

Sun Petrochemicals Private Limited

(SunPetro)

Commercial & Supply Chain Management

8th Floor, ATL Corporate Park, Opp. L&T Gate no. 7,

Saki Vihar Road, Chandivali, Powai

Andheri (E), Mumbai – 400072, Maharashtra [INDIA]

www.sunpetro.com

CIN: U24219GJ1995PTC028519

No. SunPetro/Bhaskar/Capacity Augmentation/2023-24/SPPL-153/Bulletin-1 Date:25.10.2023

BULLETIN #1

Sub: Construction for Capacity Augmentation work of CPF, Bhaskar Field.

Ref: Tender No.: SunPetro/Bhaskar/Capacity Augmentation/2023-24/SPPL-153

Sun Petrochemicals Private Limited (SunPetro), hereby authorized following amendment / clarification in the above referred Tender:

Sr. No.	Description	Remarks
1	Bidder to note Addendum to Request for Quotation for Construction Contract of Mechanical, Piping, Electrical, Instrument & Control.	Document No: BHII-CPF-MEC-RFQ-003 (Addendum) attached herewith. Note for Submission of Technical Bid <i>Technical bid with the following of Bid Evaluation Criteria (BEC) to be submitted in soft copy (email) followed by hard copy (though courier) at Correspondence / Tendering office for technical evaluation.</i>
2	SunPetro hereby provides you excel file with consolidated the Schedule of Rates for individual disciplines into one single Master SOR file.	1. Excel file for consolidated the Schedule of Rates attached separately to offer the best rates. 2. Bidder to note that, in case, bidder needs to change anything in excel file such as make, specs etc. than bidder to highlight that portion in excel file for better understanding and evaluation of bid document. Note for Submission of Price Bid ❖ <i>Price Commercial Bid in pdf / zip format with a "Pass Code / Password" to be submitted on following e-mail address at DHEERAJ.PAROCH@sunpetro.com on or before Tender closing date and time.</i> ❖ <i>The passcode/password must to be sent only upon written request from Sunpetro at email address DHEERAJ.PAROCH@sunpetro.com failing which bid will not be considered for opening & further process.</i> ❖ <i>Hard copy (though courier) can also be submitted in separate envelope mentioning price bid.</i>

All other terms and conditions of the tender remain unchanged.

Regards,

Sun Petrochemicals Pvt. Ltd

Addendum to Request for Quotation
for
Construction Contract of Mechanical, Piping, Electrical,
Instrument & Control.
(Enclosed)



ADDENDUM TO REQUEST FOR QUOTATION FOR
CONSTRUCTION CONTRACTOR: MECHANICAL,
PIPING, ELECTRICAL AND INSTRUMENT &
CONTROL



DOC. NO: BHII-CPF-MEC-RFQ-003
(Addendum)

CLIENT: SUN PETROCHEMICALS PVT LTD

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


PROJECT NO: 23134

PROJECT: CENTRAL PROCESSING FACILITY
AUGMENTATION

REV: 00

**ADDENDUM TO REQUEST FOR QUOTATION
FOR CONSTRUCTION CONTRACT
OF
MECHANICAL, PIPING, ELECTRICAL,
INSTRUMENT & CONTROL**

Document No: BHII-CPF-MEC-RFQ-003 (Addendum)

					
00	20.10.2023	ISSUED FOR REVIEW	MM	KS	SPV
REV	DATE	PURPOSE	PREPARED BY	CHECKED BY	APPROVED BY



REQUEST FOR QUOTATION: Construction Contract - Mech,
Piping, Electrical, Instrumentation & Control (Addendum)
TAG NO: MEC-RFQ-003_R0 (Addendum)
TOTAL QTY: 1 Lot

Sht.: 1 of 1

JOB NUMBER				AREA				DIC.				CODE				NUMBER				REV							
RFQ NUMBER				X	X	X	X	C	P	F	M	C	RFQ				003				0						
ALWAYS QUOTE THIS NUMBER AS OUR REFERENCE																											
CLIENT								PROJECT								VENDOR								MATERIAL REQUIRED AT DESTINATION LATEST BY:			
 SUN PETROCHEMICALS PVT. LTD.								CENTRAL PROCESSING FACILITY AUGMENTATION								TBA											
																								DELIVERY ITEM NO.			
ALL ATTACHMENT MENTIONED HEREIN ARE INTERNAL PART OF THIS REQUISITION AND MUST BE CONSIDERED																											
LIST OF ATTACHMENTS														REVISION NUMBER OF THE REQUISITION													
SR. NO.		DOCUMENT NUMBER & DESCRIPTION												0	1	2	3	4									
1		SCHEDULE OF RATES (SOR)																									
(a)		BHII-CPF-PIP-SOR-3047 SCHEDULE OF RATES (SOR) PIPING												0	1												
(b)		BHII-CPF-INI-SOR-6033 SCHEDULE OF RATES (SOR) INSTRUMENTATION & CONTROLS												0	1												
2		INSTRUMENT DATASHEETS																									
3		SPECIFICATION FOR SURFACE COATING																									
4		SPECIFICATION FOR HOT INSULATION																									
NOTES:																											
1 All revisions of the material requisition and its attachments shall be retained. In case of change, only revised pages of attachments will be issued except while issuing order.																											
2 All changes described on the 'change description' summarize revisions only.																											
0		20/10/2023		Issued for review												MM		KS		SPV							
Rev		Date		Description												Prepd. by		Chkd By		App. By							



SCHEDULE OF RATES - PIPING



DOC. NO: BHII-CPF-PIP-SOR-3047

CLIENT: SUN PETROCHEMICALS PVT LTD.

REV: 01




PROJECT NO: 23134



PROJECT: CENTRAL PROCESSING FACILITY AUGMENTATION



DATE: 20/10/2023

SCHEDULE OF RATES (SOR) FOR PIPING

DOCUMENT NO: BHII-CPF-PIP-SOR-3047

					
1	20-10-2023	Issued for Approval	MM	KS	SPV
0	05-10-2023	Issued for Approval	MM	KS	SPV
Rev	DATE	DESCRIPTION	Prepared by	Checked by	Approved by

		SCHEDULE OF RATES																											
PROJECT																													
CAPACITY AUGMENTATION OF CPF FACILITY																													
SCHEDULE OF RATES - PIPING																													
Sl. NO.	ITEM	ITEM DESCRIPTION	SPEC	SIZE 1 NB	SIZE 2	NB	UOM	QTY	CONTINGENCY 20%	TOTAL QTY	UNIT RATE (INR) - SUPPLY	UNIT RATE (INR) - SERVICE	TOTAL PRICE (INR)	REMARKS															
1	PIPE	PIPE, SEAMLESS, BE, ASTM A106 GR.B, ASME B-36.10, 12 INCH, SCH 40	B7A	300			MTR	7	1	12	-			FIM															
2	PIPE	PIPE, SEAMLESS, BE, ASTM A106 GR.B, ASME B-36.10, 8 INCH, SCH 40	B7A	200			MTR	23	4	30	-			FIM															
3	PIPE	PIPE, ERW, BE, ASTM A53 GR.B, ASME B-36.10, 8 INCH, SCH 40	A7A	200			MTR	4	1	6	-			FIM															
4	PIPE	PIPE, SEAMLESS, BE, ASTM A106 GR.B, ASME B-36.10, 6 INCH, SCH 80	D7A	150			MTR	47	8	60	-			FIM															
5	PIPE	PIPE, SEAMLESS, BE, ASTM A106 GR.B, ASME B-36.10, 6 INCH, SCH 40	B7A	150			MTR	1	1	6	-			FIM															
6	PIPE	PIPE, SEAMLESS, BE, ASTM A106 GR.B, ASME B-36.10, 4 INCH, SCH 40	B7A	100			MTR	36	7	48																			
7	PIPE	PIPE, SEAMLESS, BE, ASTM A106 GR.B, ASME B-36.10, 3 INCH, SCH 40	B7A	80			MTR	33	7	42	-			FIM															
8	PIPE	PIPE, SEAMLESS, BE, ASTM A106 GR.B, ASME B-36.10, 2 INCH, SCH 160	D7A	50			MTR	12	3	18																			
9	PIPE	PIPE, SEAMLESS, BE, ASTM A106 GR.B, ASME B-36.10, 2 INCH, SCH 80	B7A	50			MTR	12	3	18																			
10	PIPE	PIPE, SEAMLESS, BE, ASTM A106 GR.B, ASME B-36.10, 1.5 INCH, SCH 80	B7A	40			MTR	1	1	6																			
11	PIPE	PIPE, SEAMLESS, PE, ASTM A106 GR.B, ASME B-36.10, 1.5 INCH, SCH 160	D7A	40			MTR	1	1	6																			
12	PIPE	PIPE, SEAMLESS, PE, ASTM A106 GR.B, ASME B-36.10, 1 INCH, SCH 160	D7A	25			MTR	1	1	6																			
13	PIPE	PIPE, SEAMLESS, PE, ASTM A106 GR.B, ASME B-36.10, 1 INCH, SCH 80	B7A	25			MTR	50	8	60																			
14	PIPE	PIPE, SEAMLESS, PE, ASTM A106 GR.B, ASME B-36.10, 0.75 INCH, SCH 160	B7A	20			MTR	3	1	6																			
15	PIPE	PIPE, SEAMLESS, PE, ASTM A106 GR.B, ASME B-36.10, 0.5 INCH, SCH 160	B7A	15			MTR	1	1	6																			
16	ELBOW	ELBOW 90, LR, BW, ASTM A234 WPB-S, ASME B-16.9, 12 INCH, SCH 40	B7A	300			NOS	1	1	2																			
17	ELBOW	ELBOW 45, LR, BW, ASTM A234 WPB-S, ASME B-16.9, 12 INCH, SCH 40	B7A	300			NOS	1	1	2																			
18	ELBOW	ELBOW 90, LR, BW, ASTM A234 WPB-S, ASME B-16.9, 8 INCH, SCH 40	B7A	200			NOS	14	3	17																			
19	ELBOW	ELBOW 45, LR, BW, ASTM A234 WPB-S, ASME B-16.9, 8 INCH, SCH 40	B7A	200			NOS	4	1	5																			
20	ELBOW	ELBOW 90, LR, BW, ASTM A234 WPB-S, ASME B-16.9, 8 INCH, SCH 40	A7A	200			NOS	1	1	2																			
21	ELBOW	ELBOW 45, LR, BW, ASTM A234 WPB-S, ASME B-16.9, 8 INCH, SCH 40	A7A	200			NOS	1	1	2																			
22	ELBOW	ELBOW 90, LR, BW, ASTM A234 WPB-S, ASME B-16.9, 6 INCH, SCH 40	B7A	150			NOS	4	1	5																			
23	ELBOW	ELBOW 45, LR, BW, ASTM A234 WPB-S, ASME B-16.9, 6 INCH, SCH 40	B7A	150			NOS	2	1	3																			
24	ELBOW	ELBOW 90, LR, BW, ASTM A234 WPB-S, ASME B-16.9, 6 INCH, SCH 80	D7A	150			NOS	15	3	18																			
25	ELBOW	ELBOW 45, LR, BW, ASTM A234 WPB-S, ASME B-16.9, 6 INCH, SCH 80	D7A	150			NOS	2	1	3																			
26	ELBOW	ELBOW 90, LR, BW, ASTM A234 WPB-S, ASME B-16.9, 4 INCH, SCH 40	B7A	100			NOS	10	2	12																			
27	ELBOW	ELBOW 45, LR, BW, ASTM A234 WPB-S, ASME B-16.9, 4 INCH, SCH 40	B7A	100			NOS	1	1	2																			
28	ELBOW	ELBOW 90, LR, BW, ASTM A234 WPB-S, ASME B-16.9, 3 INCH, SCH 40	B7A	80			NOS	8	2	10	-			FIM															
29	ELBOW	ELBOW 90, LR, BW, ASTM A234 WPB-S, ASME B-16.9, 2 INCH, SCH 160	D7A	50			NOS	5	1	6																			
30	ELBOW	ELBOW 90, LR, BW, ASTM A234 WPB-S, ASME B-16.9, 2 INCH, SCH 80	B7A	50			NOS	7	2	8																			
31	ELBOW	ELBOW 90, SW, 3000#, ASTM A105, ASME B-16.11, 1.5 INCH, SCH 160	D7A	40			NOS	2	1	3																			
32	ELBOW	ELBOW 90, SW, 3000#, ASTM A105, ASME B-16.11, 1 INCH, SCH 80	B7A	25			NOS	12	2	14																			
33	TEE	TEE, BW, ASTM A234 WPB-S, ASME B-16.9, 12 INCH, SCH 40	B7A	300			NOS	2	1	3																			
34	TEE	TEE, BW, ASTM A234 WPB-S, ASME B-16.9, 8 INCH, SCH 40	B7A	200			NOS	4	1	5																			
35	TEE	TEE, BW, ASTM A234 WPB-S, ASME B-16.9, 6 INCH, SCH 80	B7A	150			NOS	1	1	2																			
36	TEE	TEE, BW, ASTM A234 WPB-S, ASME B-16.9, 4 INCH, SCH 40	B7A	100			NOS	1	1	2																			
37	TEE	TEE, BW, ASTM A234 WPB-S, ASME B-16.9, 2 INCH, SCH 80	B7A	50			NOS	1	1	2																			
38	TEE	TEE, BW, ASTM A234 WPB-S, ASME B-16.9, 2 INCH, SCH 160	D7A	50			NOS	1	1	2																			
39	TEE	TEE, SW, 3000#, ASTM A105, ASME B-16.11, 1 INCH, SCH 80	B7A	25			NOS	19	4	23																			
40	TEE	TEE, SW, 3000#, ASTM A105, ASME B-16.11, 1 INCH, SCH 160	D7A	25			NOS	2	1	3																			
41	RED. TEE	RED. TEE, BW, ASTM A234 WPB-S, ASME B-16.9, 6 INCH X 4 INCH, SCH 40	B7A	150	100		NOS	1	1	2																			
42	RED. TEE	RED. TEE, BW, ASTM A234 WPB-S, ASME B-16.9, 4 INCH X 2 INCH, SCH 40/80	B7A	100	50		NOS	2	1	3																			
43	BALL VALVE	BALL VALVE, BODY: ASTM A216 GR.WCB, SEAT: RPTFE, STEM: AISI 410/SS316, REDUCE BORE, 300#, 125-250 µAARH, EN ISO 17292, OPERATION: GEAR OPERATED, 12 INCH	B7A	300			NOS	3	1	4																			
44	BALL VALVE	BALL VALVE, BODY: ASTM A216 GR.WCB, SEAT: RPTFE, STEM: AISI 410/SS316, REDUCE BORE, 300#, 125-250 µAARH, EN ISO 17292, OPERATION: GEAR OPERATED, 8 INCH	B7A	200			NOS	3	1	4																			
45	BALL VALVE	BALL VALVE, BODY: ASTM A216 GR.WCB, SEAT: RPTFE, STEM: AISI 410/SS316, REDUCE BORE, 300#, 125-250 µAARH, EN ISO 17292, OPERATION: GEAR OPERATED, 8 INCH	B7A	150			NOS	1	1	2																			
46	BALL VALVE	BALL VALVE, BODY: ASTM A216 GR.WCB, SEAT: RPTFE/DEVLOIN, STEM: AISI 410, FULL BORE, 600#, 125-250 µAARH, EN ISO 17293, OPERATION: GEAR OPERATED, 6 INCH	D7A	150			NOS	1	1	2																			
47	BALL VALVE	BALL VALVE, BODY: ASTM A216 GR.WCB, SEAT: RPTFE/DEVLOIN, STEM: AISI 410, FULL BORE, 300#, 125-250 µAARH, EN ISO 17293, OPERATION: GEAR OPERATED, 3 INCH	B7A	100			NOS	2	1	3																			
48	BALL VALVE	BALL VALVE, BODY: ASTM A216 GR.WCB, SEAT: RPTFE/DEVLOIN, STEM: AISI 410, FULL BORE, 300#, 125-250 µAARH, EN ISO 17293, OPERATION: GEAR OPERATED, 3 INCH	B7A	80			NOS	3	1	4																			
49	BALL VALVE	BALL VALVE, BODY: ASTM A216 GR.WCB, SEAT: RPTFE/DEVLOIN, STEM: AISI 410 / SS316, 600#, 125-250 µAARH, EN ISO 17292, OPERATION: LEVER, 2 INCH	D7A	50			NOS	2	1	3																			
50	BALL VALVE	BALL VALVE, BODY: ASTM A216 GR.WCB, SEAT: RPTFE/DEVLOIN, STEM: AISI 410 / SS316, 300#, 125-250 µAARH, EN ISO 17292, OPERATION: LEVER, 2 INCH	B7A	50			NOS	1	1	2																			
51	BALL VALVE	BALL VALVE, BODY: ASTM A216 GR.WCB/A105, SEAT: RPTFE, STEM: SS316, FULL BORE, 600#, 125-250 µAARH, EN ISO 17292, OPERATION: LEVER, 1 INCH	D7A	25			NOS	4	1	5																			
52	BALL VALVE	BALL VALVE, BODY: ASTM A216 GR.WCB/A105, SEAT: RPTFE, STEM: SS316, REDUCE BORE, 300#, 125-250 µAARH, EN ISO 17292, OPERATION: LEVER, 1 INCH	B7A	25			NOS	26	5	31																			
53	BALL VALVE	BALL VALVE, BODY: ASTM A105, SEAT: RPTFE, STEM: SS316, 300#, 125-250 µAARH, EN ISO 17292, OPERATION: LEVER, 0.5 INCH	B7A	15			NOS	10	2	12																			
54	GATE VALVE	GATE VALVE, BODY: ASTM A216 GR.WCB, TRIM-STEELLITED, STEM-13% CR. STEEL, 300#, 125-250 µAARH, API-600, OPERATION: HANDWHEEL, 8 INCH	B7A	200			NOS	2	1	3	-			FIM															
55	GATE VALVE	GATE VALVE, BODY: ASTM A216 GR.WCB, TRIM-STEELLITED, STEM-13% CR. STEEL, 600#, 125-250 µAARH, API-600, OPERATION: HANDWHEEL, 6 INCH	D7A	150			NOS	2	1	3																			
56	GATE VALVE	GATE VALVE, BODY: ASTM A216 GR.WCB, TRIM-STEELLITED, FLGD, 900#, ASME B - 16.5, RT1/63AARH, API-600, 0.75 INCH	B7A	20			NOS	10	2	12																			
57	NRV	CHECK VALVE, RF, BODY: ASTM A216 GR.WCB, TRIM-STEELLITED, STEM-13%CR. STEEL, 600#, 125-250 µ AARH, 6 INCH	D7A	150			NOS	1	1	2																			
58	NRV	CHECK VALVE, RF, BODY: ASTM A216 GR.WCB, TRIM-STEELLITED, STEM-13%CR. STEEL, 300#, 125-250 µ AARH, 4 INCH	B7A	100			NOS	2	1	3																			
59	NRV	CHECK VALVE, RF, BODY: ASTM A216 GR.WCB, TRIM-STEELLITED, STEM-13%CR. STEEL, 300#, 125-250 µ AARH, 3 INCH	B7A	80			NOS	2	1	3																			
60	NRV	CHECK VALVE, RF, BODY: ASTM A216 GR.WCB, TRIM-STEELLITED, STEM-13%CR. STEEL, 300#, 125-250 µ AARH, 2 INCH	B7A	50			NOS	2	1	3																			
61	NRV	CHECK VALVE, RF, BODY: ASTM A216 GR.WCB, TRIM-STEELLITED, STEM-13%CR. STEEL, 300#, 125-250 µ AARH, 1 INCH	B7A	25			NOS	8	2	10																			
62	CON. REDUCER	CON. REDUCER, BW, ASTM A234 GR. WPB, ASME B-16.9, 8 INCH X 6 INCH SCH 40	B7A	200	150		NOS	1	1	2																			
63	CON. REDUCER	CON. REDUCER, BW, ASTM A234 GR. WPB, ASME B-16.9, 8 INCH X 4 INCH SCH 40	B7A	200	100		NOS	6	2	8																			
64	CON. REDUCER	CON. REDUCER, BW, ASTM A234 GR. WPB, ASME B-16.9, 6 INCH X 3 INCH SCH 80	D7A	150	80		NOS	6	1	7																			
65	CON. REDUCER	CON. REDUCER, BW, ASTM A234 GR. WPB-S, ASME B-16.9, 3 INCH X 2 INCH SCH 40/80	B7A	80	50		NOS	1	1	2																			
66	CON. SWAGE	CON. SWAGE, PBE, 3000#, ASTM A105, BS 3799, 2 INCH X 1.5 INCH	D7A	50	40		NOS	2	1	3																			
67	CON. SWAGE	CON. SWAGE, PBE, 3000#, ASTM A105, BS 3799, 1 INCH X 0.75 INCH	B7A	25	20		NOS	10	2	12																			
68	CON. SWAGE	CON. SWAGE, PBE, 3000#, ASTM A105, BS 3799, 1 INCH X 0.5 INCH	B7A	25	15		NOS	8	2	10																			
69	ECC. REDUCER	ECC. REDUCER, BW, ASTM A234 GR. WPB, ASME B-16.9, 12 INCH X 8 INCH SCH 40	B7A	300	200		NOS	2	1	3																			
70	ECC. REDUCER	ECC. REDUCER, BW, ASTM A234 GR. WPB, ASME B-16.9, 8 INCH X 6 INCH SCH 40	B7A	200	150		NOS	4	1	5																			
71	ECC. REDUCER	ECC. REDUCER, BW, ASTM A234 GR. WPB, ASME B-16.9, 6 INCH X 3 INCH SCH 40	B7A	150	80		NOS	2	1	3																			
72	STRAINER	STRAINER 12" X 300# BASKET TYPE 80 MICRON MESS SIZE	B7A	300			NOS	2	1	3																			

			SCHEDULE OF RATES																									
PROJECT																												
CAPACITY AUGMENTATION OF CPF FACILITY																												
73	STRAINER	STRAINER 8" X 300# BASKET TYPE 80 MICRON MESS SIZE	B7A	200		NOS	2		1		3																	
74	FLANGE	WN FLANGE, RF, 300#, ASTM A105, 125-250 µAARH, ASME B-16.5, 12 INCH, SCH 40	B7A	300		NOS	10		2		12																	
75	FLANGE	WN FLANGE, RF, 300#, ASTM A105, 125-250 µAARH, ASME B-16.5, 8 INCH, SCH 40	B7A	200		NOS	21		4		25																	
76	FLANGE	SLIPON, FLANGE, RF, 150#, ASTM A105, 125-250 µAARH, ASME B-16.5, 8 INCH	A7A	200		NOS	1		1		2																	
77	FLANGE	WN FLANGE, RF, 600#, ASTM A105, 125-250 µAARH, ASME B-16.5, 6 INCH, SCH 80	D7A	150		NOS	13		2		15																	
78	FLANGE	WN FLANGE, RF, 300#, ASTM A105, 125-250 µAARH, ASME B-16.5, 6 INCH, SCH 40	B7A	150		NOS	6		2		8																	
79	FLANGE	WN FLANGE, RF, 300#, ASTM A105, 125-250 µAARH, ASME B-16.5, 4 INCH, SCH 40	B7A	100		NOS	8		2		10																	
80	FLANGE	WN FLANGE, RF, 600#, ASTM A105, 125-250 µAARH, ASME B-16.5, 3 INCH, SCH 80	D7A	80		NOS	6		2		8																	
81	FLANGE	WN FLANGE, RF, 300#, ASTM A105, 125-250 µAARH, ASME B-16.5, 3 INCH, SCH 40	B7A	80		NOS	3		1		4																	
82	FLANGE	WN FLANGE, RF, 600#, ASTM A105, 125-250 µAARH, ASME B-16.5, 2 INCH, SCH 160	D7A	50		NOS	10		2		12																	
83	FLANGE	WN FLANGE, RF, 300#, ASTM A105, 125-250 µAARH, ASME B-16.5, 2 INCH, SCH 80	B7A	50		NOS	8		2		10																	
84	FLANGE	SW FLANGE, RF, 600#, ASTM A105, 125-250 µAARH, ASME B-16.5, 1.5 INCH, SCH 160	D7A	40		NOS	3		1		4																	
85	FLANGE	SW FLANGE, RF, 300#, ASTM A105, 125-250 µAARH, ASME B-16.5, 1.5 INCH, SCH 160	B7A	40		NOS	2		1		3																	
86	FLANGE	SW FLANGE, RF, 600#, ASTM A105, 125-250 µAARH, ASME B-16.5, 1 INCH, SCH 160	D7A	25		NOS	8		2		10																	
87	FLANGE	SW FLANGE, RF, 300#, ASTM A105, 125-250 µAARH, ASME B-16.5, 1 INCH, SCH 160	B7A	25		NOS	55		11		66																	
88	FLANGE	SW FLANGE, RTJ, 900#, ASTM A105, 125-250 µAARH, ASME B-16.5, 0.75 INCH, SCH 160	E7A	20		NOS	10		2		12																	
89	FLANGE	SW FLANGE, RF, 300#, ASTM A105, 125-250 µAARH, ASME B-16.5, 1 INCH, SCH 160	B7A	15		NOS	10		2		12																	
90	FLANGE	BLIND FLANGE, RF, 300#, ASTM A105, 125-250 µAARH, ASME B-16.5, 6 INCH, SCH 40	B7A	150		NOS	1		1		2																	
91	FLANGE	BLIND FLANGE, RF, 300#, ASTM A105, 125-250 µAARH, ASME B-16.5, 4 INCH, SCH 40	B7A	100		NOS	1		1		2																	
92	FLANGE	BLIND FLANGE, RF, 600#, ASTM A105, 125-250 µAARH, ASME B-16.5, 1 INCH, SCH 160	D7A	25		NOS	2		1		3																	
93	FLANGE	BLIND FLANGE, RF, 300#, ASTM A105, 125-250 µAARH, ASME B-16.5, 1 INCH, SCH 160	B7A	25		NOS	17		4		21																	
94	SOCKOLET	SOCKOLET, 3000#, ASTM A105, MSS SP-97, 12 INCH X 1.5 INCH, SCH 40/80	B7A	300	40	NOS	2		1		3																	
95	SOCKOLET	SOCKOLET, 3000#, ASTM A105, MSS SP-97, 12 INCH X 1 INCH, SCH 40/80	B7A	300	25	NOS	7		1		9																	
96	SOCKOLET	SOCKOLET, 3000#, ASTM A105, MSS SP-97, 8 INCH X 1 INCH	B7A	200	25	NOS	8		2		10																	
97	SOCKOLET	SOCKOLET, 6000#, ASTM A105, MSS SP-97, 8 INCH X 1 INCH	D7A	200	15	NOS	2		2		4																	
98	SOCKOLET	SOCKOLET, 6000#, ASTM A105, MSS SP-97, 6 INCH X 1 INCH	D7A	150	25	NOS	2		2		4																	
99	STUD BOLT	STUD BOLT, BOLT: A193GR. B7, NUT: A194 GR 2H, ASME B18.2.1/ASME18.2.2, 12 INCH	B7A	M30x170L		SET	160		32		192																	
100	STUD BOLT	STUD BOLT, BOLT: A193GR. B7, NUT: A194 GR 2H, ASME B18.2.1/ASME18.2.2, 8 INCH	B7A	M24x160L		SET	12		3		15																	
101	STUD BOLT	STUD BOLT, BOLT: A193GR. B7, NUT: A194 GR 2H, ASME B18.2.1/ASME18.2.2, 8 INCH	B7A	M24x140L		SET	216		44		260																	
102	STUD BOLT	STUD BOLT, BOLT: A193GR. B7, NUT: A194 GR 2H, ASME B18.2.1/ASME18.2.2, 6 INCH	D7A	M27x170L		SET	132		27		159																	
103	STUD BOLT	STUD BOLT, BOLT: A193GR. B7, NUT: A194 GR 2H, ASME B18.2.1/ASME18.2.2, 6 INCH	B7A	M20x125L		SET	60		12		72																	
104	STUD BOLT	STUD BOLT, BOLT: A193GR. B7, NUT: A194 GR 2H, ASME B18.2.1/ASME18.2.2, 4 INCH	B7A	M20x110L		SET	100		20		120																	
105	STUD BOLT	STUD BOLT, BOLT: A193GR. B7, NUT: A194 GR 2H, ASME B18.2.1/ASME18.2.2, 3 INCH	D7A	M20x125L		SET	48		10		58																	
106	STUD BOLT	STUD BOLT, BOLT: A193GR. B7, NUT: A194 GR 2H, ASME B18.2.1/ASME18.2.2, 1.5 INCH	B7A	M20x90L		SET	8		2		10																	
107	STUD BOLT	STUD BOLT, BOLT: A193GR. B7, NUT: A194 GR 2H, ASME B18.2.1/ASME18.2.2, 2 INCH	B7A	M16x110L		SET	8		2		10																	
108	STUD BOLT	STUD BOLT, BOLT: A193GR. B7, NUT: A194 GR 2H, ASME B18.2.1/ASME18.2.2, 2 INCH	D7A	M16x120L		SET	32		7		39																	
109	STUD BOLT	STUD BOLT, BOLT: A193GR. B7, NUT: A194 GR 2H, ASME B18.2.1/ASME18.2.2, 2 INCH	D7A	M16x110L		SET	32		7		39																	
110	STUD BOLT	STUD BOLT, BOLT: A193GR. B7, NUT: A194 GR 2H, ASME B18.2.1/ASME18.2.2, 1.5 INCH	D7A	M20x110L		SET	8		2		10																	
111	STUD BOLT	STUD BOLT, BOLT: A193GR. B7, NUT: A194 GR 2H, ASME B18.2.1/ASME18.2.2, 1 INCH	D7A	M16x90L		SET	88		18		106																	
112	STUD BOLT	STUD BOLT, BOLT: A193GR. B7, NUT: A194 GR 2H, ASME B18.2.1/ASME18.2.2, 1 INCH	B7A	M16x80L		SET	256		52		308																	
113	STUD BOLT	STUD BOLT, BOLT: A193GR. B7, NUT: A194 GR 2H, ASME B18.2.1/ASME18.2.2, 0.75 INCH	E7A	M20x115L		SET	72		15		87																	
114	STUD BOLT	STUD BOLT, BOLT: A193GR. B7, NUT: A194 GR 2H, ASME B18.2.1/ASME18.2.2, 0.5 INCH	B7A	M14x65L		SET	88		18		106																	
115	GASKET	GASKET, 4.5mm THK./300#, SPIRAL WOUND GRAPHOIL FILLED, SS316 INNER AND VS OUTER RING, ASME B16.20, ASME 16.5, 12 INCH	B7A	300		NOS	10		2		12																	
116	GASKET	GASKET, 4.5mm THK./150#, SPIRAL WOUND GRAPHOIL FILLED, SS316 INNER AND VS OUTER RING, ASME B16.20, ASME 16.5, 8 INCH	A7A	200		NOS	1		1		2																	
117	GASKET	GASKET, 4.5mm THK./300#, SPIRAL WOUND GRAPHOIL FILLED, SS316 INNER AND VS OUTER RING, ASME B16.20, ASME 16.5, 8 INCH	B7A	200		NOS	19		4		23																	
118	GASKET	GASKET, 4.5mm THK./600#, SPIRAL WOUND GRAPHOIL FILLED, SS316 INNER AND VS OUTER RING, ASME B16.20, ASME 16.5, 6 INCH	D7A	150		NOS	9		2		11																	
119	GASKET	GASKET, 4.5mm THK./300#, SPIRAL WOUND GRAPHOIL FILLED, SS316 INNER AND VS OUTER RING, ASME B16.20, ASME 16.5, 6 INCH	B7A	150		NOS	6		2		8																	
120	GASKET	GASKET, 4.5mm THK./300#, SPIRAL WOUND GRAPHOIL FILLED, SS316 INNER AND VS OUTER RING, ASME B16.20, ASME 16.5, 4 INCH	B7A	100		NOS	8		2		10																	
121	GASKET	GASKET, 4.5mm THK./600#, SPIRAL WOUND GRAPHOIL FILLED, SS316 INNER AND VS OUTER RING, ASME B16.20, ASME 16.5, 3 INCH	D7A	80		NOS	6		2		8																	
122	GASKET	GASKET, 4.5mm THK./300#, SPIRAL WOUND GRAPHOIL FILLED, SS316 INNER AND VS OUTER RING, ASME B16.20, ASME 16.5, 3 INCH	B7A	80		NOS	3		1		4																	
123	GASKET	GASKET, 4.5mm THK./300#, SPIRAL WOUND GRAPHOIL FILLED, SS316 INNER AND VS OUTER RING, ASME B16.20, ASME 16.5, 2 INCH	B7A	50		NOS	8		2		10																	
124	GASKET	GASKET, 4.5mm THK./600#, SPIRAL WOUND GRAPHOIL FILLED, SS316 INNER AND VS OUTER RING, ASME B16.20, ASME 16.5, 2 INCH	D7A	50		NOS	6		2		8																	
125	GASKET	GASKET, 4.5mm THK./300#, SPIRAL WOUND GRAPHOIL FILLED, SS316 INNER AND VS OUTER RING, ASME B16.20, ASME 16.5, 1.5 INCH	B7A	40		NOS	2		1		3																	
126	GASKET	GASKET, 4.5mm THK./600#, SPIRAL WOUND GRAPHOIL FILLED, SS316 INNER AND VS OUTER RING, ASME B16.20, ASME 16.5, 1.5 INCH	D7A	40		NOS	2		1		3																	
127	GASKET	GASKET, 4.5mm THK./600#, SPIRAL WOUND GRAPHOIL FILLED, SS316 INNER AND VS OUTER RING, ASME B16.20, ASME 16.5, 1 INCH	D7A	25		NOS	10		2		12																	
128	GASKET	GASKET, 4.5mm THK./300#, SPIRAL WOUND GRAPHOIL FILLED, SS316 INNER AND VS OUTER RING, ASME B16.20, ASME 16.5, 1 INCH	B7A	25		NOS	67		14		81																	
129	GASKET	GASKET, 4.5mm THK./900#, SPIRAL WOUND GRAPHOIL FILLED, SS316 INNER AND VS OUTER RING, ASME B16.20, ASME 16.5, 0.75 INCH	E7A	20		NOS	10		2		12																	
130	GASKET	GASKET, 4.5mm THK./300#, SPIRAL WOUND GRAPHOIL FILLED, SS316 INNER AND VS OUTER RING, ASME B16.20, ASME 16.5, 0.5 INCH	B7A	15		NOS	20		4		24																	
131	SPECTACLE BLIND	SPECTACLE BLIND, RF, 300#, ASTM A105, 125-250 µAARH, ASME B-16.48, 8 INCH	B7A	200		NOS	1		1		2																	
132	ORIFICE	RESTRICTION ORIFICE, 2 INCH, 300# 6 THK, SS316	B7A	50		NOS	1		1		2																	
133	ORIFICE	RESTRICTION ORIFICE, 2 INCH, 600# 6 THK, SS316	D7A	50		NOS	1		1		2																	
134	INSULATION	THERMAL INSULATION FOR 12" PIPE LINE (50 mm Thick Insulation) - ROCKWOOL WITH ALUMINIUM CLADDING OF 1mm THK + SS BINDING WIRE + SS BAND OVER CLADDING				M2	7		2		9																	
135	INSULATION	THERMAL INSULATION FOR 8" PIPE LINE (50 mm Thick Insulation) - ROCKWOOL WITH ALUMINIUM CLADDING OF 1mm THK + SS BINDING WIRE + SS BAND OVER CLADDING				M2	30		6		36																	
136	INSULATION	THERMAL INSULATION FOR 6" PIPE LINE (50 mm Thick Insulation) - ROCKWOOL WITH ALUMINIUM CLADDING OF 1mm THK + SS BINDING WIRE + SS BAND OVER CLADDING				M2	54		11		65																	
137	INSULATION	THERMAL INSULATION FOR EXCHANGER E-101: (50 MM THICK INSULATION) - ROCKWOOL WITH ALUMINIUM CLADDING OF 1mm THK + SS BINDING WIRE + SS BAND OVER CLADDING WITH PROPER SEALING TO AVOID WATER INGRESS				M2	3																					
138	HOT TAPPING	HOT TAPPING WORK ON GAS PIPELINE SIZE OF HOT TAP: 12" BRANCH CONNECTION CLASS 300# MATERIAL: A106 Gr. B HOT TAP FITTINGS: FULL ENCIRCLEMENT SPLIT TEE WITH BACKING STRIP EXCLUDING FULL BORE BALL VALVE				NOS	1		----		1																	
139	EXECUTION OF HOT TAPPING WORK	EXECUTION OF HOT TAPPING WORK INCLUDING IN-SERVICE WELDING, INSTALLATION OF HOT TAP MACHINE AND ALL REQUIRED TOOLS, TACKLES AND ACCESSORIES				NOS	1		----		1																	
140	MOBILIZATION/ DEMOBILIZATION OF HOT TAPPING WORK	MOBILIZATION/ DEMOBILIZATION OF HOT TAP EQUIPMENT INCL. ACCESSORIES AND MANPOWER ETC.				NOS	1		----		1																	
141	PAINTING OF PIPES	PAINTING OF PIPES - AS PER PROJECT PAINTING SPECIFICATION - QPS_SC_001 SURFACE COATING - SYSTEM 5 FOR UN-INSULATED SURFACE AND SYSTEM 6 FOR INSULATED SURFACES.				SQ.M	200				200																	
Notes:																												
1	All pipes and pipe fittings must comply with Piping Material Specifications																											
2	All Valve must comply with Valve Material Specifications																											
3	The above quantities doesn't include construction contingency. Contractor to consider as required.																											
4	Construction contractor to consider 100% spare gasket and 10% fasteners as spare in their offer.																											
5	An engineering contingency of 20% is considered and Contractor to consider Construction contingency as required.																											
6	For Procurement and construction related notes refer to the attached SOW.																											
7	Supply cost shall include supply of materials per specification along with MTC, transportation to site, unloading, storage, safe keeping and reconciliation of materials as required.																											
8	Fabrication and testing cost should include welding, NDT, hydrotesting, Painting & preservation.																											
9	Erection cost shall include cost of erection and insitu welding and associated material handling as required to complete the activity.																											
10	Surplus materials and cut lengths shall be the property of the company and the same shall be handed over to the Company after site reconciliation.																											
11	Vendor to refer the Project Surface Coating specification - QPS_SC_001																											



SCHEDULE OF RATES - INSTRUMENTATION








DOC. NO: BHII-CPF-INI-SOR-6033	CLIENT: SUN PETROCHEMICALS PVT LTD.	REV: 01
PROJECT NO: 23134	PROJECT: CENTRAL PROCESSING FACILITY AUGMENTATION	DATE: 20/10/2023

CENTRAL PROCESSING FACILITY AUGMENTATION

SCHEDULE OF RATES - INSTRUMENTATION

DOCUMENT NO: BHII-CPF-INI-SOR-6033

					
1	20-10-2023	Issued for Approval	AK	SK	CDN
0	05-10-2023	Issued for Approval	MM	KS	SPV
Rev	DATE	Purpose of Issue	Prepared by	Checked by	Approved by

		SCHEDULE OF RATES - INSTRUMENTATION							
PROJECT							DOCUMENT NO:		
CENTRAL PROCESSING FACILITY AUGMENTATION							BHII-CPF-INI-SOR-6033		
							REV: 01		
Sr. No.	Description			Qty.	Unit	Make	Unit Rate (INR) - Supply	Unit Rate (INR) - Service	Total Price (INR)
A	Supply, testing, transport and installation of Instruments including handling, shifting from site-store/yard to the installation location, required hardware/fasteners, accessories, consumables,tagging etc,								
1.1	D.P type transmitter			8	Nos.	Rosemount/Endress Hauser			
1.2	Pressure gauge			4	Nos.	General			
1.3	Flame detector			2	Nos.	MSA Safety / Honeywell			
1.4	Motor operated valves - Free issue			4	Nos.	-	-		
1.5	Safety valves			3	Nos.	Brightech			
1.6	Control valves - Free issue			3	Nos.	-	-		
1.7	FTs			7	Nos.	Rosemount			
1.8	Orifice			4	Nos.	Precision / Emerson			
B	Calibration / refurbishment charges including handling, shifting from site-store / yard to the installation location, restore to safe place after calibration, removable and reinstallation from/to package units, if required, require tools & tackles, manpower, calibrators, calibration laboratory, changing range / engg. unit etc. as per data sheet, trouble shooting, preparation of reports, hardware/fasteners, consumables, Labelling (with range, date, tag), etc. all complete as per specification								
1.1	D.P type transmitter			8	Nos.	-			
1.2	Pressure gauge - Dia seal type, 2" Flanged conn.			4	Nos.	-			
1.3	Flame detector			2	Nos.	-			
1.4	Motor operated valve			4	Nos.	-			
1.5	DCS configuration, Development of graphics and testing			1	LOT	-			
1.6	Cause and effects checking			1	LOT	-			
1.7	Loop checking for field instruments			94	Nos.	-			
a	digital input /outputs			32	Nos.	-			
b	Analog input / outputs			16	Nos.	-			
c	Loop checking for MCC digital inputs/outputs			46	Nos.	-			
1.8	Safety valves			3	Nos.	-			
1.9	Control valves			3	Nos.	-			
1.10	Flow transmitters			7	Nos.	-			
1.11	Temperature transmitters			14	Nos.	-			
1.12	Temperature Gauges			15	Nos.	-			
C	Supply and laying of Armour cables								
1.1	Supply & laying of Armour cables								
1.1.1	1P x 1.0 mm2, Shielded Signal cable for AI/AO			1200	Meters	Polycab/KEI			
1.1.2	12Px1.0 mm2,Shielded(ind &Overall)Signal cable for AI/AO			1000	Meters				
1.1.3	1P x 1.0 mm2, Shielded Alarm cable for DI			1200	Meters				
1.1.4	12P x 1.0 mm2, Shielded (Overall) Alarm cable for DI			500	Meters				
1.1.5	2C x 1.5 mm2, Control Cable for DO			400	Meters				
1.1.6	1T X 1.5 mm2 GD cable			60	Meters				
1.1.7	8T X 1.5 mm2 GD cable			200	Meters				
1.2	Earthing cables PVC insulated Type 'C' - 85 °C as per IS 5831-1994 multi-stranded copper conductor wire in green colour								
1.2.1	1 x 2.5 MM2 multistrand copper cable, PVC insulated			300	Meters	Polycab/KEI			
1.2.2	1 x 6 MM2 multistrand copper cable, PVC insulated			200	Meters				
1.3	Cable glanding and termination with PVC hood								
	Includes glanding, ferulling ,lugging ,termination ,continuity checks for point to point wiring termination with supply of printed ferrules, Lugs, PVC tapes,PVC/Nylon cable tie,PVC sleeves for DC type cable glands								
1.3.1	size: 1 1/4"NPT x 12Px1 mm2 cable for AI/AO/DI			5	Nos.				
1.3.2	size: 1 " NPT x 6Px1 mm2 cable for AI/AO/DI			5	Nos.				
1.3.3	size: 1 "NPT x 12Cx1.5 mm2 cable for DO			5	Nos.				
1.3.4	size: 1 1/2"NPT x 24Cx1.5 mm2 cable for DO			5	Nos.				
1.3.5	size: 1/2" NPTx 1Px1.0 mm2 cable for AI/AO/DI			5	Nos.				
1.3.6	size: 1/2" NPTx 2Px1.0 mm2 cable for DI			5	Nos.				

1.3.7	size: 1/2" NPTx 1Tx1.5 mm2 cable for RTD/GD			5	Nos.	Standard			
1.3.8	size: 3/4" ETx 1Px1.0 mm2 cable with check nut			5	Nos.				
1.3.9	size: 3/4" ETx 2Cx1.5 mm2 cable with check nut			5	Nos.				
1.3.10	size: 3/4" ETx 3Cx1.5 mm2 cable with check nut			5	Nos.				
1.3.11	size: 3/4"ET x 3Cx2.5 mm2 cable with check nut			5	Nos.				
1.3.12	size: 1 1/4"ET x 12Px1.0 mm2 cable with check nut			5	Nos.				
1.3.13	size: 1 "ET x 6Px1.0 mm2 cable with check nut			5	Nos.				
1.3.14	size: 1 1/2"ET x 24Cx1.5 mm2 cable with check nut			15	Nos.				
1.3.15	size: 1 "ET x 12Cx1.5 mm2 cable with check nut			5	Nos.				
1.4	Supply of Die-cast Al Junction boxes IP-65 & flameproof to Ex'd' / Exe								
	Supply of Junction Box with 40 Terminals -Approx size: 350mm (W) x 350mm (H)			5	Nos.	Standard			
1.4.1	x150mm (D)								
	Fabrication & Erection of Ladder / Perforated GI Cable Tray including fabrication of bends, reducers, Tees and including supply of mounting SS.fastners (nut&bolts)								
1.5									
1.5.1	Perforated type, 2.0 mmthick					Standard			
	50 mm wide x 50 mm Height			400	Meters				
	100 mm wide x 50 mm Height			60	Meters				
	150 mm wide x 50 mm Height			90	Meters				
	300 mm wide x 50 mm Height			300	Meters				

1.6	Fabrication, Erection . Surface cleanning & epoxy Painting of structural Steel like Angle, Channels Flats, Plate. for support of Cable Trays, Panels, JB, Air Manifold & Field Inst.								
1.6.1	ANGLE ISA 50 X 50 X 6 mm Thk			250	Kgs	Standard			
1.6.2	CHANNEL ISMC 100 x 50 x6mm			250	Kgs				
1.6.3	Anchor fastner 12 MM X100 L			60	Nos.				
1.6.4	Anchor fastner 10 MM X100 L			120	Nos.				
1.7	Fabrication, Installation , surface cleanning & epoxy Painting of 2" Instrument Stand Pipe (Stanchion support) including supply of 4 nos of anchor fastners. Pipe shall be 2" size IS :1239 hvy duty.			8	Nos.				
1.8	Supply of tube fittings and Mislaneous items								
1.9	Transparent Tubes								
1.9.1	1/4" OD PVC tube Transparent, Max working Pressure : 150 PSI			25	Meters				
2	SS 316 Tubes.								
	Tube specification : • All stainless tubing shall be of SS316 seamless, bright finished, soft annealed as per ASTM A269 and to be supplied in 6-meter length, • All tubes shall be scratch free and suitable for bending.								
2.1	1/2", O.D. SS tube (Seamless) SS-316 (wall thickness 0.049"), MOC-316			24	Meters				
	3 Tubes fittings - Double compression type , & Fitting materials, MOC- SS316								
3.1	Cap(Nut) and Ferrule; 1/2" OD, MOC - SS316			5	Nos.	Standard			
3.2	Tube Union - Straight; 1/2" OD x 1/2"OD			5	Nos.				
3.3	Tube Union; 1/2"OD x 1/2" OD "L" type			5	Nos.				
3.4	Tube Male Connector; 1/2" NPT (M)x 1/2" O.D.			5	Nos.				
3.5	Tube Male elbow Connector; 1/2"NPT(M) x 1/2" OD "L" type			5	Nos.				
3.6	Tube Female Connector; 1/2"NPT (F)x 1/2" OD			5	Nos.				
3.7	Tube Union tee ; 1/2"OD x 1/2" OD, Equal "T" type			5	Nos.				
3.8	Tube Male Connector; 1/2" NPT (M)x 6mm OD with stainless steel cap(nut) and copper ferrule			5	Nos.				
3.9	Tube Male Connector ;1/2" NPT (M) x 3/8 inch O.D.			5	Nos.				
3.10	1/2"x1/2"Female NPT Needle Valve, SS316,			5	Nos.				
3.11	1/2"Male NPT X1/2" Female NPT angle Needle valve,			5	Nos.				
3.12	1/2"Male NPTx1/2"Female NPT Ball Valve,			5	Nos.				
3.13	Nipple; Hex, 1/2" Male NPT x 6" long,			5	Nos.				
3.14	Nipple; Hex.,1/2" Male NPT x 2" long, MOC-SS316,			5	Nos.				
3.15	Nipple; Hex, 1/2" NPT Male x 3" long, MOC-SS316,			5	Nos.				
3.16	Nipple; Hex, 1/2" NPT Male x 4" long, MOC-SS316,			5	Nos.				
3.17	Valve - Ball; 1/2"NPT(F) x 1/2" NPT(F),			5	Nos.				
3.18	Valve - Needle, 1/2" NPT Male x 1/2" NPT Female,			5	Nos.				
3.19	Plug - Blind; 1/2" Male NPT, MOC-SS316			5	Nos.				
3.20	Equal Tee 1/2"ODX 1/2"ODX 1/2"OD			5	Nos.				
	Instrument general consumables(additional Items - not to be part of cable laying work , tubing work shall be supplied as spares)								
4.1	Teflon Tape, Size: 1/2"			20	Nos.	Standard			
4.2	Terminals fork type 0.5 mm2 with soldered seam and easy-entry insulation			20	Nos.				
4.3	Terminals fork type 1 mm2 with soldered seam and easy-entry insulation			20	Nos.				
4.4	Terminals fork type 1.5 mm2 with soldered seam and easy-entry insulation			20	Nos.				
4.5	Pin cable lugs 0.5 mm2 DIN 46231with soldered seam and easy-entry insulation			20	Nos.				
4.6	Pin cable lugs 1 mm2 DIN 46231with soldered seam and easy-entry insulation			20	Nos.				
4.7	Pin cable lugs 1.5 mm2 DIN 46231with soldered seam and easy-entry insulation			20	Nos.				
4.8	Tube-shape Copper Cord end terminals/Cable lugs 0.5 mm2			20	Nos.				
4.9	Tube-shape Copper Cord end terminals/Cable lugs 1 mm2			20	Nos.				
4.10	Tube-shape Copper Cord end terminals/Cable lugs 1.5 mm2			20	Nos.				
4.11	Tube-shape Copper Cord end terminals/Cable lugs twin entry 0.5 mm2			20	Nos.				



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4	DATASHEET	1

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A. Jethava S. S. S.

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R	1	Tag No.	PSV-V103_1		PSV-V103_2	
	2	Service	Safety Inlet Pipeline		Safety Inlet Pipeline	
	3	Quantity	1 Nos.		01 (Nos)	
	4	P&ID No.	1019-PS-PID-105		1019-PS-PID-105	
R	5	Vessel Protected	V-103		V-103	
	6	Inlet Line No & Material	50-PV-B7A-10504 & ASTM A 106 GR. B		50-PV-B7A-10504 & ASTM A 106 GR. B	
	7	Outlet Line No & Material	100-VG-A7A-10505 & ASTM A 106 GR. B		100-VG-A7A-10505 & ASTM A 106 GR. B	
	8	Inlet line Size, Sch & Rating	50mm, Sch 80 & 300#		50mm, Sch 80 & 300#	
R		Outlet line Size, Sch & Rating	100mm, Sch 80 & 150#		100mm, Sch 80 & 150#	
	9	Application Type	Safety/Relief		Relief valve	
	10	Type of Valve	Bellows		Bellows	
	11	Type of Nozzle:	Full		Full	
R	12	Bonnet Type: Open,Close	Close		Close	
	13	Inlet/ Outlet Size	40/ 80 mm		40/ 80 mm	
	14	Rating /Facing :	Inlet/Outlet	300# RF /150# RF	300# RF /150# RF	
	15	Finish :	125-250 microinch AARH		125-250 microinch AARH	
R	16	Design Pressure	Kg/cm2g	3.5 VTA	3.5 VTA	
	17	Design Temperature	°C	80	80	
	18					
	19	Body and Bonnet	ASTM A 216 GR.WCB		ASTM A 216 GR.WCB	
R	20	Seat / Disk	SS316		SS316	
	21	Resilient Seat Seal	*		*	
	22	Nozzle	SS316		SS316	
	23	Guide / Rings	SS		SS	
R	24	Spring	SS304		SS304	
	25	Adjusting screw/Lock Nut	SS304/SS304		SS304/SS304	
	26	Bellows	Yes		Yes	
	27	Cap Screwed or Bolted	Screwed		Screwed	
R	28	Lever : Plain or Packed	Packed		Packed	
	29	Test Gag	Required		Required	
	30					
	31	Code	API-520/521		API-520/521	
R	32	Basis of Selection	Blocked Discharge		Blocked Discharge	
	33	Rupture Disc	No		No	
	34	Fluid / State	PV / V		PV / V	
	35	Fluid discharged to	FLARE HEADER		FLARE HEADER	
R	36	Fluid type	VG		VG	
	37	Relieving Capacity	Kg/hr	488	488	
	38	Density @ rel. temp.		2.4 kg/m3	2.4 kg/m3	
	39	Op.Pressure	Kg/cm2g	ATM	ATM	
R	40	Set Pressure	Kg/cm2g	1	1	
	41	Op. Temp	°C	49	49	
	42	Rel. Temp	°C	86.6	86.6	
	43	Back Pressure	Constant	Kg/cm2g	0.2	0.2
R	44		Variable	Kg/cm2g	-	-
	45		Builtup	Kg/cm2g	0.01	0.01
	46		Total	Kg/cm2g	0.21	0.21
R	47	Spring Set Pressure Range	VTA		VTA	
	48	Cold Diff Test Pressure	VTA		VTA	
	49	Relieving Pressure,	kg/cm ² g	1.2	1.2	
	50	% allowable Over Pressure	10%		10%	
R	51	Over Pr. factor / Disch. Coeff	VTA		VTA	
	52	Compressibility Factor	1.00		1.00	
	53	Latent Heat of Vaporization, kcal/kg	181.2		181.2	
	54	Cp / Cv	1.14		1.14	
R	55	Relieving Viscosity	cP	0.01	0.01	
	56	Molecular Weight	33.4		33.4	
	57					
	58	Calculated Area in2	Selected Area in2	0.36859063297547 (VTA)	0.503 (VTA)	0.36859063297547 (VTA) 0.503 (VTA)
R	59	Orifice designation	G		G	
	60	Total Rated Relief Flow	kg/h	666 (VTA)	666 (VTA)	
	61					
	62	Peso/DGMS as applicable	*		*	
R	63					
	64					
	65					
R	66	Requisition No.				
	67	Manufacturer	*		*	
	68	Model No.	*		*	
	69	Serial No.	*		*	
R	70					

Notes:

* Vendor to specify / confirm.

Vendor to submit sizing calculation with offer.



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R	1	Tag No.	PSV-P101C	
	2	Service	Safety Inlet Pipeline	
	3	Quantity	1 Nos.	
	4	P&ID No.	1019-PS-PID-166	
	5	Vessel Protected	-	
R	6	Inlet Line No & Material	150-E02-B7A-11211-C & ASTM A 106 GR. B	
	7	Outlet Line No & Material	150-E01-A7A-11212-C & ASTM A 106 GR. B	
	8	Inlet line Size, Sch & Rating	150 mm, Sch 40 & 300#	
		Outlet line Size, Sch & Rating	150 mm, Sch 40 & 150#	
	9	Application Type Safety/Relief	Relief valve	
R	10	Type of Valve	Bellows	
	11	Type of Nozzle:	Full	
	12	Bonnet Type: Open,Close	Close	
	13	Inlet/ Outlet Size	80/100 mm	
	14	Rating /Facing :	Inlet/Outlet	300# RF /150# RF
R	15	Finish :	125-250 microinch AARH	
	16	Design Pressure	Kg/cm2g	93
	17	Design Temperature	°C	80
	18			
	19	Body and Bonnet	ASTM A 216 GR.WCB	
M	20	Seat / Disk	SS316	
	21	Resilient Seat Seal	*	
	22	Nozzle	SS316	
	23	Guide / Rings	SS	
	24	Spring	SS304	
R	25	Adjusting screw/Lock Nut	SS304/SS304	
	26	Bellows	Yes	
	27	Cap Screwed or Bolted	Screwed	
	28	Lever : Plain or Packed	Packed	
	29	Test Gag	Required	
R	30			
	31	Code	API-520/521	
	32	Basis of Selection	Blocked Discharge	
	33	Rupture Disc	No	
	34	Fluid / State	EO2 / L	
R	35	Fluid discharged to	T-101 A/B	
	36	Fluid type	CRUDE OIL	
	37	Relieving Capacity	m3/hr	195
	38	Density @ rel. temp.	793-802	
	39	Op.Pressure	Kg/cm2g	27
	40	Set Pressure	Kg/cm2g	32
	41	Op. Temp	°C	20-45
	42	Rel. Temp	°C	20-45
	43	Back Pressure	Constant	Kg/cm2g 0.2
	44		Variable	Kg/cm2g -
	45		Builtup	Kg/cm2g -
	46		Total	Kg/cm2g 0.2
	47	Spring Set Pressure Range	VTA	
	48	Cold Diff Test Pressure	VTA	
	49	Relieving Pressure,	kg/cm ² g	36.9
	50	% allowable Over Pressure	10%	
	51	Over Pr. factor / Disch. Coeff	VTA	
	52	Compressibility Factor	-	
	53	Latent Heat of Vaporization, kcal/kg	343.5	
	54	Cp / Cv	-	
	55	Relieving Viscosity	cP	3-30
	56	Molecular Weight	-	
	57			
R	58	Calculated Area in2	Selected Area in2	1.36750151783477 (VTA) 1.838 (VTA)
	59	Orifice designation	K	
	60	Total Flow Capacity	kg/h	191200 (VTA)
R	61			
	62	Peso/DGMS as applicable	*	
	63			
	64			
	65			
R	66	Requisition No.		
	67	Manufacturer	*	
	68	Model No.	*	
	69	Serial No.	*	
	70			

Notes:

* Vendor to specify / confirm.

Vendor to submit sizing calculation with offer.



Datasheet for Differential Pressure Transmitters



Datasheet for Differential Pressure Transmitters

Datasheet for Differential Pressure Transmitters

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Datasheet for Differential Pressure Transmitters

Datasheet for Differential Pressure Transmitters

Datasheet for Differential Pressure Transmitters

Datasheet for Differential Pressure Transmitters

R	Datasheet for Differential Pressure Transmitters	
1	COVER SHEET	1
2	TABLE	1
3	DATASHEET FOR DIFFERENTIAL PRESSURE TRANSMITTERS	1

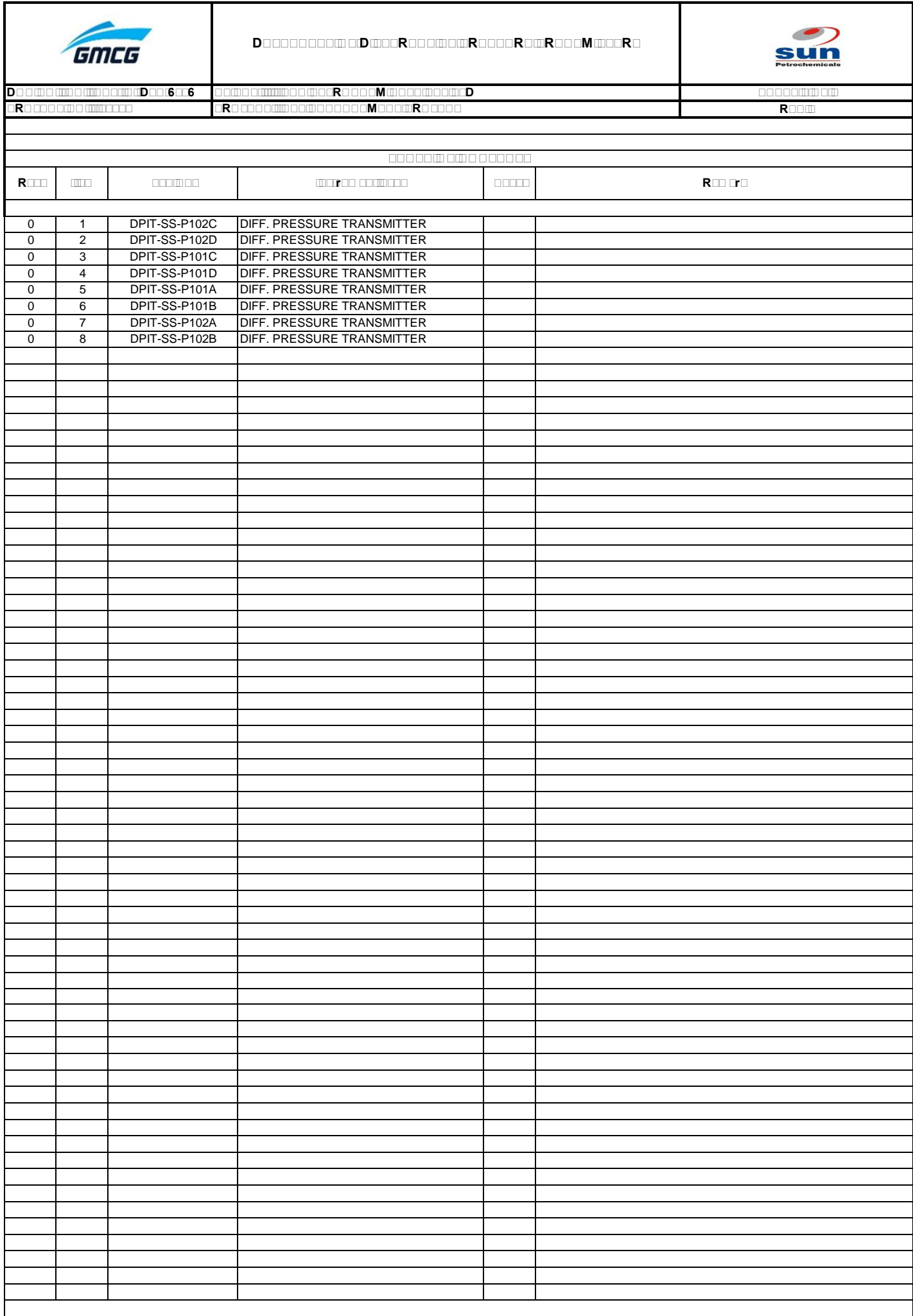
Datasheet for Differential Pressure Transmitters

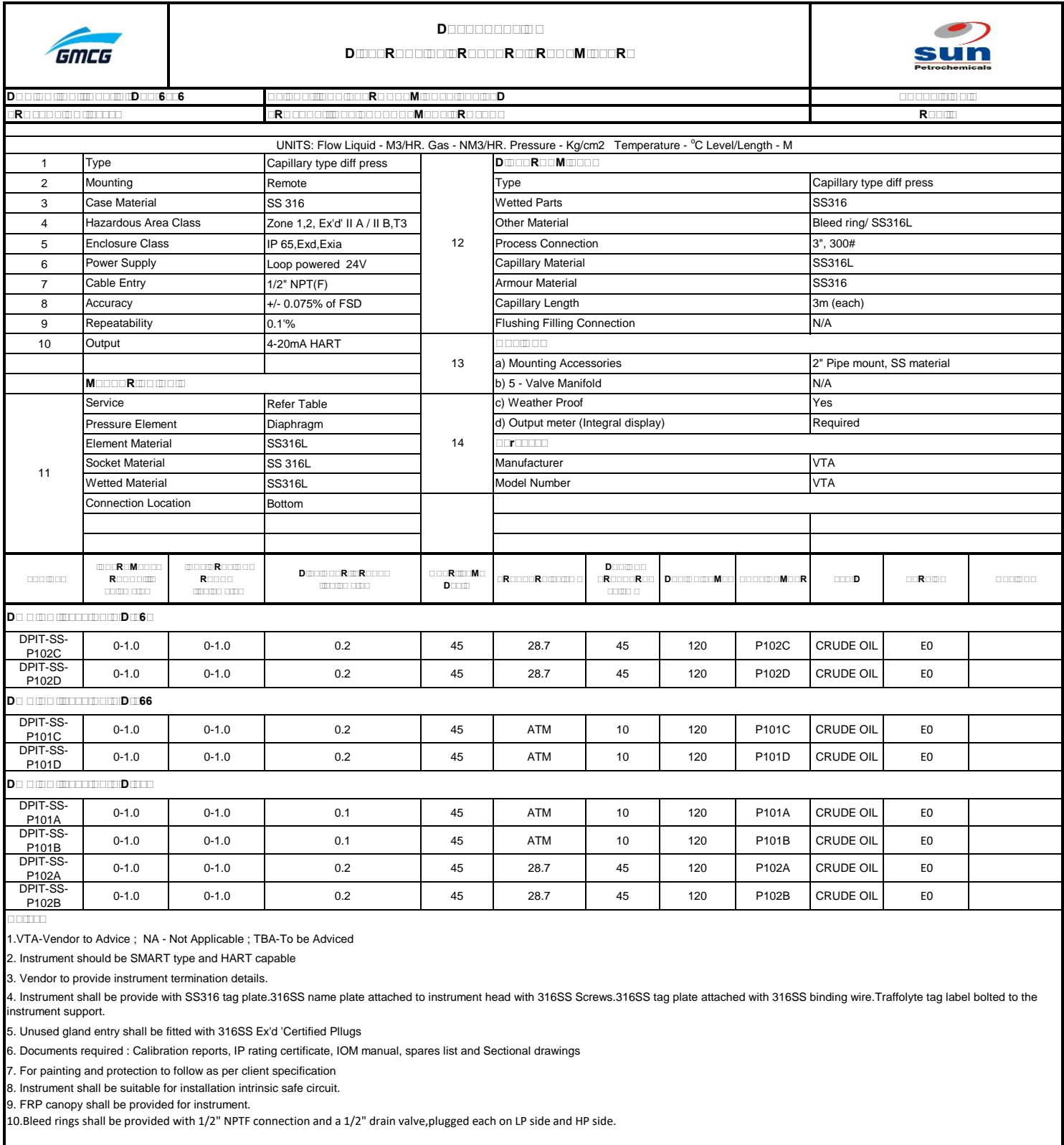
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D R R R

R	D R	
1	COVER SHEET	1
2	TABLE OF CONTENTS	1
3	DATASHEET	1

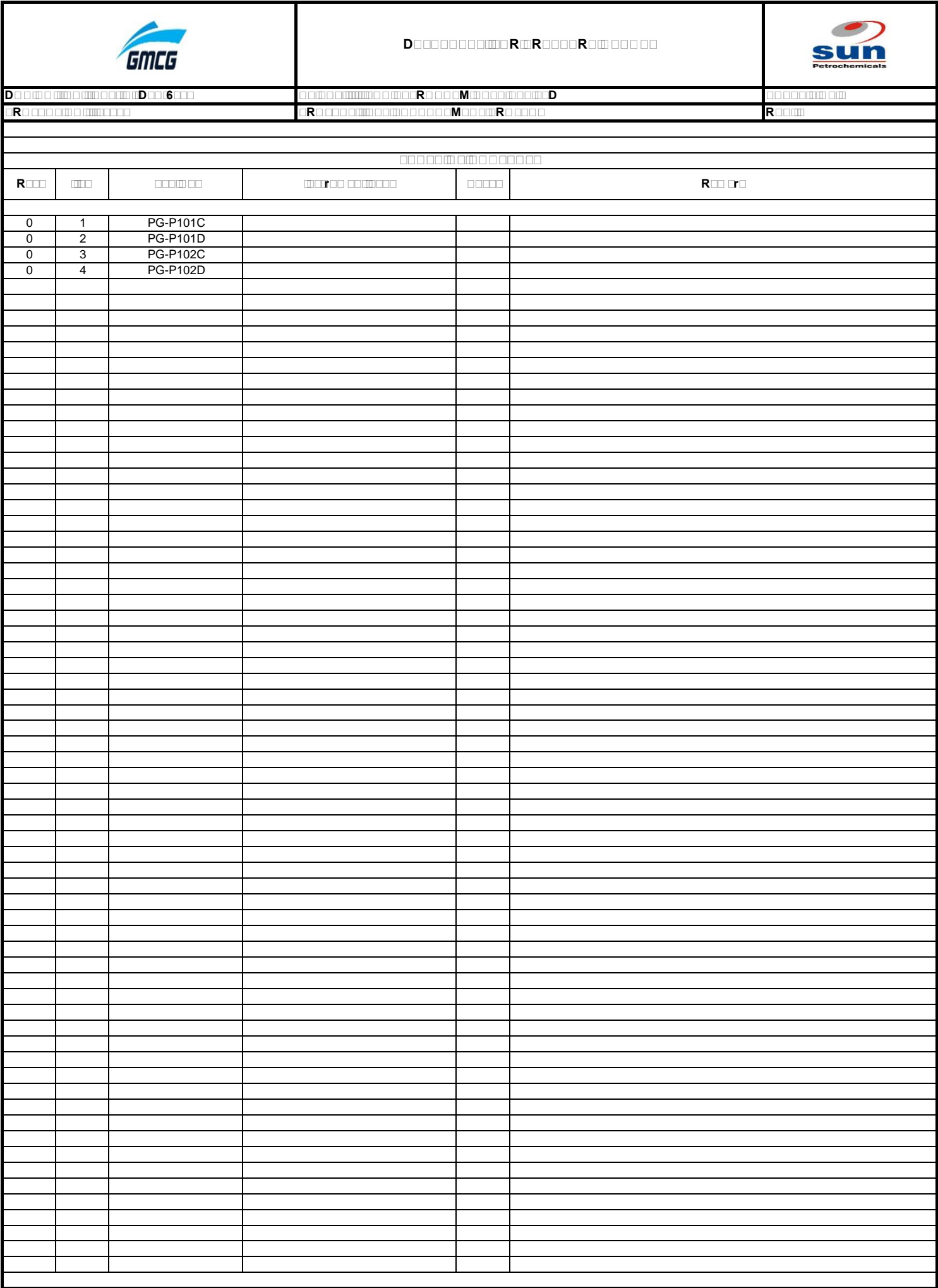
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NOTES:-

1.All certificates and documentation required to satisfy the conditions of the certification shall be provided in the Hazardous Area Dossier.

2.Bleed rings shall be provided with 1/2" NPTF connection and a 1/2" drain valve plugged on one side.



Datasheet for DP Type Flow Transmitters



Datasheet for DP Type Flow Transmitters

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Datasheet for DP Type Flow Transmitters

Datasheet for DP Type Flow Transmitters

Datasheet for DP Type Flow Transmitters

Datasheet for DP Type Flow Transmitters

Datasheet for DP Type Flow Transmitters

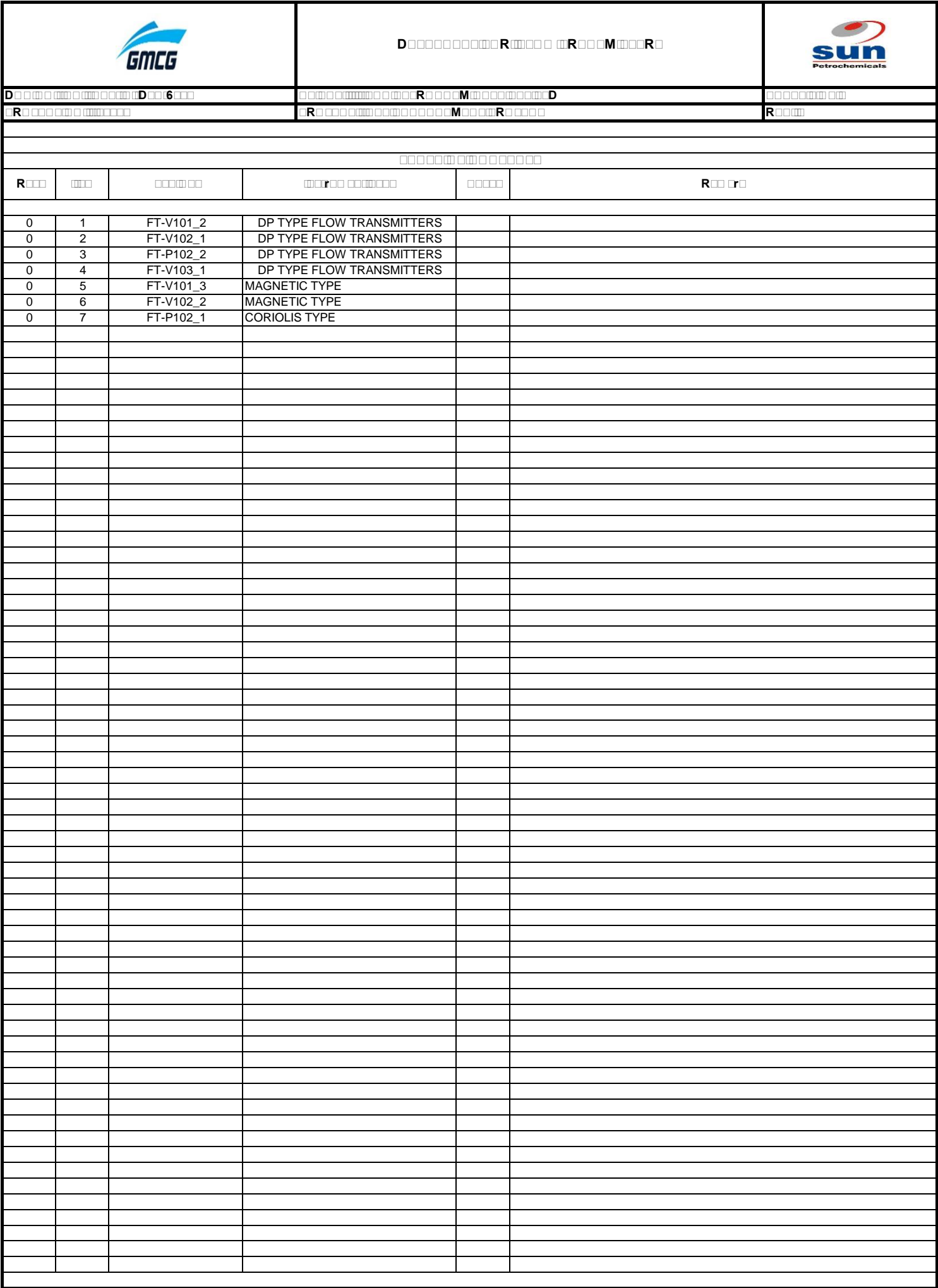
Datasheet for DP Type Flow Transmitters

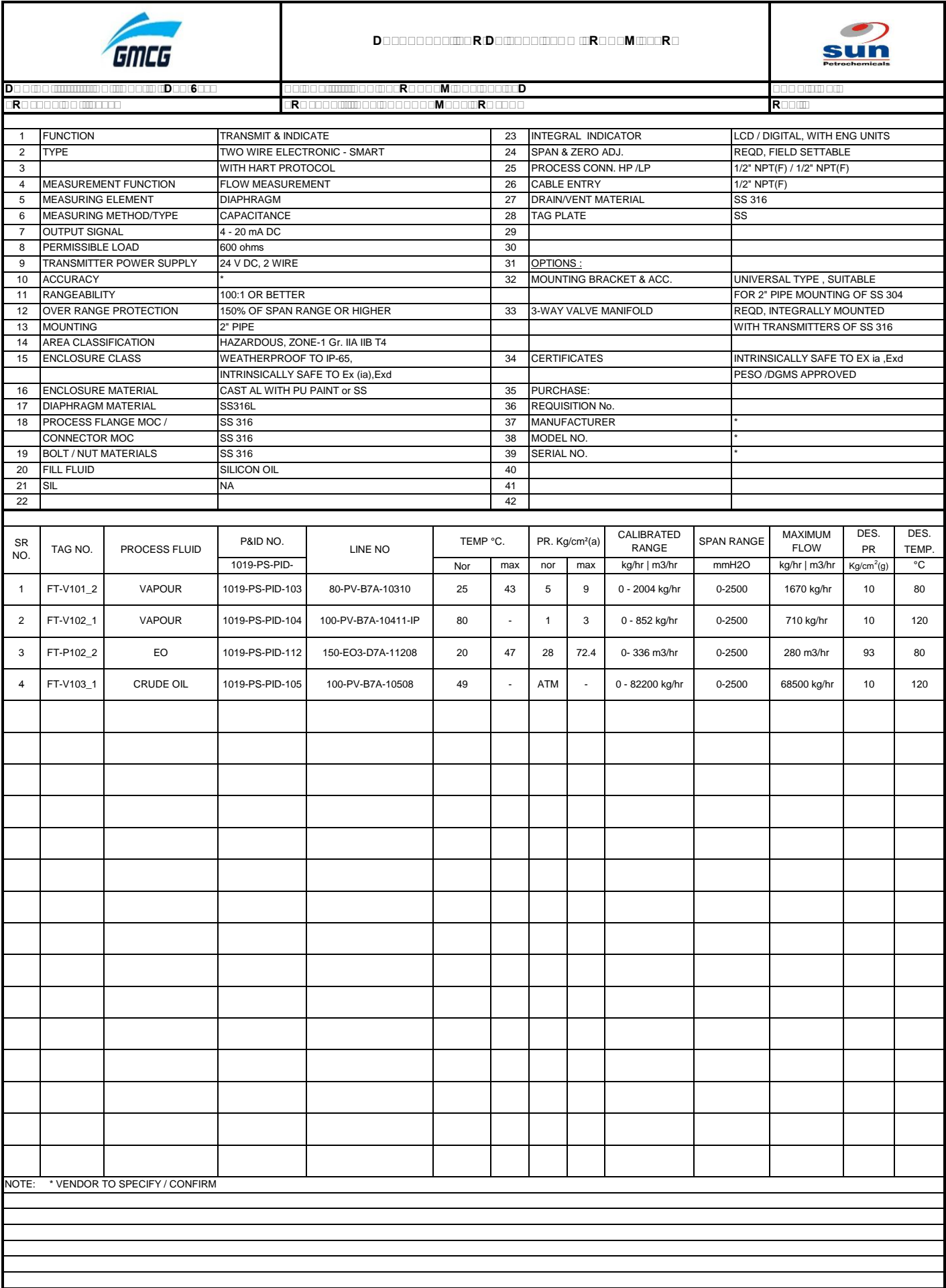
Datasheet for DP Type Flow Transmitters

R	Datasheet for DP Type Flow Transmitters	Page
1	COVER SHEET	1
2	TABLE OF CONTENTS	1
3	DATASHEET FOR DP TYPE FLOW TRANSMITTERS	1
4	DATASHEET FOR MAGNETIC FLOW TRANSMITTER	1
5	DATASHEET FOR MAGNETIC FLOW TRANSMITTER	1
6	DATASHEET FOR MASS FLOW TRANSMITTER	1

Datasheet for DP Type Flow Transmitters

1	14-10-2023	ISSUED FOR APPROVAL	AK	SK	CDN
0	13-10-2023	ISSUED FOR APPROVAL	AK	SK	CDN
R	D	R		D	R





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Vendor shall confirm suitability of instrument for the revision of calibration range

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Vendor shall confirm suitability of instrument for the revision of calibration range

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R	D R	
1	COVER SHEET	1
2	GENERAL SPECIFICATIONS FOR ORIFICE PLATE	2
3	TABLE OF CONTENTS	1
4	ORIFICE PLATE SPECIFICATIONS	2

R R D R

A. H. Khan S. Khan C. Khan

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This specification covers the general requirements for the design, engineering, sizing and selection of various types of ORIFICE plate. Supplier shall select the Orifice Plate, as per the details mentioned below and as specified in data sheets. This shall not absolve or limit the supplier's responsibility. Supplier shall be responsible for the correctness of the selection of type, material, sizing and performance of the Orifice Plate for the given process conditions.

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Design, materials, manufacturing, examination, inspection, testing and documentation shall confirm to the latest editions of codes and standards as mentioned below :

ISO-5167 : Measurement of Fluid flow by means of Orifice Plates, Nozzles and Venturi Tubes inserted in Circular Cross-section Conduits
API RP 551 : Process Measurement Instrumentation, Part-I Process Control & Instrumentation

- 2.1 The correction factor for viscosity and Reynolds number shall be taken as 1.0 for orifice bore calculations unless an estimated viscosity is given in the data sheets.
- 2.2 For gas service Cp/Cv ratio of 1.3 may be used in the calculation of the orifice bore calculations when no value is mentioned in the data sheets.
- 2.3 Orifice bore diameter shall not be less than 6mm (1/4"), use of smaller sizes requires consultant/ Owner approval. Vent / Drain holes shall be provided in orifice plates having bore diameter more than 1" or wherever necessary. Orifice d/D ratio shall be normally considered 0.4 to 0.75. Thickness of orifice plate shall be as specified in data sheet.
- 2.4 Flow measurements with orifice meters with single DP transmitter shall be designed with a rangeability of 1:4

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- 3.1.1 Flow measurements shall normally be carried out using a thin square edged concentric orifice plate mounted between a pair of weld neck flanges of minimum 300# ANSI rating for line size 2" and above
- 3.1.2 Flange taps shall be used for line sizes upto 14" while D-D/2 taps shall be used for line sizes 16" and above
- 3.1.3 Quadrant edge or quarter circle orifice plates shall be used when lower Reynolds number does not permit the use of squared edge concentric orifices as per code. Conical entrance type of orifice plates shall preferably be used for highly viscous liquids upto throat Reynolds number of 250. Segmental Type Orifice Plate shall be used for fluid containing Impurities.
- 3.1.4 The upstream and downstream face of the orifice plate shall be smooth, free from pits, burns and scratches
- 3.1.5 Sizing of the orifice plate shall be in accordance with ISO-5167. Other sizing methods like AGA Report No.3 shall be used when specified

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- 4.1 Orifice plate shall be identified with the following information punched on the upstream side of orifice on a tag (handle) of same material as orifice and welded on it.
 - a. Tag Number.
 - b. Material of construction of orifice plate
 - c. Orifice Bore diameter.(d)
 - d. Flow direction (inlet face shall be stamped '+' or 'UPSTREAM').
 - e. Nominal Line size in mm

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- 5.1 Vendor shall submit the following with the bid.
 - a. catalogues/literature for all models offered.
 - b. Sizing data, pressure drop calculations and accuracy data at specified flow rates
 - c. Detail specification
 - d. Typical General Arrangement Drawings for orifice plate assembly
 - e. Supplier's Exceptions, Deviations & Clarifications
 - f. IBR - Form IIC certification, wherever applicable.



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- 6.1 The vendor shall be responsible for completing all in - house testing and test reports for the same shall be ready before inspection by the clients / Illrd party.

Following tests shall be offered as a minimum. Percentages indicated are for each lot offered for inspection. These are indicative only and the quantity of tags selected as well as the inspection procedure followed, shall be at the sole discretion of inspection engineer of the clients / Illrd party. The inspecting authority may. If desired, request for additional tests over and above those listed below or decide to waive the inspection.

R	D	R			R
		D	R	RD	
1	Visual inspection for quantity, and conformity with specifications.	100%	100%		
2	Mechanical and dimensional inspection.	100%	100%		
3	Material Inspection , Chemical Compositions b) Mechanical Properties a)	100%	10% (Review)		

- 6.2 The vendor shall arrange for all the instruments required for inspection and testing. Least count of measuring instruments shall be at least ten times better than the minimum tolerance given in the specifications.

All the test and measuring instruments shall be calibrated in a standard laboratory and the vendor shall produce valid calibration documents for the purposes of verification. The calibration shall be traceable to any of the approved national laboratories.

- 6.3 Cost of material testing, meter run calibration in a flow-laboratory, inspection by statutory authorities, etc., shall be borne by the vendor.

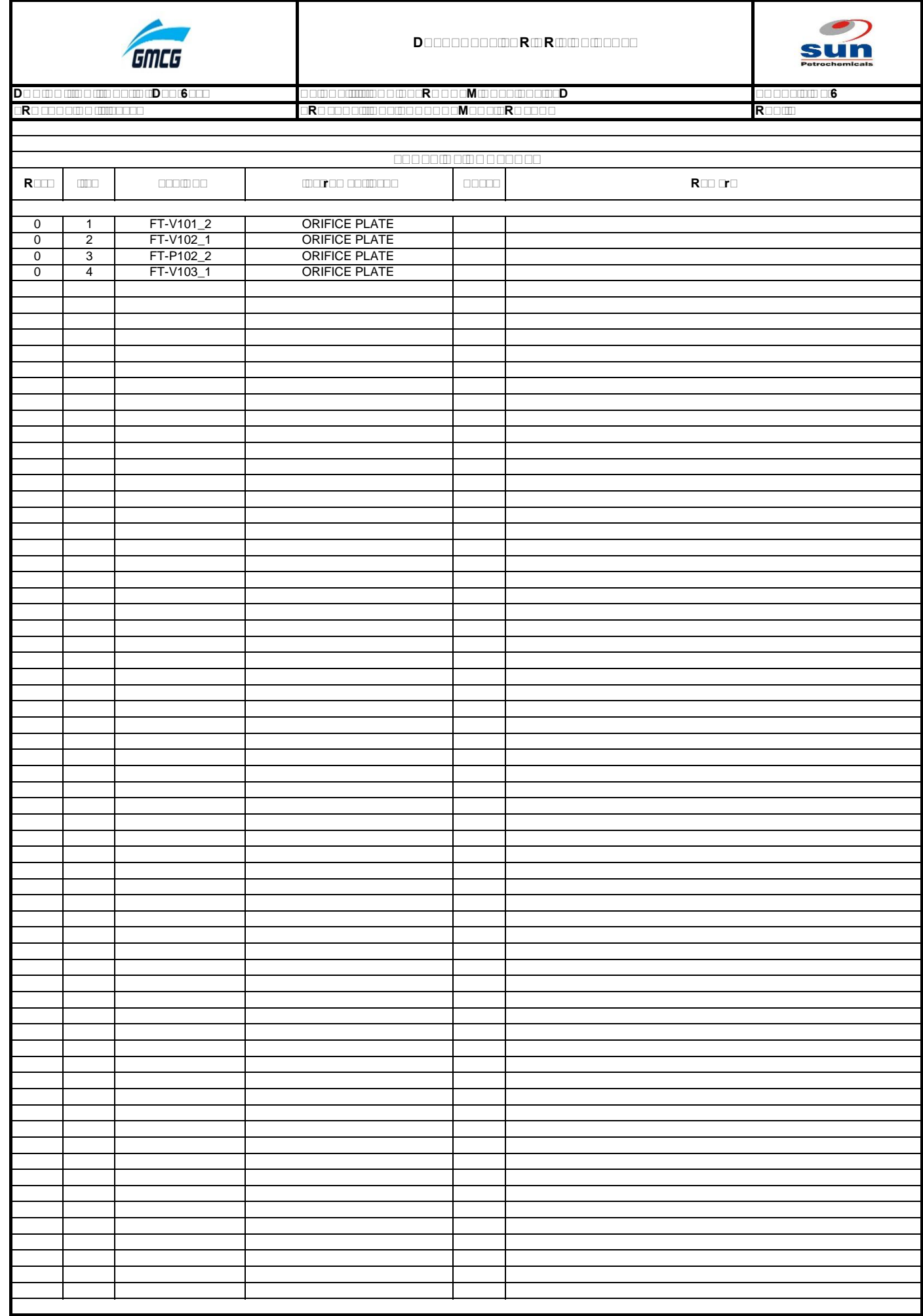
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DESCRIPTION	For approval / information after P.O.	Final copies along with dispatch	
		S	P
Material Test Certificates of complete assymblly	2 Copies	-	3 Copies
Orifice calculation sheets	2 Copies	2 Copies	3 Copies
Detail Dimensional & fabrication Drawing	2 Copies	2 Copies	3 Copies

ABBREVIATIONS:
S:SOFT COPIES ON CDs
P:PRINTS

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The quantities may be changed at the time of order Increase / Decrease in quantities and their spares shall not affect the unit price quoted.





D		6		R		M		D		6	
R				R		M		R		R	
R	1	ITEM NUMBER		1				2			
	2	TAG NUMBER		FT-V101_2				FT-V102_1			
	3	P & ID NUMBER		1019-PS-PID-103				1019-PS-PID-104			
	4	SERVICE		VAPOUR V-101 OUTLET FLOW				From V-102 Outlet Flow			
	5	LINE NUMBER		80-PV-B7A-10310				100-PV-B7A-10411-IP			
	6	PIPE MATERIAL		ASTM A106 GR.B				ASTM A106 GR.B			
	7	LINE SIZE (NB) mm / SCH		80/SCH 40				100/ SCH 40			
	8	CLASS/RATING		B7A/300#				B7A/300#			
	9	LINE VELOCITY m/s		15.27				9.2-21.6			
R	10	TYPE		CONCENTRIC SQUARE EDGE ORIFICE				CONCENTRIC SQUARE EDGE ORIFICE			
	11	STANDARD REFERENCE		AS PER ISO 5167				AS PER ISO 5167			
	12	PLATE MATERIAL / THICKNESS		SS 316 / *				SS 316 / *			
	13	VENT / DRAIN HOLE SIZE mm		VTA				VTA			
	14	ORIFICE BORE DIAMETER 'd' mm		VTA				VTA			
	15	DIAMETER RATIO (d / D)		VTA				VTA			
	16	METER MAX. (FLOW RANGE) Kg/hr		0-1816				0-2103			
	17	DIFFERENTIAL PRESSURE		0-2500				0-2500			
	18	FLANGE ASSEMBLY		NA				NA			
R	19	FLUID / STATE		PV/V				PV/V			
	20	MIN / NOR FLOW kg/hr		126				130			
	21	MAX. FLOW kg/hr		1514				1753			
	22	OPERATING TEMP. Norm /Max °C		25 / 43				80			
	23	OPERATING PR. Norm /Max Kg/cm ²		5 / 9				- / 3.0			
	24	DENSITY @ OP.COND. kg/m3		7.0				2.6 to 3.6			
	25	M. W.		24.8				43.98			
	26	VISCOSITY @ OP. COND. cP		0.01				0.01			
	27	Cp/Cv		1.3				1.14			
	28	COMPRESSIBILITY FACTOR		0.97				0.98			
	29	MAX. ALLOWABLE DP Kg/cm2		0.05				0.8			
	30	VAP. PRESSURE Kg/cm ² (g)		-				-			
	31	DESIGN PR./TEMP. Kg/cm ² (g) / °C		10 / 80				10 / 120			
	32	CORROSIVE / TOXIC									
	R	33	MATERIAL CERTIFICATE								
34		REQUISITION NO.									
35		MANUFACTURER		*				*			
36		MODEL NO.		*				*			
37		SERIAL NO.		*				*			
NOTES :- * BY VENDOR TO CONFIRM / SPECIFY 1) Orifice Shall Be Fit in Exisiting Flange Assembly											



D R R



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R	1	ITEM NUMBER	3	4
	2	TAG NUMBER	FT-P102_2	FT-V103_1
	3	P & ID NUMBER	1019-PS-PID-112	1019-PS-PID-105
	4	SERVICE	PUMP RECYCLE FLOW	TO V-103 FLOW
	5	LINE NUMBER	100-EO3-D7A-11208	100-PV-B7A-10506
	6	PIPE MATERIAL	ASTM A106 GR.B	ASTM A106 GR.B
	7	LINE SIZE (NB)mm / SCH	100/SCH80	100/SCH 40
	8	CLASS/RATING	D7A/600#	B7A/300#
	9	LINE VELOCITY m/s	8	0.3
R	10	TYPE	CONCENTRIC SQUARE EDGE ORIFICE	CONCENTRIC SQUARE EDGE ORIFICE
	11	STANDARD REFERENCE	AS PER ISO 5167	AS PER ISO 5167
	12	PLATE MATERIAL / THICKNESS	SS 316 / *	SS 316 / *
	13	VENT / DRAIN HOLE SIZE mm	VTA	VTA
	14	ORIFICE BORE DIAMETER ' d ' mm	VTA	VTA
	15	DIAMETER RATIO (d / D)	VTA	VTA
	16	METER MAX. (FLOW RANGE) m3/hr	0-305 m3/hr	0-74780
	17	DIFFERENTIAL PRESSURE	0-2500	0-2500
	18	FLANGE ASSEMBLY	NA	NA
R	19	FLUID / STATE	EO / L	PL/L
	20	MIN / NOR FLOW m3/hr	25	5718
	21	MAX. FLOW m3/hr	252 m3/hr	62317
	22	OPERATING TEMP. Norm /Max °C	20-47	49
	23	OPERATING PR. Min/max Kg/cm ²	28 / 72.4(Normal)	ATM(Normal)
	24	DENSITY @ OP.COND. kg/m3	765-802	791
	25	M. W.	-	-
	26	VISCOSITY @ OP. COND. cP	2-30	2.4
	27	Cp/Cv	-	-
	28	COMPRESSIBILITY FACTOR	-	-
	29	MAX. ALLOWABLE DP Kg/cm2	2.0	0.05
	30	VAP. PRESSURE Kg/cm ² (g)	0.97	1.033
	31	DESIGN PR./TEMP. Kg/cm ² (g) / °C	93/80	10/120
	32	CORROSIVE / TOXIC		
R	33	MATERIAL CERTIFICATE		
	34	REQUISITION NO.		
	35	MANUFACTURER	*	*
	36	MODEL NO.	*	*
	37	SERIAL NO.	*	*

NOTES :- * BY VENDOR TO CONFIRM / SPECIFY

1) Orifice Shall Be Fit in Exisiting Flange Assembly



D E F G H I J K L M N O P Q R



D E F G H I J K L M N O P Q R 6

D E F G H I J K L M N O P Q R M D

D E F G H I J K L M N O P Q R

R D E F G H I J K L M N O P Q R

R D E F G H I J K L M N O P Q R M D R

R D E F G H I J K L M N O P Q R

D E F G H I J K L M N O P Q R

D E F G H I J K L M N O P Q R

R D E F G H I J K L M N O P Q R	D E F G H I J K L M N O P Q R	D E F G H I J K L M N O P Q R
1	COVER SHEET	1
2	TABLE OF CONTENTS	1
3	DATASHEET	1

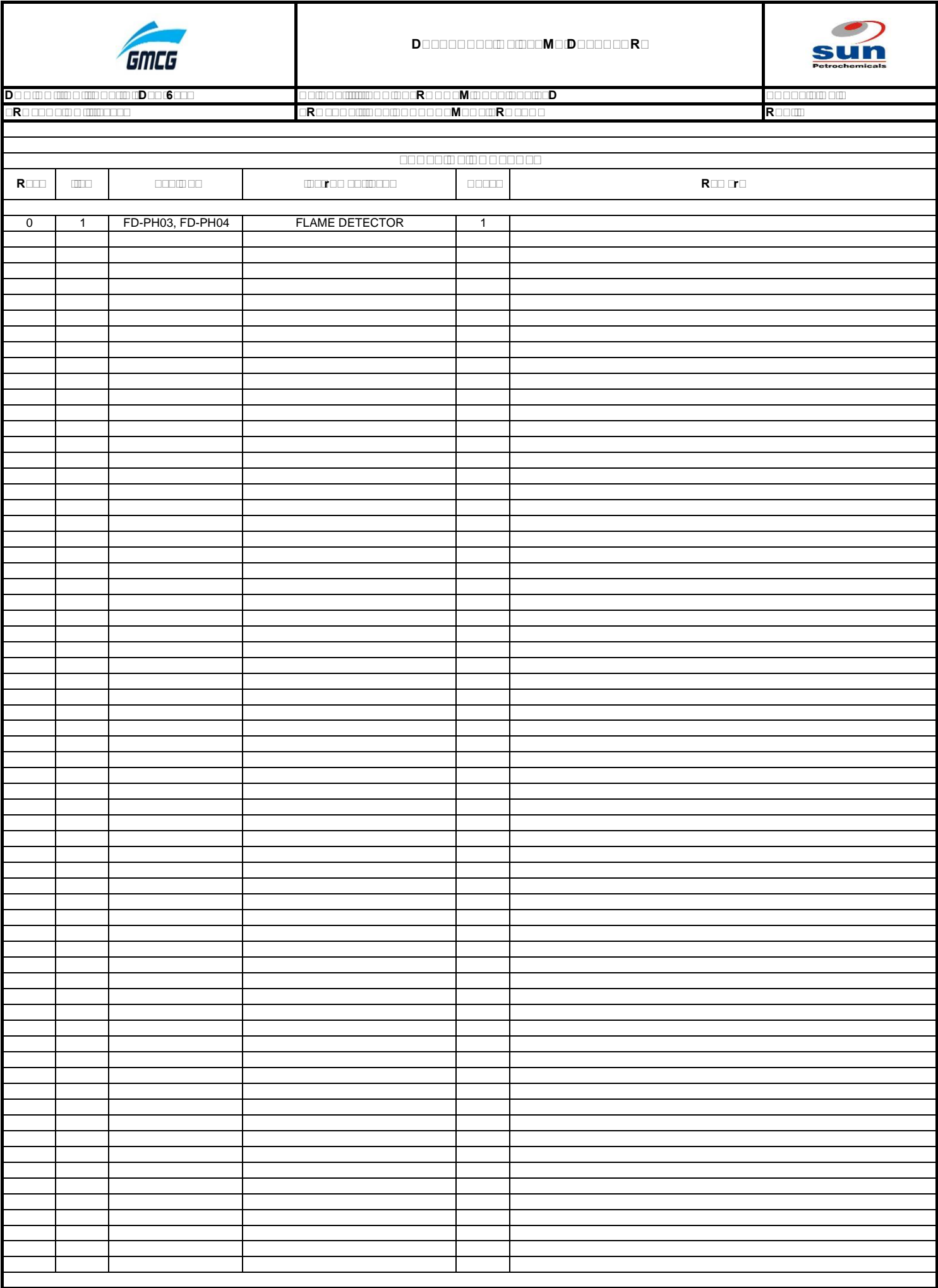
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A. Ajith Kumar

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R	D R	
1	COVER SHEET	1
2	TABLE OF CONTENTS	1
3	DATASHEET FOR TEMPERATURE TRANSMITTERS	4

R R D R



A. Ajith Kumar



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0	19-10-2023	ISSUED FOR APPROVAL	AK	SK	CDN
R	D	R		D	R



		DIPLOMA IN INSTRUMENTATION			
DIPLOMA IN INSTRUMENTATION		DIPLOMA IN INSTRUMENTATION		DIPLOMA IN INSTRUMENTATION	
R		R		R	
INSTRUMENTATION	TAG NUMBER	TIT-P102	TIT-V110_1	TIT-V110_2	TIT-X104_1
	SERVICE	EXPORT PUMP OIL TEMP	SERV GAS SUPP. HEAD. TEMP.	V-110 INLET TEMP.	FROM TFH-01 TEMP.
	QUANTITY	1	1	1	1
	P & I D NO.	1019-PS-PID-112	1019-PS-PID-151	1019-PS-PID-151	1019-PS-PID-152
INSTRUMENTATION	AREA CLASSIFICATION	Zone1,2 IIA, IIB, T4	Zone1,2 IIA, IIB, T4	Zone1,2 IIA, IIB, T4	Zone1,2 IIA, IIB, T4
	LINE NO.	150-EO3-D7A-11205	50-SG-B7A-15105	50-PV-B7A-10319	150-HOS-A3A-15201-IH
	LINE SIZE / SCH.	150/40	50/40	50/40	100/40
	FLUID / STATE	CRUDE OIL/LIQUID	SERVO GAS/GAS	HP GAS/GAS	OIL/LIQUID
INSTRUMENTATION	PRESS. Min. / Nor. / Max1. / Max2.	Barg 72.43	-6	-6	-4
	TEMP. Min. / Nor. / Max1. / Max2.	°C - / 20 / 45	25(Normal)	25(Normal)	130 (Normal)
	FLOW. Min. / Nor. / Max1. / Max2.	TPH			
	FLUID VELOCITY	m/s 0.94	5.64	5.64	0.16
INSTRUMENTATION	LIQUID DENSITY	kg/m3 603.7388547	6.820	6.82	*
	VISCOSITY (DYNAMIC)	Cp 2.2921	0.0114	0.011383	*
	DESIGN PRESSURE	Barg 93	10	10	8
	DESIGN TEMPERATURE	°C 80	80	120	150
INSTRUMENTATION	TYPE	RTD,PT-100	RTD,PT-100	RTD,PT-100	RTD,PT-100
	CALIBRATION STANDARD	IEC 60751	IEC 60751	IEC 60751	IEC 60751
	ELEMENT TYPE	DUPLEX-3 WIRED	DUPLEX-3 WIRED	DUPLEX-3 WIRED	DUPLEX-3 WIRED
	GROUNDED /UNGROUNDED	UNGROUNDED	UNGROUNDED	UNGROUNDED	UNGROUNDED
INSTRUMENTATION	SHEATH OD / MATERIAL	6mm/SS316	6mm/SS316	6mm/SS316	6mm/SS316
	ENCLOSURE MATERIAL	DIA CAST ALUMINIUM	DIA CAST ALUMINIUM	DIA CAST ALUMINIUM	DIA CAST ALUMINIUM
	ENCLOSURE CLASS	WP TO IP65,Ex d	WP TO IP65,Ex d	WP TO IP65,Ex d	WP TO IP65,Ex d
	INSULATION	MAGNESIUM OXIDE	MAGNESIUM OXIDE	MAGNESIUM OXIDE	MAGNESIUM OXIDE
INSTRUMENTATION	CABLE ENTRY	NOTE-4	NOTE-4	NOTE-4	NOTE-4
	TYPE	BAR STOCK	BAR STOCK	BAR STOCK	BAR STOCK
	MATERIAL OF CONSTRUCTION	SS316	SS316	SS316	SS316
	PROCESS CONNECTION	1 1/2" FLANGE ,300#RF	1 1/2" FLANGE ,300#RF	1 1/2" FLANGE ,300#RF	1 1/2" FLANGE ,300#RF
INSTRUMENTATION	BULB CONNECTION	1/2" NPTF	1/2" NPTF	1/2" NPTF	1/2" NPTF
	BORE DIAMETER	mm 7*	7*	7*	7*
	INSERTION (U) / EXT. (T) LENGTH	mm 280/45	280/45	280/45	320/45
	TYPE	ELECTRONIC - SMART WITH	ELECTRONIC - SMART WITH	ELECTRONIC - SMART WITH	ELECTRONIC - SMART WITH
INSTRUMENTATION	CALIBRATED RANGE	HART PROTOCOL 0-70 °C	HART PROTOCOL 0-70 °C	HART PROTOCOL 0-70 °C	HART PROTOCOL 0-150 °C
	OUTPUT	4 - 20 mA DC	4 - 20 mA DC	4 - 20 mA DC	4 - 20 mA DC
	PERMISSABLE LOAD	600 ohms At 24VDC	600 ohms At 24VDC	600 ohms At 24VDC	600 ohms At 24VDC
	POWER SUPPLY	24 V DC, 2 WIRE	24 V DC, 2 WIRE	24 V DC, 2 WIRE	24 V DC, 2 WIRE
INSTRUMENTATION	INTEGRAL INDICATOR	DIGITAL,LCD	DIGITAL,LCD	DIGITAL,LCD	DIGITAL,LCD
	INDICATION ENGG UNIT	°C	°C	°C	°C
	ACCURACY	> THAN +/- 0.15% OF SPAN	> THAN +/- 0.15% OF SPAN	> THAN +/- 0.15% OF SPAN	> THAN +/- 0.15% OF SPAN
	STABILITY	+/- 0.25% OF URL FOR 1 YR	+/- 0.25% OF URL FOR 1 YR	+/- 0.25% OF URL FOR 1 YR	+/- 0.25% OF URL FOR 1 YR
INSTRUMENTATION	ENCLOSURE CLASS	WEATHERPROOF TO IP-65,	WEATHERPROOF TO IP-65,	WEATHERPROOF TO IP-65,	WEATHERPROOF TO IP-65,
	ENCLOSURE MATERIAL	INTR. SAFE TO Ex (ia),Exd	INTR. SAFE TO Ex (ia),Exd	INTR. SAFE TO Ex (ia),Exd	INTR. SAFE TO Ex (ia),Exd
	ENCLOSURE TYPE	DIE CAST ALUMINIUM	DIE CAST ALUMINIUM	DIE CAST ALUMINIUM	DIE CAST ALUMINIUM
	SPAN & ZERO ADJ	DUAL-COMPARTMENT	DUAL-COMPARTMENT	DUAL-COMPARTMENT	DUAL-COMPARTMENT
INSTRUMENTATION	MOUNTING TYPE	REQD.,EXTERNALLY	REQD.,EXTERNALLY	REQD.,EXTERNALLY	REQD.,EXTERNALLY
	LIGHTNING ARRESTOR/PROTECTION	2"PIPE,YOKE SUPPORT	2"PIPE,YOKE SUPPORT	2"PIPE,YOKE SUPPORT	2"PIPE,YOKE SUPPORT
	MOUNTING BRACKETS	-	-	-	-
	CALIBRATION DATA SHEET	REQD,SS316	REQD,SS316	REQD,SS316	REQD,SS316
INSTRUMENTATION	MANUFACTURER	-	-	-	-
	MODEL NO	-	-	-	-
		644FAK1D2B4M5Q4HR7	644FAK1D2B4M5Q4HR7	644FAK1D2B4M5Q4HR7	644FAK1D2B4M5Q4HR7
Notes		1 * - Vendor to advise details (VTA), TBA - To be advised, N/A - Not applicable			
		2 Instrument shall be provide with SS316 tag plate.316SS name plate attached to instrument head with 316SS Screws.316SS tag plate attached with 316SS binding wire.Traffolyte tag label bolted to the instrument support.			
		3 The instrument shall be mounted in GRP shade and suitalbe for outdoor installation.			
		4 2 Nos of 1/2 NPTF cable entries shall be provided with 1/2" NPT EX-d Plug.			
		5 Wake frequency calculation shall be performed and necessary report shall be submitted by vendor on respective thermowells.			

		D M R M R M R			
D 6 1		R M D		6	
R		R M R		R	
R	TAG NUMBER	TIT-X104_2	TIT-E101_1	TIT-E101_2	TIT-E101_3
	SERVICE	FROM E-103 TEMP.	TO E-101_1 EXCHANG. TEMP.	TO E-103 INTERCHA.TEMP.	FROM V-102 INTERCHA.TEMP.
	QUANTITY	1	1	1	1
	P & I D NO.	1019-PS-PID-152	1019-PS-PID-104	1019-PS-PID-104	1019-PS-PID-104
R	AREA CLASSIFICATION	Zone1,2 IIA, IIB, T4	Zone1,2 IIA, IIB, T4	Zone1,2 IIA, IIB, T4	Zone1,2 IIA, IIB, T4
	LINE NO.	150-HOR-A3A-10409-IH	150-PL-B7A-10315	150-PL-B7A-10402-IH	150-PL-B7A-10416-IH
	LINE SIZE / SCH.	150/40	150/40	150/40	150/40
	FLUID / STATE	OIL/LIQUID	CRUDE OIL/LIQUID	OIL/LIQUID	CRUDE OIL/LIQUID
R	PRESS. Min. / Nor. / Max1. / Max2. Barg	2	5	4.89	1.8
	TEMP. Min. / Nor. / Max.1. / Max2. °C	110	25(Normal)	25 / 55 / -	80(Normal)
	FLOW. Min. / Nor. / Max.1. / Max2. TPH				
	FLUID VELOCITY m/s	1.92	1.32	1.44	1.26
R	LIQUID DENSITY kg/m3	*	769.77	683.60	750.0
	VISCOSITY (DYNAMIC) Cp	*	2.27	1.967	1.8
	DESIGN PRESSURE Barg	8	10	10	10
	DESIGN TEMPERATURE °C	150	120	120	120
R	TYPE	RTD,PT-100	RTD,PT-100	RTD,PT-100	RTD,PT-100
	CALIBRATION STANDARD	IEC 60751	IEC 60751	IEC 60751	IEC 60751
	ELEMENT TYPE	DUPLEX-3 WIRED	DUPLEX-3 WIRED	DUPLEX-3 WIRED	DUPLEX-3 WIRED
	GROUNDED /UNGROUNDED	UNGROUNDED	UNGROUNDED	UNGROUNDED	UNGROUNDED
R	SHEATH OD / MATERIAL	6mm/SS316	6mm/SS316	6mm/SS316	6mm/SS316
	ENCLOSURE MATERIAL	DIA CAST ALUMINIUM	DIA CAST ALUMINIUM	DIA CAST ALUMINIUM	DIA CAST ALUMINIUM
	ENCLOSURE CLASS	WP TO IP65,Ex d	WP TO IP65,Ex d	WP TO IP65,Ex d	WP TO IP65,Ex d
	INSULATION	MAGNESIUM OXIDE	MAGNESIUM OXIDE	MAGNESIUM OXIDE	MAGNESIUM OXIDE
R	CABLE ENTRY	NOTE-4	NOTE-4	NOTE-4	NOTE-4
	TYPE	BAR STOCK	BAR STOCK	BAR STOCK	BAR STOCK
	MATERIAL OF CONSTRUCTION	SS316	SS316	SS316	SS316
	PROCESS CONNECTION	1 1/2" FLANGE ,300#RF	1 1/2" FLANGE ,300#RF	1 1/2" FLANGE ,300#RF	1 1/2" FLANGE ,300#RF
R	BULB CONNECTION	1/2" NPTF	1/2" NPTF	1/2" NPTF	1/2" NPTF
	BORE DIAMETER mm	7*	7*	7*	7*
	INSERTION (U) / EXT. (T) LENGTH mm	320/45	280/45	280/45	280/45
	TYPE	ELECTRONIC - SMART WITH HART PROTOCOL	ELECTRONIC - SMART WITH HART PROTOCOL	ELECTRONIC - SMART WITH HART PROTOCOL	ELECTRONIC - SMART WITH HART PROTOCOL
R	CALIBRATED RANGE	0-150 °C	0-70 °C	0-70 °C	0-100 °C
	OUTPUT	4 - 20 mA DC	4 - 20 mA DC	4 - 20 mA DC	4 - 20 mA DC
	PERMISSABLE LOAD	600 ohms At 24VDC	600 ohms At 24VDC	600 ohms At 24VDC	600 ohms At 24VDC
	POWER SUPPLY	24 V DC, 2 WIRE	24 V DC, 2 WIRE	24 V DC, 2 WIRE	24 V DC, 2 WIRE
R	INTEGRAL INDICATOR	DIGITAL,LCD	DIGITAL,LCD	DIGITAL,LCD	DIGITAL,LCD
	INDICATION ENGG UNIT	°C	°C	°C	°C
	ACCURACY	> THAN +/- 0.15% OF SPAN	> THAN +/- 0.15% OF SPAN	> THAN +/- 0.15% OF SPAN	> THAN +/- 0.15% OF SPAN
	STABILITY	+/- 0.25% OF URL FOR 1 YR	+/- 0.25% OF URL FOR 1 YR	+/- 0.25% OF URL FOR 1 YR	+/- 0.25% OF URL FOR 1 YR
R	ENCLOSURE CLASS	WEATHERPROOF TO IP-65, INTR. SAFE TO Ex (ia),Exd	WEATHERPROOF TO IP-65, INTR. SAFE TO Ex (ia),Exd	WEATHERPROOF TO IP-65, INTR. SAFE TO Ex (ia),Exd	WEATHERPROOF TO IP-65, INTR. SAFE TO Ex (ia),Exd
	ENCLOSURE MATERIAL	DIE CAST ALUMINIUM	DIE CAST ALUMINIUM	DIE CAST ALUMINIUM	DIE CAST ALUMINIUM
	ENCLOSURE TYPE	DUAL-COMPARTMENT	DUAL-COMPARTMENT	DUAL-COMPARTMENT	DUAL-COMPARTMENT
	SPAN & ZERO ADJ	REQD.,EXTERNALLY	REQD.,EXTERNALLY	REQD.,EXTERNALLY	REQD.,EXTERNALLY
R	MOUNTING TYPE	2"PIPE,YOKE SUPPORT	2"PIPE,YOKE SUPPORT	2"PIPE,YOKE SUPPORT	2"PIPE,YOKE SUPPORT
	LIGHTNING ARRESTOR/PROTECTION	-	-	-	-
	MOUNTING BRACKETS	REQD,SS316	REQD,SS316	REQD,SS316	REQD,SS316
	CALIBRATION DATA SHEET	-	-	-	-
R	MANUFACTURER				
	MODEL NO	644FAK1D2B4M5Q4HR7	644FAK1D2B4M5Q4HR7	644FAK1D2B4M5Q4HR7	644FAK1D2B4M5Q4HR7
Notes	1	* - Vendor to advise details (VTA), TBA - To be advised, N/A - Not applicable			
	2	Instrument shall be provide with SS316 tag plate.316SS name plate attached to instrument head with 316SS Screws.316SS tag plate attached with 316SS binding wire.Traffolyte tag label bolted to the instrument support.			
	3	The instrument shall be mounted in GRP shade and suitalbe for outdoor installation.			
	4	2 Nos of 1/2 NPTF cable entries shall be provided with 1/2" NPT EX-d Plug.			
	5	Wake frequency calculation shall be performed and necessary report shall be submitted by vendor on respective thermowells.			



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Notes	1	* - Vendor to advise details (VTA), TBA - To be advised, N/A - Not applicable
	2	Instrument shall be provide with SS316 tag plate.316SS name plate attached to instrument head with 316SS Screws.316SS tag plate attached with 316SS binding wire.Traffolyte tag label bolted to the instrument support.
	3	The instrument shall be mounted in GRP shade and suitable for outdoor installation.
	4	2 Nos of 1/2 NPTF cable entries shall be provided with 1/2" NPT EX-d Plug.
	5	Wake frequency calculation shall be performed and necessary report shall be submitted by vendor on respective thermowells.



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R	TAG NUMBER	TIT-E103_4			
	SERVICE	TO V-103 TEMP.			
	QUANTITY	1			
	P & I D NO.	1019-PS-PID-104			
	AREA CLASSIFICATION	Zone1,2 IIA, IIB, T4			
	LINE NO.	150-HOR-A3A-10409-IH			
	LINE SIZE / SCH.	150/40			
R	FLUID / STATE	CRUDE OIL/LIQUID			
	PRESS. Min. / Nor. / Max1. / Max2. Barg	2.2			
	TEMP. Min. / Nor. / Max1. / Max2. °C	- / 110 / 130			
	FLOW. Min. / Nor. / Max1. / Max2. TPH				
	FLUID VELOCITY m/s	*			
	LIQUID DENSITY kg/m3	*			
	VISCOSITY (DYNAMIC) Cp	*			
R	DESIGN PRESSURE Barg	10			
	DESIGN TEMPERATURE °C	150			
	TYPE	RTD,PT-100			
	CALIBRATION STANDARD	IEC 60751			
	ELEMENT TYPE	DUPLEX-3 WIRED			
	GROUNDING / UNGROUNDING	UNGROUNDING			
	SHEATH OD / MATERIAL	6mm/SS316			
R	ENCLOSURE MATERIAL	DIA CAST ALUMINIUM			
	ENCLOSURE CLASS	WP TO IP65,Ex d			
	INSULATION	MAGNESIUM OXIDE			
	CABLE ENTRY	NOTE-4			
	TYPE	BAR STOCK			
	MATERIAL OF CONSTRUCTION	SS316			
	PROCESS CONNECTION	1 1/2" FLANGE ,300#RF			
R	BULB CONNECTION	1/2" NPTF			
	BORE DIAMETER mm	7"			
	INSERTION (U) / EXT. (T) LENGTH mm	280/45			
	TYPE	ELECTRONIC - SMART WITH			
		HART PROTOCOL			
	CALIBRATED RANGE	0-150 °C			
	OUTPUT	4 - 20 mA DC			
R	PERMISSABLE LOAD	600 ohms At 24VDC			
	POWER SUPPLY	24 V DC, 2 WIRE			
	INTEGRAL INDICATOR	DIGITAL, LCD			
	INDICATION ENGG UNIT	°C			
	ACCURACY	> THAN +/- 0.15% OF SPAN			
	STABILITY	+/- 0.25% OF URL FOR 1 YR			
	ENCLOSURE CLASS	WEATHERPROOF TO IP-65,			
R		INTR. SAFE TO Ex (ia),Exd			
	ENCLOSURE MATERIAL	DIE CAST ALUMINIUM			
	ENCLOSURE TYPE	DUAL-COMPARTMENT			
	SPAN & ZERO ADJ	REQD.,EXTERNALLY			
	MOUNTING TYPE	2"PIPE,YOKE SUPPORT			
	LIGHTNING ARRESTOR/PROTECTION	-			
	MOUNTING BRACKETS	REQD,SS316			
R	CALIBRATION DATA SHEET	-			
	MANUFACTURER				
	MODEL NO	644FAK1D2B4M5Q4HR7			

Notes	1	* - Vendor to advise details (VTA), TBA - To be advised, N/A - Not applicable
	2	Instrument shall be provide with SS316 tag plate.316SS name plate attached to instrument head with 316SS Screws.316SS tag plate attached with 316SS binding wire.Traffolyte tag label bolted to the instrument support.
	3	The instrument shall be mounted in GRP shade and suitalbe for outdoor installation.
	4	2 Nos of 1/2 NPTF cable entries shall be provided with 1/2" NPT EX-d Plug.
	5	Wake frequency calculation shall be performed and necessary report shall be submitted by vendor on respective thermowells.

SURFACE COATING SPECIFICATIONS

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1.1 SCOPE

This specification defines the minimum requirements for the surface preparation, material, supply and application of paints and coatings for CPF Steel structures, Piping, Vessels, Equipment and accessories.

The instructions contained herein also covers the requirements for Quality Assurance and Quality Control together with guaranteed performances.

1.2 ABBREVIATIONS

ANSI	American National Standards Institute
API	American Petroleum Institute
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
AWS	American Welding Society
BS	British Standard
DFT	Dry Film Thickness
°C	Degrees Celsius
HSE	Health Safety and Environment
ISO	International Standards Organisation
NACE	National Association of Corrosion Engineers
RAL	European Colour Standard (See tables in Appendix B and C)
SSPC	Steel Structures Painting Council
WHP	Well Head Platform

2.0 CODES AND STANDARDS

All surface preparation painting and corrosion protection shall be in accordance with the latest edition of the following codes and standards.

AMERICAN WELDING SOCIETY (AWS)

AWS C2.18 Guide For the Protection of Steel with Thermal Sprayed Coatings of Aluminium and Zinc and their alloys and composites.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A90 Test Method for Weight of Coating on Zinc-Coated (Galvanised) Iron and Steel Articles

ASTM A123/
A123M Specification for Zinc (Hot-dip Galvanised) Coatings on Iron and Steel Products

ASTM A143 Recommended Practice for Safe-guarding against Embrittlement of Hot-Dipped Galvanised Structural Steel Products and Procedure for Detecting Embrittlement

ASTM A153/
A153M Specification for Zinc Coating (Hot-Dip) on Iron and steel Hardware

ASTM A384/
A384M Standard Practice for Safeguarding Against Warpage and Distortion during Hot-Dip Galvanising of Steel Assemblies.

ASTM A385 Practice for Providing High-Quality Zinc Coatings (Hot-Dip)

ASTM D823 Method of Producing films of uniform thickness of Paint, varnish lacquer and released products on test panels.

ASTM D1200 Test method for viscosity of paints, varnishes and lacquers by ford viscosity cup.

ASTM D3359 Method of measuring adhesion by tape test

ASTM D4541 Test method for pull-off strength of coatings using portable adhesion testers.

ASTM D4940	Test method for conducting metric analysis of water-soluble ionic contamination of blasting abrasives.
ASTM D4285	Test method for indicating oil or water in compressed air.
ASTM D5064	Practice for conducting a patch test to assess coating compatibility.
ASTM E376	Practice for measuring coating thickness by magnetic field or Eddy-Current (Electromagnetic) test methods.

NATIONAL ASSOCIATION OF CORROSION ENGINEERS (NACE)

RP-01-76	Recommended Practice Corrosion Control of Steel, Fixed Offshore Platforms Associated with Petroleum Production
RP-01-88	Recommended Practice for discontinuity (holiday) testing of Protective Coatings.
RP-02-87	Field measurement of Surface profiles using Replica Tape

STEEL STRUCTURES PAINTING COUNCIL (SSPC)

SSPC-PA 1	Shop, Field and Maintenance Painting of Steel
SSPC-PA 2	Measurement of Dry Coating Thickness with Magnetic Gauges
SSPC-SP 1	Surface Preparation No. 1 Solvent Cleaning
SSPC-SP 2	Surface Preparation No. 2 Hand Tool Cleaning
SSPC-SP 3	Surface Preparation No. 3 Power Tool Cleaning
SSPC-SP-5/NACE	Surface Preparation No. 1 White Metal Blast Cleaning

SSPC-SP-7/NACE	Surface Preparation No. 4 Brush Off Blast Cleaning
SSPC-SP-10/NACE	Surface Preparation No. 2 Near White Metal Blast Cleaning
INTERNATIONAL STANDARDS ORGANISATION(ISO) 8501-1 SA2½	Surface Preparation – Near White Metal Blast Cleaning

2.1 MANUFACTURER'S STANDARDS

Paint manufacturer's data sheets, application instructions and safety precautions shall be considered part of this specification.

3.0 GENERAL

3.1 SURFACES EXCLUDED FROM ABRASIVE BLASTING AND PAINTING

The following surfaces shall not be abrasive blasted or painted.

- All surfaces made from non-ferrous materials (Nickel, Monel, Brass, Bronze)
- Instrument tubing including fusible plugs and tubing used in the ESD system.
- Fibreglass, plastic, or plastic-coated material not susceptible to ultra violet deterioration.
- Stainless steel instrument cases and process control panels.
- Nameplates, machined surfaces, instrument glass, flange faces, control valve stems and similar items.
- Stainless steel process piping and vessels (unless specifically required).
- Electrical conduit, breathers and drain fittings.
- Machined and threaded surfaces shall be protected with suitable rust preventive.
- Flange gasket facing.

If stainless steel is connected to carbon steel, the carbon steel part shall be coated 50 mm beyond the weld zone on to the stainless steel. The coating for stainless steel part shall not contain metallic Zinc and shall be free from chlorides.

3.2 MANUFACTURED ITEMS

- a) Manufactured items such as valves, level gauges and equipment shall be coated in accordance with this specification.
- b) If manufacturer's paint system is not in accordance with this specification, Seller shall blast and repaint the item in accordance with this specification. Only the Buyer may waive this condition and this shall be obtained in writing prior to commencement of works.

3.3 SURFACES IN CONTACT

- a) Surfaces of components in contact (bottom of skids, mounting surfaces of equipment, pipe supports, brackets, bolt holes, etc.) shall be painted.
- b) Surfaces in contact shall receive a minimum of one coat of primer prior to assembly (unless instructed otherwise by Buyer).
- c) Paints containing Zinc or Aluminium metal or free chlorides shall not be used on Stainless steel.
- d) When zinc rich primers are used, care shall be taken to avoid any possibility of over spraying onto Duplex or Austenitic stainless steel, Nickel alloy steel components.

3.4 ENVIRONMENTAL CRITERIA

- a) Blasting shall be performed during dry weather.
- b) Dry blast cleaning operations shall not be conducted on surfaces that are exposed to rain, water spray, or any other moisture.
- c) Surfaces shall not be coated in rain, wind, snow, fog, mist, dust, or in areas where injurious airborne elements exist.
- d) Unless otherwise authorised by Buyer, coating shall be applied only if all the following conditions exist:
 - Air temperature 10°C above dew point.
 - Surface temperature at least 3°C above dew point.
 - Relative humidity is below 85%.
 - Any other conditions as recommended by coating manufacturer.
- e) Painted surfaces upon which it rains prior to the paint being rainproof shall be re-blasted and repainted.

3.5 TIME CRITERIA

- a) Blasting shall be performed during daylight hours.
- b) Blast cleaned surfaces shall be coated with primer within 4 hours, prior to sundown of the same day, and before any rusting occurs.
- c) Coatings shall be applied only during daylight hours.

3.6 POST-PREPARATION

Nameplates, manufacturer's identification tags, instrument glass, finished flange faces, control valve stems, and similar items shall be cleaned, restored to their original condition, and reattached.

4.0 COATING SYSTEMS

- a) All equipment coatings must meet the requirements of this specification and be suitable for use in a coastal onshore environment.
- b) The type, brand, number of coats, and colour shall be as specified in the Table. A (Appendix A) and where temperatures shown shall be deemed to be maximum operating temperatures. Colour shall be as specified in Table B-1 (Appendix B) or Table C.1 (Appendix C).
- c) One manufacturer shall supply the products for each system.
- d) Buyer shall approve selection of products in writing.
- e) Only originally sealed intact, identified and undamaged manufacturer's containers shall be used. Any container exhibiting leakage or excess skinning or hard setting shall be discarded.
- f) The lead content of inorganic zinc silicates shall not exceed 0.05%.
- g) Organic coatings, excluding silicone and silicone acrylic, shall be lead and chromate free and VOC compliant.
- h) All insulated pipes shall be fully painted prior to fitting insulation.

5.0 PAINT STORAGE

5.1 FIRE AND SAFETY

Storage areas shall not constitute a potential fire hazard to the work.

5.2 TEMPERATURE

Paint, thinners, and associated materials shall be kept in fully enclosed, ventilated storage room(s) within the temperature limits and time restraints for storage specified in manufacturer's product data sheets.

5.3 REJECTION

Coating materials that have jelled or otherwise deteriorated during storage shall not be used.

6.0 SURFACE PREPARATION

6.1 PRE-BLAST PREPARATION/PROTECTION

6.1.1 Steel Surfaces

- a) Welding flux in crevices shall be removed.
- b) Burrs, weld splatter, slivers, mill scale, indentations, and other sharp surface projections shall be ground smooth prior to further surface preparation.
- c) Bolt holes shall be drilled and reamed before blast cleaning.

6.1.2 Electrical/Instrumentation

- a) Local mounted instruments, gauges, nameplates, control valve stems, controllers, code stamps, etc., shall be protected to prevent damage during blasting and painting.
- b) Where practical, electrical cable shall be installed after blasting. If not adequate cover shall be provided over the cables to protect them.
- c) Nameplates that are attached in a manner that allows corrosion to occur behind the nameplate shall be removed prior to abrasive blasting and painting and reattached after painting is complete.
- d) Surfaces of adjacent equipment and piping shall be protected from the blasting media.

6.1.3 Mechanical, Piping and Fittings

- a) Flanged valves and any other items that can not be effectively sand blasted and primed after assembly shall be blasted and primed separately prior to assembly. Mating surfaces and threads shall be carefully protected from blasting.
- b) Machined and threaded surfaces shall be protected from damage caused by the blasting medium.

6.1.4 General Clean-up

- a) Before the start of abrasive blasting, oil and/or grease contamination shall be removed in accordance with SSPC-SP 1.
- b) Acid washes or other cleaning solutions or solvents shall not be used on metal surfaces after being abrasive blasted. This includes any inhibitive washes intended to prevent rusting.

- c) Dirt, scale, or other surface contaminants shall be removed prior to the start of abrasive blasting.

6.2 ABRASIVE BLASTING

6.2.1 General

- a) Abrasive blasting shall be performed in an area away from painting operations and freshly coated surfaces.
- b) Abrasive blasting shall be performed using Buyer approved equipment.

6.2.2 Blasting Equipment

- a) Air compressors shall supply a continuous volume of air to each blast nozzle with adequate pressure and volume to achieve the required surface profile.
- b) The compressed air supply shall be provided with dryers and oil mist extractors to keep the air supply dry and oil free.
- c) The cleanliness of the compressed air shall be verified to standard ASTM D-4285, at the beginning of each shift by blowing air without abrasives or coating onto a clean white cloth. If oil or water appears on the cloth, all traps and separators shall be blown down until subsequent white cloth tests show no water or oil.

6.2.3 Abrasive

- a) Unless specifically approved in advance by Buyer, the abrasive shall be mineral slag or a metal shot/grit mixture. Silica sand shall not be used.

- b) The maximum particle size shall be no larger than that passing a No. 16 wire mesh screen and shall be capable of producing the desired anchor profile in the material.
- c) Abrasive material containing any oil, moisture, or impurities (particularly salt or organic material) or inclusions of any kind shall not be used. It shall contain no more than 100ppm of chloride (Na). Flash rust 15 minutes after blasting indicates excessive salt presence, the surface shall be fresh water cleaned then re-blasted using abrasive material meeting the requirements.

Blasting Operations

The use of centrifugal wheels to propel the abrasive, or machine shot blasting, shall be acceptable only if the Seller/sub seller can demonstrate that an anchor pattern with the required surface profile is being produced.

6.2.4 Blast Cleaned Surface Requirements

- a) Abrasive blasted surface profiles in accordance with SSPC-SP-10(Sa 2½) shall be measured using replica tape in accordance with NACE RP-02-87. Surface profiles shall follow Appendix-A coating systems. Profile measurements for abrasive blast cleaned surfaces can also be made with a Keane Tator Profile comparator, Clemtec anchor profile chips, Testex Press-O-Film or other Buyer approved method.

Prior to any coating application the substrate shall be checked for soluble salt contamination using a suitable method and the contamination shall not exceed 5µgm/cm². Surfaces that do not meet these criteria shall be reprocessed.

Should this problem occur on a frequent basis the abrasive medium shall be re-examined for quality and if necessary changed.

- b) Galvanised and aluminium surfaces shall be degreased and zinc salts removed by steam cleaning prior to surface preparation in accordance with SSPC-SP 7 (Sa 1).
- c) Stainless steel surfaces shall be thoroughly degreased and all contaminants removed prior to surface preparation in accordance with SSPC-SP-7. In no case steel abrasives or steel brushes shall be used for this operation.
- d) Abrasive blasted surfaces shall be rendered dust free by “blow-off” with compressed air or vacuum cleaning prior to the application of primer.
- e) A minimum of 100mm around the edges of abrasive blasted areas shall be left bare unless adjoining a newly coated surface. If adjoining a coated surface, blasting shall continue to a minimum of 50mm into the coated surface.

6.3 SURFACES WHICH CANNOT BE ABRASIVE BLASTED

- a) Surfaces which cannot be abrasive blasted shall be degreased by steam cleaning prior to surface preparation in accordance with SSPC-SP 3 with the prior approval of the Buyer.
- b) Care shall be taken not to burnish the metal surface.
- c) Rough edges shall be feathered.

7.0 PRE-CONSTRUCTION PRIMERS

Pre-construction primers may be used. The brand and generic type shall be submitted to the Buyer for prior approval. For equipment that has received shop prime coat, the field coating Seller shall touch-up prime coat and apply additional coats in accordance with the coating schedule. It is the Seller's responsibility to confirm the compatibility between shop and field applied painting systems with reference to the available documents. In case of any conflict, Buyer shall be contacted for resolution.

Use of Pre-construction primer or shop primer as an integral part of final coating system shall only be considered when there is a documented evidence that the surface preparation and the primer applied meets the requirement of the painting system.

8.0 PAINT APPLICATION

8.1 GENERAL

- a) The Seller shall comply with all applicable requirements of the paint manufacturer's specifications regarding surface preparation, paint storage, handling, mixing, safety, application, curing, inspection and testing. The Seller shall

have coating manufacturers coating system data sheet (CSDS) for each coating system to be used, containing at least the following information for each product:

- Surface pre-treatment requirements
 - Film thickness (max, min and specified)
 - Maximum and minimum recoating intervals at relevant temperatures
 - Information on thinners to be used (quantities and type)
 - Coating repair system
- b) Precaution shall be taken to prevent coating from being applied to equipment nameplates, instrument glasses and gauge dials, couplings, shafts, flange and nozzle faces, valve stems, bearing and other machined surfaces.
- c) All equipment components shall be in the fully painted condition prior to final assembly. Any damage due to mechanical handling shall be repaired by Seller/Sub-seller as per the paint manufacturer's specifications with the new coating overlapping the undamaged coatings surrounding the repair area.

8.2 PAINT PREPARATION

Coatings and primers shall be delivered to the jobsite in the original containers bearing the Manufacturer's name, product designation, batch number, shelf life and date of manufacture. Materials which have exceeded the Manufacturer's recommended shelf life shall not be used. Materials shall be used on a first in, first out basis.

8.2.1 Mixing

- a) Before use, coating ingredients in any container shall be thoroughly mixed by power-driven mixers to a smooth and uniform consistency for a minimum of 5 minutes. Hand mixing using paddles shall not be permitted. For two (2) component systems, the catalyst and the coating shall be thoroughly mixed after the catalyst has been added to the coating.
- b) Coating material mixed in the original container shall not be used until all settled pigment is incorporated in the vehicle. This does not imply that part of the vehicle may not be poured off temporarily to simplify the mixing.
- c) Material which does not have a limited pot life, or does not deteriorate on standing, may be mixed any time before using. If settling has occurred, material shall not remain in spray pots or buckets overnight but shall be gathered into a closed container and re-mixed before use.

8.2.2 Thinning

- a) Thinner shall not be added unless necessary for proper application.
- b) Thinning shall not exceed the limitations established by manufacturer.
- c) The thinner shall be as stated on the manufacturer's product specification sheets.
- d) The manufacturer of the coating materials in which it is used shall supply thinner.

- e) When use of thinner is permissible, it shall be added during the mixing process. Painters shall not add thinner after paint has been thinned to the proper consistency.
- f) Thinning shall be done under supervision acquainted with the correct amount and type to be added.

8.2.3 General Application Techniques

- a) Prior to the application of any coat of material, damage to previous coats shall be touched up. Edges of existing coating shall be feathered towards the substrate prior to over coating.
- b) Coating shall not be placed on edges prepared for field welds or within 100mm of these edges.
- c) Painting shall not be allowed over abrasive blasted areas less than 100 mm away from the un-blasted area.
- d) Each coat shall be uniformly applied as a continuous film of uniform thickness free of pores, skips, sags, and drips. Holidays in the final coat at edges, corners, welds, and inaccessible areas shall be protected by hand brushing with an additional layer of finish coat to meet the specified thickness.
- e) Each coat shall be in a proper state of cure or dryness before the application of the 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 undercoat, and after the manufacturer's minimum recommended drying time has elapsed

- f) The intermediate coat colours shall be distinctly different from the topcoats. Successive coats of paint shall be applied by cross-hatching the previous coat.
- g) Painters shall be equipped with wet mil gauges and each painter shall make frequent checks of wet film thickness.

8.2.4 Air Spray Equipment

- a) The equipment shall be kept in satisfactory condition for proper paint application.
- b) The air from the spray gun impinging against the surface shall show no condensed water or oil.
- c) Spray equipment shall be kept sufficiently clean so that dirt, dried paint, and other foreign materials are not deposited in the paint film.
- d) Prior to use, equipment shall be purged with thinner compatible with product to be sprayed.
- e) Traps or separators shall be installed between the air source and the spray equipment to remove oil and condensed water from the air.
- f) Traps or separators shall be of adequate size and the drain valves shall be opened slightly to permit continuous draining of condensate during operations.

8.2.5 Brush Application

- a) Coatings shall be brushed on all areas which cannot be properly spray coated for any reason.

- b) Brushing shall be done so that a smooth coat as nearly uniform in thickness as possible is obtained.
- c) Paint shall be worked into all corners and crevices.
- d) Runs or sags shall be brushed out.
- e) Successive coats of paint shall be applied by cross-hatching the previous coat.

8.3 DRYING OF COATED SURFACES

8.3.1 Forced Drying

Paint shall not be force dried under conditions which cause cracking, wrinkling, blistering, formation of pores, or detrimentally affect the condition of the paint.

8.3.2 Dryer Compounds/Accelerators

Dryer compounds or accelerators shall not be added to paint unless specifically called for in the manufacturer's specification for the paint.

9.0 HOT-DIP GALVANIZING

9.1 SPECIFICATIONS

9.1.1 Miscellaneous Steel Products

- a) Gratings and other items so specified on the Contract drawings shall be hot dip galvanised in accordance with ASTM A123 and ASTM A384.

- b) Hot dip galvanising shall provide a minimum zinc deposit of 2.5 ounces/ft² of surface.
- c) Hot dip galvanising of bolts, nuts and washers shall conform with ASTM A153 and ASTM A143. Note: Bolts and nuts for piping are PTFE coated.

9.2 PROCEDURES

9.2.1 Galvanised Connections

- a) Items to be galvanised shall be galvanised after fabrication.
- b) Where it is impossible to galvanise a completely fabricated unit, joints that must be welded after galvanising shall have the welds metalized after assembly of the unit with Buyer approved procedure.

9.2.2 Painted Connections

- a) Galvanized members that are to be permanently fixed to the structure by welding shall be attached after the supporting members are primed but before topcoats are applied.
- b) The weld and heat-affected zone shall be cleaned of all welding flux, blasted, and coated as per Appendix A.

9.2.3 Repair

- a) Galvanized surfaces that require welding, cutting, drilling, or other preparation and any galvanized surface that has been damaged shall be repaired with Buyer approved coating repair system.
- b) Rust and surface contaminants shall be removed in accordance with SSPC-SP 3. The area shall then be cleaned by solvent washing.

- c) Coating material shall be applied immediately after completion of surface preparation.

10.0 INSPECTION AND TESTING

- a) As a minimum, all surface preparation and coating application work performed shall be inspected as described in Table 11-1. The results of all the tests shall be recorded in a Daily Inspection Report. The proposed Daily Inspection Reports shall be submitted for Buyer approval.
- b) All parts of the work shall be accessible to Buyer / Buyer's representative.
- c) The Buyer/Buyer's representative shall at all times have the right to inspect any tools, materials, or equipment used or to be used in the performance of the coating application.
- d) The Buyer/Buyer's representative shall have the right to reject any and all equipment or work which does not conform to the specifications.
- e) Any defective work or work not conforming to this specification shall be repaired by Seller/ Sub-Seller at no additional time or cost to the Buyer.

MINIMUM INSPECTION AND TESTING REQUIREMENTS

Test Type	Method	Frequency	Acceptance Criteria	Consequence
Environmental conditions	Ambient and steel temperature Relative humidity Dew point	Before start of each shift + Twice per shift	In accordance to specified requirements, sec. 3.4	No blasting or coating
Visual examination	Visual for sharp edges and weld spatter, slivers, rustgrade, etc.	100% of all surfaces	No defects Specific requirements sec. 7.0	Defects to be repaired
Cleanliness	a) ISO 8501-1 b) ISO 8502-3	a) 100% visual of all surfaces b) Spot checks	a) In accordance with specified requirements, sec. 7.0 b) Max. quantity and size rating 2	a) Re-blasting b) Re-cleaning and re-testing until acceptable
Salt test	ISO 8502-6 or equivalent	Spot checks	Max conductivity corresponding to 20mg/m ² NaCl	Re-cleaning and re-testing until acceptable
Surface profile	Comparator or Stylus Instrument (ISO 8503)	Each component or once per 10m ²	As specified, sec. 7.2	Re-blasting
Visual examination of coating	Visual to determine	100% of surface after each coat	According to specified requirements,	Repair of defects

Test Type	Method	Frequency	Acceptance Criteria	Consequence
	<ul style="list-style-type: none"> • Curing • Contamination • Solvent retention • Pinholes / popping • Sagging • Surface defects 		sec. 13.0 and 14.0	
Holiday detection	NACE RP0188 Voltage, ref table 1	100% of surface after final coat or as required	No holidays	Repair and re-testing
Film thickness	SSPC-PA 2 calibration on smooth surface	SSPC-PA 2	SSPC-PA 2 and coating system data sheet	Repair, additional coats or re-coating as appropriate
Adhesion	ISO 4624 using pneumatic or hydraulic equipment	Spot checks	Ref. notes below	Coating to be rejected
Chloride content of abrasive material	To be provided by Sub-Contractor and approved by Contractor and Company		< 100 parts per million chloride by weight	To be provided by Sub-Contractor and approved by Contractor
Cathodic Disbondment	Part of prequalification of coating, according to ASTM G8, duration 30 days		Max disbonding 10 mm	Coating to be rejected

Note:

Daily Inspection Report

A Daily Inspection Report shall be maintained by the Seller.

Environmental Conditions

Prior to commencement of any surface preparation and coating application the steel temperature, ambient temperature, dew point and relative humidity shall be measured and recorded on the Seller's Daily Inspection Report. A psychrometer shall be used to determine the relative humidity.

Surface Cleanliness and Surface Profile

These assessments shall be carried out at random locations over the whole structure to provide an accurate assessment of the surface cleanliness and the surface profile. The results shall be recorded on the Seller's Daily Inspection Report.

Adhesion

Absolute minimum value is 5.0 MPa, unless otherwise agreed with Buyer.

11.0 INSPECTION RECORDS AND REPORTS

The Buyer shall have the right to inspect the paintwork at all stages of preparation and to reject any tools, instruments, materials, equipment or work that do not conform to this specification.

- a) As a minimum requirement for each system the following aspects of the work shall be documented and recorded on the Coating Inspection Report:

- General

- Names of the Seller and the responsible personnel.
- Dates when work was carried out.
- Materials Preparation
 - Equipment and techniques used.
 - Materials receipt condition.
 - Type and calibration of instruments used.
- Environmental Conditions
 - Weather and ambient conditions.
 - Painting periods
- Surface Preparation
 - Condition of surface before preparation.
 - Tools and methods used to prepare surface.
 - Condition after preparation.
 - Surface contamination test results.
- Paints and Painting
 - Condition of surface before paint application.
 - Information on systems being applied.
 - Mixing and testing prior to application.
 - Paint application techniques.
- Testing
 - Type of quality control checks carried out, and results.
 - Compliance or otherwise with specification.

12.0 REPAIR OF DAMAGE TO SHOP PAINT

- a) Where shop paint has been damaged in handling, damaged and loosely adhering paint shall be removed and the surface thoroughly cleaned by blasting wherever possible or by power tools if conditions do not permit blasting.

- b) Edges of the breaks shall be feathered using sandpaper or emery cloth and the designated number of prime and finish coats applied.
- c) Damaged to the finish coating prior to delivery shall be repaired and refinished.

13.0 SITE PAINTING AND REPAIR

- a) The type, number of coats, and thickness of coatings shall be as specified in Appendix A.
- b) The installation Seller shall touch up coatings that have been damaged during transport and installation.
- c) Minor coating repairs made necessary as a result of normal installation procedures, i.e., removal of installation aid and sling damage, etc., shall be performed in accordance with Section 13.0
- d) Installation Seller shall paint structural and piping interface connection areas.
- e) Surface preparation of the structural and piping interface connection areas shall be in accordance with Section 7.0 of this specification.

14.0 COLOUR STANDARD SCHEDULE

- a) The Buyer colour-coding standard (if any) takes precedence, otherwise the following colour schedule shall be followed.
- The final coat colours of all equipment piping and structural shall be as defined in Appendix B.

- Process piping shall be identified with two inches wide colour bands of suitable material at each side of a deck/wall penetration, close to equipment or where it is necessary to identify a piping system as Appendix C.

COATING SYSTEMS

SYSTEM NO. 1	APPLICATION	DFT (MICRONS)
Area	Onshore plant steel structures, ladders etc.	
Surface Preparation	Solvent de-grease, near white metal blast (SSPC-SP10) with 25 – 50 microns surface profile	
Primer Coat	One coat Zinc rich epoxy primer	50 – 75
Intermediate Coat	One coat polyamide cure high build epoxy	150 – 200
Finish Coat	1 coat Aliphatic Polyurethane	50 – 75
Total Dry Film Thickness (DFT) microns		250 –300

SYSTEM NO. 2	APPLICATION	DFT (MICRONS)
Area	Steel Decking / Non-slip steel surfaces	
Surface Preparation	Solvent de-grease, near white metal blast (SSPC-SP10) with 25 – 50 microns surface profile	
Primer Coat	Epoxy Zinc rich Primer	50-75
Intermediate coat	Epoxy High Build/mastic with entrained aggregate.	300-350
Final	Polyurethane-Finish	50-75
Total Dry Film Thickness (DFT) microns		400-500

SYSTEM NO. 3	APPLICATION	DFT (MICRONS)
Area	Steel Flare Structure and low maintenance areas.	
Surface Preparation	Solvent de-grease, near white metal blast (SSPC-SP10) with 25 – 50 microns surface profile	
Coating	Thermal Spraying of Aluminium Silicon resin finish (for use up to 450°C)	200-250 30 - 50
Total Dry Film Thickness (DFT) microns		230 - 300

SYSTEM NO. 4	APPLICATION	DFT (MICRONS)
Area	Uninsulated exterior surfaces of Carbon steel vessels , exchangers, Storage tanks, piping, pumps and other equipment or process skid units (including support structures) with surface <i>temperatures not exceeding 120°C.</i>	
Surface Preparation	Solvent de-grease, near white metal blast (SSPC-SP-10) with 25 – 50 microns surface profile	
Primer Coat	Inorganic zinc rich epoxy	50 – 75
Intermediate Coat	1 coat polyamide cured high build epoxy Note (1)	150 – 200
Finish Coat	1 coat Aliphatic Polyurethane	50 – 75
Total Dry Film Thickness (DFT) microns		250 – 300

SYSTEM NO. 5	APPLICATION	DFT (MICRONS)
Area	Uninsulated exterior surfaces of Carbon steel vessels, piping, pumps and other equipment or process skid units (including support structure), with surface temperatures above 120°C and not exceeding 250°C	
Surface Preparation	Solvent de-grease, near white metal blast (SSPC-SP-10) with 25 – 50 microns surface profile	
Primer Coat	Inorganic zinc silicate (self cure)	40-50
Intermediate Coat/ Finish Coat	High Temperature Silicone Acrylic	50
Total Dry Film Thickness (DFT) microns		100

SYSTEM NO. 6	APPLICATION	DFT (MICRONS)
Area	Uninsulated exterior Carbon Steel surfaces with Temperature exceeding 250°C like Flare stacks, Chimneys, Exhausts, vents, and pipework up to 450°C.	
Surface Preparation	Solvent de-grease, near white metal blast (SSPC-SP-10) with 25 – 50 microns surface profile	
Primer Coat	Inorganic zinc silicate (self cure)	40-50
Finish Coat	High Temperature Silicone Aluminium	2 x 25
Total Dry Film Thickness (DFT) microns		100

Note: For surface temperature above 450°C two coat of 100µm Poly-siloxane system can be used.

SYSTEM NO. 7	APPLICATION	DFT (MICRONS)
Area	Uninsulated exterior austenitic stainless steel surfaces operating up to 120°C and closed spaces subject to condensation.	
Surface Preparation	Solvent degrease, sweep blast to achieve an anchor profile of approximately 45 microns	
Primer Coat	1 coat epoxy Primer	50 – 75
Intermediate Coat	1 coat epoxy Polyamide	150 – 200
Finish Coat	1 coat Aliphatic Polyurethane	50 – 75
Total Dry Film Thickness (DFT) microns		250 – 300
SYSTEM NO. 7A	APPLICATION	DFT (MICRONS)
Area	Uninsulated exterior austenitic stainless steel surfaces operating between 121°C & 200°C and closed spaces subject to condensation.	
Surface Preparation	Solvent degrease, sweep blast to achieve an anchor profile of approximately 25-45 microns	
Primer Coat	1 coat High temperature Silicone Acrylic	30
Finish Coat	1 coat High temperature Silicone Acrylic	30
Total Dry Film Thickness (DFT) microns		60

NOTES:

- 1. Abrasive used shall be non-metallic and chloride free.***
- 2. All paints shall be free from both chloride and low melting point metals in any form.***

SYSTEM NO. 8	APPLICATION	DFT (MICRONS)
Area	Galvanised Steel Surfaces	
Surface Preparation	Cleaning with Alkaline detergent followed by fresh water wash.	
Primer Coat	1 coat etch primer of epoxy	10 – 15
Intermediate Coat	Polyamide Cure Epoxy	50 – 75
Finish Coat	Aliphatic Polyurethane	50 – 75
Total Dry Film Thickness (DFT) microns		100 – 125

SYSTEM NO. 9	APPLICATION	DFT (MICRONS)
Area	Internal surface of Tank for Diesel storage.	
Surface preparation	Solvent degrease, near white metal blast (SSPC-SP-10) with surface profile 50 – 75 microns	
Coating Materials	2 coats of high build epoxy phenolic	2 x 125 = 250
Total Dry Film Thickness (DFT) microns		250

SYSTEM NO. 10	APPLICATION	DFT (MICRONS)
Area	Internal surface of vessel/Tank for Fire water , Service water and Potable water(*) storage	
Surface preparation	Solvent degrease, near white metal blast (SSPC-SP-10) with surface profile 50 – 75 microns	
Coating Materials	2 coats of high build Polyamide cure epoxy	2 x 125 = 250
Total Dry Film Thickness (DFT) microns		250

***Note: (*) For Potable water storage the paint shall be certified for
potable water storage***

SYSTEM NO. 11	APPLICATION	DFT (MICRONS)
Area	Inside Bottom plates (underside) of all Onshore storage tanks	
Surface preparation	Solvent degrease, near white metal blast (SSPC-SP-10) with surface profile 50 – 75	
Primer Coat	Not required	
Intermediate coat	Option 1 - Belzona 5811 (Note 1)	250
	Option 2 - Coal Tar Epoxy (Note 2)	125 - 140
Finish Coat	Option 1 – Belzona 5811 (Note 1)	250
	Option 2 - Coal Tar Epoxy (Note 2)	125 - 140
Total Dry Film Thickness (DFT) microns for Belzona 5811		500
Total Dry Film Thickness (DFT) microns for Coal Tar Epoxy		250 - 280

NOTES:

1. This product is the preferred HSE option and the Belzona requirements relating to the application and usage as defined in their Instructions for Use, Product Specification Sheet and Material Safety Data Sheets (for Solidifier and Base) shall be complied with.

2.) This product shall only be used by personnel who have been advised of the potential risk to their health, who are fully equipped with appropriate PPE, and who are adequately supervised to ensure that the PPE is worn at all times that the product is in use"

SYSTEM NO. 12	APPLICATION	DFT (MICRONS)
Area	Internal surface of Process vessels like Liquid Separator, Production Separator and Flare KO Drums.	
Surface preparation	Solvent degrease, white metal blast (SSPC-SP-5) with 75-100 microns surface profile	
Coating Materials	Glass Flake Vinyl Ester Lining	2 x 500=1000
Total Dry Film Thickness (DFT) microns		1000

SYSTEM NO. 13	APPLICATION	DFT (MICRONS)
Area	Internal surface of Glycol and Methanol Tanks	
Surface preparation	Solvent degrease, white metal blast (SSPC-SP-5) with 75-100 microns surface profile	
Coating Materials	2 coats of two pack solvent free epoxy	2 x 300=600
Total Dry Film Thickness (DFT) microns		600

SYSTEM NO. 14	APPLICATION	DFT (MICRONS)
Area	Fire proofing (Carbon steel)	
Surface preparation	NACE No.1 / SSPC – SP 5 (H)	50 to 75 µm (2 to 3 mil)
Coating Materials	Prime Coat : Epoxy / phenolic	150 µm (6.0 mil)
	Finish Coat : Epoxy / phenolic	150 µm (6.0 mil)
Total Dry Film Thickness (DFT) microns		-

SYSTEM NO. 15	APPLICATION	DFT (MICRONS)
Area	Insulated Carbon steel & Austenitic stainless steel exterior surfaces of Vessels, exchangers, Storage tanks, piping, pumps and other equipment or process skid units (<i>including support structures</i>) with surface temperatures up to 150°C.	
Surface Preparation	Solvent degrease, sweep blast to achieve an anchor profile of 25 – 45 microns	
Primer Coat	1 coat immersion grade epoxy phenolic	125
Finish Coat	1 coat immersion grade epoxy phenolic	125
Total Dry Film Thickness (DFT) microns		250

NOTES:

- 1. For stainless steel, abrasive used shall be non-metallic and chloride free.***
- 2. All paints shall be free from both chloride and low melting point metals in any form.***

Note:

COLOUR CODE

Colour Code of Piping shall be as per OMR-2017 and IS 2379.

SPECIFICATION FOR HOT INSULATION

0	23.01.2021	ISSUED FOR REVIEW	SD	RZ	BDP
REV.	DATE	PURPOSE	PREPARED BY	CHECKED BY	APPROVED BY

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1.0 □ GENERAL

1.1. □ SCOPE

- 1.1.1. This specification shall be applicable for external insulation of offsite vessels and tanks and all above ground piping operating between ambient to 760 °C for the purpose of heat conservation, process stabilization, temperature maintenance, personnel protection and fire protection.
- 1.1.2. This specification applies for the bhasker field Project plant being set up in the khmbhat. All the codes/ standards mentioned in this specification shall be of the latest issue.
- 1.1.3. Piping, equipment, storage tanks and vessels requiring insulation and the temperatures (operating) shall normally be specified which would govern the selection of insulation, as applicable, on the following project documents:
- Piping and Instrument Diagrams (P&IDs) and Line Lists
 - Piping General Arrangement Drawings & Isometrics
 - Instrument Piping Details and Schedules
 - Vessel, exchanger and storage tank documents and insulation schedules.
 - Equipment suppliers General Arrangement Drawings for equipment items in the package plant.

1.2. □ REFERENCE CODES AND STANDARDS

ASTM Standards and Specifications

ASTM A167	Specification for Stainless and Heat-Resisting Chromium Nickel Steel Plate, Sheet and Strip
ASTM A240	Specification for Heat-Resisting Chromium and Chromium- Nickel Steel Plate, Sheet and Strip for Pressure Vessels
ASTM A463	Specification for Steel Sheet, Aluminum Coated, by Hot-Dip Process
ASTM A526	Specification for Steel Sheet, Zinc Coated, by Hot-Dip Process, Commercial Quality
ASTM B209	Aluminum Alloy Sheet and Plate
ASTM C165	Measuring Compressive Properties of Thermal Insulations
ASTM C177	Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus
ASTM C240	Standard Test Methods of Testing Cellular Glass Insulation Block
ASTM C302	Standard Test Methods of Density and Dimensions of Preformed Pipe Covering Type Thermal Insulation
ASTM C303	Standard Test Methods of Density and Dimensions of Preformed Block and Board Type Thermal Insulation
ASTM C335	Standard Test Method for Steady-State Heat Transfer Properties of Horizontal Pipe Insulation
ASTM C356	Standard Test Method for Linear Shrinkage of Preformed High Temperature Thermal Insulation Subjected To Soaking Heat
ASTM C390	Standard Criteria for Sampling and Acceptance of Preformed Thermal Insulation Lots

ASTM C446	Standard Test Method for Breaking Load and Calculated Modulus of Rupture of Preformed Insulation of Pipes
ASTM C518	Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus
ASTM C533	Standard Specification for Calcium Silicate Block and Pipe Thermal Insulation
ASTM C547	Standard Specification for Mineral Fiber Pipe Insulation
ASTM C552	Standard Specification for Cellular Glass Thermal Insulation
ASTM C591	Standard Specification for Unfaced, Rigid, Preformed Cellular Polyisocyanurate Thermal Insulation
ASTM C592	Standard Specification for Mineral Fiber Blanket Insulation and Blanket-Type Pipe Insulation (Metal-Mesh Covered), Industrial Type
ASTM C610	Standard Specification for Block and Pipe Thermal Insulation
ASTM C612	Standard Specification for Mineral Fiber Block and Board Thermal Insulation
ASTM C795	Standard Specification for Thermal Insulation for Use in Contact With Austenitic Stainless Steel
ASTM C871	Standard Test Methods for Chemical Analysis of Thermal Insulation Materials for Leachable Chloride, Fluoride, Silicate and Sodium Ions
ASTM C892	Standard Specification for High Temperature Fiber Blanket Thermal Insulation
ASTM D1622	Test Method for Apparent Density of Rigid Cellular Plastics
ASTM D2126	Test Method for Response of Rigid Cellular Plastics To Thermal and Humid Aging
ASTM E96	Standard Test Methods for Water Vapour Transmission of Materials

BS Standards and Specifications

BS 1902, part 6	Ceramic Fiber Products
BS 2972	Method of Test for Inorganic Thermal Insulating Materials
BS 4370, part 2	Method of Test for Rigid Cellular Materials
BS 4370	Specification for Preformed Rigid Polyurethane (PUR) and Polyisocyanurate (PIR) Foams for Thermal Insulation of Pipework and Equipments

2.0 ☐ INSULATION DESIGN (MATERIAL, THICKNESS AND EXTENT OF INSULATION)

2.1. ☐ INSULATION MATERIAL AND THICKNESS

- 2.1.1. In general, rock wool & perlite insulation shall be used up to 550 °C and calcium silicate for temperatures above. Insulation material and thickness as given in schedule of rate shall apply.
- 2.1.2. Insulation is required for any of the following purposes, as indicated in P&IDs and line lists:
- Process Lines
 - Hot oil
 - Fire protection
 - Personnel protection

- 2.1.3. Insulation is not required for piping and equipment for which heat loss is desired- excepting for personnel protection or to avoid thermal stress problems.
- 2.1.4. Instruments and associated piping (other than impulse piping/tubing) subject to operating flow and/or temperature conditions prevailing in the connected piping or equipment shall be insulated to the same requirements as that of the piping or equipment.

2.2.□ EXTENT OF INSULATION ON PIPING SYSTEMS

- 2.2.1. Insulated piping systems shall have straight pipe, bends, tees and pipe-fittings completely insulated.
- 2.2.2. Unless otherwise specified, all valves and flanged joints shall be completely insulated only in hot oil lines and Process lines to maintain temperatures.
- 2.2.3. Insulation shall not be applied to the following, unless otherwise specified.
- Piping which becomes hot intermittently, such as relief valves, vents, steam-out and snuffing steam systems, flare and blow-down systems.
 - Supports for piping, excluding pipe hangers to the extent covered by insulation.
 - Valves, including control valves and flanges in process piping systems (except as noted in para 2.2.2). However, personnel protection insulation for these items shall be applied as required.
 - Pipe union fittings
 - Thermowell bosses, temperature and pressure tappings.
 - Expansion joints, hinged joints and hose assemblies

2.3.□ EXTENT OF INSULATION ON EQUIPMENT

- 2.3.1. Support skirts of insulated vertical vessel greater than 1200 mm diameter shall be insulated both internally and externally for a minimum distance of 600 mm below the bottom tangent line. The insulation shall terminate not less than 300 mm above the anchor chair.
- 2.3.2. Support skirts of insulated vertical vessels of diameter 1200 mm and less shall be insulated externally only, as described in para 2.3.1.
- 2.3.3. Bottom heads of insulated vertical vessels enclosed by a support skirt shall be insulated without finishing material and shall be insulated only when the vessel outside diameter is greater than 1200 mm.
- 2.3.4. Liquid ends of pumps shall be insulated when heat traced and jacketed.
- 2.3.5. Insulation shall not be applied to the following unless otherwise specified:
- Pumps with operating temperature below 200 °C, unless the pumped fluid has a pour point above minimum design ambient temperature
 - Fans, compressors and blowers
 - Liquid ends of pumps except as noted in para 2.3.5 above

- Internally insulated or refractory lined equipment unless specifically designed for metal temperature control.
- Heads of vessels enclosed by support skirts with vessel diameters 1200 mm and less.
- Internal surfaces of insulated vessel support skirts with vessel diameters 1200 mm and less.
- Exchanger channel and covers, shell and channel flanges & expansion joints
- Nozzle flanges, manholes, hand-holes and flanges of equipment
- Surfaces of coolers and condensers
- Nameplates of all equipment items
- Thermowell bosses, temperature and pressure tapings

2.4. □ PERSONNEL PROTECTION

- 2.4.1. Personnel protection is applicable where exposed surface temperature exceeds 65 °C in normal or short term operating condition. Personnel protections shall be provided on the portion of equipment or piping 2100 mm or less above grade, platforms or walkways and within 600 mm horizontally of handrails, platforms or walkways adjacent to path travelled by personnel.
- 2.4.2. For operating temperature 175 °C or less, where corrosion under insulation is a concern, no insulation shall be used. Personnel protection shall be by metal cage away from the hot surface. The metal cage shall be placed typically at a distance of 50 mm for pipe size up to 6 inches, 75 mm for 6 to 10 inches and 100 mm above 10 inches.
- 2.4.3. For temperature above 175 °C, insulation shall be used for personnel protection.

2.5. □ CORROSION PREVENTION

- 2.5.1. Equipment and piping shall be protected from corrosion by providing appropriate painting under insulation, as per applicable painting specification for the project.
- 2.5.2. For operating temperature below 175 °C, additional corrosion protection measures shall be used, for which any of the following shall be applied:
 - a) Insulation system with closed cell structure e.g. per-shaped rigid PIR (use up to 125 °C)/ cellular glass followed by non-metallic UV cured GRP (glass reinforced polyester) cladding.
 - b) For insulation system with open cell structure material, e.g. rock wool, wrap the insulation with multiplex foil (composite of aluminum and polyester) followed by non metallic UV cured GRP (glass reinforced polyester) cladding.
- 2.5.3. For fire safe insulation, GRP cladding shall not be used, cladding shall be of stainless steel or aluminized steel. When metal cladding is used, moisture barrier shall be used underneath the metal cladding (irrespective of insulation type).

3.0 □ MATERIAL

3.1. □ GENERAL

- 3.1.1. Insulation material shall be as per specifications described in para 3.2. Selected material(s) for a particular job shall be as per Process Design Basis.
- 3.1.2. All materials 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 and aluminum (even if soaked in water at ambient temperatures for extended periods).
- 3.1.3. The use of insulation or finishing materials containing asbestos in any form is not permitted.
- 3.1.4. No inflammable material shall be attached to the insulation.
- 3.1.5. Fibrous insulators, calcium silicate, perlite and ceramic fibers can be used for the full temperature range mentioned against the respective material for all applications except for electrically heated ones.
- 3.1.6. Insulation materials to be used over austenitic stainless steel surfaces shall be zinc free and shall be inhibited with sodium silicate as per ASTM C-795. The amount of leachable chloride in the insulation material (except for calcium silicate) before application shall not exceed 10 ppm. In case of calcium silicate, it should not exceed 50 ppm. For the chemical analysis of insulation materials, ASTM C-871 shall be referred.
- 3.1.7. Dimensions and dimensional tolerances for pipe selections, mattresses and slabs shall generally be as per respective codes unless otherwise mentioned. The number of pieces to be used shall be as less as possible. When installed, the insulation shall fit snugly and shall have a tight joint.
- 3.1.8. The insulation materials shall be as per ASTM/BS standards/codes for overseas jobs unless otherwise specified.

3.2. □ INSUALTION MATERIALS

3.2.1. Rockwool

Rock wool or glass shall be a pre-formed insulation and shall be of long fibered rock or glass material processed from a molten state into fibrous form bonded with a binder and suitable for the intended operational temperature range from ambient to 550 °C.

Unless otherwise specified, insulation material shall conform to the requirement of quality standards listed below:

• Pre-formed pipe insulation	ASTM C547 type II/ IS 9842
• Metal-mesh covered bonded mineral fiber blanket and blanket type pipe insulation	ASTM C592 Class II/ IS 8183 for piping and equipment. Blankets shall be faced on one side with 20 mm galvanized 22 SWG wire mesh stitched through with 22 SWG galvanized lacing wire. For insulation over austenitic SS piping and equipment, instead of galvanized wire mesh and lacing wire, SS304/316 wire mesh and lacing wire shall be applied.
• Bonded mineral fibre slab insulation	ASTM C612/ IS 8183
• Mineral fibre block and board thermal insulation	ASTM C612 type IV/type V

Material shall conform to the requirements of respective codes and minimum requirements stated below:

• Density (min.)	<ul style="list-style-type: none"> Preformed pipe section: 140 kg/m³* Rockwool LRB blanket: 128 kg/m³* <p>*Max. resin content at the above mentioned densities shall be 2%.</p> <ul style="list-style-type: none"> Bonded mineral fiber slab: 192 kg/m³ and 320 kg/m³ 														
• Thermal Conductivity (max.)	<table> <thead> <tr> <th>Mean Temperature °C</th><th>Thermal Conductivity (W/m-K)</th></tr> </thead> <tbody> <tr><td>50</td><td>0.043</td></tr> <tr><td>100</td><td>0.052</td></tr> <tr><td>150</td><td>0.062</td></tr> <tr><td>200</td><td>0.068</td></tr> <tr><td>250</td><td>0.080</td></tr> <tr><td>300</td><td>0.090</td></tr> </tbody> </table>	Mean Temperature °C	Thermal Conductivity (W/m-K)	50	0.043	100	0.052	150	0.062	200	0.068	250	0.080	300	0.090
Mean Temperature °C	Thermal Conductivity (W/m-K)														
50	0.043														
100	0.052														
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200	0.068														
250	0.080														
300	0.090														
• Linear Shrinkage	Not more than 2% when subjected to soaking heat at the stated max. temperature of use (649 °C), for 24 hours														
• Compressive Strength (minimum) at 10% deformation	250 kg/m ³ for resin bonded pipe sections, curved beveled segments and LRB slabs; 120 kg/m ³ for LRB blankets (mattresses) unless otherwise specified.														
• Water vapour sorption by weight, max. %	5														
• Leachable chloride content, ppm, ASTM C871, max.	10														

3.2.2. Calcium Silicate

Insulation shall conform to ASTM C533 type II/ IS 9428, shall be suitable for operating temperatures up to 760 °C. Material shall conform to the requirements of respective codes and minimum requirements stated below:

• Bulk Density (max.)	352 kg/m ³																						
• Compressive Strength (min.)	Reduction in thickness shall not exceed 5% when tested. Dry under a load of 688 kN/m ²																						
• Linear Shrinkage (when soaked at 927 °C for 24 hours), max.	20%																						
• Mass Loss by tumbling, after 10 minutes, max.	20%																						
• Thermal Conductivity (max.)	<table> <tr> <th>Mean Temperature °C</th><th>Thermal Conductivity (W/m-K)</th></tr> <tr><td>38</td><td>0.072</td></tr> <tr><td>93</td><td>0.078</td></tr> <tr><td>149</td><td>0.084</td></tr> <tr><td>204</td><td>0.088</td></tr> <tr><td>260</td><td>0.092</td></tr> <tr><td>316</td><td>0.097</td></tr> <tr><td>371</td><td>0.101</td></tr> <tr><td>427</td><td>0.105</td></tr> <tr><td>482</td><td>0.108</td></tr> <tr><td>538</td><td>0.111</td></tr> </table>	Mean Temperature °C	Thermal Conductivity (W/m-K)	38	0.072	93	0.078	149	0.084	204	0.088	260	0.092	316	0.097	371	0.101	427	0.105	482	0.108	538	0.111
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538	0.111																						
• Moisture content, by weight, max.	20%																						
• Leachable chloride content, ppm, ASTM C871, max.	50																						

3.2.3. Perlite

Block and pipe covering shall be suitable for a temperature of 649°C (1200°F), and confirming to ASTM C610.

Minimum density shall be 192 kg/m³ (12 lb/ft³).

Compressive Strength 412kPa(Min). Test as per ASTM C 165.

Sectional (two-piece or quads) pipe covering shall be used for all commercially available sizes.

All other pipe sizes and for all equipment's, insulation shall be curved radius or scored blocks. Width of block shall not be less than 150 mm (six inches).

'Perlite material shall be tested as per C-692 for application over SS surfaces'.

3.3.□ WEATHER PROTECTION JACKET (CLADDING)

3.3.1. Insulation shall be protected with cladding. Type of cladding shall be as below:

- a) For operating temperature 175 °C or less, non-metallic UV cured GRP shall be used as weather protection cladding.
- b) For temperature between 176 -550 °C or unless otherwise mentioned. Aluminum jacketing shall be used as weather protection cladding. Aluminum cladding shall be as per ASTM C1729, class- A having polysurlyn lamination on inside surface and shall meet the requirements of ASTM B209 alloy 3003 H14.
- c) For temperature above 550 °C and/or for fire safe insulation (for all temperature range) cladding shall be stainless steel as per ASTM A167/ A240 type 304 or aluminized steel as per ASTM A463 type 2, coating designation T2-100, with polysurlyn lamination on inside surface.
- d) For grade piping in offsites, jacket material shall be galvanized steel. Galvanized jacketing shall not be used over insulation on or near austenitic stainless steel and/or austenitic nickel steel piping and equipment. Galvanized steel shall be as per ASTM A526 with 275 gsm of coating of zinc layer on both the surfaces.

3.3.2.□ Non metallic UV cured GRP

Glass fiber reinforced polyester (GRP) shall serve as weather protection cladding, which is supplied as flexible sheet, when exposed to sunlight UV rays, cures to hard laminate. GRP after curing shall be resistant to UV radiation, acids, caustic and salt solution. The material shall conform to the following requirement:

• Temperature of use	0 to 90 °C
• Weight (kg/m ²)	2
• Bending strength (MPa), min. ISO 178	130
• Tensile Strength (MPa), min. ISO 527	50
• Elongation at break (%)	1
• Flame spread index (ASTM E84)	20
• Water vapour permeability (g/m ² , h. mm Hg), ASTM E96	0.001
• Impact resistance (kJ/m ²), ISO 179	57
• Temper (Barcol)	45
• Layer thickness (mm)	1.7 to 1.9

3.3.3. Thickness of metal cladding shall be as follows:

Fibrous material (Rock wool)

Application	Thickness for aluminum cladding (other than grade piping in offsites- refer note below)	Thickness for stainless steel/ aluminized steel cladding
For shells of vertical storage tanks and vessels	0.7 mm (22 SWG) corrugated. The profile of corrugated sheet shall be 32 mm x 5 mm.	0.56 mm (24 SWG) corrugated. The profile of corrugated sheet shall be 32 mm x 5 mm.
For tank roofs	1.22 mm (18 SWG) flat	0.91 mm (20 SWG) flat
For Horton spheres and horizontal vessel shell and heads; vertical vessel heads	0.7 mm (22 SWG) flat	0.56 mm (24 SWG) flat
For removable covers	1.22 mm (18 SWG) flat	1.22 mm (18 SWG) flat
For all piping, other than grade piping in offsites	0.7 mm (22 SWG) flat	0.56 mm (24 SWG) flat
For grade piping in offsites	0.56 mm (24 SWG) galvanized steel (refer note below)	

Note: For grade piping in offsites the cladding material shall be galvanized steel.

Rigid material (Calcium silicate & Perlite)

Application	Thickness for aluminum jacket/cladding	Thickness for stainless steel/ aluminized steel jacket/cladding
Piping, horizontal vessel heads and tank roofs	0.56 mm (24 SWG) flat	0.46 mm (26 SWG) flat
Vertical vessel shells and vertical portion of storage tanks	0.56 mm (24 SWG) corrugated. The circular profile of corrugated sheet shall be 32 mm x 5 mm.	0.46 mm (26 SWG) corrugated. The circular profile of corrugated sheet shall be 32 mm x 5 mm.
Removable covers	1.22 mm (18 SWG) flat	1.22 mm (18 SWG) flat

3.4. □ ANCILLARY MATERIALS

3.4.1. Securement Bands/ Wires

1. If material is aluminum, then specification shall be ASTM B209 ALLOY 3003 H16. If stainless steel, it shall be 18/8.
2. For securing fibrous insulation:
 - A. On piping: Band, 24 SWG thick x 12 mm (min.) wide, stainless steel
 - B. On equipment: Band, 24 SWG thick x 20 mm wide, stainless steel
 - C. On vertical storage tanks: Band, 24 SWG thick x 25 mm wide, stainless steel
3. For securing rigid insulation:
 - A. On piping up to 16" OD: Wire, 16 SWG, stainless steel
 - B. On piping 16" OD and larger, vertical and horizontal equipment: Band, 24 SWG thick x 20 mm wide, stainless steel
4. For securing cladding on insulation (all types):
 - A. For piping: Band, 24 SWG thick x 12 mm (min.) wide, stainless steel
 - B. On equipment: Band, 24 SWG thick x 20 mm wide, stainless steel
 - C. On vertical storage tanks: Band, 24 SWG thick x 25 mm wide, stainless steel

3.4.2. Rivets

Rivets required for metal jacket securement shall be the expanding aluminum "POP" blind eye type/ stainless steel, 9.5 mm long x 5 mm diameter.

3.4.3. Screws

Screws required for metal jacket securement shall be stainless steel/ cadmium plated steel self-tapping type A no. 8 dia x 12 mm long to BS 4176 complete with neoprene washers under the head.

3.4.4. 'S' and 'J' Clips

Formed from 25 mm wide stainless steel banding.

3.4.5. Heat Transfer Cement

Maximum exposure temperature: 677 °C

Heat transfer coefficient to equipment wall: 114-227 W/m²-°C

Bond shear: 1.034 kPa

Electrical resistivity: 1.299 ohm/cm

3.4.6. Sealant for Cladding

Sealing materials which may either be in the form of an elastomeric sealing compound or fiber based bituminous felt strips.

3.4.7. Multiplex Foil

- The multiplex foil shall consist of sandwiched sheets of aluminium and polyester. It shall be applied over the insulation prior to GRP cladding. It shall conform to the following requirements:

Foil composition	12 µm polyester film
	25 µm aluminium foil
	12 µm polyester film
Tensile Strength	100 MPa
Yield Strength	70 N/cm
Tear Resistance	400 g/mm
Temperature range	-60 to 120 °C
Volumetric mass	1.93 kg/dm ³
Water vapour permeability in accordance with ASTM E96, procedure E (37.8 °C, 90% RH)	maximum 10 x 10 ⁻⁶ g/(m ² .h.mmHg)

3.4.8. Sealing Tapes for Multiplex Foil

- The sealing tape for joints in the multiplex foil shall meet the following requirements:

Foil composition	12 µm polyester film
	25 µm aluminium foil

	12 µm polyester film
	adhesive layer: polyacrylate
Total thickness exclusive of adhesive layer	50 µm
Temperature range	-45 to 120 °C
Volumetric mass	1.93 kg/dm ³
Water vapour permeability in accordance with ASTM E96, procedure E (37.8 °C, 90% RH)	maximum 10 x 10 ⁻⁶ g/(m ² .h.mmHg)

3.4.9. Moisture Barrier

- (for application on the outer surface of the insulation for operating temperature up to 175 °C or less, where stainless steel/aluminized steel is used in place of GRP as cladding in fire safe insulation)
- The moisture barrier shall be a polymeric water based, breather type mastic (vapour under pressure will pass through it), fire resistive, flexible and be compatible with the type of insulation. Material shall be suitable for the range of temperature to which it is exposed.
- Material shall be for fire resistance as per ASTM E84 (flame spread index ~10) and water vapour permeability in accordance with ASTM E96, procedure B > 1 perms for 1/116" thickness. Average non-volatile content: 60 to 64% by volume (64% by weight). Typical acceptable moisture barrier are: Foster 46-50/ Childers AK-CRYL CP9/ TIC 2030.

3.4.10. Protection Guard

- Guards and their supports shall be manufactured from carbon steel, which may be galvanized or painted or with stainless steel. (The mesh may be painted with yellow stripes, 50 mm wide and shall include a hazard sign indicating 'Hot Surface'.) The guard mesh shall be 2 mm thick and 12 mm square. Guard shall be designed with end cap of 0.7 to 1 mm thickness from galvanized Al-Zn coated or Al coated carbon steel with recommended spacing of 450 mm to 600 mm. Care to be taken that end caps are fitted in an orientation that will allow water drainage. If the metal surface requires greater protection, a fibre glass insulation tape can be fitted to an area where end caps make contact to protect pipe work and reduce heat transfer. Mesh shall be rolled to shape as per normal cladding, and shall be provided with 50 mm of overlap, sharp edges of cut mesh to be filed. In case of removable guard, the same can be made from toggle clips.

4.0 □ APPLICATION

4.1. □ GENERAL

4.1.1. The application methods, given in this standard are general in nature. The contractor is responsible for applying an insulation system that will give a satisfactory operational performance and the requirements given herein shall be regarded as the acceptable minimum. The Contractor 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 have a neat, efficient and workmanlike appearance.

4.1.2. The insulation shall be designed/applied such that the ingress of water is prevented, leaked product can drain off and vapour can escape.

4.1.3. All hydrostatic tests on piping and equipment, including steam tracing systems, shall be carried out before insulating material is applied.

The insulation contractor shall only insulate those sections of the plant that have been specifically released for such work by the engineer-in-charge. If insulation must be installed before pressure test, then all welds and flanged joints in the pipe shall be left uncovered till successful completion of pressure test. Then insulation shall be completed.

4.1.4. Surfaces to be insulated shall be thoroughly cleaned, dried and made free from loose scale, oil or grease. It shall be the Contractor's responsibility to remove loosely adhering scale and dirt before applying insulation.

4.1.5. The insulation contractor shall not carry out any welding or drilling on plant equipment and piping.

4.1.6. Insulation shall be finished, bevelled and weatherproofed at all terminal points where it is required to remove bolts etc. without damage to the insulation.

4.1.7. All projections, such as lifting lugs, trunnions and stiffeners on piping and equipment (i.e. vacuum rings) shall be insulated with the same thickness of insulation as specified for the equipment item or pipeline.

4.1.8. Thermowell bosses, pressure tappings and weephole nipples shall not be insulated in but left accessible.

4.1.9. For insulation thickness upto 75 mm only single layer insulation shall be used. Multi layer insulation shall be required when the insulation thickness is greater than 75 mm with inner layer being larger. Insulation installation in two or more layers shall be staggered joint construction and each layer shall be secured in place and details of securement shall be the same for each layer.

4.1.10. Wet or damaged insulation shall not be used under any circumstances.

Material awaiting its protective cover shall be adequately protected from damage, rain, contamination and shall be covered with cladding at a minimum loss of time.

- 4.1.11. A minimum clearance of 25 mm between outside surface of any insulation finish and adjacent equipment, pipe or structural members shall be maintained.
- 4.1.12. Insulation supports shall not project out of the insulation outer surface and shall be given sufficient coverage of insulating material to avoid hot spots on the metallic cover at support positions.
- 4.1.13. 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 25 mm minimum.
- 4.1.14. Pieces of insulation with crushed and damaged ends shall not be used.
- 4.1.15. Compression spring made from stainless steel for each securement band of metal cladding shall be installed on tank, pressure vessels and equipment. Requirement for springs on banding to secure metal jacketing shall be as follows:

Equip. OD (m)	Equip. Circ. (m)	Number of Jacket expansion Springs					
		Steel Temperature					
		93 °C	204 °C	315 °C	427 °C	538 °C	649 °C
1	2.9	0	0	0	1	1	1
2	5.7	0	1	1	1	2	2
3	9.6	0	1	2	2	2	2
4.6	14.3	1	1	2	3	3	4
6	19.1	1	2	3	3	4	4
7.6	23.9	1	2	3	4	5	6

4.2. □ PIPING APPLICATIONS

Rock wool preformed pipe sections shall be supplied in two halves for sizes up to which manufactured and at least for all pipes with outside diameter over insulation of 500 mm. In bigger sizes, multi-segments are preferable if manufactured, otherwise, blankets are acceptable.

Calcium silicate shall be supplied in hollow cylindrical shapes slit in half length-wise (in a plane including the cylindrical axis) or as curved segments. Up to 14" pipe size, only hollow cylindrical shapes slit in half length-wise shall be used. Pipe sections bored/machined out of blocks shall not be used.

4.2.1. □ Horizontal Pipe

a) General

Insulation material shall be applied to fit snugly against the contours 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 suitably filled up with compatible loose fill material.

b) Pipe Section/Moulded Blocks/ Segments

End joints of the adjacent block shall be staggered one half of the block.

Included angle between segments shall not be less than 30 ° for both single and double layer insulation.

Further, minimum arc length of segments should meet the following requirements:

When double layer is applied, both longitudinal and circumferential joints shall be staggered. The arc between the longitudinal seam lines of the inside and outside layers of insulation shall have an angle of over 15° or the longitudinal joints staggered at least by one layer thickness, whichever is more stringent. Circumferential seams of the inside and outside layers shall be at least 100 mm apart.

c) Blankets (Fibrous insulation-Rock wool or Glass wool)

Blankets shall be applied over the surface with joints tightly butted and laced together with 1 mm diameter galvanized lacing wire.

d) Insulation Securement (All insulation materials)

Each layer of insulation shall be secured firmly in place with at least 3 loops of binding wire/ band, one loop to be equally spaced between end loops, for each section. Binding wire shall be drawn about the insulation with the ends tightly twisted together, bent under and pressed into the surface of the insulation. Bands or wires shall be in no case placed more than 200 mm apart.

- For calcium silicate, all joints shall be sealed with insulating cement of same composition as the moulded block.
- Each layer of insulation shall be secured by the same method as above.

e) Framework for supporting cladding fibrous insulation (See fig. 3 & 4)

This is not necessary for rigid materials. This is required only for horizontal pipe runs provided with fibrous insulations in blanket forms, vertical piping provided with fibrous materials need not be provided with this. Piping provided with fibrous resin bonded pipe sections also need not be provided with this framework.

Spacer rings shall be fabricated out of 25 x 3 MS flats. The outside diameter of these rings shall be riveted to 'Z' shaped stays fabricated from the same sized MS flats. These rings shall be suitably painted for corrosion protection. Stays shall be provided at no more than 300 mm along the circumference of the insulation, subject to a minimum of 3 stays. Spacer rings shall be provided at every approximately 900 mm. To minimize direct heat conduction through the stays, a packing of 2 sheets of 3 mm thick millboard shall be provided at the joints of the stays and the pipe. Joints between MS spacer ring and stays shall be riveted by 6 mm dia. MS rivets with 2 sheets of 3 mm thick millboard interposed.

4.2.2. □ Vertical Pipe (See fig. 5)

Insulation on vertical or near vertical piping (i.e. greater than 45 ° Angle from horizontal) shall be supported by bolted-on metal collars. Metal collars shall be of 6 mm thick MS or alloy steel bar (to suit the piping material).

Outside diameter of the collar shall be around 12 mm less than OD of the insulation. Where multi-layer insulation is used, support collar shall be extended to provide for each layer.

Support positions shall be at no greater distance apart than the following:

Pipe Operating Temp. ° C	Support Spacing (mm)
Up to 400	4500
401 to 500	3500
501 to 550	2500
551 to 650	2000
651 to 760	1500

4.2.3. □ Expansion Joints (Both vertical and horizontal piping, all insulating materials) (See fig. 5)

Expansion joint shall be provided at regular intervals as below:

Pipe Operating Temp. ° C	Spacing (m)
Up to 200	Not required
201 to 300	10
301 to 350	8
351 to 400	6
401 to 550	5
551 to 650	4
651 to 760	3

Expansion joint shall be formed by a 25 mm space between the pipe insulation sections and the space shall be filled by compressed mineral rock fibres. Expansion joints in each layer shall be offset at least 150 mm from each other in case of multi-layer insulation. Expansion joint for first layer for vertical pipe shall preferably be just below insulation support collars.

4.2.4. □ Elbows and Bends (All insulation materials) (See fig. 6 and fig. 7)

Insulation material shall be mitred and shall be the same as that pipe. Insulation securement bands/wire shall be secured with minimum 2 wires/bands. For bends/elbows of nominal pipe size 6" and below, due to lack of space, for all insulation materials, insulation shall be secured by spirally wound 16 SWG SS wire for hard materials and 10 SWG SS wire for soft materials.

Insulation joint for calcium silicate shall be suitably sealed by insulating cement. Fittings below 50 mm NB with calcium silicate insulation shall be insulated with insulating cement build up in 6 mm layers to the thickness of insulation of the adjacent piping. Each layer of insulation cement shall be reinforced with 25 mm no. 20 SWG wire netting.

4.2.5. □ Tee (All insulation materials) (See fig. 8)

Pre-formed pipe sections or segments shall be carefully cut and shaped around tee junctions and the insulation material of the tangential pipe shall be carefully and neatly cut to mate up to the material applied to the parent pipe without the creation of voids or gaps at the junction. Insulation shall be adequately secured by wire/bands of material to suit the pipe material.

4.2.6. □ Flanged joints or valves (all insulation materials) (See fig. 9 and 10)

Flanged joints or valves, if to be insulated, shall be insulated with prefabricated removable covers, lined with pipe section/lags/slabs.

Welded valves, if insulated, shall be insulated with oversized pipe sections or lags, cut and shaped to fit around the body of the valve. Insulated valves shall be completely covered, but the insulation shall be cut and shaped around the stem and kept clear of the stuffing box gland.

4.2.7. □ Insulation Flashing (all insulation materials)

Insulation shall be stopped short of flanged joints and unions by a sufficient distance to permit easy removal of the flange nuts and bolts or breaking of the unions to take place without disturbance or damage to the insulating material. At these positions the insulation shall be bevelled and sealed with a metal closure which in turn shall be sealed with waterproof sealing material.

4.2.8. □ Pipe Supports (all insulation materials) (See fig. 11)

Insulation at solid welded or clamped supports shall be cut and shaped to fit around the support and banded securely to enable the insulation to be carried with the pipe movement. When the pipe hangers pass through insulation on piping outdoors, metal hoods packed with a waterproof sealing material shall be furnished and installed. Upper bolts of the hanger clamps are not to be covered with insulation.

4.3. □ HORIZONTAL EQUIPMENTS

4.3.1. □ Standard Shapes of Insulation

- a) Rockwool: Pre-formed pipe or multiple pipe segments or slabs cut and shaped to fit or blankets
- b) Calcium Silicate / Perlite: Curved segments/ blocks/ mitre cut and shaped to fit.
- c) Ceramic Fiber: Shall be supplied in blanket strips.

4.3.2. □ Application in horizontal vessel

- a) The vessel fabricator shall provide insulation cladding support/ securement as per fabrication drawing/ standard MC-STD-033 (Annexure - I). Insulation contractor shall verify the same before commencing.
 - a. For vessels of diameter 2000 mm and above are provided insulation support at horizontal centerline as also vertically at tangent lines. Ring support at tangent lines are provided with 6 mm diameter holes. These are to be used for insulation securement.
 - b. At vessel heads above 600 mm OD are provided flats having 6 mm dia. holes. The flats are for insulation support and holes provided in them are to be used for insulation securement. Also provided on either head is a central ring made of 10 dia. galvanized steel rod. For vessels that do not have central nozzle, vessel fabricator shall not provide these rings. For such vessels, insulation contractor shall provide these rings.
 - c. Boot of vessel, if any, is provided with circular support ring with holes, as indicated in sketch.
- b) Blanket shall be applied over the surface with joints tightly butted and laced together with 1 mm dia galvanized lacing wire.

Other block insulation shall be applied with the longer dimension parallel to the axis of the vessel or the equipment. When blocks are applied in multiple layers, all joints in successive layers shall be parallel to the long axis, shall be staggered and sealed with insulating cement for calcium silicate. In all cases, the insulation is to fit the contour of the vessel or the equipment, so that the use of a leveling coat of insulating cement should not be normally necessary to get an acceptable smooth exterior.

c) Special considerations for insulating high temperature vessels (Required only if provided with calcium silicate insulation) (Fig. 15)

This provision is required to take care of the effects of equipment circumferential thermal expansion on insulation.

This provision is required only for vessels and exchangers provided with calcium silicate insulation.

Calcium silicate insulation should be installed in beveled or curved segments only, to avoid voids and provide an efficient insulation system.

For equipment up to 3000 mm in diameter and 200 °C, to take care of equipment circumferential expansion, the circumferential block is cut and fitted to be 13 mm greater in circumference than the equipment and secured so that tension of the bands produces compression on the butt edges rather than on the surface towards the vessel; the little annular space and the compressiveness of the blocks would suffice to take care of circumferential expansion of equipment.

If the vessel is above 3000 mm in diameter or if the temperature is above 200 °C or both, 25 mm thick rockwoolfibre blanket insulation shall be applied around the equipment prior to the application of calcium silicate. This acts as an expansion area around the equipment to act as mechanical and sometimes thermal cushion. The calcium silicate block must be cut and fitted to the outside radius of the equipment plus the thickness of the rockwool spacer insulation. The insulation, when installed, should not compress the fibrous blanket.

Above provision to take care of circumferential expansion is required for both shell and head.

4.3.3. □ Insulation Securement (Refer fig. 13 and 14)

Each layer of insulation on shells of equipment shall be secured by bands at every 225 centers. Each band shall be machine stretched and tensioned to remove slack only.

Each layer of insulation on vessel heads shall be secured as follows:

Band shall be in radial direction connecting the head central floating ring and shell girth ring. The radial bands shall be placed at not more than 150 centers for rigid and 300 for fibrous insulation, measured at the girth ring. These bands shall be machine stretched and sealed. Outermost layer of insulation shall also be supported by drawing and securing 16 SWG annealed wire through the 6 dia. holes provided in the shell girth rings as also the flats provided on heads. The wire shall be drawn through every hole and it shall be secured to the ring with a knot.

4.4.□ VERTICAL EQUIPMENTS

4.4.1. Standard Shapes

Shapes for different materials shall be the same as specified for horizontal equipment.

4.4.2. Application in Vertical Vessel (Fig. 16 & 17)

Application details on shell, top and bottom heads shall be similar to that of horizontal equipment. Insulation shall be laid on insulation support rings provided by the fabricator. See standard MC-STD-0025.

4.4.3. Insulation Securement (For all insulation materials) (Fig. 16, 17 & 18)

Bottom and top head insulation shall be supported by 16 SWGSS wire drawn through holes in the insulation supports provided by the fabricator.

Top head insulation shall be secured by floating ring/bands provided by vessel fabricator similar to head of horizontal vessel.

Shell insulation shall be supported by bands at every 225 centers on the cylindrical portion and the bands shall be kept horizontal.

Insulation securement of bottom heads inside skirt no floating rings/ bands need to be provided. Firm securement should be ensured just by 16SWG annealed SS wire drawn over insulation tightly and through the holes on support rings provided by the fabricator.

4.4.4. Expansion Joints (All insulation materials)

Expansion joints shall be provided every 4000 mm (max.). The joint shall be provided at insulation support rings. It shall be a 25 mm space between the top of the insulation and the bottom of the support ring. The space shall be filled up by compressed rockwool fiber.

4.5.□ FLANGE, NOZZLE, CHANNEL COVER, MANWAY & HAND-HOLE FLANGED COVER (FOR ALL INSULATION MATERIALS)

Where insulation is required, these shall be insulated with lined removable pre-fabricated covers secured with bands or quick release toggle clips. Otherwise, insulation shall be stopped short of uninsulated flanges and nozzles etc., a sufficient distance to permit the withdrawal of bolts without disturbing the insulation. Insulation shall be weatherproofed and sealed at these locations.

4.6.□ APPLICATION OVER IRREGULAR SURFACES SUCH AS PUMPS, COMPRESSORS, TURBINES ETC.

- a) Rockwool: This shall be in the form of pre-fabricated removable covers, lined with pipe sections/lags/slabs/mattresses.
- b) Calcium Silicate/ Moulded Expanded Perlite: insulation material shall be loose fill insulating cement/ block insulation cut and fitted.

Insulation shall be applied in maximum 25 mm thick layers until the scheduled thickness is obtained. Each layer shall be covered with a layer of 25 mm hex. 20 SWG galvanized iron wire mesh for other than SS surfaces and with SS wire mesh for SS surfaces. The final layers shall be finished to a smooth finish with 6 mm thick finishing cement.

Insulation shall be beveled back at 45° from all casing flanges, shaft seal caps and bearing boxes.

4.7.□ VERTICAL STORAGE TANKS (CARBON STEEL)

4.7.1.□ Supporting rings/ spikes (rods) for supporting insulation/ cladding

a) Shell

Refer standard MC-STD-403. This standard indicates the extent of insulation/ cladding supporting/ securement details provided by tank fabricator. Insulation contractor shall check for its presence before insulation application work. Following is provided by tank fabricator:

- Water Shed: At the junction of shell and roof, a watershed is provided to act as top covering for the shell insulation as shown in MC-STD-403.
- Insulation Support: Insulation support will consist of 5 mm dia. Steel rods provided at 400 mm dia diamond pitch. Length of these lugs is 3 mm less than insulation thickness.
- Cladding Support: From tank top, horizontal rings shall be provided at every 1175 mm on tank shell.

b) Tank Roof: Shall be provided as per Standard MC-STD-403.

- Insulation Laying and securement
- Shell (Application of fibrous insulation)

Insulation shall be applied between rings in horizontal ode. Mattresses insulation shall be applied with joints tightly butted and laced together with 1 mm dia. galvanized lacing wires. Mats shall be impaled to the 5 mm rod and speed washers fixed and pressed home for intimate contact of the insulation. In the case of multiple layers, speed washers are necessary only over the final layers, (up to and including 150 mm). Rods and speed washers of spring steel should be selected to suit each other. While rods are provided by tank fabricator, speed washers shall be furnished by insulation contractor. Insulation shall be further secured by bands spaced centrally between insulation supports.

- Roof (For all materials)

Application of fibrous insulation, polyisocyanurate/ polyurethane foam shall be similar to that as for shell. Insulation support from 5 mm dia. MS lugs shall be the same as in shell.

5.0□ INSULATION FINISH

5.1.□ MOISTURE BARRIER

(Applicable for application on outer surface of the insulation for operating temperature up to 175 °C or less, where stainless steel/ aluminized steel is used in place of GRP as cladding in fire safe insulation)

The mastic shall be applied in two coats with glass cloth reinforcement such that the total dry thickness is approximately 3 mm.

Immediately after the insulation, a 3 mm thick coating of the mastic shall be applied to the surface and a glass cloth shall be laid over the surface and embedded in the mastic. Care shall be taken to ensure that the glass cloth is laid smooth and free from wrinkles and that no pockets of air are trapped beneath the

surface. The glass cloth shall have minimum 75 mm overlap at joints. A second coat of 3 mm shall be applied after approximately 12 hours. During the drying time, the insulation shall be protected from the weather by "Alkathene" film type tarpaulin or similar materials approved by the engineer-in-charge.

5.2.□ INSULATION FINISH WITH GRP CLADDING

- a) Prior to the application of GRP cladding, multiplex foil shall be applied over the insulation with an overlap of 50 mm. the overlap joints shall be sealed with a sealing tape.
- b) GRP laminate sheets shall be wrapped around the insulation with a minimum overlap of 50 mm. After the application of GRP laminate, the same shall be cured by exposing to UV rays/ lamp of required UV wavelength as appropriate. A shaded area should be erected over the application area when working outside.
- c) A Barcol hardness tester shall also be used to check GRP laminates for full cure. Typically, fully cured GRP laminates have a Barcol hardness in excess of 45.

5.3.□ INSULATION FINISH WITH METAL JACKETING

The insulation finish shall provide a weatherproofed and covering 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.

5.3.1.□ Piping

- a) Straight pipe shall have metal jacketing cut and machine rolled (approx. 1 m long), wrapped around with 50 mm minimum overlaps on both longitudinal and circumferential overlaps. All laps shall be arranged to shed water.
- b) A single bead shall be made on all overlaps to ensure metal to metal water tight arrangement. Self-tapping screws, at every 150 mm shall be provided at all longitudinal overlaps for both horizontal and vertical piping.
- c) At all operating temperatures the seams at overlap positions shall be rendered watertight to ensure that insulation remains dry and unwettedf, whether the possible water impingement is from rain, hose or fire sprinklers.
- d) The metal coverings shall be secured tightly around the insulated pipe and held in place with bands on a maximum of 300 mm centers. 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.
- e) Vertical overlaps on vertical or near vertical piping shall be staggered to provide overlaps at north and south positions in alternate sections of covering.
- f) Each sections of metal covering on vertical piping with insulation ODs larger than 250 mm shall be supported from the next lower section with two 'S' clips, fabricated from banding material. The 'S' clip shall be of sufficient length to allow the minimum overlap of 50 mm.
- g) On vertical piping with ODs of 600 mm 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.
- h) Insulated bends and elbows in piping 80 mm and larger, shall be metalled with 'lobster back' segments using 10 mm minimum ball swage to assist shaping. The metal bands shall be screwed using self-tapping screws and metal sealants are to be provided to get a completely waterproofed arrangement.
- i) Insulated bends and elbows in piping smaller than 80 mm may use complete pressed and humped back flat metal elbows or 'fabricated 'stove pipe' elbows.

- j) The practice of locating all joints in the top portion of elevated horizontal pipes for the sake of good appearance when looking up from grade shall be strongly discouraged. The joints shall be located to shed water.

5.3.2.□ Equipment

- a) The metal jacket over vertical vessel shells shall be constructed of sheet metal panels with the weight of the panel taken on the equipment insulation support rings, via angle brackets bolted to the panel. Refer standard MC-STD-025 for details.
- b) The panels shall be applied commencing at the bottom of the vessel. Each circumferential ring of panels shall be tensioned by means of tensioning bands until the final joint is screwed tight. 'S' clips shall be used as sheeting support at unscrewed circumferential overlaps.
- c) The panels shall be held tight over the vessel insulation by means of circumferential bands and sealed. The bands shall be positioned on all horizontal overlaps and at 300 mm centers. Bands shall be held in their respective positions with 'J' clips fastened to the jackets with screw. Each band shall have J- clips on 1.8 m maximum center but not less than four J-clips per band. Each band shall have a compression spring as per para 4.1.16.
- d) The panels shall have a minimum overlap of one corrugation on vertical joints and 80 mm on horizontal joints. The overlaps shall be arranged to shed water at all times.
- e) The vertical and horizontal overlaps shall be secured with self-tapping screws at 150 mm pitch except the horizontal overlaps pre-selected to act as expansion joints, these shall be constructed with a 150 mm overlap and shall remain unscrewed and left free to permit expansion. All overlaps shall be rendered watertight.
- f) All equipment protections such as nozzles, shall have the jacketing sealed using a metal-flashing, cut to fit the projection and extending above the jacket at least 80 mm. the seal between the flashing and jacket shall be made watertight by use of self-tapping screws and sealing mastic.
- g) Horizontal cylindrical equipment shall be furnished with flat metal jacket arranged in circumferential bands with the edge of the sheets, with the longer dimension applied around the circumference of the equipment insulation.
- h) The panels shall have a minimum of 80 mm overlap of both longitudinal and circumferential edges, both overlaps being finished with a simple ball swage and rendered watertight.
- i) Horizontal overlaps shall be secured with no. 8 x 12 mm long self-tapping screws set in the overlap at 150 mm intervals, and shall be so arranged that staggered bands of paneling encircle the equipment. Vertical overlaps shall not be screwed for horizontal equipment.
- j) The metal finish shall be banded and sealed at 450 mm centers.
- k) The insulated heads of vertical and horizontal equipment shall be fabricated from flat metal, an "orange peel" construction with all radial seams overlapping a minimum of 50 mm and secure with self-tapping screws at 150 mm centers. All overlaps shall be ball swaged and be rendered watertight.
- l) Projections from the heads shall be sealed using metal flashings, neatly cut o fit around the projections and extending above the jacket for a minimum of 80 mm. The seal between flashing and jacket shall be weatherproofed with self-tapping screws and mastics.
- m) Insulation at bottom heads of fully skirted equipment does not require weatherproofing.
- n) Heads of equipment 24" OD and smaller shall be finished and waterproofed with square-ended fabricated covers.

5.3.3. □ Vertical Storage Tanks: Cladding Applications and Securement

a) Shell (fig. 19 and standard MC-STD-403)

Cladding is applied over the system of horizontal rings as follows:

- Overlaps in the vertical joints will be one corrugation.
- Overlaps in the horizontal joints shall be 50 mm (min.)
- Cladding to cladding fastening, at both horizontal and vertical overlaps shall be alternately by 'POP' rivets and self-tapping screws at 150 mm pitch.
- Cladding shall be secured to support ring by bolting. Bolts are provided by tank fabricator at 300 mm centers on angles provided at every 1175 mm centers vertically. Felt washer, aluminum washer and nut shall be supplied by insulation contractor for all bolted connections at shell, roof and curb angle.
- Insulation shall be tucked into the skirt portion of the curb angle.
- Horizontal stainless steel bands over-cladding to be provided every 800 mm and to coincide at every horizontal cladding overlaps. Bands shall be tightened, locked and lock fastened featuring stainless steel fastening systems. In order to prevent sliding of the bands downwards, the bands shall be secured to the cladding using 'POP' rivets at horizontal pitch not over 2 meters.

b) Roof

- All cladding joints shall be sealed by elastomeric metal sealants.
- Min. 75 mm overlap shall be ensured at all joints.
- At all joints, cladding-to-cladding securement shall be provided by self-tapping screws and pop rivets alternately, every 150 meters.
- Cladding shall be secured by bolting at every 300 provided by tank fabricator. For details of cladding arrangement and bolting, see standard MC-STD-403.

6.0 □ GUARANTEE & TEST CERTIFICATES

Insulation contractor shall guarantee all insulation works against the defects due to material and workmanship effecting performance for a period of eighteen months from the date of completion of total insulation works and shall repair/ replace promptly, without cost, any part or parts of the material that fails within said period.

All the test certificates required as per this document shall also be furnished along with the supply of materials.

7.0 ANNEXTURE I

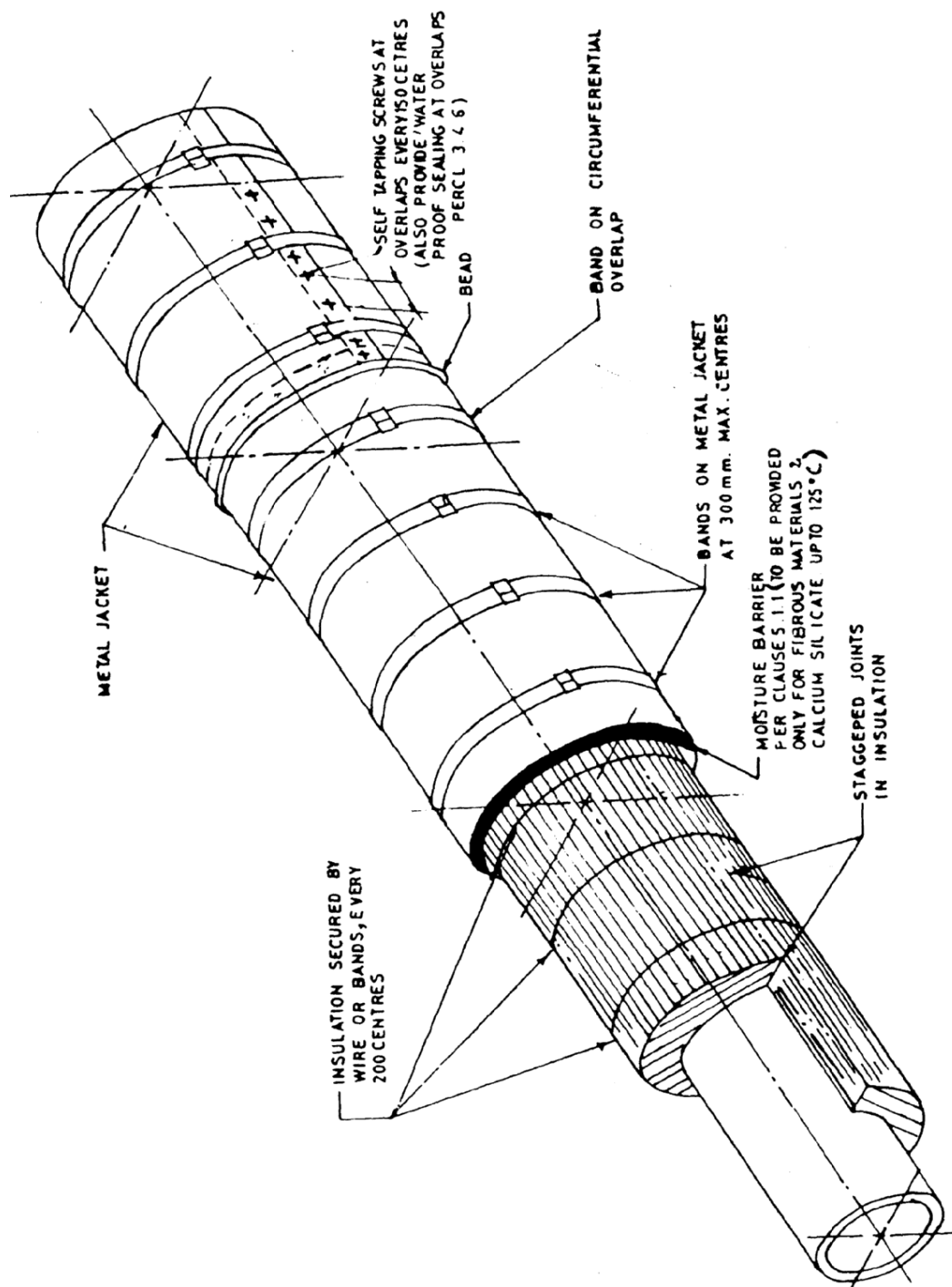


FIG 1:
Pipe Insulation Details(Fibrous & Rigid Insulation)

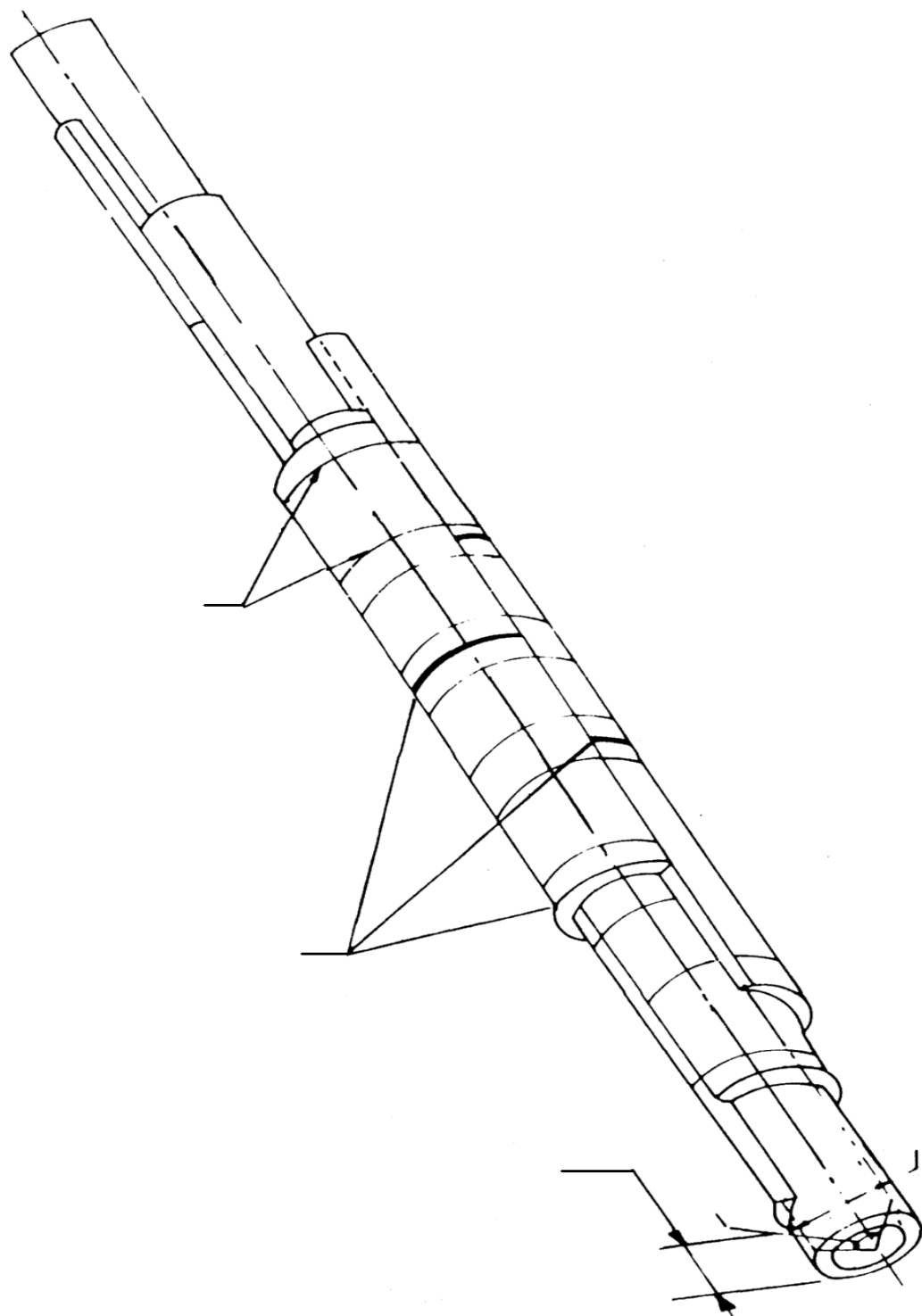


FIG: 2
Pipe Insulation: Method of Staggering of Sections
Rigid & Fibrous Insulation (Performed Pipe Sections Only)

FIBROUS INSULATION: MATTRESS

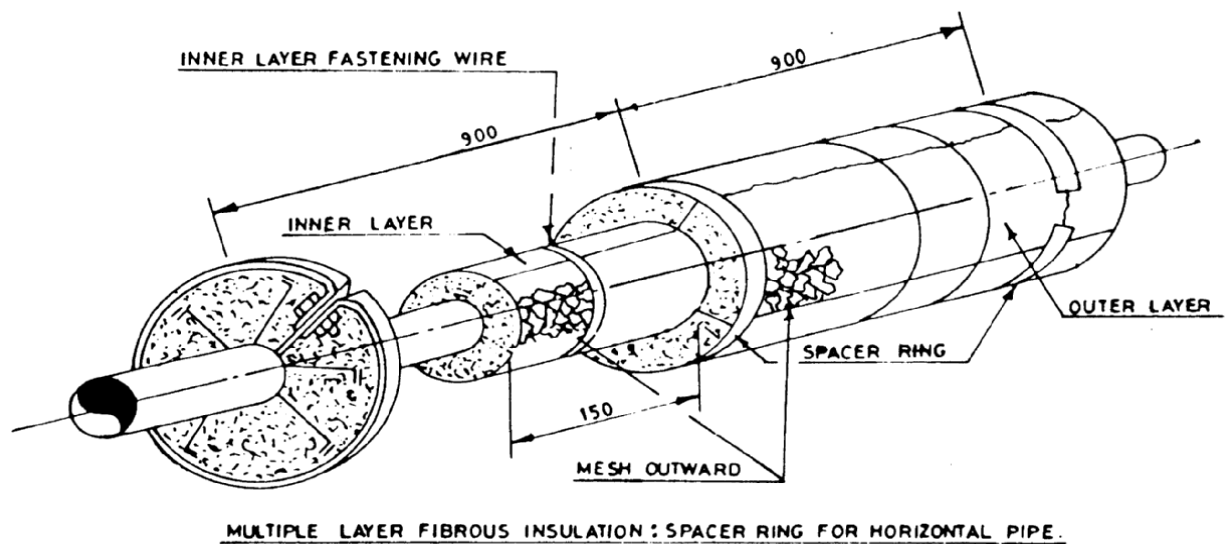
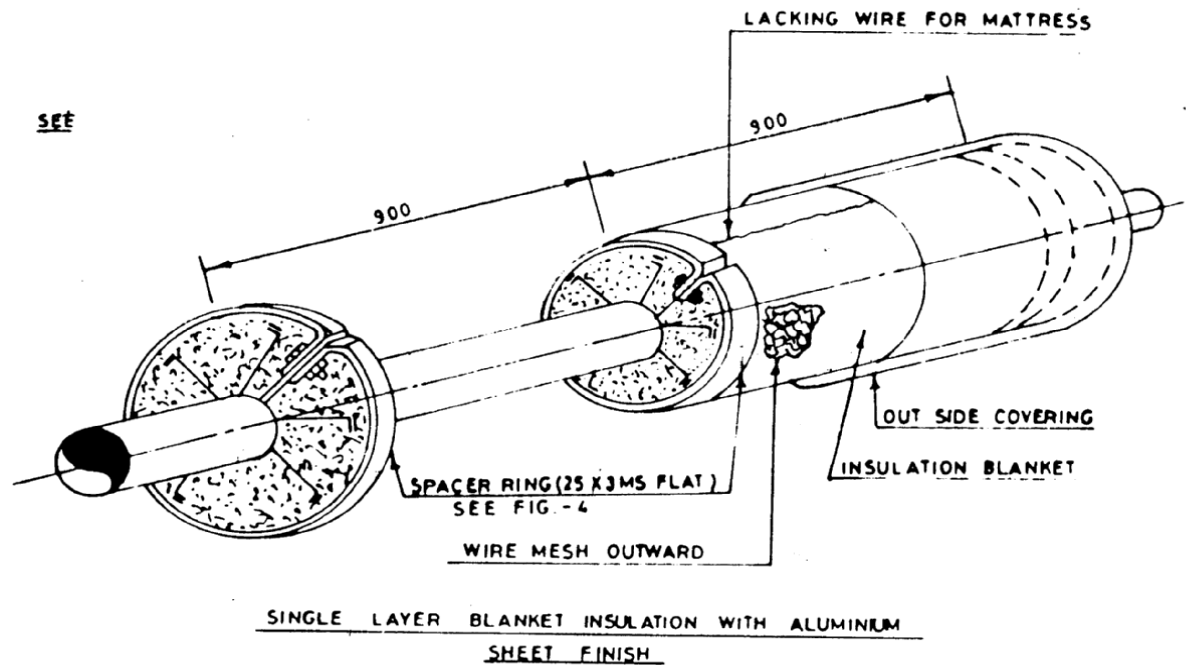


FIG: 3
Horizontal Pipe: Fibrous Mattress Insulation: Detail Of Spacer
Hinges for Cladding Support

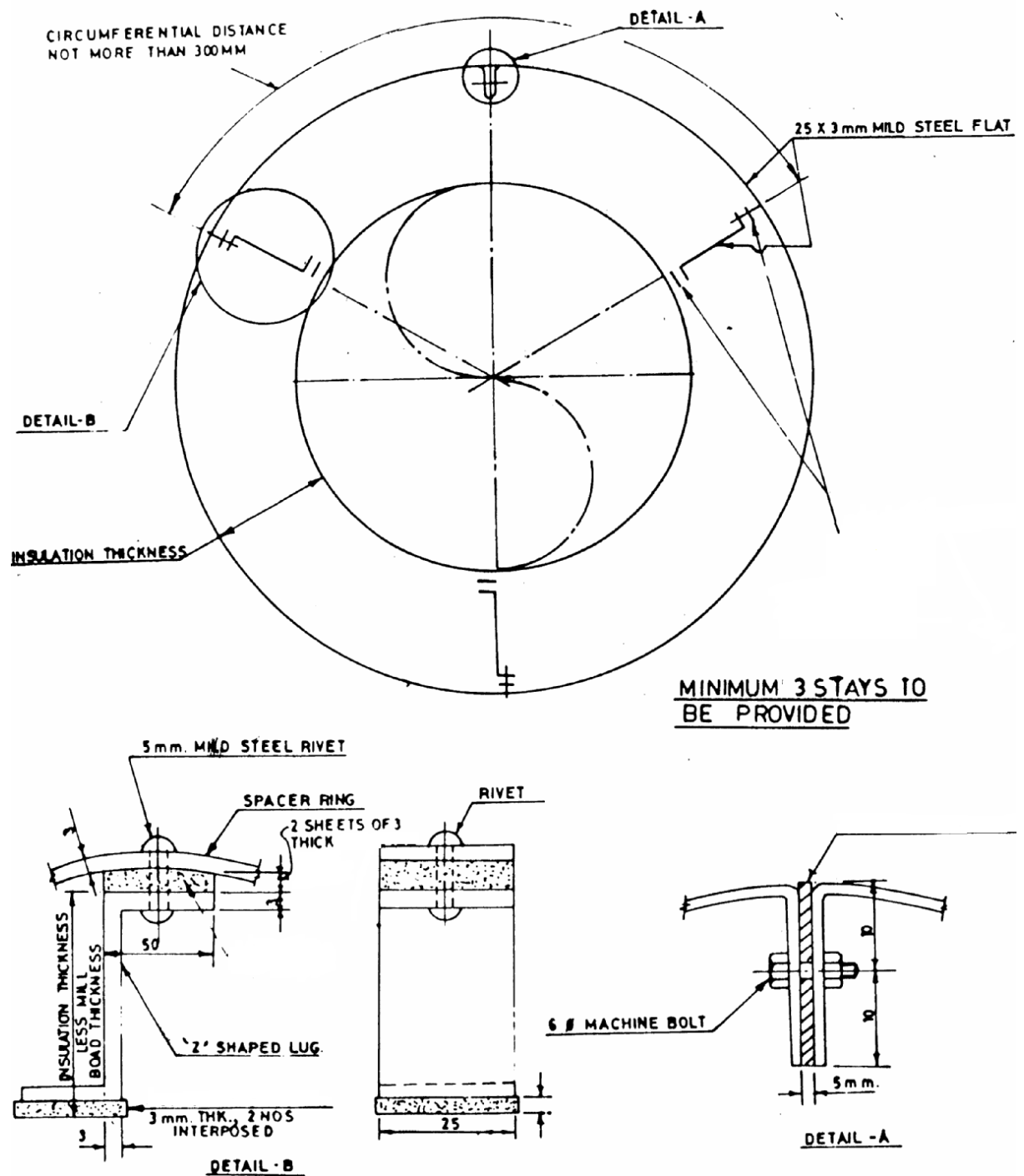


FIG:4
Detail of Spacer Ring Fibrous Insulation (Mattress)

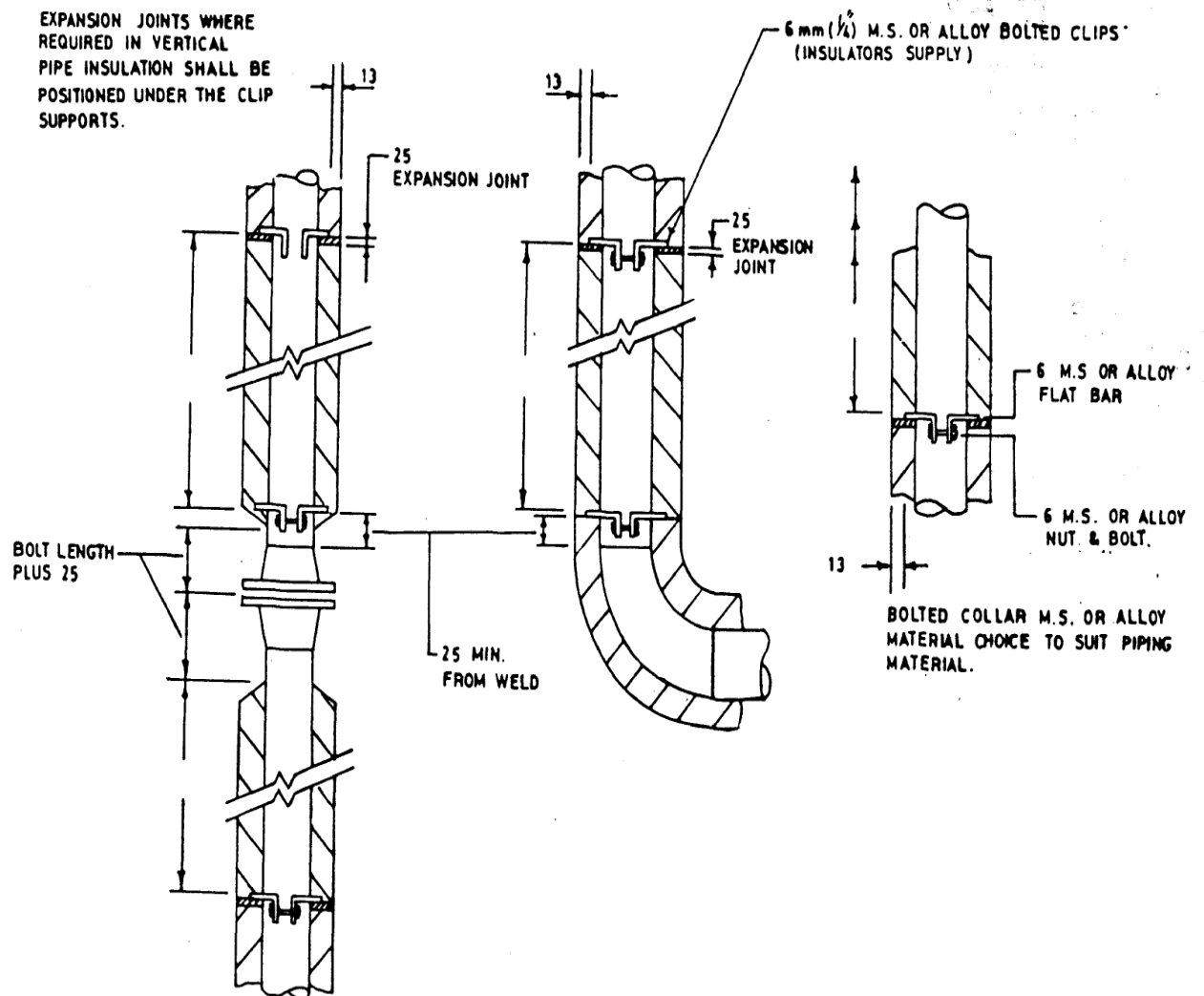


FIG:5
Bolted On Insulation Support for Vertical Pipe

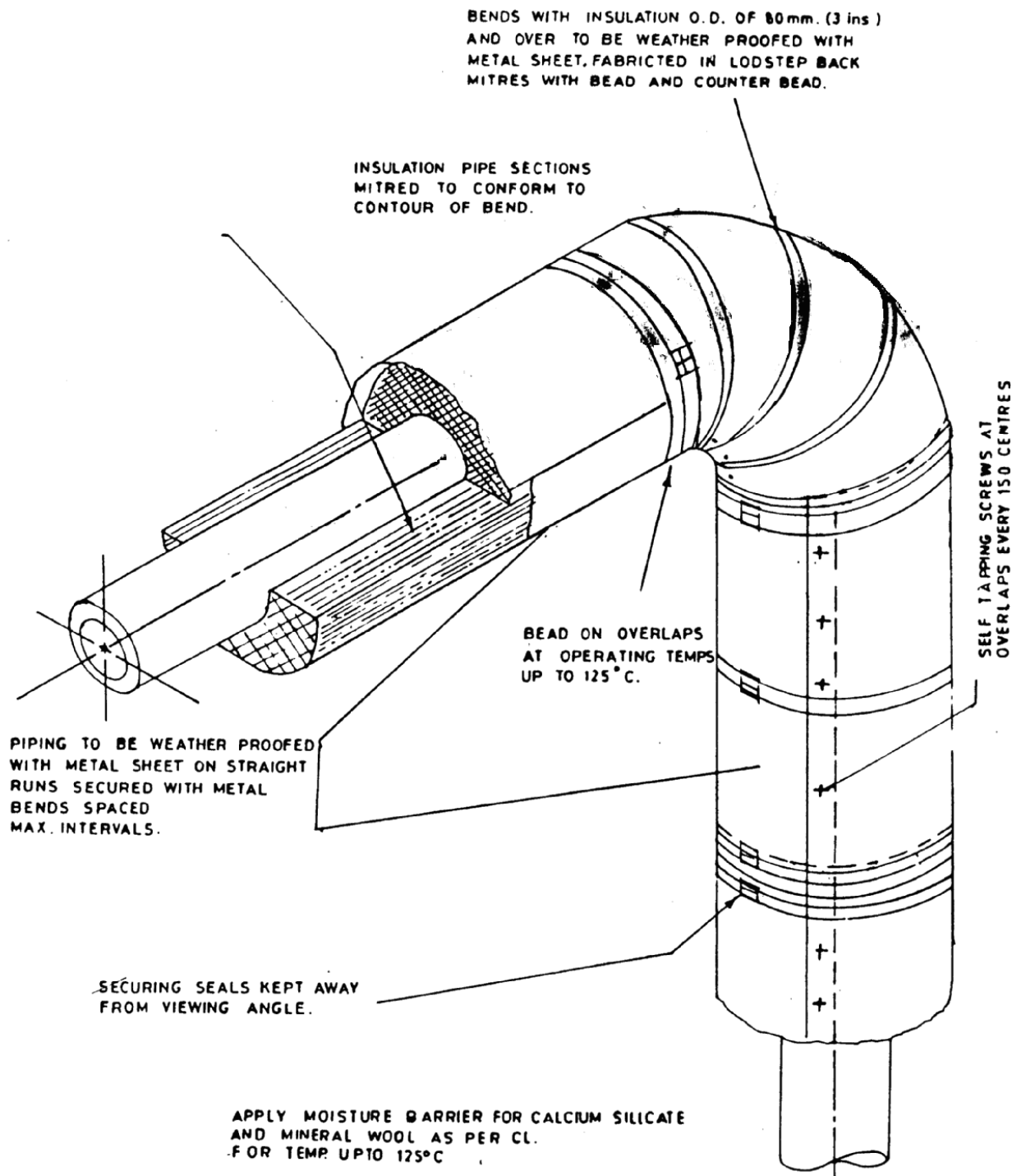


FIG:6
 Insulation Details for Bends & Elbows

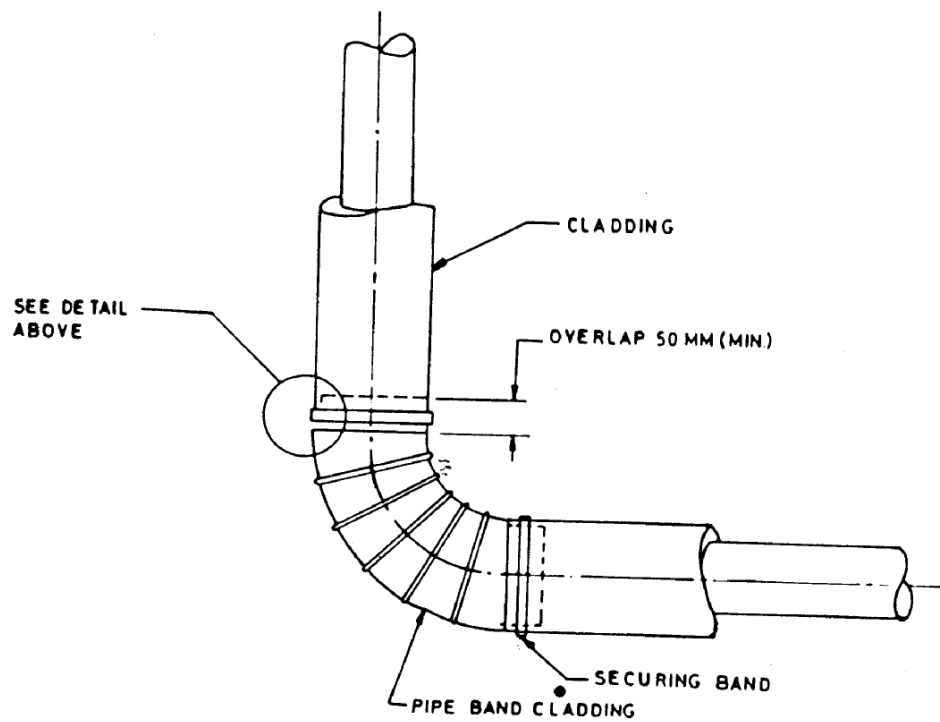
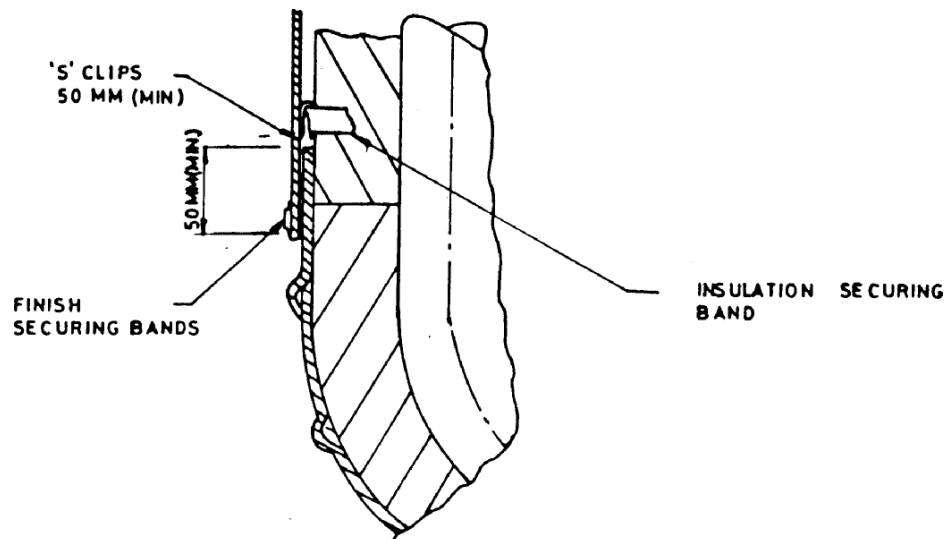
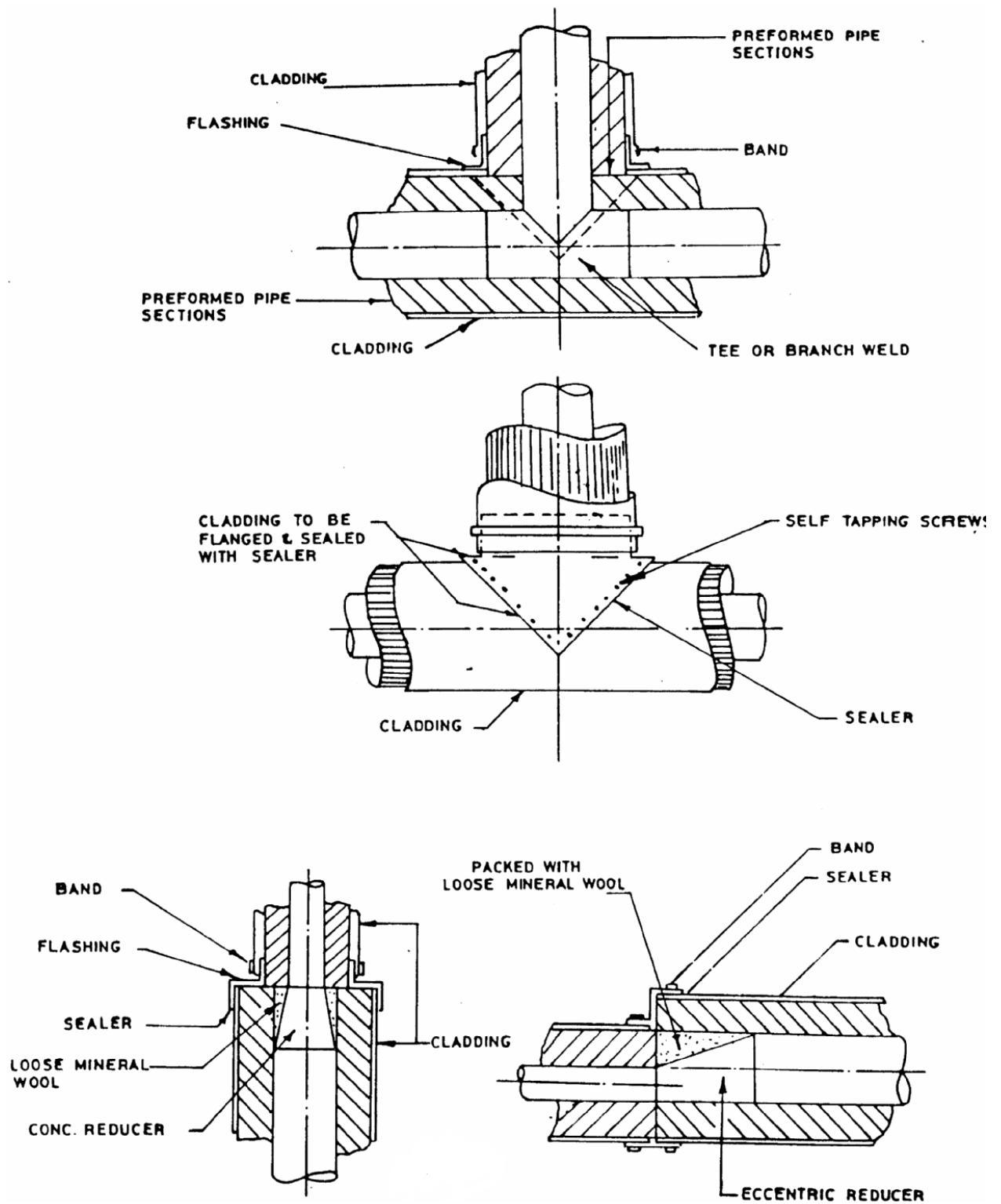


FIG:7
Insulation Details: Pipe Bends & Elbows



Apply Moisture Barrier for Calcium Silicate and Mineral Wool

FIG: 8

Insulation Details: Pipe Branched & Reducers

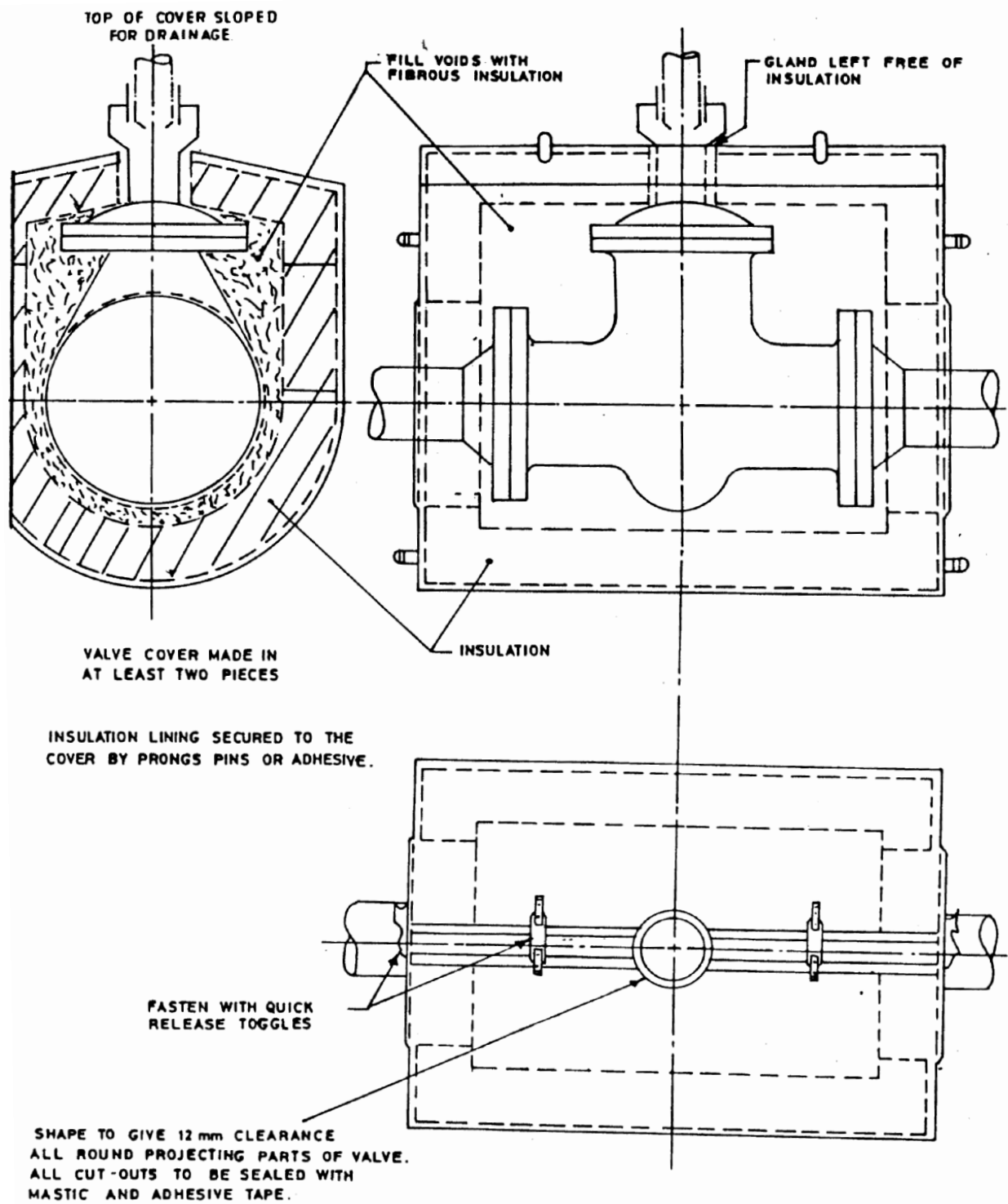


FIG: 9
Insulated Removable Cover: Valves

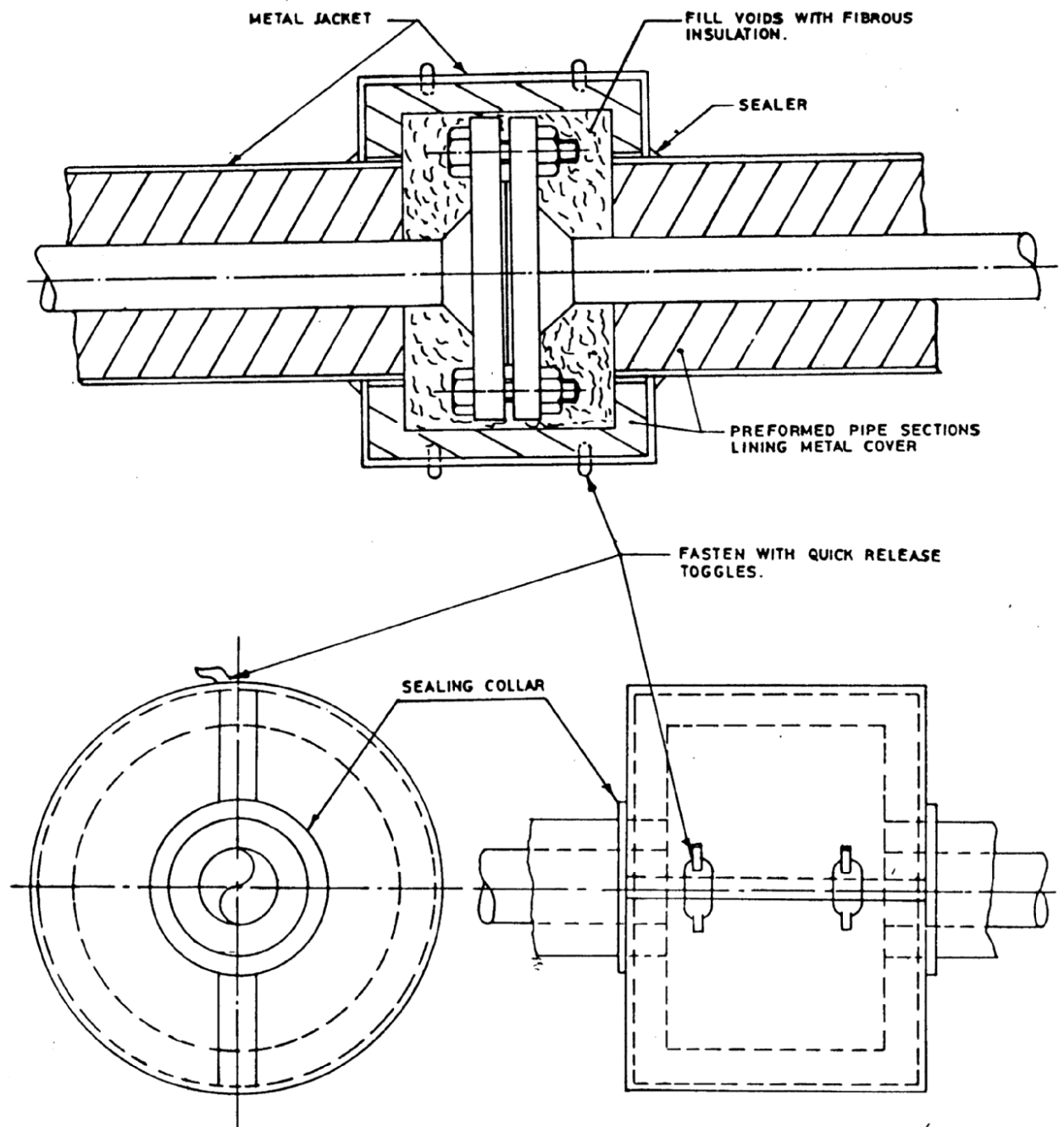
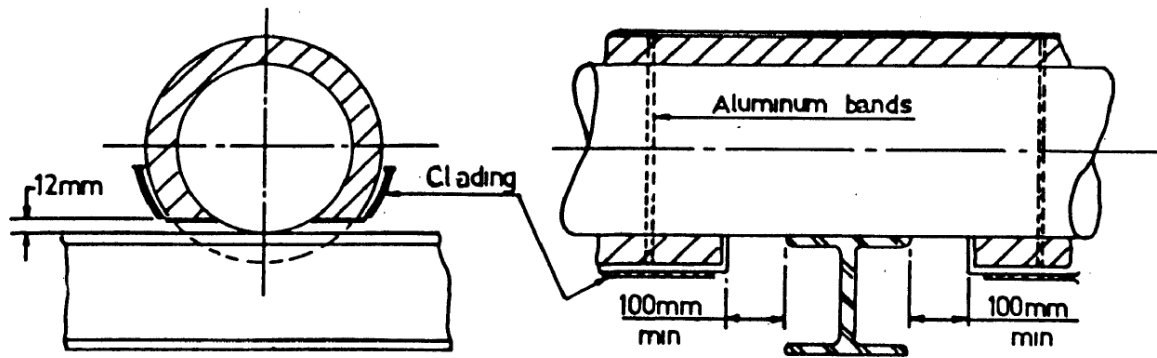
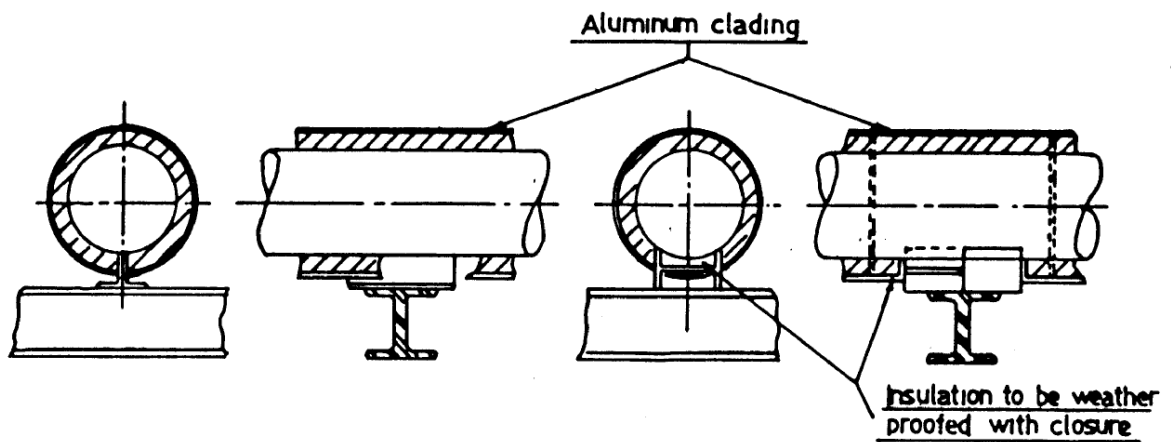


FIG: 10
Insulated Removable Covers-Flanged Joints



Where cladding is to be cut away it shall fit closely to the pipe and to be completely weatherproof

INSULATION DETAIL AT LINES WITHOUT SHOES
(This should only be required in exceptional circumstances)



INSULATION OF LINES ON SHOES

FIG: 11
Insulation Details Pipe Supports

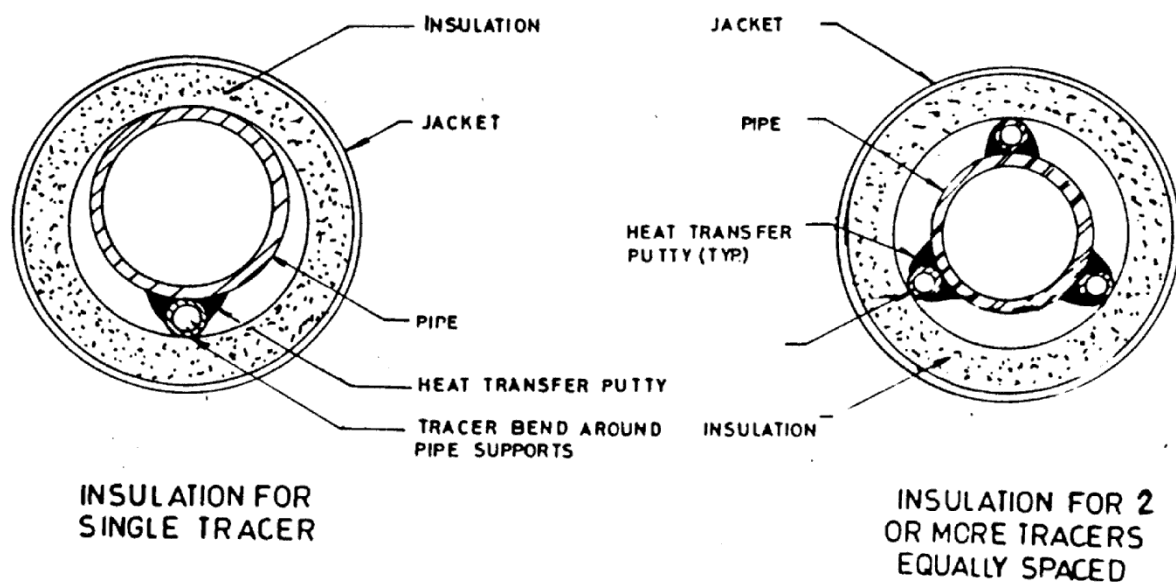
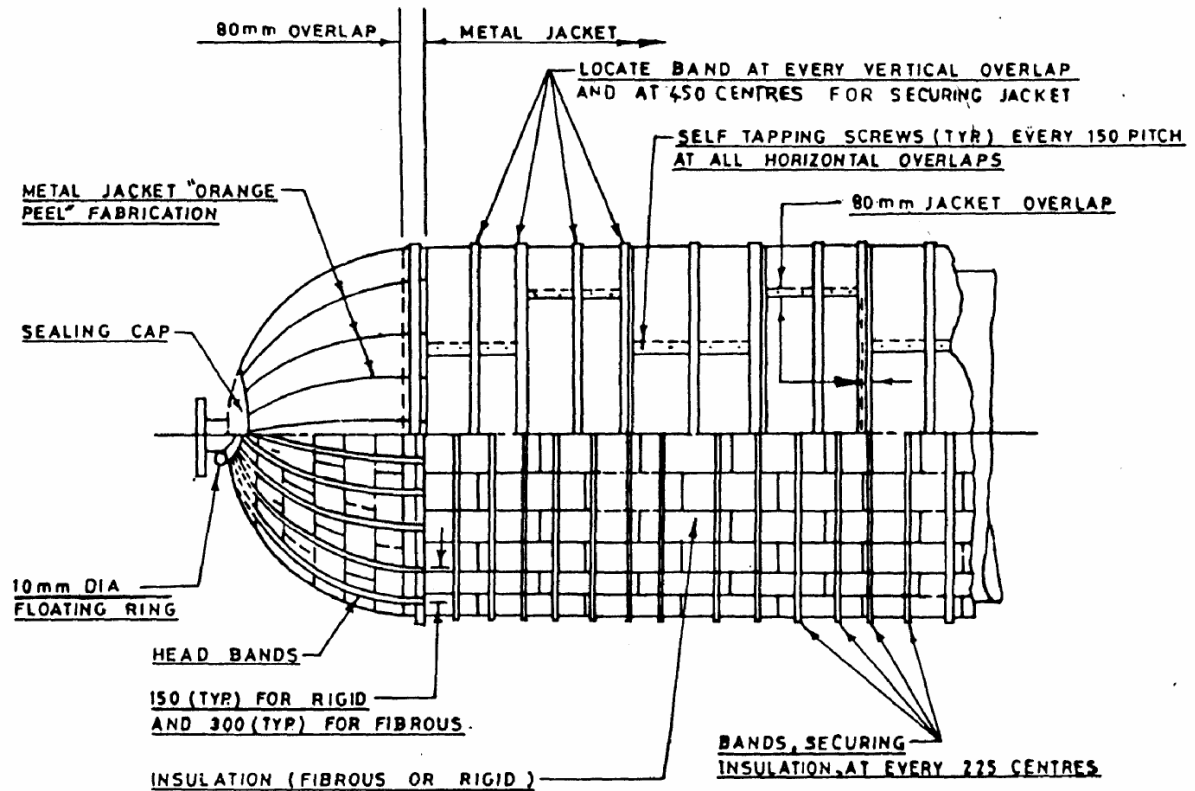


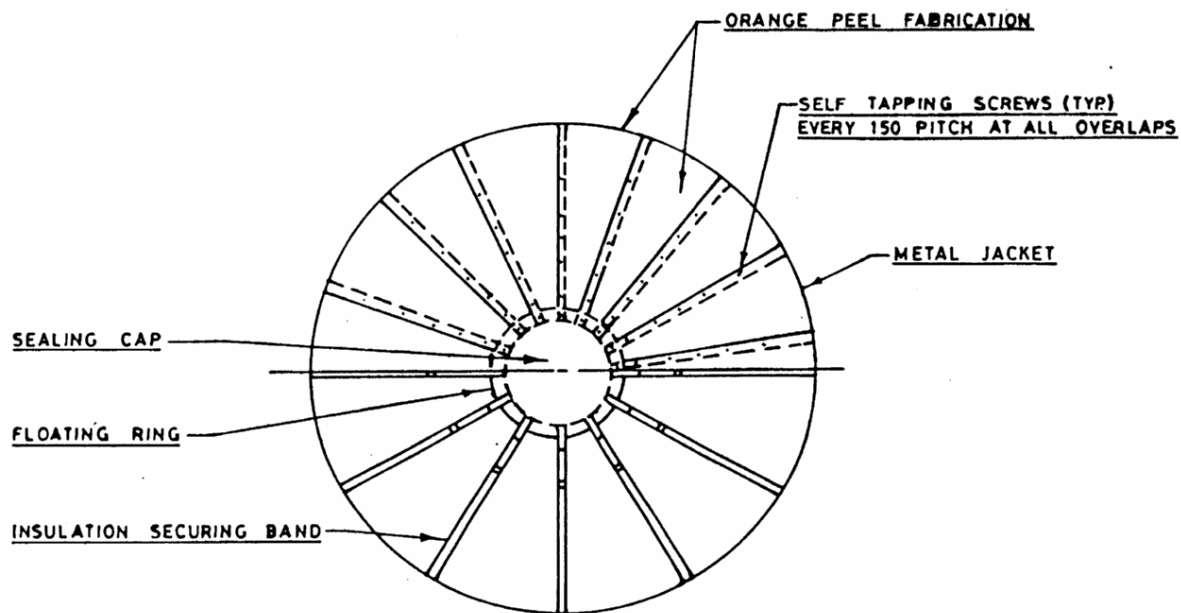
FIG: 12
Insulation of Steam Traced Piping



NOTE:-

1. SADDLE SUPPORTS FOR HORIZONTAL EQUIPMENT TOGETHER WITH SHOE AND ANCHOR SUPPORTS FOR HORIZONTAL PIPING SHALL BE DESIGNED TO INCLUDE ELONGATED CUT-OUTS IN THE SUPPORT AT SUCH A DISTANCE FROM THE SUPPORTED EQUIPMENT AND PIPING TO ALLOW THE PASSAGE OF INSULATION SECURING BANDS AND TIES AROUND THE OUTSIDE FACE OF THE INSULATING AND FINISHING MATERIAL.
2. APPLY MOISTURE BARRIER FOR CALCIUM SILICATE AND MINERAL WOOL TEMPERATURES UP TO 125°C.

FIG: 13
Horizontal Equipment Insulation



END VIEW 'A-A'

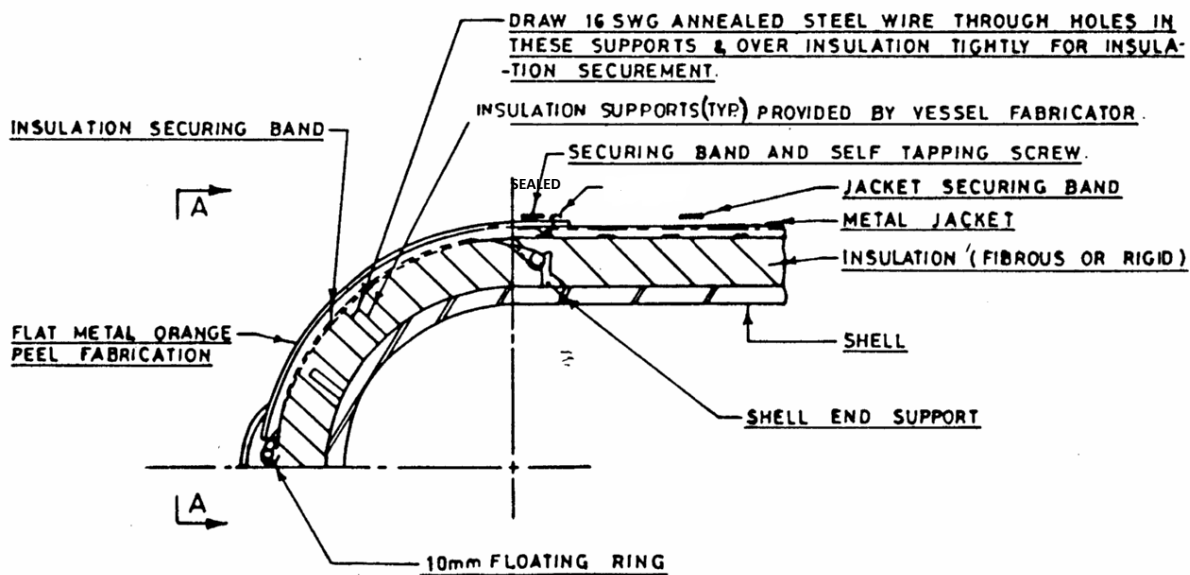
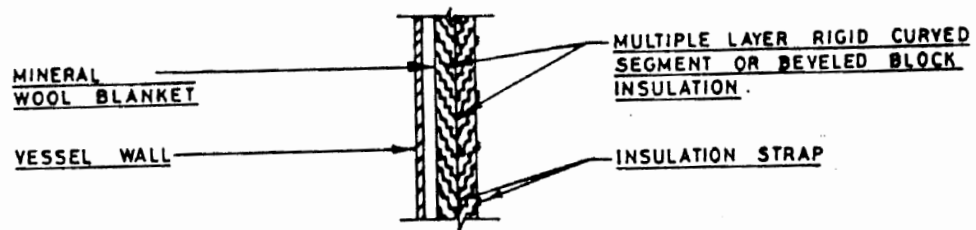


FIG: 14
Horizontal Equipment Heads



NOTE:-
SINGLE LAYER INSTEAD OF MULTIPLE LAYER,
MAY BE USED IN METHODS SHOWN. CHOICE
DEPENDS UPON TEMPERATURE AND SIZE OF
VESSEL

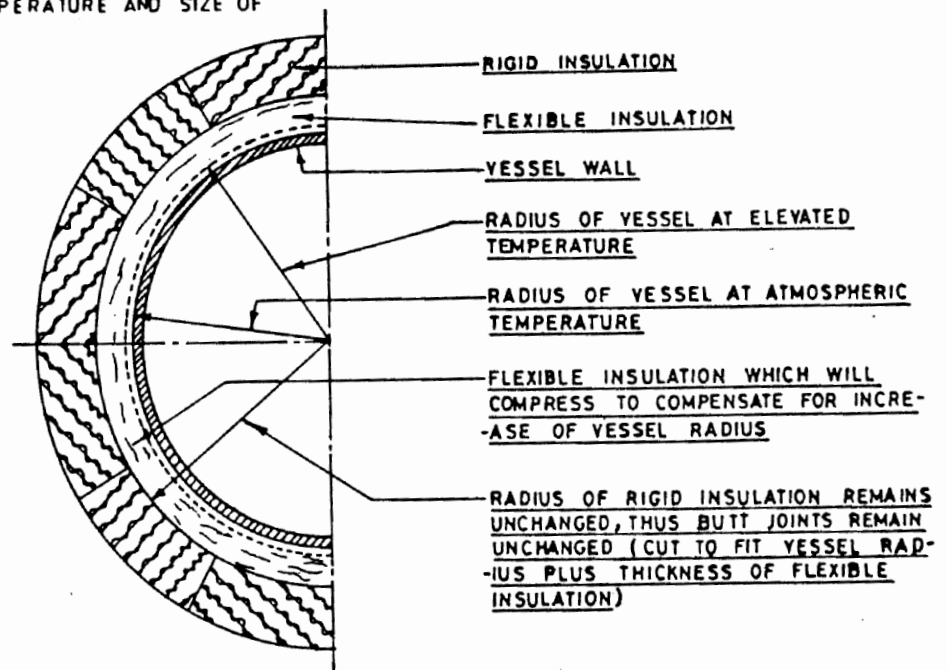
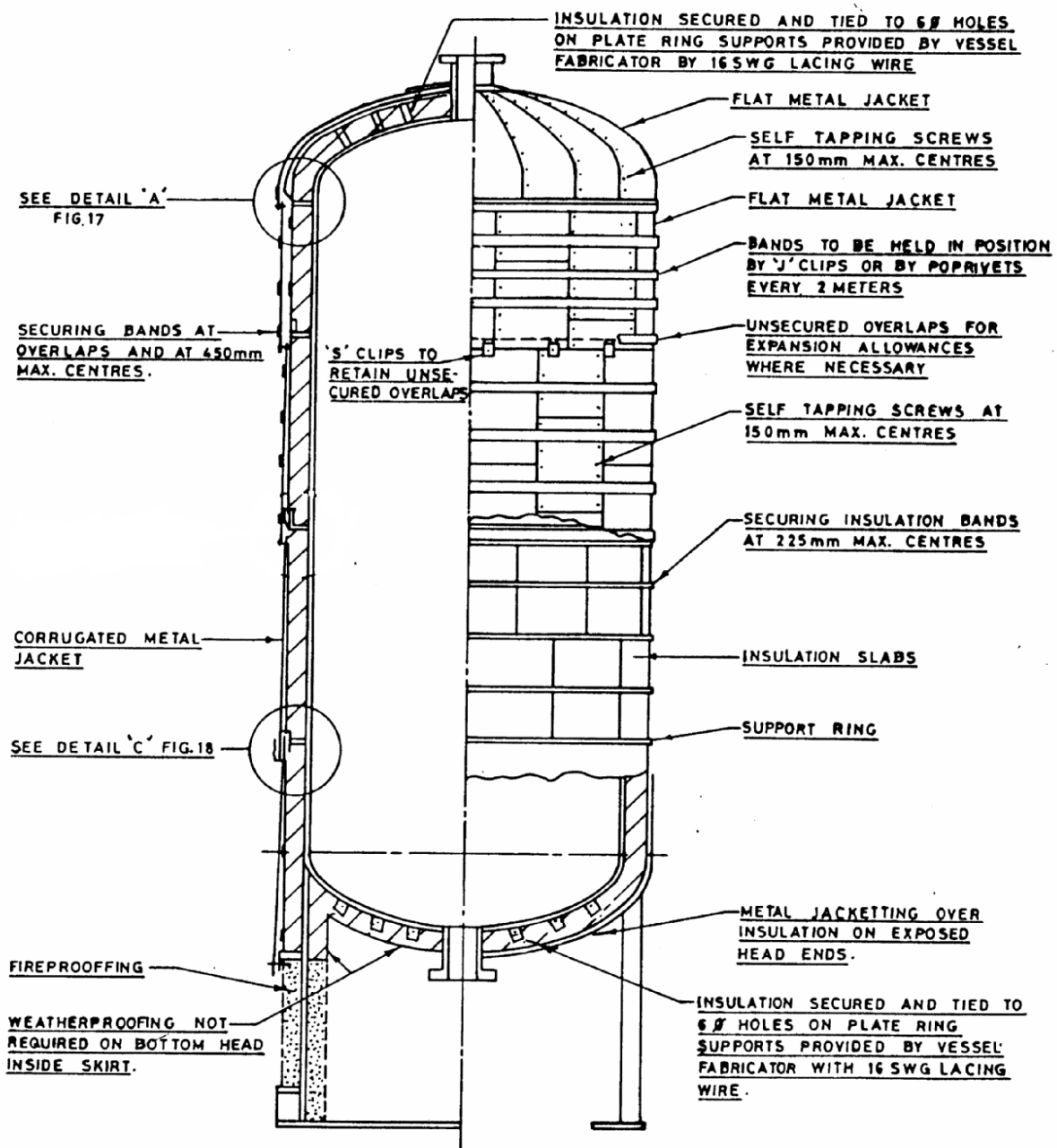


FIG: 15
Use of Flexible Insulation in Combination with Rigid Insulation
to Compensate for Vessel Expansion



NOTE:-

APPLY MOISTURE BARRIER FOR CALCIUM SILICATE AND MINERAL WOOL

FIG: 16
Insulation Details: Vertical Vessels

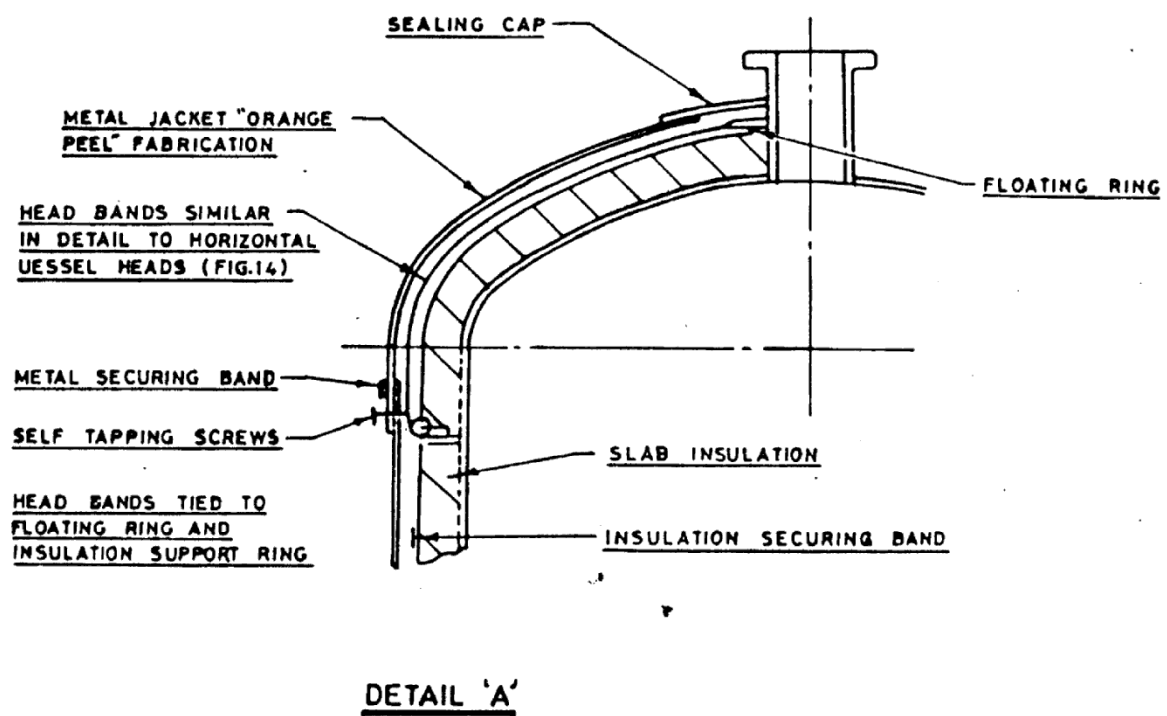
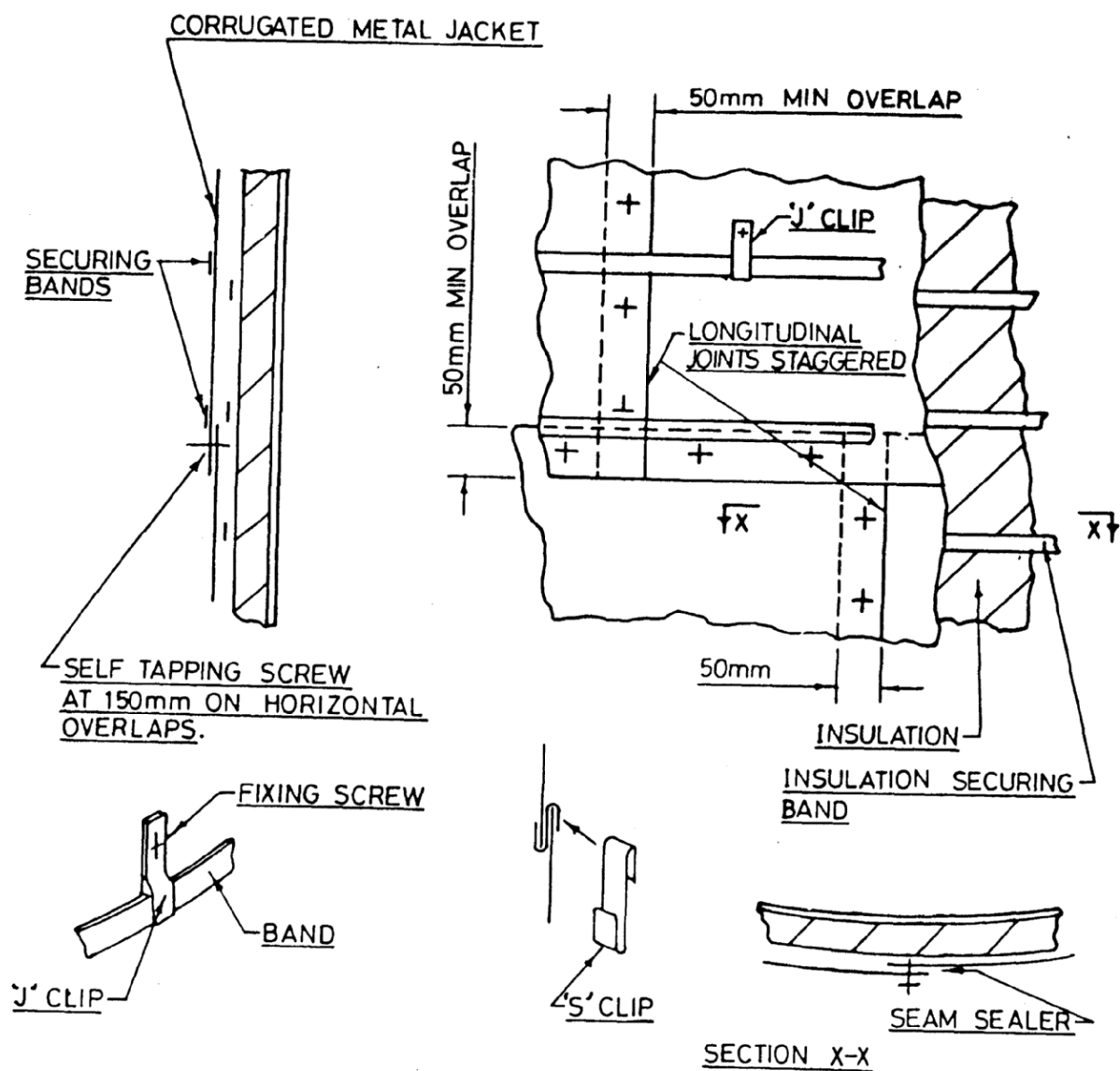


FIG: 17
Insulation Details Vertical Vessel Heads

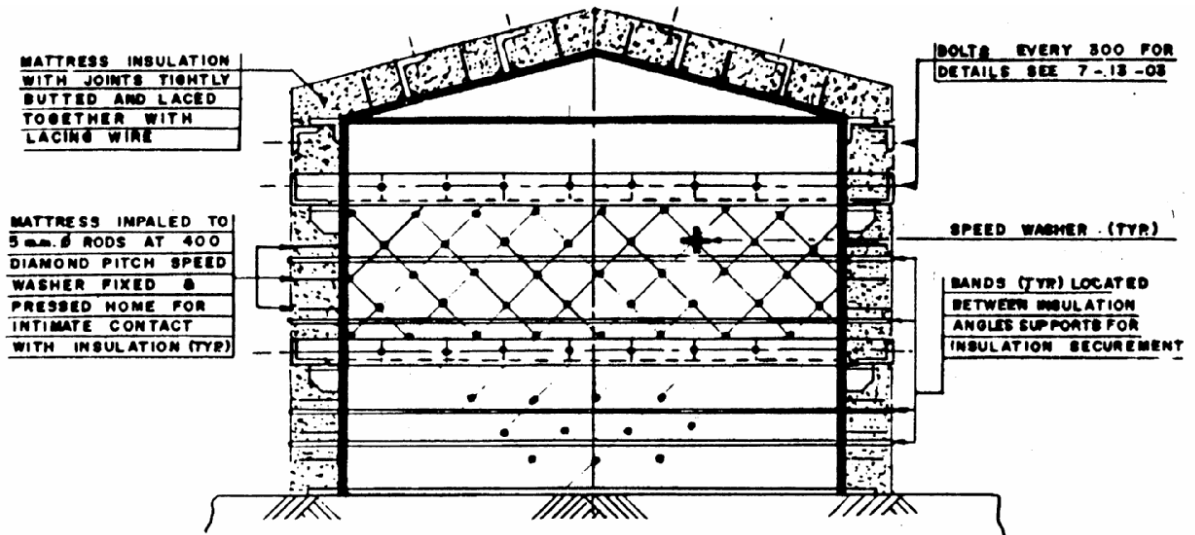


NOTE:

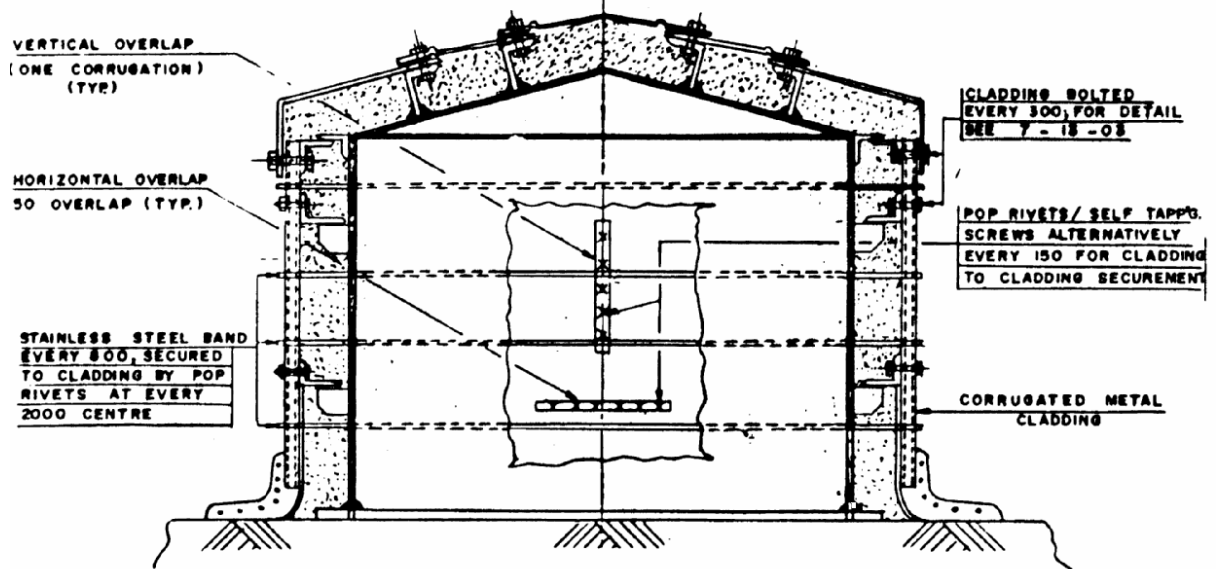
FINISHING SHEETING TO BE BANDED AND SCREWED. HORIZONTAL OVERLAPS LEFT UNSCREWED FOR EXPANSION PURPOSES SHALL BE SECURED AND SUPPORTED WITH 'S' CLIPS.

DETAIL 'C'

FIG: 18
Insulation Details: Vertical Vessels



INSULATION SECUREMENT DETAIL

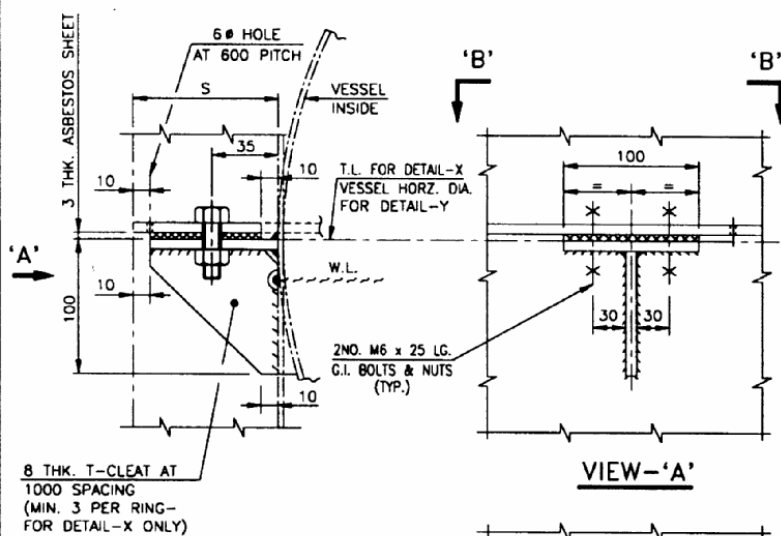
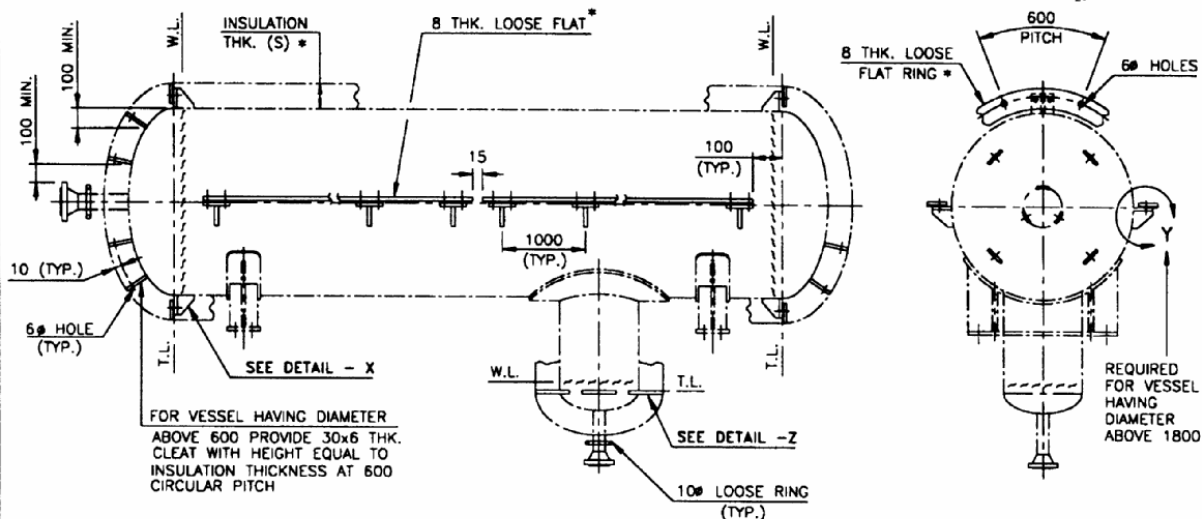


CLADDING SECUREMENT DETAIL

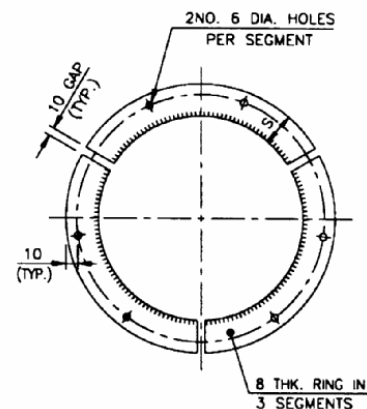
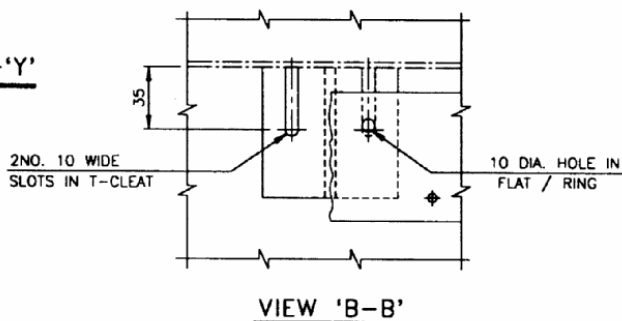
NOTE: PROVIDE MASTIC MOISTURE BARRIER ON SHELL & ROOF INSULATION, APPLYING CLADDING.

BEFORE

FIG: 19



DETAIL - 'X' / DETAIL - 'Y'
(SEE NOTE-6)



NOTES

1. ALL DIMENSIONS ARE IN mm.
2. FOR MATERIAL SPECIFICATION REFER ENGINEERING DRAWING.
3. DETAILS, DIMENSIONS AND NOTES ON ENGINEERING DRAWING SHALL TAKE PRECEDENCE OVER THOSE SHOWN HEREIN.
4. CLEATS SHALL CLEAR WELD SEAMS AND IN CASE OF INTERFERENCE WITH NOZZLES/ATTACHMENTS, INSULATION RINGS SHALL BE NOTCHED/MODIFIED SUITABLY.
5. ONLY T-CLEATS WITH G.I. BOLTING, INSULATION SUPPORT CLEATS AND LOOSE RING/FLAT SHALL BE SUPPLIED BY THE EQUIPMENT FABRICATOR.
- * 6. FOR INSULATION THICKNESS (S) 40mm AND LESS, ONLY RINGS AND FLATS IN PIECES SHALL BE DIRECTLY WELDED TO SHELL/HEAD, AS SHOWN IN DETAIL - 'Z'.

FIG: 20

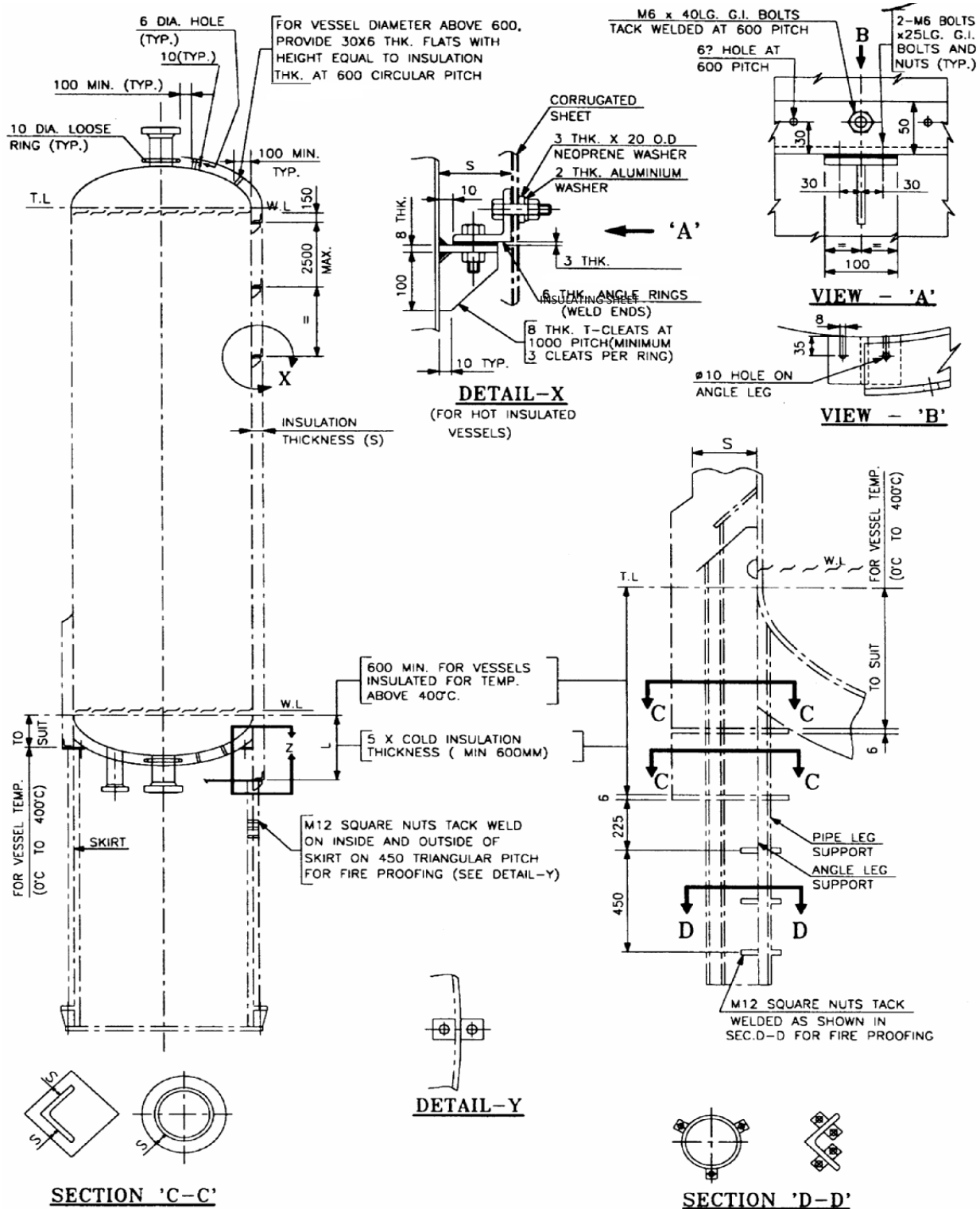
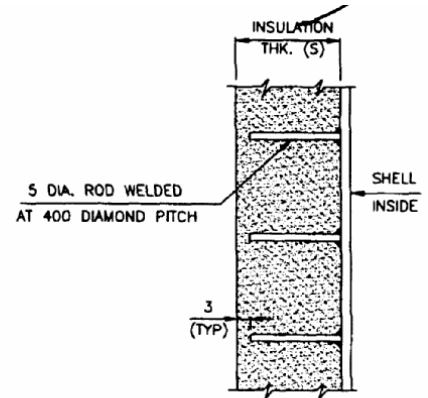
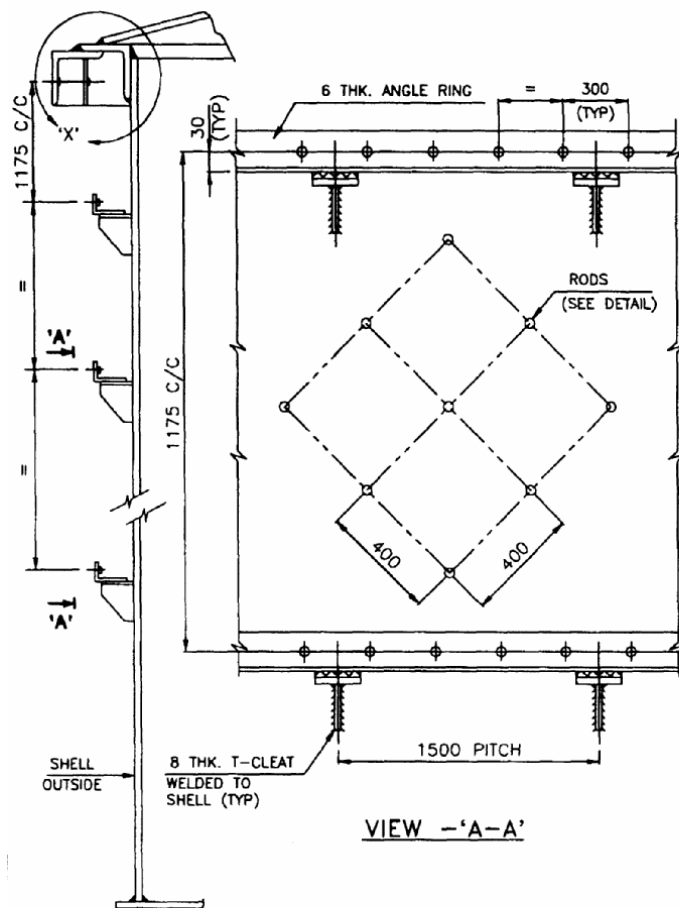
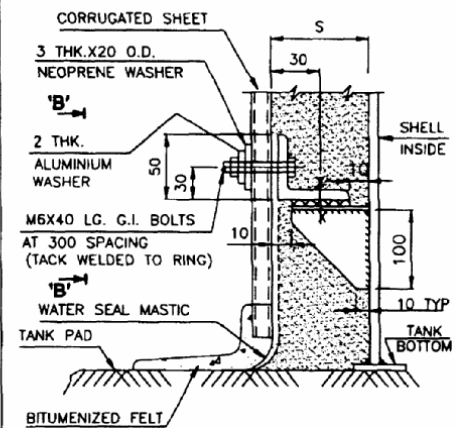


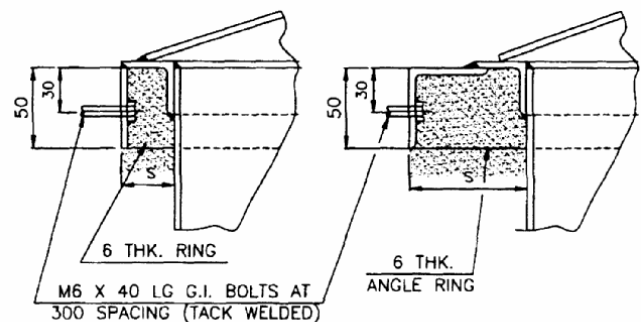
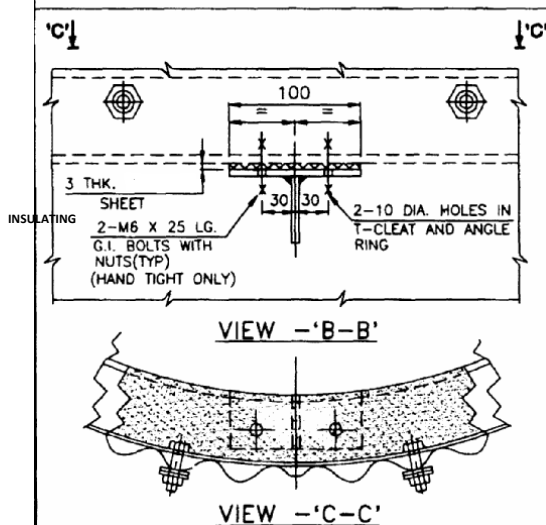
FIG: 21
 Detail of Vertical Storage Tank Insulation



DETAIL OF RODS ON SHELL



DETAIL OF INSULATION SUPPORT AND SEALING ARRANGEMENT AT BOTTOM OF THE TANK

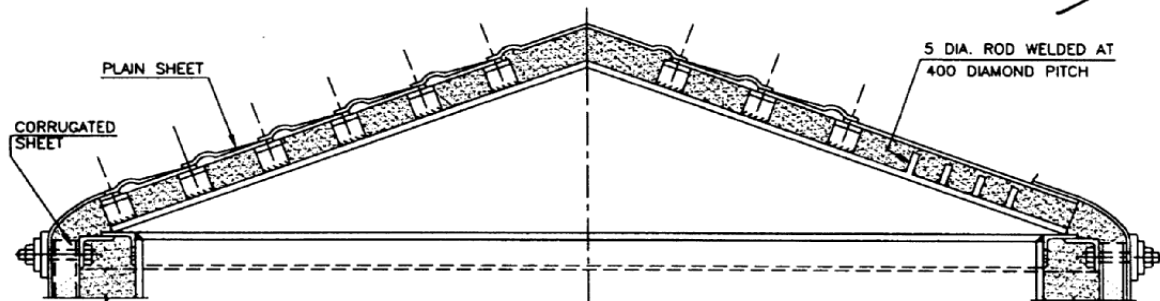


(i) WHEN INSULATION THK. IS EQUAL TO CURB ANGLE LEG WIDTH OR LESS

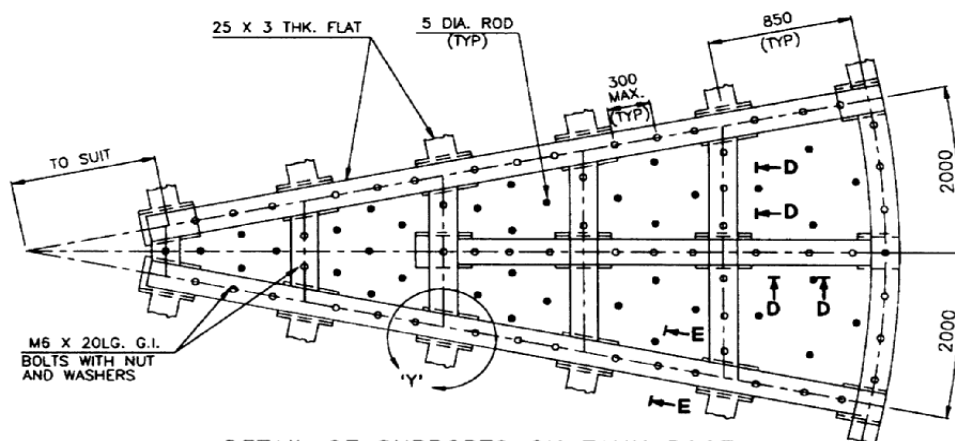
(ii) WHEN INSULATION THK. IS MORE THAN THE CURB ANGLE LEG WIDTH.

DETAIL -X'

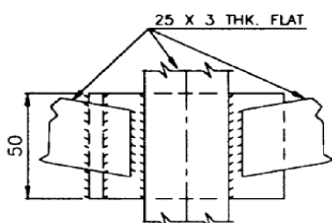
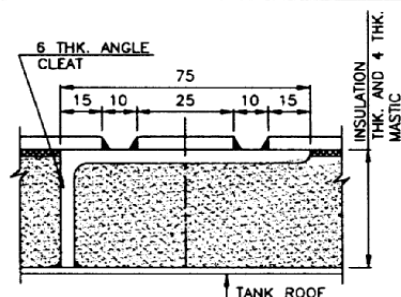
FIG: 22



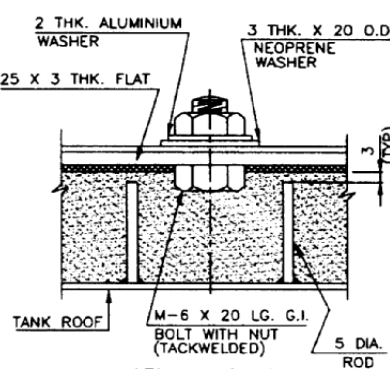
ARRANGEMENT OF BLANKET AND PLAIN SHEETING ON ROOF



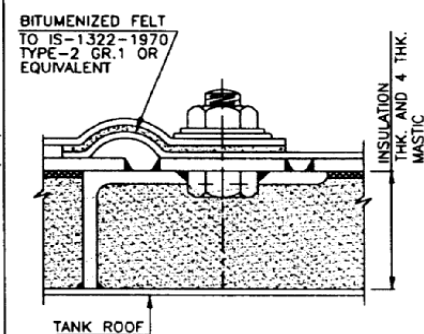
DETAIL OF SUPPORTS ON TANK ROOF



DETAIL - 'Y'



VIEW - 'D-D'



TYPICAL DETAIL OF LAP JOINTS OF PLAIN SHEETING & SEC. 'E-E'

NOTES :-

1. ALL DIMENSIONS ARE IN MM.
2. FOR MATERIAL SPECIFICATION REFER ENGINEERING DRAWING.
3. ONLY T-CLEATS WITH ASBESTOS SHEET AND G.I. BOLTINGS, ANGLE / FLAT RINGS ALONG WITH TACK WELDED G.I. BOLTS, 5 DIA. RODS, ROOF ANGLE CLEATS AND FLATS WITH TACK WELDED G.I. BOLTS SHALL BE SUPPLIED BY TANK FABRICATOR.
4. ALL ATTACHMENTS SHALL CLEAR WELD SEAMS AS PER REQUIREMENT OF CODE.

FIG: 23

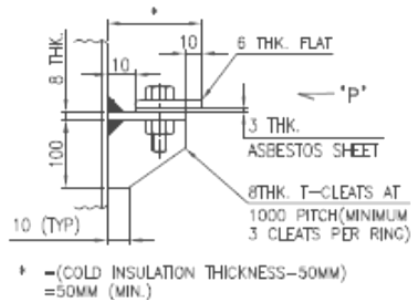
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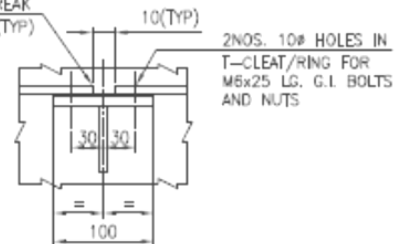
MECHANICAL

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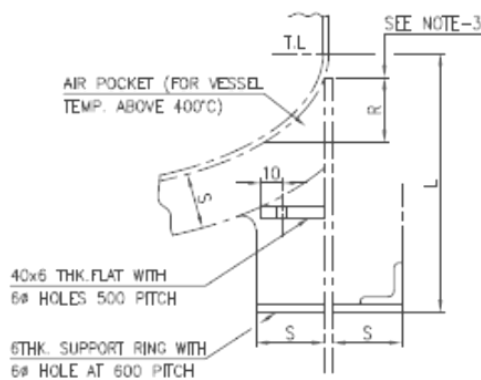


DETAIL:X
(FOR COLD INSULATED VESSELS)

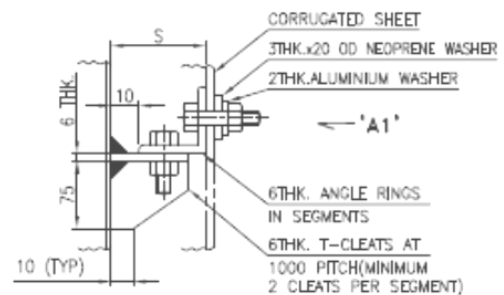
PROVIDE ONE HEAT BREAK
BETWEEN TWO CLEAT (TYP)



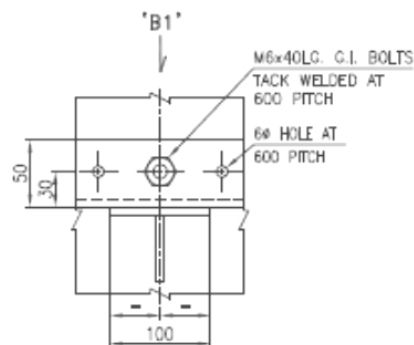
VIEW:P



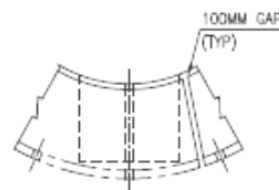
DETAIL:Z



DETAIL:X
(FOR HOT INSULATED VESSELS)
(WHERE S = <40)



VIEW:A1



VIEW:B1

NOTES:

1. ALL DIMENSION ARE IN MM.
2. FOR MATERIAL SPECIFICATION REFER ENGINEERING DRAWING.
3. 'R' SHALL BE EQUAL TO 175MM FOR VESSELS UPTO 3000MM DIAMETER AND 300MM FOR VESSELS ABOVE 3000MM DIAMETER.
4. DETAILS, DIMENSION AND NOTES ON ENGINEERING DRAWING SHALL TAKE PRECEDENCE OVER THOSE SHOWN HEREIN.
5. CLIPS SHALL CLEAR WELD SEAMS AND INSULATION RINGS SHALL BE SUITABLY NOTCHED INCASE OF INTERFERENCE WITH NOZZLE/ATTACHMENTS.
6. ONLY T-CLEATS WITH ASBESTOS SHEET AND G.I. BOLTING, ANGLE RING ALONG WITH TACK WELDED BOLTS, INSULATION SUPPORT CLEATS WELDED TO EQUIPMENT, LOOSE RING & M12 NUTS SHALL BE SUPPLIED BY EQUIPMENT FABRICATOR.
7. a) FOR COLD INSULATED VESSELS CLEATS ON DISHED ENDS ARE NOT REQUIRED.
b) FOR COLD INSULATED VESSELS CLEATS ON SHELL ARE TO BE PROVIDED IF COLD INSULATION THICKNESS IS MORE THAN 60MM.
8. FOR UNINSULATED VESSELS SQUARE NUTS SHALL BE PROVIDED FOR ENTIRE HEIGHT OF SUPPORT (SKIRT, PIPE/ANGLE LEG)

SHEET 2 OF 2



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TITLE: FIRE PROOFING AND
INSULATION SUPPORTS

STANDARD NO.

MC - STD - 025

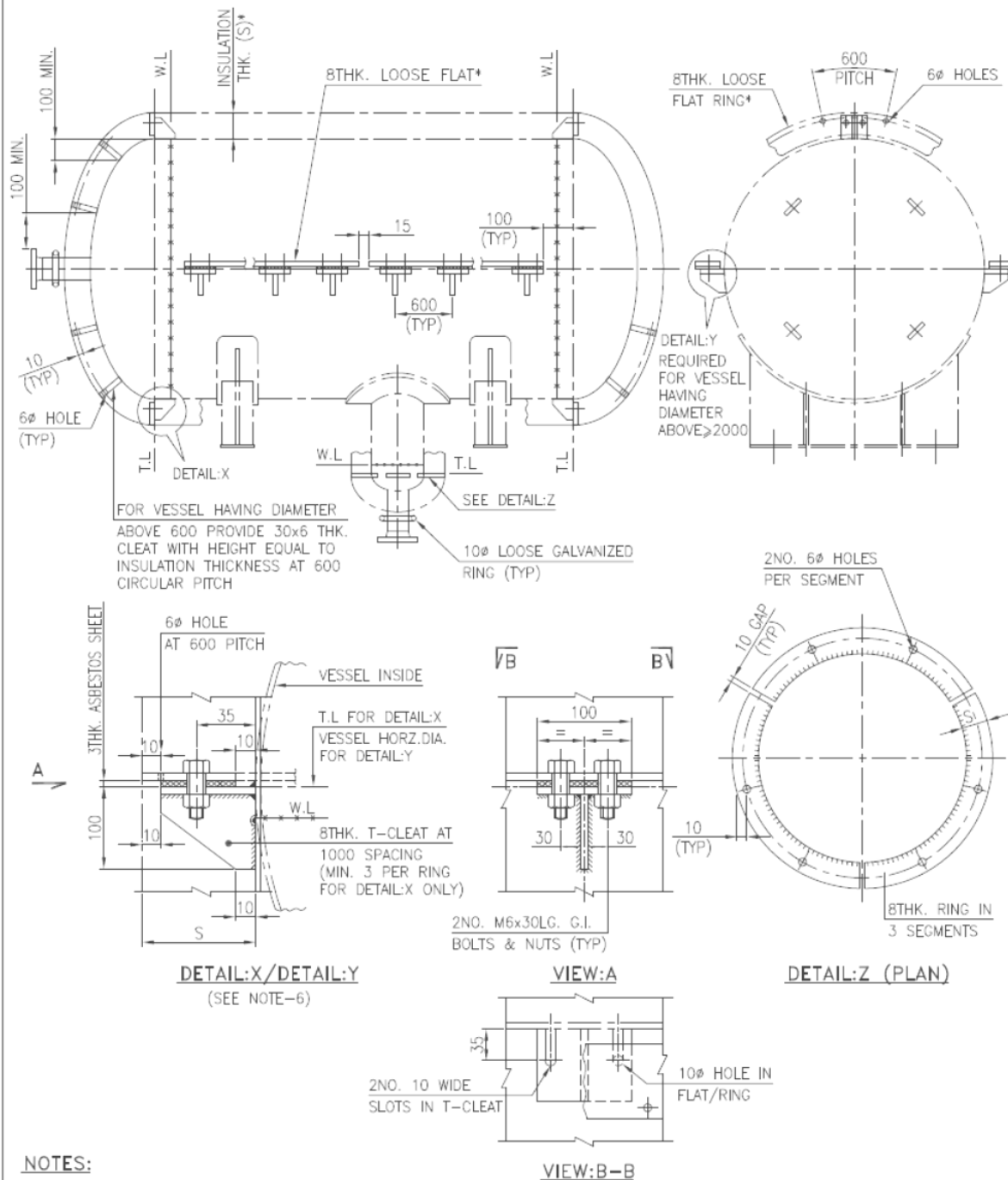
REV.

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MECHANICAL

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NOTES:

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- ONLY T-CLEATS WITH ASBESTOS SHEET, G.I. BOLTING, INSULATION SUPPORT CLEATS AND LOOSE RING/FLAT SHALL BE SUPPLIED BY THE EQUIPMENT FABRICATOR.
- * 6. FOR INSULATION THICKNESS (S) 40MM AND LESS, ONLY RINGS AND FLATS IN PIECES SHALL BE DIRECTLY WELDED TO SHELL/HEAD, AS SHOWN IN DETAIL:Z.

SHEET 1 OF 1



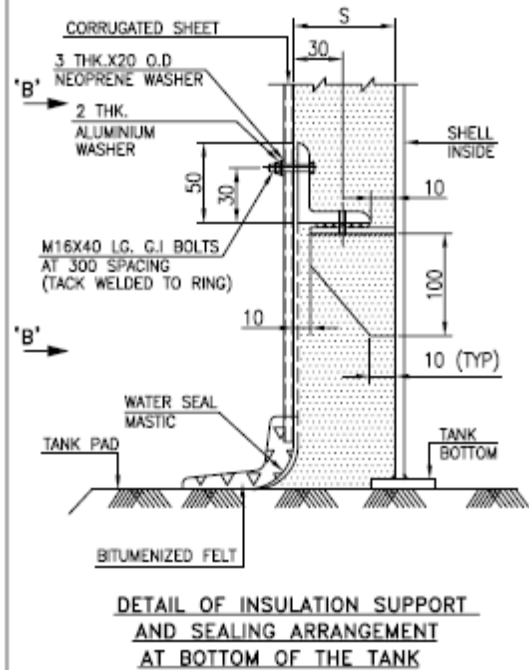
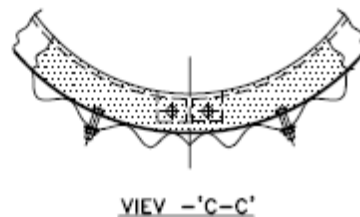
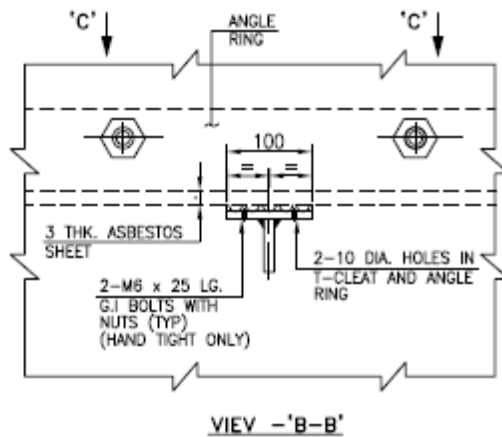
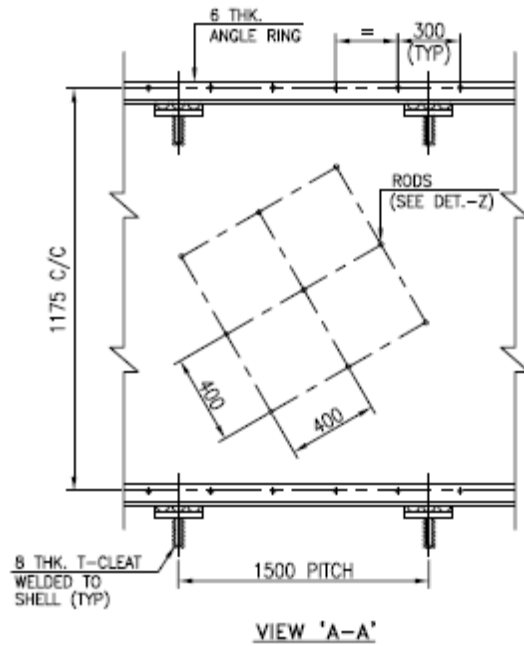
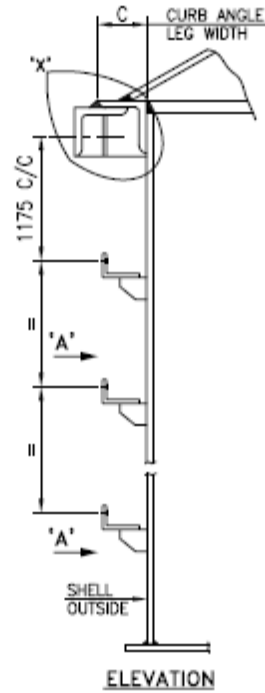
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TITLE:
HOT INSULATON SUPPORTS
FOR HORIZONTAL VESSEL

STANDARD NO.	REV.
MC - STD - 033	0

MECHANICAL

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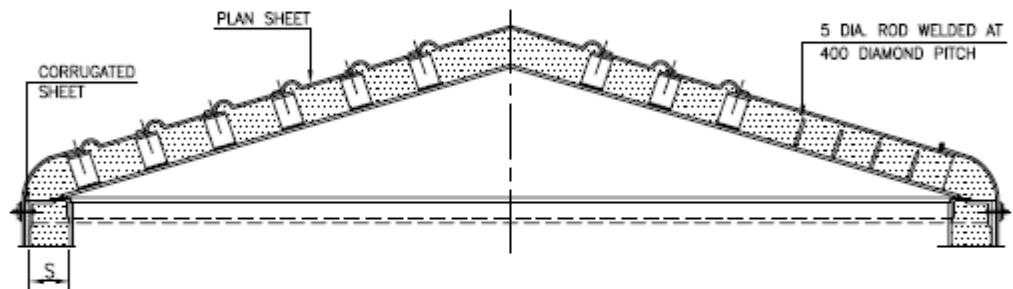
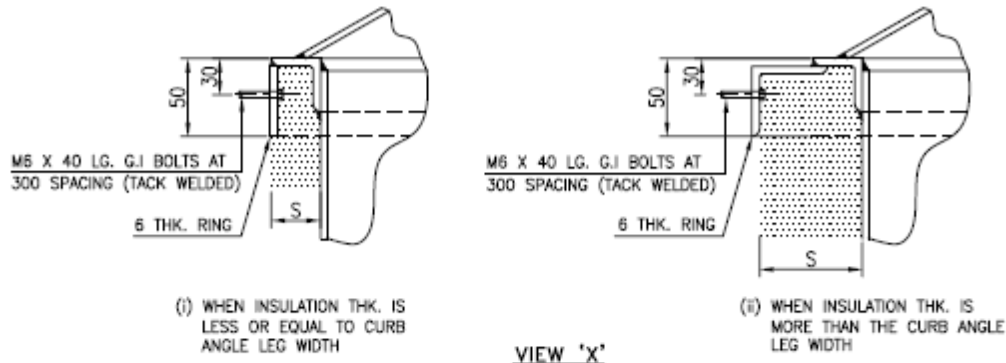


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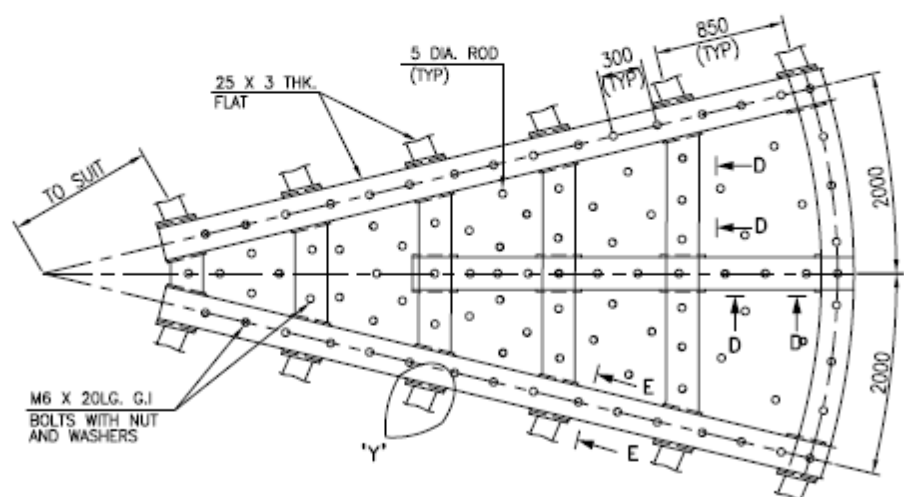
SHEET 1 OF 3

MECHANICAL

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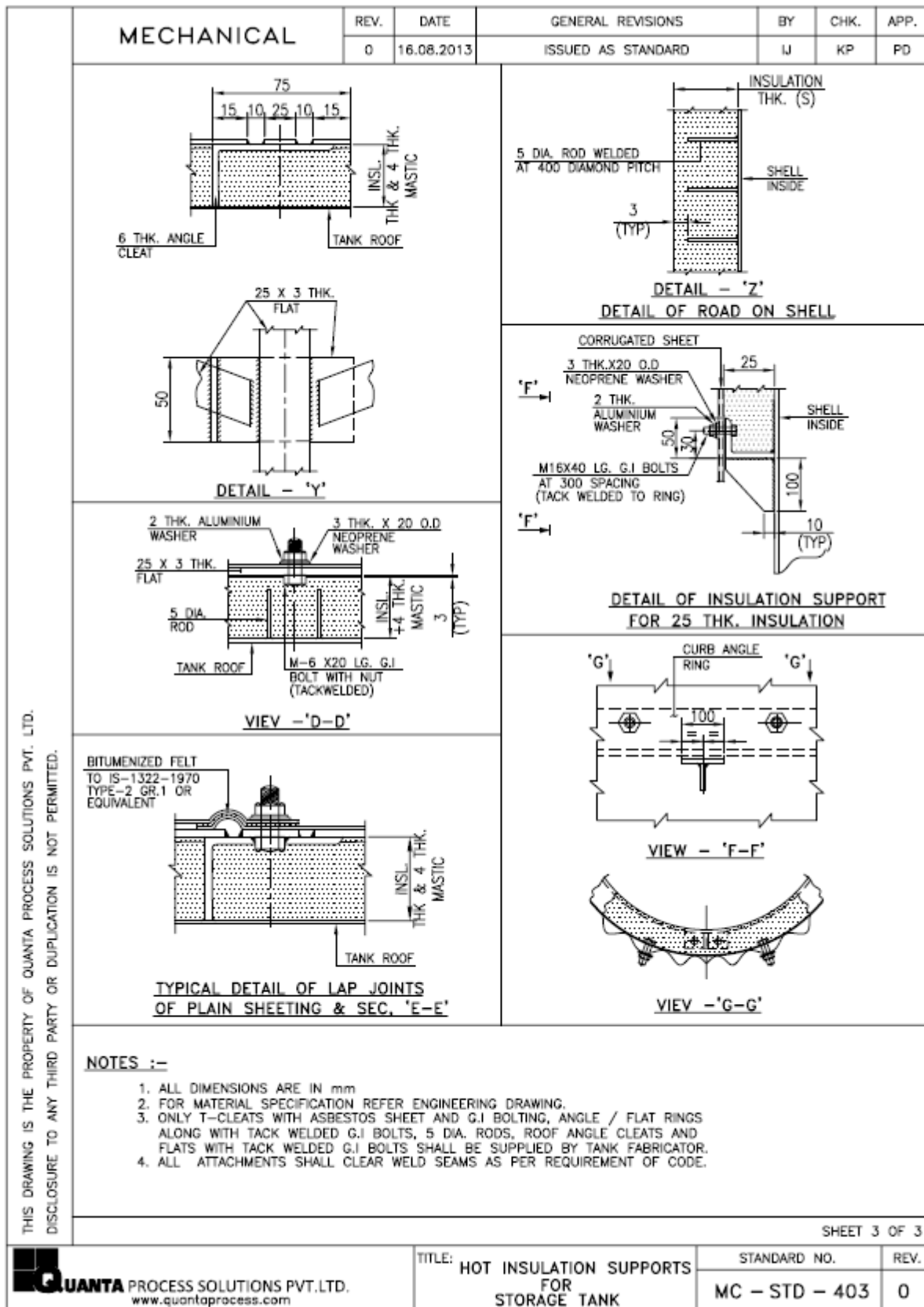
ARRANGEMENT OF BLANKET AND PLAIN SHEETING ON ROOF



DETAIL OF SUPPORTS ON TANK ROOF

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SHEET 2 OF 3



8.0 ☐ INSULATION THICKNESS TABLE FOR PERLITE

HOT Insulation thickness in mm											
Pipe Size, NB	Operating Temperatures, °C										
	≤60	61 to 100	101 to 150	151 to 200	201 to 250	251 to 300	301 to 350	351 to 400	401 to 450	451 to 500	501 to 550
25	25	25	30	40	50	70	80	100	110	120	140
40	25	25	40	40	60	80	90	110	120	140	140
50	25	30	40	50	60	80	90	120	140	140	160
80	25	30	50	50	70	90	110	140	140	160	160
100	25	30	50	60	70	100	110	140	160	160	180
150	25	35	60	60	80	110	120	140	160	180	200
200	25	35	60	70	90	120	130	160	180	180	200
250	25	40	70	70	90	120	130	160	180	200	220
300	25	40	70	80	100	120	140	160	180	200	220
350	25	40	70	80	100	130	140	180	180	200	220
400	25	50	70	90	110	140	150	180	200	200	220
450	25	50	70	90	110	140	150	180	200	220	240
500	25	50	80	100	110	140	150	180	200	220	240
600	25	50	80	100	110	140	150	180	200	220	240
>600/FI at surface	25	60	90	110	120	150	170	180	200	200	240