnt_mod_id
	3	Line No	Equipment No	line_num	equip_id
	4	Enclosure Type	Electrical Area Class	spec_udf_c01	spec_udf_c02
	5	Approvals		spec_udf_c03	

P R O C E S S  D A T A	6	Service		cmpnt_serv		
	7	Fluid	Phase	pd_fluid_name	pd_fluid_phase	
	8	Corrosive	Erosive	pd_corrosive	pd_erosive	
	9	Oper Temperature	Min / Max Temperature	pd_temp_nor      pd_temp_uir	pd_temp_r to pd_temp_r lookupdispl	
	10	Design Temperature		pd_design to pd_design lookupdispl		
	11	Reference Temperature		pd_temp_ref	pd_temp_re	
	12	Operating Pressure		pd_press_nor	if(pd_press_uflg='G',rigspec_udf_c13	
	13	Design Pressure		pd_press to pd_press	if(pd_press_uflg='G',rigspec_udf_c15	
	14	spec_udf_c16	spec_udf_c12	spec_udf_c17		
	15	spec_udf_c18	spec_udf_c14	spec_udf_c19		

I N P U T	16	Element Tag No(s)		spec_udf_c20		
	17	Element Data Sheet No		spec_udf_c21		
	18	Thermocouple :	Type	spec_udf_c23		
	19		Range	spec_udf_ to spec_udf_ lookupdispl		
	20		Cold Junc Ref	spec_udf_c26		
	21	spec_udf_c28		spec_udf_c29		
	22	RTD :	Type	spec_udf_c33		
	23		Range	spec_udf_ to spec_udf_ lookupdispl		
	24		Coefficient	spec_udf_c36		
	25	spec_udf_c38		spec_udf_c39		

T R A N S M I T T E R	26	Type		spec_udf_c40		
	27	Output	Power Supply	udf_c22	udf_c23	
	28	Instrument Range		inst_range to inst_range	LookUpDisp	inst_range_
	29	Calibrated Range		calib_range to calib_range	LookUpDisp	calib_range_
	30	Accuracy	Response Time	spec_udf_c42	spec_udf_c43	
	31	Burnout High / Low	Failure Mode Output	spec_udf_c44	spec_udf_c45	
	32	Integral Indicator	Luminated ( Y/N )	spec_udf_c46	spec_udf_c47	
	33	Ambient Temp Rating		spec_udf_ to spec_udf_ lookupdispl		
	34	Electrical Connection		spec_udf_c52		
	35	spec_udf_c56		spec_udf_c57		

M I S C	37	Mounting Type	Mounting Model No	spec_udf_c60	spec_udf_c61
	38	Location		spec_udf_c62	
	39	Lightning Protection		spec_udf_c64	
	40	spec_udf_c72		spec_udf_c73	
	41	spec_udf_c74		spec_udf_c75	
	42	spec_udf_c76		spec_udf_c77	
	43	spec_udf_c78		spec_udf_c79	
	44	spec_udf_c80		spec_udf_c81	
	45	spec_udf_c82		spec_udf_c83	
	46	spec_udf_c84		spec_udf_c85	

N O T E S	spec_note				
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### Pressure Transmitter DATA SHEET

Sheet _____ of _____	Rev: _____
Data Sheet No: _____	
Req No: _____	
Po No: _____	

Rev	Description	Date	By	Ckd	Appr
	Client:				
	Project:				
	Project No:				
	Location:				
	Tag No:				

GENERAL	1	Vendor	P&ID							
	2	Manufacturer	Model No							
	3	Line No	Equipment No	Schedule						
	4	Pipe Class	Pipe Material	Equipment Material						
	5	Enclosure Type	Electrical Area Class							
	6	Approvals	Equipment System							
PROCESS DATA	7	Service								
	8	Fluid	Phase	Build up Tendency						
	9	Corrosive	Erosive	EO Ser.	O2 Ser.					
	10	Diff Press	Min.	Oper.	Max.	Unit				
	11	Pressure	Min.	Oper.	Max.	Unit				
	12	Temperature	Min.	Oper.	Max.	Unit				
	13	Design Press.Min./ Max.	Design Temp.Min./Max.			to		to		
	14	Oper SG	Molecular Weight							
	15	Oper Viscosity								
BODY & SENSOR	16	Body Type								
	17	Process Conn Size	Conn Type & Rating							
	18	Body Material	Seal Ring Material							
	19	Sensor Type	Sensor Material							
	20	Fill Fluid								
	21	Vent / Drain Location	Size							
	22	Bolting Material								
	23									
TRANSMITTER	24	Type								
	25	Output	Power Supply							
	26	Instrument Range	Min.	Max.	Unit					
	27	Calibrated Range	Min.	Max.	Unit					
	28	DCS Range	Min.	Max.	Unit					
	29	Trans.O/P Range	Min.	Max.	Unit					
	30	Accuracy	Response Time							
	31	Damping	Failure Mode Output							
	32	Integral Indicator	Luminated ( Y/N )							
	33	Ambient Temp Rating				to				
	34	Elevation/Supression	SIL Rating							
35	Electrical Connection	Signal Termination								
36	Housing Type	Material								
37	Zero / Span Adjustment									
SEAL	38	Seal Conn Size	Conn Type & Rating							
	39	Diaphragm Material	Seal Flange Material							
	40	Capilliary Conn Size	Capilliary Conn Type							
	41	Capilliary Material	Capilliary Length							
	42	HP Seal Model	LP Seal Model							
	43	Fill Fluid								
	44	Bolting Material								
MISC	45	Manifold Type	Manifold Mounting							
	46	Manifold Manufacturer	Manifold Model							
	47	Lightning Protection								
	48	Hydrostatic Test								
NOTES										

Form: 0126	Manufacturer:	Model:	Tag No.:
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### Rupture Disc DATA SHEET

Sheetspec_sl of spec_sl	Rev:				
Data Sheet No:dwg_name					
Req No:req_no					
Po No: spec_cmpnt_po_no					
Rev	Description	Date	By	Ckd	Appr

Client: udf_c61
Project: udf_c62
Project No: udf_c63
Location: udf_c64
Tag No: cmpnt_name

G E N	1	Vendor	P&ID	udf_c65	pid_no	
	2	Manufacturer	Model No	cmpnt_mfr_id	cmpnt_mod_id	
	3	Line No	Equipment No	line_num	equip_id	
	4	Inlet Line Size/Schd	Outlet Line Size/Schd	line_size line_uor Schd: line_sched	spec_ufd_.Lookup  Schd: spec_ufd_.	
	5	Inlet Line Material	Outlet Line Material	spec_ufd_c03	spec_ufd_c04	
P R O C E S S D A T A	6	Service	cmpnt_serv			
	7	Fluid	Phase	pd_fluid_name	pd_fluid_phase	
	8	Corrosive		pd_corrosive	spec_ufd_c58 pd_erosi	
	9	Required Capacity	Oper Pressure	pd_flow_max if ( pd_flow_	pd_press_nor if ( pd_press	
	10	Burst Pressure	% Allow Overpressure	pd_val_set_pres_max if ( pd_val_s	pd_accumulation pd_accumul	
	11	Back Pressure	Constant	pd_const_back_pres if ( pd_const		
	12		Variable	pd_var_back_pres if ( pd_var_t		
	13		Total	sum( pd_const_back_pr if ( pd_val_s		
	14	Oper Temperature	Relief Temperature	pd_temp_nor pd_temp_uir	pd_relief_temp pd_relief_te	
	15	SG @ Relief	Visc @ Relief	pd_spec_grav_relief	pd_visc_relief pd_visc_reli	
	16	Sp Heat Ratio (Cp/Cv)	Compressibility (Z)	pd_cp_cv_nor	pd_compres_flow_nor	
	17	Latent Heat of Vap	Barometric Pressure	pd_latent_heat_nor pd_latent_h	spec_ufd_c16 spec_ufd_c	
	18	Design Pressure	Design Temperature	pd_press_des if ( pd_press	pd_design to pd_design pd_design_t	
	19	Molecular Weight	spec_ufd_c19			
D I S C	20	Size	spec_ufd_c20	spec_ufd_c1		
	21	Type	spec_ufd_c22			
	22	Material	spec_ufd_c23			
	23	Inlet Coating	Outlet Coating	spec_ufd_c24	spec_ufd_c25	
	24	Quantity Per Assembly	spec_ufd_c26			
	25	Bursting Pressure Range	spec_ufd_.to spec_ufd_ if ( pd_val_s spec_ud spec_ufd_c18			
	26	Estimated Burst Pressure	spec_ufd_c30 if ( pd_val_s spec_ufd_c38			
	27	Manufacturing Range	spec_ufd_c39			
H O L D E R	28	Model No	spec_ufd_c40			
	29		Inlet	Outlet		
	30	Size	spec_ufd_c42	Lookupdispl	spec_ufd_c43	LookupDisp
	31	Type	spec_ufd_c44			
	32	Rating	spec_ufd_c46			
	33	Material	spec_ufd_c48			
	34	Coating	spec_ufd_c50			
	35	Seal	spec_ufd_c52			
	36	Gasket	spec_ufd_c54			
	37	Flange	spec_ufd_c59			
M I S C	38	Vacuum Model No	Vacuum Material	spec_ufd_c60	spec_ufd_c61	
	39	Qty per Assembly	Attached to Disc	spec_ufd_c62	spec_ufd_c63	
	40	Bolting Material ( Studs / Nuts )		spec_ufd_c64		
	41	Preassembly Screws		spec_ufd_c66		
	42	Excess Flow Valve		spec_ufd_c68		
	43	Pressure Gauge		spec_ufd_c70		
	44	Jack Screws		spec_ufd_c71		
	45	Baffle Plate	Muffled Plug	spec_ufd_c72	spec_ufd_c73	
	46	Tell Tale Assembly		spec_ufd_c75		
	47	Pressure Transmitter		spec_ufd_c77		
	48	Burst Disc Detector		spec_ufd_c79		

N O T E S	spec_note				

Form: 0302	Manufacturer: LookupDisplay(cmpnt_mfr_i	Model: LookupDisplay(cmpnt_mod_id)	Tag No.: cmpnt_name
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### Magnetic Gauge DATA SHEET

Sheet _____ of _____	Rev: _____
Data Sheet No: _____	
Req No: _____	
Po No: _____	

	Rev	Description	Date	By	Ckd	Appr
Client:						
Project:						
Project No:						
Location:						
Tag No:						

GENERAL	1	Vendor	P&ID	
	2	Manufacturer	Model No	
	3	Equipment No	Trim Spec	
	4	Enclosure	Electrical Area Class	
	5	Approvals		
PROCESS DATA	6	Service		
	7	Upper Fluid	Lower Fluid	
	8	Corrosive	Erosive	
	9	Oper Pressure	Design Pressure	
	10	Oper Temperature	Design Temperature	to
	11	Upper SG @ Oper	Upper SG Min / Max	to
	12	Lower SG @ Oper	Lower SG Min / Max	to
	13	Upper % Solids	Lower % Solids	
	14			
CHAMBER	15	Configuration	Style	
	16	Chamber Size	Chamber Material	
	17	Conn Size	Conn Type/Rating	
	18	Dimension Units		
	19	C.Line Upper Conn to Top of Gauge Dimension		
	20	C.Line Lower Conn to Bot of Gauge Dimension		
	21	Chamber Flange Size	Chamber Flange Rating	
	22	Vent Connection	Drain Connection	
	23	Float Material	Min SG ( Sink-Point )	
	24	Design Pressure	Design Temperature	to
INDICATOR	25	Type		
	26	Ind Colour - Front/Back		
	27	Number Colour		
	28	Background Colour		
	29	Scale Units	Unit Interval	
	30	Upper Scale Range	Lower Scale Range	
	31			
TRANSMITTER	32	Type		
	33	Model No		
	34	Xmtr Head Orientation	Tag No	
	35	Upper Calib Range	Upper Output Range	
	36	Lower Calib Range	Lower Output Range	
	37	Power Supply		
	38	Ambient Temp Rating	to	
	39			
SWITCH	40	Type	Model No	
	41	Quantity	Tag No(s)	
	42	Switch #1 Setting	Switch #2 Setting	
	43	Rating	Form	
	44			
MISC	45	Heat Tracing	Controller	
	46	Insulation Blanket	Frost Extension	
	47	Transmitter Mounting	Support Bracket	
	48			

NOTES	
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Form: 0400	Manufacturer:	Model:	Tag No.:
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### Level Gauge DATA SHEET

Sheet of	Rev:
Data Sheet No:	
Req No:	
Po No:	

	Rev	Description	Date	By	Ckd	Appr
Client:						
Project:						
Project No:						
Location:						
Tag No:						

G E N	1	Vendor	P&ID	
	2	Manufacturer	Model No	
	3	Line No	Equipment No	
	4	Instrument Location		
	5	Vessel/Pipe Class		
	6			
	7			

P R O C · D A T A	8	Service		
	9	Fluid		
	10	Corrosive	Errosive	
	11	Pressure Oper		
	12	Temperature Oper		
	13	Design Pressure	Design Temperature	to
	14			
	15			

G A U G E G L A S S	16	Gauge Cocks	Assembled with Nipples	
	17	Gauge Glass Type	Process Conn Location	
	18	Glass Size	Visible length	
	19	Tempered Borosilicate Glass		
	20	Center to Center Length		
	21	Material of Chamber and Connections		
	22	Gauge Connection: Location and Size		
	23	MFG Rated Pressure	Temperature Limits	to
	24			
	25			

G A U G E C O C K S	26	Notes	Rev	
	27	Type		
	28	Mounting		
	29	Material	Body	Trim
	30	Min Rating	Pressure	Temp
	31	Vessel Connection	Size	Type
	32	Gauge Connection	Size	Type
	33	Vent/Drain Conn	Size	Type
	34	Bonnet Type		
	35	Ball Checks		
	36	Renewable Seats		
	37	Packing Type		
	38			
	39			

M I S C	40			
	41			
	42			
	43	Throttle Screw	Throttle Screw Matl	
	44	Press Snub Hous Matl	Press Snub Filter Matl	
	45	Pulsation Damper		

N O T E S	
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Code: 0401



### Pressure Gauge DATA SHEET

Sheet of	Rev:
Data Sheet No:	
Req No:	
Po No:	

Rev	Description	Date	By	Ckd	Appr
	Client:				
	Project:				
	Project No:				
	Location:				
	Tag No:				

G E N	1	Vendor	P&ID	
	2	Manufacturer	Model No	
	3	Line No	Equipment No	
	4	Line / Vessel MOC	Pipe Spec	
	5	Enclosure Protection	Design Code	

D A T A	6	Service		
	7	Fluid	State	
	8	Normal Op.Pressure	Normal Op.Temperature	
	9	Design Pressure		
	10	Design Temperature		
	11	Density	Viscosity	
	12	Pulsation / Vibration		
13	EO Service	O2 Service		

E L E M E N T	14	Element Type		
	15	Element Material	Pointer Material	
	16	Stem Material		
	17	Movement Type	Movement Material	
	18			

D E S C R I P T I O N	19	Type		
	20	Mounting		
	21	Conn Size & Type	Conn Location	
	22	Case Type	Case Material	
	23	Dial Size	Dial Colour	
	24	Dial Material	Window Material	
	25	Ring Type		
	26	Blow Out Protection	Blow Out Location	
	27	Inst.Range (Min / Max) psig		to
	28	Case Fill Fluid	Accuracy	
	29	Ambient Temp Rating		to      °F
	30	Pointer Adjustment		
	31	Overrange Pressure Protection		

S E A L	32	Type		
	33	Seal Process Conn Size & Type		
	34	Diaphragm Material		
	35	Material	Upper Hsg.Flange	Bottom Hsg.Flange
	36	Instrument Conn	Capillary Type	
	37	Capillary Material	Capillary Length	
	38	Fill Fluid	Flush Qty.	
	39	Seal Model Number		
	40			
41				

M I S C	42	Siphon	Snubber	
	43	Gauge Saver		
	44	Cooling Element		
	45	Tag Plate		
	46			
	47	Weight		
	48			

N O T E S	
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Form: 0515	Manufacturer:	Model:	Tag No.:
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### Temperature Gauge DATA SHEET

Sheet	of	Rev:
Data Sheet No:		
Req No:		
Po No:		

Rev	Description	Date	By	Ckd	Appr
	Client:				
	Project:				
	Project No:				
	Location:				
	Tag No:				

G E N	1	Vendor	P&ID			
	2	Manufacturer	Model No			
	3	Line No	Equipment No			
	4	Line Size	Pipe Class			
	5	Line/Vessel Trim MOC	Line Sch.			
	6	Nozzle Projection	Nozzle ID	Nozzle MOC		
	7	Insulation Code	Insulation Thk.			
	8	Approvals				
	9	Complete Assembly Model Number				

P R O C	10	Service				
	11	Fluid	State			
	12	Oper Temperature	Max Temperature			
	13	Design Pressure	Design Temperature			
	14	Density	Velocity	Viscosity		
15	Corrosive	Toxic	Erosive			

G A U G E	16	Element Type				
	17	Element Material				
	18	Mounting Type				
	19	Mounting Connection	Connection Location			
	20	Inst.Connection Size				
	21	Stem Length ( L Dim )	Stem Diameter	Stem MOC		
	22	Case Material	Window			
	23	Ring Style / Ring MOC				
	24	Dial Size	Scale Type			
	25	Dial Colour /Scale Colour	MOC			
	26	Range	Accuracy			
	27	External Calibration				
	28	Herm Sealed Case	Vibration Requirement			
29	Over Range Tolerance	Connector MOC				
30	Enclosure Protection					

W E L L	31	Type	Applicable Figure			
	32	Construction	Material (Thermowell / Flange)			
	33	Process Connection	Instrument Connection			
	34	Outside Diamter (OD)	Bore Diameter			
	35	Tip Diameter	Tip Thickness			
	36	Lag Length ( T Dim )	Insertion ( U Dim )			
	37	Maximum Allowable Insertion ( U Max )				
	38	Wake / Natural Frequency				
	39	Weight				
	40	Stamping				

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N O T E S	
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Form: 0606	Manufacturer:	Model:	Tag No.:
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### Coriolis Mass Flowmeter DATA SHEET

Sheetspec\_sl of spec\_sl    Rev:  
Data Sheet No: dwg\_name  
Req No: req\_no  
Po No: spec\_cmpnt\_po\_no

Rev	Description	Date	By	Ckd	Appr
	Client: udf_c61				
	Project: udf_c62				
	Project No: udf_c63				
	Location: udf_c64				
	Tag No: cmpnt_name				

G E N	1	P&ID	pid_no	
	2	Manufacturer	Model No	cmpnt_mfr_id      cmpnt_mod_id
	3	Line No	Equipment No	line_num      equip_id
	4	Line Material	Electrical Area Class	spec_ufd_c100      spec_ufd_c01
	5	Line Size (In)	Pipe Schedule	spec_ufd_c03      spec_ufd_c04

P R O C E S S  D A T A	6	Service	cmpnt_serv		
	7	Fluid	Phase	pd_fluid_name	pd_fluid_phase
	8	Corrosive	Errosive	pd_corrosive	pd_erosive
	9	Min Flow Rate	Max Flow Rate	pd_flow_min      if ( pd_flow	pd_flow_max      if ( pd_flr
	10	Norm Flow Rate		pd_flow_nor      if ( pd_flow	spec_ufd_c16
	11	Oper Temperature	Max Temperature	pd_temp_nor      pd_temp_t	pd_temp_max
	12	Oper Pressure	Max Pressure	pd_press_nor      if ( pd_pre:	pd_press_max      if ( pd_press
	13	Design Temperature	Design Pressure	pd_design to pd_design      pd_design	pd_press_des      if ( pd_press
	14	Allowable DP	Viscosity (Oper)	spec_ufd_c18	pd_visc_nor      pd_visc_uid
	15	Molecular Weight	Vapour Pressure	spec_ufd_c14	udf_c65

F L O W M E T E R	16	Specific Gravity @68 F	Specific Gravity (Oper)	pd_spec_grav_base	pd_spec_grav_nor
	17	Z-Compressibility	Sp. Heat Ratio (Cp/Cv)	pd_compres_flow_nor	spec_ufd_c02
	18	Density	spec_ufd_c06	spec_ufd_c17	spec_ufd_c15
	19	Type	Model No	spec_ufd_c19	spec_ufd_c20
	20	Flowmeter Size	Flowtube Type	spec_ufd_c21	spec_ufd_c85
	21	Connection Size	Connection Type&Rating	spec_ufd_c23	spec_ufd_c22
	22	Flow Range	Flow Accuracy	spec_ufd_c25	spec_ufd_c24
	23	Density Range	Density Accuracy	spec_ufd_c to spec_ufd_c	spec_ufd_c26
	24	Temperature Range		spec_ufd_c28	
	25	Orientation (Up/Down/Flag)		spec_ufd_c30	
	26	Housing Material	Wetted Parts Material	spec_ufd_c32	spec_ufd_c33
	27	Housing Press Rating	Flow Tube Press Rat	spec_ufd_c34	spec_ufd_c35

T R A N S M I T T E R	28	Electrical Conn Size	Electrical Area Class	spec_ufd_c36	spec_ufd_c86
	29	Ambient Temp Range	spec_ufd_c27	spec_ufd_c37	spec_ufd_c31
	30	spec_ufd_c38	spec_ufd_c29	spec_ufd_c39	spec_ufd_c52
	31	spec_ufd_c53	spec_ufd_c56	spec_ufd_c40	spec_ufd_c41
	32	Model No		spec_ufd_c70	spec_ufd_c05
	33	Location	Ambient Temperature	spec_ufd_c46	spec_ufd_c45
	34	Mounting	Enclosure Rating	spec_ufd_c47	spec_ufd_c48
	35	Power Supply	Housing Material	udf_c23	spec_ufd_c90      spec_ufd_c81
	36	Calibrated Flow Range	Calib Density Range	spec_ufd_c49	spec_ufd_c50
	37	Calibrated Temp Range		spec_ufd_c51      LookUpL	
	38	Output Options		udf_c22	spec_ufd_c82      spec_ufd_c80
	39	Analog	Frequency	spec_ufd_c55	spec_ufd_c54
	40	Digital	Communication	spec_ufd_c59	spec_ufd_c58
	41	Local Indicator	Mounting Material	spec_ufd_c60	spec_ufd_c61
	42	Electrical Connection	Electrical Wiring	spec_ufd_c62	spec_ufd_c63

M I S C	43	Certification	SIL Rating	spec_ufd_c64	spec_ufd_c65
	44	Interconnecting Cable Length		spec_ufd_c66	spec_ufd_c67
	45	spec_ufd_c84	spec_ufd_c87	spec_ufd_c68	spec_ufd_c69
	46	Mounting Hardware	Hand-held Programmer	spec_ufd_c74	spec_ufd_c88
N O T E S	47	Purge/Drain Fittings	Jacketing	spec_ufd_c77	spec_ufd_c89
	48	spec_ufd_c78	spec_ufd_c07	spec_ufd_c79      spec_ufd_c57	spec_ufd_c76      spec_ufd_c83
	spec_note				

Form: 0804	Manufacturer: LookUpDisplay(cmpnt_mfr_i	Model: LookUpDisplay(cmpnt_mod_id)	Tag No.: cmpnt_name
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### CONTROL VALVE DATA SHEET

Sheet	of	Rev:	
Data Sheet No:			
Req No:			
Po No:			
Date	By	Ckd	Appr

Client:  
Project:  
Project No:  
Location:  
Tag No:

GEN	1	Vendor	P&ID					
	2	Line No	Equipment No					
	3	Inlet Line Size/Schd	Outlet Line Size/Schd		Schd:		Schd:	
	4	Line Material	Electrical Area Class					
	5	Ambient Temperature:	Min.	Max.				
	6	Allowable Noise Level, dBA	Tightness Requirements					
	7	Design Press Max	Min	Design Temp Max	Min			
	8	Power Failure Position	Air Failure Position					
PROCESS DATA	9	Service						
	10	Fluid Name	Fluid State	Corrosive/Erosive/Toxic				
	11				Units	@ Max. Flow	@ Norm. Flow	@ Min. Flow
	12	Flow Rate						
	13	Inlet Pressure						
	14	Pressure Drop						
	15	Inlet Temperature: Max / Normal / Min Operating						
	16	Density@Oper	Sp Grav@Oper	Mol Wt				
	17	Inlet Compressibility Factor			---			
	18	Inlet Viscosity						
	19	Inlet Specific Heats Ratio (Cp/Cv)			---			
	20	Inlet Vapor Pressure						
	21	Critical Pressure						
	22	Base Temperature	Base Pressure					
	23	Maximum Shutoff DP						
CV	24	Flow Coefficient Cv			---			
	25	Travel						
	26	Sound Pressure Level			dBA			
BODY & TRIM	27	Manufacturer		POSITIONER	52	MFR	Model	
	28	Model			53	Signal: Inlet	Outlet	
	29	Body Type			54	Increase Input, Output:		
	30	Body Size	Trim Size		55	Cam Characteristic		
	31	Rated Cv	Characteris.		56	Bypass	Gauges	
	32	End Conn & Rating			57			
	33	Body Material			58			
	34	Bonnet Type	Material		SOLENOID	59	MFR	Model
	35	Flow Directn	Action to			60	Type	
	36	Lubricator	Isolat. Valve			61	When De-Enegr.Valve:	
	37	Guiding	No. of Ports		62			
	38	Trim Type			63			
	39	Rated Travel			SWITCH	64	MFR	Model
	40	Plug/Ball/Disk Material				65	Type	Quantity
	41	Seat Material				66	Contacts / Rating	
42	Cage	Stem Material		67	Contacts Close on:			
43	Special Requirements			68				
44	Packing Type	MOC		AIR	69	MFR	Model	
45	MFR	Model			70	Set Pressure		
46	Type				71	Filter	Gauge	
47	Size	Area		72	Instr. Air Supply	Min	Max	
48	Air Failure Lockup Vlv						kgf/cm2-g	
49	Handwheel Location			MISC	73	Hydro. Test		
50	Bench Range				74	Leakage		
51					75			
51				76				

NOTE

Form: 2200      Manufacturer:      Model:      Tag No.:



### On Off Valve DATA SHEET

Sheet spec\_ε of spec\_ε Rev:  
 Data Sheet No:dwg\_name  
 Req No:req\_no  
 Po No:spec\_cmpnt\_po\_no

Rev	Description	Date	By	Ckd	Appr
	Client: udf_c61				
	Project: udf_c62				
	Project No: udf_c63				
	Location: udf_c64				
	Tag No: cmpnt_name				

GEN	1	Pipe Spec	P&ID	spec_ufd_c140		pid_no					
	2	Manufacturer	Model No	cmpnt_mfr_id		cmpnt_mod_id					
	3	Line No	Equipment No	line_num		equip_id					
	4	Inlet Line Size/Schd	Outlet Line Size/Schd	line_size	line_uom	Schd:line_sche	spec_ufd_LookUpI Schd: spec_ufd_c				
	5	Line Material	Electrical Area Class	spec_ufd_c03		spec_ufd_c04					
	6	Ambient Temperature:	Max.	Min.	spec_ufd_c109	spec_ufd_c110	spec_ufd_c05				
	7	Allowable Noise Level, dBA	Leakage Class	spec_ufd_c06		pd_seat_leak					
	8	Design Press Max	Min	Design Temp Max	Min	pd_press_d	pd_press_c	if ( pd_press	pd_design_	pd_design_	pd_design_
	9	Available Air Supply Pressure:	Max.	Min.	spec_ufd_c10		spec_ufd_c08	spec_ufd_c09			
	10	Power Failure Position	Air Failure Position		pd_failure_action		spec_ufd_c53				
	11	Pipe Material	Pipe Insulation		spec_ufd_c17		spec_ufd_c18				
PROCESS DATA	12	Service		cmpnt_serv							
	13	Fluid Name	Fluid State		pd_fluid_name		pd_fluid_phase				
	14	Fluid Property(Corrosive/Toxic)		spec_ufd_c93							
	15	Maximum Shutoff DP	spec_ufd_c191		pd_max_shut_off		pd_max_shut_off	spec_ufd_c11			
	16	spec_ufd_c63	spec_ufd_c67		Units	Maximum	Normal	Minimum			
	17	Flow Rates		if ( pd_flow_uflg='	pd_flow_max	pd_flow_nor	pd_flow_min				
	18	Inlet Pressure		if ( pd_press_uflg	pd_press_ma>	pd_press_nor	pd_press_min				
	19	Pressure Drop		pd_press_drp_uic	pd_press_drp_	pd_press_drp_nor	pd_press_drp_min				
	20	Inlet Temperature: Max / Normal / Min Operating		pd_temp_uid	pd_temp_max	pd_temp_nor	pd_temp_min				
	21	Density @ Oper	Sp Grav @ Oper	Mol Mass@Oper							
	CV	22	Viscosity		pd_visc_uid	pd_visc_max	pd_visc_nor	pd_visc_min			
23		Base Liquid Gravity @ 68 F		spec_ufd_c70	spec_ufd_c75	spec_ufd_c79	spec_ufd_c83				
24		spec_ufd_c32		spec_ufd_c43	spec_ufd_c42	spec_ufd_c56	spec_ufd_c97				
25		spec_ufd_c120		spec_ufd_c121							
26		spec_ufd_c122		spec_ufd_c123		spec_ufd_c19					
BODY & TRIM	27	Manufacturer	lookupdisplay( cmpnt_mfr_id		52	Manufacturer	spec_ufd_c74				
	28	Model	lookupdisplay( cmpnt_mod_ic		53	Model	spec_ufd_c55				
	29	Body Type		cv_valve_type	54	Type	spec_ufd_c52				
	30	Body Size	Port Style	cv_valvcv_val	spec_ufd_c77	55	Tag Number	spec_ufd_c51			
	31	Body Std.		spec_ufd_c78	56	Body Material	spec_ufd_c50				
	32	End Conn & Rating		spec_ufd_c80	57	Voltage	Coil Type	spec_ufd_c47	spec_ufd_c4		
	33	Body Material		ufd_c31	58	Elec.Connection Size		spec_ufd_c49			
	34	Plug/Ball/Disk Material		spec_ufd_c82	59	Manufacturer		spec_ufd_c44			
	35	Lining Material		spec_ufd_c84	60	Model		spec_ufd_c40			
	36	Seat	Stem	spec_ufd_c85	spec_ufd_c86	61	Type		spec_ufd_c39		
	37	Req. Torque (in-lbs)		spec_ufd_c88		62	Tag Number - Closed		spec_ufd_c37		
38	Packing Type / MOC		spec_ufd_c90	spec_ufd_c72	63	Tag Number - Open		spec_ufd_c59			
39	Fire Safe STD.		spec_ufd_c89		64	Electrical Connection Size		spec_ufd_c34			
40	Torque Safety Factor		spec_ufd_c81		65	Enclosure		spec_ufd_c31			
ACTUATOR	41	Manufacturer		spec_ufd_c68	66	Position Indicator		spec_ufd_c30			
	42	Model		spec_ufd_c66	67	Air Filter Regulator		spec_ufd_c28			
	43	Type		spec_ufd_c65	68	Gauge Range		spec_ufd_c27			
	44	Valve Open/Close(Sec)	spec_ufd_c62	spec_ufd_c71	69	Solenoid Elec Area Class		spec_ufd_c26			
	45	Mounting Position		spec_ufd_c61		70	Limit Switch Elec Area Class		spec_ufd_c25		
	46	Air Connection Size		spec_ufd_c60		71	spec_ufd_c35		spec_ufd_c22		
	47	Handwheel		spec_ufd_c58		72	spec_ufd_c07		spec_ufd_c41		
	48	spec_ufd_c76		spec_ufd_c21		73	spec_ufd_c&spec_ufd_c92		spec_ufd_c3'; spec_ufd_c64		
	49	Break Torques (in-lbs)		spec_ufd_c20		74	spec_ufd_c&spec_ufd_c23		spec_ufd_c9'; spec_ufd_c24		
	50	Run Torque (in-lbs)		spec_ufd_c12		75	spec_ufd_c spec_ufd_c29		spec_ufd_c14'; spec_ufd_c38		
	51	End Torque (in-lbs)		spec_ufd_c141		76	spec_ufd_c&spec_ufd_c54		spec_ufd_c145 udf_c65		

NOTE spec\_note

Form: 2260 Manufacturer: LookUpDisplay(cmpnt\_mfr\_i) Model: LookUpDisplay(cmpnt\_mod\_id) Tag No.: cmpnt\_name





**PRESSURE SAFETY VALVE  
DATA SHEET**

Sheet	of	Rev:			
Data Sheet No:					
Req No:					
Po No:					
Rev	Description	Date	By	Ckd	Appr

GENERAL	1	Vendor	P&ID				
	2	Manufacturer	Model No				
	3	Line No.	Equip No.				
	4	Nozzle (Full, Semi)	Bonnet Type / Style				
	5	Design	Safety, Relief, Safety-Relief				
	6	Type	Conventional, Bellow, Pilot Operated				
	7	Design Press	Max	Min	Design Temp	Max	Min
	8	Line Schedule	Pipe Class	Pipe Material			
PROCESS DATA	9	Service					
	10	Fluid Name(s)	Fluid State(s)	Fluid Phase(s)			
	11	Required Capacity	Rated Relieving Capacity				
	12	Flammable / Lethal / HHM	NACE				
	13	Pressure	Max	Oper	Min		
	14	Temperature	Max	Oper	Min		
	15	Back Pressure	Superimposed Constant				
	16		Superimposed Variable				
	17		Built Up	Total			
	18	Allowable Overpress	Overpressure Factor				
	19	Set Pressure	Spring Set at				
	20	Compressibility Factor	Relieving Temperature				
	21	Latent Heat of Vap	Ratio of Spec Heats				
	22	Density @ Relieving	Sp Grav @ Relieving				
	23	Density @ Operating	Sp Grav @ Operating				
	24	Molecular Weight	Sp Grav @ Base				
	25	Relief Viscosity	Barometric Pressure				
26	ATM Pressure	MAWP					
27							
DESIGN BASIS	28	Design Code	Code Stamp				
	29	Sizing Basis					
	30	Blowdown Type	Seat Style				
	31	Calculated Area	Rupture Disk				
	32	Selected Area	Orifice Designation				
	33	Inlet Size	Outlet Size				
	34	Inlet Rating/Facing/Type					
	35	Outlet Rating/Facing/Type					
MATERIALS	36	Disc	Disc Holder				
	37	Stem	Cap				
	38	Body and Bonnet	Nozzle				
	39	Seat and Rings	Guide and Rings				
	40	Spring / Spring Washer / Stem Spindle					
	41	Bellows					
	42	Resilient Seat Seal					
	43						
MISC	44	Cap: Screwed/Bolted	Lever: Plain or Packed				
	45	Test Gag					
	46	Bonnet Vent (Bug) Screen					
	47	Noise dBA	Rated Seat Leakage Rate				
	48	Reactive Force	Spring Range				
NOTES							

Form: 2301	Manufacturer:	Model:	Tag No.:
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**TEMP ELEMENT TC OR RTD  
DATA SHEET**

Sheet of Rev:  
Data Sheet No:  
Req No:  
Po No:

Rev	Description	Date	By	Ckd	Appr
Client:					
Project:					
Project No:					
Location:					
Tag No:					

GENERAL	1	Vendor	P&ID						
	2	Manufacturer	Model No						
	3	Line No	Equipment No						
	4	Enclosure Type	Electrical Area Class						
	5	Line Size	Pipe Class						
	6	Line/ Vessel Trim MOC	Line Sch.						
	7	Nozzle Projection	Nozzle ID	Nozzle MOC					
	8	Insulation Code	Insulation Thk.						
	9	Approvals/ Certification	Ambient Temp (Min/Max)						
	10	Complete Assembly Model Number							
PROCESS	11	Service							
	12	Fluid	State	Spec Grav/ Density @ Oper					
	13	Pressure (Design)	Max	Min					
	14	Temperature (Design)	Max	Min					
	15	Pressure	Max	Nor	Min				
	16	Temperature	Max	Nor	Min				
	17	Flow	Max	Nor	Min				
	18	Velocity	Viscosity (cP)						
	19	Vibrations	Oxidizing Atm.	Corrosive	Toxic	Erosive			
ELEMENT	20	Element Type	Single / Double						
	21	Grounded/ Unground							
	22	Type	Standard Code						
	23	Wire Size	Insulation	Spring Load					
	24	Sheath Material	Sheath Dia.						
	25	Tolerance Class							
	26	Instrument Connection							
	27	Element Length	Electrical Connection						
HEAD	28	Transmitter Mounting Type							
	29	N-U-N Type	N-U-N Length						
	30	Electrical Connection	Terminal Block						
	31	Enclosure	Enclosure Protection						
	32								
	33								
	34								
	35								
	36								
WELL	37	Type							
	38	Process Connection	Applicable Figure						
	39	Tip Diameter	Root Diameter	Bore Diameter					
	40	Material	Construction Type						
	41	Flange Material	Instrument Connection						
	42	Probe Length (U dim)	Max Calc-d U Allowed						
	43	Overall Length	Lagging Extension						
	44	Plug & Chain							
	45	Stamping	Weight						
	NOTES	46	Full Penetration Weld						
47		Tag No. (Thermowell)							

Form: 2600      Manufacturer:      Model:      Tag No.:



## Orifice Plate DATA SHEET

Sheet _____ of _____	Rev: _____
Data Sheet No: _____	
Req No: _____	
Po No: _____	

	Rev	Description	Date	By	Ckd	Appr
Client:						
Project:						
Project No:						
Location:						
Tag No:						

G E N	1	P&ID			
	2	Manufacturer	Model No		
	3	Line No	Equipment No		
	4	Inlet Line Size/Schd	Outlet Line Size/Schd	Schd:	Schd:
	5	Inlet Line Material	Outlet Line Material		

P R O C E S S  D A T A	6	Service				
	7	Fluid	Phase			
	8	Corrosive	Erosive			
	9		Units	@ Min Flow	@ Norm Flow	@ Max Flow
	10	Flow Rate				
	11	Inlet Pressure				
	12	Allowable Pressure Drop				
	13	Temperature				
	14	Design Pressure	Design Temperature	to		
	15	Vapour Pressure	Visc @ Oper Temp			
16	Specific Gravity @68 °F	SG @ Oper Temp				
17	Sp Heat Ratio (Cp/Cv)	Compressibility (Z)				
18	Barometric Pressure	Base Temperature				
19	Steam Quality	Superheated				
20	Mol. Wt.	Density				



F L A N G E S / T A P S	21	Flange Size	Flange Rating, Finish		
	22	Flange Type	Flange Material		
	23	Ring Type	Ring Material		
	24	Tap Orientation	Tap Type		
	25	Gasket Material	Tap Size		
	26	Flange Supplied By	Orifice Flange STD		
	27	Tap Quantity			

P L A T E	28	Type			
	29	Reference Standard			
	30	Vent or Drain Hole			
	31	Plate Material	Plate Thickness		
	32	Bore Type	To Nearest		
	33	Bore Diameter	Pipe ID		
	34	Beta Ratio ( d / D )	Plate Finish		
	35	Flow Full Scale			
36	Differential Pressure @ Full Scale				
37					
38					

M I S C	39	Meter Run / Orifice Fitting: Tag No			
	40	Data Sheet No			
	41				
	42				
	43				
	44	Flow Instrument / Meter:	Tag No		
	45	Data Sheet No			
	46	Calibration Range	to		
47	System Range	to			
48					

N O T E S					
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Code: 09001	Manufacturer:	Model:	Tag No.:
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  <b>IndianOil</b>	<b>DESIGN DATA SHEET AVERAGING PITOT TUBES</b>			DOC . NO.	
				REQN. NO.	
				SHEET	
				APPD BY	
				CHKD BY	
			PRPD BY		
			DATE		
			ISSUE		
Supplier : *					
GENERAL	1	Item No.			
	2	Tag No.			
	3	Quantity			
	4	PID No.			
	5	Line No.	SCH		
	6	Line I.D.	Line O.D.		
	7	Service			
	8	Pipe Material			
ANNUBAR FLOW ELEMENT	9	Type			
	10	Installation			
	11	Material			
	12	Process Connection			
	13	Inst. Tap Connection			
	14	Process Isolating Valve Type			
	15	Process Isolating Valve Size and Rating			
	16	Valve Body Material /Trim material			
	17	flange material			
	18	Probe material			
	19	Close & Cage Nipple Material			
	20	Packing Material			
	21	Accuracy			
	22	Repeatability			
	23	Permissible pressure loss			
	24	Double Mounting Materials			
METER	25	Type			
	26	Meter Range (kg/hr)			
	27	Meter Diff. Range			
	28	Transmitter scope of supply			
OPTIONS	29	Safety Chain			
	30	Insert Retract Mechanism			
	31	End Support			
	32	Material			
	33	Weld Coupling	Size	Mtl.	
	34	Support Plug	Size	Mtl.	
	35	Extension			
	36	Material			
	37	Length			
	38	Purging			
	39				
	40				
SERVICE CONDITIONS	41	Fluid and State			
	42	Flow	Min.	Max.	
	43	Flow Normal			
	44	Inlet Pressure (kg/cm2a)			
	45	Temp.C	Oper.	Max.	
	46	Specific Gravity			
	47	Mol Wt.		Cp/Cv	
	48	Viscosity (mPa.s)			
	49	Velocity (m/s)			
	50	Compressibility Factor			
	51	Max Permissible pressure loss			
52	Model No.				
<b>Note :</b> 1) *** : Vendor to advise					





**DESIGN DATA SHEET FOR GAS DETECTORS (H2)**

Data Sheet . No.

REQN. No.

SHEET

APPD BY

CHKD BY

PRPD BY

DATE

ISSUE

A

Project No .

Client

Indian Oil Corporation Limited

Location

Plant

**General**

1	Tag No.	Qty
2	Make	
3	Model No.	
4	Service	
5	Area classification	
6	Line No	Equipment No Location
7	P & ID No	
8	Major Constituents	
9	Gas Molecular Weight	
10	Lower Explosive Limit (LEL)	(%V/V in Air)
11	Operating Range	Component Mol %
12	Alarm Set Point	
13	Pre Alarm	
14	20 % LEL (Pre Alarm)	60% LEL
15		
16		
17		



**Sensor**



18	Sensor Type	
19	Gas to be Analysed	
20	Construction	
21	Filter	
22		

**Transmitter**

23	Transmitter Type	
24	Power Supply	
25	Protection	
26	MOC of Enclosure	
27	Range	
28	Output	
29	Accuracy	
30	Response Time	
31	Self Diagnostic Facility	
32	Auto Calibration	
33	Cable Entry	
34	Intrinsic safe to specified area	
35	Enclosure	
36	Certificate	
37	Dust cover / weather protection	
38	Mounting	
39	Cable B/W Detector & Transmitter	
40		

**Notes :** 1) VTS : VENDOR TO SPECIFY  
2) N.A. :- NOT APPLICABLE

  <b>IndianOil</b>	<b>DESIGN DATA SHEET FOR GAS DETECTORS (H2S)</b>			Data Sheet . No.		
				REQN. No.		
	Project No .			SHEET		20 OF 23
	Client			APPD BY		
Location			CHKD BY			
Plant			PRPD BY			
			DATE			
			ISSUE			
<b>General</b>	1	Tag No.	Qty			
	2	Make				
	3	Model No.				
	4	Service				
	5	Area classification				
	6	Line No	Equipment No	Location		
	7	P & ID No				
	8	Major Constituents				
	9	Gas Molecular Weight				
	10	Lower Explosive Limit (LEL)		(%V/V in Air)		
	11	Operating Range	Component	Mol %		
	12	Alarm Set Point				
	13	Pre Alarm				
	14	20 % LEL (Pre Alarm)	60% LEL			
	15	HIGH HIGH ALARM				
	16					
	17					
<b>Sensor</b>	18	Sensor Type				
	19	Gas to be Analysed				
	20	Construction				
	21	Filter				
	22					
	23	Transmitter Type				
<b>Transmitter</b>	24	Power Supply				
	25	Protection				
	26	MOC of Enclosure				
	27	Range				
	28	Immunity to Catalytic Poisoning				
	29	Output				
	30	Accuracy				
	31	Response Time				
	32	Self Diagnostic Facility				
	33	Auto-Calibration				
	34	Cable Entry				
	35	Intrinsic safe to specified area				
	36	Enclosure				
	37	Certificate				
	38	Dust cover / weather protection				
	39	Mounting				
	40	Cable B/W Detector & Transmitter				
	41					
<b>Notes :</b> 1) VTS : VENDOR TO SPECIFY 2) N.A. :- NOT APPLICABLE						

  <b>IndianOil</b>	<b>DESIGN DATA SHEET FOR GAS DETECTORS (HC)</b>			Data Sheet . No.		
				REQN. No.		
	Project No .			SHEET		
	Client			APPD BY		
Location			CHKD BY			
Plant			PRPD BY			
			DATE			
			ISSUE			
<b>General</b>	1	Tag No.	Qty			
	2	Make				
	3	Model No.				
	4	Service				
	5	Area classification				
	6	Line No	Equipment No	Location		
	7	P & ID No				
	8	Major Constituents				
	9	Gas Molecular Weight				
	10	Lower Explosive Limit (LEL)		(%V/V in Air)		
	11	Operating Range	Component	Mol %		
	12	Alarm Set Point				
	13	Pre Alarm				
	14	20 % LEL (Pre Alarm)	60% LEL			
	15					
	16					
	17					
<b>Sensor</b>	18	Sensor Type				
	19	Gas to be Analysed				
	20	Construction				
	21	Filter				
	22					
	23	Transmitter Type				
<b>Transmitter</b>	24	Power Supply				
	25	Protection				
	26	MOC of Enclosure				
	27	Range				
	28	Immunity to Catalytic Poisoning				
	29	Temperature Compensation				
	30	Output				
	31	Accuracy				
	32	Response Time				
	33	Self Diagnostic Facility				
	34	Auto Calibration				
	35	Cable Entry				
	36	Intrinsic safe to specified area				
	37	Enclosure				
38	Certificate					
39	Dust cover / splash guard / weather protection					
40	Mounting					
41	Cable B/W Detector & Transmitter					
42						
<b>Notes :</b> 1) VTS : VENDOR TO SPECIFY 2) N.A. :- NOT APPLICABLE						

## INDICATIVE INSPECTION &amp; TEST PLAN\*\*

SHEET 1 OF 1

Project: 44AC9100 – Acrylic / Oxo Alcohol Project at Gujarat Refinery, Dumad

EQUIPMENT / ITEM DESCRIPTION : **LEVEL INSTRUMENT / TRANSMITTERS**VENDOR :  
P.O. NO. :EQUIPMENT / ITEM TAG NO. :  
TEST & INSPECTION AS PER :  
(CODES & SPECIFICATIONS) :PR/PS NO.  
DRG. NO.

A C T I V I T Y	1				1	WITNESS INSPECTION AND / OR DOCUMENT REVIEW BY OWNER / PMC.
	2				2	WITNESS INSPECTION AND / OR DOCUMENT REVIEW BY THIRD PARTY INSPECTION AGENCY (TPIA) NOMINATED BY LSTK / STATUTORY AUTHORITY.
	3				3	WITNESS INSPECTION BY SUB VENDOR, VENDOR & LSTK CONTRACTOR.
	4				4	CERTIFICATES / DATA TO BE SUBMITTED BY LSTK CONTRACTOR / VENDOR FOR APPROVAL / REVIEW BY TPIA / OWNER / PMC.
1	A	A	R	X		Detailed inspection & test plan after issue of PO/PR/PS.
2	R	A	R	X		Inspection & test procedures.
3	-	R	R	X		Summary of all supplementary requirements as specified in the PO/PR/PS.
4	-	R	A	X		Packing procedure / shipping drawing of completed equipment.
5	-	H	P	X		Routine test consists of: – Dimensional check/general workmanship. – Checking of name plate, tag nos., calibration range, Certification Label check. – Correctness of flange/process connection (100%). – Checking of supply of accessories, IBR marking. – Requirement of enclosure protection / area classification. cable entry type and size. .
6	-	H	P	X		Performance & acceptance test consisting of: – Calibration check at different range. – Functional check repeatability, hysteresis, functional check of other in-built items. – PMI Test, hydrotest on random basis. – Power supply variation check, IR/ HV Test, Load Test at 24 Volts DC and reverse Polarity Test – any other tests as per PR/PS.
7	H	H	W	X		Closeout of Concession Request (CR) / Non-Conformance Notice (NCN).
8	-	H	P	X		Spares & packing list check. packing & loading of equipment as per shipping drawing.
9	R	R	R	X		Review of documents as below: – Internal test & calibration certificate (100%), PMI Report (100%) etc – Calibration report of all measuring instruments. – Material test certificate for all wet components, flange including accessories. – Degree of Protection, Certificates as following for Statutory Requirements to be submitted: <b>Imported:</b> ATEX + CCOE <b>Indigenous:</b> CMRS/ BIS + CCOE.
10	R	H	H	-		Inspection Release Certificate (IRC) by TPIA.

LEGENDS: P – PERFORM, H - HOLD, W – WITNESS, R – REVIEW, A - APPROVAL, I – INFORMATION, X – SUBMIT  
PO – PURCHASE ORDER, PR – PURCHASE REQUISITION, PS – PURCHASE SPECIFICATION

\*\* NOTE : THIS IS AN INDICATIVE INSPECTION AND TEST PLAN IDENTIFYING SCOPE OF INSPECTION /REVIEW OF DOCUMENTS AS A MINIMUM REQUIREMENT, DETAILED INSPECTION AND TEST PLAN INDICATING ALL SPECIFIED REQUIREMENTS AFTER ISSUE OF PO / PR TO BE GENERATED BY LSTK / VENDOR / SUB-VENDOR AND SAME DULY VETTED BY TPIA TO BE SUBMITTED TO OWNER/PMC FOR REVIEW AND APPROVAL.

\* TPIA TO CARRY OUT INSPECTION AT SUB-VENDORS' WORKS.

OWNER / PMC RESERVES RIGHT TO WITNESS INSPECTION OF ANY ITEM AT ANY STAGE WHICH SHALL BE INDICATED ON INSPECTION & TEST PLAN / QAP AT THE TIME OF APPROVAL AND SAME TO BE COVERED AS PART OF PURCHASE ORDER CONDITION ISSUED BY LSTK CONTRACTOR.

## INDICATIVE INSPECTION &amp; TEST PLAN\*\*

Project: 44AC9100 – Acrylic / Oxo Alcohol Project at Gujarat Refinery, Dumad

SHEET 1 OF 1

EQUIPMENT / ITEM DESCRIPTION : FLOW INSTRUMENTS

VENDOR :  
P.O. NO. :EQUIPMENT / ITEM TAG NO. :  
TEST & INSPECTION AS PER :  
(CODES & SPECIFICATIONS) :PR/PS NO.  
DRG. NO.

A C T I V I T Y	1	WITNESS INSPECTION AND / OR DOCUMENT REVIEW BY OWNER / PMC.			
	2	WITNESS INSPECTION AND / OR DOCUMENT REVIEW BY THIRD PARTY INSPECTION AGENCY (TPIA) NOMINATED BY LSTK / STATUTORY AUTHORITY.			
	3	WITNESS INSPECTION BY SUB VENDOR, VENDOR & LSTK CONTRACTOR.			
	4	CERTIFICATES / DATA TO BE SUBMITTED BY LSTK CONTRACTOR / VENDOR FOR APPROVAL / REVIEW BY TPIA / OWNER / PMC.			
1	A	A	R	X	Detailed inspection & test plan after issue of PO/PR/PS.
2	R	A	R	X	Inspection & test procedures.
3	-	R	R	X	Summary of all supplementary requirements as specified in the PO/PR/PS.
4	-	R	A	X	Packing procedure / shipping drawing of completed equipment.
5	-	H	P	X	Routine test consists of: – Dimensional check / general workmanship – Checking of name plate, tag. nos., calibration range, Marking and Traceability, flow direction, certification label etc – Correctness of flange / process connection, sr. nos. requirement of enclosure protection / area classification – Check for supply of accessories; IBR markings verification etc
6	-	H	P	X	Performance & acceptance test consisting of: – Calibration check at different range and at operating range, hysteresis, repeatability, linearity – Over range protection – Hydro test on random basis, PMI Test – any other tests as per PR/PS
7	H	H	W	X	Closeout of Concession Request (CR) / Non-Conformance Notice (NCN).
8	-	H	P	X	Spares & packing list check. packing & loading of equipment as per shipping drawing.
9	R	R	R	X	Review of documents as below: – Internal test & calibration certificate (100%) – NDT Reports (if required by spec), PMI report – Calibration report of all instruments – Material test certificates; IBR certificate – Degree of Protection, Certificates as following for Statutory Requirements to be submitted: <b>Imported:</b> ATEX + CCOE <b>Indigenous:</b> CMRS/ BIS + CCOE.
10	R	H	H	-	Inspection Release Certificate (IRC) by TPIA.

LEGENDS: P – PERFORM, H - HOLD, W – WITNESS, R – REVIEW, A - APPROVAL, I – INFORMATION, X – SUBMIT  
PO – PURCHASE ORDER, PR – PURCHASE REQUISITION, PS – PURCHASE SPECIFICATION

\*\* NOTE : THIS IS AN INDICATIVE INSPECTION AND TEST PLAN IDENTIFYING SCOPE OF INSPECTION /REVIEW OF DOCUMENTS AS A MINIMUM REQUIREMENT, DETAILED INSPECTION AND TEST PLAN INDICATING ALL SPECIFIED REQUIREMENTS AFTER ISSUE OF PO / PR TO BE GENERATED BY LSTK / VENDOR / SUB-VENDOR AND SAME DULY VETTED BY TPIA TO BE SUBMITTED TO OWNER/PMC FOR REVIEW AND APPROVAL.

\* TPIA TO CARRY OUT INSPECTION AT SUB-VENDORS' WORKS.

OWNER / PMC RESERVES RIGHT TO WITNESS INSPECTION OF ANY ITEM AT ANY STAGE WHICH SHALL BE INDICATED ON INSPECTION & TEST PLAN / QAP AT THE TIME OF APPROVAL AND SAME TO BE COVERED AS PART OF PURCHASE ORDER CONDITION ISSUED BY LSTK CONTRACTOR.

**INDICATIVE INSPECTION & TEST PLAN\*\***

**Project: 44AC9100- EPCM / PMC Services for Acrylic / Oxo Alcohol Project at Gujarat Refinery, Dumad**

EQUIPMENT / ITEM DESCRIPTION: <b>TEMPRATURE GAUGE WITH THERMOWELL</b>	VENDOR: P.O. NO:
EQUIPMENT / ITEM TAG NO: TEST & INSPECTION AS PER: (CODES & SPECIFICATIONS):	PR/PS NO. DRG. NO.

A C T I V I T Y	1	WITNESS INSPECTION AND / OR DOCUMENT REVIEW BY OWNER / PMC/ EPCM			
	2	WITNESS INSPECTION AND/ OR DOCUMENT REVIEW BY THIRD PARTY INSPECTION AGENCY (TPIA) / STATUTORY AUTHORITY.			
	3	WITNESS INSPECTION BY SUB VENDOR, VENDOR AND/ OR LSTK			
	4	CERTIFICATES / DATA TO BE SUBMITTED BY VENDOR FOR APPROVAL / REVIEW BY TPIA / LSTK/ EPCM/ PMC/ OWNER			
1	A	A	R	X	Detailed inspection & test plan after issue of PO/PR/PS.
2	R	A	R	X	Inspection & test procedures.
3	-	R	R	X	Summary of all supplementary requirements as specified in the PO/PR/PS.
4	-	R	A	X	Packing procedure / shipping drawing of completed equipment.
5	R	R	P	X	NDT (RT, UT, MT etc as specified) examination records
6	R	H	P	X	Routine test consists of: <ul style="list-style-type: none"> <li>- Dimensional check/general workmanship.</li> <li>- Checking of name plate, tag no./Model no./Cat no. calibration range.</li> <li>- Correctness of flange/process connection.</li> <li>- Requirement of enclosure protection/area</li> <li>- Classification. check IBR no. and marking. (As applicable)</li> </ul>
7	R	H	P	X	Performance & acceptance test consisting of: <ul style="list-style-type: none"> <li>- Calibration check at different range and at operating range, hysteresis, repeatability, linearity.</li> <li>- Hydro test on random basis. (Internal &amp; External)</li> <li>- Weld Soundness of Thermowell to Flange join (Dye penetrant Test)</li> <li>- PMI Test on SS, AS material</li> <li>- Over range Protection</li> <li>- any other tests as per PR/PS</li> </ul>
8	R	R	R	X	Review of documents as below: <ul style="list-style-type: none"> <li>- Internal test &amp; calibration certificate (100%).</li> <li>- Bore Concentricity Check for Thermowells</li> <li>- NDT Reports</li> <li>- Calibration report of all measuring instruments.</li> <li>- Degree of Protection,</li> <li>- Material test certificate/IBR certificates for all wet components/flanges. enclosure protection.</li> </ul>
9	H	H	W	X	Closeout of Concession Request (CR) / Non-Conformance Notice (NCN).
10	-	H	P	X	Spares & packing list check. packing & loading of equipment as per shipping drawing.
11	R	H	H	X	Inspection Release Certificate (IRC) by TPIA including IBR items (TPIA to highlight pending site activities exclusively in IRC prior to its release)
12	H	-	-	X	Shipping authorization/ Despatch instructions by WORLEY after review of IRC & reports per approved ITP

**INDICATIVE INSPECTION & TEST PLAN\*\***

**Project:** 44AC9100- EPCM / PMC Services for Acrylic / Oxo Alcohol Project at Gujarat Refinery, Dumad

EQUIPMENT / ITEM DESCRIPTION: <b>TEMPRATURE GAUGE WITH THERMOWELL</b>		VENDOR: P.O. NO:
EQUIPMENT / ITEM TAG NO: TEST & INSPECTION AS PER: (CODES & SPECIFICATIONS):		PR/PS NO. DRG. NO.
A C T I V I T Y	1	WITNESS INSPECTION AND / OR DOCUMENT REVIEW BY OWNER / PMC/ EPCM
	2	WITNESS INSPECTION AND/ OR DOCUMENT REVIEW BY THIRD PARTY INSPECTION AGENCY (TPIA) / STATUTORY AUTHORITY.
	3	WITNESS INSPECTION BY SUB VENDOR, VENDOR AND/ OR LSTK
	4	CERTIFICATES / DATA TO BE SUBMITTED BY VENDOR FOR APPROVAL / REVIEW BY TPIA / LSTK/ EPCM/ PMC/ OWNER

**LEGENDS: H - HOLD, W – WITNESS, R – REVIEW, A - APPROVAL, I – INFORMATION, X – SUBMIT  
PO – PURCHASE ORDER, PR – PURCHASE REQUISITION, PS – PURCHASE SPECIFICATION**

**\*\* NOTE:**

- THIS IS AN INDICATIVE INSPECTION AND TEST PLAN IDENTIFYING SCOPE OF INSPECTION /REVIEW OF DOCUMENTS AS A MINIMUM REQUIREMENT, DETAILED INSPECTION AND TEST PLAN INDICATING ALL SPECIFIED REQUIREMENTS AFTER ISSUE OF PO / PR TO BE GENERATED BY VENDOR / SUB-VENDOR AND SAME DULY VETTED BY TPIA / LSTK (AS APPLICABLE) TO BE SUBMITTED TO OWNER/ PMC/ EPCM FOR REVIEW AND APPROVAL.
- TPIA TO ENSURE ALL DRAWINGS/ DATASHEETS/ ITP ARE APPROVED IN CODE-1 PRIOR TO FINAL INSPECTION.

OWNER / WORLEY RESERVES RIGHT TO WITNESS INSPECTION OF ANY ITEM AT ANY STAGE WHICH SHALL BE INDICATED ON QAP / INSPECTION & TEST PLAN AT THE TIME OF APPROVAL AND SAME TO BE COVERED AS PART OF PURCHASE ORDER CONDITION ISSUED BY OWNER / LSTK. VENDOR SHALL SUBMIT CONCESSION REQUEST AND NCR TO WORLEY FOR FINAL APPROVAL PRIOR TO ACTION ON ANY DEVIATION. CONCESSION REQUEST AND NCR SHALL BE CLOSED BY TPIA/ LSTK/ WORLEY

**INDICATIVE INSPECTION & TEST PLAN\*\***

**Project: 44AC9100- EPCM / PMC Services for Acrylic / Oxo Alcohol Project at Gujarat Refinery, Dumad**

EQUIPMENT / ITEM DESCRIPTION: <b>CABLE TRAY</b>	VENDOR: P.O. NO:
EQUIPMENT / ITEM TAG NO: TEST & INSPECTION AS PER: (CODES & SPECIFICATIONS):	PR/PS NO. DRG. NO.

A P P R O V E D	1	WITNESS INSPECTION AND / OR DOCUMENT REVIEW BY OWNER / PMC/ EPCM			
	2	WITNESS INSPECTION AND/ OR DOCUMENT REVIEW BY THIRD PARTY INSPECTION AGENCY (TPIA) / STATUTORY AUTHORITY.			
	3	WITNESS INSPECTION BY SUB VENDOR, VENDOR AND/ OR LSTK			
	4	CERTIFICATES / DATA TO BE SUBMITTED BY VENDOR FOR APPROVAL / REVIEW BY TPIA / LSTK/ EPCM/ PMC/ OWNER			
1	A	A	R	X	Detailed inspection & test plan after issue of PO/PR/PS
2	A	A	R	X	Inspection & test procedures.
3	R	R	R	X	Summary of all supplementary requirements as specified in the PO/PR/PS
4	R	R	A	X	Packing procedure / shipping drawing of completed equipment
5	R	W	W	X	Routine & Acceptance Test: - Visual Check of workmanship - Galvanizing Coating thickness, - Uniformity of coating, adhesion - test & mass of coating & dimensional check etc. - Quantity - Load test. - Check of Fasteners/ hardware Any other test as per PO/PR/SPEC
6	R	R	W	X	Review of documents as below: - Internal test reports - Material Certificates- Chemical Analysis, Physical Properties - Fasteners/ hardware Test certificates - Test for Flameproofers (CCOE/PESO & CIMFR/ATEX etc. certificates Calibration report of all instruments used for testing
7	R	W	H	X	Spares & packing list check. Packing & loading of equipment as per shipping drawing.
8	H	H	H	X	Clearance of Concession Request (CR) and Non-Conformance Notice (NCN) prior to final inspection.
9	R	H	H	X	Inspection Release Certificate (IRC) by TPIA. (TPIA to highlight pending site activities exclusively in IRC prior to its release)
10	H	-	-	X	Shipping authorization/ Despatch instructions by WORLEY after review of IRC & reports per approved ITP

**LEGENDS: H - HOLD, W – WITNESS, R – REVIEW, A - APPROVAL, I – INFORMATION, X – SUBMIT  
PO – PURCHASE ORDER, PR – PURCHASE REQUISITION, PS – PURCHASE SPECIFICATION**

**\*\* NOTE:**  
1. THIS IS AN INDICATIVE INSPECTION AND TEST PLAN IDENTIFYING SCOPE OF INSPECTION /REVIEW OF DOCUMENTS AS A MINIMUM REQUIREMENT, DETAILED INSPECTION AND TEST PLAN INDICATING ALL SPECIFIED REQUIREMENTS AFTER ISSUE OF PO / PR TO BE GENERATED BY VENDOR / SUB-VENDOR AND SAME DULY VETTED BY TPIA / LSTK (AS APPLICABLE) TO BE SUBMITTED TO OWNER/ PMC/ EPCM FOR REVIEW AND APPROVAL.  
2. TPIA TO ENSURE ALL DRAWINGS/ DATASHEETS/ ITP ARE APPROVED IN CODE-1 PRIOR TO FINAL INSPECTION.

OWNER / WORLEY RESERVES RIGHT TO WITNESS INSPECTION OF ANY ITEM AT ANY STAGE WHICH SHALL BE INDICATED ON QAP / INSPECTION & TEST PLAN AT THE TIME OF APPROVAL AND SAME TO BE COVERED AS PART OF PURCHASE ORDER CONDITION ISSUED BY OWNER / LSTK. VENDOR SHALL SUBMIT CONCESSION REQUEST AND NCR TO WORLEY FOR FINAL APPROVAL PRIOR TO ACTION ON ANY DEVIATION. CONCESSION REQUEST AND NCR SHALL BE CLOSED BY TPIA/ LSTK/ WORLEY





**QUALITY ASSURANCE PLAN  
FOR  
INSTRUMENT FITTING AND MANIFOLDS**



Sl. No.	Stage Description	Type of Check	Reference Document	Acceptance Criteria	Verifying Document	Inspection			Remark
						Manufacterurer	TPI	PMC/ Owner	
1	Positive Material Identification	Chemical Analysis for SS and AS fittings	Purchase Requisition/ Applicable code	Applicable material code	Test certificate	H	W	R	Witness at Random
2	Traceability Verification	Verification of marking and stamping	Purchase Requisition/ Applicable code	Full compliance to Purchase Requisition/ Applicable code/ 100% stamping by Inspector	Inspection report	H	W	R	Witness at Random
3	Pressure Test	Pressure Test	Purchase Requisition/ Applicable code	Purchase Requisition/ Applicable code	Pressure Test Report	H	R	R	
4	Visual & Dimensional	Visual & Dimensional examination	Purchase Requisition/ Applicable code	Purchase Requisition/ Applicable code	Vendor certificate	H	W	R	Extent :- 10% of each type & size at random
5	Review of Manufacturer's Test Certificates	Review of Manufacturer Test Certificate	Purchase Requisition/ Applicable code	Applicable material code	Material Certificate	H	R	R	



**QUALITY ASSURANCE PLAN  
FOR  
INSTRUMENT FITTING AND MANIFOLDS**



Sl. No.	Stage Description	Type of Check	Reference Document	Acceptance Criteria	Verifying Document	Inspection		Remark
						Manufacter	TPI	
6	Preservation & Packing	Preservation & Packing	Purchase Requisition	Full compliance to Purchase Requisition	Preservation Report and Packing list	H	R	Check of lifting arrangement, cleanliness, protection, marking, name plate, packing condition and quantity
7	Inspection Record Book	Review of Inspection Record Book	Purchase Requisition	Full compliance to Purchase Requisition	Inspection Record Book	H	R	
8	Final Inspection	Issue of Release Note	Purchase Requisition	Confirmation of all required inspection	Inspection Record Book	H	R	

**NOTES:**

- 1) Requirements of Purchase Requisition shall govern, wherever more stringent than this QAP
- 2) Comments on Purchase Requisition, having an impact on Inspection & Testing will be followed.
- 3) For IBR items, Availability of IBR related documents shall also be checked by TPI.

**LEGEND: H - HOLD POINT;  
W - WITNESS; ; R - REVIEW OF DOCUMENTS;  
S - SURVEILLANCE;**

Please refer Notes on page 54



**QUALITY ASSURANCE PLAN  
FOR  
INSTRUMENT TUBES**



Sl. No.	Stage Description	Type of Check	Reference Document	Acceptance Criteria	Verifying Document	Inspection			Remark
						Manufacterurer	TPI	PMC/ Owner	
1	Positive Material Identification	Chemical Analysis for SS and Copper Tubes	Purchase Requisition/ Applicable code	Applicable material code	Test certificate	H	W	R	Witness at Random
2	Traceability Verification	Verification of marking and stamping	Purchase Requisition/ Applicable code	Full compliance to Purchase Requisition/Applicable code/ 100% stamping by Inspector	Inspection report	W	W	R	Witness at Random
3	Ball Test & Pneumatic test	Ball pass & Pneumatic Test for Copper Tubes	Purchase Requisition	No obstruction	Test Report	H	W	R	Extent :- 100%
4	Visual & Dimensional	Visual & Dimensional examination	Purchase Requisition/ Applicable code	Purchase Requisition/ Applicable code	Vendor certificate	H	W	R	Extent :- 10% of each type & size at random
5	Review of Manufacturer's Test Certificates	Review of Manufacturer's Test Certificates/Check Test for Chemical Properties and hardness	Purchase Requisition/ Applicable code	Applicable material code	Material Certificate	H	R/W	R	Hardness to be witnessed by TPI
6	Pressure Test	Pressure Test	Purchase Requisition/ Applicable code	Purchase Requisition/ Applicable code	Pressure Test Report	H	R	R	



**QUALITY ASSURANCE PLAN  
FOR  
INSTRUMENT TUBES**



Sl. No.	Stage Description	Type of Check	Reference Document	Acceptance Criteria	Verifying Document	Inspection			Remark
						Manufacter	TPI	PMC/ Owner	
7	Preservation & Packing	Preservation & Packing	Purchase Requisition	Full compliance to Purchase Requisition	Preservation Report and Packing list	H	R	R	Check of lifting arrangement, cleanliness, protection, marking, name plate, packing condition and quantity
8	Inspection Record Book	Review of Inspection Record Book	Purchase Requisition	Full compliance to Purchase Requisition	Inspection Record Book	H	R	R	
9	Final Inspection	Issue of Release Note	Purchase Requisition	Confirmation of all required inspection	Inspection Record Book	H	H	R	

**NOTES:**

- 1) Requirements of Purchase Requisition shall govern, wherever more stringent than this QAP
- 2) Comments on Purchase Requisition, having an impact on Inspection & Testing will be followed.

Please refer Notes on page 54

**LEGEND: H - HOLD POINT;  
W - WITNESS; ; R - REVIEW OF DOCUMENTS;  
S - SURVEILLANCE;**

## INDICATIVE INSPECTION &amp; TEST PLAN\*\*

Project: 44AC9100 – Acrylic / Oxo Alcohol Project at Gujarat Refinery, Dumad

SHEET 1 OF 2

EQUIPMENT / ITEM DESCRIPTION : <b>INSTRUMENT CABLES</b>					VENDOR :
EQUIPMENT / ITEM TAG NO. :					P.O. NO. :
TEST & INSPECTION AS PER :					PR/PS NO.
(CODES & SPECIFICATIONS) :					DRG. NO.
A C T I V I T Y	1				1 WITNESS INSPECTION AND / OR DOCUMENT REVIEW BY OWNER / PMC.
	2				2 WITNESS INSPECTION AND / OR DOCUMENT REVIEW BY THIRD PARTY INSPECTION AGENCY (TPIA) NOMINATED BY LSTK / STATUTORY AUTHORITY.
	3				3 WITNESS INSPECTION BY SUB VENDOR, VENDOR & LSTK CONTRACTOR.
	4				4 CERTIFICATES / DATA TO BE SUBMITTED BY LSTK CONTRACTOR / VENDOR FOR APPROVAL / REVIEW BY TPIA / OWNER / PMC.
1	A	A	R	X	Detailed inspection & test plan after issue of PO/PR/PS.
2	R	A	R	X	Inspection & test procedures.
3	-	R	R	X	Summary of all supplementary requirements as specified in the PO/PR/PS.
4	-	R	A	X	Packing procedure / shipping drawing of completed equipment.
5	-	R	P	X	Routine test consist of : <ul style="list-style-type: none"> <li>- Visual test inclusive of cable marking &amp; pair/core identification, insulation colors etc.</li> <li>- Insulation test,</li> <li>- High Voltage,</li> <li>- Conductor Resistance,</li> <li>- Thermal Emf,</li> <li>- L/R ratio,</li> <li>- Capacitance,</li> <li>- Armor test</li> <li>- any other test as per PR/PS</li> </ul>
6	-	H	P	X	Acceptance test : (One Sample from each size & type) <ul style="list-style-type: none"> <li>- Conductor resistance test</li> <li>- Visual test inclusive of cable marking &amp; pair/core identification, insulation colors etc.</li> <li>- Annealing test (for copper)</li> <li>- Test for thickness of insulation &amp; sheath</li> <li>- Tensile strength &amp; elongation at break test for insulation and sheath</li> <li>- High voltage test</li> <li>- Insulation resistance test (volume resistivity) test</li> <li>- Capacitance</li> <li>- L/R ratio</li> <li>- Drain wire resistance</li> <li>- Thermal EMF for thermocouple Extension cables</li> <li>- Continuity Test</li> <li>- Attenuation Test</li> <li>- Impedance Test</li> <li>- Hot set test for insulation</li> <li>- FRLS Test - Oxygen Index, Temperature Index, Flammability test, Acid generation test, Swedish Chimney test, Smoke density check etc.</li> <li>- any other test as per PR/PS</li> </ul>

**INDICATIVE INSPECTION & TEST PLAN\*\***  
**Project: 44AC9100 – Acrylic / Oxo Alcohol Project at Gujarat Refinery, Dumad** SHEET 2 OF 2

EQUIPMENT / ITEM DESCRIPTION : <b>INSTRUMENT CABLES</b>	VENDOR : P.O. NO. :
EQUIPMENT / ITEM TAG NO. : TEST & INSPECTION AS PER : (CODES & SPECIFICATIONS) :	PR/PS NO.: DRG. NO.:

A C T I V I T Y	1	WITNESS INSPECTION AND / OR DOCUMENT REVIEW BY OWNER / PMC.			
	2	WITNESS INSPECTION AND / OR DOCUMENT REVIEW BY THIRD PARTY INSPECTION AGENCY (TPIA) NOMINATED BY LSTK / STATUTORY AUTHORITY.			
	3	WITNESS INSPECTION BY SUB VENDOR, VENDOR & LSTK CONTRACTOR.			
	4	CERTIFICATES / DATA TO BE SUBMITTED BY LSTK CONTRACTOR / VENDOR FOR APPROVAL / REVIEW BY TPIA / OWNER / PMC.			
7	-	H	P	X	Type test : <ul style="list-style-type: none"> <li>- Annealing test (copper),</li> <li>- Conductor resistance test</li> <li>- Physical test of armor wire,</li> <li>- Test for uniformity of zinc Coating,</li> <li>- Physical test for insulation &amp; sheath ageing,</li> <li>- Hot deformation for PVC,</li> <li>- Heat shrinkage,</li> <li>- Thermal stability,</li> <li>- Noise rejection ratio.</li> <li>- Flame Retardant Test,</li> <li>- Spark Test,</li> <li>- Fire survival test.</li> <li>- FRLS Test - Oxygen Index, Temperature Index, Flammability test, Acid generation test, Swedish Chimney test, Smoke density check etc.</li> <li>- any other test as per PR/PS</li> </ul>
8	H	H	W	X	Closeout of Concession Request (CR) / Non-Conformance Notice (NCN).
9	R	R	R	X	Review of document <ul style="list-style-type: none"> <li>- test certificate for bought out items</li> <li>- review of calibration certificate for measuring Instruments</li> <li>- type test certificates</li> </ul>
10	R	H	H	-	Inspection Release Certificate (IRC) by TPIA.

**LEGENDS: P – PERFORM, H - HOLD, W – WITNESS, R – REVIEW, A - APPROVAL, I – INFORMATION, X – SUBMIT  
 PO – PURCHASE ORDER, PR – PURCHASE REQUISITION, PS – PURCHASE SPECIFICATION**

**\*\* NOTE :** THIS IS AN INDICATIVE INSPECTION AND TEST PLAN IDENTIFYING SCOPE OF INSPECTION /REVIEW OF DOCUMENTS AS A MINIMUM REQUIREMENT, DETAILED INSPECTION AND TEST PLAN INDICATING ALL SPECIFIED REQUIREMENTS AFTER ISSUE OF PO / PR TO BE GENERATED BY LSTK / VENDOR / SUB-VENDOR AND SAME DULY VETTED BY TPIA TO BE SUBMITTED TO OWNER/PMC FOR REVIEW AND APPROVAL.

**\* TPIA TO CARRY OUT INSPECTION AT SUB-VENDORS' WORKS.**

**OWNER / PMC RESERVES RIGHT TO WITNESS INSPECTION OF ANY ITEM AT ANY STAGE WHICH SHALL BE INDICATED ON INSPECTION & TEST PLAN / QAP AT THE TIME OF APPROVAL AND SAME TO BE COVERED AS PART OF PURCHASE ORDER CONDITION ISSUED BY LSTK CONTRACTOR.**



**QUALITY ASSURANCE PLAN  
FOR  
JUNCTION BOX, CABLES GLANDS & PLUGS**



Sl. No.	Stage Description	Type of Check	Reference Document	Acceptance Criteria	Verifying Document	Inspection			Remark
						Manufa cturer	TPI	PMC/ Owner	
1	Material Identification	Review of Material Test Certificates	Purchase Requisition/Approved drawings	Purchase Requisition /Approved drgs/ Applicable Code	Manufacturer's Certificate	H	R	R	
2	IR/ HV test and Repeat IR	Insulation Resistance check, HV Test	Purchase Requisition / Applicable IEC, IS standards,	Purchase Requisition / Applicable IEC, IS standards	Manufacturer's Certificate	H	W	R	
3	Pressure tests	Pressure test	Purchase Requisition / Applicable IEC, IS standards	Purchase Requisition / Applicable IEC, IS standards	Manufacturer's Certificate	H	RW	R	
4	Electrical test	Function & Continuity	Purchase Requisition/ Approved drawings	Purchase Requisition/ Approved drawings	Manufacturer's Certificate	H	W	R	
5	Visual & Dimensional Check	Visual & Dimensional, gap , clearances	Purchase Requisition/ Approved drawings, applicable standards	Purchase Requisition/ Approved drawings, applicable standards	Manufacturer's Certificate	H	W	R	
6	Review of enclosure protection certificates as applicable	Review of enclosure protection certificates	Purchase Requisition/ Approved drawings	Applicable code /specification	Manufacturer's test certificates / Statutory body certificates	H	R	R	Certificates as following for Statutory Requirements to be submitted: <b>Imported:</b> ATEX + CCOE <b>Indigenous:</b> CMRS/ BIS + CCOE



**QUALITY ASSURANCE PLAN  
FOR  
JUNCTION BOX, CABLES GLANDS & PLUGS**



Sl. No.	Stage Description	Type of Check	Reference Document	Acceptance Criteria	Verifying Document	Inspection			Remark
						Manufa cturer	TPI	PMC/ Owner	
7	Cable Glands & Plugs check	To check Threads, rubber grommet compression	Purchase Requisition/ Approved drawings	Purchase Requisition/ Approved drawings, cable dimension	Manufacturer's test / Statutory body certificates	H	W	R	
8	Preservation & Packing	Preservation & Packing	Purchase Requisition/ Approved Procedure	Full compliance to Purchase Requisition	Preservation Report and Packing List	H	R	R	Check , cleanliness, protection, marking, name plate, packing condition and quantity
9	Inspection Record Book	Review of Inspection Record Book	Purchase Requisition	Full compliance to Purchase Requisition	Inspection Record Book	H	R	R	All Inspection Records
10	Final Inspection	Issue of Release Note	Purchase Requisition/ Approved Procedure	Confirmation of completion of all required inspection	Inspection Record Book	H	H	R	

**NOTES:**

- 1) Requirements of Purchase Requisition shall govern, wherever more stringent than this QAP
- 2) Comments on Purchase Requisition, having an impact on Inspection & Testing will be followed.

**LEGEND: H - HOLD POINT;  
W - WITNESS; ; R - REVIEW OF DOCUMENTS;  
S - SURVEILLANCE;**

Please refer Notes on page 54



## INDICATIVE INSPECTION &amp; TEST PLAN\*\*

SHEET 1 OF 1

Project: 44AC9100 – Acrylic / Oxo Alcohol Project at Gujarat Refinery, Dumad

EQUIPMENT / ITEM DESCRIPTION : CONTROL PANEL

VENDOR :  
P.O. NO. :EQUIPMENT / ITEM TAG NO. :  
TEST & INSPECTION AS PER :  
(CODES & SPECIFICATIONS) :PR/PS NO.  
DRG. NO.

A C T I V I T Y	1	WITNESS INSPECTION AND / OR DOCUMENT REVIEW BY OWNER / PMC.			
	2	WITNESS INSPECTION AND / OR DOCUMENT REVIEW BY THIRD PARTY INSPECTION AGENCY (TPIA) NOMINATED BY LSTK / STATUTORY AUTHORITY.			
	3	WITNESS INSPECTION BY SUB VENDOR, VENDOR & LSTK CONTRACTOR.			
	4	CERTIFICATES / DATA TO BE SUBMITTED BY LSTK CONTRACTOR / VENDOR FOR APPROVAL / REVIEW BY TPIA / OWNER / PMC.			
1	A	A	R	X	Detailed inspection & test plan after issue of PO/PR/PS.
2	R	A	R	X	Inspection & test procedures.
3	-	R	R	X	Summary of all supplementary requirements as specified in the PO/PR/PS.
4	-	R	A	X	Packing procedure / shipping drawing of completed equipment.
5	-	H	W	X	Routine test consist of : <ul style="list-style-type: none"> <li>- Straightness, alignment, paint quality, thickness &amp; shade.</li> <li>- Visual &amp; dimensional check including accessories</li> <li>- Name plate, labels, bill of material</li> <li>- Bus bar size &amp; clearance, bus sleeving &amp; shrouding</li> <li>- Degree of protection</li> <li>- Compartmentalization, shrouding, termination facility, glanding, earthing arrangement, operating height.</li> <li>- Functional check of switches, contactors, meters, lamps including current injection test</li> <li>- Electrical operation check (wiring and scheme check, relay operation check)</li> <li>- HV test, IR test before and after HV test</li> <li>- Continuity test, earth continuity test</li> <li>- any other test as per PR/PS</li> </ul>
6	H	H	W	X	Closeout of Concession Request (CR) / Non-Conformance Notice (NCN).
7	-	H	W	X	Spares & packing list check. packing & loading of equipment as per shipping drawing.
8	R	R	R	X	Review of documents: <ul style="list-style-type: none"> <li>- Test certificate for bought out components</li> <li>- Calibration report of instruments</li> <li>- Short circuit &amp; temperature rise test of bus bars</li> <li>- Test certificate for enclosure protection and weather proof/flame proof requirement as applicable.</li> </ul>
9	R	H	H	-	Inspection Release Certificate (IRC) by TPIA.

LEGENDS: H - HOLD, W - WITNESS, R - REVIEW, A - APPROVAL, I - INFORMATION, X - SUBMIT  
 PO - PURCHASE ORDER, PR - PURCHASE REQUISITION, PS - PURCHASE SPECIFICATION

\*\* NOTE : THIS IS AN INDICATIVE INSPECTION AND TEST PLAN IDENTIFYING SCOPE OF INSPECTION /REVIEW OF DOCUMENTS AS A MINIMUM REQUIREMENT, DETAILED INSPECTION AND TEST PLAN INDICATING ALL SPECIFIED REQUIREMENTS AFTER ISSUE OF PO / PR TO BE GENERATED BY LSTK / VENDOR / SUB-VENDOR AND SAME DULY VETTED BY TPIA TO BE SUBMITTED TO OWNER/PMC FOR REVIEW AND APPROVAL.

\* TPIA TO CARRY OUT INSPECTION AT SUB-VENDORS' WORKS.

OWNER / PMC RESERVES RIGHT TO WITNESS INSPECTION OF ANY ITEM AT ANY STAGE WHICH SHALL BE INDICATED ON INSPECTION & TEST PLAN / QAP AT THE TIME OF APPROVAL AND SAME TO BE COVERED AS PART OF PURCHASE ORDER CONDITION ISSUED BY LSTK CONTRACTOR.



**QUALITY ASSURANCE PLAN  
FOR  
ON-OFF VALVES**





Sl. No.	Stage Description	Type of Check	Reference Document	Acceptance Criteria	Verifying Document	Inspection			Remark
						Manufacter	TPI	PMC/ Owner	
1	Material Identification	Review of Material Test certificates of valve	Purchase Requisition/ Applicable Code	Purchase Requisition/ Applicable Code	Material Certificate	H	R	R	NDT requirement of shell & bonnet to be verified as per PR/Approved drawing
2	Hydrostatic test	Bench Hydrostatic test of Valve (at minimum 1.5 times of design pressure rating)	Purchase Requisition/ Applicable Code/ Approved data sheet	No leakage through Body & Bonnet	Hydro Test Certificate	H	W	R	
3	Seat leakage test of valves	Seat leakage test of valves	Purchase Requisition/ Applicable Code/ Approved data sheet	Purchase Requisition/ Approved data sheet	Leakage Test Report	H	W	R	
4	Review of test certificates for bought outs / accessories	Review of test certificates for bought outs / accessories (Sol.Valves, Actuators, limit switches etc.)	Purchase Requisition/ Approved data sheet	Purchase Requisition/ Approved data sheet	Test Certificate	H	R	R	Certificates as following for Statutory Requirements to be submitted: <b>Imported:</b> ATEX + CCOE <b>Indigenous:</b> CMRS/ BIS + CCOE
5	Actuator leakage test	Actuator leakage test	Approved drgs/data sheet	Approved drgs/data sheet	Leakage Test report	H	W	R	
6	Function check	Function check (stroke check, opening/closing time check etc..)	Purchase Requisition	Purchase Requisition/ Data sheet/ smooth operation	Vendor Certificate	H	W	R	



**QUALITY ASSURANCE PLAN  
FOR  
ON-OFF VALVES**



Sl. No.	Stage Description	Type of Check	Reference Document	Acceptance Criteria	Verifying Document	Inspection			Remark
						Manufacturer	TPI	PMC/Owner	
7	Operational check	Operational check for accessories	Purchase Requisition	Smooth Operation	Test Certificate	H	W	R	
8	Special requirements (if any)	Verification of Special Requirements (if any)	Purchase Requisition / Job Specification	Full Compliance to Job Specification	Test certificate	H	H	R	
9	Visual & Dimensional inspection	Visual & Dimensional inspection	Purchase Requisition/ Approved Drawings	Approved Drawings	Inspection Report	H	W	R	
10	Name plate verification including tag nos.	Name plate verification including tag nos.	Purchase Requisition	Easily retractable	Test certificate	H	W	R	
11	Verification of Spares	and Review of Manufacturer's Test	Purchase Requisition/ Approved Drawings	Purchase Requisition / Approved drgs / Applicable Code	Inspection Report / Packing List	H	H	R	
12	Preservation & Packing	Preservation & Packing	Purchase Requisition/ Approved procedure	Full compliance to Purchase Requisition / Applicable code	Preservation Report and Packing list	H	R	R	Check of lifting arrangement, cleanliness, protection, marking, name plate, packing condition and quantity
13	Inspection Record Book	Review of Inspection Record Book	Purchase Requisition	Full compliance to Purchase Requisition/ Clearance of NCR	Inspection Record Book	H	R	R	

 IndianOil		<b>QUALITY ASSURANCE PLAN FOR ON-OFF VALVES</b>					 energy   chemicals   resources	
Sl. No.	Stage Description	Type of Check	Reference Document	Acceptance Criteria	Verifying Document	Inspection		Remark
						Manu- facturer	TPI	PMC/ Owner
14	Final Inspection	Issue of Release Note	Purchase Requisition	Confirmation of completion of all required inspection	Inspection Record Book	H	H	R
<b>NOTES:</b> 1) Requirements of Purchase Requisition shall govern, wherever more stringent than this QAP 2) For IBR Valves, Availability of IBR related documents shall also be verified by TPI. 3) Comments on Purchase Requisition, having an impact on Inspection & Testing will be followed.								
<b>LEGEND: H - HOLD POINT; W - WITNESS; R - REVIEW OF DOCUMENTS; S - SURVEILLANCE;</b>								

Please refer Notes on page 54



**QUALITY ASSURANCE PLAN  
FOR  
PRESSURE AND DIFFERENTIAL PRESSURE GAUGE**



Sl. No.	Stage Description	Type of Check	Reference Document	Acceptance Criteria	Verifying Document	Inspection			Remark
						Manu- facturer	TPI	PMC/ Owner	
1	Visual & Dimensional Check	Visual & Dimensional Check	Purchase Requisition/ Approved drawings	Purchase Requisition/ Approved drawings	Manufacturer's certificates	W	W	R	
2	Quality of glass for shatterproof	Review of Test Certificate & source	Purchase Requisition/ Approved drawings	Purchase Requisition/ Approved drawings	Certificate from the Source	H	R	R	
3	Calibration check & Over Pressure test	Range, Accuracy Repeatability, Hysteresis, Zero & span adjustment, Over range	Purchase Requisition/ Approved drawings	Purchase Requisition/ Approved drawings	Manufacturer's Certificate	H	R	R	
4	Review of Material Test Certificate and enclosure protection certificates (where applicable)	Review of Material Test Certificate and enclosure protection certificates	Purchase Requisition/ Approved drawings	Purchase Requisition/ Approved drawings/ Applicable code	Manufacturer's Certificate	H	R	R	
5	Name plate verification including tag	Name plate verification including tag nos.	Purchase Requisition/ Approved drawings	Easily retractable	Manufacturer's Certificate	H	R	R	
6	Preservation & Packing	Preservation & Packing	Purchase Requisition/ Approved Procedure	Full compliance to Purchase Requisition	Preservation Report and Packing List	H	R	R	Check, cleanliness, protection, marking, name plate, packing condition and quantity



**QUALITY ASSURANCE PLAN  
FOR  
PRESSURE AND DIFFERENTIAL PRESSURE GAUGE**



Sl. No.	Stage Description	Type of Check	Reference Document	Acceptance Criteria	Verifying Document	Inspection			Remark
						Manufacturer	TPI	PMC/ Owner	
7	Inspection Record Book	Review of Inspection Record Book	Purchase Requisition	Full compliance to Purchase Requisition/ Clearance of Non-conformities	Inspection Record Book	H	R	R	
8	Final Inspection	Issue of Release Note	Purchase Requisition/ Approved Procedure	Confirmation of completion of all required inspection	Inspection Record Book	H	H	R	
<b>NOTES:</b> 1) Requirements of Purchase Requisition shall govern, wherever more stringent than this QAP 2) Comments on Purchase Requisition, having an impact on Inspection & Testing will be followed.									

**LEGEND: H - HOLD POINT;  
W - WITNESS; ;  
R - REVIEW OF DOCUMENTS;  
S - SURVEILLANCE;**

Please refer Notes on page 54



**QUALITY ASSURANCE PLAN  
FOR  
PRESSURE, DIFFERENTIAL PRESSURE, FLOW & TEMPERATURE  
TRANSMITTERS**



Sl. No.	Stage Description	Type of Check	Reference Document	Acceptance Criteria	Verifying Document	Inspection			Remark
						Manufacturer	TPI	PMC/ Owner	
1	Material Identification	Review of Manufacturer's Test certificates & Intrinsically safe certificates as applicable	Purchase Requisition/ Approved drawings	Purchase Requisition/ Approved drawings	Manufacturer's test certificates	H	R	R	
2	Enclosure protection certificates( as applicable)	Review of enclosure protection certificates	Purchase Requisition	Purchase Requisition	Manufacturer's Test certificate & Statutory body Certificate Statutory body certificate	H	R	R	Certificates as following for Statutory Requirements to be submitted: <b>Imported: ATEX + CCOE</b> <b>Indigenous: CMRS/ BIS + CCOE</b>
3	Visual & Dimensional and Mounting Check	Visual & Dimensional Check	Purchase Requisition/ Approved drawings	Purchase Requisition/ Approved drawings	Manufacturer 's Certificate	H	W	R	
4	Hydrostatic Test	Hydrostatic Test	Purchase Requisition/ Approved drawings	1.5 times the maximumm operating pressure for 5 Minutes to be with stood	Hydro Test Report	H	R/W	R	
5	Calibration and Accuracy check	Calibration and Accuracy check, Zero, Span adjustment	Purchase Requisition/ Approved drawings	Purchase Requisition/ Approved drawings	Calibration Report	H	W	R	
6	IR/ HV Test	IR/ HV Test	Purchase Requisition /Approved drawings, Manufacturer's standard	Purchase Requisition /Approved drawings, Manufacturer's standard	Manufacturer's certificate	H	W	R	
7	Power supply variation check	To check the output for varying voltage	Purchase Requisition/ Approved drawings	Purchase Requisition/ Approved drawings	Manufacturer's certificate	H	W	R	







**QUALITY ASSURANCE PLAN  
FOR  
PRESSURE, DIFFERENTIAL PRESSURE, FLOW & TEMPERATURE  
TRANSMITTERS**



Sl. No.	Stage Description	Type of Check	Reference Document	Acceptance Criteria	Verifying Document	Inspection			Remark
						Manufacturer	TPI	PMC/ Owner	
8	Load Test at 24 Volts DC and reverse Polarity Test	To check the output for load up to 600 Ohms and effect of Reversing the Polarity	Purchase Requisition/ Approved drawings	Purchase Requisition/ Approved drawings	Manufacturer's certificate	H	W	R	
9	Configuration and Self Diagnostic facility check	Configuration parameters, Local/ Remote (with Hand held configurator), check for failure of sensor, electronics, power supply	Purchase Requisition/ Approved drawings	Purchase Requisition/ Approved drawings	Manufacturer's certificate	H	W	R	
10	Tag, range, span material check	Tag, range, span material check	Purchase Requisition/ Approved drawings	Purchase Requisition/ Approved drawings	Manufacturer's certificate	H	W	R	
11	Preservation & Packing	Preservation & Packing	Purchase Requisition/ Approved Procedure	Full compliance to Purchase Requisition/ Approved Procedure	Preservation Report and Packing List	H	R	R	Check, cleanliness, protection, marking, name plate, packing condition and quantity
12	Inspection Record Book	Review of Inspection Record Book	Purchase Requisition	Full compliance to Purchase Requisition	Inspection Record Book	H	R	R	
13	Final Inspection	Issue of Release Note	Purchase Requisition/ Approved Procedure	Confirmation of completion of all required inspection	Inspection Record Book	H	H	R	



 <b>IndianOil</b>		<b>QUALITY ASSURANCE PLAN FOR PRESSURE, DIFFERENTIAL PRESSURE, FLOW &amp; TEMPERATURE TRANSMITTERS</b>						 <b>Worley</b> <small>energy   chemicals   resources</small>	
Sl. No.	Stage Description	Type of Check	Reference Document	Acceptance Criteria	Verifying Document	Inspection			Remark
						Manufacturer	TPI	PMC/Owner	
<b>NOTES:</b> 1) Requirements of Purchase Requisition shall govern, wherever more stringent than this QAP 2) Comments on Purchase Requisition, having an impact on Inspection & Testing will be followed.									
<b>LEGEND: H - HOLD POINT; W - WITNESS;; R - REVIEW OF DOCUMENTS; S - SURVEILLANCE;</b>									

Please refer Notes on page 54



**QUALITY ASSURANCE PLAN  
FOR  
TEMPERATURE ELEMENTS WITH THERMOWELLS**



Sl. No.	Stage Description	Type of Check	Reference Document	Acceptance Criteria	Verifying Document	Inspection			Remark
						Manufacturer	TPI	PMC/ Owner	
1	Material Identification	Review of Manufacturer's Test certificates of Raw Material and Bought outs as applicable	Purchase Requisition/ Approved drawings/ Applicable Code	Purchase Requisition/ Approved drawings/ Applicable code	Manufacturer's test certificates	W	R	R	
2	Electrical Tests	Check of continuity and Polarity	Purchase Requisition/ Approved drawings/ Applicable Code	Purchase Requisition/ Approved drawings/ Applicable Code	Manufacturer's test certificates	W	R	R	
3	Wake frequency test for thermowells	Review of Test certificates & sources	Purchase Requisition/ Approved drawings	Purchase Requisition/ Approved drawings	Manufacturer's test certificates	H	R	R	
4	Insulation Resistance and HV Test	Insulation Resistance and HV Test	Purchase Requisition/ Approved drawings/ Applicable Code	Purchase Requisition/ Approved drawings/ Applicable Code	test certificates	H	R	R	
5	Verification of Enclosure Protection of Terminal heads	Review of statutory Certificates	Purchase Requisition/ Approved Data Sheet	Purchase Requisition/ Approved Data Sheet	Purchase Requisition/ Approved Data Sheet	H	R	R	Certificates as following for Statutory Requirements to be submitted: <b>Imported:</b> ATEX + CCOE <b>Indigenous:</b> CMRS/ BIS + CCOE
6	Visual & Dimensional Check	Visual & Dimensional Check	Purchase Requisition/ Approved drawings	Purchase Requisition/ Approved drawings	Manufacturer's certificates	W	W	R	



**QUALITY ASSURANCE PLAN  
FOR  
TEMPERATURE ELEMENTS WITH THERMOWELLS**



Sl. No.	Stage Description	Type of Check	Reference Document	Acceptance Criteria	Verifying Document	Inspection			Remark
						Manu- facturer	TPI	PMC/ Owner	
7	Hydrostatic test of Thermowells	Internal at 100kg/sq.cm and external at 1.5 times the flange rating	Purchase Requisition/ Approved drawings	No leakage	Test Report	H	R	R	Minimum 10 % to be witness by inspector
8	Calibration Check	Calibration and response time check	Purchase Requisition/ Approved drawings/ Applicable Code	Purchase Requisition/ Approved drawings/ Applicable Code	Calibration Test Certificate	H	W	R	
9	PMI for Alloy /SS materials	Alloy Verification	Purchase Requisition/ Applicable Code	Purchase Requisition/ Applicable Code	Test Report	H	W/R	R	
10	Bore Concentricity Check for Thermowells	By Radiography or Ultrasonic Test	Approved drawings	No Eccentricity	NDT Report/ RT Films	H	R	R	
11	Weld Soundness of Thermowell to Flange joint	Dye penetrant Test	Applicable Code	Applicable Code	PT Test report	H	R	R	
12	Preservation & Packing	Preservation & Packing	Purchase Requisition/ Approved Procedure	Full compliance to Purchase Requisition	Preservation Report and Packing List	H	R	R	Check , cleanliness, protection, marking, name plate, packing condition and quantity
13	Inspection Record Book	Review of Inspection Record Book	Purchase Requisition	Full compliance to Purchase Requisition	Inspection Record Book	H	R	R	



**QUALITY ASSURANCE PLAN  
FOR  
TEMPERATURE ELEMENTS WITH THERMOWELLS**



Sl. No.	Stage Description	Type of Check	Reference Document	Acceptance Criteria	Verifying Document	Inspection			Remark
						Manufacturer	TPI	PMC/ Owner	
14	Final Inspection	Issue of Release Note	Purchase Requisition/ Approved Procedure	Confirmation of completion of all required inspection	Inspection Record Book	H	H	R	
<b>NOTES:</b> 1) Requirements of Purchase Requisition shall govern, wherever more stringent than this QAP 2) Comments on Purchase Requisition, having an impact on Inspection & Testing will be followed. 3) The above QAP/ QCP is applicable to Multipoint Thermocouples also.									

**LEGEND: H - HOLD POINT;  
W - WITNESS;;  
R - REVIEW OF DOCUMENTS;  
S - SURVEILLANCE;**

Please refer Notes on page 54

**INDICATIVE INSPECTION & TEST PLAN\*\***

Project: 44AC9100 – Acrylic / Oxo Alcohol Project at Gujarat Refinery, Dumad

SHEET 1 OF 2

EQUIPMENT / ITEM DESCRIPTION : **SAFETY VALVE**VENDOR :  
P.O. NO. :EQUIPMENT / ITEM TAG NO. :  
TEST & INSPECTION AS PER :  
(CODES & SPECIFICATIONS) :PR/PS NO.  
DRG. NO.

A C T I V I T Y	1	WITNESS INSPECTION AND / OR DOCUMENT REVIEW BY OWNER / PMC.			
	2	WITNESS INSPECTION AND / OR DOCUMENT REVIEW BY THIRD PARTY INSPECTION AGENCY (TPIA) NOMINATED BY LSTK / STATUTORY AUTHORITY.			
	3	WITNESS INSPECTION BY SUB VENDOR, VENDOR & LSTK CONTRACTOR.			
	4	CERTIFICATES / DATA TO BE SUBMITTED BY LSTK CONTRACTOR / VENDOR FOR APPROVAL / REVIEW BY TPIA / OWNER / PMC.			
1	H	H	H	X	Pre-inspection meeting (PIM) to be conducted after issue of PO / PR / PS. Agenda to be prepared by LSTK contractor.
2	A	A	R	X	Detailed inspection & test plan after issue of PO/PR/PS.
3	R	A	R	X	Inspection & test procedures.
4	-	R	R	X	Summary of all supplementary requirements as specified in the PO/PR/PS.
5	-	R	A	X	Packing procedure / shipping drawing of completed equipment.
6	A	H	W	X	Valves casting repair procedure (no weld repair to be carried out without client's / PMC approval)
7	R	R	R	X	Manufacturers' test certificates for valve body, nozzle trim components, accessories etc. IBR test certificates wherever applicable.
8	R	W	P	X	NDT (RT, UT, MT, PT etc, as specified) examination records
9	W	H	P	X	Routine tests: <ul style="list-style-type: none"> <li>- Visual check of all assembled valves – Tag No, Marking, Paint shade &amp; thickness etc..</li> <li>- Dimensional check (100% by vendor &amp; at random by TPI, Client/PMC)</li> <li>- Hydro test for body &amp; nozzle</li> <li>- Pneumatic test for body</li> <li>- Seat leakage test</li> <li>- Valve lift check</li> <li>- Cold bench set pressure test</li> <li>- Set pressure check (pressure change by minimum plus / minus 5% by changing tension of spring and without effecting valve lift</li> <li>- Operation check</li> <li>- Blow down test</li> <li>- PMI Test</li> <li>- any other test, as specified in PR/PS</li> </ul>
10	R	R	P	X	Type test : - capacity check
11	H	H	W	X	Closeout of Concession Request (CR) / Non-Conformance Notice (NCN).
12	-	H	P	X	Spares & packing list check. packing & loading of equipment as per shipping drawing.

**INDICATIVE INSPECTION & TEST PLAN\*\***

**Project: 44AC9100 – Acrylic / Oxo Alcohol Project at Gujarat Refinery, Dumad** SHEET 2 OF 2

EQUIPMENT / ITEM DESCRIPTION : <b>SAFETY VALVE</b>	VENDOR :
EQUIPMENT / ITEM TAG NO. :	P.O. NO. :
TEST & INSPECTION AS PER :	PR/PS NO.:
(CODES & SPECIFICATIONS):	DRG. NO.:

A C T I V I T Y	1	WITNESS INSPECTION AND / OR DOCUMENT REVIEW BY OWNER / PMC.			
	2	WITNESS INSPECTION AND / OR DOCUMENT REVIEW BY THIRD PARTY INSPECTION AGENCY (TPIA) NOMINATED BY LSTK / STATUTORY AUTHORITY.			
	3	WITNESS INSPECTION BY SUB VENDOR, VENDOR & LSTK CONTRACTOR.			
	4	CERTIFICATES / DATA TO BE SUBMITTED BY LSTK CONTRACTOR / VENDOR FOR APPROVAL / REVIEW BY TPIA / OWNER / PMC.			
13	R	R	P	X	Final documentation Review : <ul style="list-style-type: none"> <li>- Internal test &amp; calibration certificate (100%), PMI Report (100%) etc</li> <li>- calibration report of all measuring instruments.</li> <li>- Material test certificate for all wet components, flange including accessories.</li> <li>- Certificates as following for Statutory Requirements to be submitted: <b>Imported:</b> ATEX + CCOE <b>Indigenous:</b> CMRS/ BIS + CCOE. As applicable</li> </ul>
14	R	H	H	-	Inspection Release Certificate (IRC) by TPIA.

**LEGENDS: P – PERFORM, H - HOLD, W – WITNESS, R – REVIEW, A - APPROVAL, I – INFORMATION, X – SUBMIT  
PO – PURCHASE ORDER, PR – PURCHASE REQUISITION, PS – PURCHASE SPECIFICATION**

**\*\* NOTE :** THIS IS AN INDICATIVE INSPECTION AND TEST PLAN IDENTIFYING SCOPE OF INSPECTION /REVIEW OF DOCUMENTS AS A MINIMUM REQUIREMENT, DETAILED INSPECTION AND TEST PLAN INDICATING ALL SPECIFIED REQUIREMENTS AFTER ISSUE OF PO / PR TO BE GENERATED BY LSTK / VENDOR / SUB-VENDOR AND SAME DULY VETTED BY TPIA TO BE SUBMITTED TO OWNER/PMC FOR REVIEW AND APPROVAL.

**\* TPIA TO CARRY OUT INSPECTION AT SUB-VENDORS' WORKS.**

**OWNER / PMC RESERVES RIGHT TO WITNESS INSPECTION OF ANY ITEM AT ANY STAGE WHICH SHALL BE INDICATED ON INSPECTION & TEST PLAN / QAP AT THE TIME OF APPROVAL AND SAME TO BE COVERED AS PART OF PURCHASE ORDER CONDITION ISSUED BY LSTK CONTRACTOR.**

**INDICATIVE INSPECTION & TEST PLAN\*\***

Project: 44AC9100 – Acrylic / Oxo Alcohol Project at Gujarat Refinery, Dumad

SHEET 1 OF 2

EQUIPMENT / ITEM DESCRIPTION : **TRANSMITTERS**

VENDOR :

P.O. NO. :

EQUIPMENT / ITEM TAG NO. :

TEST &amp; INSPECTION AS PER :

(CODES &amp; SPECIFICATIONS) :

PR/PS NO.

DRG. NO.

A C T I V I T Y	1	WITNESS INSPECTION AND / OR DOCUMENT REVIEW BY OWNER / PMC.			
	2	WITNESS INSPECTION AND / OR DOCUMENT REVIEW BY THIRD PARTY INSPECTION AGENCY (TPIA) NOMINATED BY LSTK / STATUTORY AUTHORITY.			
	3	WITNESS INSPECTION BY SUB VENDOR, VENDOR & LSTK CONTRACTOR.			
	4	CERTIFICATES / DATA TO BE SUBMITTED BY LSTK CONTRACTOR / VENDOR FOR APPROVAL / REVIEW BY TPIA / OWNER / PMC.			
1	A	A	R	X	Detailed inspection & test plan after issue of PO/PR/PS.
2	R	A	R	X	Inspection & test procedures.
3	-	R	R	X	Summary of all supplementary requirements as specified in the PO/PR/PS.
4	-	R	A	X	Packing procedure / shipping drawing of completed equipment.
5	-	H	R	X	Shop calibration records of 100% instruments & material test certificates for all wet components, flanges including accessories.
6	-	H	P	X	Visual check (on 100% instruments) for: <ul style="list-style-type: none"> <li>- Dimensional check/general workmanship.</li> <li>- Checking of name plate, tag nos., Model No, calibration range, Certification Label check.</li> <li>- Type of mounting, correctness of flange/process connection (100%).</li> <li>- Checking of supply of accessories, IBR marking. requirement of enclosure protection / area classification. cable entry type and size.</li> <li>- Cable entry type and size, accessories.</li> <li>- Zero adjustment, capillary length (if applicable)</li> </ul>
7	-	H	P	X	Performance test: <ul style="list-style-type: none"> <li>- Calibration check, repeatability check</li> <li>- Functional check of built-in indicator, hand held configurator and accessories etc.</li> <li>- Over range protection</li> <li>- Static pressure test</li> </ul>
8	-	R	W	X	Type test reports for: <ul style="list-style-type: none"> <li>- Degree of protection</li> <li>- Increased safety requirements</li> <li>- any other requirement</li> </ul>
9	H	H	W	X	Closeout of Concession Request (CR) / Non-Conformance Notice (NCN).
10	-	W	H	X	Spares & packing list check. packing & loading of equipment as per shipping drawing.
11	R	R	R	X	Documentation Review: <ul style="list-style-type: none"> <li>- Internal test &amp; calibration certificate (100%), PMI Report (100%) etc</li> <li>- Calibration report of all measuring instruments.</li> <li>- Material test certificate for all wet components, flange including accessories.</li> <li>- Degree of Protection, Certificates as following for Statutory Requirements to be submitted: Imported: ATEX + CCOE Indigenous: CMRS/ BIS + CCOE.</li> </ul>







**QUALITY ASSURANCE PLAN  
FOR  
(General)**





Sl. No.	Stage Description	Type of Check	Reference Document	Acceptance Criteria	Verifying Document	Inspection			Remark
						Manufa cturer	TPI	PMC/ Owner	
1	Material Identification	Review of Manufacturer's Test Certificates for raw materials & bought outs	Purchase Requisition/Approved drawings	Purchase Requisition/Approved drawings /Applicable Material Code	Manufacturer's Test Certificate	H	R	R	
2	Visual and Dimensional	Visual and Dimensional including Tag No verification	Purchase Requisition/Approved drawings	Purchase Requisition/Approved drawings	Inspection Report	H	W	R	
3	Bill of Material	Quantitative Check input /out put modules, Power supply, switches etc, Name Plate checks., model no, SI No	Purchase Requisition/ Approved Drawing	Purchase Requisition/ Approved Drawing	Manufacturer's Test Certificate	H	W	R	
4	Review of Documents	Review of Material TC, Certificate for Ingress protection, enclosure protection, etc.	Purchase Requisition/ Approved Drawing	Purchase Requisition/ Approved Drawing	Manufacturer's Test Certificate	R	R	R	Certificates as following for Statutory Requirements to be submitted: <b>Imported:</b> ATEX + CCOE <b>Indigenous:</b> CMRS/ BIS + CCOE
5	Functional test and operational tests (including accessories)	Functional Test (Specify extent: _____) Operational Test (Specify extent: _____)	Purchase Requisition/ Data Sheet/ Approved Drawings	Purchase Requisition/ Data Sheet/ Approved drawings	Function Test Report	H	W/R	R	W: _____ % R: 100%



**QUALITY ASSURANCE PLAN  
FOR  
(General)**



Sl. No.	Stage Description	Type of Check	Reference Document	Acceptance Criteria	Verifying Document	Inspection			Remark
						Manufacterurer	TPI	PMC/ Owner	
6	Pressure Test Hydraulic/Pneumatic)	Leak test/ Pressure test (Pressure : _____)	Purchase Requisition/ Approved Drawing	Purchase Requisition/ Approved Drawing	Manufacturer's Test Certificate	W	W	R	
7	Marking and Traceability Verification	Verification of marking and Traceability of material	Purchase Requisition/Approved drawings/ data sheets	Full compliance to Purchase Requisition /Applicable code/ stamping by TPI	Inspection Report	H	W	R	
8	Verification of Spares	Verification of items and Quantity	Purchase Requisition/ Approved Drawings	Purchase Requisition / Approved drgs	Inspection Report / Packing List	H	W	R	
9	Preservation & Packing	Preservation & Packing	Purchase Requisition/ Approved Procedure	Full compliance to Purchase Requisition	Preservation Report and Packing List	H	R	R	
10	Inspection Record Book	Review of Inspection Record Book	Purchase Requisition	Full compliance to Purchase Requisition	Inspection Record Book	H	R	R	
11	Final Inspection	Issue of Release Note	Purchase Requisition/ Approved Procedure	Confirmation of completion of all required inspection	Inspection Record Book	H	H	R	

		<b>QUALITY ASSURANCE PLAN FOR (General)</b>							
Sl. No.	Stage Description	Type of Check	Reference Document	Acceptance Criteria	Verifying Document	Inspection			Remark
						Manufacterer	TPI	PMC/Owner	
<b>NOTES:</b> 1) Requirements of Purchase Requisition shall govern, wherever more stringent than this QAP 2) Comments on Purchase Requisition, having an impact on Inspection & Testing will be followed. 3) A general format for of the Quality Assurance Plan has been included which may be used as a guideline for developing the QAPs of Instrument Items for which no QAP has been indicated in this document.									
<b>LEGEND: H - HOLD POINT; W - WITNESS;; R - REVIEW OF DOCUMENTS; S - SURVEILLANCE;</b>									

Please refer Notes on page 54

**INDICATIVE INSPECTION & TEST PLAN\*\***

Project: 44AC9100 – Acrylic / Oxo Alcohol Project at Gujarat Refinery, Dumad

SHEET 1 OF 1

EQUIPMENT / ITEM DESCRIPTION : **GATE, GLOBE, CHECK AND BALL VALVE**VENDOR :  
P.O. NO. :EQUIPMENT / ITEM TAG NO. :  
TEST & INSPECTION AS PER :  
(CODES & SPECIFICATIONS) :PR/PS NO.  
DRG. NO.

A C T I V I T Y	1	WITNESS INSPECTION AND / OR DOCUMENT REVIEW BY OWNER / PMC.			
	2	WITNESS INSPECTION AND / OR DOCUMENT REVIEW BY THIRD PARTY INSPECTION AGENCY (TPIA) NOMINATED BY LSTK / STATUTORY AUTHORITY.			
	3	WITNESS INSPECTION BY SUB VENDOR, VENDOR & LSTK CONTRACTOR.			
	4	CERTIFICATES / DATA TO BE SUBMITTED BY LSTK CONTRACTOR / VENDOR FOR APPROVAL / REVIEW BY TPIA / OWNER / PMC.			
1	A	A	R	X	Detailed inspection & test plan after issue of PO / PR / PS.
2	R	A	R	X	Inspection & test procedures including NDT, PWHT, Pneumatic test, Hydro test, Pickling & Passivation procedures, Painting, etc...
3	-	A	R	X	Summary of all supplementary requirements as specified in the PO/PR/PS.
4	-	R	A	X	Packing procedure / shipping drawing of completed equipment.
5	-	R	R	X	WPS/PQR qualification / welder performance records for overlay / stelling including weld repair procedure
6	-	R	R	X	Manufacturers' test certificates for body / bonnet / trim material, etc.
7	-	R	R	X	Fire safe test certificates for ball valves
8	-	H*	W	X	NDT (RT, UT, MPT, LPT – as applicable) examination
9	-	R	R	X	Heat treatment records / charts
10	-	R	R	X	Hardness check / corrosion test, if applicable
11	-	H	W	X	Hydrostatic / pneumatic test for body, seat and back seat.(100% by vendor & at random by tpi agency)
12	-	H	W	X	Strip check on sample valves to verify components (one valve per size / type / order)
13	-	H	W	X	Functional / operational check for gear / actuator operated valves
14	-	H	W	X	Visual and dimensional inspection including coating check
15	-	H	W	X	Verification of marking & review of vendor's final certificates & review of ibr certificates, as applicable.
16	-	H	W	X	PMI inspection for AS / SS valves
17	H	H	W	X	Closeout of Concession Request (CR) / Non-Conformance Notice (NCN).
18	-	H	H	X	Packing & loading of items as per shipping drawing
19	R	R	R	X	Final documentation
20	R	H	H	-	Inspection Release Certificate (IRC) by TPIA.

**LEGENDS: H - HOLD, W – WITNESS, R – REVIEW, A - APPROVAL, I – INFORMATION, X – SUBMIT  
PO – PURCHASE ORDER, PR – PURCHASE REQUISITION, PS – PURCHASE SPECIFICATION**

**\*\* NOTE :** THIS IS AN INDICATIVE INSPECTION AND TEST PLAN IDENTIFYING SCOPE OF INSPECTION /REVIEW OF DOCUMENTS AS A MINIMUM REQUIREMENT, DETAILED INSPECTION AND TEST PLAN INDICATING ALL SPECIFIED REQUIREMENTS AFTER ISSUE OF PO / PR TO BE GENERATED BY LSTK / VENDOR / SUB-VENDOR AND SAME DULY VETTED BY TPIA TO BE SUBMITTED TO OWNER/PMC FOR REVIEW AND APPROVAL.

\* TPIA TO CARRY OUT INSPECTION AT SUB-VENDORS' WORKS.

OWNER / PMC RESERVES RIGHT TO WITNESS INSPECTION OF ANY ITEM AT ANY STAGE WHICH SHALL BE INDICATED ON INSPECTION & TEST PLAN / QAP AT THE TIME OF APPROVAL AND SAME TO BE COVERED AS PART OF PURCHASE ORDER CONDITION ISSUED BY LSTK CONTRACTOR.

## INDICATIVE INSPECTION &amp; TEST PLAN\*\*

Project: 44AC9100 – Acrylic / Oxo Alcohol Project at Gujarat Refinery, Dumad

SHEET 1 OF 1

EQUIPMENT / ITEM DESCRIPTION : **EXPANSION BELLOWS (METTALIC)**VENDOR :  
P.O. NO. :EQUIPMENT / ITEM TAG NO. :  
TEST & INSPECTION AS PER :  
(CODES & SPECIFICATIONS) :PR/PS NO.  
DRG. NO.

A C T I V I T Y	1	WITNESS INSPECTION AND / OR DOCUMENT REVIEW BY OWNER / PMC.			
	2	WITNESS INSPECTION AND / OR DOCUMENT REVIEW BY THIRD PARTY INSPECTION AGENCY (TPIA) NOMINATED BY LSTK / STATUTORY AUTHORITY.			
	3	WITNESS INSPECTION BY SUB VENDOR, VENDOR & LSTK CONTRACTOR.			
	4	CERTIFICATES / DATA TO BE SUBMITTED BY LSTK CONTRACTOR / VENDOR FOR APPROVAL / REVIEW BY TPIA / OWNER / PMC.			
1	A	A	R	X	Detailed inspection & test plan after issue of PO/PR/PS, (including for bought-out items)
2	R	A	R	X	Inspection & test procedures including NDT procedures, PWHT procedure and weld repair procedures, etc.
3	-	R	R	X	Summary of all supplementary requirements as specified in the PO/PR/PS.
4	-		A	X	Packing procedure / shipping drawing of completed items.
5	R	A	W	X	Welding procedure specifications and procedure qualification record including weld repair.
6	-	A	W	X	Welders' qualification / welders' performance records
7	-	H	W	X	Raw material inspection / identification for all pressure parts / components w.r.t. mill / manufacturer's tcs
8	-	R	R	X	Sub – orders verification for bought – out items viz flanges / forgings, fittings, bellows, fasteners etc.
9	-	W	W	X	Long-seam, circ-seam set up check.
10	-	W	W	X	Identification of all bought out items at fabrication shop.
11	-	W	W	X	Bellow formation check.
12	-	H	W	X	NDT (as applicable) check & records / film review.
13	-	H	W	X	Check for supplementary requirement, if any.
14	-	H	W	X	Leak tightness test (if applicable).
15	-	H	W	X	Pressure test.
16	-	H	W	X	Final inspection including paint, pickling & passivation, as applicable.
17	-	H	H	X	Packing & loading of items as per shipping drawing.
18	R	R	R	X	Final documentation.
19	R	H	H	-	Inspection Release Certificate (IRC) by TPIA.

**LEGENDS: H - HOLD, W – WITNESS, R – REVIEW, A - APPROVAL, I – INFORMATION, X – SUBMIT  
PO – PURCHASE ORDER, PR – PURCHASE REQUISITION, PS – PURCHASE SPECIFICATION**

**\*\* NOTE :** THIS IS AN INDICATIVE INSPECTION AND TEST PLAN IDENTIFYING SCOPE OF INSPECTION /REVIEW OF DOCUMENTS AS A MINIMUM REQUIREMENT, DETAILED INSPECTION AND TEST PLAN INDICATING ALL SPECIFIED REQUIREMENTS AFTER ISSUE OF PO / PR TO BE GENERATED BY LSTK / VENDOR / SUB-VENDOR AND SAME DULY VETTED BY TPIA TO BE SUBMITTED TO OWNER/PMC FOR REVIEW AND APPROVAL.

\* TPIA TO CARRY OUT INSPECTION AT SUB-VENDORS' WORKS.

OWNER / PMC RESERVES RIGHT TO WITNESS INSPECTION OF ANY ITEM AT ANY STAGE WHICH SHALL BE INDICATED ON INSPECTION & TEST PLAN / QAP AT THE TIME OF APPROVAL AND SAME TO BE COVERED AS PART OF PURCHASE ORDER CONDITION ISSUED BY LSTK CONTRACTOR.

**INDICATIVE INSPECTION & TEST PLAN\*\***

Project: 44AC9100 – Acrylic / Oxo Alcohol Project at Gujarat Refinery, Dumad

SHEET 1 OF 2

EQUIPMENT / ITEM DESCRIPTION : **SEAMLESS/WELDED PIPES**VENDOR :  
P.O. NO. :EQUIPMENT / ITEM TAG NO. :  
TEST & INSPECTION AS PER :  
(CODES & SPECIFICATIONS) :PR/PS NO.  
DRG. NO.

A C T I V I T Y	1				1 WITNESS INSPECTION AND / OR DOCUMENT REVIEW BY OWNER / PMC.
	2				2 WITNESS INSPECTION AND / OR DOCUMENT REVIEW BY THIRD PARTY INSPECTION AGENCY (TPIA) NOMINATED BY LSTK / STATUTORY AUTHORITY.
	3				3 WITNESS INSPECTION BY SUB VENDOR, VENDOR & LSTK CONTRACTOR.
	4				4 CERTIFICATES / DATA TO BE SUBMITTED BY LSTK CONTRACTOR / VENDOR FOR APPROVAL / REVIEW BY TPIA / OWNER / PMC.
1	A	A	R	X	Detailed inspection & test plan after issue of PO / PR / PS.
2	R	A	R	X	Inspection & test procedures including NDT, PWHT, Pneumatic / Hydro / Eddy current test, etc...
3	-	A	R	X	Summary of all supplementary requirements as specified in the PO/PR/PS.
4	-	R	A	X	Packing procedure / shipping drawing of completed equipment.
5	R	R	R	X	WPS/PQR qualification / welder performance records including weld repair procedure.
6	-	R	W	X	Raw material inspection identification
7	-	R	W	X	heat treatment records / chart
8	-	H*	W	X	NDT (RT, UT, MPT, LPT – as applicable) examination
9	-	H	W	X	Stamping of samples for all required tests
10	-	H	W	X	Mechanical tests (as applicable) – Tensile testing – Bend / reverse bend – Flattening test – Flaring / flanging test – Impact test – Hardness check – IGC test / corrosion test
11	-	H	W	X	Product chemical check analysis from independent lab
12	-	H	W	X	Hydrostatic / Pneumatic / Eddy current test, as applicable (100% by vendor and at random by TPIA agency)
13	-	H	W	X	Other examination / tests, as applicable – Micro, Macro – Ferrite check in weld metal – Additional test specimen for mechanical testing
14	-	H	W	X	Check for galvanizing, pickling & passivation, as applicable
15	-	H	W	X	Final inspection – Visual examination – Dimension check – Verification of marking – Colour coding – Ends protection – Review of manufacturer's test certificate

<b>INDICATIVE INSPECTION &amp; TEST PLAN**</b>	SHEET 2 OF 2
<b>Project: 44AC9100 – Acrylic / Oxo Alcohol Project at Gujarat Refinery, Dumad</b>	

<b>EQUIPMENT / ITEM DESCRIPTION : SEAMLESS/WELDED PIPES</b>  EQUIPMENT / ITEM TAG NO. : TEST & INSPECTION AS PER : (CODES & SPECIFICATIONS) :	VENDOR : P.O. NO. :  PR/PS NO.: DRG. NO.:
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<b>A C T I V I T Y</b>	1	WITNESS INSPECTION AND / OR DOCUMENT REVIEW BY OWNER / PMC.			
	2	WITNESS INSPECTION AND / OR DOCUMENT REVIEW BY THIRD PARTY INSPECTION AGENCY (TPIA) NOMINATED BY LSTK / STATUTORY AUTHORITY.			
	3	WITNESS INSPECTION BY SUB VENDOR, VENDOR & LSTK CONTRACTOR.			
	4	CERTIFICATES / DATA TO BE SUBMITTED BY LSTK CONTRACTOR / VENDOR FOR APPROVAL / REVIEW BY TPIA / OWNER / PMC.			
16	-	H	W	X	PMI inspection for AS / SS pipes
17	-	H	H	X	Packing & loading of items as per shipping drawing
18	R	H	H	-	Inspection Release Certificate (IRC) by TPIA.

**LEGENDS: H - HOLD, W – WITNESS, R – REVIEW, A - APPROVAL, I – INFORMATION, X – SUBMIT  
 PO – PURCHASE ORDER, PR – PURCHASE REQUISITION, PS – PURCHASE SPECIFICATION**

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**\* TPIA TO CARRY OUT INSPECTION AT SUB-VENDORS' WORKS.**

**OWNER / PMC RESERVES RIGHT TO WITNESS INSPECTION OF ANY ITEM AT ANY STAGE WHICH SHALL BE INDICATED ON INSPECTION & TEST PLAN / QAP AT THE TIME OF APPROVAL AND SAME TO BE COVERED AS PART OF PURCHASE ORDER CONDITION ISSUED BY LSTK CONTRACTOR.**



## INDICATIVE INSPECTION &amp; TEST PLAN\*\*

Project: 44AC9100 – Acrylic / Oxo Alcohol Project at Gujarat Refinery, Dumad

SHEET 1 OF 1

EQUIPMENT / ITEM DESCRIPTION : FORGED FLANGES

VENDOR :  
P.O. NO. :EQUIPMENT / ITEM TAG NO. :  
TEST & INSPECTION AS PER :  
(CODES & SPECIFICATIONS) :PR/PS NO.  
DRG. NO.

A C T I V I T Y	1	WITNESS INSPECTION AND / OR DOCUMENT REVIEW BY OWNER / PMC.			
	2	WITNESS INSPECTION AND / OR DOCUMENT REVIEW BY THIRD PARTY INSPECTION AGENCY (TPIA) NOMINATED BY LSTK / STATUTORY AUTHORITY.			
	3	WITNESS INSPECTION BY SUB VENDOR, VENDOR & LSTK CONTRACTOR.			
	4	CERTIFICATES / DATA TO BE SUBMITTED BY LSTK CONTRACTOR / VENDOR FOR APPROVAL / REVIEW BY TPIA / OWNER / PMC.			
1	A	A	R	X	Detailed inspection & test plan after issue of PO/PR/PS
2	R	A	R	X	Inspection & test procedures including NDT procedures, PWHT procedure and weld repair procedures, etc.
3	-	R	R	X	Summary of all supplementary requirements as specified in the PO/PR/PS.
4	-	A	A	X	Packing procedure / shipping drawing of completed items.
5	-	H	W	X	Raw material inspection and identification.
6	-	R	W	X	Heat treatment records / chart
7	-	W	W	X	Stamping of samples for testing (samples / per heat / per heat treatment charge / per size)
8	-	H*	W	X	Mechanical testing for following tests: – Tensile test – Impact test (if applicable) – IGC or any other corrosion tests (if applicable) – Hardness check on samples
9	-	R	R	X	Product chemical check analysis from independent lab.
10	-	H	W	X	NDT (UT / LPT / MPT – as applicable) examination – 100%.
11	-	H	W	X	Final inspection – visual / dimensional inspection per each Size, Pressure Rating and Type (100% by Vendor/LSTK, 10% at random by TPIA).
12	-	H	W	X	Marking check / review of manufacturers test certificate & stamping/ review of IBR certificate, as applicable.
13	-	H	W	X	PMI inspection for AS / SS flanges.
14	H	H	W	X	Closeout of Concession Request (CR) / Non-Conformance Notice (NCN).
15	-	R	H	X	Packing & loading of items as per shipping drawing.
16	R	H	H	-	Inspection Release Certificate (IRC) by TPIA.
17	W	-	-	-	At Site – Dimensional inspection per each Size, Pressure Rating and Type: 1% by PMC and surprise check by Owner.

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\* TPIA TO CARRY OUT INSPECTION AT SUB-VENDORS' WORKS.

OWNER / PMC RESERVES RIGHT TO WITNESS INSPECTION OF ANY ITEM AT ANY STAGE WHICH SHALL BE INDICATED ON INSPECTION & TEST PLAN / QAP AT THE TIME OF APPROVAL AND SAME TO BE COVERED AS PART OF PURCHASE ORDER CONDITION ISSUED BY LSTK CONTRACTOR.



## INDICATIVE INSPECTION &amp; TEST PLAN\*\*

Project: 44AC9100 – Acrylic / Oxo Alcohol Project at Gujarat Refinery, Dumad

SHEET 1 OF 1

EQUIPMENT / ITEM DESCRIPTION : GASKET

VENDOR :

P.O. NO. :

EQUIPMENT / ITEM TAG NO. :

TEST &amp; INSPECTION AS PER :

(CODES &amp; SPECIFICATIONS) :

PR/PS NO.

DRG. NO.

A C T I V I T Y	1	WITNESS INSPECTION AND / OR DOCUMENT REVIEW BY OWNER / PMC.			
	2	WITNESS INSPECTION AND / OR DOCUMENT REVIEW BY THIRD PARTY INSPECTION AGENCY (TPIA) NOMINATED BY LSTK / STATUTORY AUTHORITY.			
	3	WITNESS INSPECTION BY SUB VENDOR, VENDOR & LSTK CONTRACTOR.			
	4	CERTIFICATES / DATA TO BE SUBMITTED BY LSTK CONTRACTOR / VENDOR FOR APPROVAL / REVIEW BY TPIA / OWNER / PMC.			
1	A	A	R	X	Detailed inspection & test plan after issue of PO/PR/PS
2	R	A	R	X	Inspection & test procedures.
3	-	R	R	X	Summary of all supplementary requirements as specified in the PO/PR/PS.
4	-	A	A	X	Packing procedure / shipping drawing of completed items.
5	-	H	W	X	Raw material inspection and identification.
6	-	H*	W	X	Stamping of samples for testing (samples per heat / per heat treatment charge / per size)
7	-	R	R	X	Product chemical analysis from NABL accredited lab.
8	-	W	W	X	Hardness check.
9	-	W	W	X	Supplementary requirement (if any) check
10	-	H	W	X	Final inspection – visual / dimensional check / sealability test/ Compressibility test.
11	-	H	H	X	Packing and loading of items as per shipping drawings.
12	R	R	R	X	Final documentation
13	R	H	H	-	Inspection Release Certificate (IRC) by TPIA.

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OWNER / PMC RESERVES RIGHT TO WITNESS INSPECTION OF ANY ITEM AT ANY STAGE WHICH SHALL BE INDICATED ON INSPECTION & TEST PLAN / QAP AT THE TIME OF APPROVAL AND SAME TO BE COVERED AS PART OF PURCHASE ORDER CONDITION ISSUED BY LSTK CONTRACTOR.

## INDICATIVE INSPECTION &amp; TEST PLAN\*\*

Project: 44AC9100 – Acrylic / Oxo Alcohol Project at Gujarat Refinery, Dumad

SHEET 1 OF 1

EQUIPMENT / ITEM DESCRIPTION : METTALIC GASKETS

VENDOR :  
P.O. NO. :EQUIPMENT / ITEM TAG NO. :  
TEST & INSPECTION AS PER :  
(CODES & SPECIFICATIONS) :PR/PS NO.  
DRG. NO.

A C T I V I T Y	1	WITNESS INSPECTION AND / OR DOCUMENT REVIEW BY OWNER / PMC.			
	2	WITNESS INSPECTION AND / OR DOCUMENT REVIEW BY THIRD PARTY INSPECTION AGENCY (TPIA) NOMINATED BY LSTK / STATUTORY AUTHORITY.			
	3	WITNESS INSPECTION BY SUB VENDOR, VENDOR & LSTK CONTRACTOR.			
	4	CERTIFICATES / DATA TO BE SUBMITTED BY LSTK CONTRACTOR / VENDOR FOR APPROVAL / REVIEW BY TPIA / OWNER / PMC.			
1	A	A	R	X	Detailed inspection & test plan after issue of PO/PR/PS
2	R	A	R	X	Inspection & test procedures.
3	-	R	R	X	Summary of all supplementary requirements as specified in the PO/PR/PS.
4	-	A	A	X	Packing procedure / shipping drawing of completed items.
5	-	H	W	X	Raw material inspection and identification.
6	-	W	W	X	Stamping of samples for testing (samples per heat / per heat treatment charge / per size)
7	-	H*	R	X	Product chemical analysis from NABL accredited lab.
8	-	W	W	X	Hardness check.
9	-	W	W	X	Supplementary requirement (if any) check
10	-	H	W	X	Final inspection – visual / face finish check / dimensional check
11	-	W	H	X	Packing & loading of items as per shipping drawing
12	R	R	R	X	Final documentation
13	R	H	H	-	Inspection Release Certificate (IRC) by TPIA.

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OWNER / PMC RESERVES RIGHT TO WITNESS INSPECTION OF ANY ITEM AT ANY STAGE WHICH SHALL BE INDICATED ON INSPECTION & TEST PLAN / QAP AT THE TIME OF APPROVAL AND SAME TO BE COVERED AS PART OF PURCHASE ORDER CONDITION ISSUED BY LSTK CONTRACTOR.