LIST OF ENGINEERING / INSTALLATION STANDARDS

SL. NO.	DESCRIPTION	DOCUMENT NO.	REV.	No. of Sheets
	Flow			
1.	Flow instruments DP type liquid & cond. vapour service meter below without Integral Manifold	7-52-1325	0	1
2.	Flow instrument diaphragm seal type	7-52-1313	0	1
3.	Flow instrument DP type liquid and cond. vap. service intg. manifold meter below	7-52-1329	0	1
4.	Flow instrument DP type gas service meter above high pressure	7-52-1311	1	1
5.	Flow instrument DP type liquid and cond. vap. service (2 Tx) meter below - SW	7-52-1387	0	1
6.	Flow instrument DP type dry gas service intg. manifold meter above	7-52-1332	0	1
7.	Flow instrument DP type steam service meter below	7-52-1344	0	1
8.	Flow instrument DP type averaging pitot tube - gas services intg. manifold meter above	7-52-1333	0	1
9.	Flow instrument DP type flow nozzle steam service with seal pot meter below	7-52-1301	0	1
10.	Flow instrument DP type steam service with seal pot meter below - SW	7-52-1302	0	1
11.	Flow instrument DP type steam service with seal pot meter below - WN	7-52-1303	0	1
12.	Flow instrument DP type prefabricated hookups direct	7-52-1305	0	1
13.	Flow instrument DP type liq. / cond. vap. service meter below high pressure	7-52-1310	1	1
14.	Flow Instrument DP Type Liquid and Cond. Vap. Service (D-D/2) Intg. Manifold Meter Below	7-52-1334	1	1
15.	Flow instrument DP type liquid service meter above	7-52-1326	0	1
16.	Flow instrument DP type dry gas service meter below	7-52-1327	0	1
17.	Flow instrument DP type gas service meter above	7-52-1328	0	1
18.	Flow instrument DP type liquid & cond. vapour service integral manifold, meter below	7-52-1312	0	1
19.	Flow instrument DP type gas service integral manifold meter above	7-52-1347	0	1
20.	Flow instrument DP type liquid service Integral manifold meter above	7-52-1345	0	1
	Pressure & Differential Pressure			
21.	Pressure gauge liquid / gas service	7-52-1112	0	1

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SL. NO.	DESCRIPTION	DOCUMENT NO.	REV.	No. of Sheets
22.	Pressure gauge steam service	7-52-1113	0	1
23.	Pressure instrument liquid & cond. vapour service meter below on pipe	7-52-1131	0	1
24.	Pressure instrument (PT & PG) diaphragm seal type vessel mounted	7-52-1115	0	1
25.	Pressure instrument (PT and PG) diaphragm seal type-line mounted	7-52-1114	0	1
26.	Differential pressure instrument DP - type meter below	7-52-1171	0	1
27.	Pressure instrument pressure transmitter & pressure gauge draft	7-52-1138	1	1
28.	Pressure instrument high temperature heater	7-52-2127	0	1
29.	Differential pressure instrument with both side diaphragm seal (on vessel/ pipe) with spacer ring	7-52-1117	0	1
30.	Pressure instrument / gauge diaphragm seal type on pipe - SW (with purging connection)	7-52-1225	0	1
31.	Pressure instrument liq. and cond. vapour service (on cladded vessel) meter below	7-52-1282	0	1
32.	Diff. pressure instrument both side diaphragm seal (with purging connection) (on pipe)	7-52-1237	1	1
33.	Differential pressure instrument DP type hydrogen service meter above	7-52-1200	0	1
34.	Pressure instrument liquid & cond. vapour meter below (high pressure)	7-52-1202	0	1
35.	Pressure instrument liquid and cond. vap. service meter below	7-52-1273	0	1
36.	Pressure instrument heater/ duct – WN	7-52-1243	0	1
37.	Pressure gauge hydrogen service – SW	7-52-1275	0	1
38.	Pressure gauge gas service high pressure	7-52-2142	0	1
39.	Pressure gauge remote mounting high pressure - WN	7-52-1209	0	1
40.	Pressure instrument gas service meter above - WN	7-52-1159	0	1
41.	Pressure instrument 3 way 2 valve manifold pre-fabricated	7-52-1143	0	1
42.	Pressure gauge liquid / gas service high pressure - WN	7-52-1144	0	1
43.	Pressure gauge steam service high pressure	7-52-1111	0	1

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SL. NO.	DESCRIPTION	DOCUMENT NO.	REV.	No. of Sheets
44.	Pressure instrument gas service meter above	7-52-1134	0	1
45.	Pressure instrument gas service (on vessel) meter below	7-52-1154	0	1
46.	Pressure instrument gas service (on vessel) meter above	7-52-1155	0	1
47.	Pressure Instrument Liquid and Cond. Vapour Service Meter Below - High Pressure	7-52-1139	0	1
48.	Pressure gauge high temperature remote mounted - WN	7-52-1120	0	1
49.	Pressure instrument liquid and cond. vapour service meter above	7-52-1132	0	1
50.	Pressure instrument liquid service meter above	7-52-1123	0	1
51.	Pressure instrument gas service (On vessel) meter above	7-52-1155	0	1
52.	Differential pressure instrument DP - type meter below	7-52-1171	0	1
53.	Diff. pressure instrument with one side diaphragm seal	7-52-1157	0	1
54.	Pressure instrument liquid and cond. vapour service meter below	7-52-1151	1	1
55.	Pressure instrument gas service meter above	7-52-1153	0	1
56.	Pressure instrument gas service meter above threaded - 1/2"	7-52-1176	0	1
57.	Diff. press. instrument DP – type meter below	7-52-1137	0	1
58.	Differential pressure gauge - meter below	7-52-1160	0	1
	Level			
59.	Level gauge magnetic type with hydrogen service	7-52-1565	0	1
60.	Level instrument diaphragm seal type drain / vent to CBD / flare	7-52-1618	0	1
61.	Level gauge - magnetic on vessel / standpipe drain / vent to CBD / flare	7-52-1562	0	1
62.	Level instrument dia. seal type on vessel with drain to CBD / ABD and vent to flare (3/4 inch conn.) with purging connection– SW	7-52-1541	1	1
63.	Level instrument DP type on vessel meter below - SW drain / vent to CBD / flare	7-52-1502	0	1
64.	DP instr. (2 legs on vessel) / DP type level instr. Meter below high pressure	7-52-1584	0	1
65.	Level / diff. press. instrument DP type on vessel meter below	7-52-1515	0	1
66.	Level instrument DP-type on stand pipe meter below	7-52-1552	0	1
67.	Level instrument diaphragm seal type	7-52-1514	0	1
68.	Level gauge magnetic type on vessel / standpipe	7-52-1520	1	1

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SL. NO.	DESCRIPTION	DOCUMENT NO.	REV.	No. of Sheets
69.	Level gauge on vessel	7-52-1518	0	1
70.	Level gauge on stand pipe	7-52-1519	0	1
71.	DP instrument (2 legs on vessel) / DP type level instrument (dia. seal type) high pressure with drain to CBD / ABD vent to flare (3/4 inch connection)	7-52-1545	2	1
72.	DP instrument (2 legs on vessel) / DP type level instrument meter below hydrogen service	7-52-1568	0	1
73.	Level instrument guided wave radar on vessel / standpipe	7-52-1595	0	1
74.	Level gauge magnetic type (WN) on vessel / standpipe with drain to CBD / ABD and vent to flare (3/4 inch connection) high pressure	7-52-1549	0	1
	Control & On-off Valves			
75.	Tubing hook - up control valve with solenoid valve 1/2 inch OD	7-52-1902	0	1
76.	Tubing hook - up control valve with smart / FF positioner - 1/2 inch OD	7-52-1906	0	1
77.	Tubing hook - up control valve with smart positioner with sov -1/2 inch OD	7-52-1908	0	1

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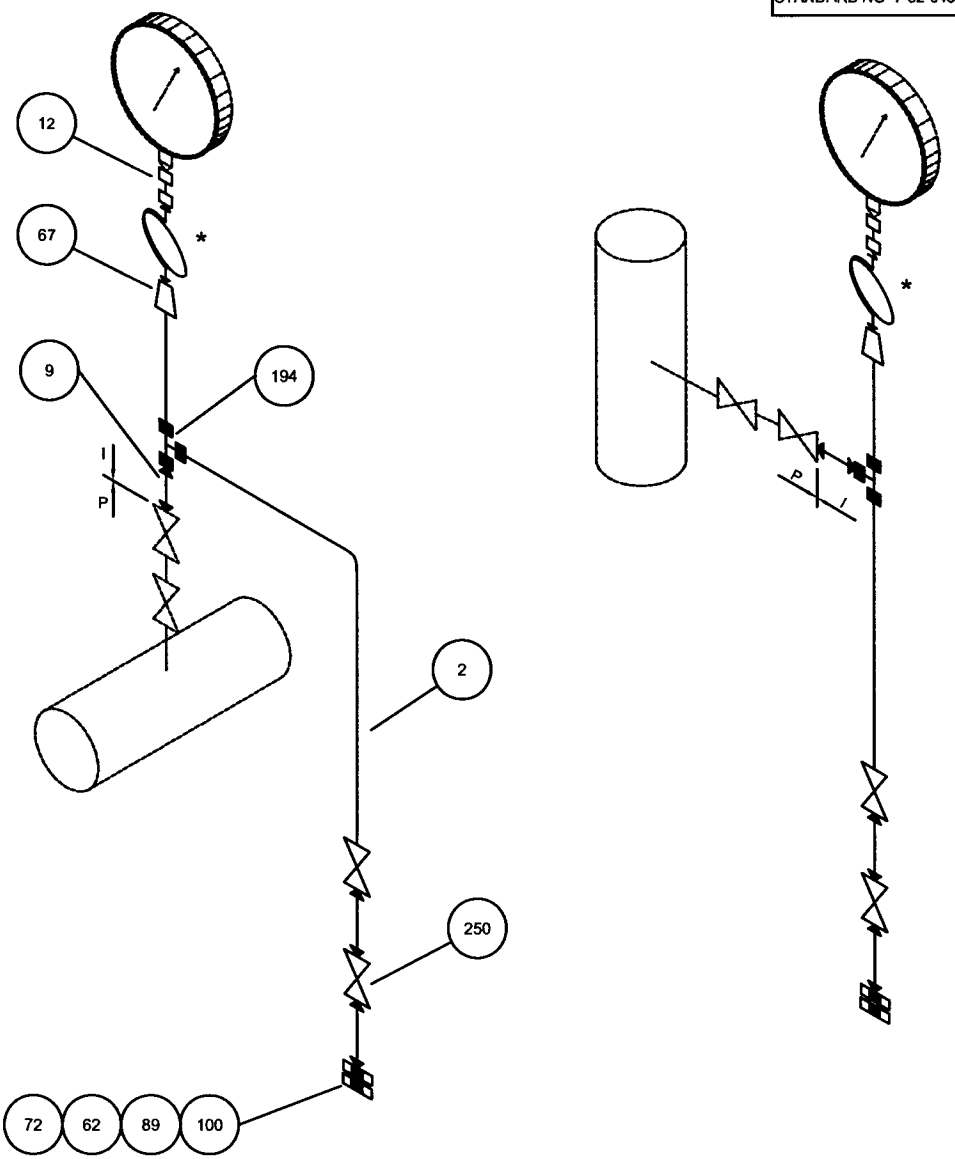

P - BY PIPING
I - BY INSTRUMENTATION

* SYPHON SITE FABRICATED

LIST OF ITEMS

CODE	DESCRIPTION	SIZE	ENDS	QTY.	UNIT	CODE	DESCRIPTION	SIZE	ENDS	QTY.	UNIT
2	PIPE	3/4"	PL	A/R	m						
9	NIPPLE	3/4"	PL X PL	3	Nø						
12	COUPLING	1/2"	TH	1	Nø						
62	GASKET	FOR 3/4" FL		1	Nø						
72	STUDS & NUTS	FOR 3/4" FL		1	Set						
67	REDUCER	3/4" X 1/2"	BW	1	Nø						
89	FLANGE	3/4"	WN	1	Nø						
100	BLIND FLANGE	3/4"		1	Nø						
194	EQUAL TEE	3/4"	BW	1	Nø						
250	GATE VALVE	3/4"	BW	2	Nø						

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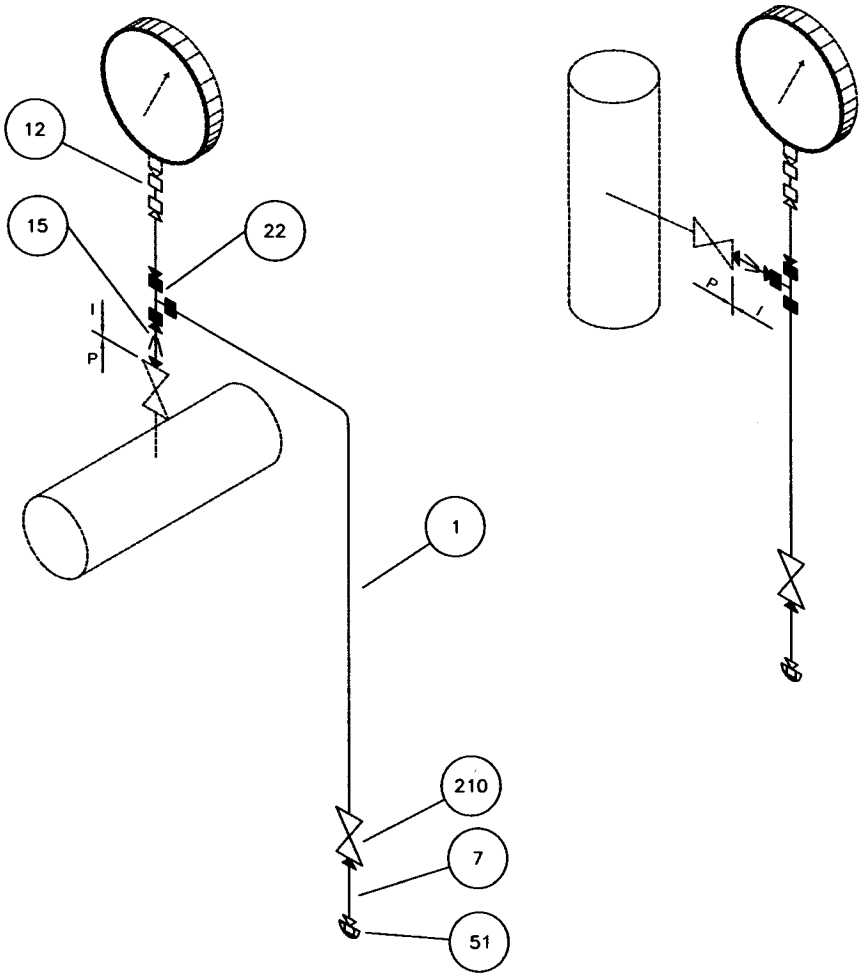
STANDARD NO. 7-52-0432 REV-5 RENUMBERED



P - BY PIPING
I - BY INSTRUMENTATION

LIST OF ITEMS

CODE	DESCRIPTION	SIZE	ENDS	QTY.	UNIT	CODE	DESCRIPTION	SIZE	ENDS	QTY.	UNIT
1	PIPE	1/2"	PL	A/R	m						
7	NIPPLE	1/2"	TH X PL	2	Nø						
12	COUPLING	1/2"	TH	1	Nø						
15	SWAGE NIPPLE	3/4" X 1/2"	PL X PL	1	Nø						
22	EQUAL TEE	1/2"	SW	1	Nø						
51	CAP	1/2"	TH	1	Nø						
210	GATE VALVE	1/2"	SW	1	Nø						

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0	01.07.2021	Issued As Standard	Manoj	AJS	MN	SM

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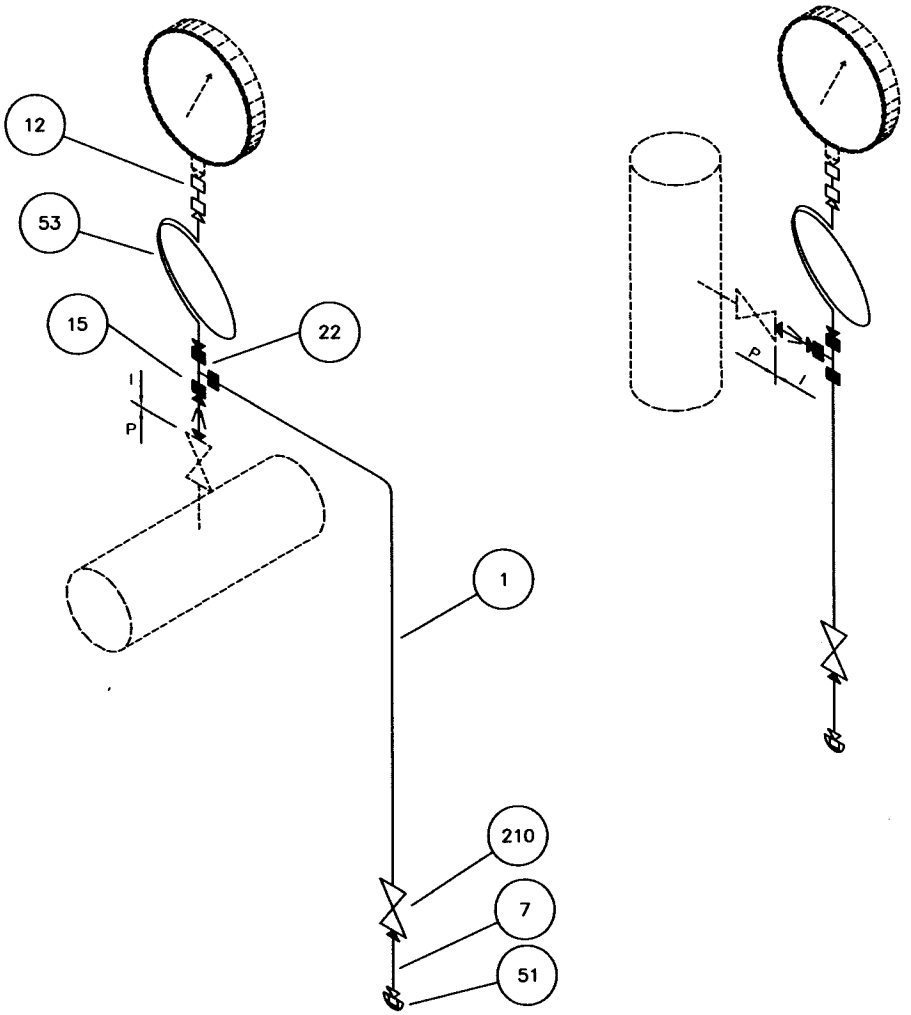
STANDARD NO. 7-52-0433 REV-5 RENUMBERED



P - BY PIPING
I - BY INSTRUMENTATION

LIST OF ITEMS

CODE	DESCRIPTION	SIZE	ENDS	QTY.	UNIT	CODE	DESCRIPTION	SIZE	ENDS	QTY.	UNIT
1	PIPE	1/2"	PL	A/R	m						
7	NIPPLE	1/2"	TH X PL	1	Nø						
12	COUPLING	1/2"	TH	1	Nø						
15	SWAGE NIPPLE	3/4" X 1/2"	PL X PL	1	Nø						
22	EQUAL TEE	1/2"	SW	1	Nø						
51	CAP	1/2"	TH	1	Nø						
53	SYPHON C-TYPE	1/2" X 1/2"	TH(Ext) X PL	1	Nø						
210	GATE VALVE	1/2"	SW	1	Nø						

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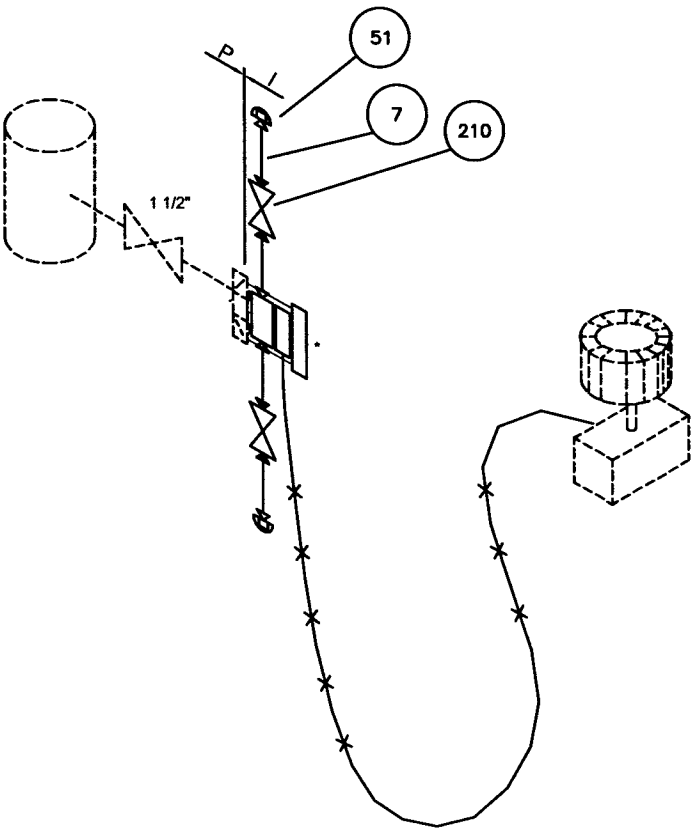

P - BY PIPING
I - BY INSTRUMENTATION

* DRIP RING WITH BLIND FLANGE (1 1/2"), GASKET, STUDS & NUTS (EXTRA LONG) BY VENDOR

LIST OF ITEMS

CODE	DESCRIPTION	SIZE	ENDS	QTY.	UNIT	CODE	DESCRIPTION	SIZE	ENDS	QTY.	UNIT
7	NIPPLE	1/2"	TH X PL	4	Nø						
51	CAP	1/2"	TH	2	Nø						
210	GATE VALVE	1/2"	SW	2	Nø						

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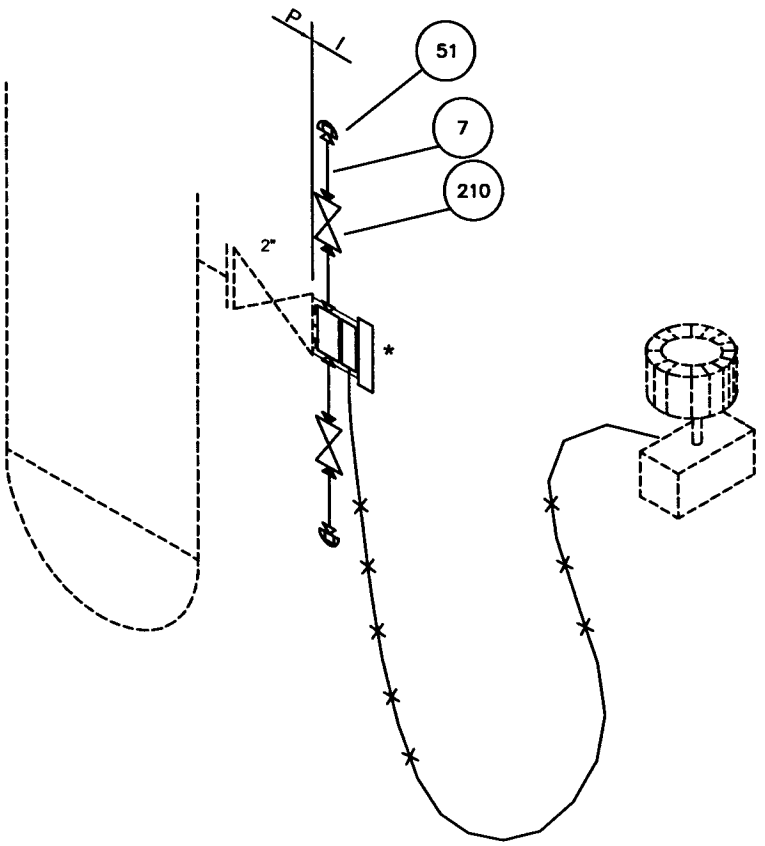

P - BY PIPING
I - BY INSTRUMENTATION

* DRIP RING WITH BLIND FLANGE (2"), GASKET, STUDS & NUTS (EXTRA LONG) BY VENDOR

LIST OF ITEMS

CODE	DESCRIPTION	SIZE	ENDS	QTY.	UNIT	CODE	DESCRIPTION	SIZE	ENDS	QTY.	UNIT
7	NIPPLE	1/2"	TH X PL	4	Nø						
51	CAP	1/2"	TH	2	Nø						
210	GATE VALVE	1/2"	SW	2	Nø						

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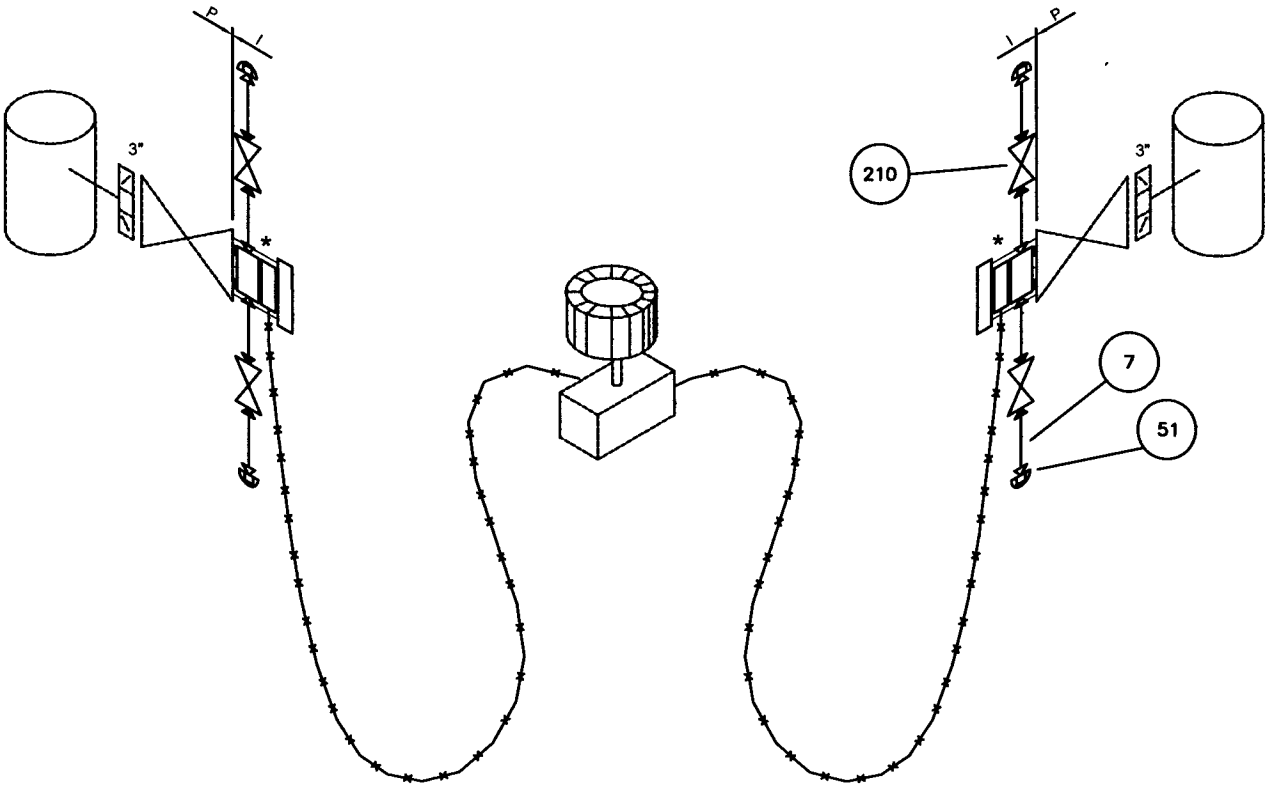

P - BY PIPING
I - BY INSTRUMENTATIDN

* DRIP RING WITH BLIND FLANGE (3"), GASKET, STUDS & NUTS (EXTRA LONG) BY VENDOR

LIST OF ITEMS

CODE	DESCRIPTION	SIZE	ENDS	QTY.	UNIT	CODE	DESCRIPTION	SIZE	ENDS	QTY.	UNIT
7	NIPPLE	1/2"	TH X PL	8	Nø						
51	CAP	1/2"	TH	4	Nø						
210	GATE VALVE	1/2"	SW	4	Nø						

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0	10.10.2019	Issued As Standard	Manoj	AJS	RG	PKT

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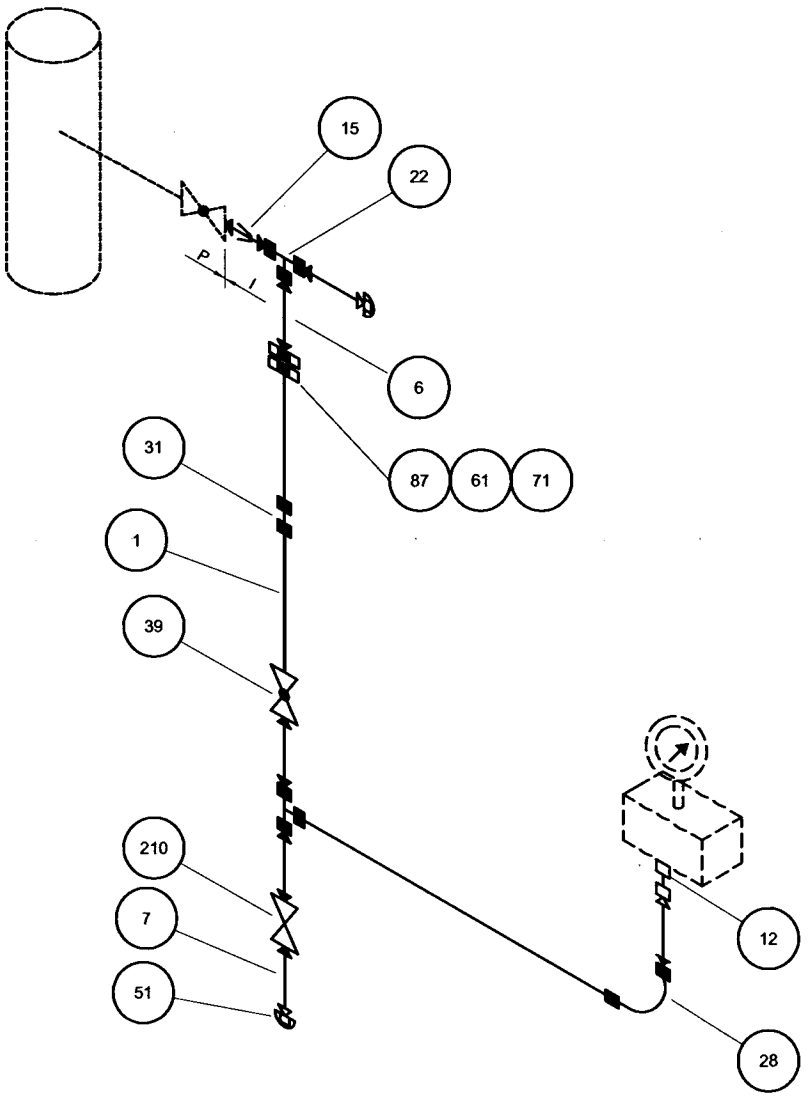

P - BY PIPING
I - BY INSTRUMENTATION

* PL x PL NIPPLE SHALL BE FABRICATED FROM PIPE

LIST OF ITEMS

CODE	DESCRIPTION	SIZE	ENDS	QTY.	UNIT	CODE	DESCRIPTION	SIZE	ENDS	QTY.	UNIT
1	PIPE	1/2"	PL	A/R	m	71	STUDS & NUTS	FOR 1/2" FLG.		1	Set
6	NIPPLE *	1/2"	PL X PL	3	Nø	87	FLANGE	1/2"	WN	2	Nø
7	NIPPLE	1/2"	TH X PL	3	Nø	210	GATE VALVE	1/2"	SW	1	Nø
12	COUPLING	1/2"	TH	1	Nø						
15	SWAGE NIPPLE	3/4" X 1/2"	PL X PL	1	Nø						
22	EQUAL TEE	1/2"	SW	2	Nø						
28	ELBOW	1/2"	SW	1	Nø						
31	COUPLING	1/2"	SW	1	Nø						
39	GLOBE VALVE	1/2"	SW	1	Nø						
51	CAP	1/2"	TH	2	Nø						
61	GASKET	FOR 1/2" FLG.		1	Nø						

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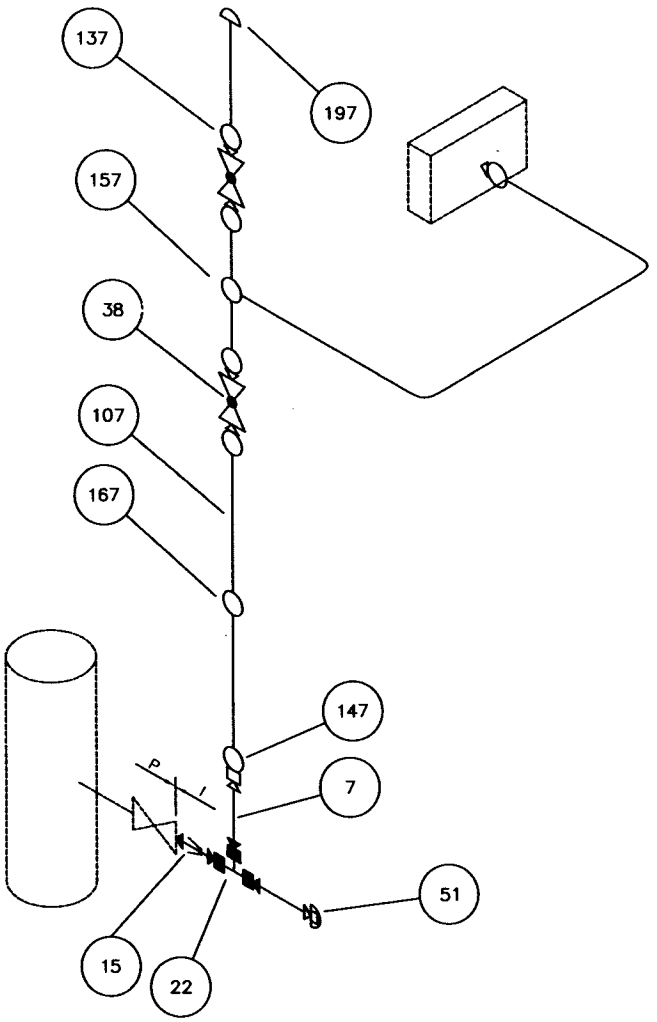
STANDARD NO. 7-52-0443 REV-5 RENUMBERED



P - BY PIPING
I - BY INSTRUMENTATION

LIST OF ITEMS

CODE	DESCRIPTION	SIZE	ENDS	QTY.	UNIT	CODE	DESCRIPTION	SIZE	ENDS	QTY.	UNIT
7	NIPPLE	1/2"	TH X PL	2	Nø	107	TUBE	1/2"	OD	A/R	m
15	SWAGE NIPPLE	3/4" X 1/2"	PL X PL	1	Nø	137	MALE CONNECTOR	1/2" X 1/2"	TH X OD	5	Nø
22	EQUAL TEE	1/2"	SW	1	Nø	147	FEMALE CONNECTOR	1/2" X 1/2"	TH X OD	1	Nø
38	GLOBE VALVE	1/2"	TH	2	Nø	157	UNION TEE	1/2"	OD	1	Nø
51	CAP	1/2"	TH	1	Nø	167	TUBE UNION	1/2"	OD	1	Nø
						197	TUBING CAP	1/2"	OD	1	Nø

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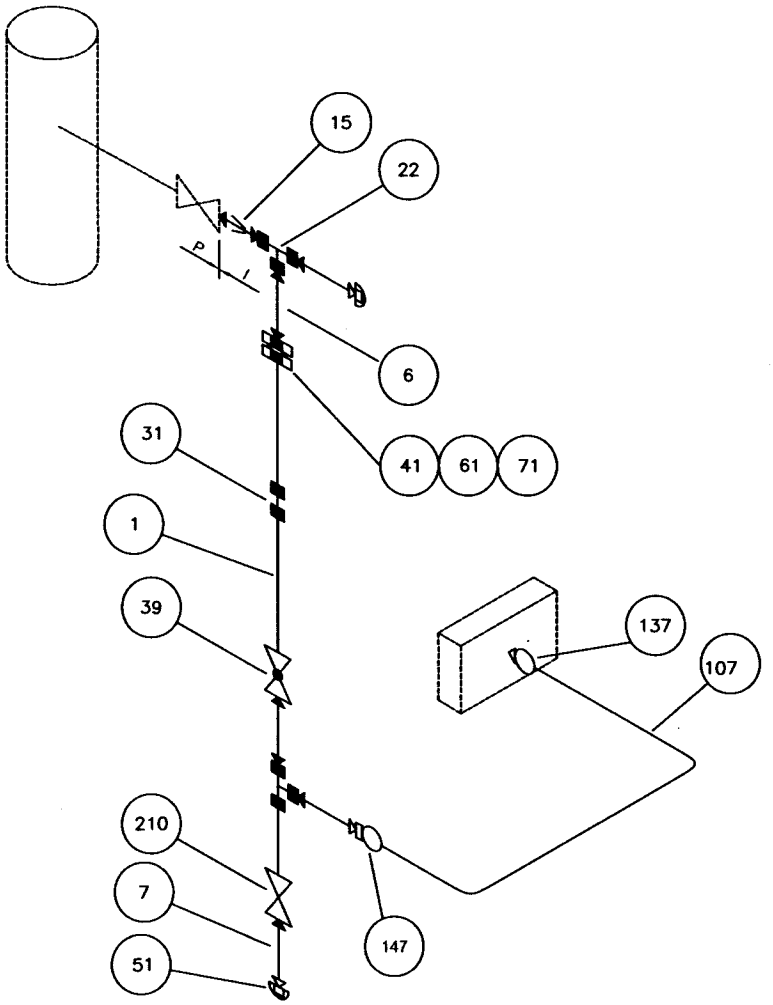
STANDARD NO. 7-52-0437 REV-5 RENUMBERED



P - BY PIPING
I - BY INSTRUMENTATION

* PL x PL NIPPLE SHALL BE FABRICATED FROM PIPE

LIST OF ITEMS

CODE	DESCRIPTION	SIZE	ENDS	QTY.	UNIT	CODE	DESCRIPTION	SIZE	ENDS	QTY.	UNIT
1	PIPE	1/2"	PL	A/R	m	107	TUBE	1/2"	OD	A/R	m
6	NIPPLE *	1/2"	PL X PL	2	Nø	137	MALE CONNECTOR	1/2" X 1/2"	TH X OD	1	Nø
7	NIPPLE	1/2"	TH X PL	3	Nø	147	FEMALE CONNECTOR	1/2" X 1/2"	TH X OD	1	Nø
15	SWAGE NIPPLE	3/4" X 1/2"	PL X PL	1	Nø						
22	EQUAL TEE	1/2"	SW	2	Nø						
31	COUPLING	1/2"	SW	1	Nø						
39	GLOBE VALVE	1/2"	SW	1	Nø						
41	FLANGE	1/2"	SW	2	Nø						
51	CAP	1/2"	TH	2	Nø						
61	GASKET	FOR 1/2" FLG.		1	Nø						
71	STUDS & NUTS	FOR 1/2" FLG.		1	Set						
210	GATE VALVE	1/2"	SW	1	Nø						

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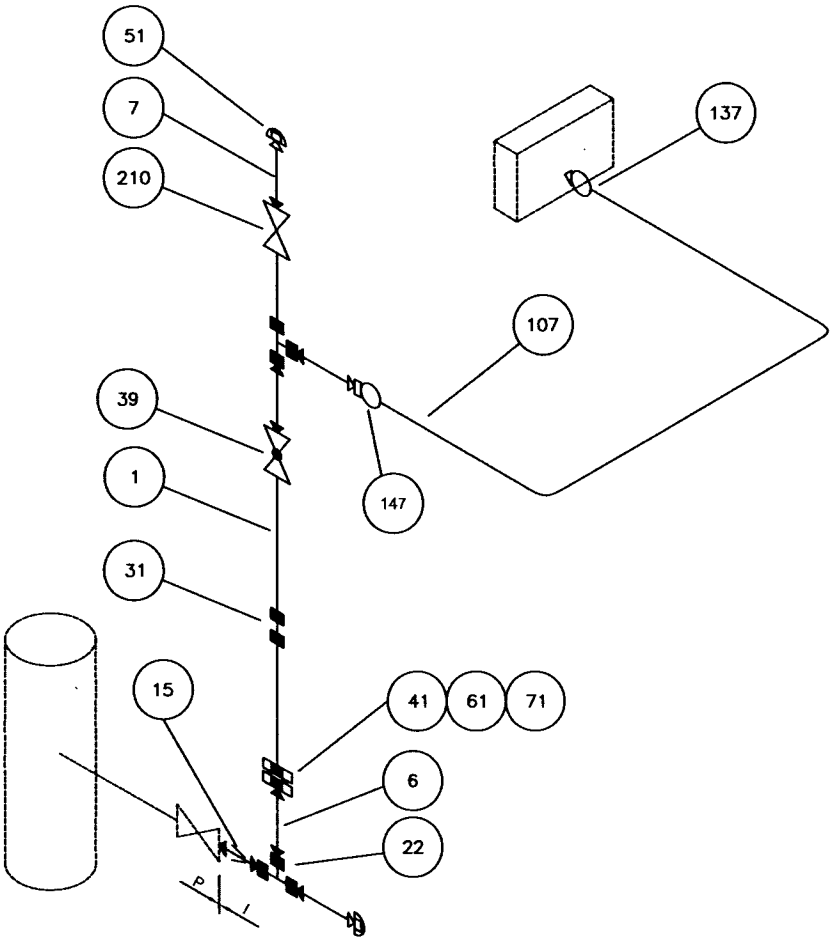
STANDARD NO. 7-52-0438 REV-5 RENUMBERED



P - BY PIPING
I - BY INSTRUMENTATION

* PL x PL NIPPLE SHALL BE FABRICATED FROM PIPE

LIST OF ITEMS

CODE	DESCRIPTION	SIZE	ENDS	QTY.	UNIT	CODE	DESCRIPTION	SIZE	ENDS	QTY.	UNIT
1	PIPE	1/2"	PL	A/R	m	107	TUBE	1/2"	OD	A/R	m
6	NIPPLE *	1/2"	PL X PL	2	Nø	137	MALE CONNECTOR	1/2" X 1/2"	TH X OD	1	Nø
7	NIPPLE	1/2"	TH X PL	3	Nø	147	FEMALE CONNECTOR	1/2" X 1/2"	TH X OD	1	Nø
15	SWAGE NIPPLE	3/4" X 1/2"	PL X PL	1	Nø						
22	EQUAL TEE	1/2"	SW	2	Nø						
31	COUPLING	1/2"	SW	1	Nø						
39	GLOBE VALVE	1/2"	SW	1	Nø						
41	FLANGE	1/2"	SW	2	Nø						
51	CAP	1/2"	TH	2	Nø						
61	GASKET	FOR 1/2" FLG.		1	Nø						
71	STUDS & NUTS	FOR 1/2" FLG.		1	Set						
210	GATE VALVE	1/2"	SW	1	Nø						

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0	01.07.2021	Issued As Standard	Manoj	AJS	MN	SM

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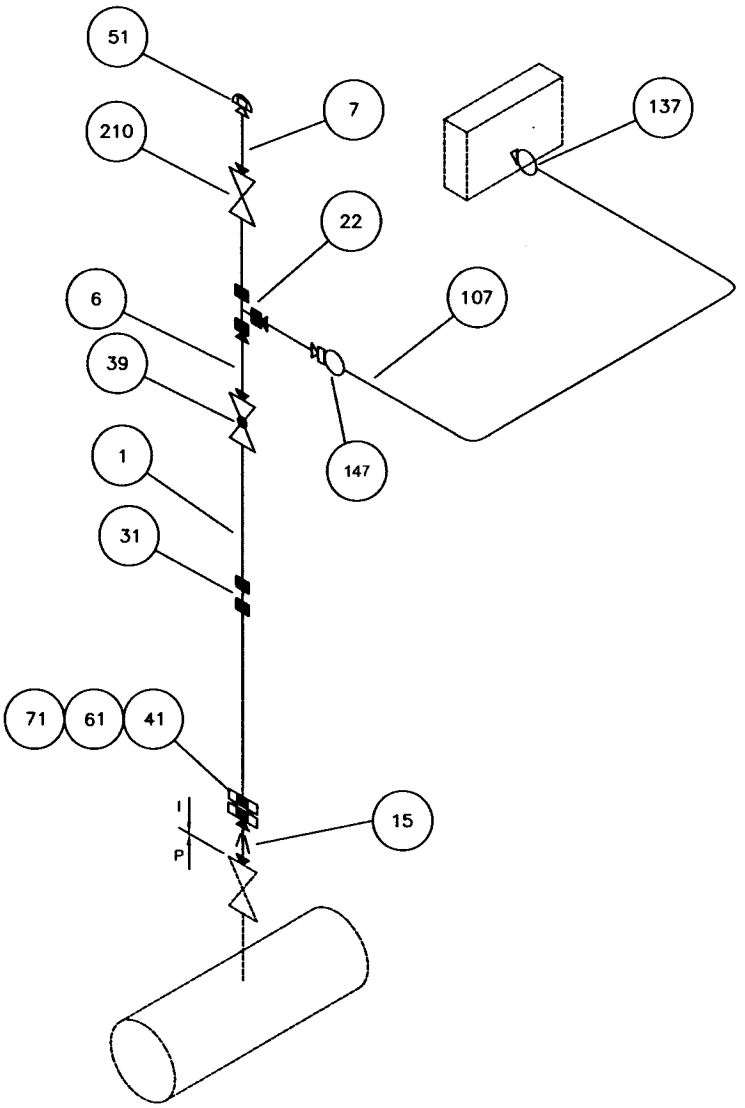
STANDARD NO. 7-52-0441 REV-5 RENUMBERED



P - BY PIPING
I - BY INSTRUMENTATION

* PL x PL NIPPLE SHALL BE FABRICATED FROM PIPE

LIST OF ITEMS

CODE	DESCRIPTION	SIZE	ENDS	QTY.	UNIT	CODE	DESCRIPTION	SIZE	ENDS	QTY.	UNIT
1	PIPE	1/2"	PL	A/R	m	107	TUBE	1/2"	OD	A/R	m
6	NIPPLE *	1/2"	PL X PL	1	Nø	137	MALE CONNECTOR	1/2" X 1/2"	TH X OD	1	Nø
7	NIPPLE	1/2"	TH X PL	2	Nø	147	FEMALE CONNECTOR	1/2" X 1/2"	TH X OD	1	Nø
15	SWAGE NIPPLE	3/4" X 1/2"	PL X PL	1	Nø						
22	EQUAL TEE	1/2"	SW	1	Nø						
31	COUPLING	1/2"	SW	1	Nø						
39	GLOBE VALVE	1/2"	SW	1	Nø						
41	FLANGE	1/2"	SW	2	Nø						
51	CAP	1/2"	TH	1	Nø						
61	GASKET	FOR 1/2" FLG.		1	Nø						
71	STUDS & NUTS	FOR 1/2" FLG.		1	Set						
210	GATE VALVE	1/2"	SW	1	Nø						

Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
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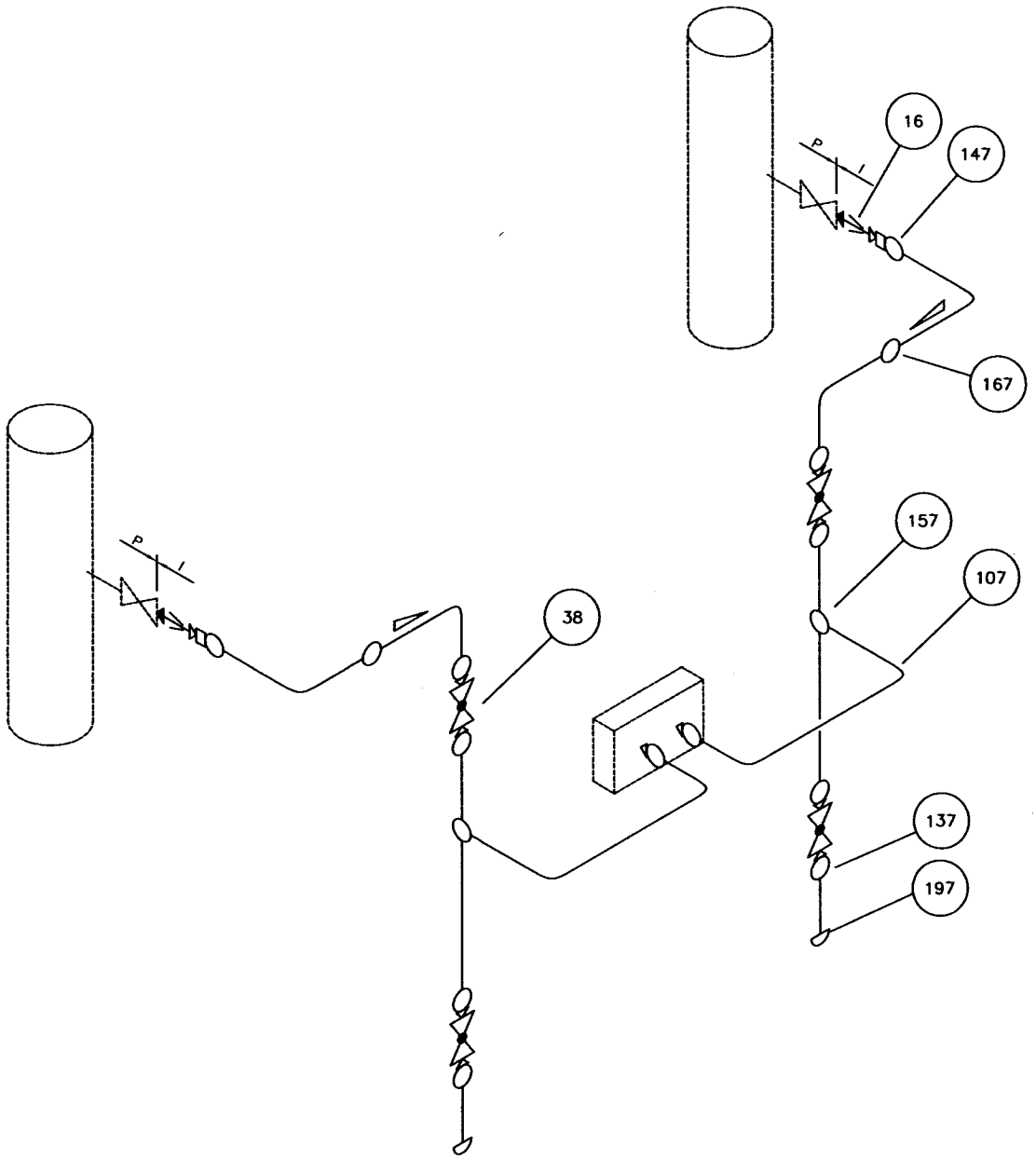
STANDARD NO. 7-52-0453 REV-5 RENUMBERED



P - BY PIPING
I - BY INSTRUMENTATION

LIST OF ITEMS

CODE	DESCRIPTION	SIZE	ENDS	QTY.	UNIT	CODE	DESCRIPTION	SIZE	ENDS	QTY.	UNIT
16	SWAGE NIPPLE	3/4" X 1/2"	PL X TH	2	Nø	107	TUBE	1/2"	OD	A/R	m
38	GLOBE VALVE	1/2"	TH	4	Nø	137	MALE CONNECTOR	1/2" X 1/2"	TH X OD	10	Nø
						147	FEMALE CONNECTOR	1/2" X 1/2"	TH X OD	2	Nø
						157	UNION TEE	1/2"	OD	2	Nø
						167	TUBE UNION	1/2"	OD	2	Nø
						197	TUBING CAP	1/2"	OD	2	Nø

Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
0	01.07.2021	Issued As Standard	Manoj	AJS	MN	SM

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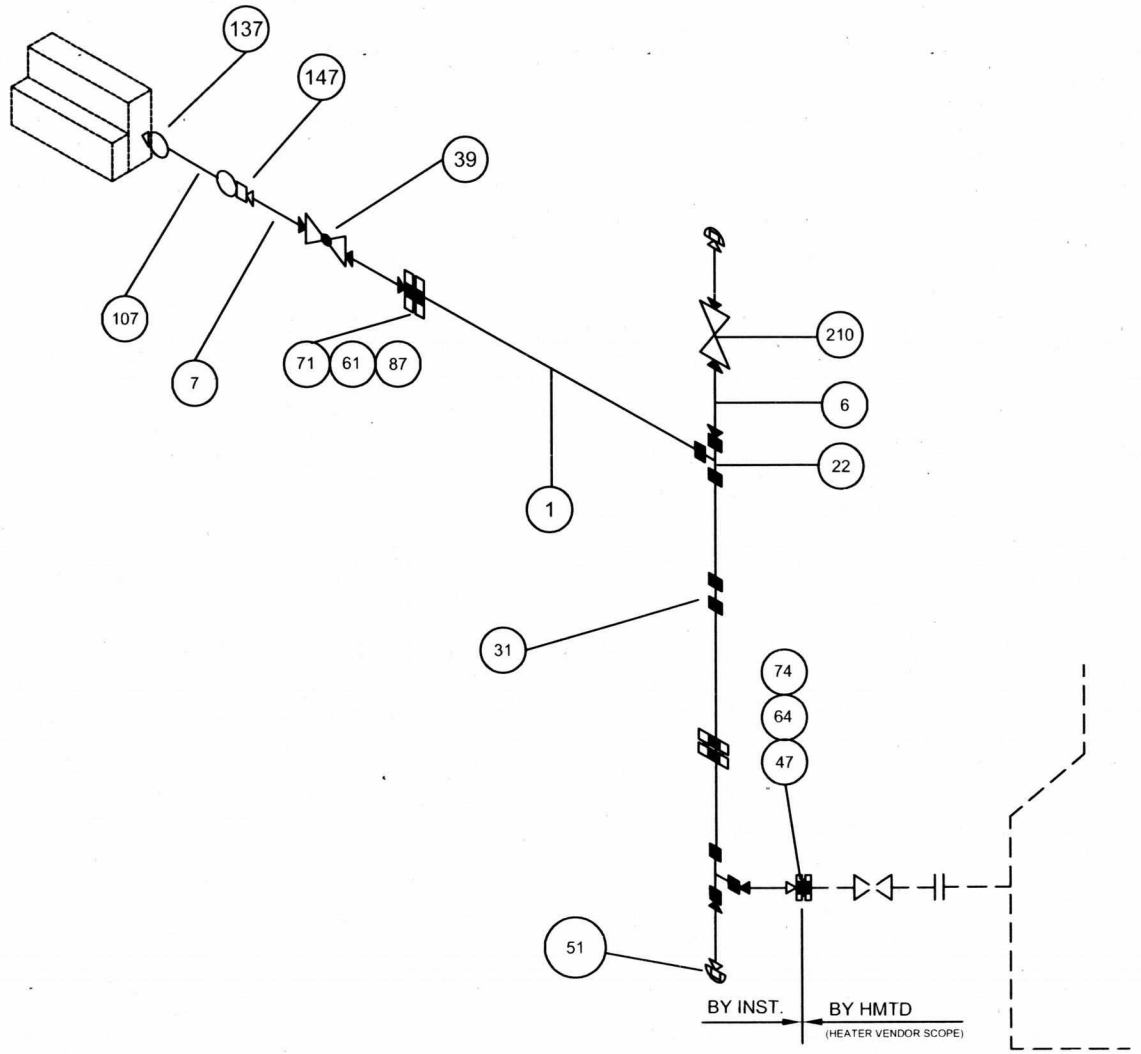
STANDARD NO. 7-52-0456 REV-0 RENUMBERED



* PL x PL NIPPLE SHALL BE FABRICATED FROM PIPE

LIST OF ITEMS

CODE	DESCRIPTION	SIZE	ENDS	QTY.	UNIT	CODE	DESCRIPTION	SIZE	ENDS	QTY.	UNIT
1	PIPE	1/2"	PL	A/R	m	87	FLANGE	1/2"	WN	4	Nø
6	NIPPLE *	1/2"	PL x PL	2	Nø	210	GATE VALVE	1/2"	SW	1	Nø
7	NIPPLE	1/2"	PL x TH	4	Nø						
22	EQUAL TEE	1/2"	SW	2	Nø						
31	COUPLING	1/2"	SW	1	Nø						
39	GLOBE VALVE	1/2"	SW	1	Nø	107	TUBE	1/2"	OD	A/R	m
47	FLANGE	11/2" x 1/2"TH	FL x TH (Red)	1	Nø	137	MALE CONNECTOR	1/2" X 1/2"	TH X OD	1	Nø
51	CAP	1/2"	TH	2	Nø	147	FEMALE CONNECTOR	1/2" X 1/2"	TH X OD	1	Nø
61	GASKET	FOR 1/2" FLG.		2	Nø						
64	GASKET	FOR 11/2" FLG.		1	Nø						
71	STUDS & NUTS	FOR 1/2" FLG.		4	Set						
74	STUDS & NUTS	FOR 11/2" FLG.		1	Set						

Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
1	01.12.2022	Revised & Reissued	Manoj	GG/AR	MN	SM
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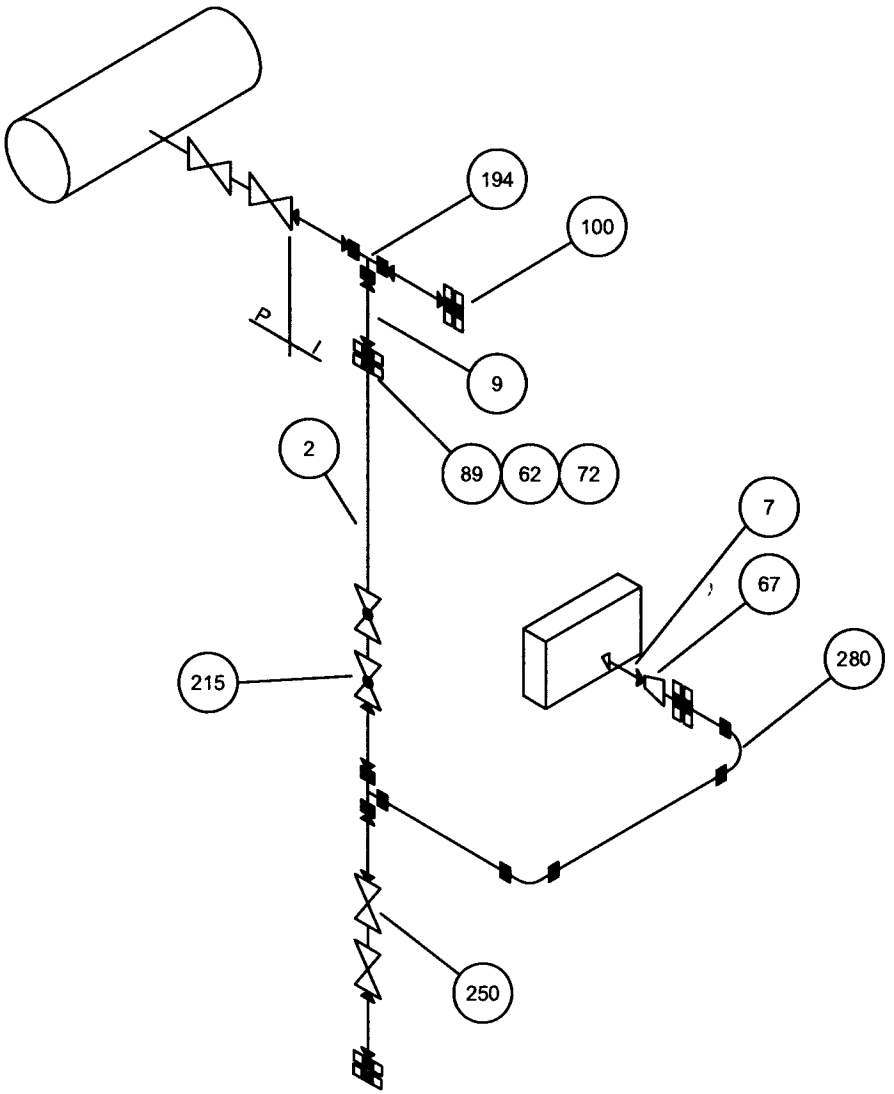
STANDARD NO 7-52-0457 REV-0 RENUMBERED



P - BY PIPING
I - BY INSTRUMENTATION

LIST OF ITEMS

CODE	DESCRIPTION	SIZE	ENDS	QTY.	UNIT	CODE	DESCRIPTION	SIZE	ENDS	QTY.	UNIT
2	PIPE	3/4"	PL	A/R	m						
7	NIPPLE	1/2"	PL X TH	1	Nø						
9	NIPPLE	3/4"	PL X PL	9	Nø						
62	GASKET	FOR 3/4" FL		4	Nø						
72	STUDS & NUTS	FOR 3/4" FL		4	Set						
67	REDUCER	3/4" x 1/2"	BW	1	Nø						
89	FLANGE	3/4"	WN	6	Nø						
100	BLIND FLANGE	3/4"		2	Nø						
194	EQUAL TEE	3/4"	BW	2	Nø						
215	GLOBE VALVE	3/4"	BW	2	Nø						
250	GATE VALVE	3/4"	BW	2	Nø						
280	ELBOW	3/4"	BW	2	Nø						

Rev No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
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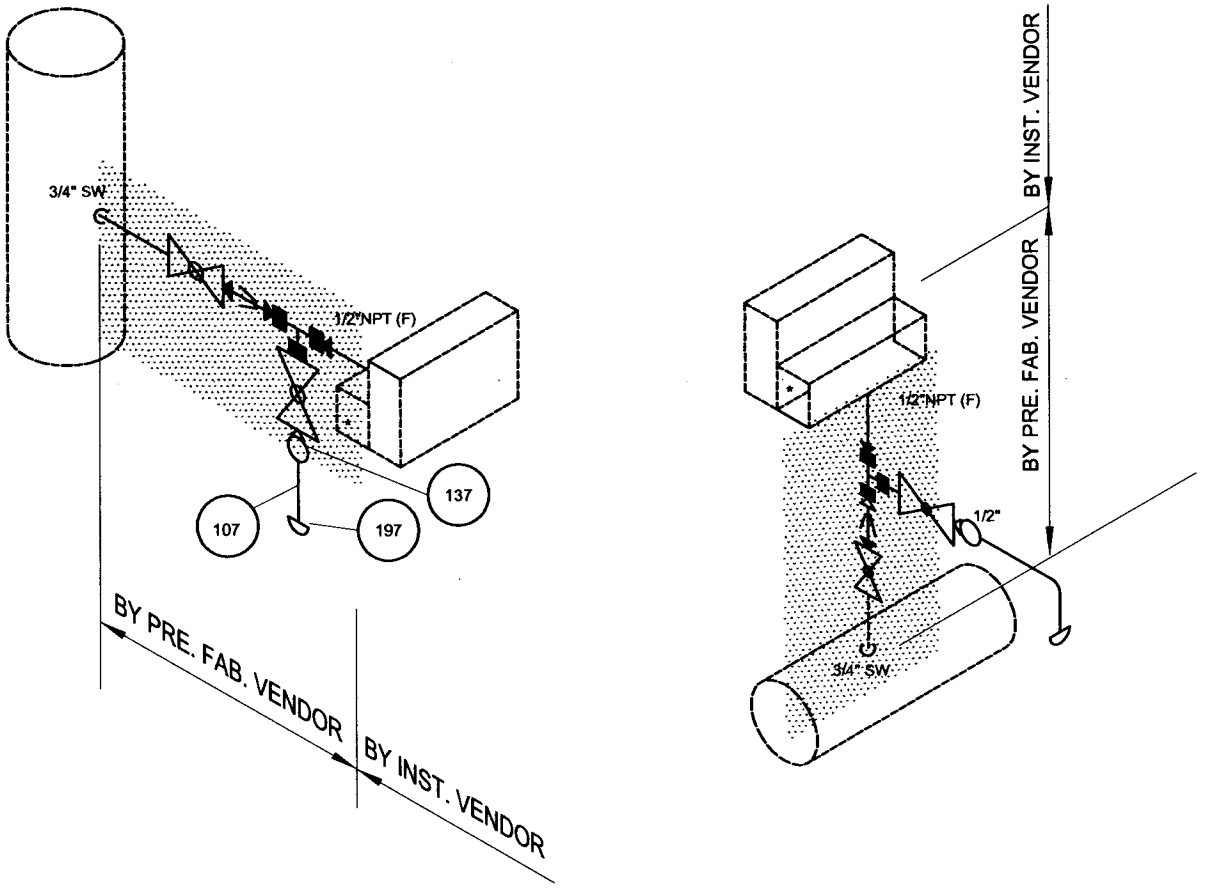

LIST OF ITEMS

CODE	DESCRIPTION	SIZE	ENDS	QTY.	UNIT	CODE	DESCRIPTION	SIZE	ENDS	QTY.	UNIT
						107	TUBE	1/2"	OD	A/R	m
						137	MALE CONNECTOR	1/2" X 1/2"	TH X OD	1	Nø
						197	TUBING CAP	1/2"	OD	1	Nø

Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
0	11.02.2022	Issued As Standard	Mano/AB	GG/AR	MN	SM

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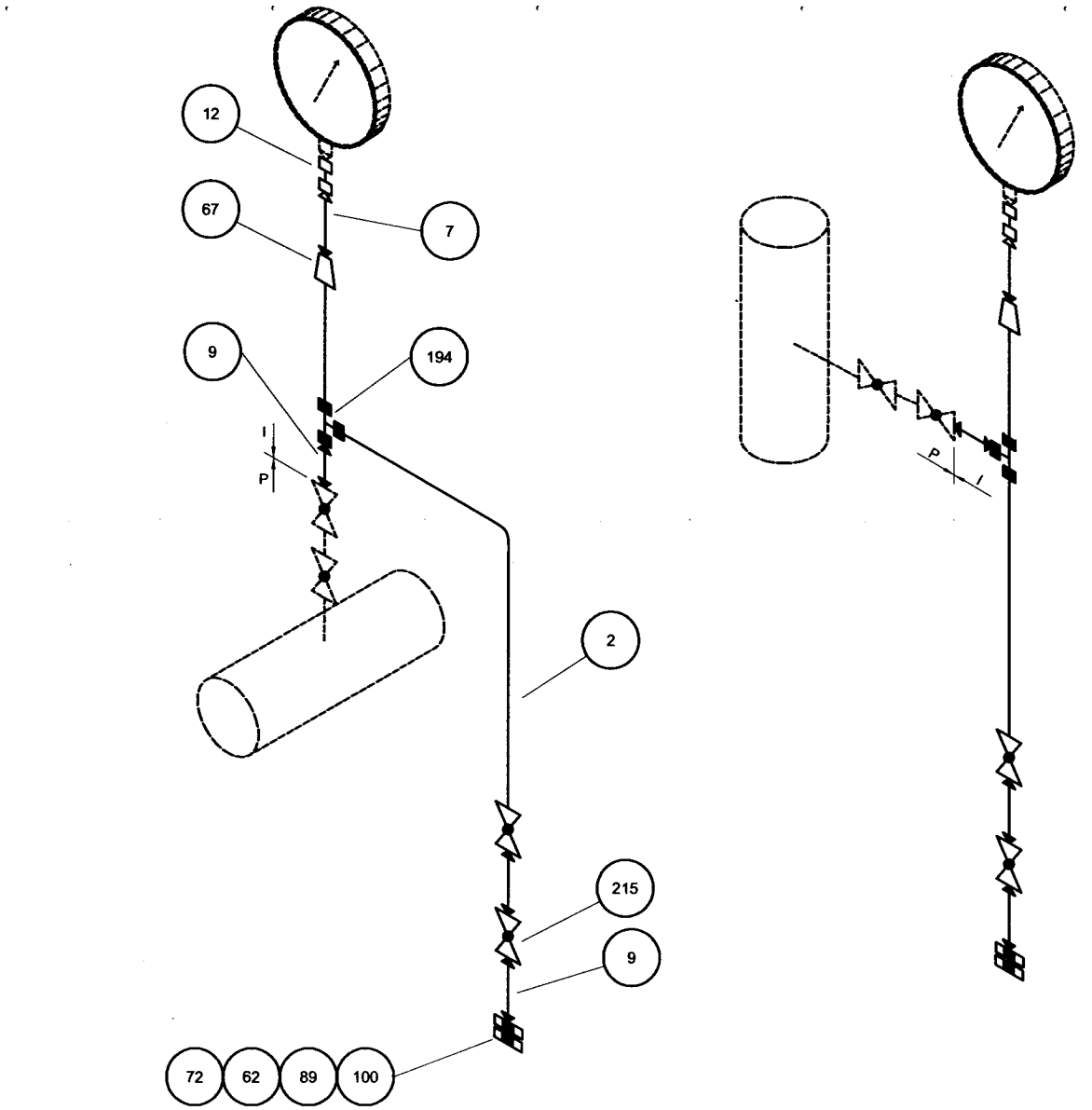

P - BY PIPING
I - BY INSTRUMENTATION

* PL x PL NIPPLE SHALL BE FABRICATED FROM PIPE

LIST OF ITEMS

CODE	DESCRIPTION	SIZE	ENDS	QTY.	UNIT	CODE	DESCRIPTION	SIZE	ENDS	QTY.	UNIT
2	PIPE	3/4"	PL	A/R	m						
7	NIPPLE	1/2"	TH X PL	1	Nø						
9	NIPPLE *	3/4"	PL X PL	3	Nø						
12	COUPLING	1/2"	TH	1	Nø						
62	GASKET	FOR 3/4" FL		1	Nø						
67	REDUCER	3/4" X 1/2"	BW	1	Nø						
72	STUDS & NUTS	FOR 3/4" FL		1	Set						
89	FLANGE	3/4"	WN	1	Nø						
100	BLIND FLANGE	3/4"		1	Nø						
194	EQUAL TEE	3/4"	BW	1	Nø						
215	GLOBE VALVE	3/4"	BW	2	Nø						

Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
0	11.02.2022	Issued As Standard	Manoj/AB	GG/AR	MN	SM

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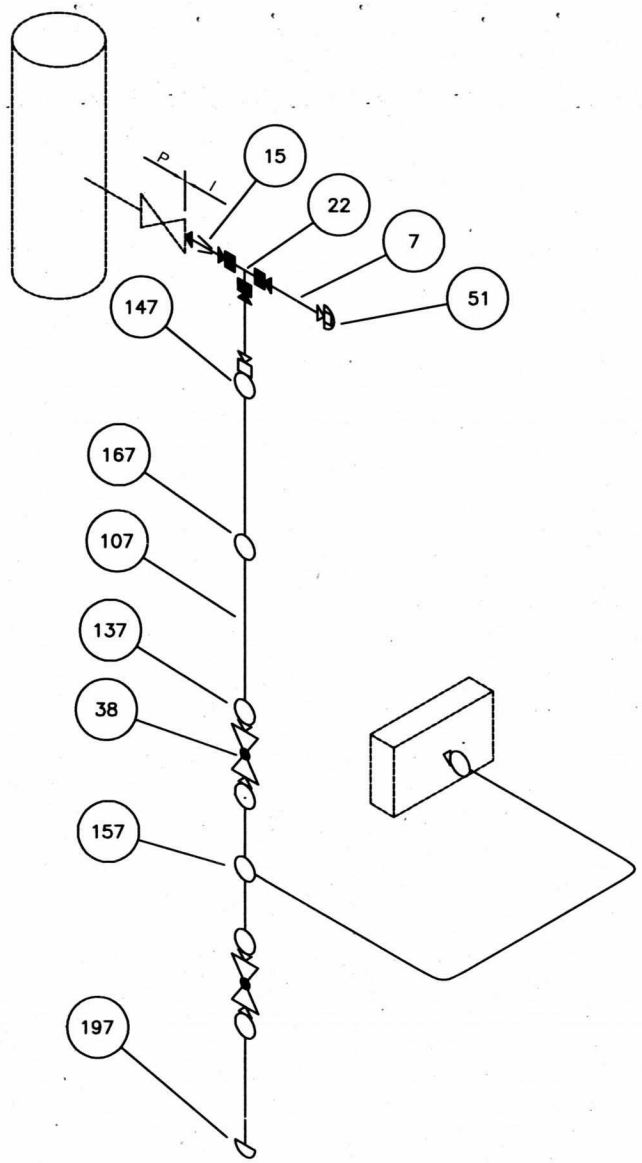
STANDARD NO. 7-52-0442 REV-5 RENUMBERED



P - BY PIPING
I - BY INSTRUMENTATION

LIST OF ITEMS

CODE	DESCRIPTION	SIZE	ENDS	QTY.	UNIT	CODE	DESCRIPTION	SIZE	ENDS	QTY.	UNIT
7	NIPPLE	1/2"	TH X PL	2	Nø	107	TUBE	1/2"	OD	A/R	m
15	SWAGE NIPPLE	3/4" X 1/2"	PL X PL	1	Nø	137	MALE CONNECTOR	1/2" X 1/2"	TH X OD	5	Nø
22	EQUAL TEE	1/2"	SW	1	Nø	147	FEMALE CONNECTOR	1/2" X 1/2"	TH X OD	1	Nø
38	GLOBE VALVE	1/2"	TH	2	Nø	157	UNION TEE	1/2"	OD	1	Nø
51	CAP	1/2"	TH	1	Nø	167	TUBE UNION	1/2"	OD	1	Nø
						197	TUBING CAP	1/2"	OD	1	Nø

Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
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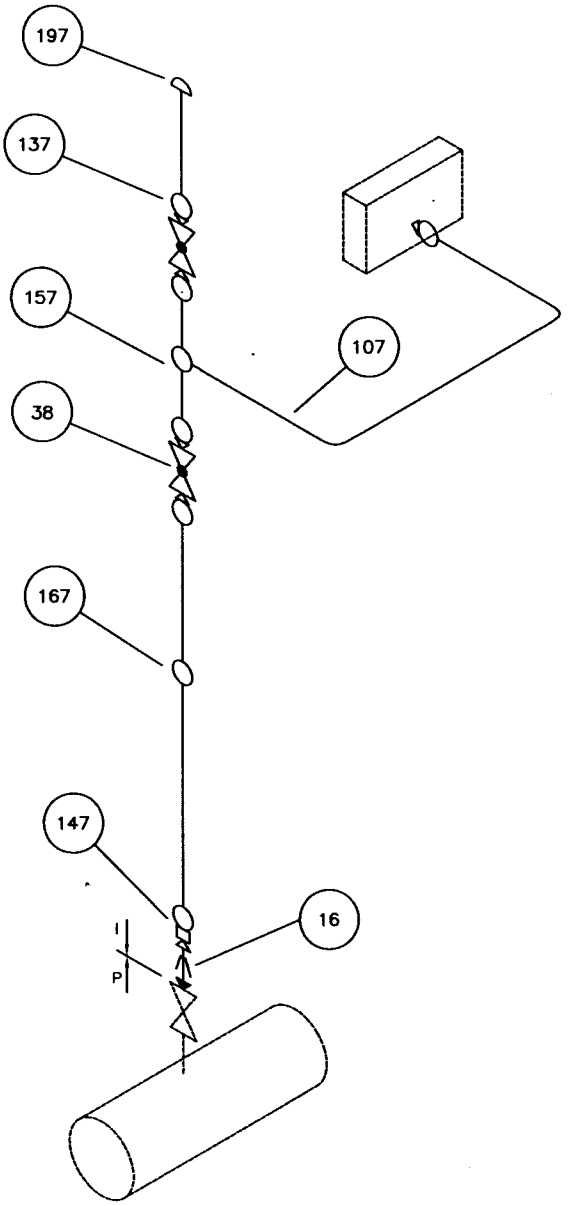
STANDARD NO. 7-52-0446 REV-5 RENUMBERED



LIST OF ITEMS

CODE	DESCRIPTION	SIZE	ENDS	QTY.	UNIT	CODE	DESCRIPTION	SIZE	ENDS	QTY.	UNIT
16	SWAGE NIPPLE	3/4" X 1/2"	PL X TH	1	Nø	107	TUBE	1/2"	OD	A/R	m
38	GLOBE VALVE	1/2"	TH	2	Nø	137	MALE CONNECTOR	1/2" X 1/2"	TH X OD	5	Nø
						147	FEMALE CONNECTOR	1/2" X 1/2"	TH X OD	1	Nø
						157	UNION TEE	1/2"	OD	1	Nø
						167	TUBE UNION	1/2"	OD	1	Nø
						197	TUBING CAP	1/2"	OD	1	Nø

Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
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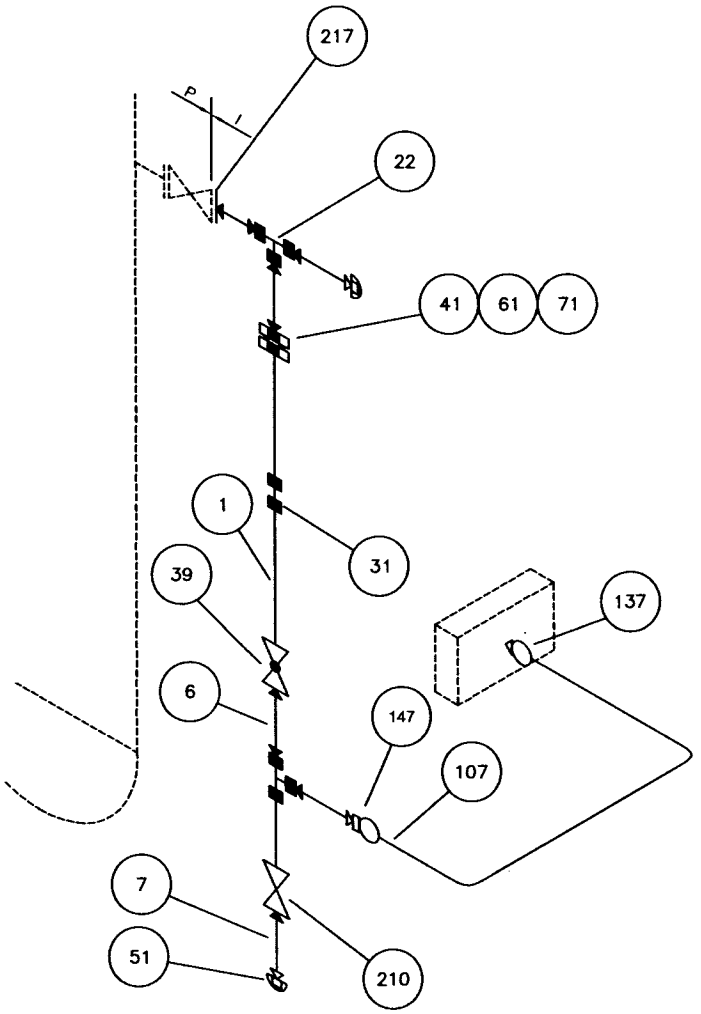
STANDARD NO. 7-52-0447 REV-3 RENUMBERED



P - BY PIPING
I - BY INSTRUMENTATION

* PL x PL NIPPLE SHALL BE FABRICATED FROM PIPE

LIST OF ITEMS

CODE	DESCRIPTION	SIZE	ENDS	QTY.	UNIT	CODE	DESCRIPTION	SIZE	ENDS	QTY.	UNIT
1	PIPE	1/2"	PL	A/R	m	107	TUBE	1/2"	OD	A/R	m
6	NIPPLE *	1/2"	PL X PL	3	Nø	137	MALE CONNECTOR	1/2" X 1/2"	TH X OD	1	Nø
7	NIPPLE	1/2"	TH X PL	3	Nø	147	FEMALE CONNECTOR	1/2" X 1/2"	TH X OD	1	Nø
22	EQUAL TEE	1/2"	SW	1	Nø						
31	COUPLING	1/2"	SW	1	Nø						
39	GLOBE VALVE	1/2"	SW	1	Nø						
41	FLANGE	1/2"	SW	2	Nø						
217	FLANGE	2" X 1/2"	FL X SW (Red)	1	Nø						
51	CAP	1/2"	TH	2	Nø						
61	GASKET	FOR 1/2" FLG.		1	Nø						
71	STUDS & NUTS	FOR 1/2" FLG.		1	Set						
210	GATE VALVE	1/2"	SW	1	Nø						

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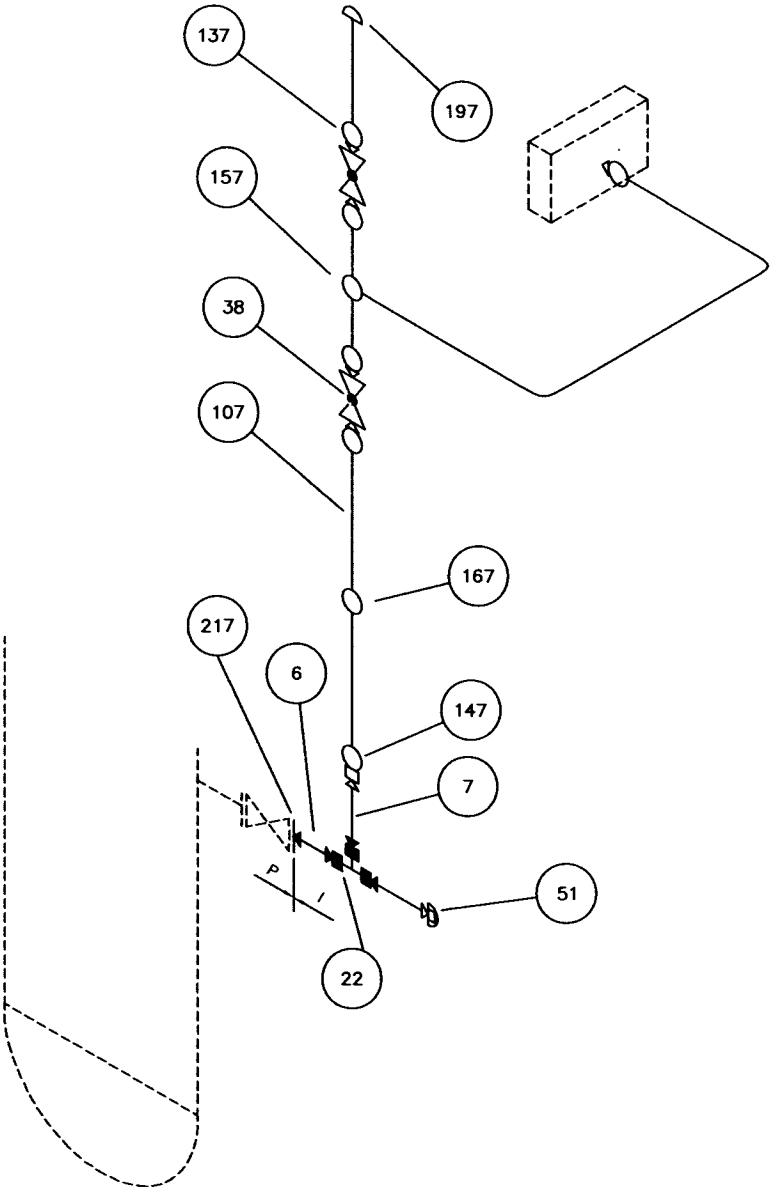
STANDARD NO. 7-52-0450 REV-3 RENUMBERED



P - BY PIPING
I - BY INSTRUMENTATION

* PL x PL NIPPLE SHALL BE FABRICATED FROM PIPE

LIST OF ITEMS

CODE	DESCRIPTION	SIZE	ENDS	QTY.	UNIT	CODE	DESCRIPTION	SIZE	ENDS	QTY.	UNIT
6	NIPPLE *	1/2"	PL X PL	1	Nø	107	TUBE	1/2"	OD	A/R	m
7	NIPPLE	1/2"	TH X PL	2	Nø	137	MALE CONNECTOR	1/2" X 1/2"	TH X OD	5	Nø
22	EQUAL TEE	1/2"	SW	1	Nø	147	FEMALE CONNECTOR	1/2" X 1/2"	TH X OD	1	Nø
38	GLOBE VALVE	1/2"	TH	2	Nø	157	UNION TEE	1/2"	OD	1	Nø
217	FLANGE	2"x1/2"	FL X SW (Red)	1	Nø	167	TUBE UNION	1/2"	OD	1	Nø
51	CAP	1/2"	TH	1	Nø	197	TUBING CAP	1/2"	OD	1	Nø

Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
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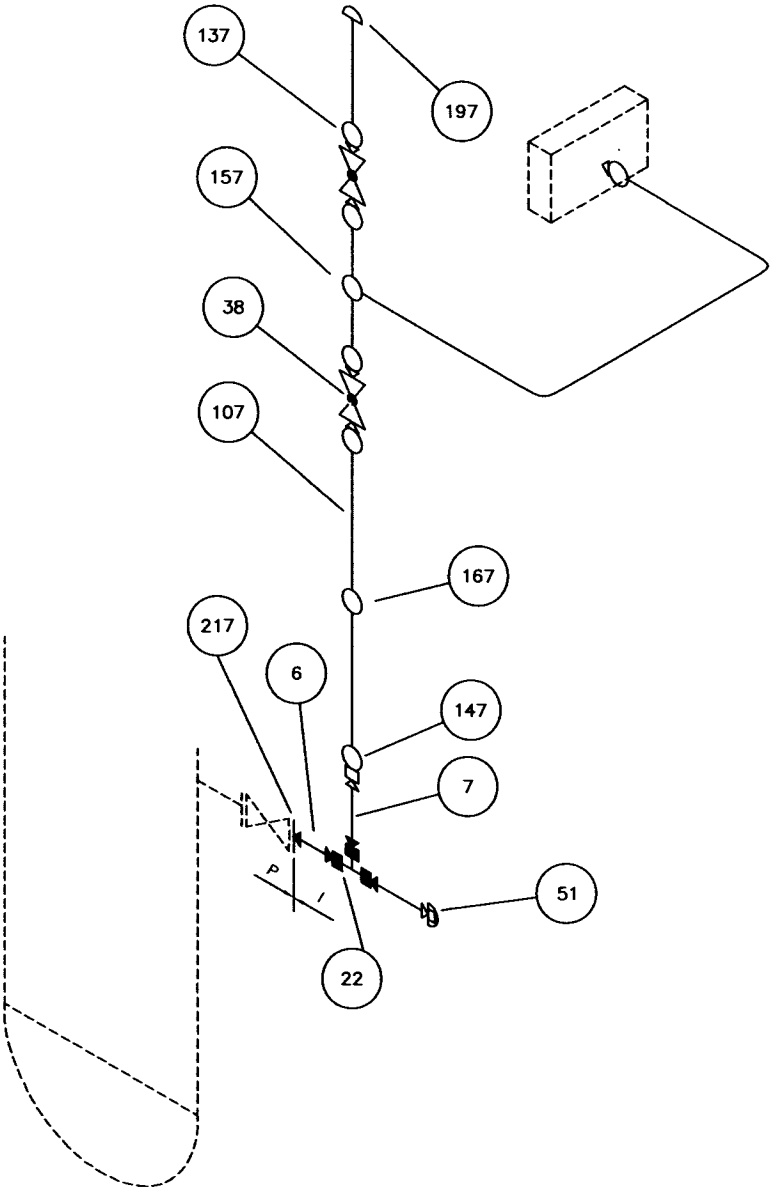
STANDARD NO. 7-52-0450 REV-3 RENUMBERED



P - BY PIPING
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* PL x PL NIPPLE SHALL BE FABRICATED FROM PIPE

LIST OF ITEMS

CODE	DESCRIPTION	SIZE	ENDS	QTY.	UNIT	CODE	DESCRIPTION	SIZE	ENDS	QTY.	UNIT
6	NIPPLE *	1/2"	PL X PL	1	Nø	107	TUBE	1/2"	OD	A/R	m
7	NIPPLE	1/2"	TH X PL	2	Nø	137	MALE CONNECTOR	1/2" X 1/2"	TH X OD	5	Nø
22	EQUAL TEE	1/2"	SW	1	Nø	147	FEMALE CONNECTOR	1/2" X 1/2"	TH X OD	1	Nø
38	GLOBE VALVE	1/2"	TH	2	Nø	157	UNION TEE	1/2"	OD	1	Nø
217	FLANGE	2"x1/2"	FL X SW (Red)	1	Nø	167	TUBE UNION	1/2"	OD	1	Nø
51	CAP	1/2"	TH	1	Nø	197	TUBING CAP	1/2"	OD	1	Nø

Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
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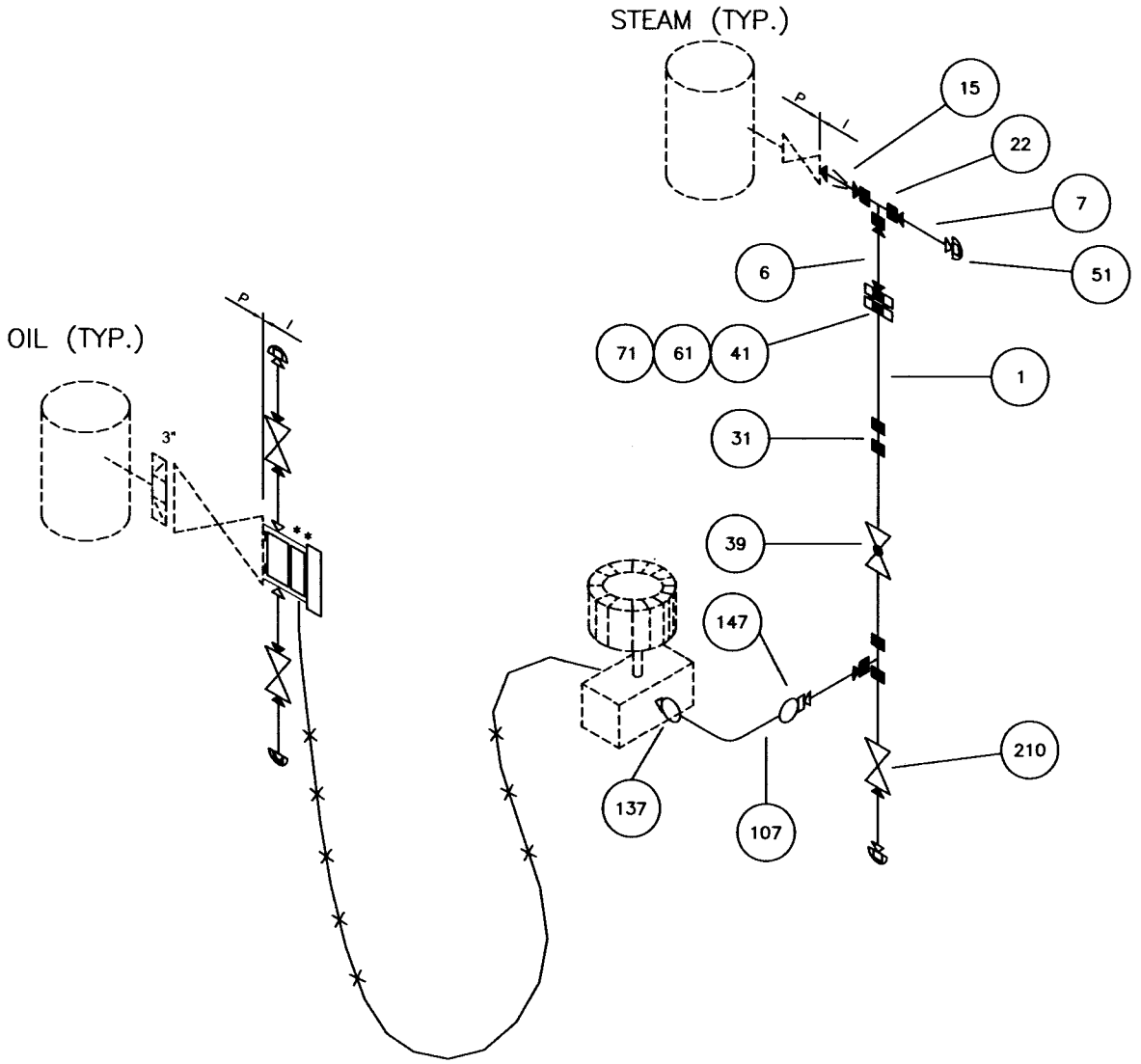
STANDARD NO. 7-52-0454 REV-5 RENUMBERED



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** DRIP RING WITH BLIND FLANGE (3"), GASKET, STUDS & NUTS (EXTRA LONG) BY VENDOR

* PL x PL NIPPLE SHALL BE FABRICATED FROM PIPE

LIST OF ITEMS

CODE	DESCRIPTION	SIZE	ENDS	QTY.	UNIT	CODE	DESCRIPTION	SIZE	ENDS	QTY.	UNIT
1	PIPE	1/2"	PL	A/R	m	107	TUBE	1/2"	OD	A/R	m
6	NIPPLE *	1/2"	PL X PL	1	Nø	137	MALE CONNECTOR	1/2" X 1/2"	TH X OD	1	Nø
7	NIPPLE	1/2"	TH X PL	7	Nø	147	FEMALE CONNECTOR	1/2" X 1/2"	TH X OD	1	Nø
15	SWAGE NIPPLE	3/4" X 1/2"	PL X PL	1							
22	EQUAL TEE	1/2"	SW	2	Nø						
31	COUPLING	1/2"	SW	1	Nø						
39	GLOBE VALVE	1/2"	SW	1	Nø						
41	FLANGE	1/2"	SW	2	Nø						
51	CAP	1/2"	TH	4	Nø						
61	GASKET	FOR 1/2" FL		1	Nø						
71	STUDS & NUTS	FOR 1/2" FL		1	Set						
210	GATE VALVE	1/2"	SW	3	Nø						

Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
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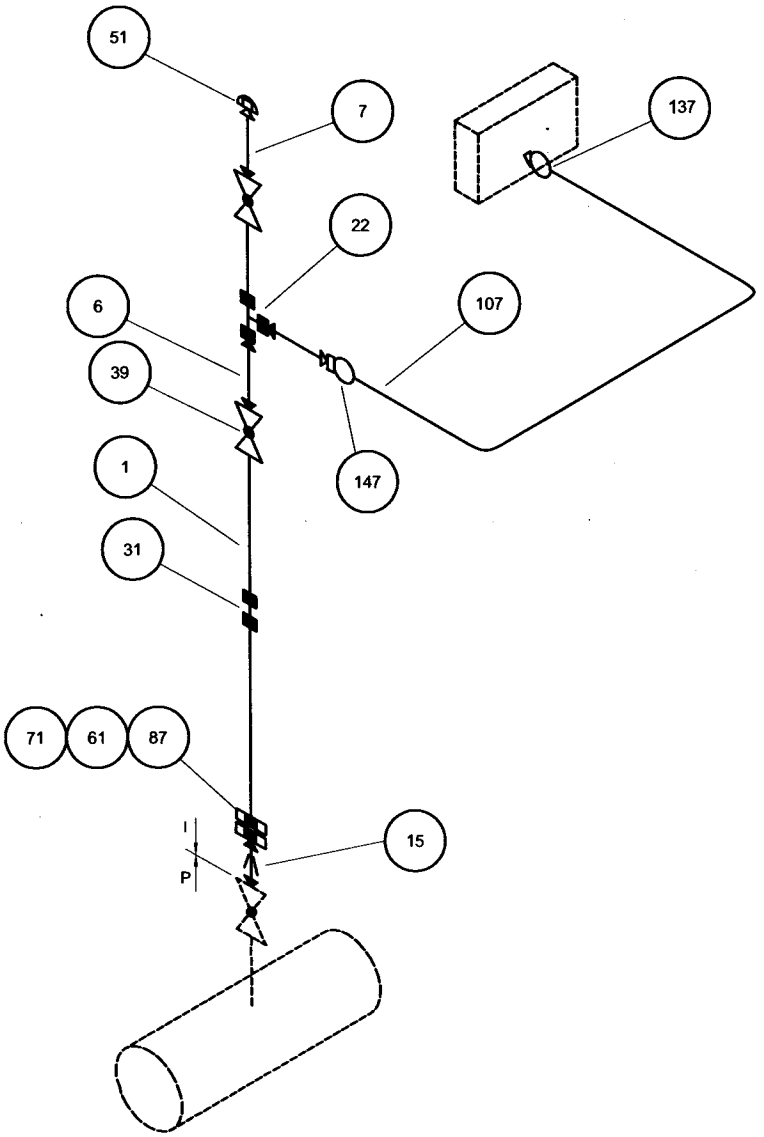

P - BY PIPING
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* PL x PL NIPPLE SHALL BE FABRICATED FROM PIPE

LIST OF ITEMS

CODE	DESCRIPTION	SIZE	ENDS	QTY.	UNIT	CODE	DESCRIPTION	SIZE	ENDS	QTY.	UNIT
1	PIPE	1/2"	PL	A/R	m	107	TUBE	1/2"	OD	A/R	m
6	NIPPLE *	1/2"	PL X PL	1	Nø	137	MALE CONNECTOR	1/2" X 1/2"	TH X OD	1	Nø
7	NIPPLE	1/2"	TH X PL	2	Nø	147	FEMALE CONNECTOR	1/2" X 1/2"	TH X OD	1	Nø
15	SWAGE NIPPLE	3/4" X 1/2"	PL X PL	1	Nø						
22	EQUAL TEE	1/2"	SW	1	Nø						
31	COUPLING	1/2"	SW	1	Nø						
39	GLOBE VALVE	1/2"	SW	2	Nø						
51	CAP	1/2"	TH	1	Nø						
61	GASKET	FOR 1/2" FLG.		1	Nø						
71	STUDS & NUTS	FOR 1/2" FLG.		1	Set						
87	FLANGE	1/2"	WN	2	Nø						

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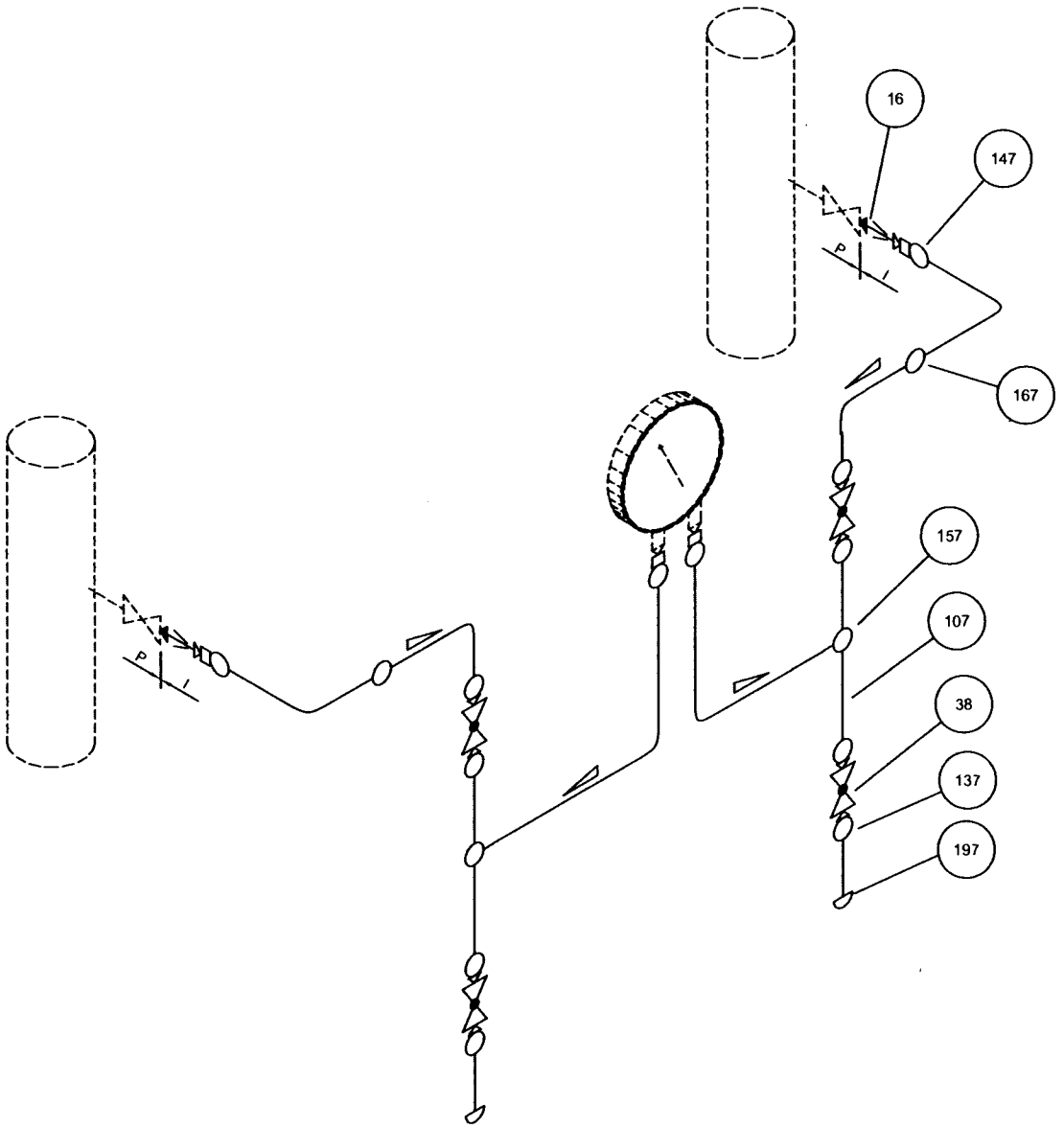
STANDARD NO. 7-52-0572 REV-3 RENUMBERED



LIST OF ITEMS

CODE	DESCRIPTION	SIZE	ENDS	QTY.	UNIT	CODE	DESCRIPTION	SIZE	ENDS	QTY.	UNIT
16	SWAGE NIPPLE	3/4" X 1/2"	PL X TH	2	Nø	107	TUBE	1/2"	OD	A/R	m
38	GLOBE VALVE	1/2"	TH	4	Nø	137	MALE CONNECTOR	1/2" X 1/2"	TH X OD	8	Nø
						147	FEMALE CONNECTOR	1/2" X 1/2"	TH X OD	4	Nø
						157	UNION TEE	1/2"	OD	2	Nø
						167	TUBE UNION	1/2"	OD	2	Nø
						197	TUBING CAP	1/2"	OD	2	Nø

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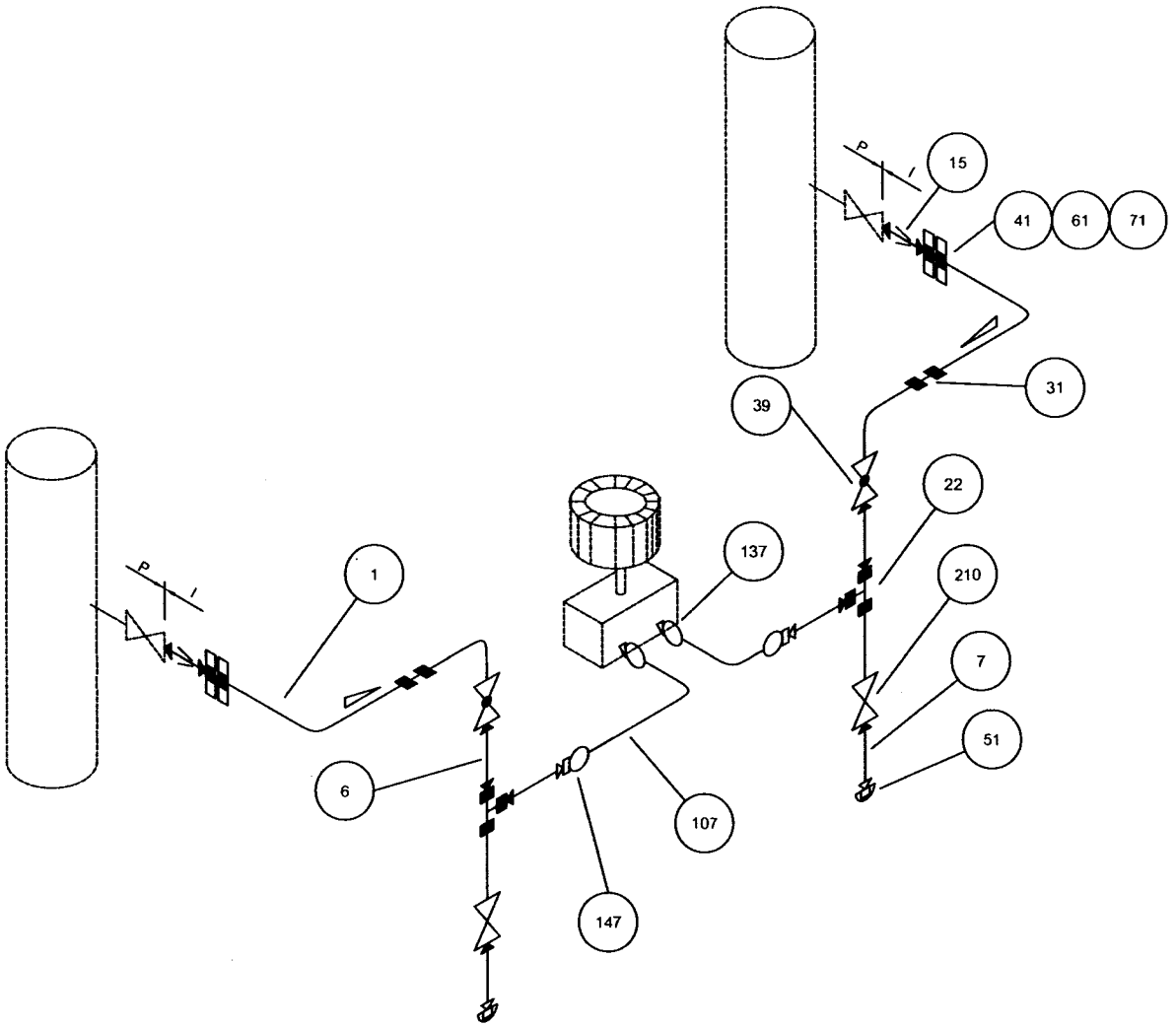
STANDARD NO. 7-52-0452 REV-5 RENUMBERED



P - BY PIPING
I - BY INSTRUMENTATION

* PL x PL NIPPLE SHALL BE FABRICATED FROM PIPE

LIST OF ITEMS

CODE	DESCRIPTION	SIZE	ENDS	QTY.	UNIT	CODE	DESCRIPTION	SIZE	ENDS	QTY.	UNIT
1	PIPE	1/2"	PL	A/R	m	107	TUBE	1/2"	OD	A/R	m
6	NIPPLE *	1/2"	PL X PL	2	Nø	137	MALE CONNECTOR	1/2" X 1/2"	TH X OD	2	Nø
7	NIPPLE	1/2"	TH X PL	4	Nø	147	FEMALE CONNECTOR	1/2" X 1/2"	TH X OD	2	Nø
15	SWAGE NIPPLE	3/4" X 1/2"	PL X PL	2	Nø						
22	EQUAL TEE	1/2"	SW	2	Nø						
31	COUPLING	1/2"	SW	2	Nø						
39	GLOBE VALVE	1/2"	SW	2	Nø						
41	FLANGE	1/2"	SW	4	Nø						
51	CAP	1/2"	TH	2	Nø						
61	GASKET	FOR 1/2" FLG.		2	Nø						
71	STUDS & NUTS	FOR 1/2" FLG		2	Set						
210	GATE VALVE	1/2"	SW	2	Nø						

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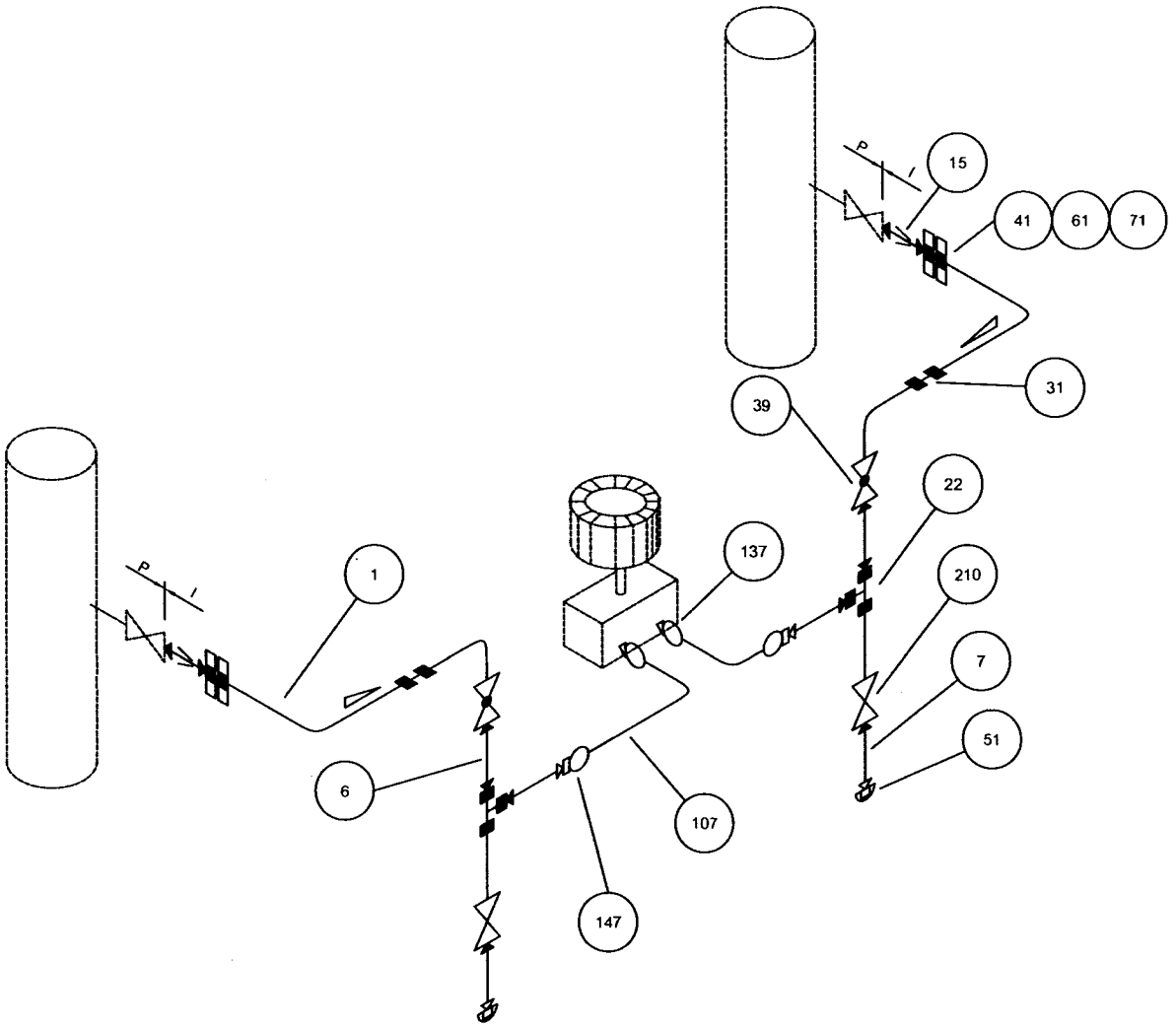
STANDARD NO. 7-52-0452 REV-5 RENUMBERED



P - BY PIPING
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* PL x PL NIPPLE SHALL BE FABRICATED FROM PIPE

LIST OF ITEMS

CODE	DESCRIPTION	SIZE	ENDS	QTY.	UNIT	CODE	DESCRIPTION	SIZE	ENDS	QTY.	UNIT
1	PIPE	1/2"	PL	A/R	m	107	TUBE	1/2"	OD	A/R	m
6	NIPPLE *	1/2"	PL X PL	2	Nø	137	MALE CONNECTOR	1/2" X 1/2"	TH X OD	2	Nø
7	NIPPLE	1/2"	TH X PL	4	Nø	147	FEMALE CONNECTOR	1/2" X 1/2"	TH X OD	2	Nø
15	SWAGE NIPPLE	3/4" X 1/2"	PL X PL	2	Nø						
22	EQUAL TEE	1/2"	SW	2	Nø						
31	COUPLING	1/2"	SW	2	Nø						
39	GLOBE VALVE	1/2"	SW	2	Nø						
41	FLANGE	1/2"	SW	4	Nø						
51	CAP	1/2"	TH	2	Nø						
61	GASKET	FOR 1/2" FLG.		2	Nø						
71	STUDS & NUTS	FOR 1/2" FLG		2	Set						
210	GATE VALVE	1/2"	SW	2	Nø						

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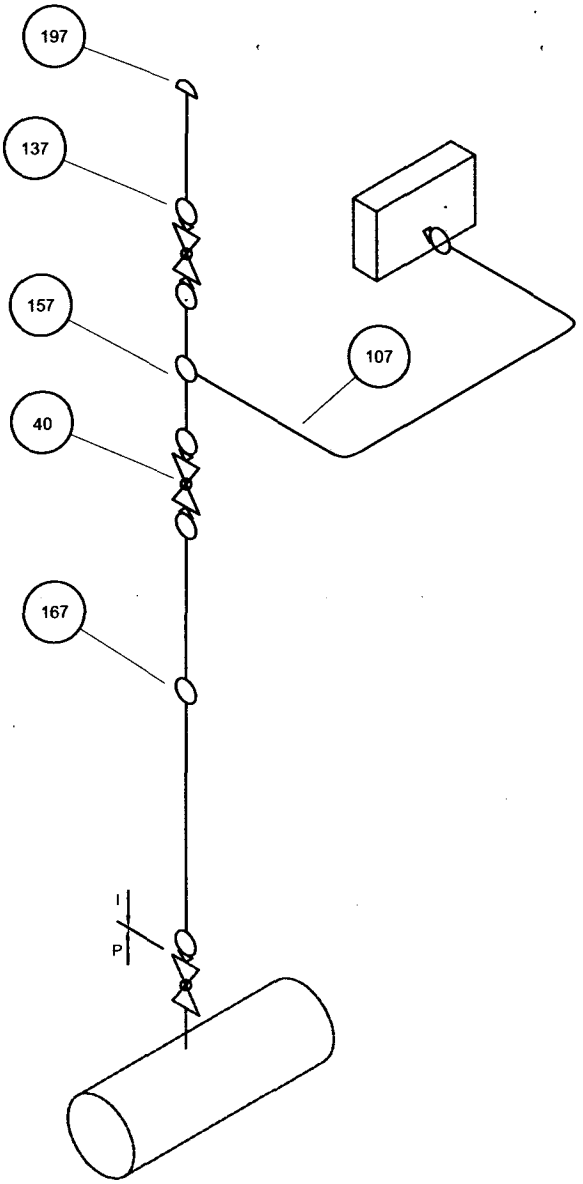

P - BY PIPING
I - BY INSTRUMENTATION

LIST OF ITEMS

CODE	DESCRIPTION	SIZE	ENDS	QTY.	UNIT	CODE	DESCRIPTION	SIZE	ENDS	QTY.	UNIT
40	BALL VALVE	1/2"	TH	2	Nø	107	TUBE	1/2"	OD	A/R	m
						137	MALE CONNECTOR	1/2" X 1/2"	TH X OD	6	Nø
						157	UNION TEE	1/2"	OD	1	Nø
						167	TUBE UNION	1/2"	OD	1	Nø
						197	TUBING CAP	1/2"	OD	1	Nø

Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
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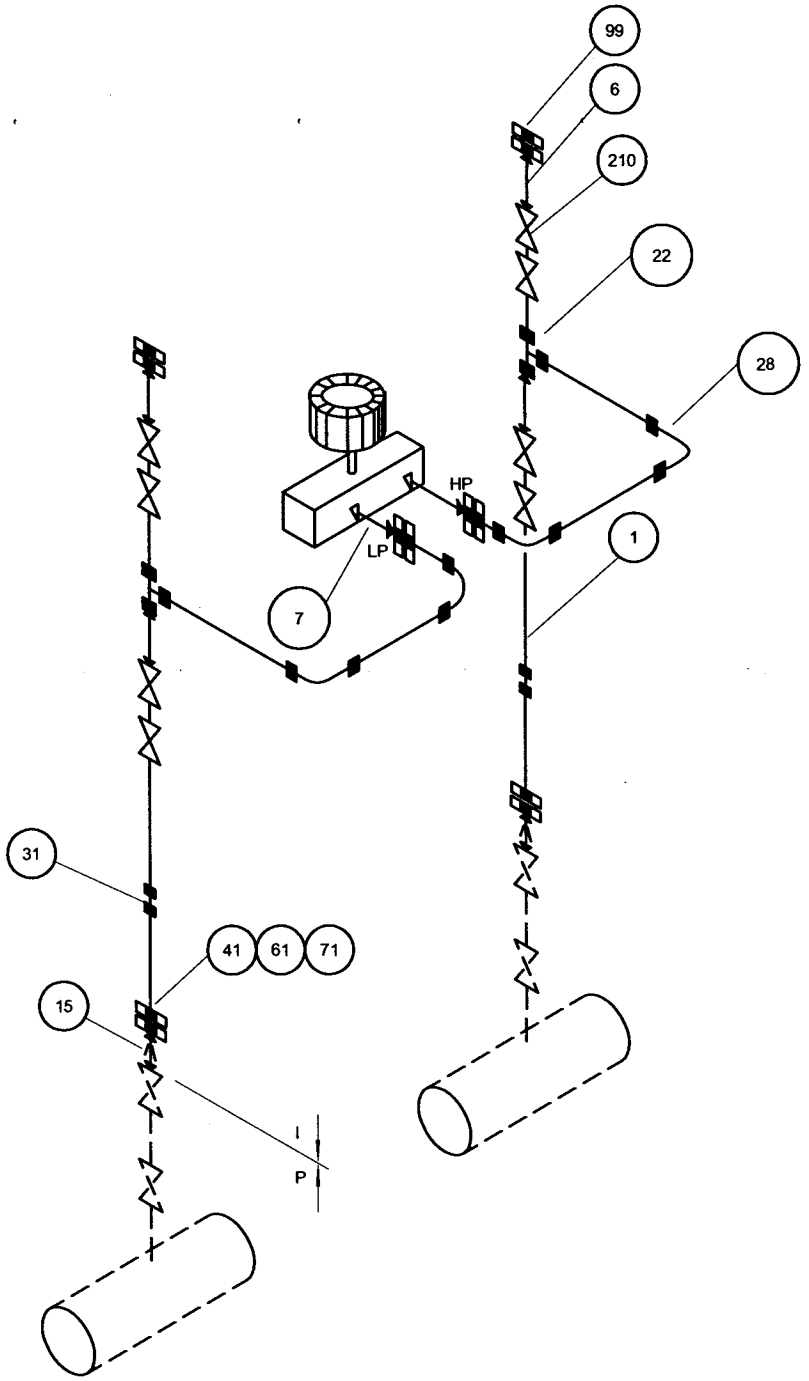

P - BY PIPING
I - BY INSTRUMENTATION

* PL x PL NIPPLE SHALL BE FABRICATED FROM PIPE

LIST OF ITEMS

CODE	DESCRIPTION	SIZE	ENDS	QTY.	UNIT	CODE	DESCRIPTION	SIZE	ENDS	QTY.	UNIT
1	PIPE	1/2"	PL	A/R	m						
6	NIPPLE *	1/2"	PL X PL	4	Nø						
7	NIPPLE	1/2"	TH X PL	2	Nø						
15	SWAGE NIPPLE	3/4" X 1/2"	PL X PL	2	Nø						
22	EQUAL TEE	1/2"	SW	2	Nø						
28	ELBOW	1/2"	SW	4	Nø						
31	COUPLING	1/2"	SW	2	Nø						
41	FLANGE	1/2"	SW	10	Nø						
61	GASKET	FOR 1/2" FLG		6	Nø						
71	STUDS & NUTS	FOR 1/2" FLG		6	Set						
99	BLIND FLANGE	1/2"		2	Nø						
210	GATE VALVE	1/2"	SW	8	Nø						

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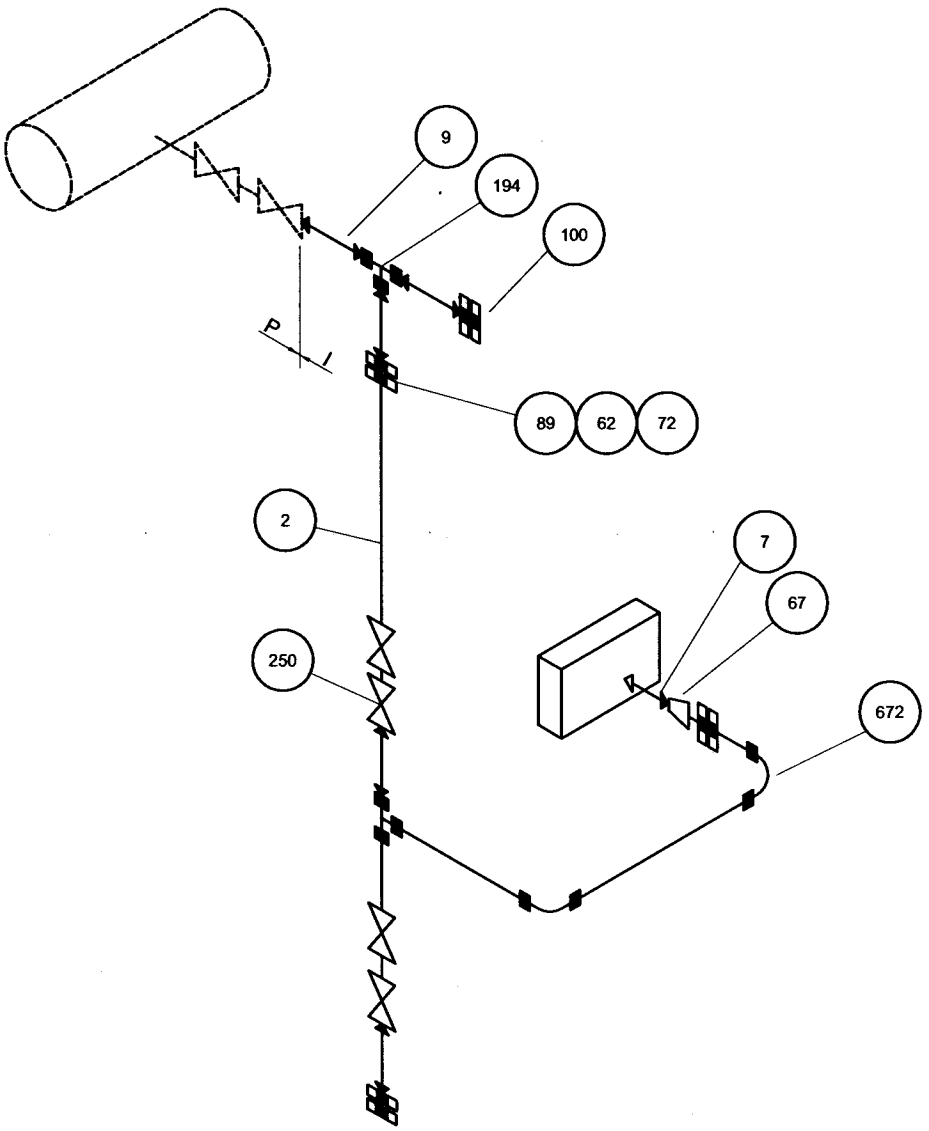

P - BY PIPING
I - BY INSTRUMENTATION

* PL x PL NIPPLE SHALL BE FABRICATED FROM PIPE

LIST OF ITEMS

CODE	DESCRIPTION	SIZE	ENDS	QTY.	UNIT	CODE	DESCRIPTION	SIZE	ENDS	QTY.	UNIT
2	PIPE	3/4"	PL	A/R	m						
7	NIPPLE	1/2"	TH X PL	1	Nø						
9	NIPPLE *	3/4"	PL X PL	5	Nø						
62	GASKET	FOR 3/4" FL		4	Nø						
67	REDUCER	3/4" x 1/2"	BW	1	Nø						
72	STUDS & NUTS	FOR 3/4" FL		4	Set						
89	FLANGE	3/4"	WN	6	Nø						
100	BLIND FLANGE	3/4"		2	Nø						
194	EQUAL TEE	3/4"	BW	2	Nø						
250	GATE VALVE	3/4"	BW	4	Nø						
672	ELBOW	3/4"	BW	2	Nø						

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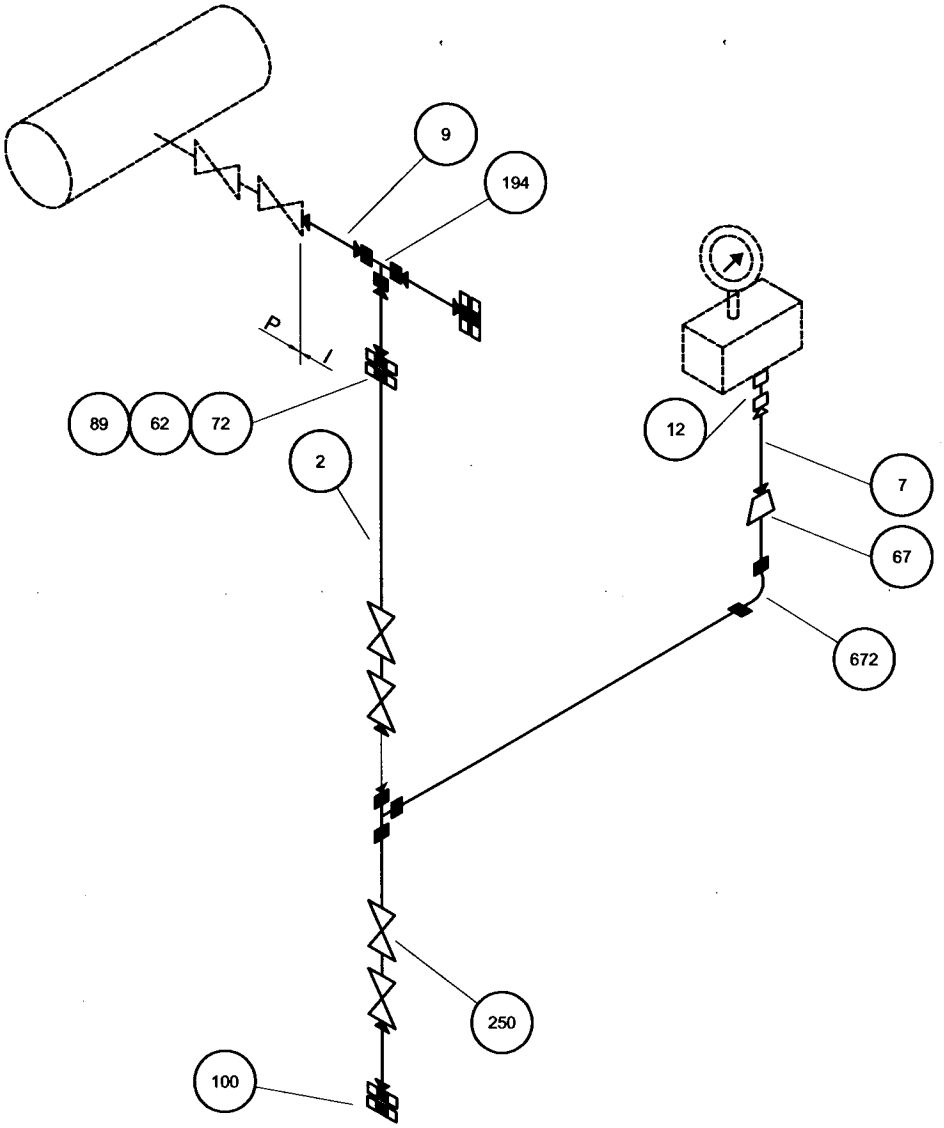

P - BY PIPING
I - BY INSTRUMENTATION

* PL x PL NIPPLE SHALL BE FABRICATED FROM PIPE

LIST OF ITEMS

CODE	DESCRIPTION	SIZE	ENDS	QTY.	UNIT	CODE	DESCRIPTION	SIZE	ENDS	QTY.	UNIT
2	PIPE	3/4"	PL	A/R	m						
7	NIPPLE	1/2"	PL X TH	1	Nø						
9	NIPPLE *	3/4"	PL X PL	5	Nø						
12	COUPLING	1/2"	TH	1	Nø						
62	GASKET	FOR 3/4" FL		3	Nø						
67	REDUCER	3/4" x 1/2"	BW	1	Nø						
72	STUDS & NUTS	FOR 3/4" FL		3	Set						
89	FLANGE	3/4"	WN	4	Nø						
100	BLIND FLANGE	3/4"		2	Nø						
194	EQUAL TEE	3/4"	BW	2	Nø						
250	GATE VALVE	3/4"	BW	4	Nø						
672	ELBOW	3/4"	BW	1	Nø						

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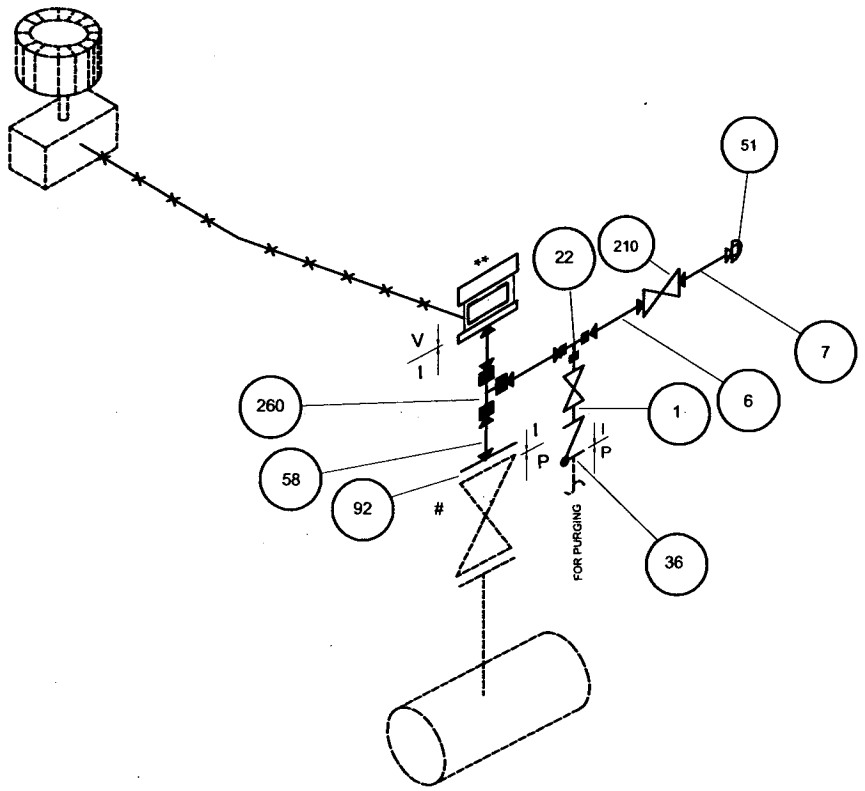

** SPACER RING WITH COMPANION FLANGE, GASKET, STUDS & NUTS (EXTRA LONG) BY VENDOR.
PRESSURE INST. TYPE WITH OR WITHOUT CAPILLARY SHALL BE AS PER INST. DATA SHEET.

V - BY VENDOR
P - BY PIPING
I - BY INSTRUMENTATION

STUD NUTS & GASKET BY PIPING
* PL x PL NIPPLE SHALL BE FABRICATED FROM PIPE

LIST OF ITEMS

CODE	DESCRIPTION	SIZE	ENDS	QTY.	UNIT	CODE	DESCRIPTION	SIZE	ENDS	QTY.	UNIT
1	PIPE	1/2"	PL	A/R	M						
6	NIPPLE *	1/2"	PL X PL	2	Nø						
7	NIPPLE	1/2"	TH X PL	1	Nø						
22	EQUAL TEE	1/2"	SW	1	Nø						
36	CHECK VALVE	1/2"	SW	1	Nø						
51	CAP	1/2"	TH	1	Nø						
58	NIPPLE	1-1/2"	PL X PL	2	Nø						
92	FLANGE	1-1/2"	SW	2	Nø						
210	GATE VALVE	1/2"	SW	2	Nø						
260	REDUCER TEE	1-1/2 x 1-1/2" x 1/2"	SW	1	Nø						

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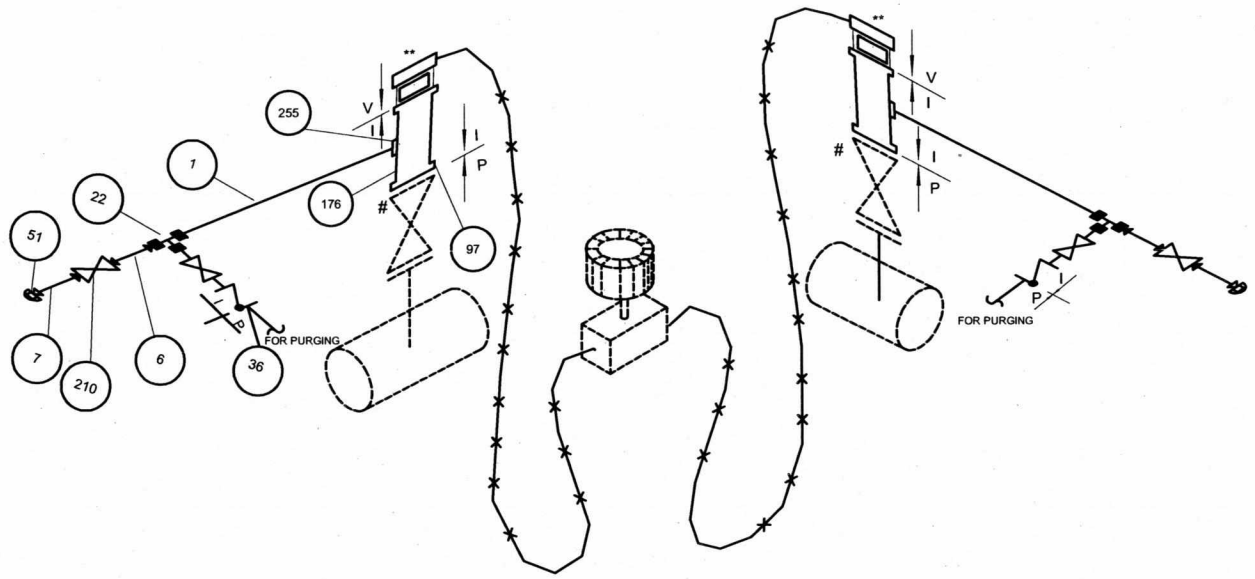

** GASKET, STUDS & NUTS (EXTRA LONG) BY VENDOR.

V - BY INSTR. VENDOR

P - BY PIPING
I - BY INSTRUMENTATION

STUD NUTS & GASKET BY PIPING
* PL x PL NIPPLE SHALL BE FABRICATED FROM PIPE

LIST OF ITEMS

CODE	DESCRIPTION	SIZE	ENDS	QTY.	UNIT	CODE	DESCRIPTION	SIZE	ENDS	QTY.	UNIT
1	PIPE	1/2"	PL	A/R	m						
6	NIPPLE *	1/2"	PLXPL	2	Nø						
7	NIPPLE	1/2"	PLXTH	2	Nø						
22	EQUAL TEE	1/2"	SW	2	Nø						
36	CHECK VALVE	1/2"	SW	2	Nø						
51	CAP	1/2"	TH	2	Nø						
97	FLANGE	3"	WN	4	Nø						
176	PIPE	3"	PL	A/R	m						
210	GATE VALVE	1/2"	SW	4	Nø						
255	HALF COUPLING	1/2"		2	Nø						

Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
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1	18.11.2022	Revised & Reissued	Manoj	GG/AR	MN	SM
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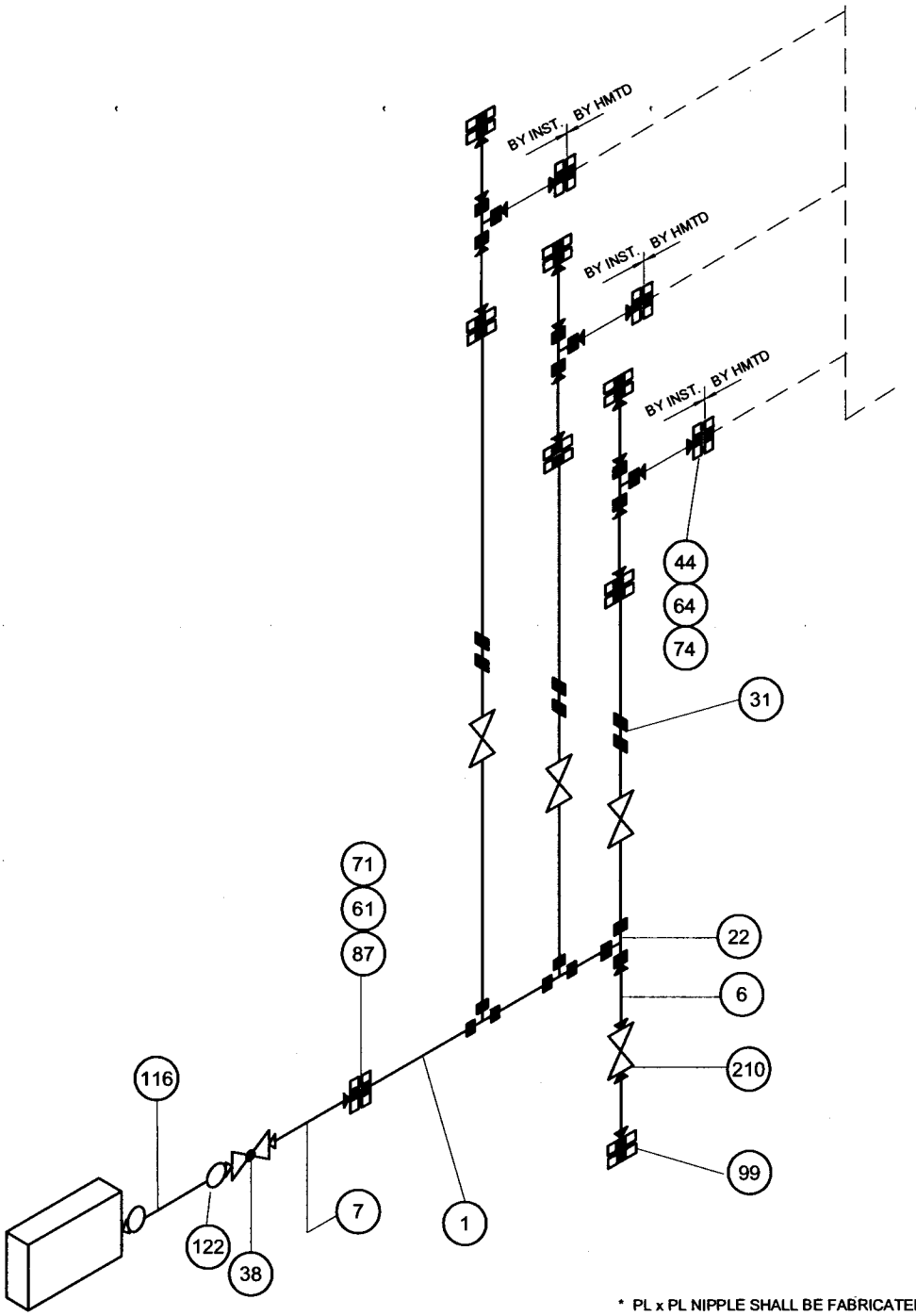

I - BY INSTRUMENTATION

* PL x PL NIPPLE SHALL BE FABRICATED FROM PIPE

LIST OF ITEMS

CODE	DESCRIPTION	SIZE	ENDS	QTY.	UNIT	CODE	DESCRIPTION	SIZE	ENDS	QTY.	UNIT
1	PIPE	1/2"	PL	A/R	m	116	TUBE	12mm	OD	A/R	m
6	NIPPLE *	1/2"	PL X PL	11	Nø	122	MALE CONNECTOR	1/2" X 12mm	TH X OD	2	Nø
7	NIPPLE	1/2"	TH X PL	1	Nø						
22	EQUAL TEE	1/2"	SW	6	Nø						
31	COUPLING	1/2"	SW	3	Nø						
38	GLOBE VALVE	1/2"	TH	1	Nø						
44	FLANGE	1 1/2" X 1/2" FL	FL X SW (Red)	3	Nø						
61	GASKET	FOR 1/2" FL		8	Nø						
64	GASKET	FOR 1 1/2" FL		3	Nø	99	BLIND FLANGE	1/2"		4	Nø
71	STUDS & NUTS	FOR 1/2" FL		8	Set	210	GATE VALVE	1/2"	SW	4	Nø
74	STUDS & NUTS	FOR 1 1/2" FL		3	Set						
87	FLANGE	1/2"	WN	12	Nø						

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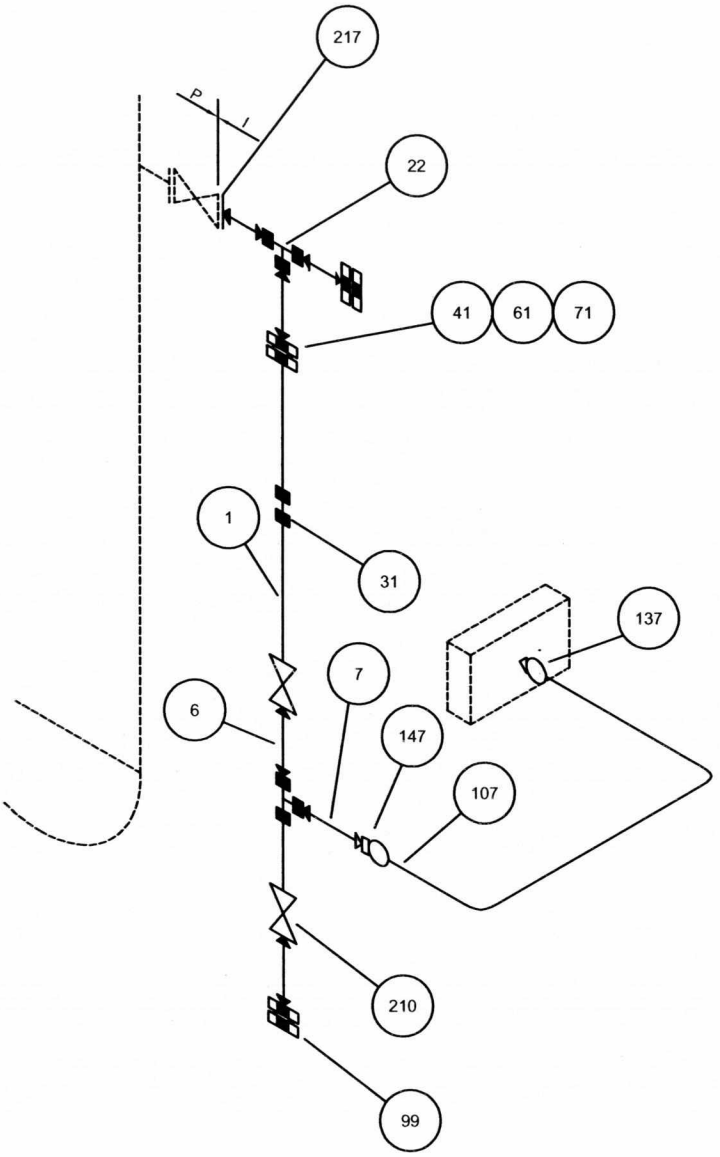

P - BY PIPING
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* PL x PL NIPPLE SHALL BE FABRICATED FROM PIPE

LIST OF ITEMS

CODE	DESCRIPTION	SIZE	ENDS	QTY.	UNIT	CODE	DESCRIPTION	SIZE	ENDS	QTY.	UNIT
1	PIPE	1/2"	PL	A/R	m	107	TUBE	1/2"	OD	A/R	m
6	NIPPLE *	1/2"	PL X PL	5	Nø	137	MALE CONNECTOR	1/2" X 1/2"	TH X OD	1	Nø
7	NIPPLE	1/2"	TH X PL	1	Nø	147	FEMALE CONNECTOR	1/2" X 1/2"	TH X OD	1	Nø
22	EQUAL TEE	1/2"	SW	2	Nø						
31	COUPLING	1/2"	SW	1	Nø						
41	FLANGE	1/2"	SW	4	Nø						
61	GASKET	FOR 1/2" FLG.		3	Nø						
71	STUDS & NUTS	FOR 1/2" FLG.		3	Set						
99	BLIND FLANGE	1/2"		2	Nø						
210	GATE VALVE	1/2"	SW	2	Nø						
217	FLANGE	2" X 1/2"	FL X SW (Red)	1	Nø						

Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
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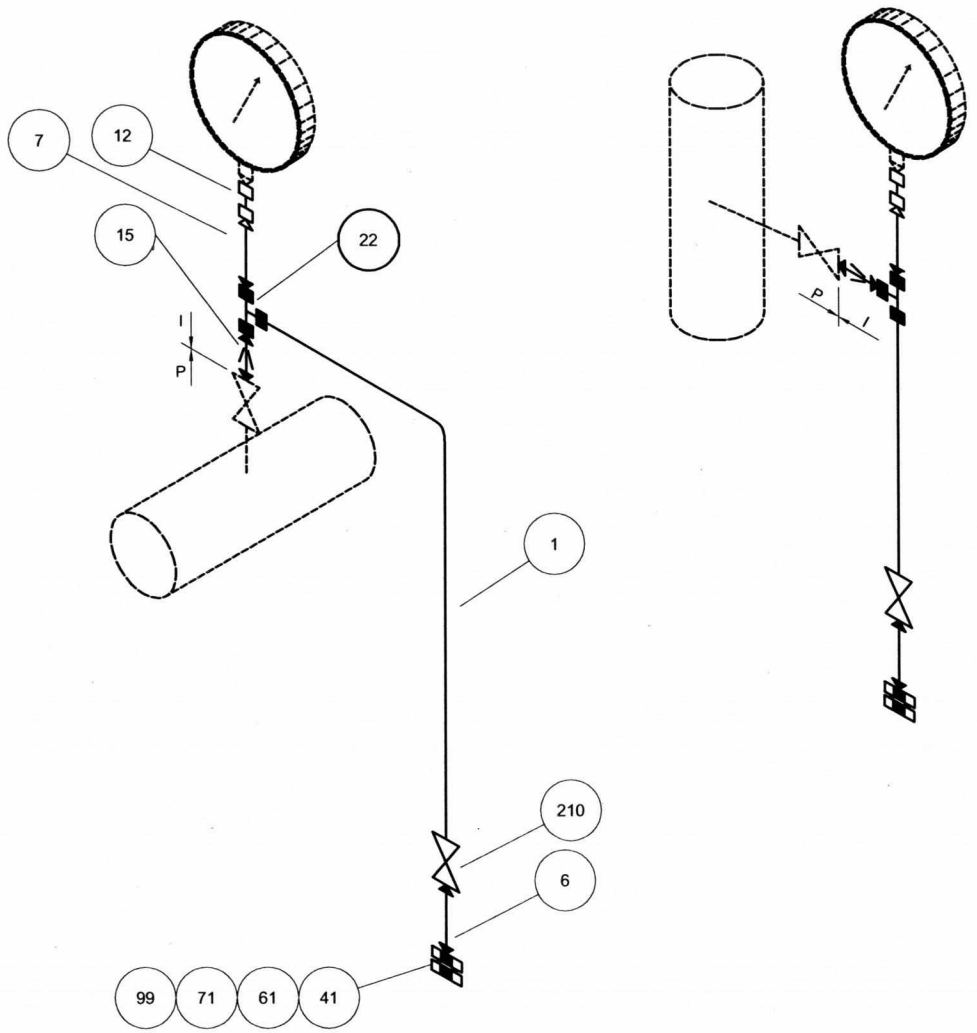

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LIST OF ITEMS

CODE	DESCRIPTION	SIZE	ENDS	QTY.	UNIT	CODE	DESCRIPTION	SIZE	ENDS	QTY.	UNIT
1	PIPE	1/2"	PL	A/R	m						
6	NIPPLE *	1/2"	PL X PL	1	Nø						
7	NIPPLE	1/2"	TH X PL	1	Nø						
12	COUPLING	1/2"	TH	1	Nø						
15	SWAGE NIPPLE	3/4" X 1/2"	PL X PL	1	Nø						
22	EQUAL TEE	1/2"	SW	1	Nø						
41	FLANGE	1/2"	SW	1	Nø						
61	GASKET	FOR 1/2" FLG.		1	Nø						
71	STUDS & NUTS	FOR 1/2" FLG.		1	Set						
99	BLIND FLANGE	1/2"		1	Nø						
210	GATE VALVE	1/2"	SW	1	Nø						

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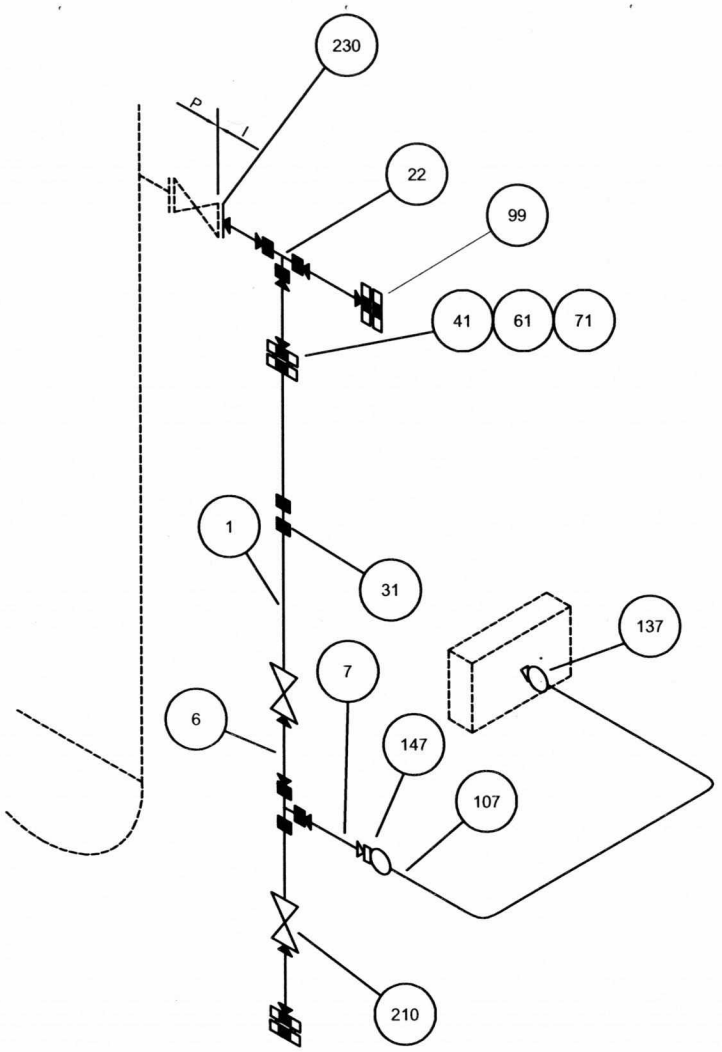

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LIST OF ITEMS

CODE	DESCRIPTION	SIZE	ENDS	QTY.	UNIT	CODE	DESCRIPTION	SIZE	ENDS	QTY.	UNIT
1	PIPE	1/2"	PL	A/R	m	107	TUBE	1/2"	OD	A/R	m
6	NIPPLE *	1/2"	PL X PL	5	Nø	137	MALE CONNECTOR	1/2" X 1/2"	TH X OD	1	Nø
7	NIPPLE	1/2"	TH X PL	1	Nø	147	FEMALE CONNECTOR	1/2" X 1/2"	TH X OD	1	Nø
22	EQUAL TEE	1/2"	SW	1	Nø						
31	COUPLING	1/2"	SW	1	Nø						
41	FLANGE	1/2"	SW	4	Nø						
61	GASKET	FOR 1/2" FLG.		3	Nø						
71	STUDS & NUTS	FOR 1/2" FLG.		3	Set						
99	BLIND FLANGE	1/2"		2	Nø						
210	GATE VALVE	1/2"	SW	2	Nø						
230	FLANGE	3" X 1/2"	FL X SW (Red)	1	Nø						

Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
0	01.07.2022	Issued As Standard	Manoj/AB	GG/AR	MN	SM

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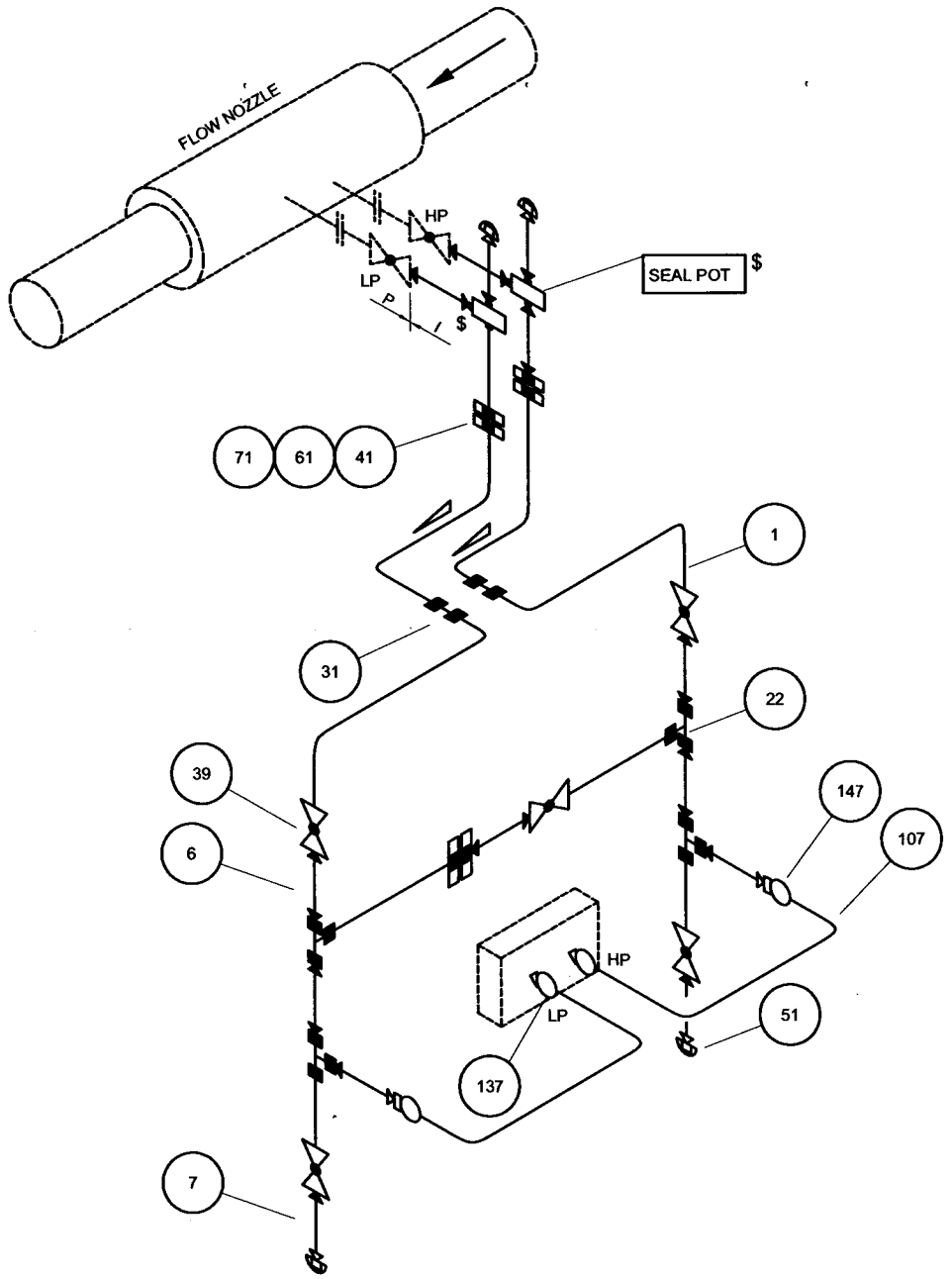

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$ SEAL POT SUPPLIED BY CONTRACTOR
SEAL POT MATERIAL AS PER PMS

* PL x PL NIPPLE SHALL BE FABRICATED FROM PIPE

LIST OF ITEMS

CODE	DESCRIPTION	SIZE	ENDS	QTY.	UNIT	CODE	DESCRIPTION	SIZE	ENDS	QTY.	UNIT
1	PIPE	1/2"	PL	A/R	m	107	TUBE	1/2"	OD	A/R	m
6	NIPPLE *	1/2"	PL X PL	7	Nø	137	MALE CONNECTOR	1/2" X 1/2"	TH X OD	2	Nø
7	NIPPLE	1/2"	TH X PL	6	Nø	147	FEMALE CONNECTOR	1/2" X 1/2"	TH X OD	2	Nø
22	EQUAL TEE	1/2"	SW	4	Nø						
31	COUPLING	1/2"	SW	2	Nø						
39	GLOBE VALVE	1/2"	SW	5	Nø						
41	FLANGE	1/2"	SW	6	Nø						
51	CAP	1/2"	TH	4	Nø						
61	GASKET	FOR 1/2" FLG.		3	Nø						
71	STUDS & NUTS	FOR 1/2" FLG.		3	Set						

Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
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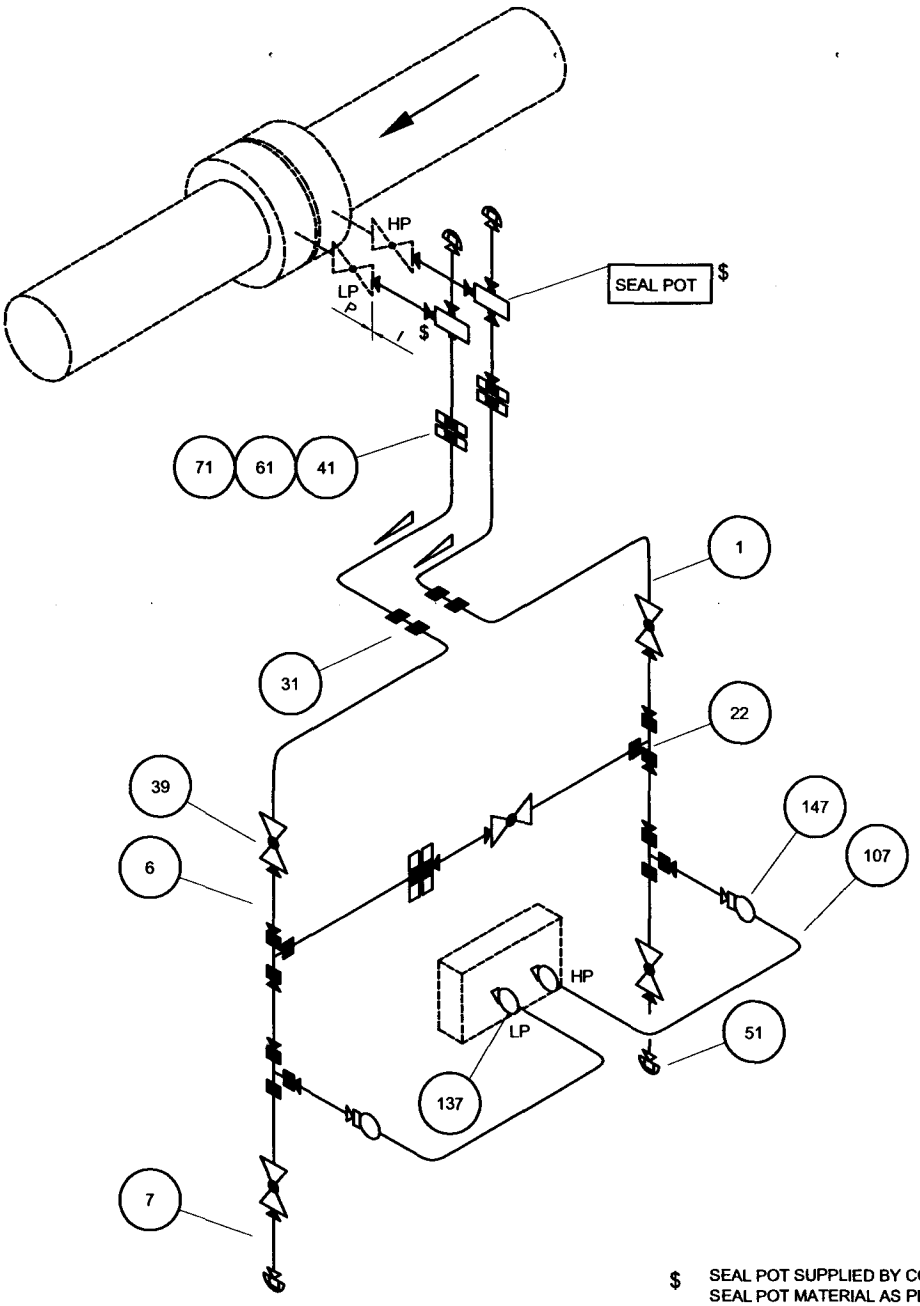

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$ SEAL POT SUPPLIED BY CONTRACTOR
SEAL POT MATERIAL AS PER PMS

* PL x PL NIPPLE SHALL BE FABRICATED FROM PIPE

LIST OF ITEMS

CODE	DESCRIPTION	SIZE	ENDS	QTY.	UNIT	CODE	DESCRIPTION	SIZE	ENDS	QTY.	UNIT
1	PIPE	1/2"	PL	A/R	m	107	TUBE	1/2"	OD	A/R	m
6	NIPPLE *	1/2"	PL X PL	8	Nø	137	MALE CONNECTOR	1/2" X 1/2"	TH X OD	2	Nø
7	NIPPLE	1/2"	TH X PL	6	Nø	147	FEMALE CONNECTOR	1/2" X 1/2"	TH X OD	2	Nø
22	EQUAL TEE	1/2"	SW	4	Nø						
31	COUPLING	1/2"	SW	2	Nø						
39	GLOBE VALVE	1/2"	SW	5	Nø						
41	FLANGE	1/2"	SW	6	Nø						
51	CAP	1/2"	TH	4	Nø						
61	GASKET	FOR 1/2" FLG.		3	Nø						
71	STUDS & NUTS	FOR 1/2" FLG.		3	Set						

Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
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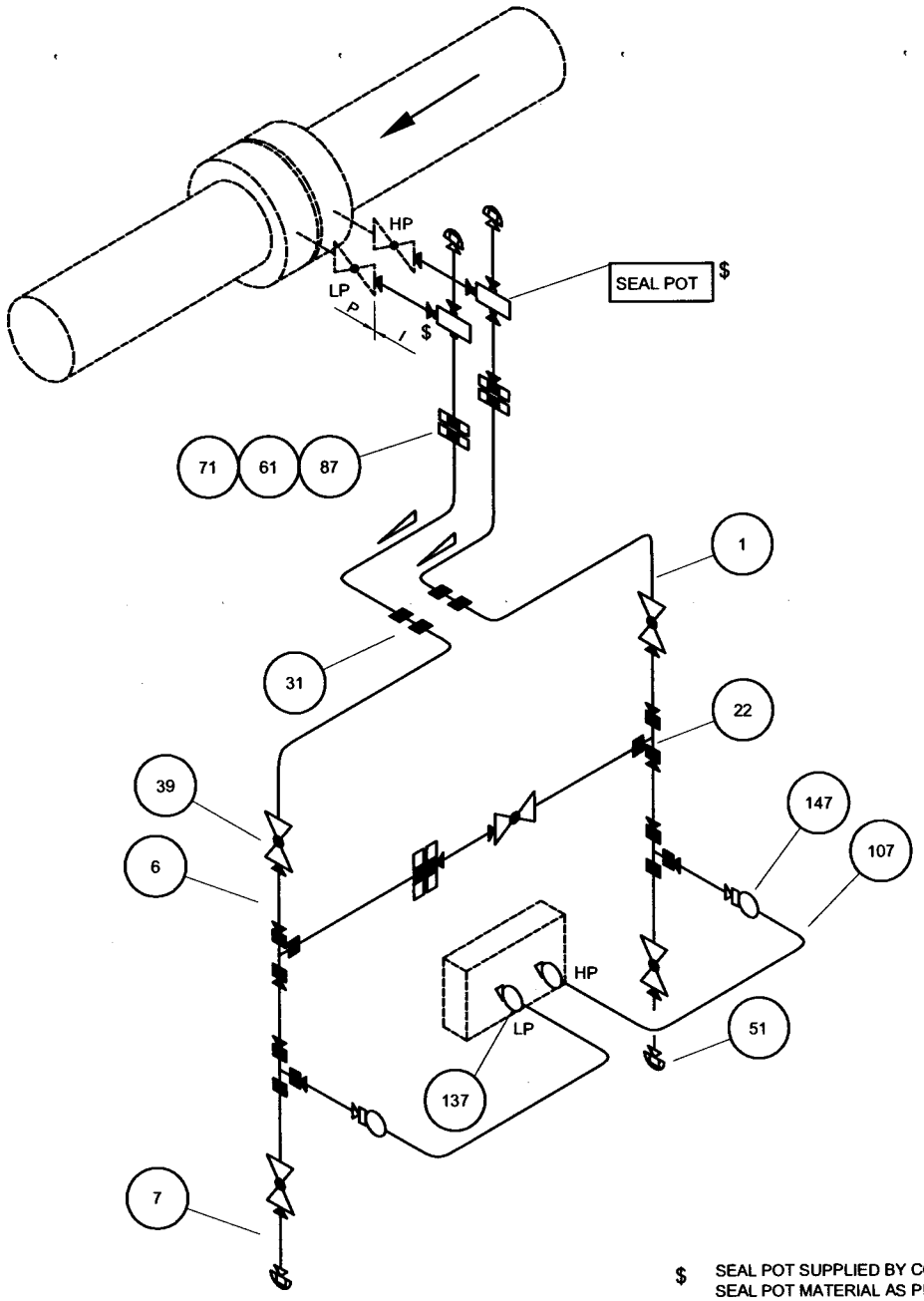

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$ SEAL POT SUPPLIED BY CONTRACTOR
SEAL POT MATERIAL AS PER PMS

* PL x PL NIPPLE SHALL BE FABRICATED FROM PIPE

LIST OF ITEMS

CODE	DESCRIPTION	SIZE	ENDS	QTY.	UNIT	CODE	DESCRIPTION	SIZE	ENDS	QTY.	UNIT
1	PIPE	1/2"	PL	A/R	m	107	TUBE	1/2"	OD	A/R	m
6	NIPPLE *	1/2"	PL X PL	8	Nø	137	MALE CONNECTOR	1/2" X 1/2"	TH X OD	2	Nø
7	NIPPLE	1/2"	TH X PL	6	Nø	147	FEMALE CONNECTOR	1/2" X 1/2"	TH X OD	2	Nø
22	EQUAL TEE	1/2"	SW	4	Nø						
31	COUPLING	1/2"	SW	2	Nø						
39	GLOBE VALVE	1/2"	SW	5	Nø						
51	CAP	1/2"	TH	4	Nø						
61	GASKET	FOR 1/2" FLG.		3	Nø						
71	STUDS & NUTS	FOR 1/2" FLG.		3	Set						
87	FLANGE	1/2"	WN	6	Nø						

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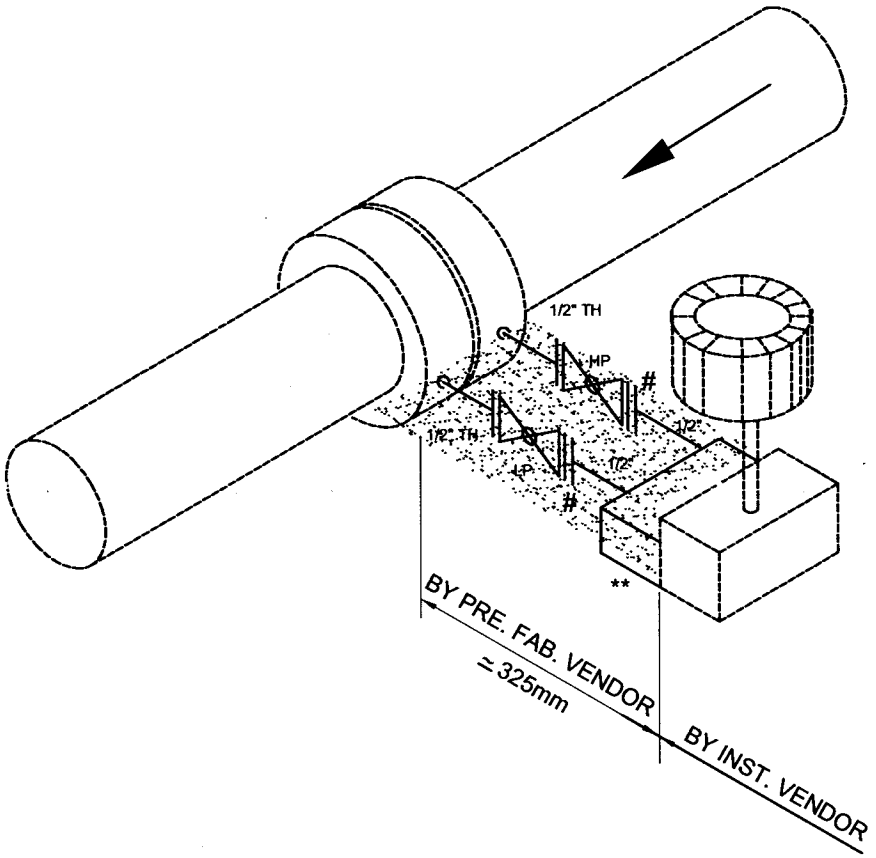

ONE FLANGE SHALL BE PART OF ISOLATION VALVE AND OTHER SHALL BE PART OF 5 WAY MANIFOLD.

** 5 WAY MANIFOLD

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LIST OF ITEMS

CODE	DESCRIPTION	SIZE	ENDS	QTY.	UNIT	CODE	DESCRIPTION	SIZE	ENDS	QTY.	UNIT

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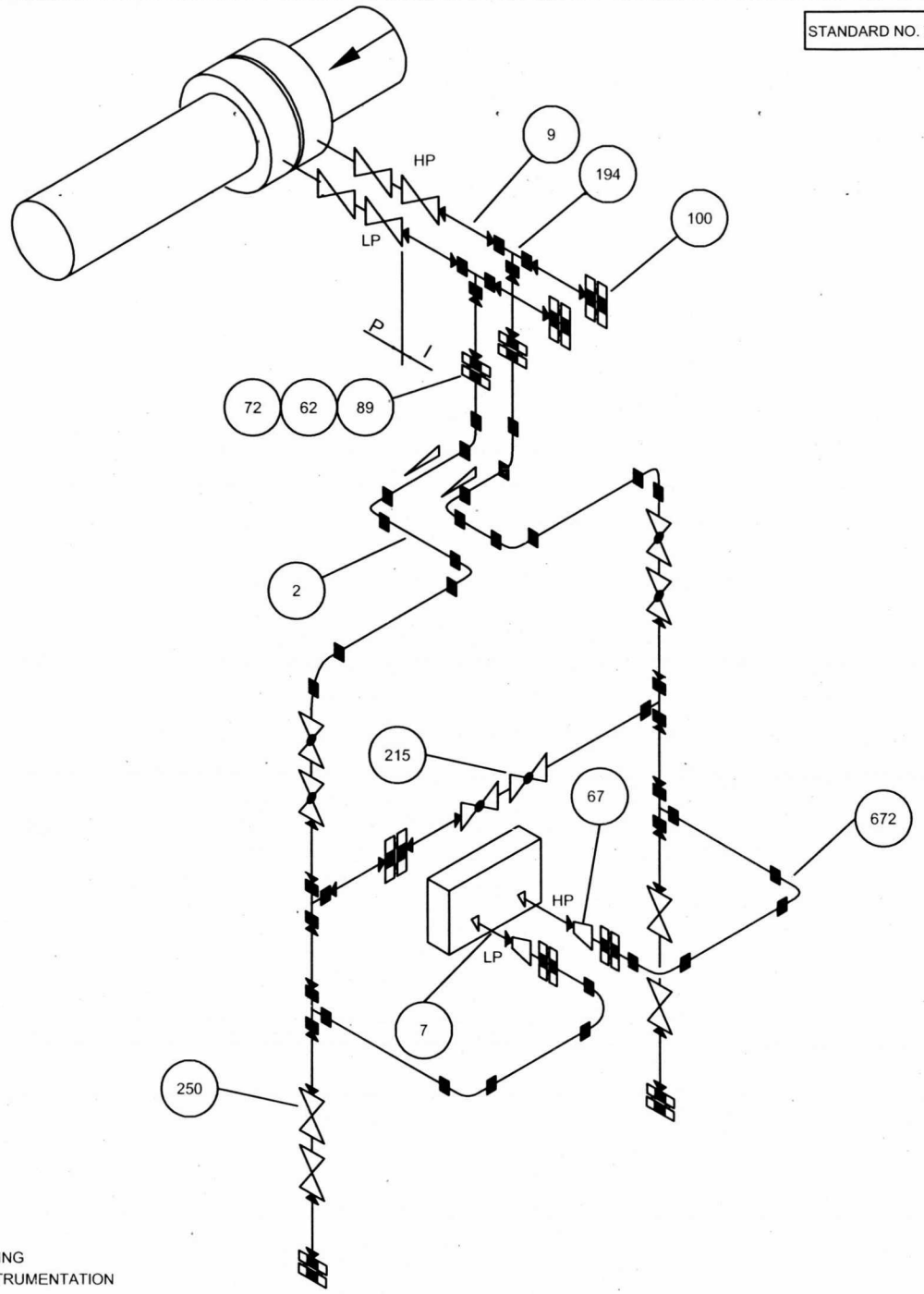
STANDARD NO. 7-52-0404 REV-1 RENUMBERED



P - BY PIPING
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LIST OF ITEMS

CODE	DESCRIPTION	SIZE	ENDS	QTY.	UNIT	CODE	DESCRIPTION	SIZE	ENDS	QTY.	UNIT
2	PIPE	3/4"	PL	A/R	m						
7	NIPPLE	1/2"	TH X PL	2	Nø						
9	NIPPLE	3/4"	PL X PL	16	Nø						
62	GASKET	FOR 3/4" FL		9	Nø						
67	REDUCER	3/4" x 1/2"	BW	2	Nø						
72	STUDS & NUTS	FOR 3/4" FL		9	Set						
89	FLANGE	3/4"	WN	14	Nø						
100	BLIND FLANGE	3/4"		4	Nø						
194	EQUAL TEE	3/4"	BW	6	Nø						
215	GLOBE VALVE	3/4"	BW	6	Nø						
250	GATE VALVE	3/4"	BW	4	Nø						
672	ELBOW	3/4"	BW	12	Nø						

Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
					Approved by	
1	01.12.2022	Revised & Reissued	Manoj	SG/AR	MN	SM
0	09.06.2021	Issued As Standard	Manoj	AJS	MN	SM

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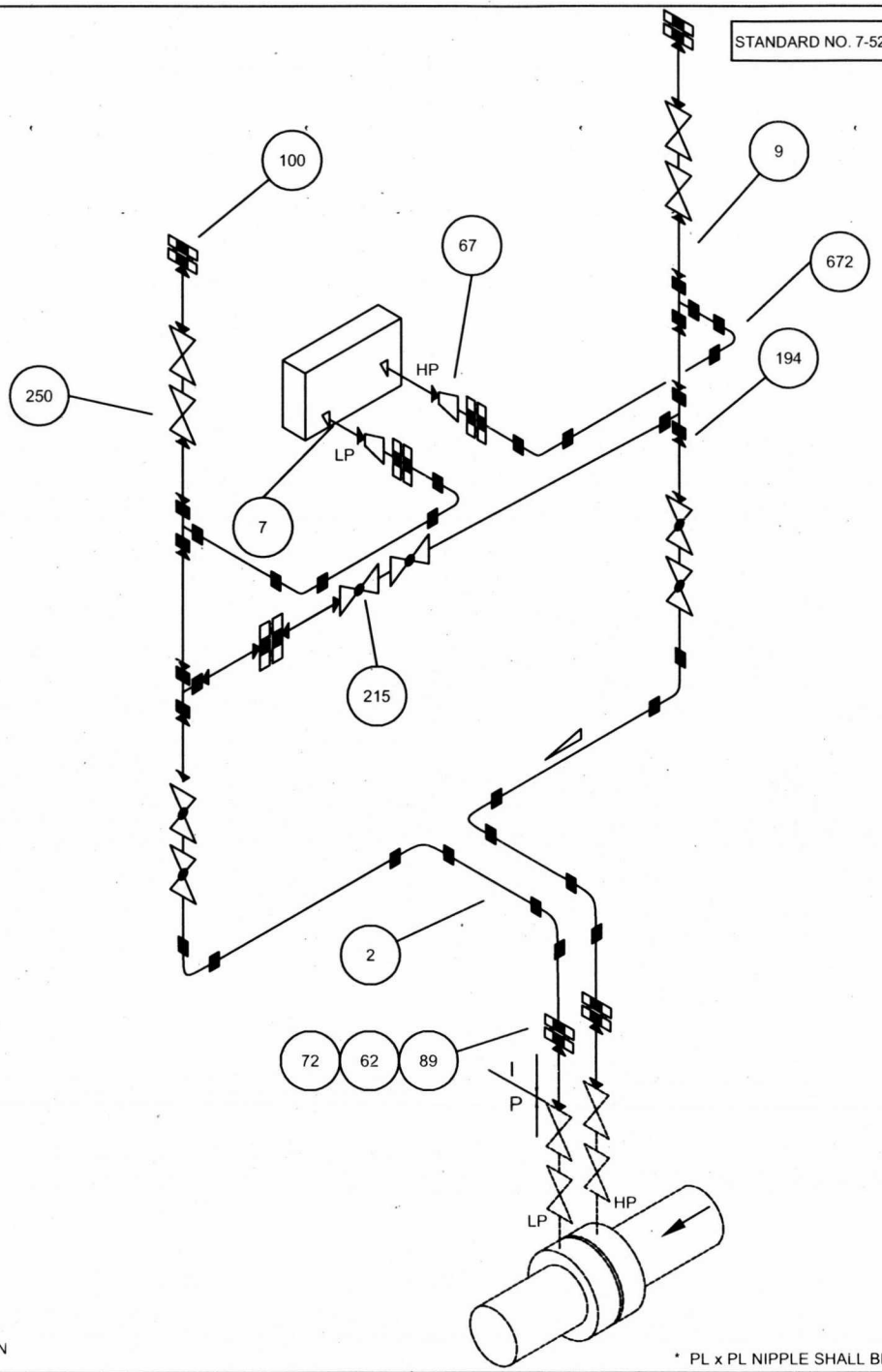
STANDARD NO. 7-52-0409 REV-1 RENUMBERED



P - BY PIPING
I - BY INSTRUMENTATION

* PL x PL NIPPLE SHALL BE FABRICATED FROM PIPE

LIST OF ITEMS

CODE	DESCRIPTION	SIZE	ENDS	QTY.	UNIT	CODE	DESCRIPTION	SIZE	ENDS	QTY.	UNIT
2	PIPE	3/4"	PL	A/R	m						
7	NIPPLE	1/2"	TH X PL	2	Nø						
9	NIPPLE *	3/4"	PL X PL	12	Nø						
62	GASKET	FOR 3/4" FL		7	Nø						
67	REDUCER	3/4" x 1/2"	BW	2	Nø						
72	STUDS & NUTS	FOR 3/4" FL		7	Set						
89	FLANGE	3/4"	WN	12	Nø						
100	BLIND FLANGE	3/4"		2	Nø						
194	EQUAL TEE	3/4"	BW	4	Nø						
215	GLOBE VALVE	3/4"	BW	6	Nø						
250	GATE VALVE	3/4"	BW	4	Nø						
672	ELBOW	3/4"	BW	10	Nø						

Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
1	01.12.2022	Revised & Reissued	Manoj	GG/AR	MN	SM
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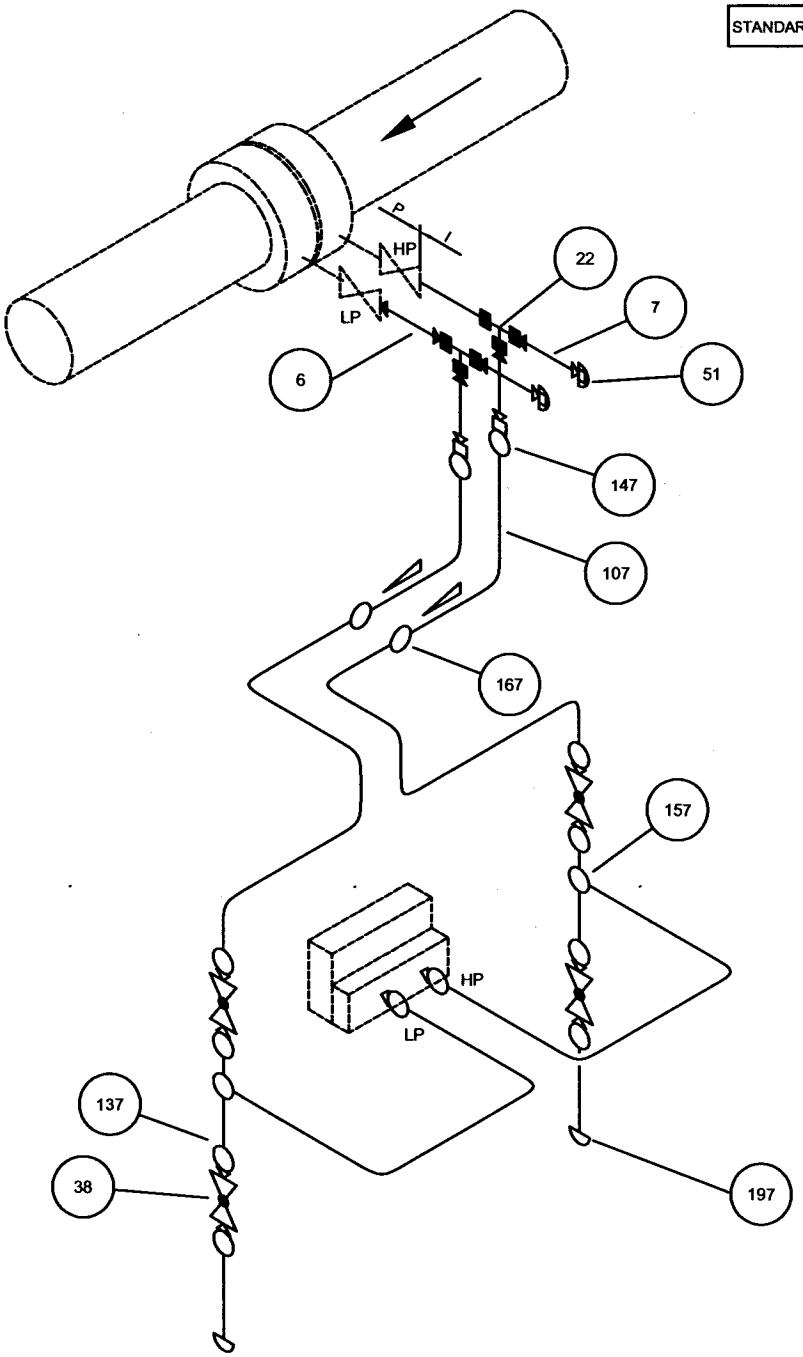
STANDARD NO. 7-52-0411 REV-3 RENUMBERED



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* PL x PL NIPPLE SHALL BE FABRICATED FROM PIPE

LIST OF ITEMS

CODE	DESCRIPTION	SIZE	ENDS	QTY.	UNIT	CODE	DESCRIPTION	SIZE	ENDS	QTY.	UNIT
6	NIPPLE *	1/2"	PL X PL	1	Nø	107	TUBE	1/2"	OD	A/R	m
7	NIPPLE	1/2"	TH X PL	4	Nø	137	MALE CONNECTOR	1/2" X 1/2"	TH X OD	10	Nø
22	EQUAL TEE	1/2"	SW	2	Nø	147	FEMALE CONNECTOR	1/2" X 1/2"	TH X OD	2	Nø
38	GLOBE VALVE	1/2"	TH	4	Nø	157	UNION TEE	1/2"	OD	2	Nø
51	CAP	1/2"	TH	2	Nø	167	TUBE UNION	1/2"	OD	2	Nø
						197	TUBING CAP	1/2"	OD	2	Nø

Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
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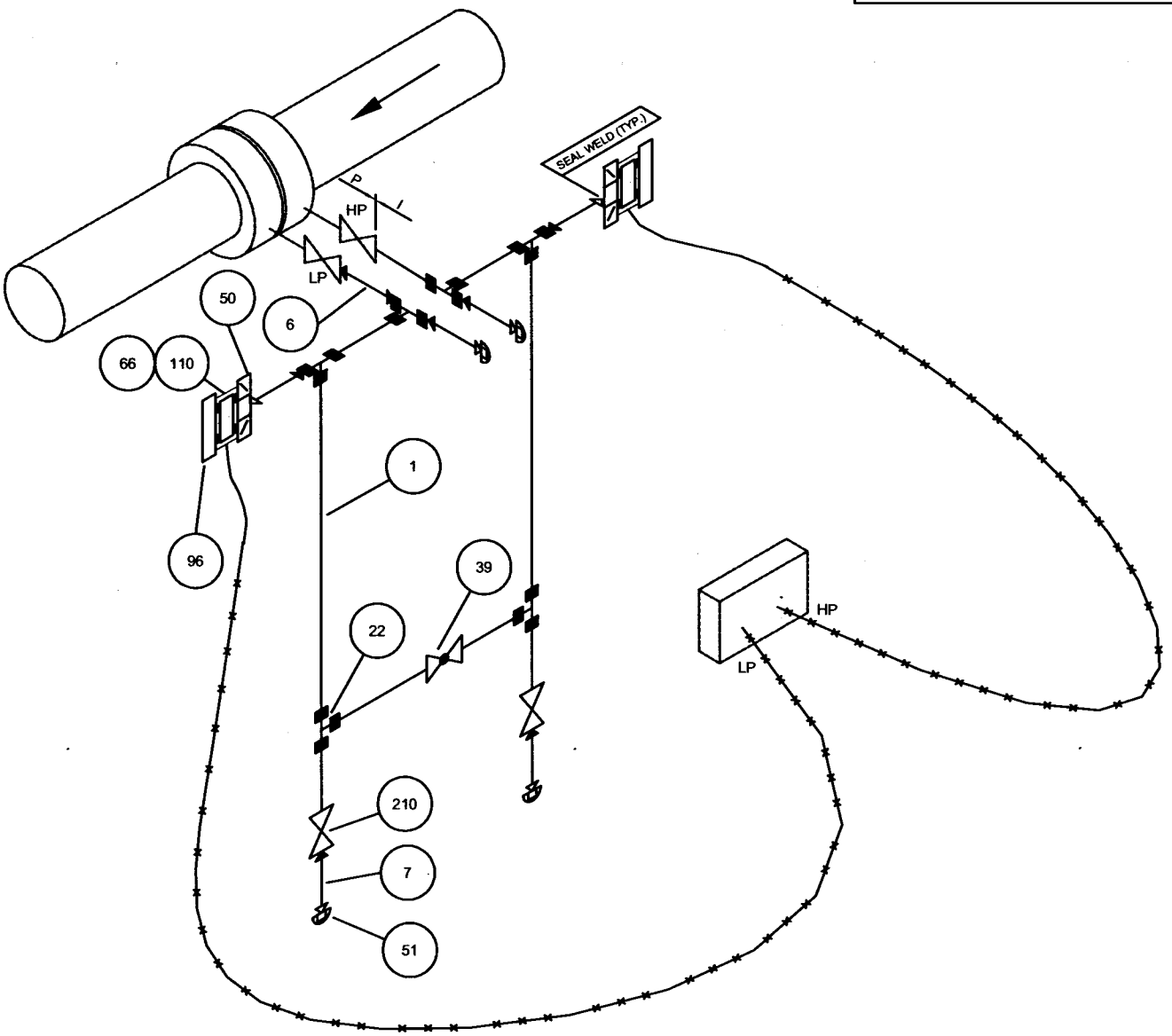
STANDARD NO. 7-52-0421 REV-5 RENUMBERED



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I - BY INSTRUMENTATION

* PL x PL NIPPLE SHALL BE FABRICATED FROM PIPE

LIST OF ITEMS

CODE	DESCRIPTION	SIZE	ENDS	QTY.	UNIT	CODE	DESCRIPTION	SIZE	ENDS	QTY.	UNIT
1	PIPE	1/2"	PL	A/R	m						
6	NIPPLE *	1/2"	PL X PL	1	Nø						
7	NIPPLE	1/2"	TH X PL	6	Nø						
22	EQUAL TEE	1/2"	SW	6	Nø						
39	GLOBE VALVE	1/2"	SW	1	Nø						
50	FLANGE	3" X 1/2"	FL X TH (Red)	2	Nø						
51	CAP	1/2"	TH	4	Nø						
66	GASKET	FOR 3" FL		4	Nø						
96	BLIND FLANGE	3"		2	Nø						
110	STUDS & NUTS	FOR 3" FL	LONG	2	Set						
210	GATE VALVE	1/2"	SW	2	Nø						

Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
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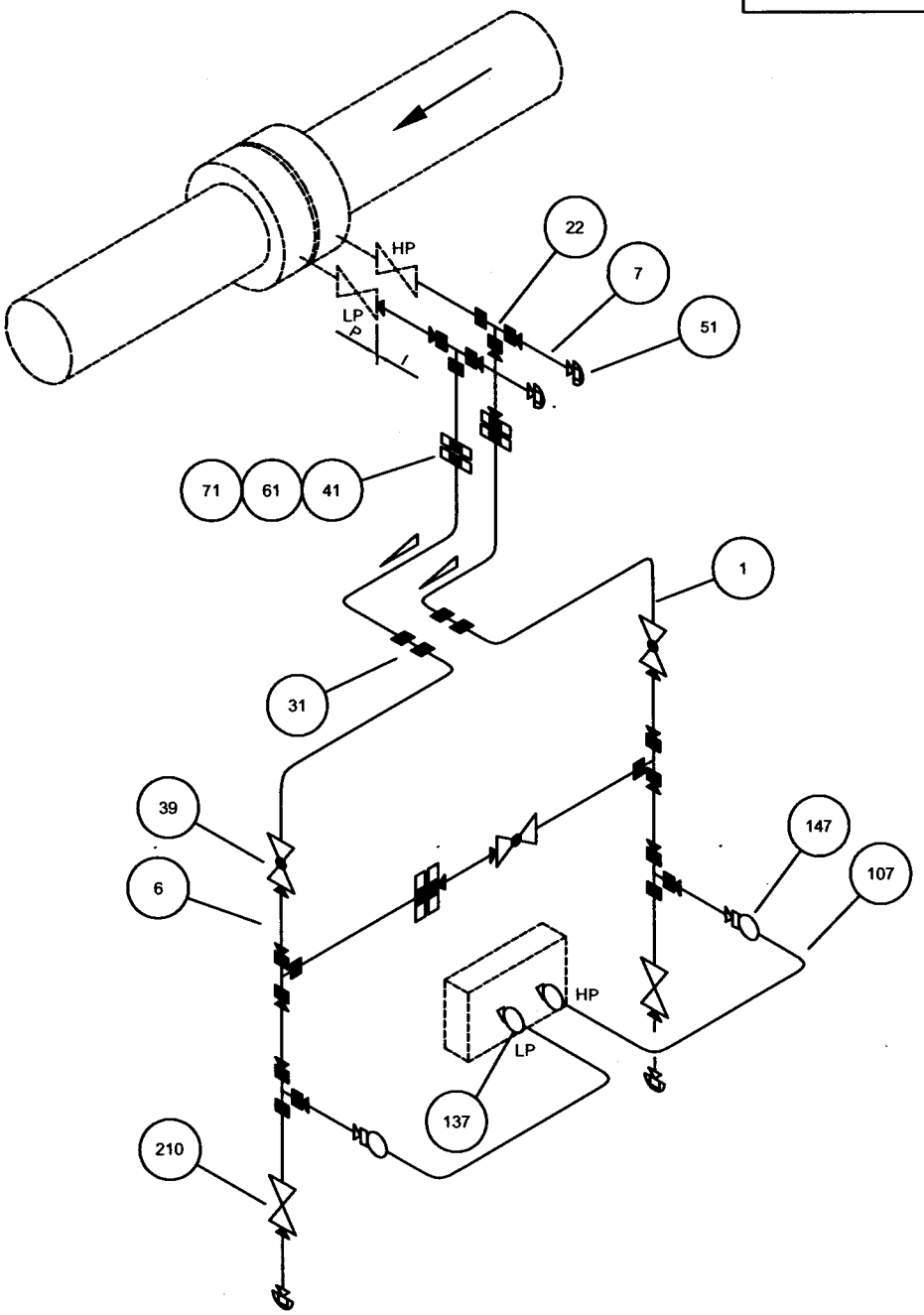
STANDARD NO. 7-52-0401 REV-5 RENUMBERED



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* PL x PL NIPPLE SHALL BE FABRICATED FROM PIPE

LIST OF ITEMS

CODE	DESCRIPTION	SIZE	ENDS	QTY.	UNIT	CODE	DESCRIPTION	SIZE	ENDS	QTY.	UNIT
1	PIPE	1/2"	PL	A/R	m	107	TUBE	1/2"	OD	A/R	m
6	NIPPLE *	1/2"	PL X PL	7	Nø	137	MALE CONNECTOR	1/2" X 1/2"	TH X OD	2	Nø
7	NIPPLE	1/2"	TH X PL	6	Nø	147	FEMALE CONNECTOR	1/2" X 1/2"	TH X OD	2	Nø
22	EQUAL TEE	1/2"	SW	6	Nø						
31	COUPLING	1/2"	SW	2	Nø						
39	GLOBE VALVE	1/2"	SW	3	Nø						
41	FLANGE	1/2"	SW	6	Nø						
51	CAP	1/2"	TH	4	Nø						
61	GASKET	FOR 1/2" FLG.		3	Nø						
71	STUDS & NUTS	FOR 1/2" FLG.		3	Set						
210	GATE VALVE	1/2"	SW	2	Nø						

Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
0	09.06.2021	Issued As Standard	Manoj	AJS	MN	SM

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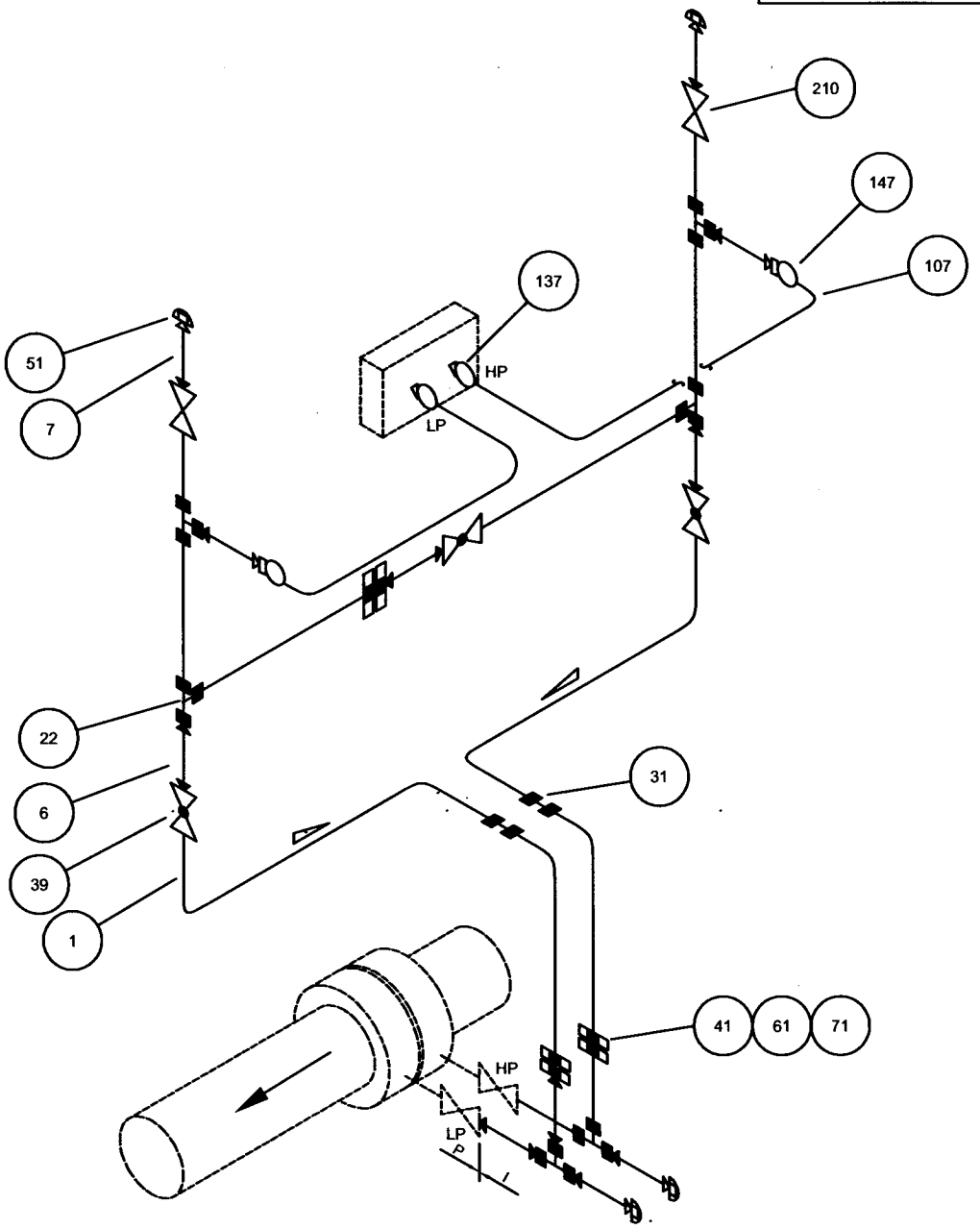
STANDARD NO. 7-52-0402 REV-5 RENUMBERED



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LIST OF ITEMS

CODE	DESCRIPTION	SIZE	ENDS	QTY.	UNIT	CODE	DESCRIPTION	SIZE	ENDS	QTY.	UNIT
1	PIPE	1/2"	PL	A/R	m	107	TUBE	1/2"	OD	A/R	m
6	NIPPLE *	1/2"	PL X PL	5	Nø	137	MALE CONNECTOR	1/2" X 1/2"	TH X OD	2	Nø
7	NIPPLE	1/2"	TH X PL	6	Nø	147	FEMALE CONNECTOR	1/2" X 1/2"	TH X OD	2	Nø
22	EQUAL TEE	1/2"	SW	6	Nø						
31	COUPLING	1/2"	SW	2	Nø						
39	GLOBE VALVE	1/2"	SW	3	Nø						
41	FLANGE	1/2"	SW	6	Nø						
51	CAP	1/2"	TH	4	Nø						
61	GASKET	FOR 1/2" FLG.		3	Nø						
71	STUDS & NUTS	FOR 1/2" FLG.		3	Set						
210	GATE VALVE	1/2"	SW	2	Nø						

Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Chairman
0	09.06.2021	Issued As Standard	Manoj	AJS	MN	SM

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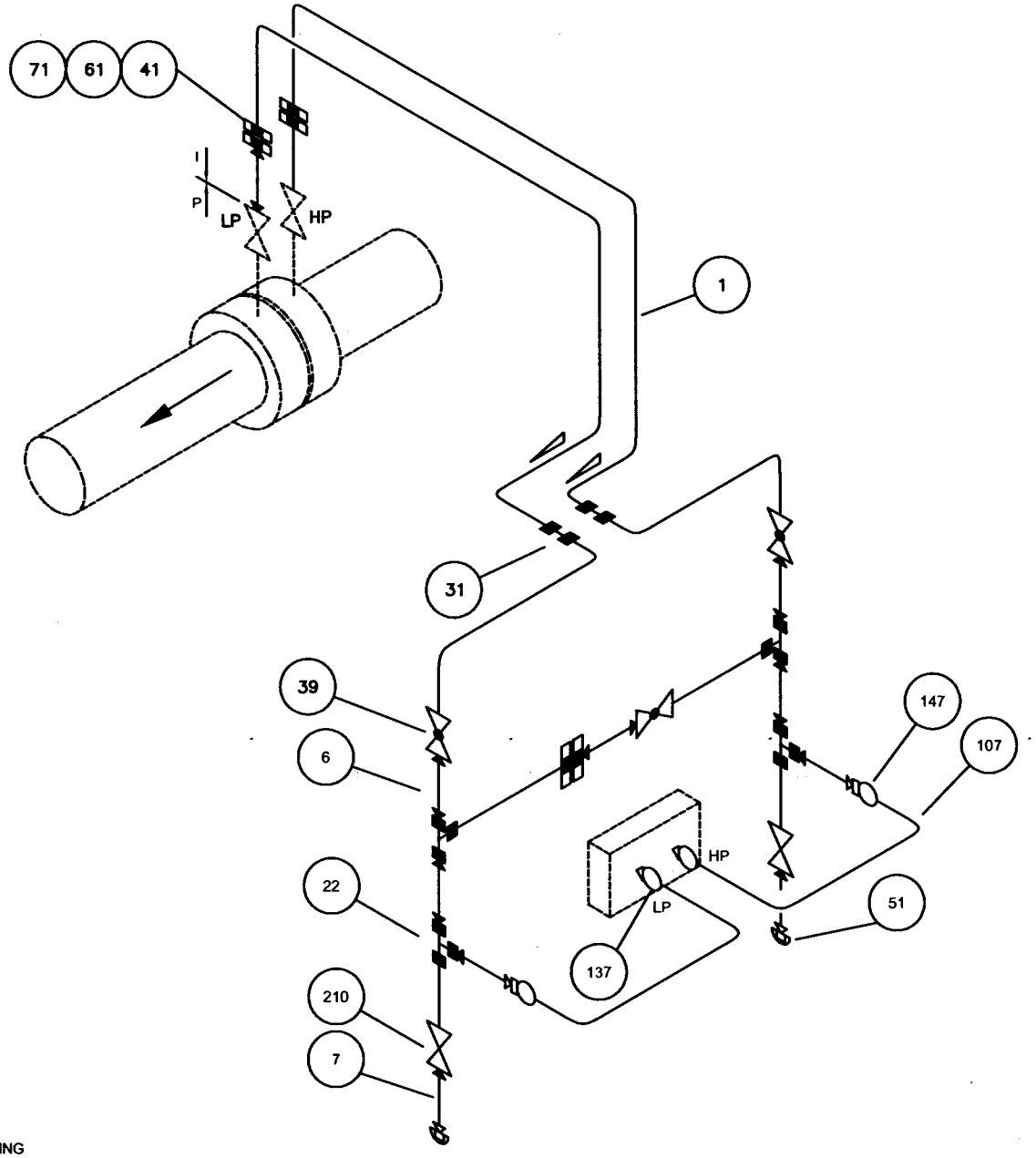
STANDARD NO. 7-52-0403 REV-5 RENUMBERED



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* PL x PL NIPPLE SHALL BE FABRICATED FROM PIPE

LIST OF ITEMS

CODE	DESCRIPTION	SIZE	ENDS	QTY.	UNIT	CODE	DESCRIPTION	SIZE	ENDS	QTY.	UNIT
1	PIPE	1/2"	PL	A/R	m	107	TUBE	1/2"	OD	A/R	m
6	NIPPLE *	1/2"	PL X PL	6	Nø	137	MALE CONNECTOR	1/2" X 1/2"	TH X OD	2	Nø
7	NIPPLE	1/2"	TH X PL	4	Nø	147	FEMALE CONNECTOR	1/2" X 1/2"	TH X OD	2	Nø
22	EQUAL TEE	1/2"	SW	4	Nø						
31	COUPLING	1/2"	SW	2	Nø						
39	GLOBE VALVE	1/2"	SW	3	Nø						
41	FLANGE	1/2"	SW	6	Nø						
51	CAP	1/2"	TH	2	Nø						
61	GASKET	FOR 1/2" FLG.		3	Nø						
71	STUDS & NUTS	FOR 1/2" FLG.		3	Set						
210	GATE VALVE	1/2"	SW	2	Nø						

Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
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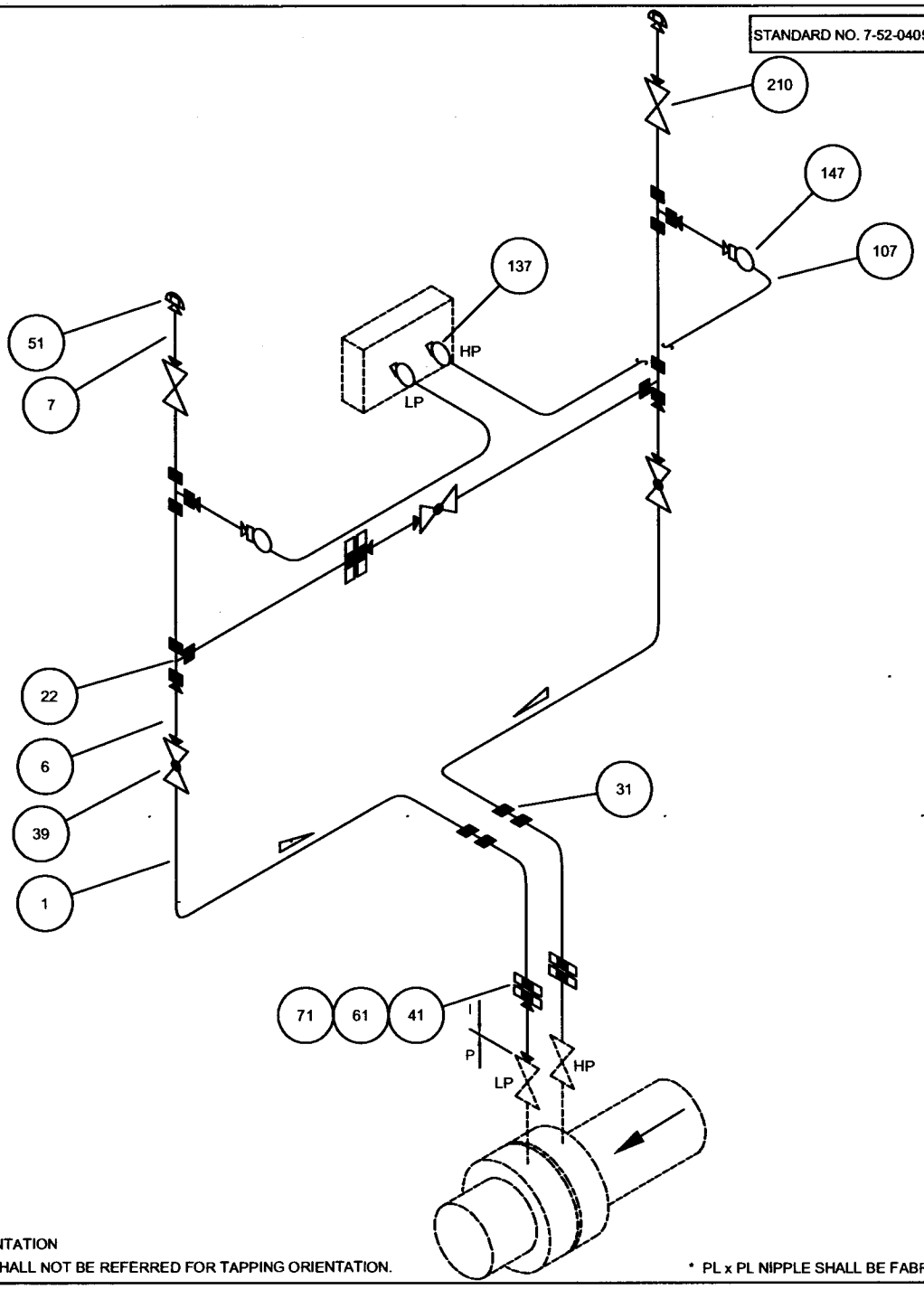
STANDARD NO. 7-52-0405 REV-5 RENUMBERED



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THIS DRAWING SHALL NOT BE REFERRED FOR TAPPING ORIENTATION.

* PL x PL NIPPLE SHALL BE FABRICATED FROM PIPE

LIST OF ITEMS

CODE	DESCRIPTION	SIZE	ENDS	QTY.	UNIT	CODE	DESCRIPTION	SIZE	ENDS	QTY.	UNIT
1	PIPE	1/2"	PL	A/R	m	107	TUBE	1/2"	OD	A/R	m
6	NIPPLE *	1/2"	PL X PL	4	Nø	137	MALE CONNECTOR	1/2" X 1/2"	TH X OD	2	Nø
7	NIPPLE	1/2"	TH X PL	4	Nø	147	FEMALE CONNECTOR	1/2" X 1/2"	TH X OD	2	Nø
22	EQUAL TEE	1/2"	SW	4	Nø						
31	COUPLING	1/2"	SW	2	Nø						
39	GLOBE VALVE	1/2"	SW	3	Nø						
41	FLANGE	1/2"	SW	6	Nø						
51	CAP	1/2"	TH	2	Nø						
61	GASKET	FOR 1/2" FLG.		3	Nø						
71	STUDS & NUTS	FOR 1/2" FLG.		3	Set						
210	GATE VALVE	1/2"	SW	2	Nø						

Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
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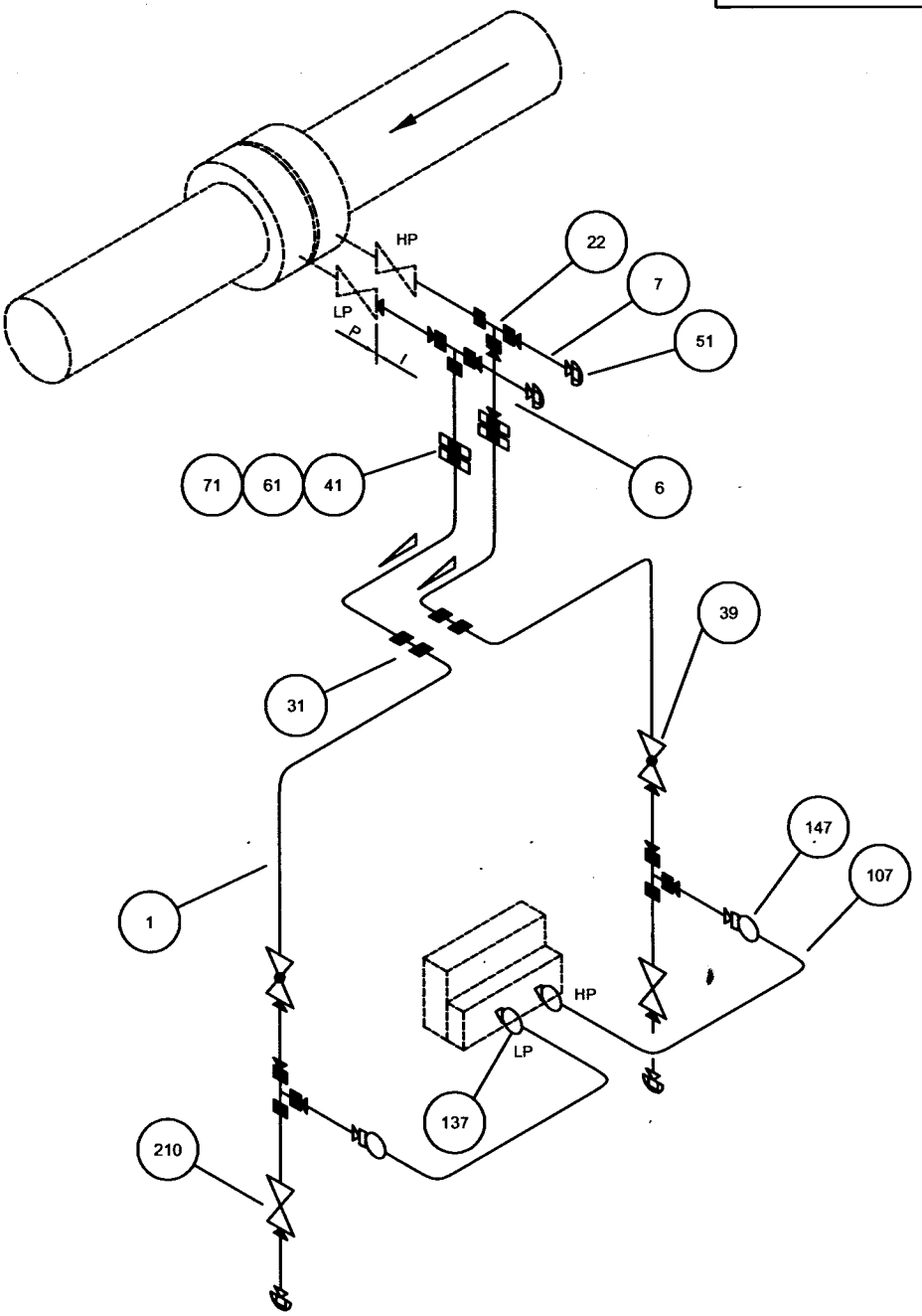
STANDARD NO. 7-52-0406 REV-5 RENUMBERED



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THIS DRAWING SHALL NOT BE REFERRED FOR TAPPING ORIENTATION.

* PL x PL NIPPLE SHALL BE FABRICATED FROM PIPE

LIST OF ITEMS

CODE	DESCRIPTION	SIZE	ENDS	QTY.	UNIT	CODE	DESCRIPTION	SIZE	ENDS	QTY.	UNIT
1	PIPE	1/2"	PL	A/R	m	107	TUBE	1/2"	OD	A/R	m
6	NIPPLE *	1/2"	PL X PL	4	Nø	137	MALE CONNECTOR	1/2" X 1/2"	TH X OD	2	Nø
7	NIPPLE	1/2"	TH X PL	6	Nø	147	FEMALE CONNECTOR	1/2" X 1/2"	TH X OD	2	Nø
22	EQUAL TEE	1/2"	SW	4	Nø						
31	COUPLING	1/2"	SW	2	Nø						
39	GLOBE VALVE	1/2"	SW	2	Nø						
41	FLANGE	1/2"	SW	4	Nø						
51	CAP	1/2"	TH	4	Nø						
61	GASKET	FOR 1/2" FLG.		2	Nø						
71	STUDS & NUTS	FOR 1/2" FLG.		2	Set						
210	GATE VALVE	1/2"	SW	2	Nø						

Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Chairman
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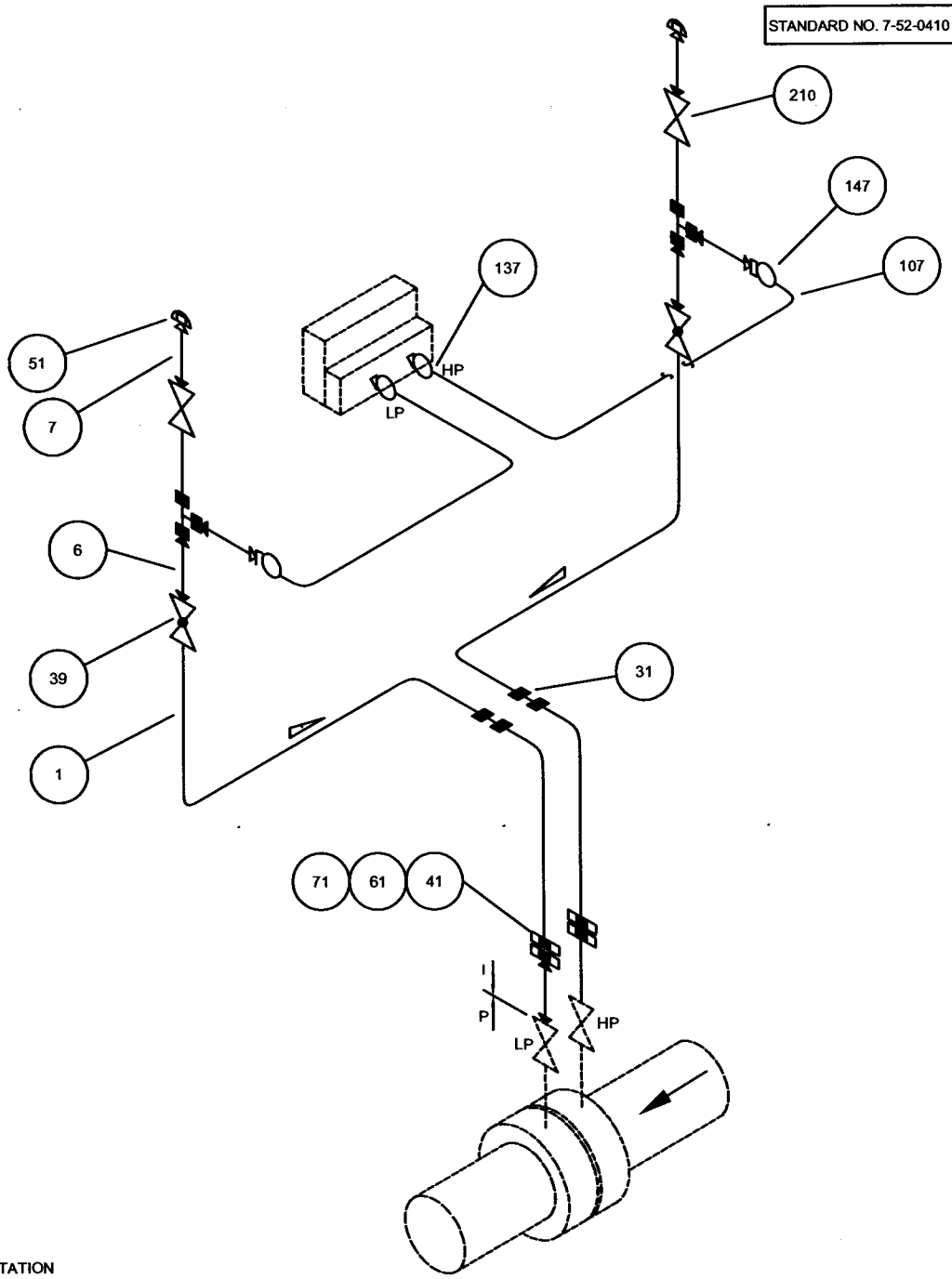
STANDARD NO. 7-52-0410 REV-5 RENUMBERED



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* PL x PL NIPPLE SHALL BE FABRICATED FROM PIPE

LIST OF ITEMS

CODE	DESCRIPTION	SIZE	ENDS	QTY.	UNIT	CODE	DESCRIPTION	SIZE	ENDS	QTY.	UNIT
1	PIPE	1/2"	PL	A/R	m	107	TUBE	1/2"	OD	A/R	m
6	NIPPLE *	1/2"	PL X PL	3	Nø	137	MALE CONNECTOR	1/2" X 1/2"	TH X OD	2	Nø
7	NIPPLE	1/2"	TH X PL	4	Nø	147	MALE CONNECTOR	1/2" X 1/2"	TH X OD	2	Nø
22	EQUAL TEE	1/2"	SW	2	Nø						
31	COUPLING	1/2"	SW	2	Nø						
39	GLOBE VALVE	1/2"	SW	2	Nø						
41	FLANGE	1/2"	SW	4	Nø						
51	CAP	1/2"	TH	2	Nø						
61	GASKET	FOR 1/2" FLG.		2	Nø						
71	STUDS & NUTS	FOR 1/2" FLG.		2	Set						
210	GATE VALVE	1/2"	SW	2	Nø						

Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
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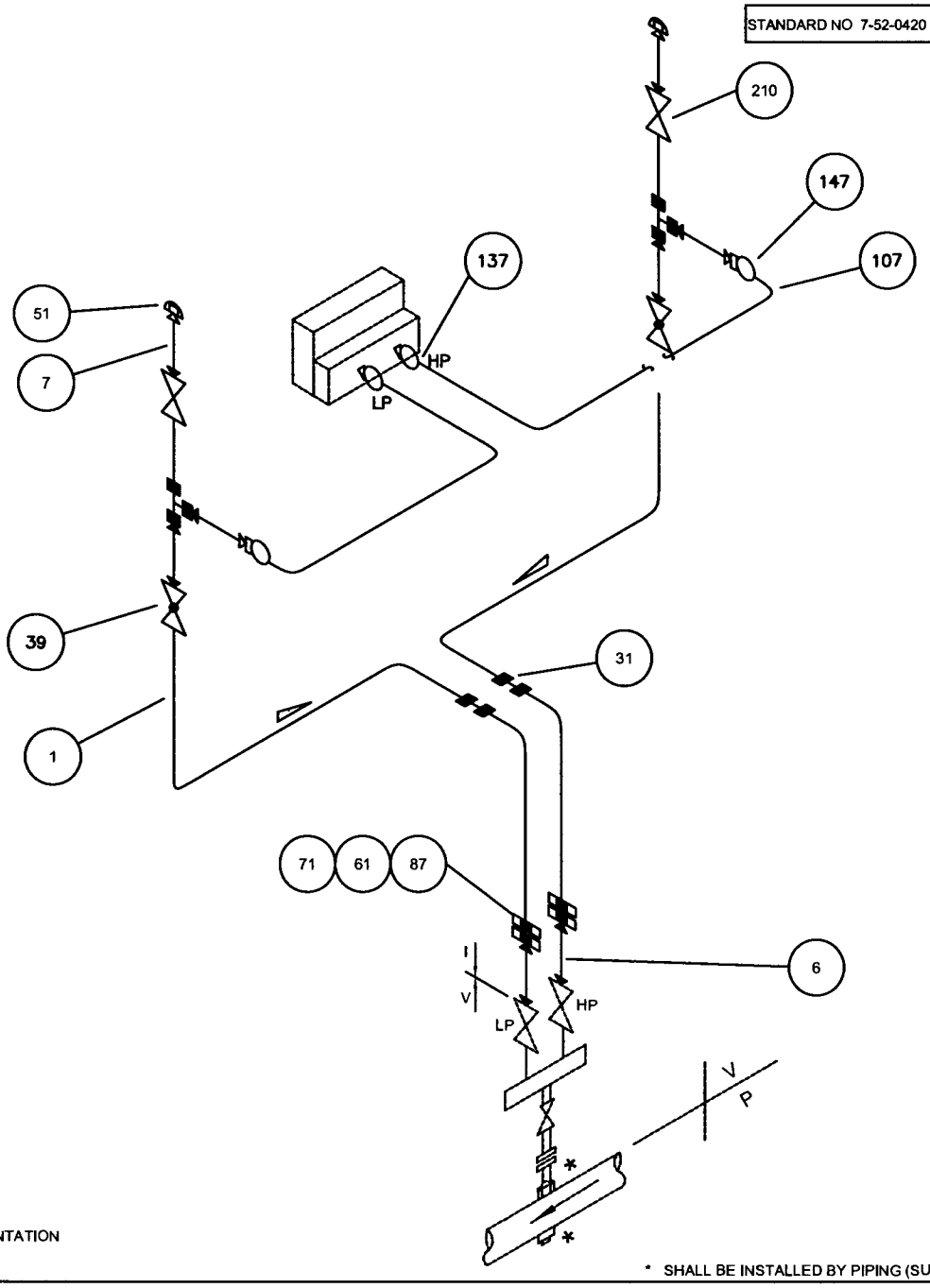
STANDARD NO 7-52-0420 REV-0 RENUMBERED



P - BY PIPING
I - BY INSTRUMENTATION
V - BY VENDOR

* SHALL BE INSTALLED BY PIPING (SUPPLIED BY VENDOR)

LIST OF ITEMS

CODE	DESCRIPTION	SIZE	ENDS	QTY.	UNIT	CODE	DESCRIPTION	SIZE	ENDS	QTY.	UNIT
1	PIPE	1/2"	PL	A/R	m	107	TUBE	1/2"	OD	A/R	m
6	NIPPLE	1/2"	PL X PL	4	Nø	137	MALE CONNECTDR	1/2" X 1/2"	TH X OD	2	Nø
7	NIPPLE	1/2"	TH X PL	4	Nø	147	FEMALE CONNECTOR	1/2" X 1/2"	TH X OD	2	Nø
22	EQUAL TEE	1/2"	SW	2	Nø						
31	COUPLING	1/2"	SW	2	Nø						
39	GLOBE VALVE	1/2"	SW	2	Nø						
51	CAP	1/2"	TH	2	Nø						
61	GASKET	FOR 1/2" FLG.		2	Nø						
71	STUDS & NUTS	FOR 1/2" FLG		2	Set						
87	FLANGE	1/2"	WN	4	Nø						
210	GATE VALVE	1/2"	SW	2	Nø						

Rev No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
0	10.10 2019	Issued As Standard	Manoj	AJS	CRG	RKT

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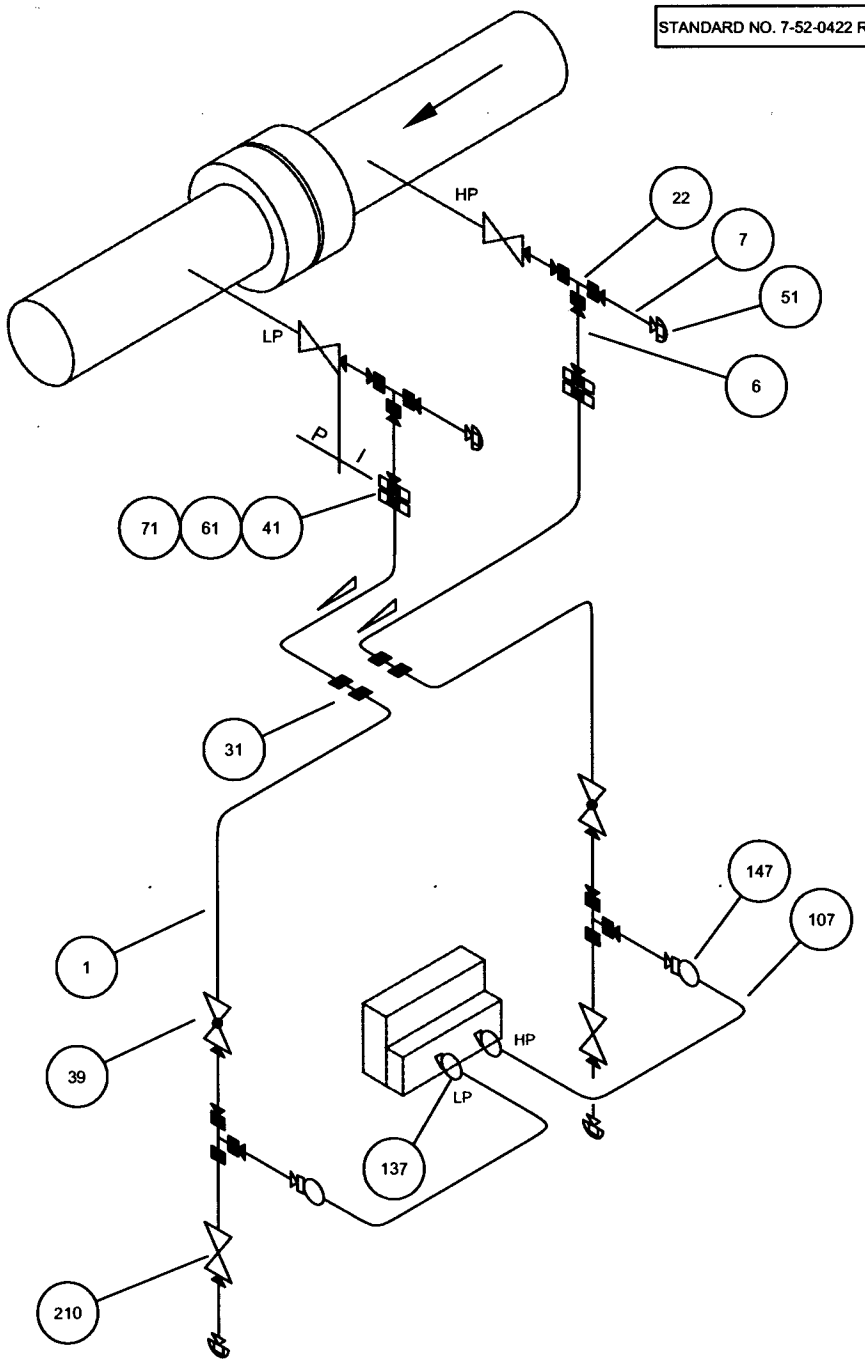
STANDARD NO. 7-52-0422 REV-0 RENUMBERED



P - BY PIPING
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LIST OF ITEMS

CODE	DESCRIPTION	SIZE	ENDS	QTY.	UNIT	CODE	DESCRIPTION	SIZE	ENDS	QTY.	UNIT
1	PIPE	1/2"	PL	A/R	m	107	TUBE	1/2"	OD	A/R	m
6	NIPPLE	1/2"	PL X PL	6	Nø	137	MALE CONNECTOR	1/2" X 1/2"	TH X OD	2	Nø
7	NIPPLE	1/2"	TH X PL	4	Nø	147	FEMALE CONNECTOR	1/2" X 1/2"	TH X OD	2	Nø
22	EQUAL TEE	1/2"	SW	4	Nø						
31	COUPLING	1/2"	SW	2	Nø						
39	GLOBE VALVE	1/2"	SW	2	Nø						
41	FLANGE	1/2"	SW	4	Nø						
51	CAP	1/2"	TH	4	Nø						
61	GASKET	FOR 1/2" FLG.		2	Nø						
71	STUDS & NUTS	FOR 1/2" FLG.		2	Set						
210	GATE VALVE	1/2"	SW	2	Nø						

Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
1	28.06.2021	Revised & Reissued	Manoj	AJS	MN	SM
0	10.10.2019	Issued As Standard	Manoj	AJS	RG	RKT

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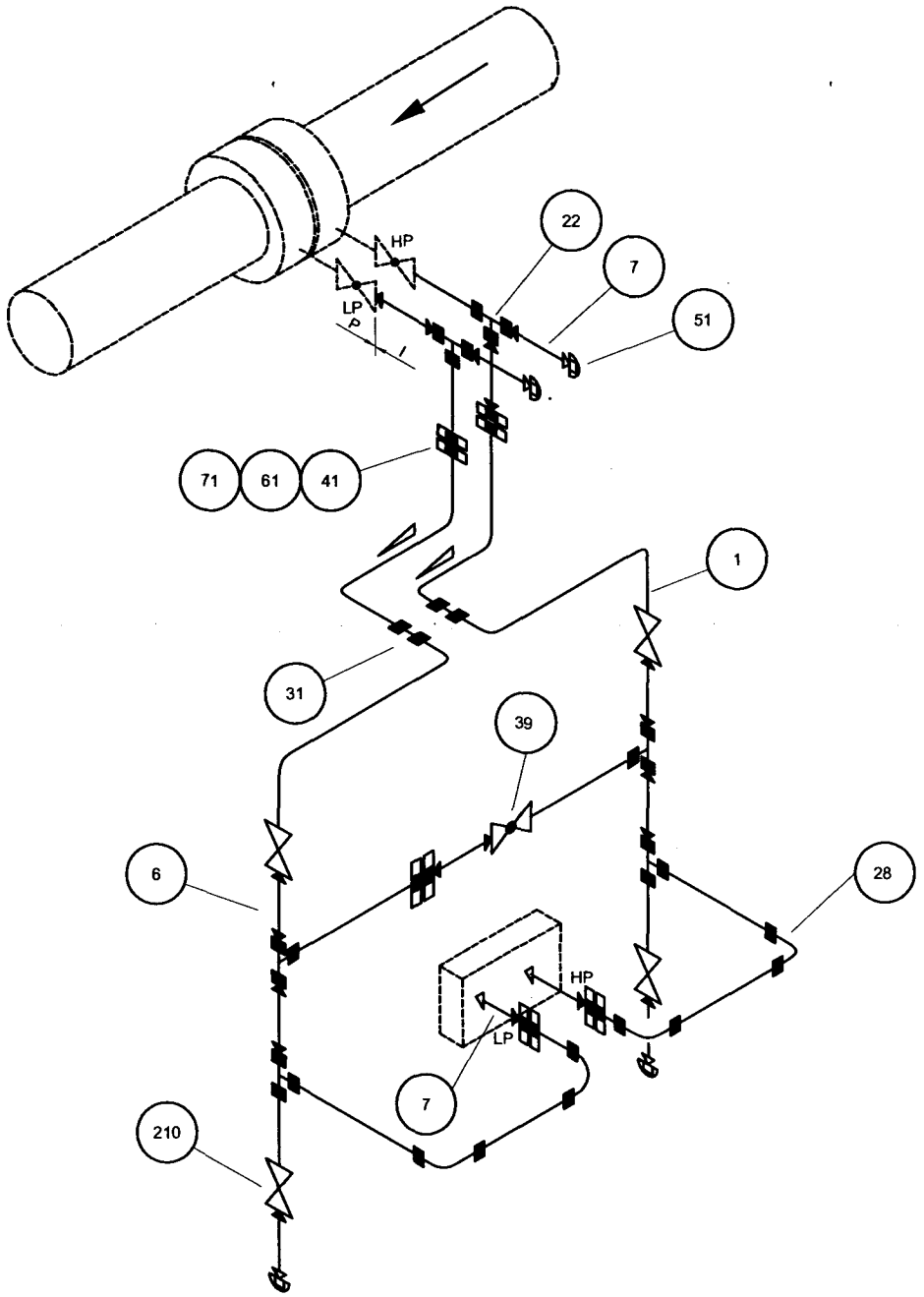

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* PL x PL NIPPLE SHALL BE FABRICATED FROM PIPE

LIST OF ITEMS

CODE	DESCRIPTION	SIZE	ENDS	QTY.	UNIT	CODE	DESCRIPTION	SIZE	ENDS	QTY.	UNIT
1	PIPE	1/2"	PL	A/R	m						
6	NIPPLE *	1/2"	PL X PL	7	Nø						
7	NIPPLE	1/2"	TH X PL	6	Nø						
22	EQUAL TEE	1/2"	SW	6	Nø						
28	ELBOW	1/2"	SW	4	Nø						
31	COUPLING	1/2"	SW	2	Nø						
39	GLOBE VALVE	1/2"	SW	1	Nø						
41	FLANGE	1/2"	SW	10	Nø						
51	CAP	1/2"	TH	4	Nø						
61	GASKET	FOR 1/2" FLG.		5	Nø						
71	STUDS & NUTS	FOR 1/2" FLG.		5	Set						
210	GATE VALVE	1/2"	SW	4	Nø						

Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
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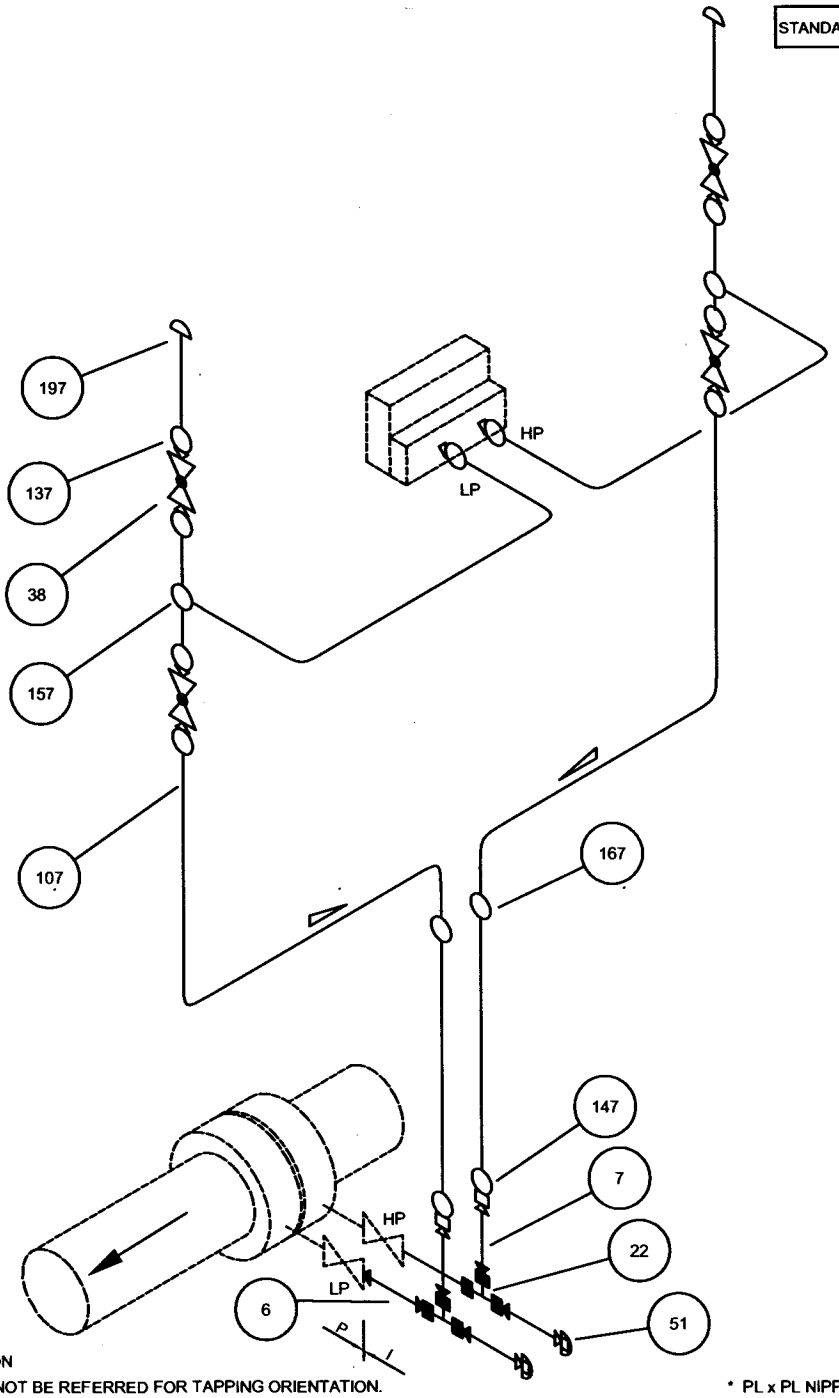
STANDARD NO. 7-52-0412 REV-5 RENUMBERED



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* PL x PL NIPPLE SHALL BE FABRICATED FROM PIPE

LIST OF ITEMS

CODE	DESCRIPTION	SIZE	ENDS	QTY.	UNIT	CODE	DESCRIPTION	SIZE	ENDS	QTY.	UNIT
6	NIPPLE *	1/2"	PL X PL	1	Nø	107	TUBE	1/2"	OD	A/R	m
7	NIPPLE	1/2"	TH X PL	4	Nø	137	MALE CONNECTOR	1/2" X 1/2"	TH X OD	10	Nø
22	EQUAL TEE	1/2"	SW	2	Nø	147	FEMALE CONNECTOR	1/2" X 1/2"	TH X OD	2	Nø
38	GLOBE VALVE	1/2"	TH	4	Nø	157	UNION TEE	1/2"	OD	2	Nø
51	CAP	1/2"	TH	2	Nø	167	TUBE UNION	1/2"	OD	2	Nø
						197	TUBING CAP	1/2"	OD	2	Nø

Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
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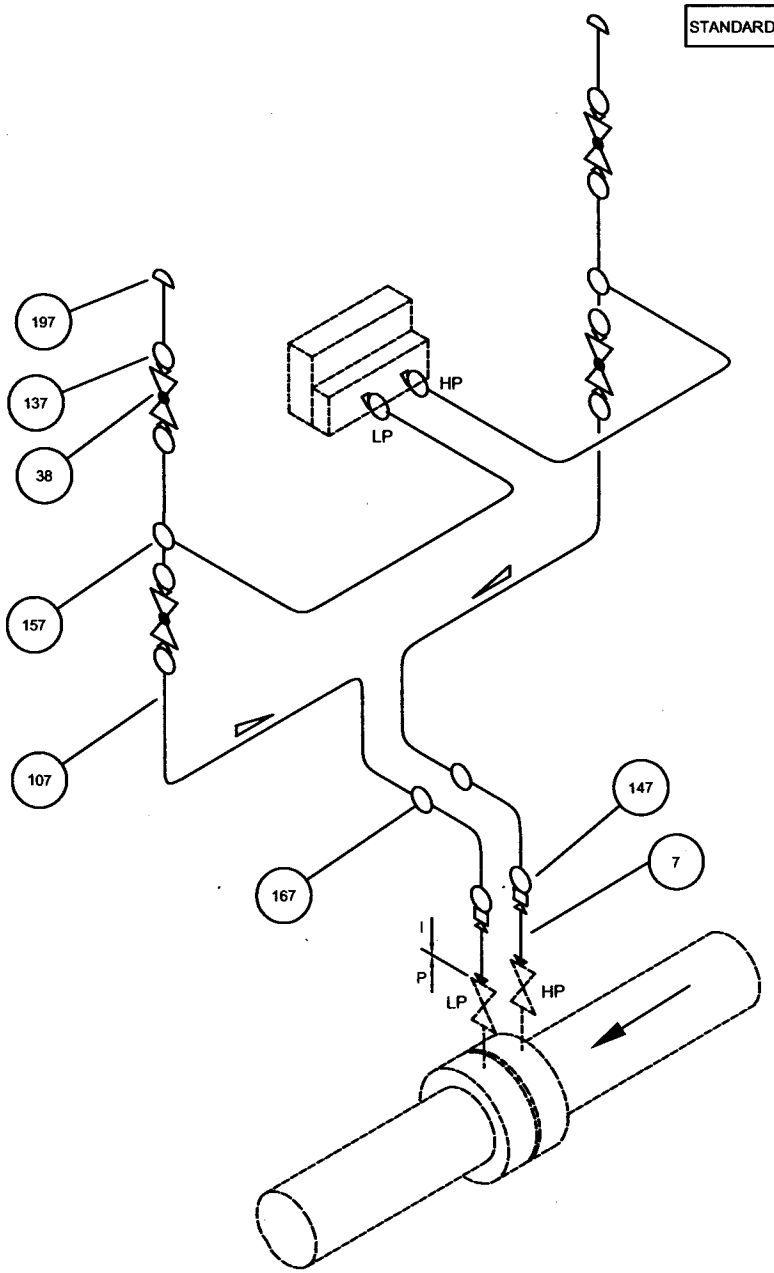

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THIS DRAWING SHALL NOT BE REFERRED FOR TAPPING ORIENTATION.

LIST OF ITEMS

CODE	DESCRIPTION	SIZE	ENDS	QTY.	UNIT	CODE	DESCRIPTION	SIZE	ENDS	QTY.	UNIT
7	NIPPLE	1/2"	TH X PL	2	m	107	TUBE	1/2"	OD	A/R	m
38	GLOBE VALVE	1/2"	TH	4	Nø	137	MALE CONNECTOR	1/2" X 1/2"	TH X OD	10	Nø
						147	FEMALE CONNECTOR	1/2" X 1/2"	TH X OD	2	Nø
						157	UNION TEE	1/2"	OD	2	Nø
						167	TUBE UNION	1/2"	OD	2	Nø
						197	TUBING CAP	1/2"	OD	2	Nø

Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
0	09.06.2021	Issued As Standard	Manoj	AJS	MN	SM

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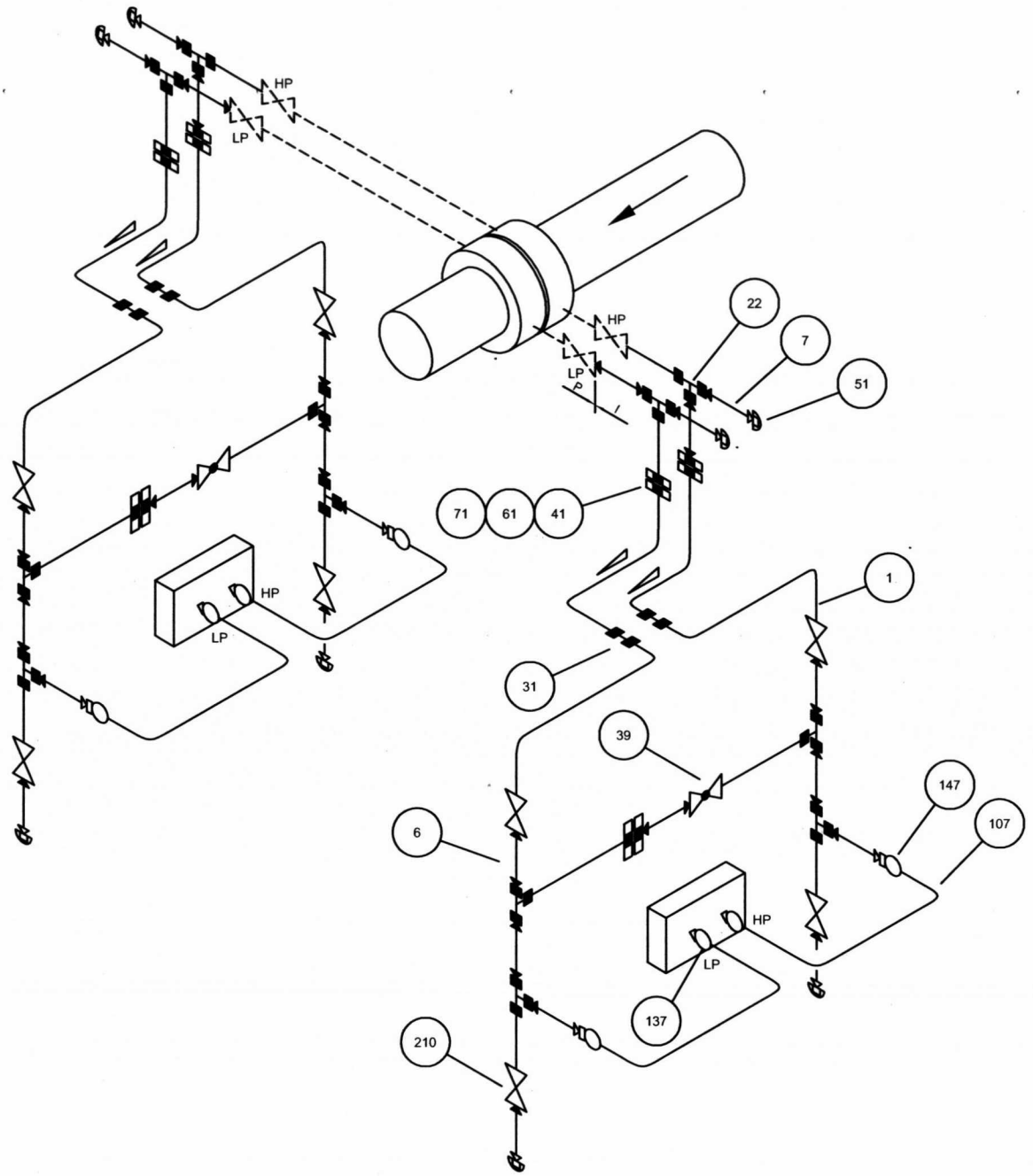

P - BY PIPING
I - BY INSTRUMENTATION

* PL x PL NIPPLE SHALL BE FABRICATED FROM PIPE

LIST OF ITEMS

CODE	DESCRIPTION	SIZE	ENDS	QTY.	UNIT	CODE	DESCRIPTION	SIZE	ENDS	QTY.	UNIT
1	PIPE	1/2"	PL	A/R	m	107	TUBE	1/2"	OD	A/R	m
6	NIPPLE *	1/2"	PL X PL	14	Nø	137	MALE CONNECTOR	1/2" X 1/2"	TH X OD	4	Nø
7	NIPPLE	1/2"	TH X PL	12	Nø	147	FEMALE CONNECTOR	1/2" X 1/2"	TH X OD	4	Nø
22	EQUAL TEE	1/2"	SW	12	Nø						
31	COUPLING	1/2"	SW	4	Nø						
39	GLOBE VALVE	1/2"	SW	2	Nø						
41	FLANGE	1/2"	SW	12	Nø						
51	CAP	1/2"	TH	8	Nø						
61	GASKET	FOR 1/2" FLG.		6	Nø						
71	STUDS & NUTS	FOR 1/2" FLG.		6	Set						
210	GATE VALVE	1/2"	SW	8	Nø						

Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
0	01.07.2022	Issued As Standard	Manoj/AB	GG/AR	MN	SM

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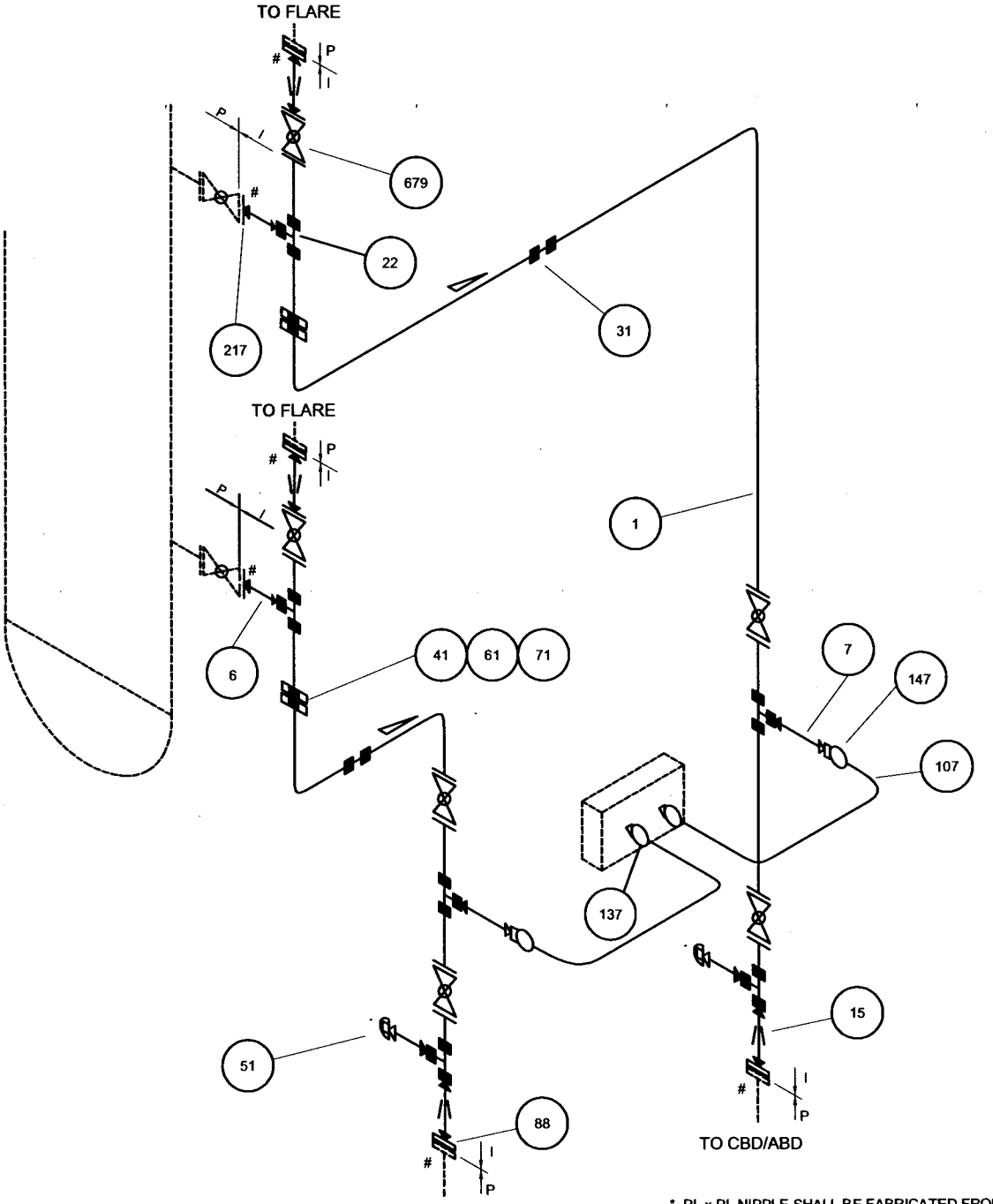

P - BY PIPING
I - BY INSTRUMENTATION

* PL x PL NIPPLE SHALL BE FABRICATED FROM PIPE
# STUD NUTS & GASKET BY PIPING

LIST OF ITEMS

CODE	DESCRIPTION	SIZE	ENDS	QTY.	UNIT	CODE	DESCRIPTION	SIZE	ENDS	QTY.	UNIT
1	PIPE	1/2"	PL	A/R	m	217	FLANGE	2" X 1/2"	FL X SW (Red)	2	Nø
6	NIPPLE *	1/2"	PL X PL	2	Nø	679	BALL VALVE	1/2"	FLG	6	Nø
7	NIPPLE	1/2"	TH X PL	4	Nø						
15	SWAGE NIPPLE	3/4"x 1/2"	PL X PL	4	Nø						
22	EQUAL TEE	1/2"	SW	6	Nø	107	TUBE	1/2"	OD	A/R	m
31	COUPLING	1/2"	SW	2	Nø	137	MALE CONNECTOR	1/2" X 1/2"	TH X OD	2	Nø
41	FLANGE	1/2"	SW	16	Nø	147	FEMALE CONNECTOR	1/2" X 1/2"	TH X OD	2	Nø
51	CAP	1/2"	TH	2	Nø						
61	GASKET	FOR 1/2" FLG.		14	Set						
71	STUDS & NUTS	FOR 1/2" FLG.		14	Nø						
88	FLANGE	3/4"	SW	4	Nø						

Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
0	11.02.2022	Issued As Standard	Manoj/AB	GG/AR	MN	SM

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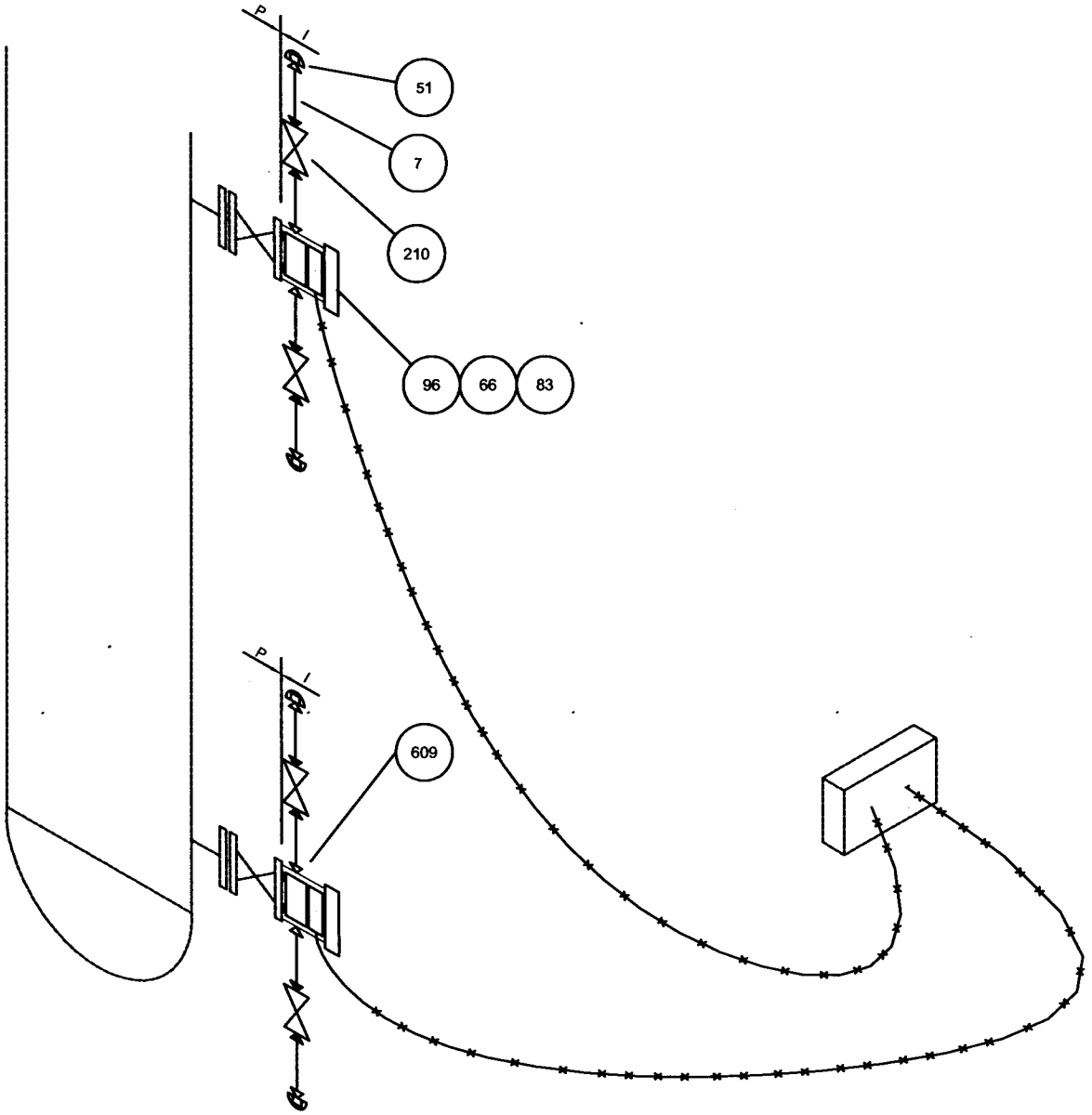
STANDARD NO. 7-52-0468 REV-5 RENUMBERED



P - BY PIPING
I - BY INSTRUMENTATION

LIST OF ITEMS

CODE	DESCRIPTION	SIZE	ENDS	QTY.	UNIT	CODE	DESCRIPTION	SIZE	ENDS	QTY.	UNIT
7	NIPPLE	1/2"	TH X PL	8	Nø	609	DRIP RING (2 TAPS)	3" X 1/2"	FL X TH	2	Nø
51	CAP	1/2"	TH	4	Nø						
66	GASKET	FOR 3" FL		6	Nø						
83	STUDS & NUTS	FOR 3" FL	LONG (EXTRA)	2	Set						
96	BLIND FLANGE	3"		2	Nø						
210	GATE VALVE	1/2"	SW	4	Nø						

Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
0	09.06.2021	Issued As Standard	Manoj	AJS	MN	SM

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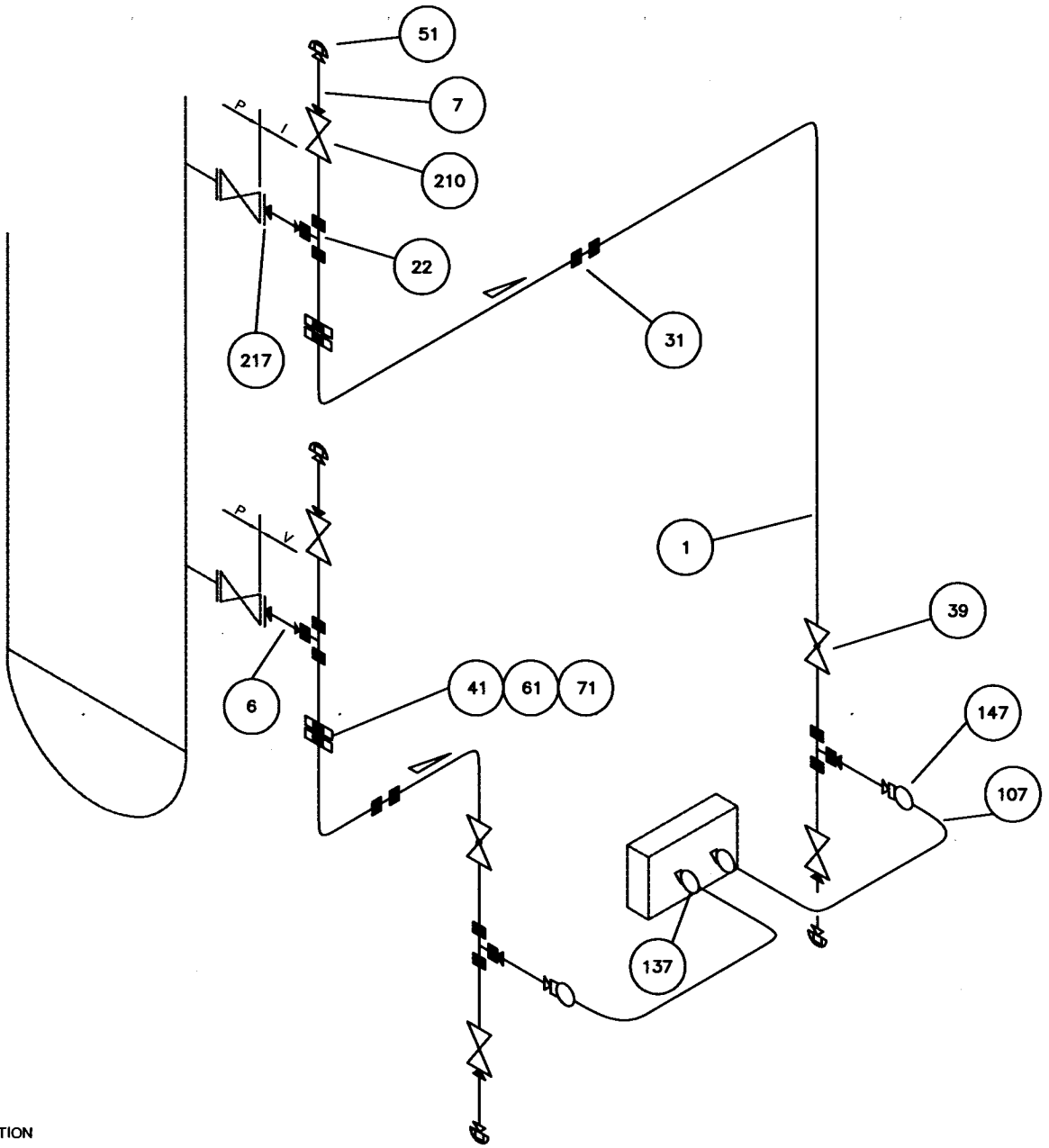
STANDARD NO. 7-52-0469 REV-6 RENUMBERED



P - BY PIPING
I - BY INSTRUMENTATION

* PL x PL NIPPLE SHALL BE FABRICATED FROM PIPE

LIST OF ITEMS

CODE	DESCRIPTION	SIZE	ENDS	QTY.	UNIT	CODE	DESCRIPTION	SIZE	ENDS	QTY.	UNIT
1	PIPE	1/2"	PL	A/R	m	107	TUBE	1/2"	OD	A/R	m
6	NIPPLE *	1/2"	PL X PL	2	Nø	137	MALE CONNECTOR	1/2" X 1/2"	TH X OD	2	Nø
7	NIPPLE	1/2"	TH X PL	6	Nø	147	FEMALE CONNECTOR	1/2" X 1/2"	TH X OD	2	Nø
22	EQUAL TEE	1/2"	SW	4	Nø						
31	COUPLING	1/2"	SW	2	Nø						
39	GLOBE VALVE	1/2"	SW	2	Nø						
41	FLANGE	1/2"	SW	4	Nø						
51	CAP	1/2"	TH	4	Nø						
61	GASKET	FOR 1/2" FLG.		2	Nø						
71	STUDS & NUTS	FOR 1/2" FLG.		2	Set						
210	GATE VALVE	1/2"	SW	4	Nø						
217	FLANGE	2" X 1/2"	FL X SW (Red)	2	Nø						

Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
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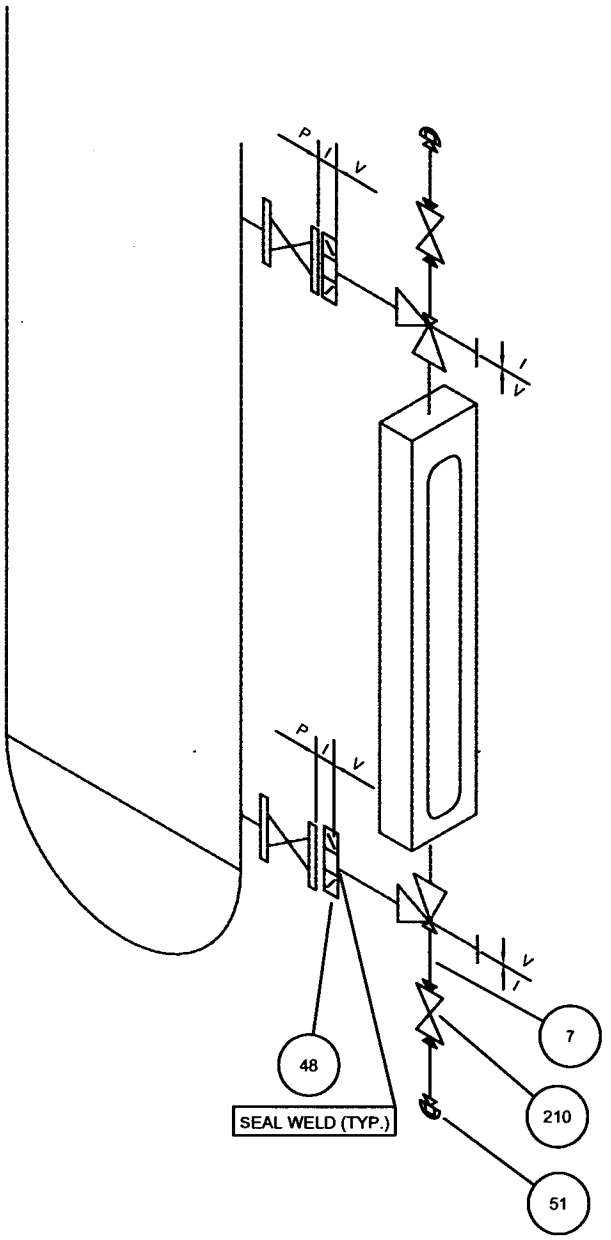
LEVEL GAUGE

ON VESSEL

STANDARD NO. 7-52-0481 REV-5 RENUMBERED



P - BY PIPING
I - BY INSTRUMENTATION
V - BY INSTRUMENT VENDOR

LIST OF ITEMS

CODE	DESCRIPTION	SIZE	ENDS	QTY.	UNIT	CODE	DESCRIPTION	SIZE	ENDS	QTY.	UNIT
7	NIPPLE	1/2"	TH X PL	4	Nø						
48	FLANGE	2" X 3/4"	FL X TH (Red)	2	Nø						
51	CAP	1/2"	TH	2	Nø						
210	GATE VALVE	1/2"	SW	2	Nø						

Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
0	09.06.2021	Issued As Standard	Manoj	AJS	MN	SM

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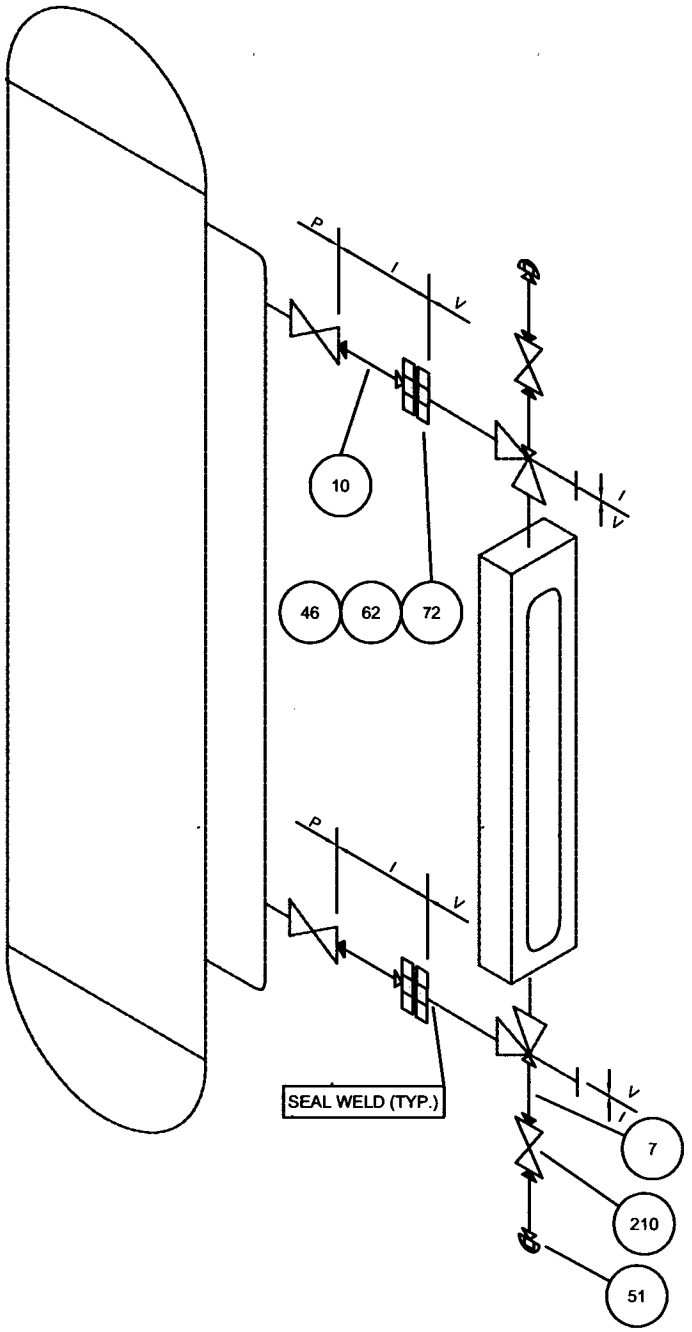
LEVEL GAUGE ON STAND PIPE

STANDARD NO. 7-52-0483 REV-3 RENUMBERED



P - BY PIPING
I - BY INSTRUMENTATION
V - BY INSTRUMENT VENDOR

LIST OF ITEMS

CODE	DESCRIPTION	SIZE	ENDS	QTY.	UNIT	CODE	DESCRIPTION	SIZE	ENDS	QTY.	UNIT
7	NIPPLE	1/2"	TH X PL	4	Nø						
10	NIPPLE	3/4"	TH X PL	2	Nø						
46	FLANGE	3/4"	TH	4	Nø						
51	CAP	1/2"	TH	2	Nø						
62	GASKET	FOR 3/4" FL		2	Nø						
72	STUDS & NUTS	FOR 3/4" FL		2	Set						
210	GLOBE VALVE	1/2"	SW	2	Nø						

Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
0	09.06.2021	Issued As Standard	Manoj	AJS	MN	SM

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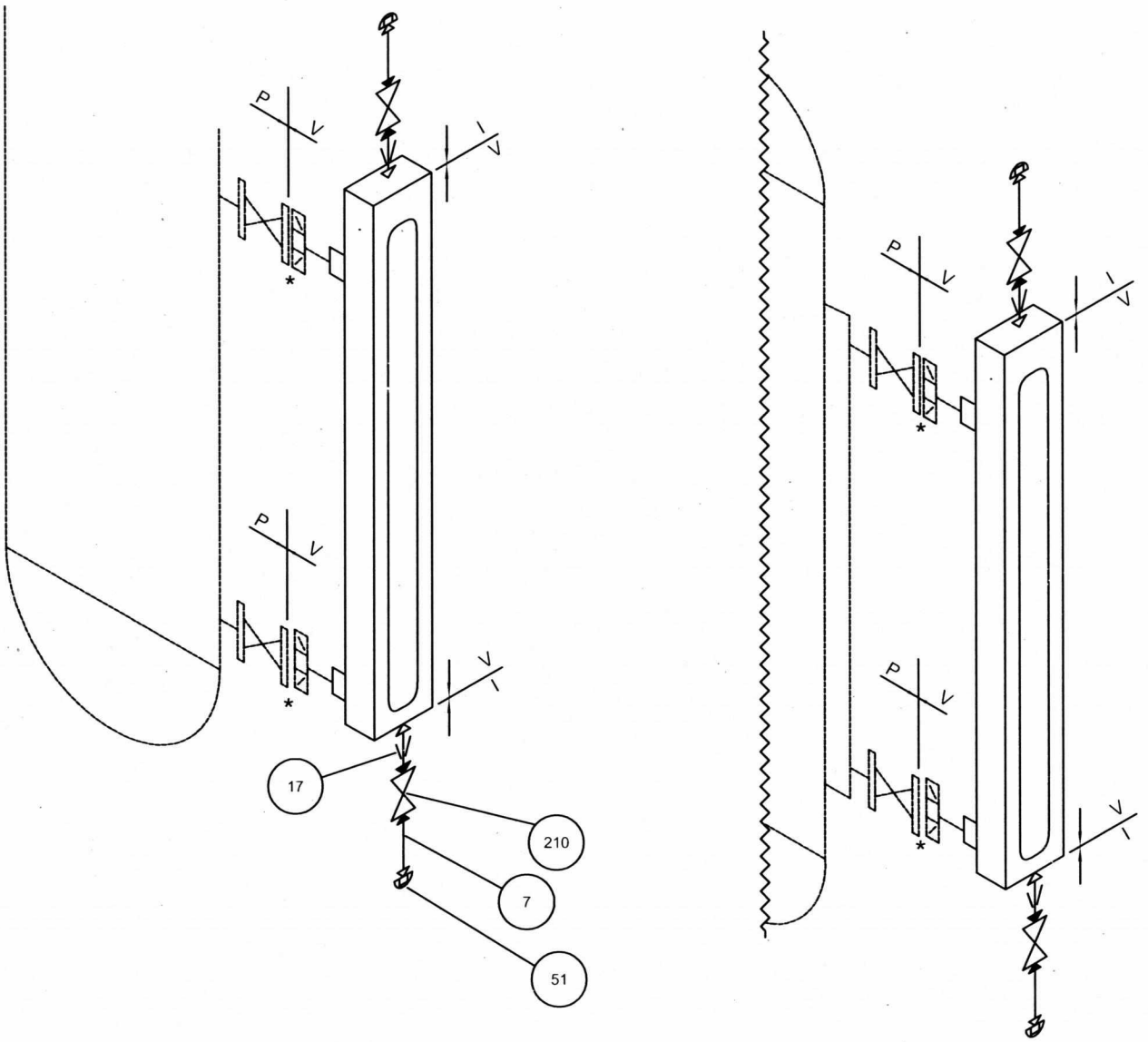
LEVEL GAUGE
MAGNETIC TYPE
ON VESSEL / STANDPIPE

STANDARD NO. 7-52-0484 REV-0 RENUMBERED



P - BY PIPING
I - BY INSTRUMENTATION
V - BY INST. VENDOR

* - STUD NUTS & GASKET BY PIPING

LIST OF ITEMS

CODE	DESCRIPTION	SIZE	ENDS	QTY.	UNIT	CODE	DESCRIPTION	SIZE	ENDS	QTY.	UNIT
7	NIPPLE	1/2"	PL X TH	2	Nø						
17	SWAGE NIPPLE	3/4" x 1/2"	TH X PL	2	Nø						
51	CAP	1/2"	TH	2	Nø						
210	GATE VALVE	1/2"	SW	2	Nø						

Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
1	01.05.2023	Revised & Reissued As Standard	Manoj	SG/AR	MN	SM
0	09.06.2021	Issued As Standard	Manoj	AJS	RG	RKT

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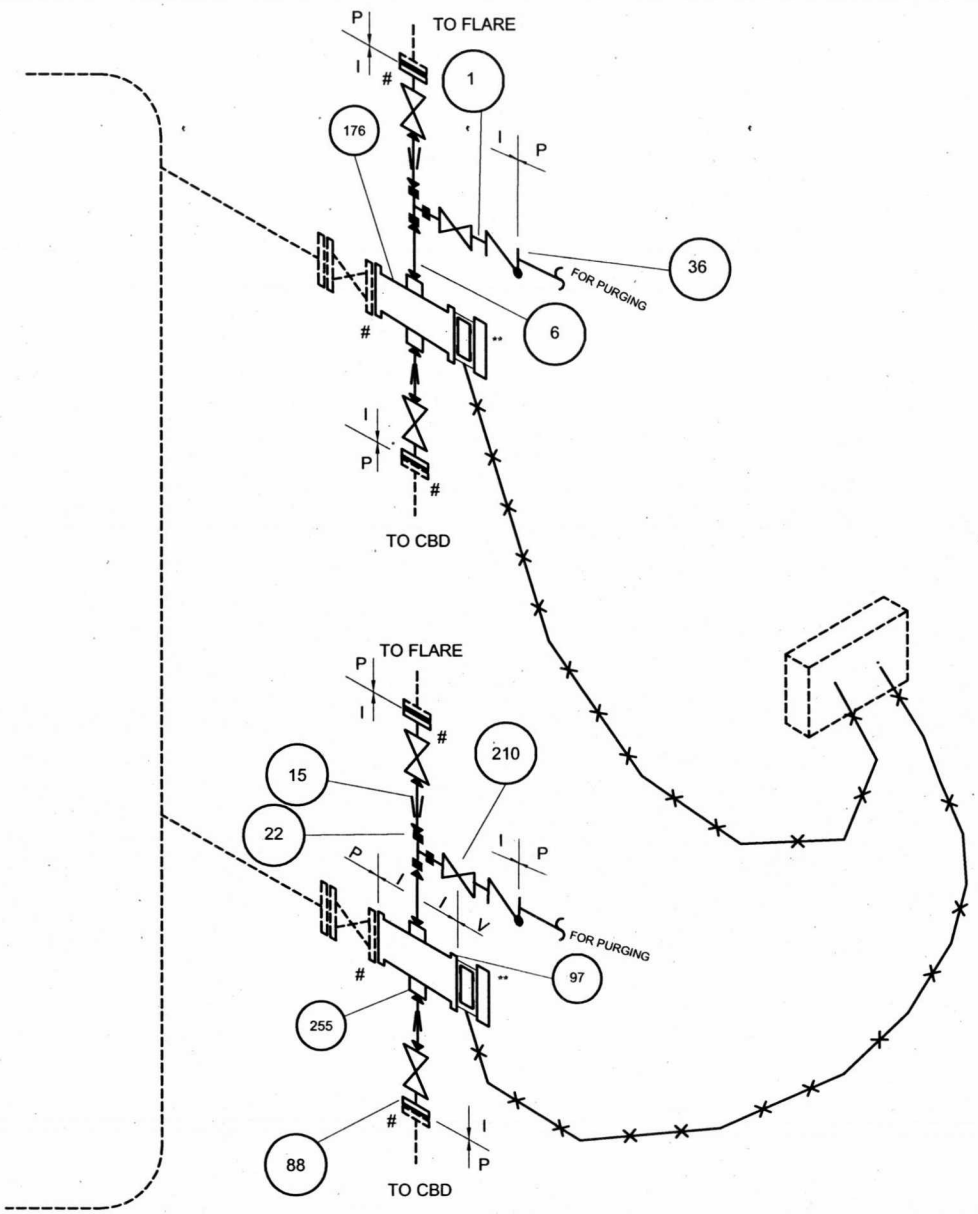

** GASKET, STUDS & NUTS (EXTRA LONG) BY VENDOR.

V - BY INSTR. VENDOR
P - BY PIPING
I - BY INSTRUMENTATION

STUD NUTS & GASKET BY PIPING

* PL x PL NIPPLE SHALL BE FABRICATED FROM PIPE

LIST OF ITEMS

CODE	DESCRIPTION	SIZE	ENDS	QTY.	UNIT	CODE	DESCRIPTION	SIZE	ENDS	QTY.	UNIT
1	PIPE	1/2"	PL	A/R	m						
6	NIPPLE	1/2"	PL X PL	2	Nø						
15	SWAGE NIPPLE	1/2"x3/4"	PL X PL	4	Nø						
22	EQUAL TEE	1/2"	SW	2	Nø						
36	CHECK VALVE	1/2"	SW	2	Nø						
88	FLANGE	3/4"	SW	4	Nø						
97	FLANGE	3"	WN	4	Nø						
176	PIPE	3"	PL	A/R	m						
210	GATE VALVE	1/2"	SW	6	Nø						
255	HALF COUPLING	1/2"		4	Nø						

Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
1	18.11.2022	Revised & Reissued	Manoj	GG/AR	MN	SM
0	11.02.2022	Issued As Standard	Manoj/AB	GG/AR	MN	SM

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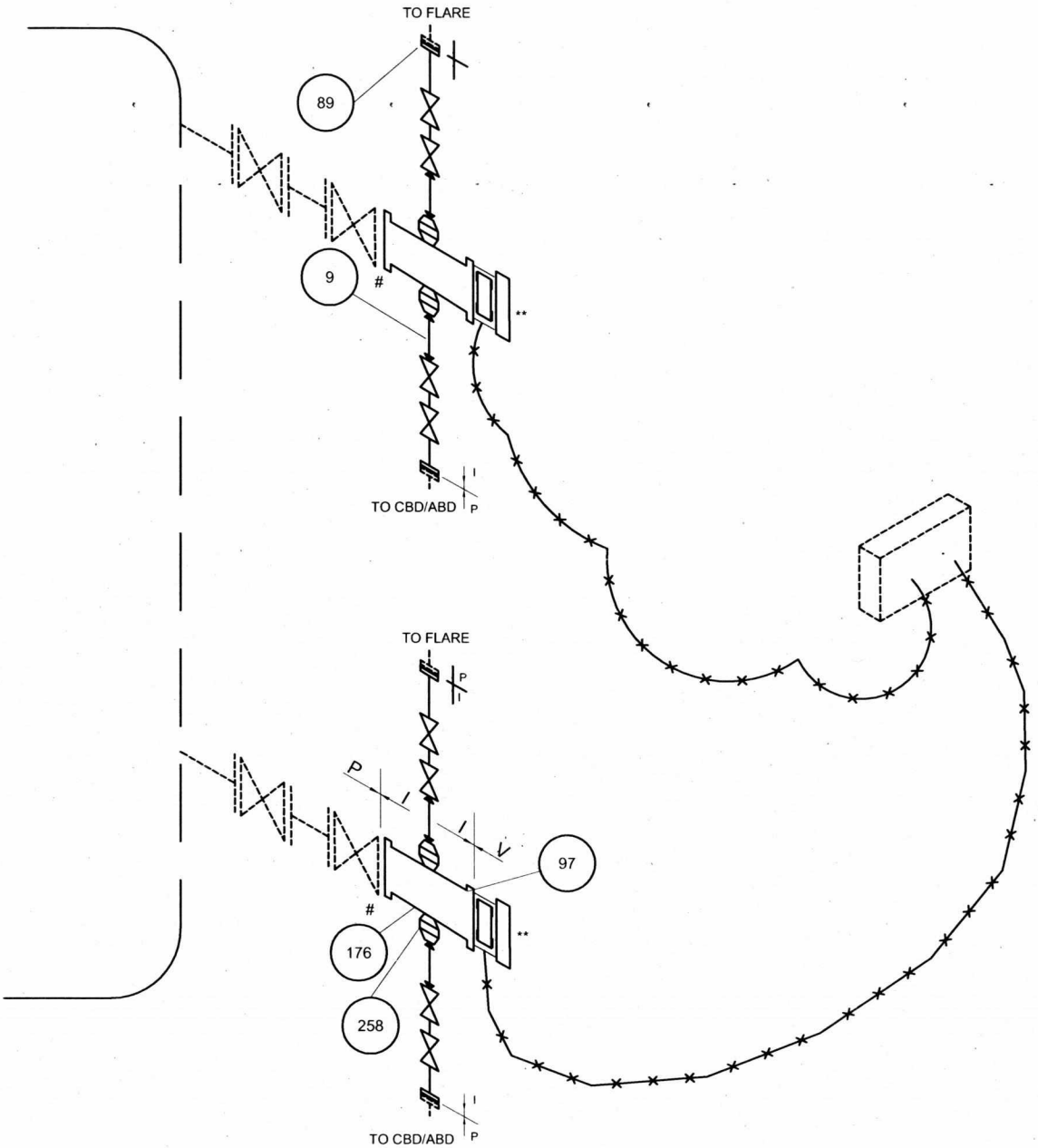

** GASKET, STUDS & NUTS (EXTRA LONG) BY VENDOR.
V - BY INSTR. VENDOR
P - BY PIPING
I - BY INSTRUMENTATION

STUD NUTS & GASKET BY PIPING
* PL x PL NIPPLE SHALL BE FABRICATED FROM PIPE

LIST OF ITEMS

CODE	DESCRIPTION	SIZE	ENDS	QTY.	UNIT	CODE	DESCRIPTION	SIZE	ENDS	QTY.	UNIT
9	NIPPLE *	3/4"	PL X PL	4	Nø						
89	FLANGE	3/4"	WN	4	Nø						
97	FLANGE	3"	WN	4	Nø						
176	PIPE	3"	PL	A/R	m						
251	GATE VALVE	3/4"	SW	4	Nø						
258	WELDOLET	3/4"	BW	4	Nø						

Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
2	01.12.2022	Revised & Reissued	Manoj	GG/AR	MN	SM
1	18.11.2022	Revised & Reissued	Manoj	GG/AR	MN	SM

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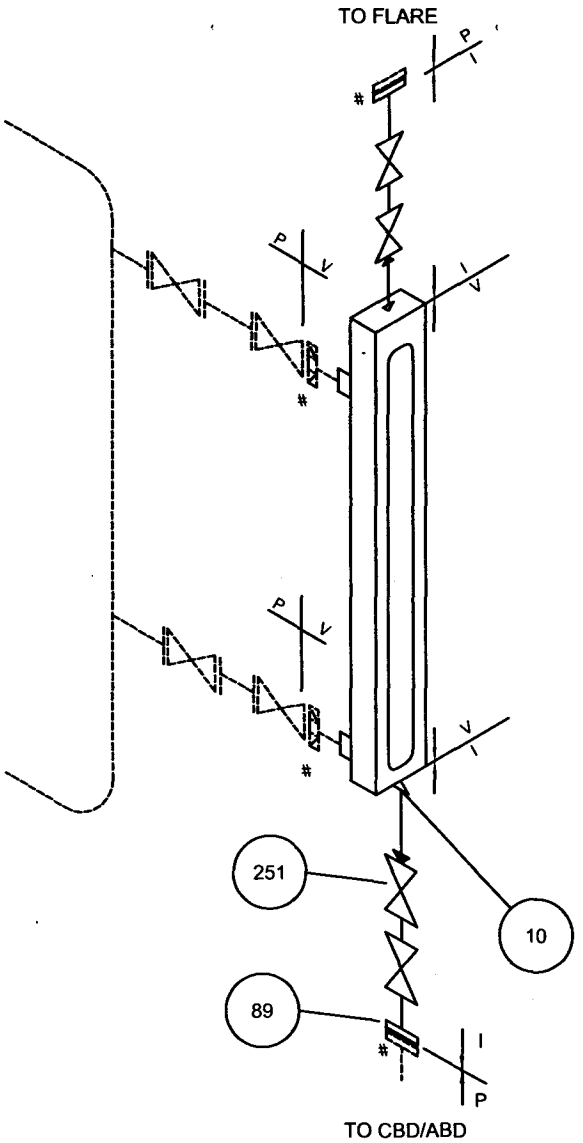

V - BY INSTR. VENDOR
P - BY PIPING
I - BY INSTRUMENTATION

STUD NUTS & GASKET BY PIPING

LIST OF ITEMS

CODE	DESCRIPTION	SIZE	ENDS	QTY.	UNIT	CODE	DESCRIPTION	SIZE	ENDS	QTY.	UNIT
10	NIPPLE	3/4"	TH X PL	2	Nø						
89	FLANGE	3/4"	WN	2	Nø						
251	GATE VALVE	3/4"	SW	4	Nø						

Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
0	11.02.2022	Issued As Standard	Manoj/AB	GG/AR	MN	SM

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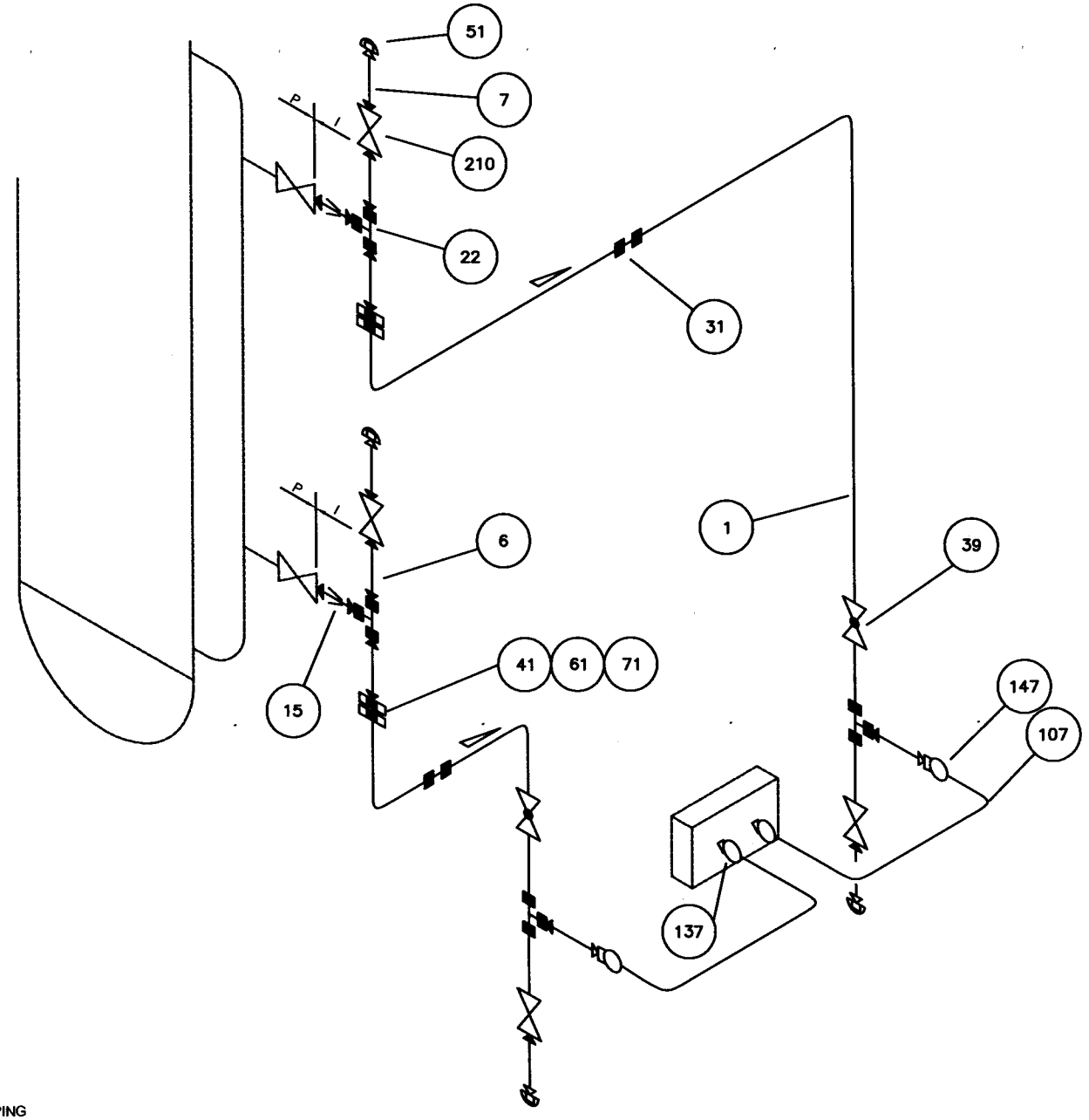
STANDARD NO. 7-52-0473 REV-5 RENUMBERED



P - BY PIPING
I - BY INSTRUMENTATION

* PL x PL NIPPLE SHALL BE FABRICATED FROM PIPE

LIST OF ITEMS

CODE	DESCRIPTION	SIZE	ENDS	QTY.	UNIT	CODE	DESCRIPTION	SIZE	ENDS	QTY.	UNIT
1	PIPE	1/2"	PL	A/R	m	107	TUBE	1/2"	OD	A/R	m
6	NIPPLE *	1/2"	PL X PL	4	Nø	137	MALE CONNECTOR	1/2" X 1/2"	TH X OD	2	Nø
7	NIPPLE	1/2"	TH X PL	6	Nø	147	FEMALE CONNECTOR	1/2" X 1/2"	TH X OD	2	Nø
15	SWAGE NIPPLE	3/4" X 1/2"	PL X PL	2	Nø						
22	EQUAL TEE	1/2"	SW	4	Nø						
31	COUPLING	1/2"	SW	2	Nø						
39	GLOBE VALVE	1/2"	SW	2	Nø						
41	FLANGE	1/2"	SW	4	Nø						
51	CAP	1/2"	TH	4	Nø						
210	GATE VALVE	1/2"	SW	4	Nø						
61	GASKET	FOR 1/2" FLG.		2	Nø						
71	STUDS & NUTS	FOR 1/2" FLG.		2	Set						

Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
0	09.06.2021	Issued As Standard	Manoj	JAJS	MN	SM

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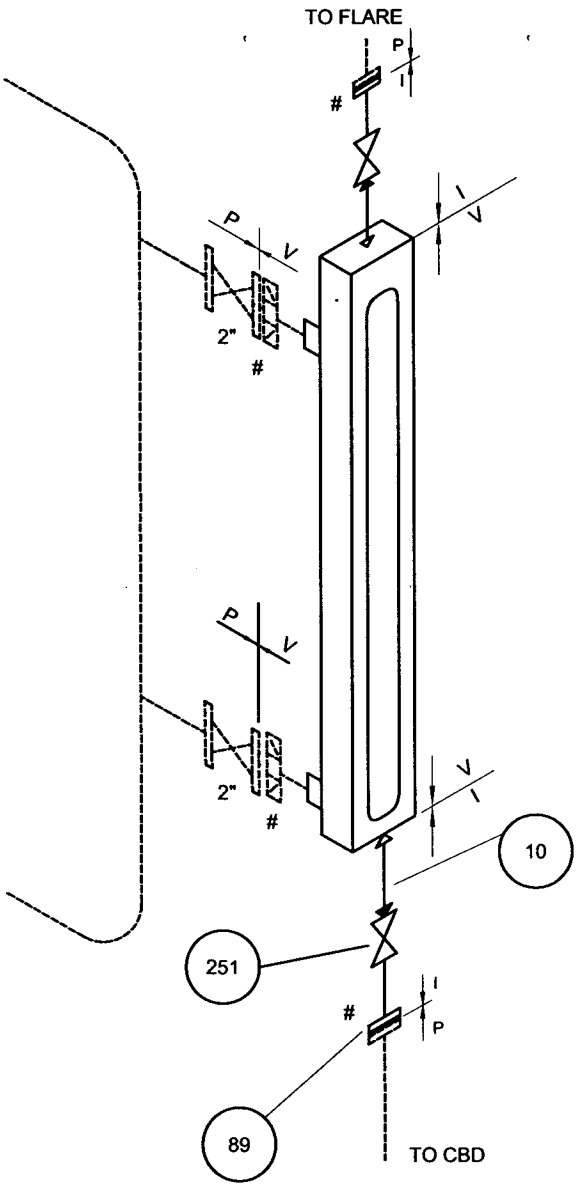
LEVEL GAUGE MAGNETIC TYPE (WN) ON VESSEL / STANDPIPE
3/4" VENT & DRAIN TO ABD / CBD



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P - BY PIPING
I - BY INSTRUMENTATION

STUD NUTS & GASKET BY PIPING

LIST OF ITEMS

CODE	DESCRIPTION	SIZE	ENDS	QTY.	UNIT	CODE	DESCRIPTION	SIZE	ENDS	QTY.	UNIT
10	NIPPLE	3/4"	TH X PL	2	Nø						
89	FLANGE	3/4"	WN	2	Nø						
251	GATE VAVE	3/4"	SW	2	Nø						

Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
0	11.02.2022	Issued As Standard	Mano/AB	GG/AR	MN	SM

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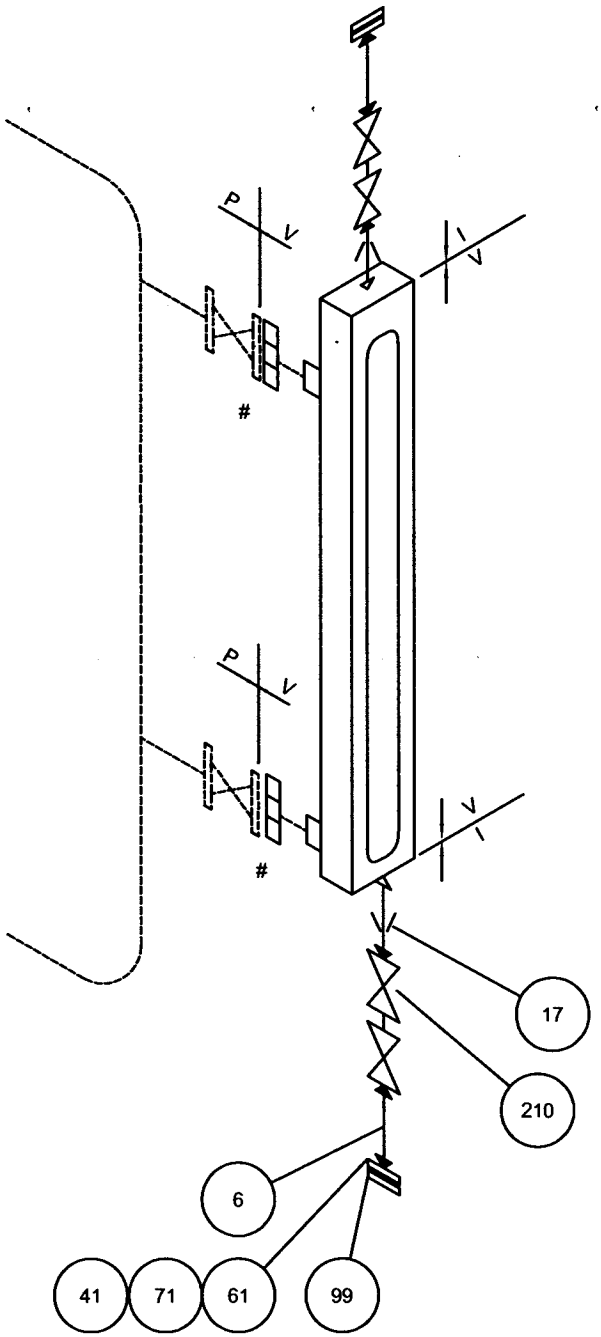

V - BY INSTR. VENDOR
P - BY PIPING
I - BY INSTRUMENTATION

STUD NUTS & GASKET BY PIPING
* PL x PL NIPPLE SHALL BE FABRICATED FROM PIPE

LIST OF ITEMS

CODE	DESCRIPTION	SIZE	ENDS	QTY.	UNIT	CODE	DESCRIPTION	SIZE	ENDS	QTY.	UNIT
6	NIPPLE *	1/2"	PL X PL	2	Nø						
17	SWAGE NIPPLE	3/4" X 1/2"	TH X PL	2	Nø						
41	FLANGE	1/2"	SW	2	Nø						
61	GASKET	FOR 1/2" FLG		2	Nø						
71	STUDS & NUTS	FOR 1/2" FLG		2	Set						
99	BLIND FLANGE	1/2"		2	Nø						
210	GATE VALVE	1/2"	SW	4	Nø						

Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
0	11.02.2022	Issued As Standard	Manoj/AB	GG/AR	MN	SM

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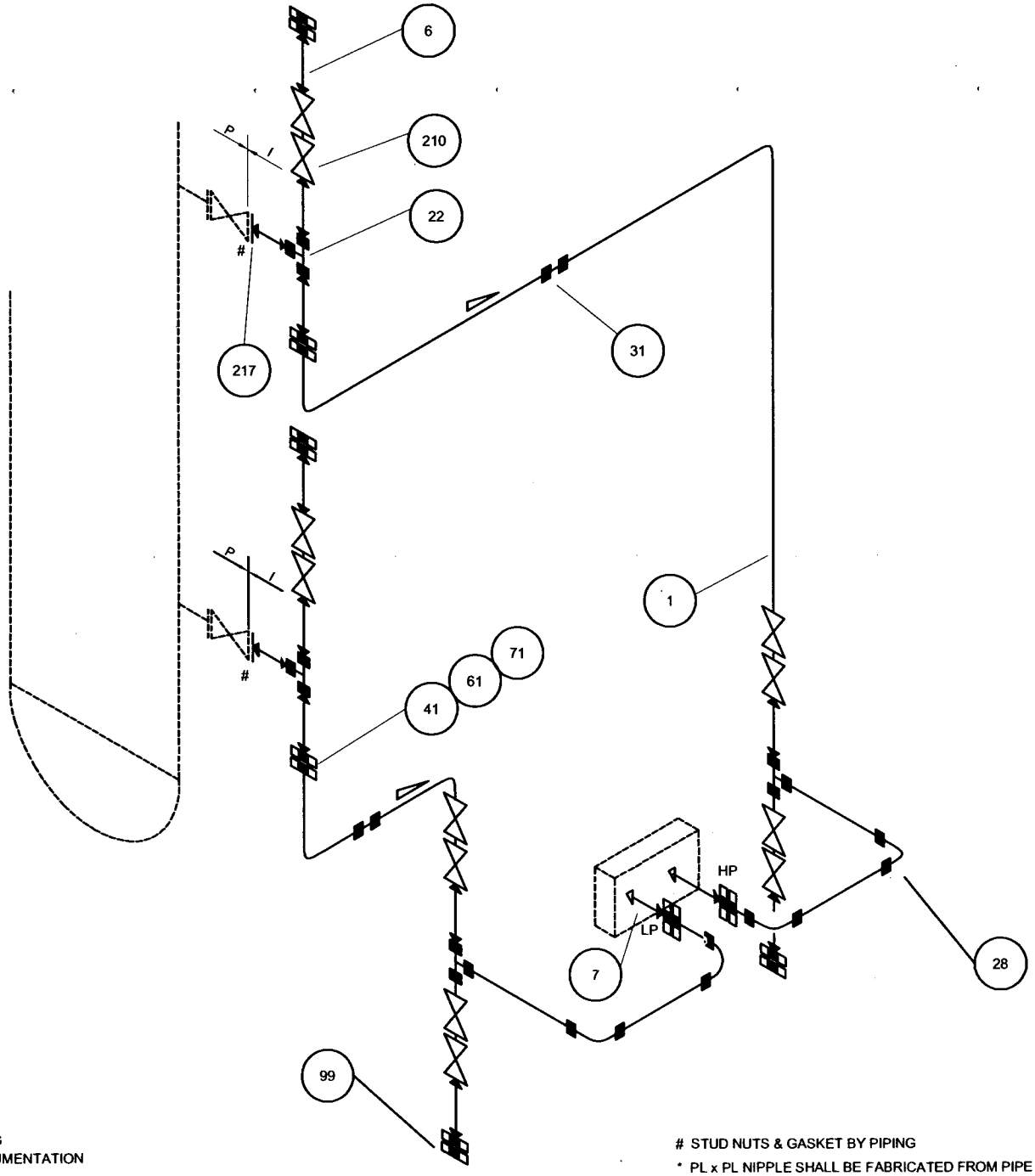

P - BY PIPING
I - BY INSTRUMENTATION

STUD NUTS & GASKET BY PIPING
* PL x PL NIPPLE SHALL BE FABRICATED FROM PIPE

LIST OF ITEMS

CODE	DESCRIPTION	SIZE	ENDS	QTY.	UNIT	CODE	DESCRIPTION	SIZE	ENDS	QTY.	UNIT
1	PIPE	1/2"	PL	A/R	m						
6	NIPPLE *	1/2"	PL X PL	12	Nø						
7	NIPPLE	1/2"	TH X PL	2	Nø						
22	EQUAL TEE	1/2"	SW	4	Nø						
28	ELBOW	1/2"	SW	4	Nø						
31	COUPLING	1/2"	SW	2	Nø						
41	FLANGE	1/2"	SW	12	Nø						
217	FLANGE	2" X 1/2"	FL X SW (Red)	2	Nø						
99	BLIND FLANGE	1/2"		4	Nø						
210	GATE VALVE	1/2"	SW	12	Nø						
61	GASKET	FOR 1/2" FLG.		8	Nø						
71	STUDS & NUTS	FOR 1/2" FLG.		8	Set						

Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
0	11.02.2022	Issued As Standard	Manoj/AB	GG/AR	MN	SM

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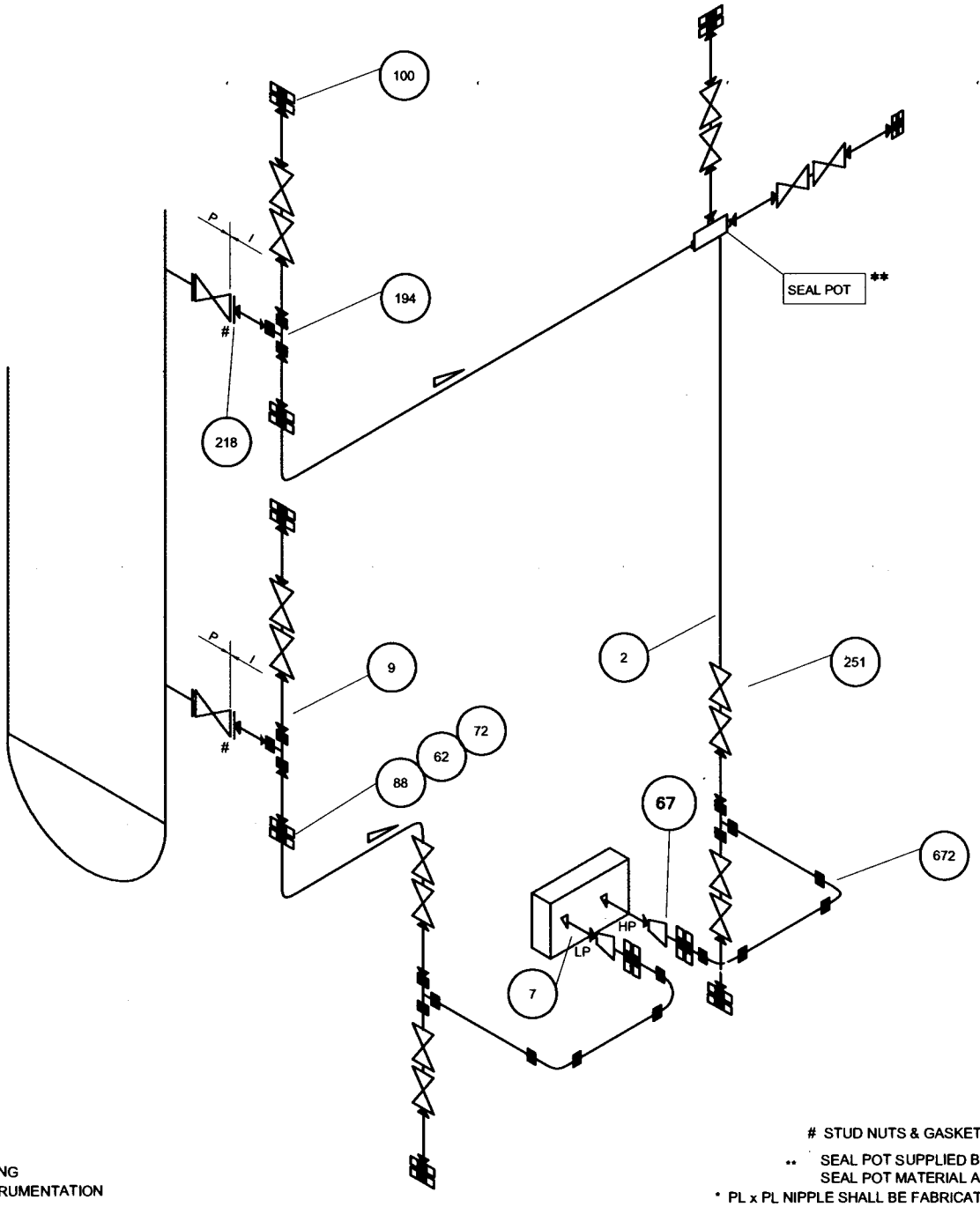

P - BY PIPING
I - BY INSTRUMENTATION

STUD NUTS & GASKET BY PIPING
** SEAL POT SUPPLIED BY CONTRACTOR
SEAL POT MATERIAL AS PER PMS
* PL x PL NIPPLE SHALL BE FABRICATED FROM PIPE

LIST OF ITEMS

CODE	DESCRIPTION	SIZE	ENDS	QTY.	UNIT	CODE	DESCRIPTION	SIZE	ENDS	QTY.	UNIT
2	PIPE	3/4"	PL	A/R	m						
7	NIPPLE	1/2"	TH X PL	2	Nø						
9	NIPPLE *	3/4"	PL X PL	16	Nø						
62	GASKET	FOR 3/4" FLG.		10	Nø						
67	REDUCER	3/4" x 1/2"	BW	2	Nø						
72	STUDS & NUTS	FOR 3/4" FLG.		10	Set						
88	FLANGE	3/4"	WN	14	Nø						
100	BLIND FLANGE	3/4"		6	Nø						
194	EQUAL TEE	3/4"	SW	4	Nø						
218	FLANGE	2" X 3/4"	FL X SW (Red)	2	Nø						
250	GATE VALVE	3/4"	BW	16	Nø						
672	ELBOW	3/4"	BW	4	Nø						

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0	11.02.2022	Issued As Standard	Manoj/AB	GG/AR	MN	SM

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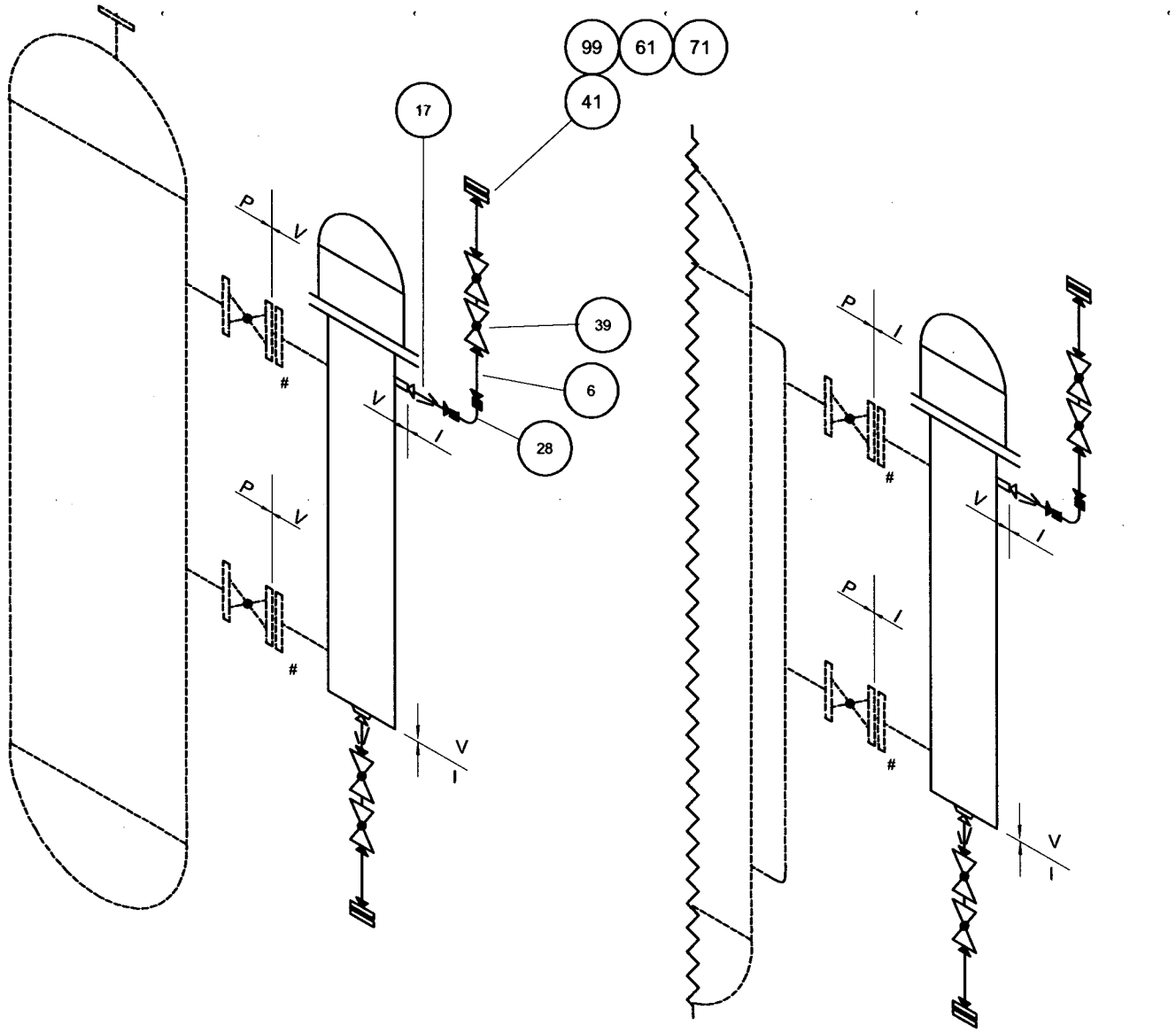

P - BY PIPING
I - BY INSTRUMENTATION
V - BY INSTR. VENDOR

STUD NUTS & GASKET BY PIPING
* PL x PL NIPPLE SHALL BE FABRICATED FROM PIPE

LIST OF ITEMS

CODE	DESCRIPTION	SIZE	ENDS	QTY.	UNIT	CODE	DESCRIPTION	SIZE	ENDS	QTY.	UNIT
6	NIPPLE *	1/2"	PL X PL	3	No						Nø
17	SWAGE NIPPLE	3/4" X 1/2"	TH X PL	2	No						
28	ELBOW	1/2"	SW	1	No						
39	GLOBE VALVE	1/2"	SW	4	No						
41	FLANGE	1/2"	PL x TH	2	Nø						
61	GASKET	FOR 1/2" FLG	SW	2	Nø						
71	STUDS & NUTS	FOR 1/2" FLG	TH	2	Set						
99	BLIND FLANGE	1/2"		2	Nø						

Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
0	11.02.2022	Issued As Standard	Manoj/AB	GG/AR	MN	SM

Approved by

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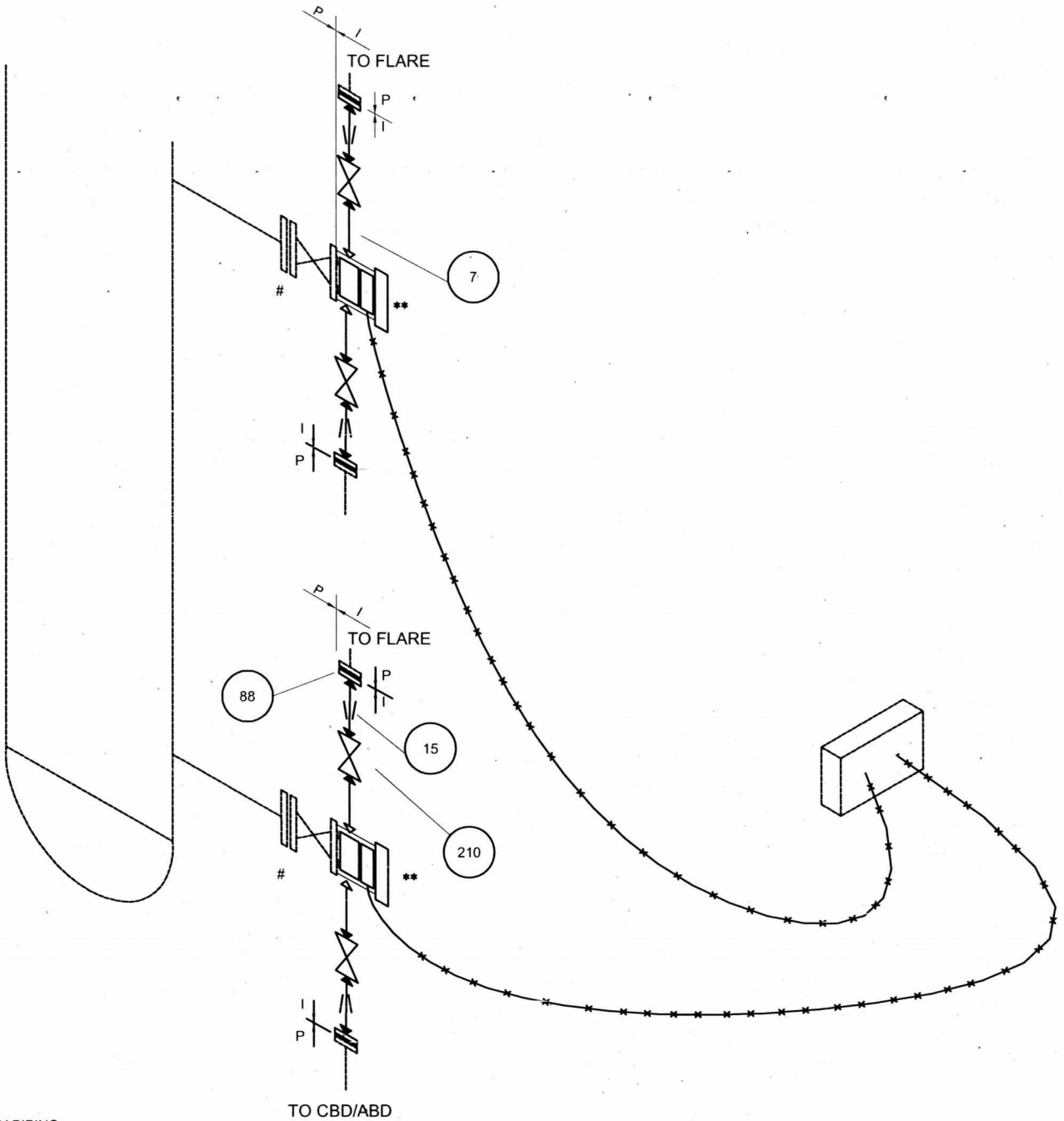

P - BY PIPING
I - BY INSTRUMENTATION

** SPACER RING WITH COMPANION FLANGE, GASKET, STUDS & NUTS (EXTRA LONG) BY VENDOR.
* PL x PL NIPPLE SHALL BE FABRICATED FROM PIPE

LIST OF ITEMS

CODE	DESCRIPTION	SIZE	ENDS	QTY.	UNIT	CODE	DESCRIPTION	SIZE	ENDS	QTY.	UNIT
7	NIPPLE	1/2"	PL X TH	4	Nø						
15	SWAGE NIPPLE	3/4"x 1/2"	PL X PL	4	Nø						
88	FLANGE	3/4"	SW	4	Nø						
210	GATE VALVE	1/2"	SW	4	Nø						

Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
0	14.11.2022	Issued As Standard	Manoj/AB	GG/AR	MN	SM

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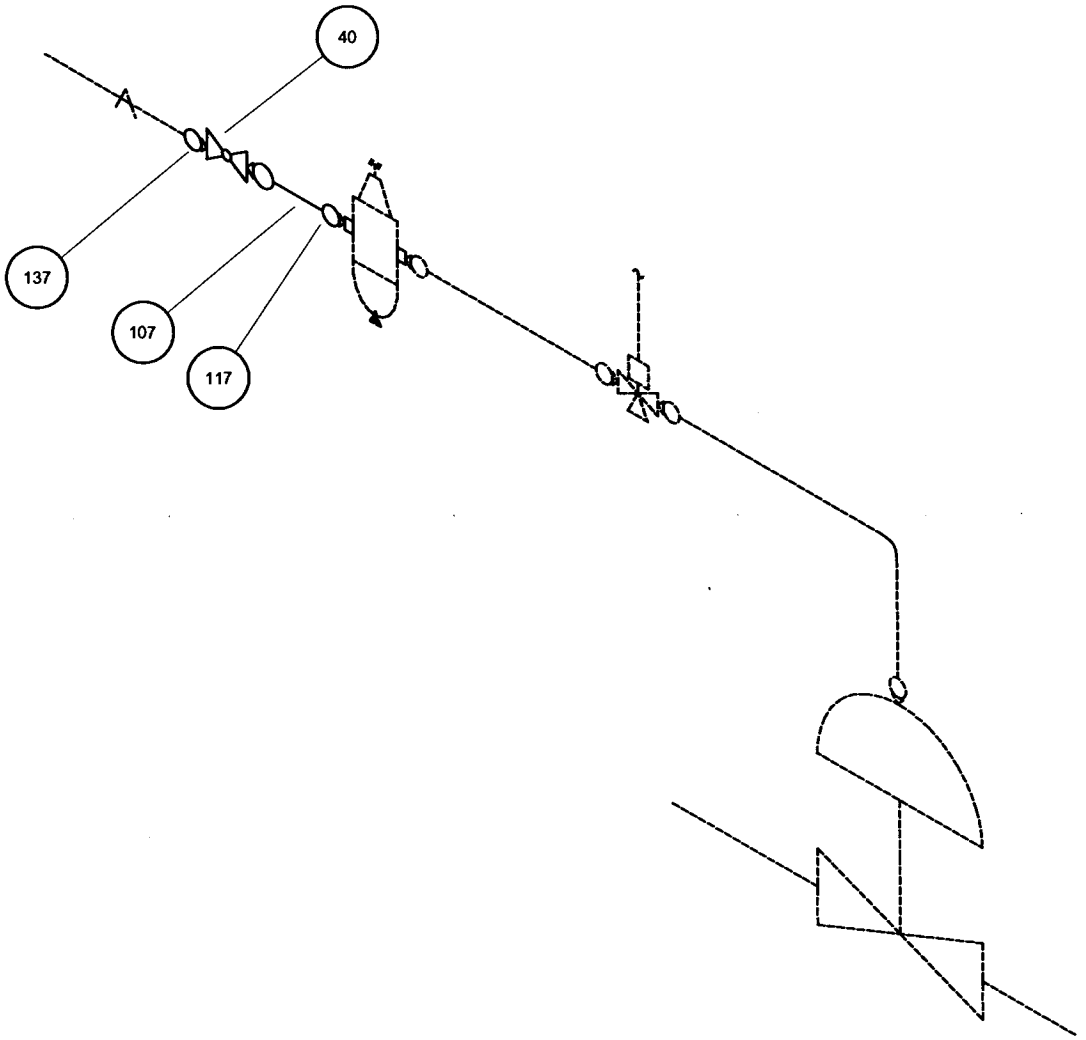

LIST OF ITEMS

CODE	DESCRIPTION	SIZE	ENDS	QTY.	UNIT	CODE	DESCRIPTION	SIZE	ENDS	QTY.	UNIT
40	BALL VALVE	1/2"	TH	1	Nø	107	TUBE	1/2"	OD	A/R	m
						117	MALE CONNECTOR	1/4" X 1/2"	TH X OD	1	Nø
						137	MALE CONNECTOR	1/2" X 1/2"	TH X OD	2	Nø

Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
0	11.02.2022	Issued As Standard	Manoj/AB	GG/AR	MN	SM

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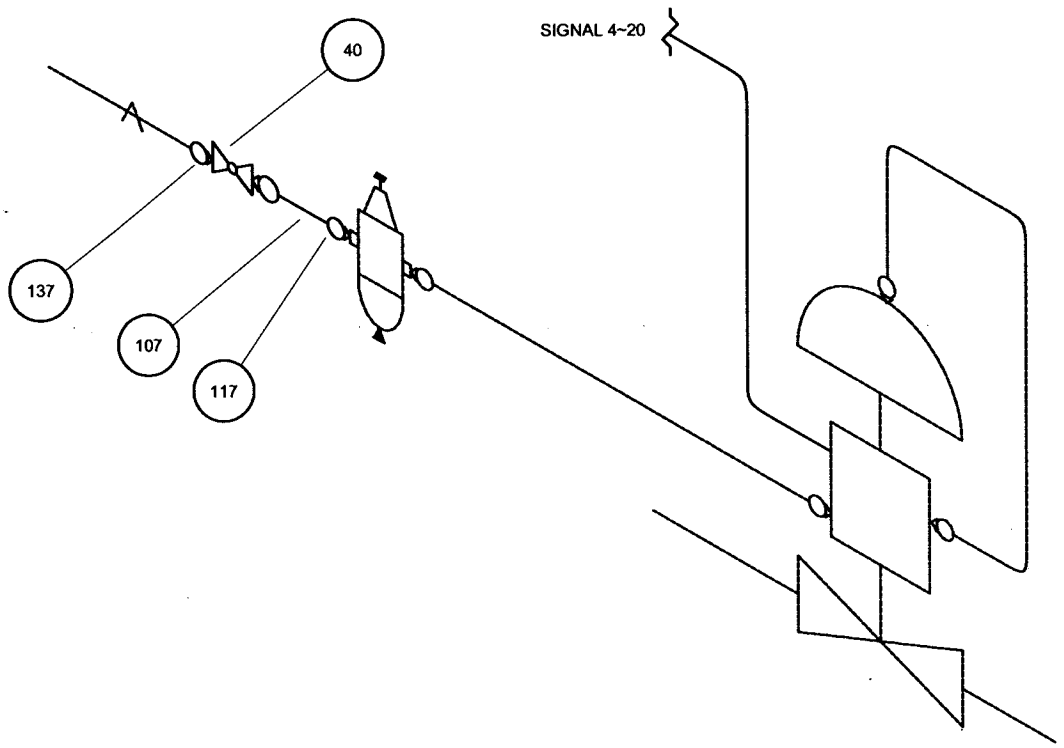

LIST OF ITEMS

CODE	DESCRIPTION	SIZE	ENDS	QTY.	UNIT	CODE	DESCRIPTION	SIZE	ENDS	QTY.	UNIT
40	BALL VALVE	1/2"	TH	1	Nø	107	TUBE	1/2" mm	OD	A/R	m
						117	MALE CONNECTOR	1/4" X 1/2"	TH X OD	1	Nø
						137	MALE CONNECTOR	1/2" X 1/2"	TH X OD	2	Nø

Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
0	11.02.2022	Issued As Standard	Manoj/AB	GG/AR	MN	SM

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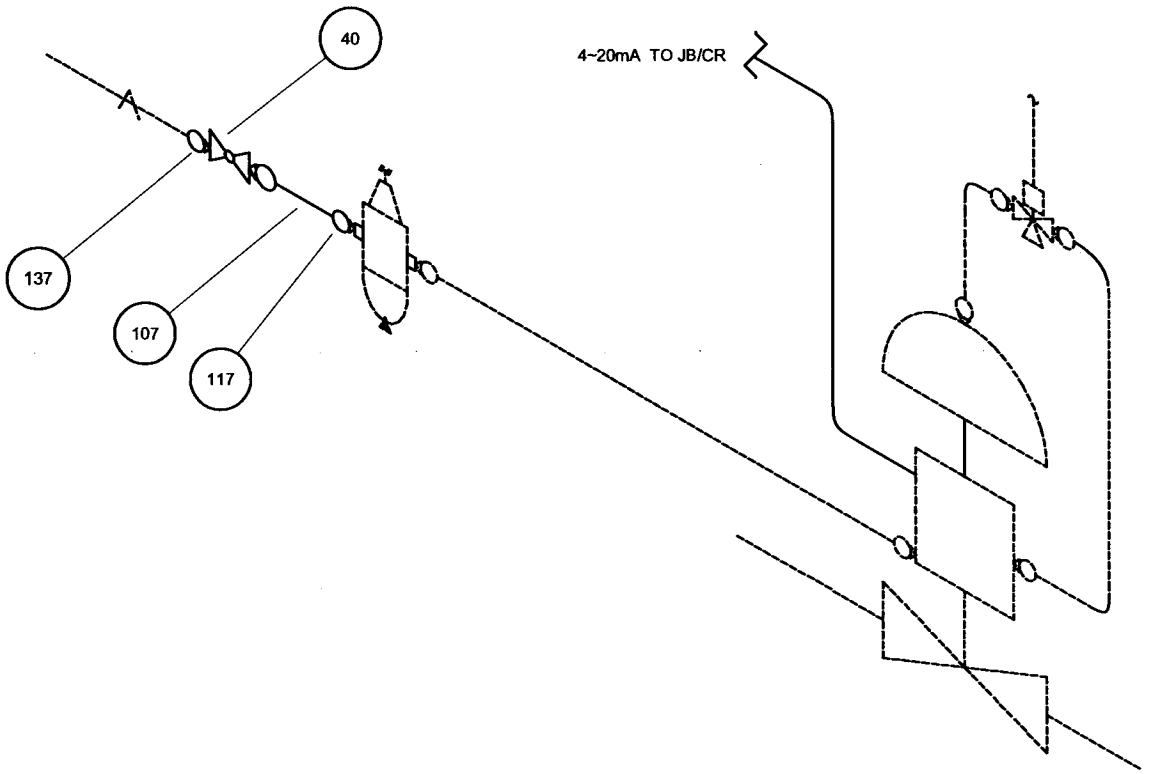

LIST OF ITEMS

CODE	DESCRIPTION	SIZE	ENDS	QTY.	UNIT	CODE	DESCRIPTION	SIZE	ENDS	QTY.	UNIT
40	BALL VALVE	1/2"	TH	1	Nø	107	TUBE	1/2"	OD	A/R	m
						117	MALE CONNECTOR	1/4" X 1/2"	TH X OD	1	Nø
						137	MALE CONNECTOR	1/2" X 1/2"	TH X OD	2	Nø

Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
0	11.02.2022	Issued As Standard	Manoj/AB	GG/AR	MN	SM

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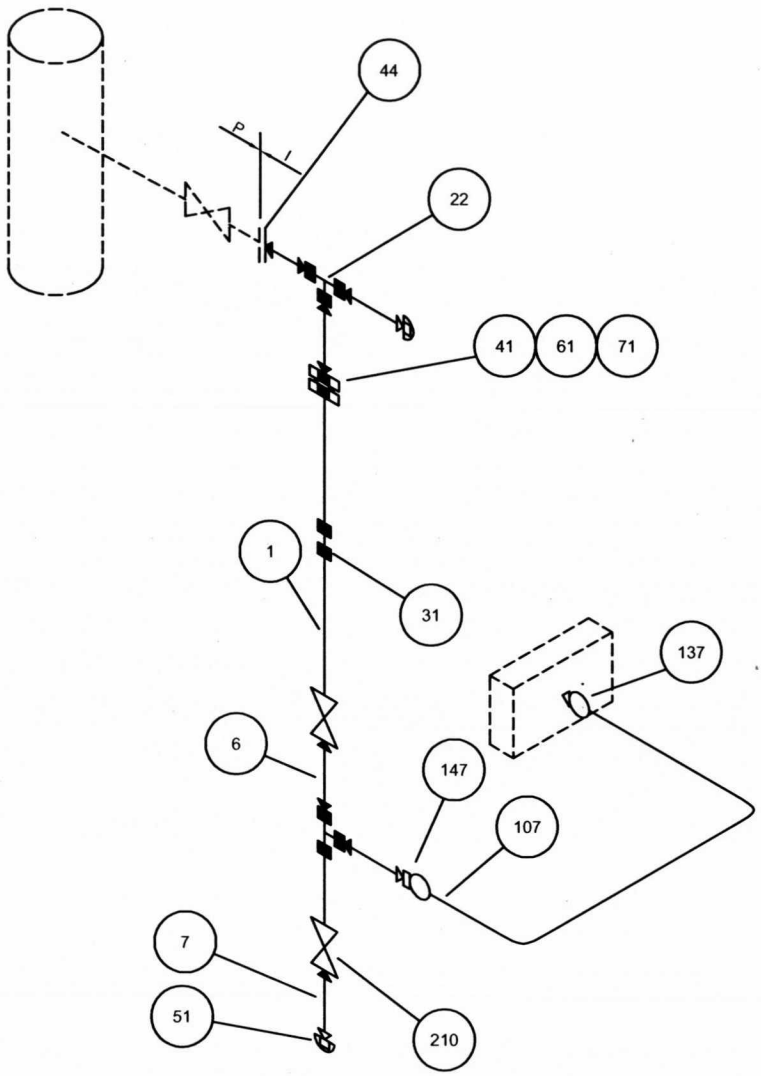

P - BY PIPING
I - BY INSTRUMENTATION

* PL x PL NIPPLE SHALL BE FABRICATED FROM PIPE

LIST OF ITEMS

CODE	DESCRIPTION	SIZE	ENDS	QTY.	UNIT	CODE	DESCRIPTION	SIZE	ENDS	QTY.	UNIT
1	PIPE	1/2"	PL	A/R	m	107	TUBE	1/2"	OD	A/R	m
6	NIPPLE *	1/2"	PL X PL	3	Nø	137	MALE CONNECTOR	1/2" X 1/2"	TH X OD	1	Nø
7	NIPPLE	1/2"	TH X PL	3	Nø	147	FEMALE CONNECTOR	1/2" X 1/2"	TH X OD	1	Nø
22	EQUAL TEE	1/2"	SW	1	Nø						
31	COUPLING	1/2"	SW	1	Nø						
41	FLANGE	1/2"	SW	2	Nø						
44	FLANGE	1 1/2" X 1/2"	FL X SW (Red)	1	Nø						
51	CAP	1/2"	TH	2	Nø						
61	GASKET	FOR 1/2" FLG.		1	Nø						
71	STUDS & NUTS	FOR 1/2" FLG.		1	Set						
210	GATE VALVE	1/2"	SW	2	Nø						

Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
0	01.07.2022	Issued As Standard	Manoj/AB	GG/AR	MN	SM

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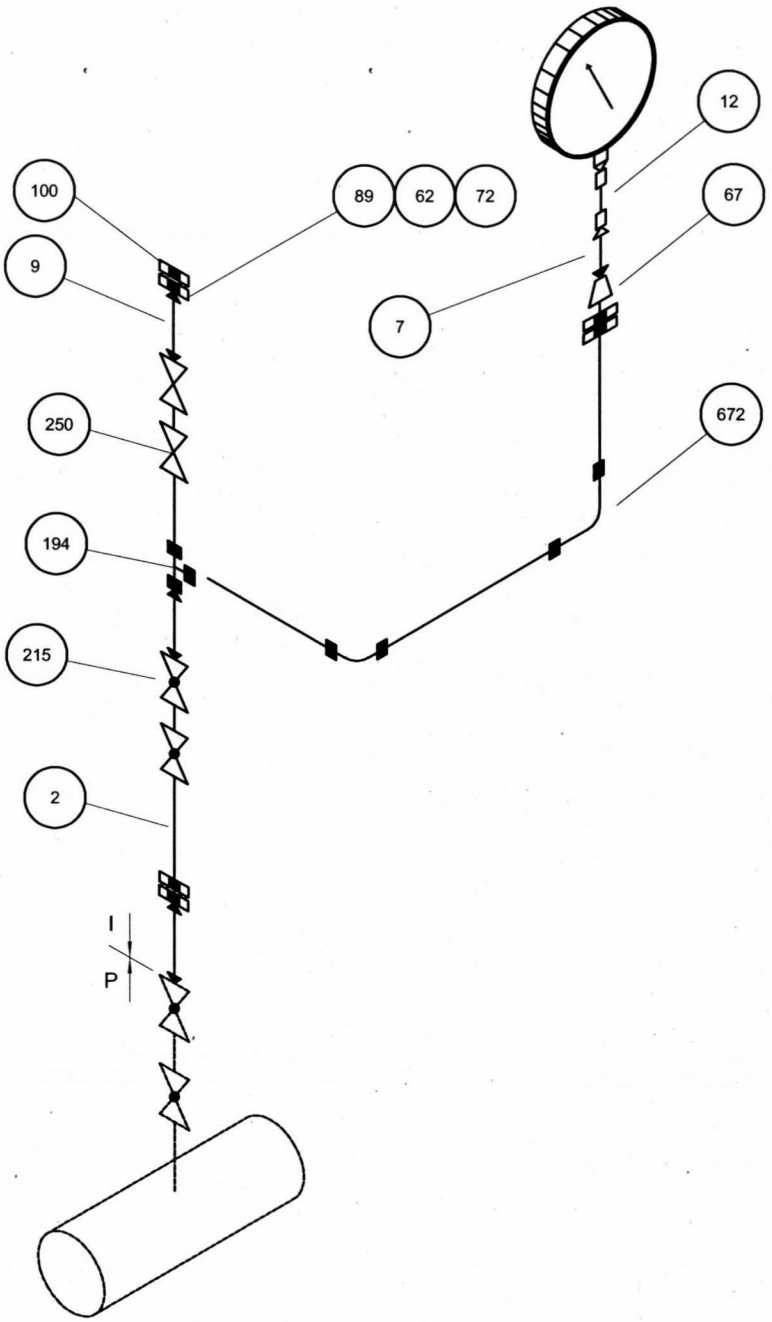

P - BY PIPING
I - BY INSTRUMENTATION

* PL x PL NIPPLE SHALL BE FABRICATED FROM PIPE

LIST OF ITEMS

CODE	DESCRIPTION	SIZE	ENDS	QTY.	UNIT	CODE	DESCRIPTION	SIZE	ENDS	QTY.	UNIT
2	PIPE	3/4"	PL	A/R	m	672	ELBOW	3/4"	BW	2	Nø
7	NIPPLE	1/2"	TH X PL	1	Nø						
9	NIPPLE *	3/4"	PL X PL	3	Nø						
12	COUPLING	1/2"	TH	1	Nø						
62	GASKET	FOR 3/4" FL		3	Nø						
67	REDUCER	3/4" x 1/2"	BW	1	Nø						
72	STUDS & NUTS	FOR 3/4" FL		3	Set						
89	FLANGE	3/4"	WN	5	Nø						
100	BLIND FLANGE	3/4"		1	Nø						
194	EQUAL TEE	3/4"	BW	1	Nø						
250	GATE VALVE	3/4"	BW	2	Nø						
215	GLOBE VALVE	3/4"	BW	2	Nø						

Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
0	27.10.2022	Issued As Standard	Manoj/AB	GG/AR	MN	SM

Approved by

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LIST OF DRAWINGS
(INSTRUMENTATION)
FOR
COOLING TOWER PACKAGE
TENDER No: C050-1U68-81-45-PB-T-8010

PROJECT : **EPCM SERVICES FOR POLYPROPYLENE UNIT AT NRL**

UNIT/UNIT NO. : **PROPYLENE UNIT (PP) / 1U68**

OWNER : **NUMALIGARH REFINERY LIMITED (NRL)**

CONSULTANT : **M/s ENGINEERS INDIA LTD.**

JOB NO. : **C050**

Rev. No	Date	Purpose	Prepared by	Checked by	Approved by
A	07.08.2025	ISSUED WITH TENDER	SS	RK	NK

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LIST OF DRAWINGS
(INSTRUMENTATION)

S. No.	Description	Document No.	No. of sheets	Rev.
1.	Schematic for IAMS Interface for Package PLCs.	C050-1U68-16-51-SK-8010	1	A
2.	Instrument Air Distribution	C050-1U68-16-51-IS-91	1	A
3.	Thermowell	7-52-0035	4	5
4.	Thermocouple / RTD assembly with thermowell	7-52-0036	1	6
5.	Orifice plates and flanges dimensional details.	7-52-0041	14	5
6.	Orifice plates and flanges dimensional details RTJ flanges	7-52-0042	18	1
7.	Instrument support single instrument	7-52-0101	3	4
8.	Instrument support two instruments	7-52-0102	3	4
9.	Support details for junction boxes	7-52-0104	2	4
10.	Fabricated canopy for instruments	7-52-0105	7	4
11.	Perforated tray supports & cables clamping details	7-52-0107	1	4
12.	Schematic for Instrument air distribution with manifold	7-52-1924	1	0

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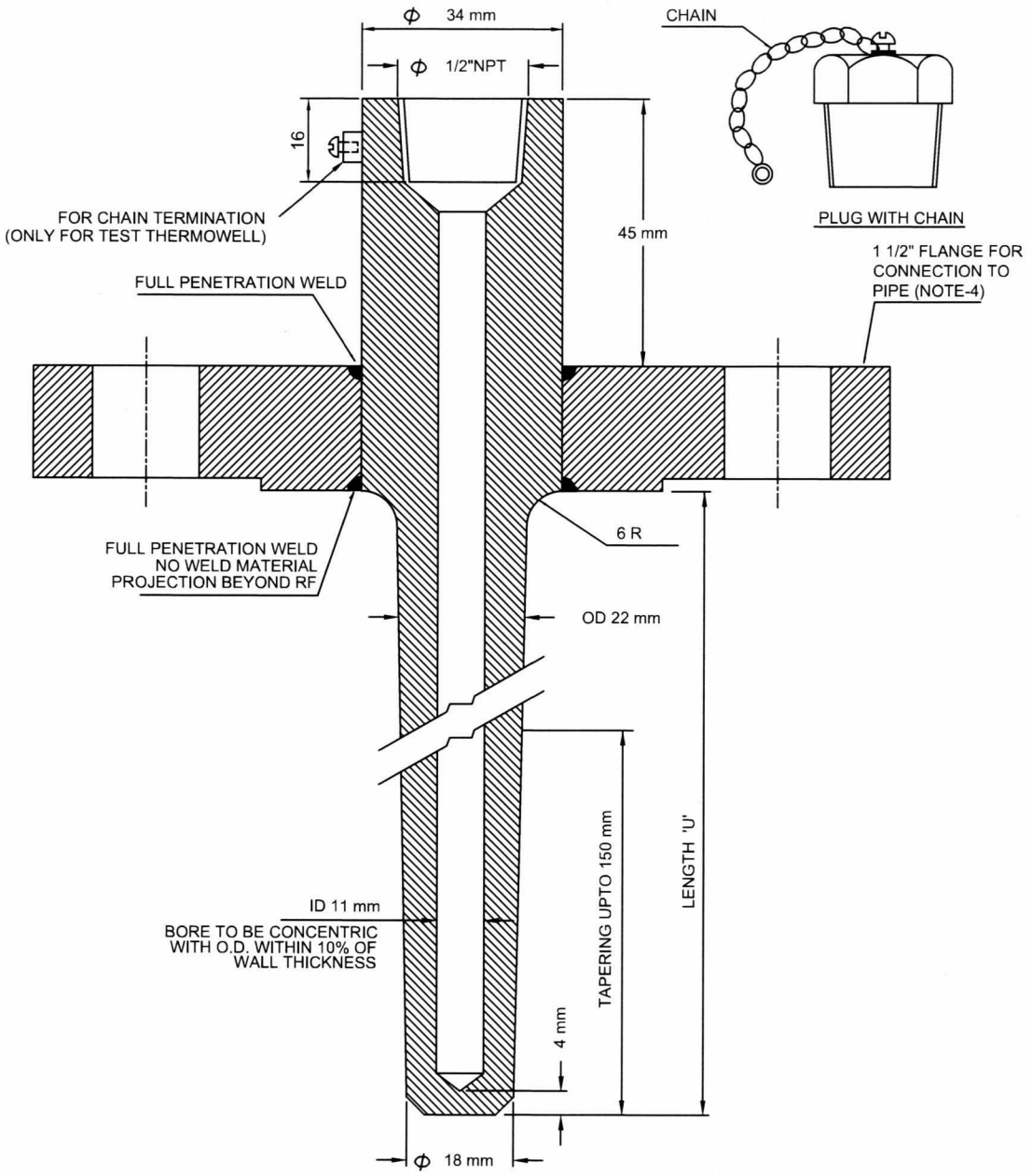

NOTES -

1. THIS STANDARD IS APPLICABLE FOR ;
   a) TEMPERATURE GAUGES, BEADED TEMPERATURE ELEMENTS AND DUPLEX TEMPERATURE ELEMENTS.
   b) THERMOWELL UPTO 1500 CLASS AS PER ASME OR EQUIVALENT WITH RF AS PER SPECIFICATIONS/PMS.
2. DP TEST SHALL BE CARRIED OUT FOR ALL WELD JOINTS. OTHER TESTING REQUIREMENT AS PER PMS.
3. CHAIN AND PLUG SHALL BE APPLICABLE ONLY FOR TEST THERMOWELLS.
4. FLANGE SIZE SHALL BE 2" FOR RATING (AS PER ASME CLASS) >600 OR THERMOWELL CONNECTION ON UNCLADDED EQUIPMENT. FOR CLADDED EQUIPMENT FLANGE SIZE SHALL BE 3"

Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
5	14-11-23	REVISED & REISSUED	Kushal/RSC	AJS	MN	MN
4	25-04-18	REAFFIRMED & REISSUED	Manoj	MN	RG	RN

Approved by

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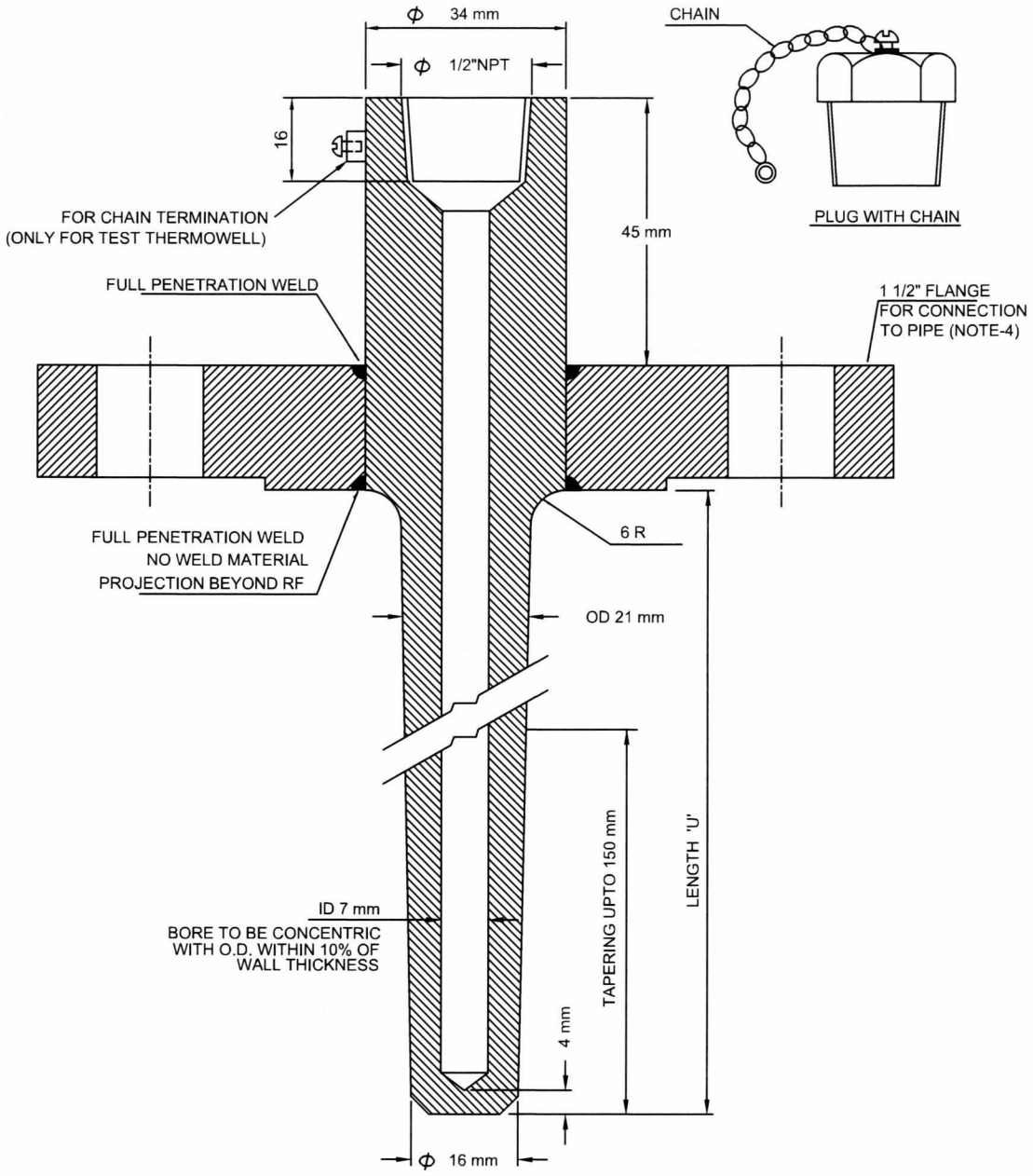

NOTES -

1. THIS STANDARD IS APPLICABLE FOR ;
   a) SINGLE TEMPERATURE ELEMENT.
   b) THERMOWELL UPTO 1500 CLASS AS PER ASME OR EQUIVALENT WTIH RF AS PER SPECIFICATIONS/PMS.
2. DP TEST SHALL BE CARRIED OUT FOR ALL WELD JOINTS. OTHER TESTING REQUIREMENT AS PER PMS.
3. CHAIN AND PLUG SHALL BE APPLICABLE ONLY FOR TEST THERMOWELLS.
4. FLANGE SIZE SHALL BE 2" FOR RATING (AS PER ASME CLASS) >600 OR THERMOWELL CONNECTION ON UNCLADDED EQUIPMENT. FOR CLADDED EQUIPMENT FLANGE SIZE SHALL BE 3"

Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
					Approved by	
5	14-11-23	REVISED & REISSUED	Kushal/RSC	AJS	MN	MN
4	25-04-18	REAFFIRMED & REISSUED	Manoj	MN	RG	RN

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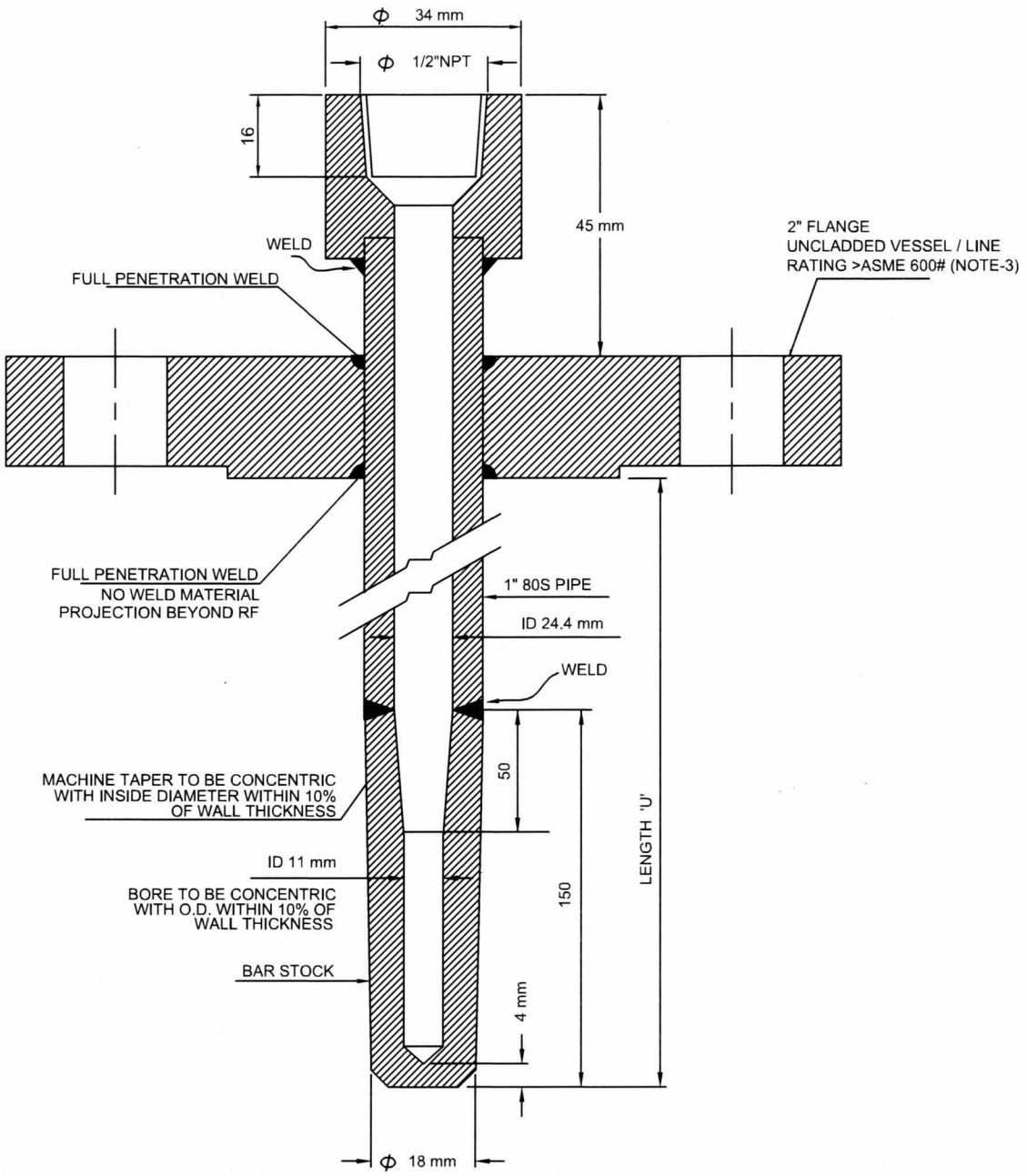
BUILT-UP THERMOWELL



NOTES:-

1. THIS STANDARD IS APPLICABLE FOR ;
   a) TEMPERATURE GAUGES, BEADED TEMPERATURE ELEMENTS AND DUPLEX TEMPERATURE ELEMENTS.
   b) THERMOWELL UPTO 1500 CLASS AS PER ASME OR EQUIVALENT WITH RF AS PER SPECIFICATIONS/PMS.
2. DP TEST SHALL BE CARRIED OUT FOR ALL WELD JOINTS. OTHER TESTING REQUIREMENT AS PER PMS.
3. FLANGE SIZE SHALL BE 3" FOR CLADDED EQUIPMENT, FLANGE SIZE SHALL BE 1.5" FOR LINE UP TO ASME CLASS 600#.

Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
					Approved by	
5	14-11-23	REVISED & REISSUED	Kushal/RSC	AJS	MN	MN
4	25-04-18	REAFFIRMED & REISSUED	Manoj	MN	RG	RN

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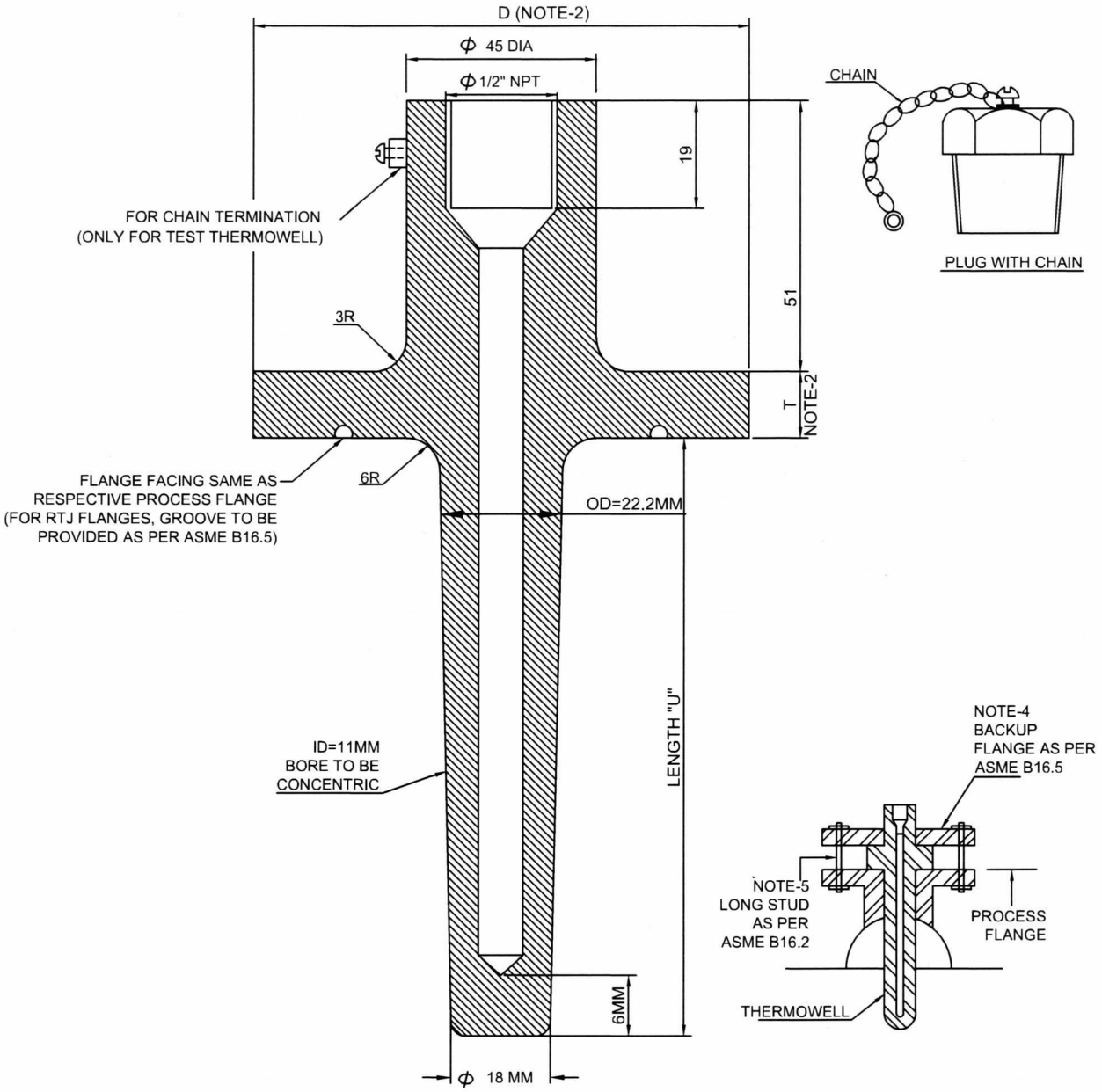
VANSTONE THERMOWELL BARSTOCK TAPERED



NOTES -

1. ALL DIMENSIONS ARE IN "MM". FIGURES IN BRACKETS ARE IN INCHES.
2. THE COLLAR SHOULD BE EQUAL TO RF DIA "R" FOR RF FACING WELD AND COLLAR DIA SHOULD BE DIA "K" AS PER ASME B16.5. THE COLLAR THICKNESS SHOULD BE 15MM FOR RF FACING UP TO 1500# AND 20MM FOR RF UPTO 2500# FLANGE END FOR ALL RATING OF RTJ FLANGE
3. THERMOWELLS SHALL BE HYDROSTATICALLY TESTED INTERNALLY FOR RESPECTIVE PRESSURE RATING.
4. VENDOR SHALL SUPPLY ASME BACK-UP FLANGE WITH A HOLE OF I.D. TO SUIT 45MM O.D. OF THERMOWELL WITH EACH THERMOWELL. THIS BACK UP FLANGE IS TO BE MOUNTED ON THE THERMOWELL ON THE OTHER SIDE OF PROCESS FLANGE. THE BACKUP FLANGE MATERIAL SHALL BE AS PER DATA SHEET.
5. SPECIAL LONG STUDS WITH NUTS TO FIX THE THERMOWELL WITH PROCESS FLANGE AND BACK-UP FLANGES SHALL BE SUPPLIED ALONG WITH EACH TAG.
6. FLANGE SIZE & RATING AS PER DATA SHEET.

Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
					Approved by	
5	14-11-23	ISSUED AS STANDARD	Kushal/RSC	AJS	MN	MN

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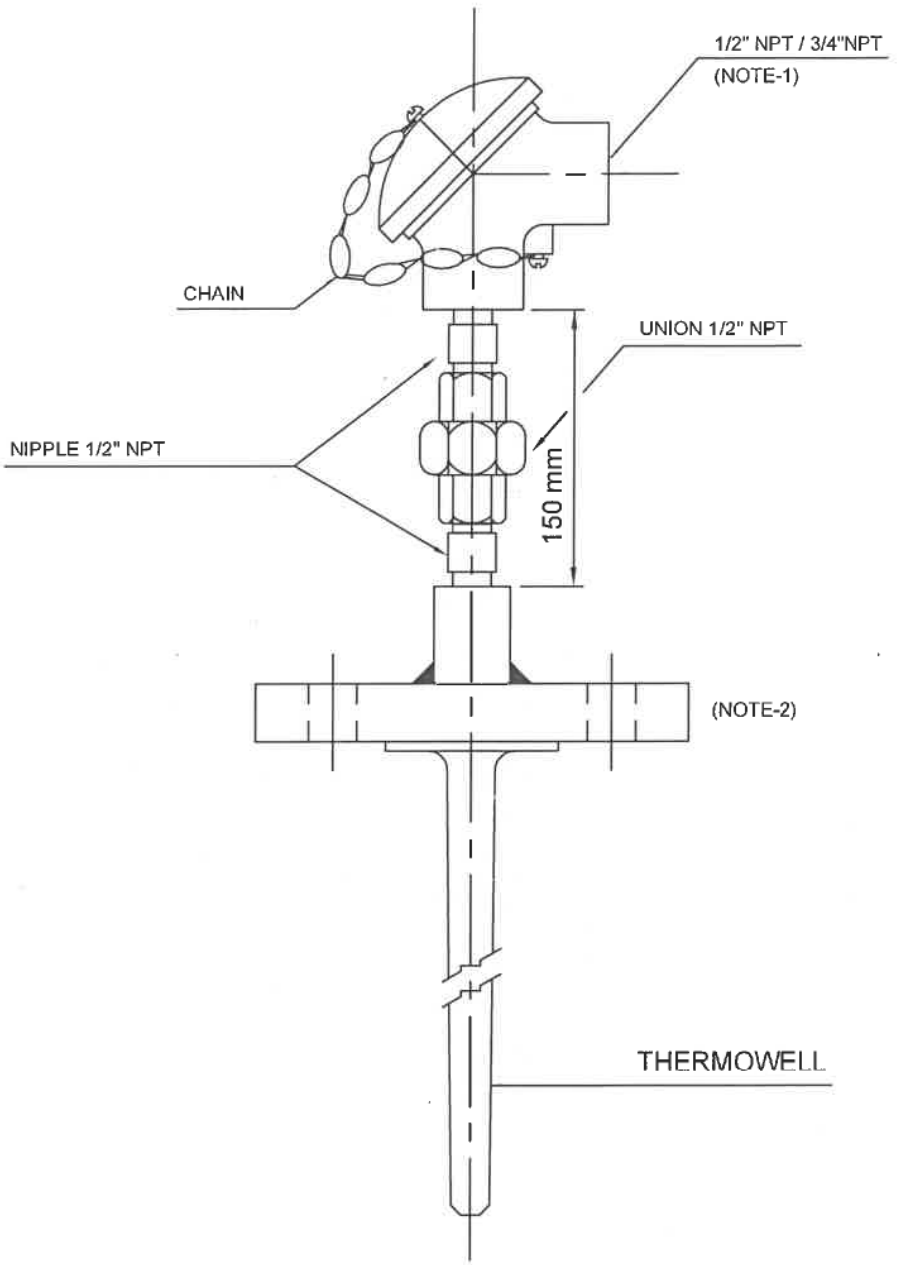

NOTE -
1. IN THE CASE OF DUPLEX THERMOCOUPLE/RTD, TWO INDEPENDENT 3/4"(NPT) CABLE ENTRIES SHALL BE PROVIDED.
2. FLANGE TYPE, SIZE AND RATING SHALL BE AS PER DATA SHEET.

Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
					Approved by	
6	21.10.24	Reaffirmed & Reissued As Standard	Sonu	AJS	MN	MN
5	10.10.19	Reaffirmed & Reissued As Standard	Manoj	MN	RG	RN

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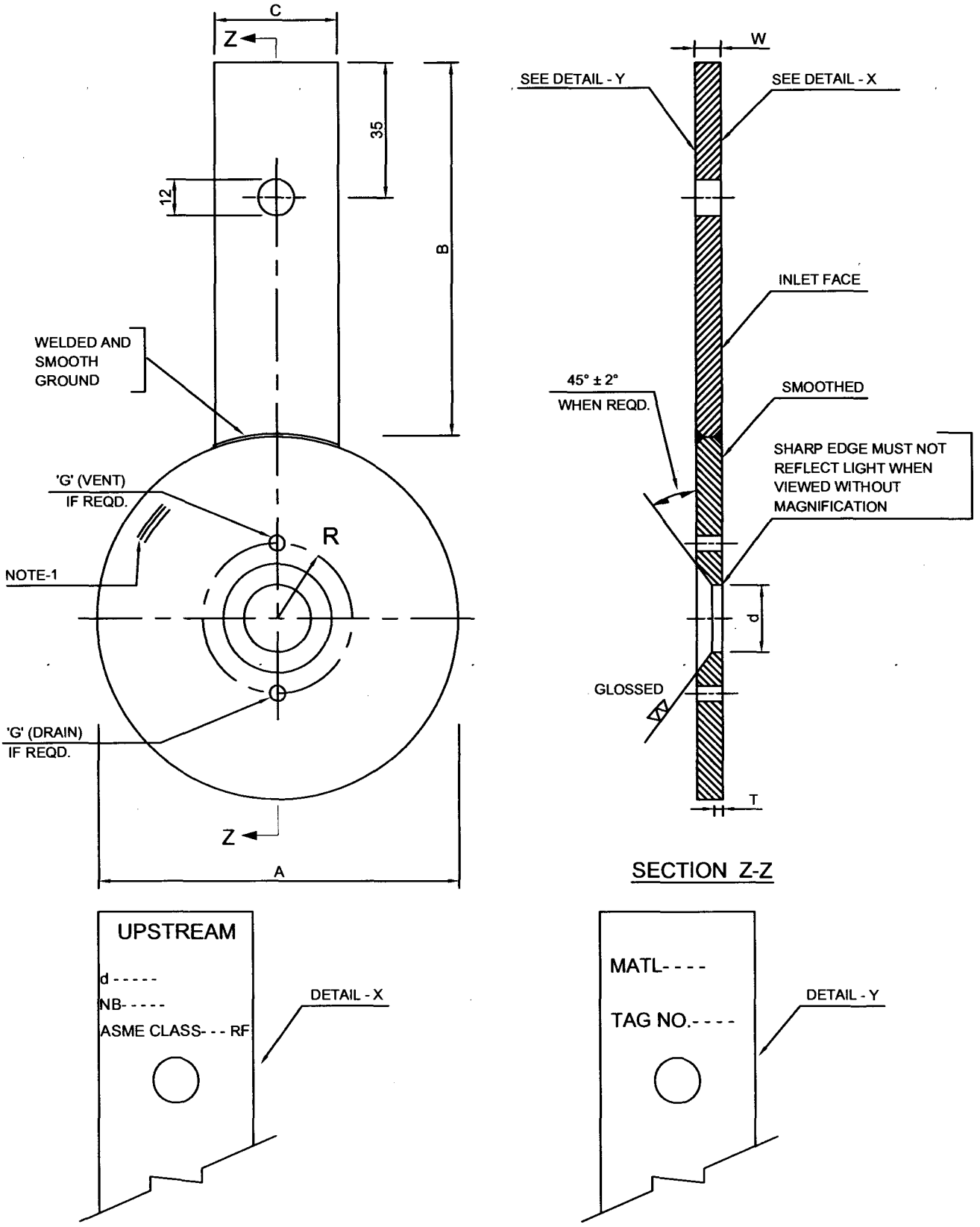

CONCENTRIC SQUARE EDGED ORIFICE PLATE

NOTE :-

1. SERRATION SHALL BE CONSIDERED ON THE ORIFICE PLATE NEAR THE GASKET ZONE.

Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
5	12-02-21	REVISED & REISSUED	Manoj	JJ	MN	SM
4	28.03.17	REVISED & REISSUED	Manoj/RS	MN	RG	RN

Approved by

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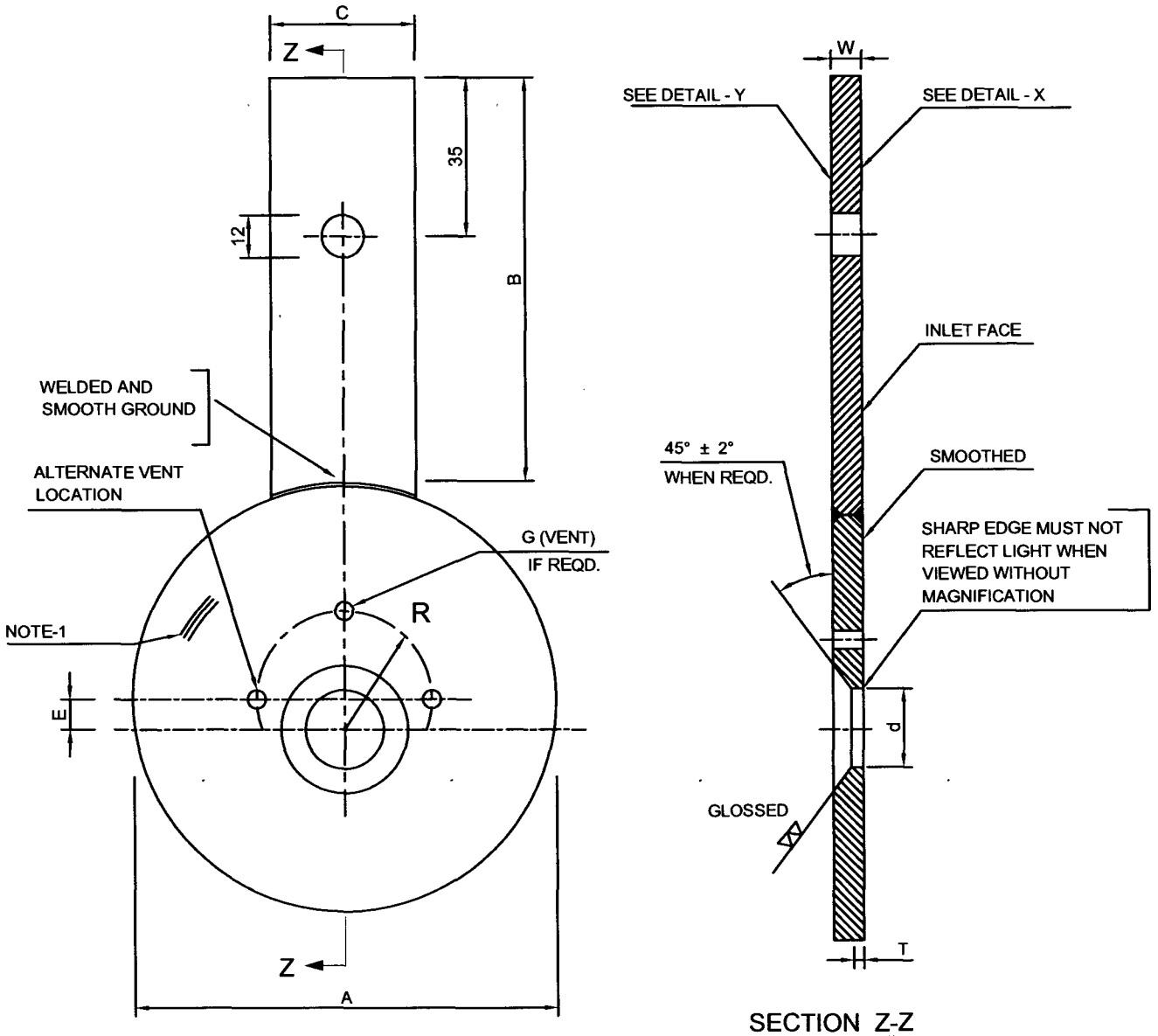
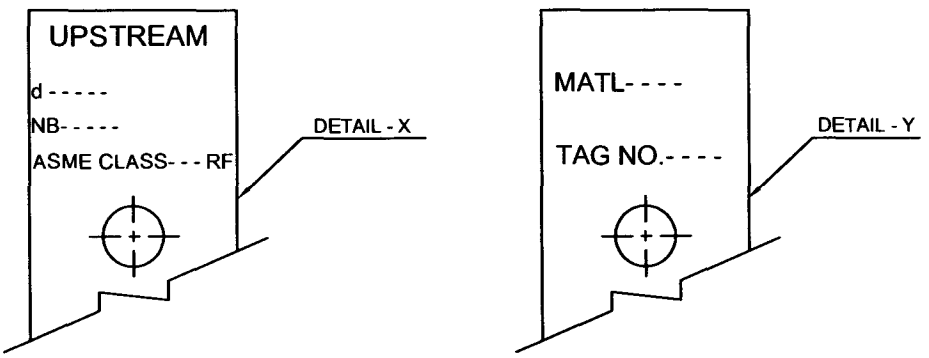


SECTION Z-Z

$$E = \frac{(D-d)}{2} - 0.01D$$



ECCENTRIC ORIFICE PLATE

NOTE :-

1. SERRATION SHALL BE CONSIDERED ON THE ORIFICE PLATE NEAR THE GASKET ZONE.

Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
5	12-02-21	REVISED & REISSUED	Manoj	JJ	MN	SM
4	28.03.17	REVISED & REISSUED	Manoj/RS	MN	RG	RN

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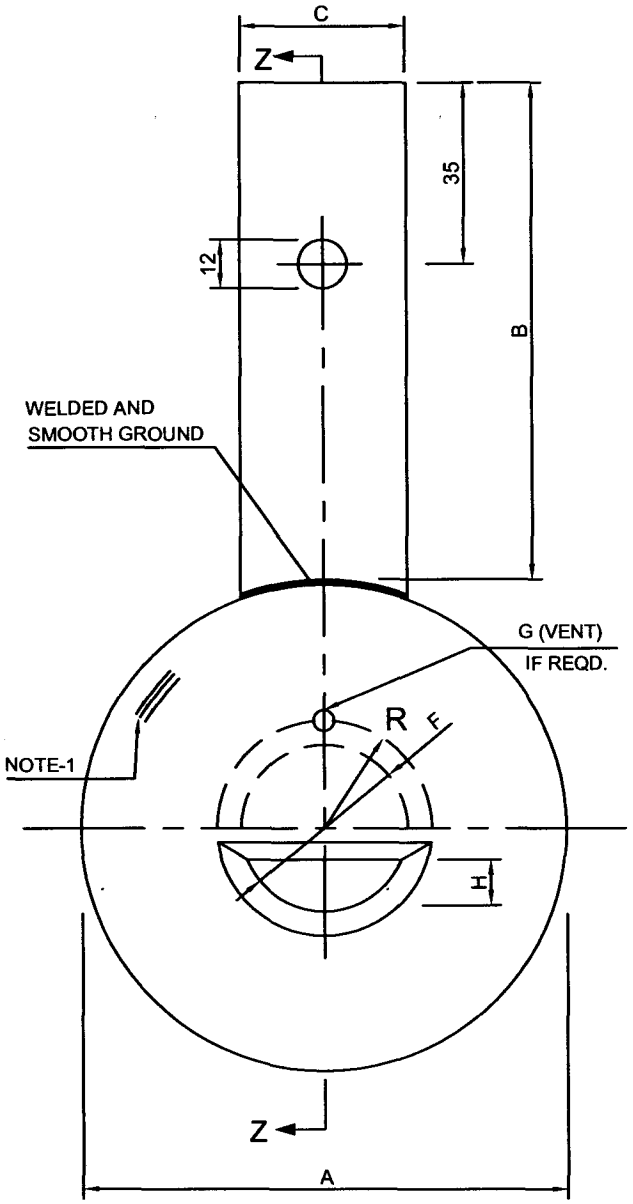
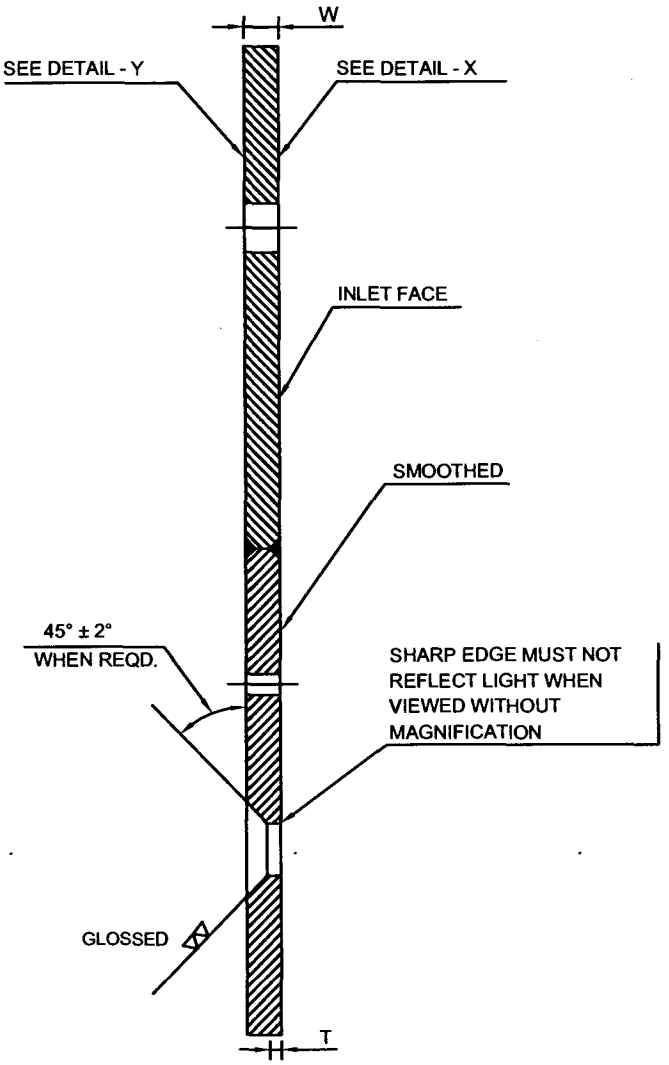
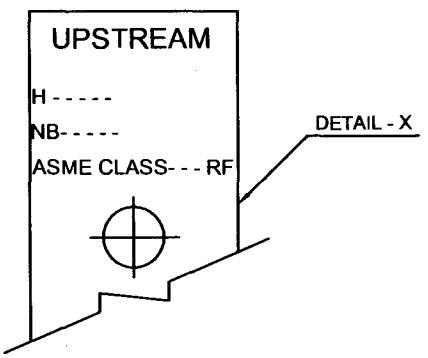
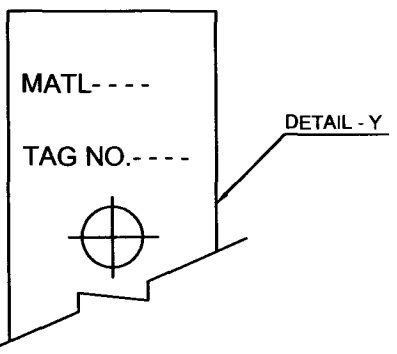




SECTION Z-Z

F = 0.98D





SEGMENTAL ORIFICE PLATE

NOTE :-

1. SERRATION SHALL BE CONSIDERED ON THE ORIFICE PLATE NEAR THE GASKET ZONE.

Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
5	12-02-21	REVISED & REISSUED	Manoj	JJ	MN	SM
4	28.03.17	REVISED & REISSUED	Manoj/RS	MN	RG	RN

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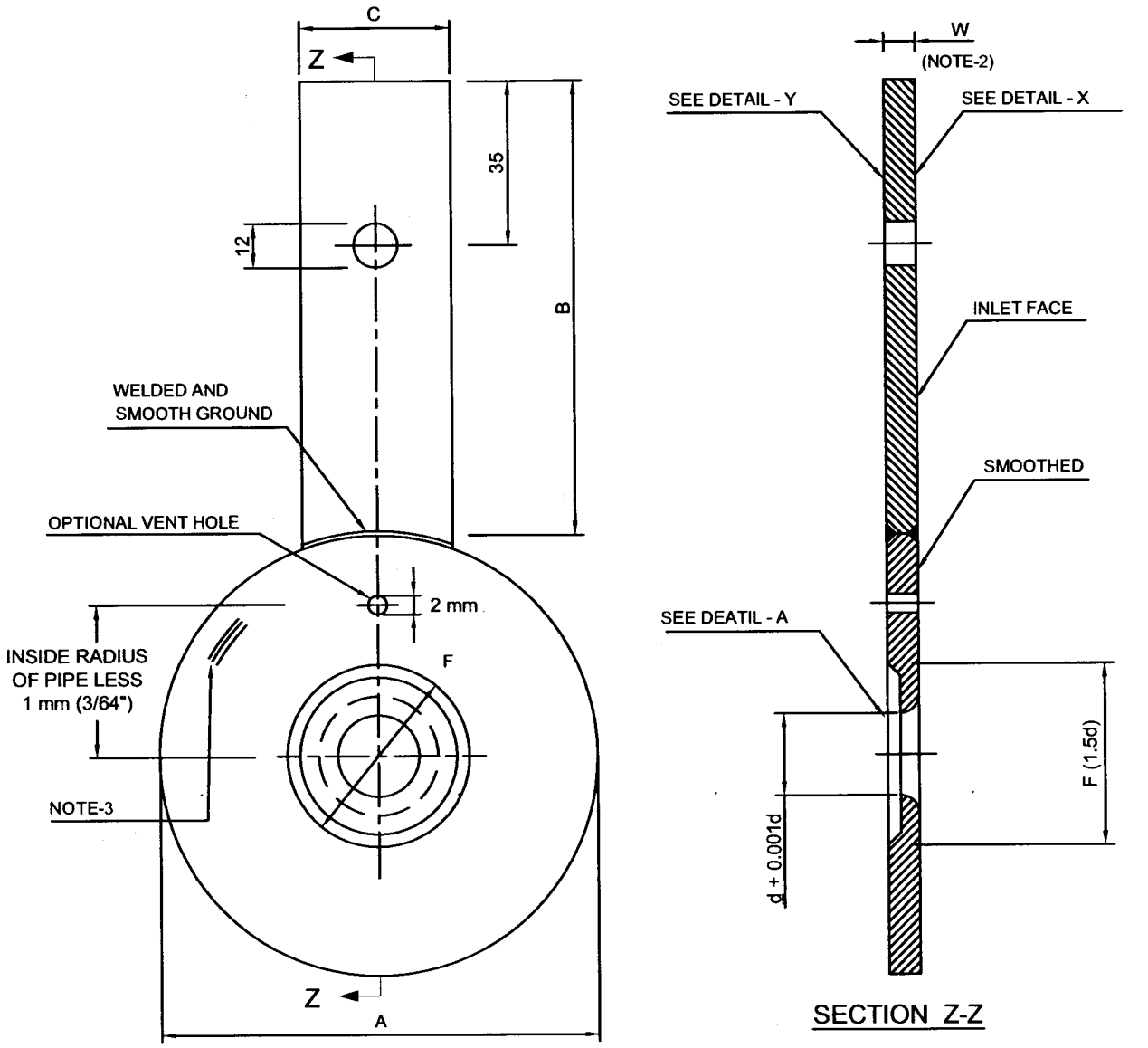
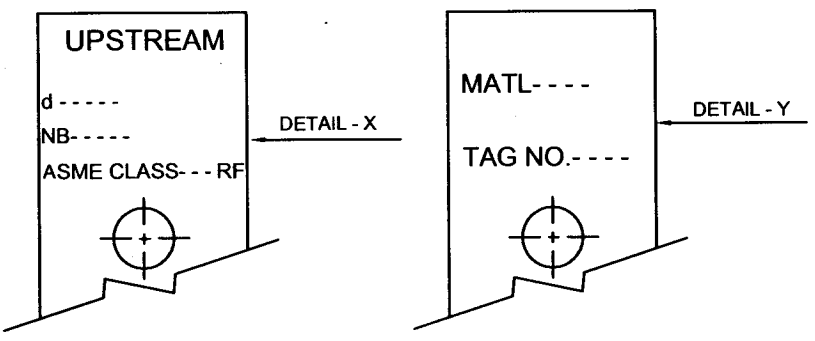
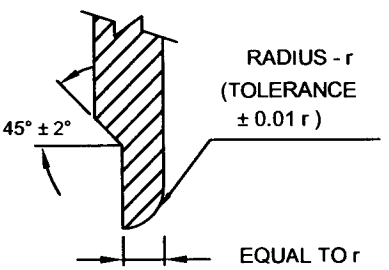


SECTION Z-Z

F = 1.5d BUT NOT GREATER THAN INTERNAL PIPE DIA "D"



QUADRANT EDGE ORIFICE PLATE



DETAIL - A

NOTES :-

1. DIMENSIONS A,B,C ARE SAME AS FOR SQUARE EDGE ORIFICE PLATES.
2. 'W' SHALL NOT BE LESS THAN 2.54 mm AND SHALL NOT EXCEED 0.1D WHERE THE RADIUS ' r ' OF THE UPSTREAM PROFILE EQUALS OR EXCEEDS 0.1D (WHERE IS THE CASE WHEN ß ≥ 0.571 OR m ≥0.325). 'W' SHALL BE REDUCED FROM 'r' TO 0.1D BY REMOVING METAL FROM THE UPSTREAM FACE.
3. SERRATION SHALL BE CONSIDERED ON THE ORIFICE PLATE NEAR THE GASKET ZONE.

Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
					Approved by	
5	12-02-21	REVISED & REISSUED	Manoj	JJ	MN	SM
4	28.03.17	REVISED & REISSUED	Manoj/RS	MN	RG	RN

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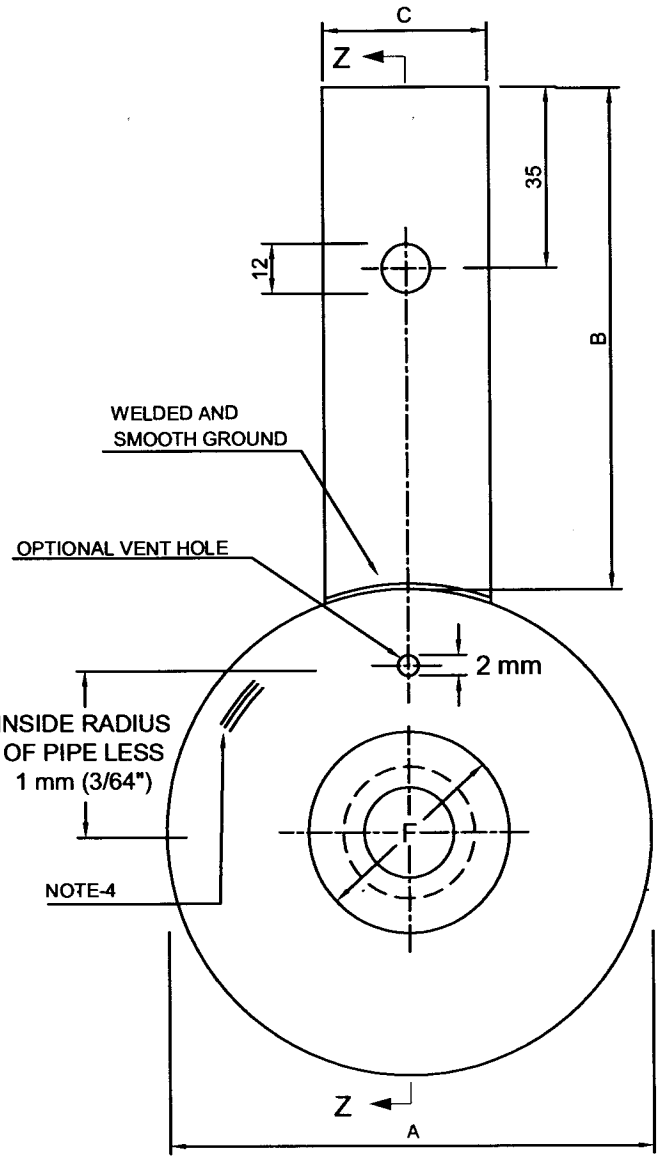
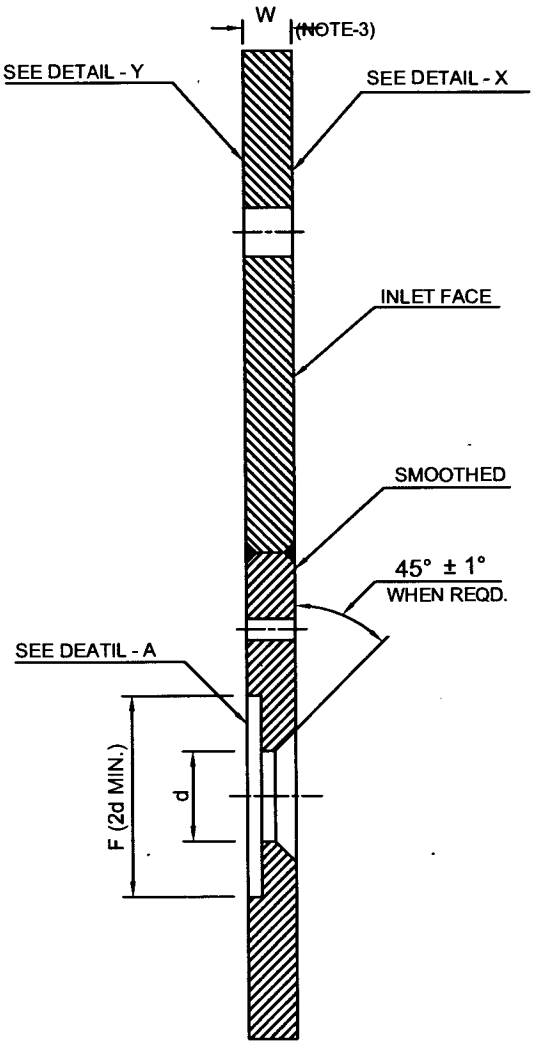
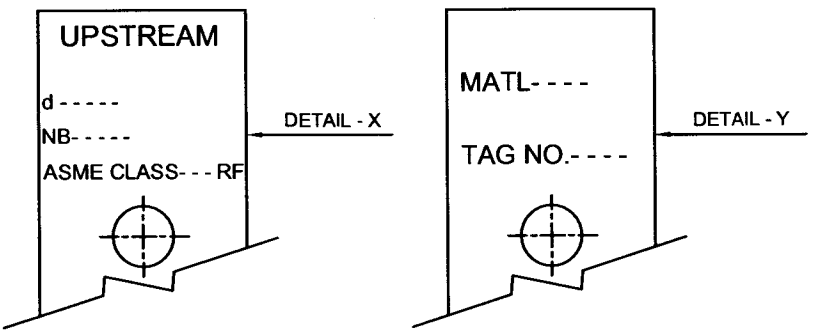
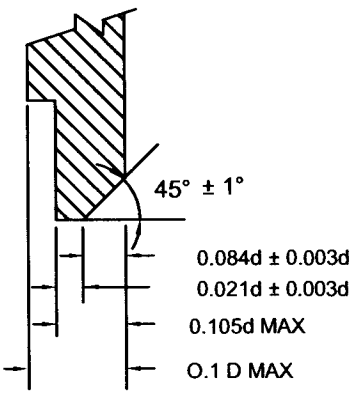




SECTION Z-Z



CONICAL ENTRANCE ORIFICE PLATE



DETAIL - A

NOTES :-

1. DIMENSIONS A,B,C ARE SAME AS FOR SQUARE EDGE ORIFICE PLATES.
2. DIMENSION-d SHALL NOT BE LESS THAN 0.25" AND NOT GREATER THAN 0.316D.
3. DIMENSION- W SHALL BE GENERALLY SAME AS FOR SQUARE EDGE ORIFICE PLATES AND SHALL NECESSARILY CONFORM TO FOLLOWING;

   'W' SHALL NOT EXCEED 0.1D WHERE D IS THE INTERNAL DIAMETER OF UPSTREAM PIPE LINE.
4. SERRATION SHALL BE CONSIDERED ON THE ORIFICE PLATE NEAR THE GASKET ZONE.

Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
5	12-02-21	REVISED & REISSUED	Manoj	JJ	MN	SM
4	28.03.17	REVISED & REISSUED	Manoj/RS	MN	RG	RN

Approved by

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(ALL RATING AS PER ASME CLASS)

NB mm (")	A ± 0.40 RATING 125 150	250 300	400	600	900	1500	2500	RATING 125 TO 2500 ≤315° C W	TOLER.	T +0 -0.25	>315° C W	TOLER.	T +0 -0.25
25 (1)	66.7	73.0	73.0	73.0	79.4	79.4	85.7	3.18			6.35		
40 (1 1/2)	85.7	95.3	95.3	95.3	98.4	98.4	117.5	3.18	+0.12		6.35		
50 (2)	104.8	111.1	111.1	111.1	142.9	142.9	146.1	3.18			6.35		
80 (3)	136.5	149.2	149.2	149.2	168.3	174.6	196.9	3.18	-0.25		6.35		
100 (4)	174.6	181.0	177.8	193.7	206.4	209.6	235.0	3.18			6.35		
150 (6)	222.3	250.8	247.7	266.7	288.9	282.6	317.5	3.18			6.35	± 0.25	
200 (8)	279.4	308.0	304.8	320.7	358.8	352.4	387.4	6.35			9.52		
250 (10)	339.7	362.0	358.8	400.1	435.0	435.0	476.3	6.35		SEE	9.52		SEE
300 (12)	409.6	422.3	419.1	457.2	498.5	520.7	549.3	6.35		NOTE -2	9.52		NOTE -2
350 (14)	450.8	485.8	482.6	492.1	520.7	577.9		6.35	± 0.25		9.52		
400 (16)	514.4	539.8	536.6	565.2	574.7	641.4		6.35			9.52		
450 (18)	549.3	596.9	593.7	612.8	638.2	704.9		9.52			12.7		
500 (20)	606.4	654.1	647.7	682.6	698.5	755.7		9.52			12.7		
550 (22)	660.4	704.9	701.7	733.4				9.52			12.7		
600 (24)	717.6	774.7	768.4	790.6	838.2	901.7		9.52			12.7		

NB mm (")	B - 0 + 10 RATING 125 150	250 300	400	600	900	1500	2500	C ±0.4 RATING 125 TO 400	600 TO 2500	R
25 (1)										
40 (1 1/2)		88	88	88	100	100	100	30		$R = \frac{(D-G)}{2}$
50 (2)							114			
80 (3)						114	127			
100 (4)		100	100	100						
150 (6)	88				114		158	40		
200 (8)						127				
250 (10)				114		140	165			
300 (12)							177			
350 (14)		114	114							
400 (16)					127	152				
450 (18)	100								50	
500 (20)		127	127	127	140	177				
550 (22)	144									
600 (24)		40	140	140	165	203				

d		
FROM	TO	TOLER.
< 6.350		0.007
6.350	9.525	0.013
9.526	12.700	0.015
12.701	15.875	0.020
15.876	19.050	0.023
19.051	22.225	0.025
22.226	25.400	0.030
25.401	31.750	0.036
31.751	38.100	0.043
38,101	44.450	0.051
44.451	127.000	0.064
> 127.000		0.0005 x d

G		
≤ d		TOLER.
FROM	TO	± 0.05
< 25.400	-	-
25.400	88.900	2.38
88.901	104.775	3.18
104.776	127.000	3.97
127.001	152.400	4.76
152.401	171.450	5.56
171.451	190.500	6.35
190.501	212.725	7.14
212.726	234.950	7.94
234.951	254.000	8.73
254.001	276.225	9.53
276.226	295.275	10.32
295.276	317.500	11.11
317.501	336.550	11.91
> 336.550	-	12.70

ORIFICE PLATE DIMENSIONS

LEGEND:-

D - INTERNAL DIAMETER OF THE PIPE
NB - NOMINAL BORE.
d - ORIFICE BORE DIAMETER.
DIMENSIONS IN mm UNLESS OTHERWISE SPECIFIED.

NOTE :-

1. FOR BIDIRECTIONAL FLOW BEVELLING SHALL NOT BE PROVIDED. RESTRICTION ORIFICE PLATE SHALL NOT BE BEVELED AND THEY SHALL NOT HAVE WEEPHOLES.

2. VALUES OF 'T' SHOWN IN THIS STANDARD ARE VALID FOR THE CORRESPONDING 'W' AND d/D (ß) BETWEEN 0.25 AND 0.70 INCL WHEN THE VALUES ARE NOT SHOWN AND FOR ß < 0.25 AND ß > 0.70, T SHALL BE CALCULATED EVERY TIME AND SHALL NOT BE HIGHER THAN THE SMALLER OF THE VALUES RESULTING FROM THE FOLLOWING RATIOS :-

$\frac{d}{8}$, $\frac{D}{50}$, $\frac{D-d}{8}$

Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
5	12-02-21	REVISED & REISSUED	Manoj	JJ	MN	SM
4	28.03.17	REVISED & REISSUED	Manoj/RS	MN	RG	RN

Approved by

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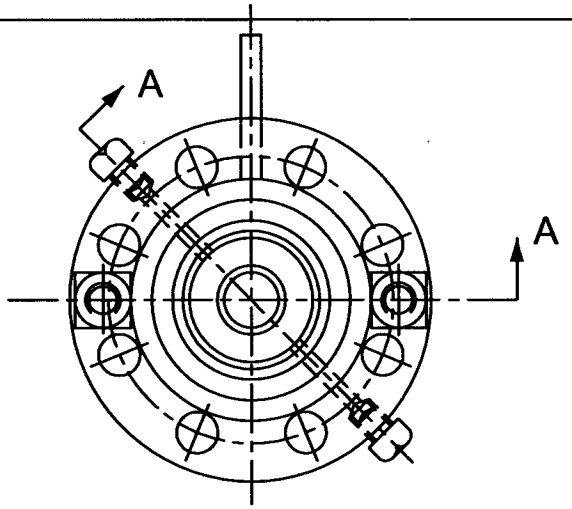
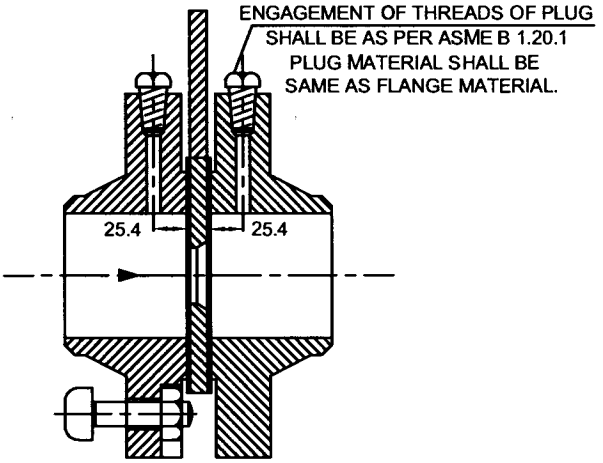
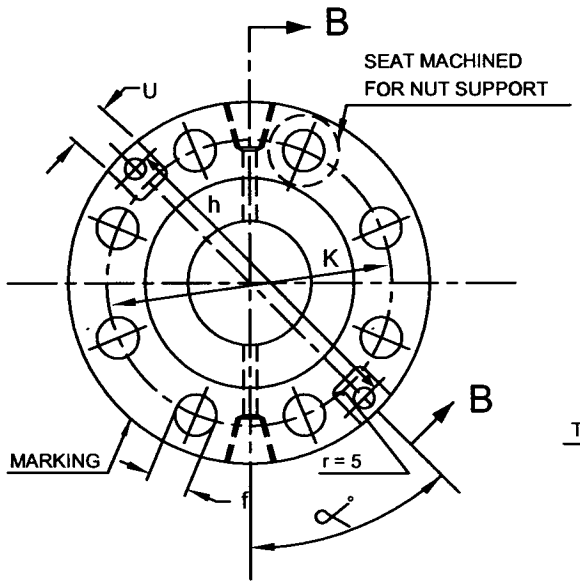
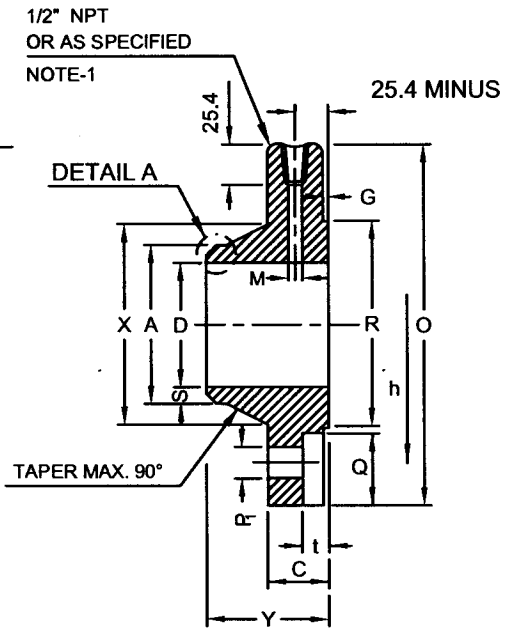




SECTION A-A

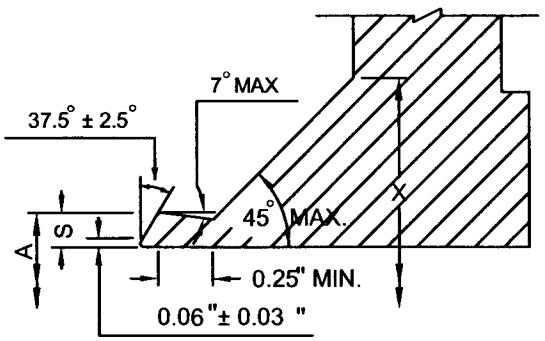




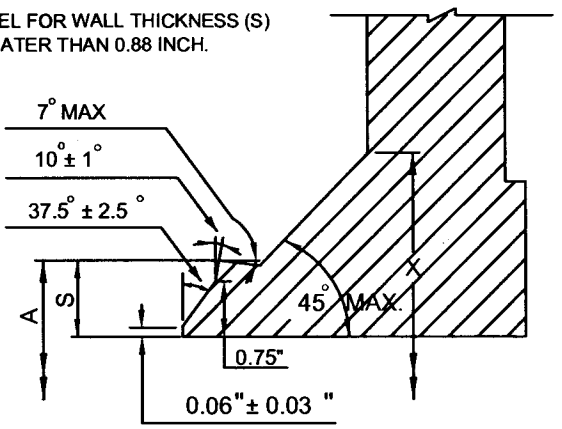
DETAIL - A

SECTION B-B

BEVEL FOR WALL THICKNESS (S)
0.19 INCH TO 0.88 INCH INCLUSIVE.



BEVEL FOR WALL THICKNESS (S)
GREATER THAN 0.88 INCH.



WELD NECK, RAISED FACE ORIFICE FLANGES

Notes:

1. UNLESS OTHERWISE SPECIFIED PRESSURE TAP ORIENTATION SHALL BE AS FOLLOW:
> FOR TWO TAPS - 90 DEG. APART WITH ONE SET OF TAPS PLUGGED.
> FOR FOUR TAPS - EQUALLY SPACED APART IN THE SAME HALF SECTION OF THE FLANGE WITH TWO SETS OF TAPS PLUGGED.
> PLUG MATERIAL SHALL BE SAME AS FLANGE MATERIAL.

Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
5	12-02-21	REVISED & REISSUED	Manoj	JJ	MN	SM
4	28.03.17	REVISED & REISSUED	Manoj/RS	MN	RG	RN

Approved by

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DIMENSIONS (IN mm) - WELD NECK, RAISED FACE ORIFICE FLANGES

FLANGE RATING	FLANGE NB mm (")	A	X	O	K	C	Y	f	R	G	NO. OF BOLT HOLES	M	h	P_1	t	q	U	∝ °	WEIGHT kg.
300	25 (1)	33.5	54.0	124.0	88.9	38.1	82.6	17.5	50.8	1.6	4	6.4	102.2	12.7	9.5	21.8	19.1	82°30'	8
	40 (1.5)	48.3	69.9	155.6	114.3	38.1	85.9	20.6	73.2	1.6	4	6.4	133.8	12.7	9.5	21.8	19.1	82°30'	12
	50 (2)	60.5	84.1	165.1	127.0	38.1	85.9	17.5	92.1	1.6	8	6.4	141.3	14.3	12.7	23.8	20.6	45°	15
	80 (3)	88.9	117.5	209.6	168.3	38.1	88.9	20.6	127.0	1.6	8	9.5	185.7	14.3	12.7	23.8	20.6	45°	22
	100 (4)	114.3	146.1	254.0	200.0	38.1	92.1	20.6	157.2	1.6	8	12.7	230.2	14.3	12.7	23.8	20.6	45°	31
	150 (6)	168.4	206.4	317.5	269.9	38.1	100.1	22.4	215.9	1.6	12	12.7	293.7	14.3	12.7	23.8	20.6	60°	45
	200 (8)	219.2	260.4	381.0	330.2	41.3	111.2	25.4	269.9	1.6	12	12.7	351.6	15.9	15.9	29.4	25.4	60°	70
	250 (10)	273.1	320.7	444.5	387.4	47.8	117.5	28.6	323.9	1.6	16	12.7	411.6	19.1	19.1	32.9	28.6	67°30'	100
	300 (12)	323.9	374.7	520.7	450.9	50.8	130.2	31.8	381.0	1.6	16	12.7	482.2	22.2	22.2	38.5	33.3	67°30'	150
	350 (14)	355.6	425.5	584.2	514.4	54.0	142.9	31.8	412.8	1.6	20	12.7	545.7	22.2	22.2	38.5	33.3	72°	193
	400 (16)	406.4	482.6	647.7	571.5	57.2	146.1	35.1	469.9	1.6	20	12.7	603.6	25.4	25.4	44.1	38.1	72°	260
	450 (18)	457.2	533.4	711.2	628.7	60.5	158.8	35.1	533.4	1.6	24	12.7	667.1	25.4	25.4	44.1	38.1	75°	340
	500 (20)	508.0	587.4	774.7	685.8	63.5	162.1	35.1	584.2	1.6	24	12.7	730.6	25.4	25.4	44.1	38.1	75°	413
	550 (22)	558.8	641.4	838.2	743.0	66.7	165.1	41.3	641.4	1.6	24	12.7	783.4	31.8	31.8	54.8	47.6	75°	510
	600 (24)	609.6	701.7	914.4	812.8	69.9	168.3	41.3	692.1	1.6	24	12.7	854.1	34.9	31.8	60.3	52.4	75°	618

(ALL RATING AS PER ASME CLASS)

NOTE-
1. GASKET HARDNESS SHALL BE 20 BHN (MIN) LESS THAN FLANGE HARDNESS.

Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
					Approved by	
5	12-02-21	REVISED & REISSUED	Manoj	JJ	MN	SM
4	28.03.17	REVISED & REISSUED	Manoj/RS	MN	RG	RN

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DIMENSIONS (IN mm) - WELD NECK, RAISED FACE ORIFICE FLANGES

FLANGE RATING	FLANGE NB mm (")	A	X	O	K	C	Y	f	R	G	NO. OF BOLT HOLES	M	h	P_1	t	q	U	∝°	WEIGHT kg.
600	25 (1)	33.5	54.0	124.0	88.9	38.1	82.6	17.5	50.8	1.6	4	6.4	102.2	12.7	9.5	21.8	19.1	82°30'	8
	40 (1.5)	48.3	69.9	155.6	114.3	38.1	85.9	20.6	73.2	1.6	4	6.4	133.8	12.7	9.5	21.8	19.1	82°30'	12
	50 (2)	60.5	84.1	165.1	127.0	38.1	85.9	17.5	92.1	1.6	8	6.4	141.3	14.3	12.7	23.8	20.6	45°	15
	80 (3)	88.9	117.5	209.6	168.3	38.1	88.9	20.6	127.0	1.6	8	9.5	185.7	14.3	12.7	23.8	20.6	45°	22
	100 (4)	114.3	152.4	273.1	215.9	44.5	108.0	25.4	157.2	6.4	8	12.7	234.6	22.2	14.7	38.5	33.3	45°	44
	150 (6)	168.4	222.3	355.6	292.1	54.0	123.8	28.6	215.9	6.4	12	12.7	311.5	25.4	21.1	44.1	38.1	60°	89
	200 (8)	219.2	273.1	419.1	349.3	61.9	139.7	31.8	269.9	6.4	12	12.7	375.0	25.4	21.1	44.1	38.1	60°	130
	250 (10)	273.1	342.9	508.0	431.8	69.9	158.8	35.1	323.9	6.4	16	12.7	463.9	25.4	21.1	44.1	38.1	67°30'	204
	300 (12)	323.9	400.1	558.9	489.0	73.0	161.9	35.1	381.0	6.4	20	12.7	514.7	25.4	21.1	44.1	38.1	72°	245
	350 (14)	355.6	431.8	603.3	527.1	76.2	171.5	38.1	412.8	6.4	20	12.7	559.2	25.4	21.1	44.1	38.1	72°	312
	400 (16)	406.4	495.3	685.8	603.3	82.6	184.2	41.2	469.9	6.4	20	12.7	636.2	28.6	21.1	49.6	42.9	72°	428
	450 (18)	457.2	546.1	743.0	654.1	88.9	190.5	44.5	533.4	6.4	20	12.7	693.3	28.6	21.1	49.6	42.9	72°	525
	500 (20)	508.0	609.6	812.8	723.9	95.3	196.9	44.5	584.2	6.4	24	12.7	763.2	28.6	21.1	49.6	42.9	75°	650
	550 (22)	558.8	666.8	870.0	777.9	101.6	203.2	47.6	641.4	6.4	24	12.7	820.3	28.6	21.1	49.6	42.9	75°	797
	600 (24)	609.6	717.6	939.8	838.2	108.0	209.6	50.8	692.1	6.4	24	12.7	890.2	28.6	21.1	49.6	42.9	75°	926

(ALL RATING AS PER ASME CLASS)

NOTE-
1. GASKET HARDNESS SHALL BE 20 BHN (MIN) LESS THAN FLANGE HARDNESS.

Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
					Approved by	
5	12-02-21	REVISED & REISSUED	Manoj	JJ	MN	SM
4	28.03.17	REVISED & REISSUED	Manoj/RS	MN	RG	RN

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DIMENSIONS (IN mm) - WELD NECK, RAISED FACE ORIFICE FLANGES

FLANGE RATING	FLANGE NB mm (")	A	X	O	K	C	Y	f	R	G	NO. OF BOLT HOLES	M	h	P_1	t	q	U	∠ °	WEIGHT kg.
900	25 (1)	33.5	52.4	149.2	101.6	44.5	89.0	25.4	50.8	6.4	4	6.4	116.3	19.1	14.7	32.9	28.6	82°30'	12
	40 (1.5)	48.3	69.9	177.8	124.0	44.5	95.3	28.6	73.2	6.4	4	6.4	144.9	19.1	14.7	32.9	28.6	82°30'	16
	50 (2)	60.5	104.8	215.9	165.1	44.5	108.0	25.4	92.1	6.4	8	6.4	183.0	19.1	14.7	32.9	28.6	45°	29
	80 (3)	88.9	127.0	241.3	190.5	44.5	108.0	25.4	127.0	6.4	8	9.5	208.4	19.2	17.9	32.9	28.6	45°	34
	100 (4)	114.3	158.8	292.1	235.0	50.8	120.7	31.8	157.2	6.4	8	12.7	253.6	22.2	17.9	38.5	33.3	45°	57
	150 (6)	168.4	235.0	381.0	317.5	61.9	146.1	31.8	215.9	6.4	12	12.7	336.9	25.4	24.2	44.1	38.1	60°	118
	200 (8)	219.2	298.5	469.9	393.7	69.9	168.3	38.1	269.9	6.4	12	12.7	420.3	28.6	24.2	49.6	42.9	60°	190
	250 (10)	273.1	368.3	546.1	469.9	76.2	190.5	38.1	323.9	6.4	16	12.7	496.5	28.6	24.2	49.6	42.9	67°30'	277
	300 (12)	323.9	419.1	609.6	533.4	85.7	206.4	38.1	381.0	6.4	20	12.7	560.0	28.6	24.2	49.6	42.9	72°	345
	350 (14)	355.6	450.9	641.4	558.8	92.1	219.1	41.3	412.8	6.4	20	12.7	591.7	28.6	24.2	49.6	42.9	72°	441
	400 (16)	406.4	508.0	704.9	616.0	95.3	222.3	44.5	469.9	6.4	20	12.7	655.2	28.6	24.2	49.6	42.9	72°	545
	450 (18)	457.2	565.2	787.4	685.8	108.0	235.0	50.8	533.4	6.4	20	12.7	732.6	31.8	27.4	54.8	47.6	72°	761
	500 (20)	508.0	622.3	857.3	749.3	114.3	254.0	54.0	584.2	6.4	20	12.7	802.5	31.8	27.4	54.8	47.6	75°	927
	600 (24)	609.6	749.3	1041.4	901.7	146.1	298.5	66.7	692.1	6.4	20	12.7	986.6	31.8	27.4	54.8	47.6	75°	1697

(ALL RATING AS PER ASME CLASS)

NOTE-
1. GASKET HARDNESS SHALL BE 20 BHN (MIN) LESS THAN FLANGE HARDNESS.

Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
					Approved by	
5	12-02-21	REVISED & REISSUED	Manoj	JJ	MN	SM
4	28.03.17	REVISED & REISSUED	Manoj/RS	MN	RG	RN

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DIMENSIONS (IN mm) - WELD NECK, RAISED FACE ORIFICE FLANGES

FLANGE RATING	FLANGE NB mm (")	A	X	O	K	C	Y	f	R	G	NO. OF BOLT HOLES	M	h	P_1	t	q	U	∝ °	WEIGHT kg.
1500	25 (1)	33.5	52.4	149.2	101.6	44.5	89.0	25.4	50.8	6.4	4	6.4	116.3	19.1	14.7	32.9	28.6	82°30'	12
	40 (1.5)	48.3	69.9	177.8	124.0	44.5	95.3	28.6	73.2	6.4	4	6.4	144.9	19.1	14.7	32.9	28.6	82°30'	16
	50 (2)	60.5	104.8	215.9	165.1	44.5	108.0	25.4	92.1	6.4	8	6.4	183.0	19.1	14.7	32.9	28.6	45°	29
	80 (3)	88.9	133.4	266.7	203.2	54.0	123.8	31.8	127.0	6.4	8	9.5	228.2	22.2	17.9	38.5	33.3	45°	55
	100 (4)	114.3	161.9	311.2	241.3	60.3	130.2	34.9	157.2	6.4	8	12.7	272.7	22.2	17.9	38.5	33.3	45°	82
	150 (6)	168.4	228.6	393.7	317.5	88.9	177.8	38.1	215.9	6.4	12	12.7	349.6	25.4	24.2	44.1	38.1	60°	184
	200 (8)	219.2	292.1	482.6	393.7	98.4	219.1	44.5	269.9	6.4	12	12.7	433.0	28.6	24.2	49.6	42.9	60°	286
	250 (10)	273.1	368.3	584.2	482.6	114.3	260.4	50.8	323.9	6.4	12	12.7	534.6	28.6	24.2	49.6	42.9	60°	498
	300 (12)	323.9	450.9	673.1	571.5	130.2	288.9	54.0	381.0	6.4	16	12.7	623.5	28.6	24.2	49.6	42.9	67°30'	760
	350 (14)	355.6	495.3	749.3	635.0	139.7	304.8	60.3	412.8	6.4	16	12.7	694.5	31.8	27.4	54.8	47.6	67°30'	1053
	400 (16)	406.4	552.5	825.5	704.9	152.4	317.5	66.7	469.9	6.4	16	12.7	765.2	34.9	27.4	60.3	52.4	67°30'	1406
	450 (18)	457.2	596.9	914.4	774.7	168.3	333.4	73.0	533.4	6.4	16	12.7	854.1	34.9	27.4	60.3	52.4	67°30'	1836
	500 (20)	508.0	641.4	984.3	831.9	184.2	362.0	79.4	584.2	6.4	16	12.7	923.9	34.9	27.4	60.3	52.4	67°30'	2324
	600 (24)	609.6	762.0	1168.4	990.6	209.6	412.8	92.1	692.1	6.4	16	12.7	1108.1	34.9	27.4	60.3	52.4	67°30'	3749

(ALL RATING AS PER ASME CLASS)

NOTE-
1. GASKET HARDNESS SHALL BE 20 BHN (MIN) LESS THAN FLANGE HARDNESS.

Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
5	12-02-21	REVISED & REISSUED	Manoj	JJ	MN	SM
4	28.03.17	REVISED & REISSUED	Manoj/RS	MN	RG	RN

Approved by

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TOLERANCES ALLOWED ON FLANGES ACCORDING TO ASME B16.36 / B16.5

DIMENSIONS mm (Inches)		TOLERANCES (Inches)
O	≤ 609.6 mm	± 1.59 *
	> 609.6 mm	± 3.18 *
C	NB ≤ 450 (18)	+ 3.18 - 0
	NB > 450 (18)	+ 4.76 - 0
X	≤ 609.6 mm	± 1.59 *
	> 609.6 mm	± 3.18 *
A	NB ≤ 100 (4)	+ 2.38 - 0.79
	NB ≤ 150 (6)	+ 3.96 - 0.79
Y	NB ≤ 250 (10)	± 1.59
	NB ≤ 300 (12)	± 3.18
DRILLING	K	± 1.59
	CENTRES BETWEEN HOLES	± 0.79
R	FOR GV/GD < 6.35 mm	± 0.79
	FOR GV/GD ≥ 6.35 mm	± 0.40
ECCENTRICITY BETWEEN K AND R DIAMETERS		± 0.79
ECCENTRICITY BETWEEN K AND D DIAMETERS		± 0.79 *
ECCENTRICITY BETWEEN R AND D DIAMETERS		± 0.79 *
D	NB ≤ 150 (6)	± 0.12 *
	NB 200 &250 (8 &10)	+ 0.12 - 0.25 *
	NB 300 (12)	+ 0.12 - 0.38 *
	NB 350 &400 (14 &16)	+ 0.12 - 0.50 *
	NB ≤ 450 (18)	+ 0.12 - 0.76 *

* NOT COVERED BY ASME B16.5

WELD NECK RAISED FACE ORIFICE FLANGES

Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
					Approved by	
5	12-02-21	REVISED & REISSUED	Manoj	JJ.	MN	SM
4	28.03.17	REVISED & REISSUED	Manoj/RS	MN	RG	RN

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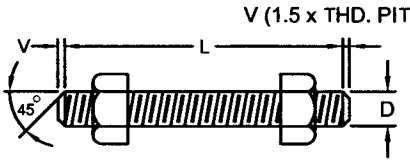
DIMENSIONS AS SHOWN

THREAD : ASME B 1.1
FOR D" ≤1 - UNC - 2A
FOR D" ≥1 1/8 - 8 UN - 2A

CONSTRUCTION

FORGED, BAR STOCK



D mm (Inches)		THREAD PITCH		V	2V *
15.9	(5/8)	UNC	2.309	3.46	7
19.0	(3/4)		2.54	3.78	7.5
22.2	(7/8)		2.822	4.23	8.5
25.4	(1)		3.175	4.76	9.5
≥ 28.6	(1 1/8)	8 UN	3.175	4.76	9.5

* APPROXIMATE VALUE OF THE TWO BEVELS

(ALL RATING AS PER ASME CLASS)

DIAMETER (NB,D) mm (INCHES) & LENGTH - (L) IN mm (NOTE-1)											
RATING		300			600			900			1500		
DIM.	N B	D		L	D		L	D		L	D		L
25	(1)	15.9	(5/8)	127	15.9	(5/8)	127	22.2	(7/8)	152	22.2	(7/8)	152
40	(1 1/2)	19.0	(3/4)	133	19.0	(3/4)	133	25.4	(1)	159	25.4	(1)	159
50	(2)	15.9	(5/8)	127	15.9	(5/8)	127	22.2	(7/8)	152	22.2	(7/8)	152
80	(3)	19.0	(3/4)	133	19.0	(3/4)	133	22.2	(7/8)	152	28.6	(1 1/8)	184
100	(4)	19.0	(3/4)	133	22.2	(7/8)	152	28.6	(1 1/8)	178	31.7	(1 1/4)	203
150	(6)	19.0	(3/4)	133	25.4	(1)	178	28.6	(1 1/8)	203	34.9	(1 3/8)	266
200	(8)	22.2	(7/8)	146	28.6	(1 1/8)	203	34.9	(1 3/8)	229	41.3	(1 5/8)	298
250	(10)	25.4	(1)	165	31.7	(1 1/4)	222	34.9	(1 3/8)	241	47.6	(1 7/8)	343
300	(12)	28.6	(1 1/8)	178	31.7	(1 1/4)	229	34.9	(1 3/8)	260	50.8	(2)	381
350	(14)	28.6	(1 1/8)	191	34.9	(1 3/8)	248	38.1	(1 1/2)	282	57.1	(2 1/4)	418
400	(16)	31.7	(1 1/4)	203	38.1	(1 1/2)	266	41.3	(1 5/8)	295	63.5	(2 1/2)	456
450	(18)	31.7	(1 1/4)	209	41.3	(1 5/8)	286	47.6	(1 7/8)	333	69.8	(2 3/4)	503
500	(20)	31.7	(1 1/4)	216	41.3	(1 5/8)	298	50.8	(2)	355	76.2	(3)	548
600	(24)	38.1	(1 1/2)	241	47.6	(1 7/8)	337	63.5	(2 1/2)	445	88.9	(3 1/2)	623

TOLERANCES ON 'L'

L-LENGTH mm	≤ 305	310 TO 455	≥ 455
TOLERANCE mm	- 0 + 1.6	- 0 + 3.2	- 0 + 6.4

STUD BOLT DETAILS FOR RAISED FACE FLANGES

NOTES :-

1. FOR BOLT DIAMETER 1" (25mm) & ABOVE IN EACH RATING, FOLLOWING SHALL BE CONSIDERED TO TAKE CARE OF BOLT TENSIONING.
(i) ONE EXTRA NUT SHALL BE CONSIDERED FOR EACH BOLT/STUD.
(ii) BOLT/STUD LENGTH SHALL BE INCREASED BY ONE DIAMETER.

Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
					Approved by	
5	12-02-21	REVISED & REISSUED	Manoj	JJ	MN	SM
4	28.03.17	REVISED & REISSUED	Manoj/RS	MN	RG	RN

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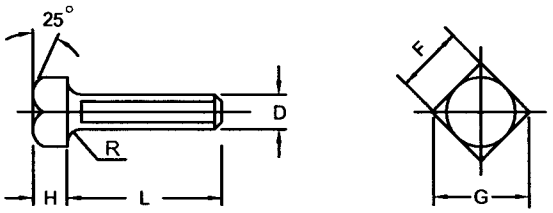
DIMENSIONS :ASME B 18.2.1
CONSTRUCTION FORGED, BAR STOCK
TOLERANCES : ASME B 18.2.1 ASME B 1.1

THREAD :ASME B 1.1
FOR D" ≤1 - UNC - 2A
FOR D" ≥1 1/8 - 8 UN - 2A



D mm (Inches)	F	G mm		H	R
		MAX.	MIN.	mm	mm
9.5 (3/8)	14.3	20.2	19.0	6.4	0.8
11.1 (7/16)	15.9	22.5	21.0	7.5	0.8
12.7 (1/2)	19.1	26.9	25.3	8.3	0.8
15.9 (5/8)	23.8	33.7	31.6	10.7	1.6
19.1 (3/4)	28.6	40.4	37.9	12.7	1.6
22.2 (7/8)	33.3	47.1	44.2	15.1	1.6
25.4 (1)	38.1	53.9	50.6	16.7	2.4
28.6 (1 1/8)	42.9	60.6	56.9	19.1	2.4
31.8 (1 1/4)	47.6	67.4	63.2	21.4	2.4
38.1 (1 1/2)	57.2	80.8	75.8	25.4	2.4

(ALL RATING AS PER ASME CLASS)

DIAMETER (NB,D): mm (INCHES) AND LENGTH - (L) IN mm											
RATING		300			600			900			1500		
DIM.	N B	D		L	D		L	D		L	D		L
25	(1)	9.5	(3/8)	75	9.5	(3/8)	75	15.9	(5/8)	90	15.9	(5/8)	90
40	(1 1/2)	9.5	(3/8)	75	9.5	(3/8)	75	15.9	(5/8)	90	15.9	(5/8)	90
50	(2)	11.1	(7/16)	85	11.1	(7/16)	85	15.9	(5/8)	100	15.9	(5/8)	100
80	(3)	11.1	(7/16)	85	11.1	(7/16)	85	15.9	(5/8)	100	19.1	(3/4)	115
100	(4)	11.1	(7/16)	85	19.1	(3/4)	100	19.1	(3/4)	110	19.1	(3/4)	120
150	(6)	11.1	(7/16)	90	22.2	(7/8)	115	22.2	(7/8)	130	22.2	(7/8)	160
200	(8)	12.7	(1/2)	100	22.2	(7/8)	130	25.4	(1)	140	25.4	(1)	170
250	(10)	15.9	(5/8)	110	22.2	(7/8)	135	25.4	(1)	145	25.4	(1)	190
300	(12)	19.1	(3/4)	115	22.2	(7/8)	140	25.4	(1)	155	25.4	(1)	215
350	(14)	19.1	(3/4)	120	22.2	(7/8)	140	25.4	(1)	165	28.6	(1 1/8)	235
400	(16)	22.2	(7/8)	130	25.4	(1)	155	25.4	(1)	170	31.8	(1 1/4)	255
450	(18)	22.2	(7/8)	130	25.4	(1)	160	28.6	(1 1/8)	200	31.8	(1 1/4)	275
500	(20)	22.2	(7/8)	140	25.4	(1)	165	28.6	(1 1/8)	205	31.8	(1 1/4)	295
550	(22)	28.6	(1 1/8)	155	25.4	(1)	180	-	-	-	-	-	-
600	(24)	31.8	(1 1/4)	160	25.4	(1)	185	28.6	(1 1/8)	240	31.8	(1 1/4)	315

SEMI-FINISHED, SQUARE HEAD, FULL THREAD, JACK SCREW

Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
					Approved by	
5	12-02-21	REVISED & REISSUED	Manoj	JJ	MN	SM
4	28.03.17	REVISED & REISSUED	Manoj/RS	MN	RG	RN

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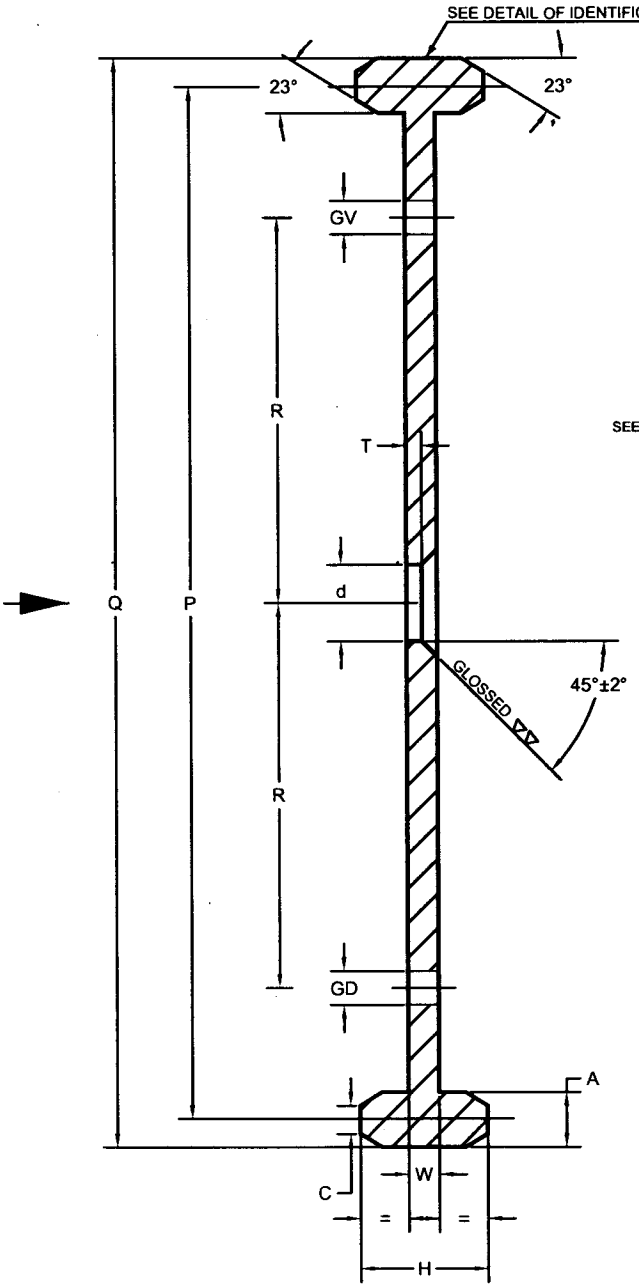
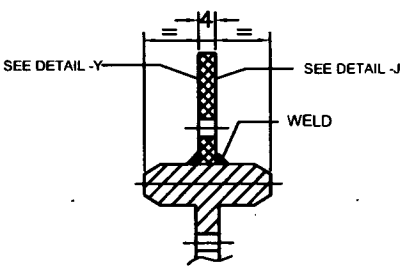
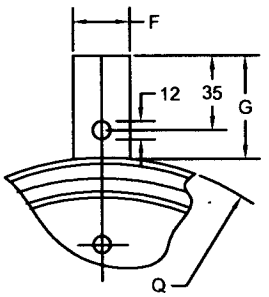
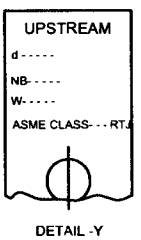
ORIFICE PLATE AND HOLDER FOR FLANGE SIZE ≤ 3"



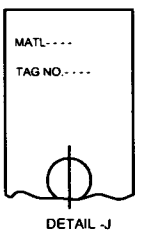




DETAIL OF IDENTIFICATION NAMEPLATE



DETAIL -Y



DETAIL -J

NAME PLATE INFORMATION

NOTES:-

1. FOR BI-DIRECTIONAL FLOW ELEMENTS BEVELLING SHALL NOT BE PROVIDED. RESTRICTIONS ORIFICE PLATES SHALL NOT BE BEVELED AND THEY SHALL NOT HAVE WEEPHOLES.

Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
					Approved by	
1	12-02-21	REVISED & REISSUED	Manoj	JJ	MN	SM
0	19-02-16	ISSUED AS STANDARD	Manoj / RS	MN	RG	SC

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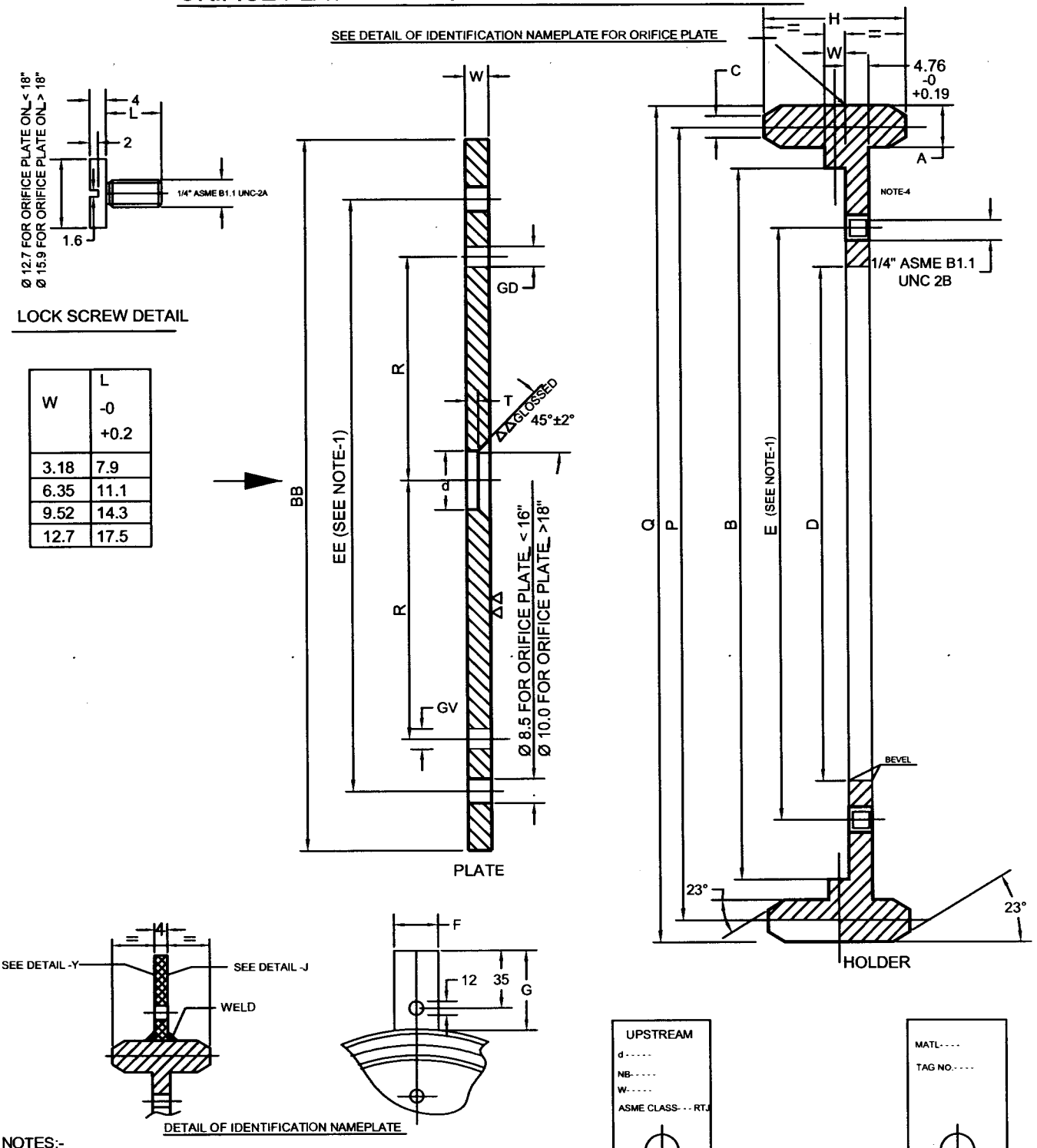
ORIFICE PLATE AND HOLDER FOR FLANGE SIZE ≥ 4"



NOTES:-

1. THE NUMBER OF HOLES AND LOCK SCREWS FOR PLATE SHALL BE
   4 FOR LINE SIZES 4~8 INCH
   8 FOR LINE SIZES 10~16 INCH
   12 FOR LINE SIZES 18~24 INCH
   THESE SHALL BE EQUALLY SPACED FROM CENTER OF ANY VENT/DRAIN HOLE.
2. ON ASSEMBLY OF PLATE & HOLDER A DEVIATION OF -0.2mm IS ALLOWED BETWEEN CENTRES OF 'd' AND 'P'.
3. FOR BI-DIRECTIONAL FLOW ELEMENTS BEVELLING SHALL NOT BE PROVIDED. RESTRICTIONS ORIFICE PLATES SHALL NOT BE BEVELED AND THEY SHALL NOT HAVE WEEPHOLES.
4. MOC OF RTJ HOLDER SHALL BE AS PER DATA SHEET ENSURING HARDNESS OF THE HOLDER SHALL BE 20 BHN LESSER THAN THE FLANGE HARDNESS. ADDITIONAL 1 NO. BLIND RTJ HOLDER SHALL BE PROVIDED AS SPARE WITH EACH ORIFICE TAG.

Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
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Approved by

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ORIFICE PLATE DIMENSIONS

d		
FROM	TO	TOLER.
<6.350		0.007
6.350	9.525	0.013
9.526	12.700	0.015
12.701	15.875	0.020
15.876	19.050	0.023
19.051	22.225	0.025
22.226	25.400	0.030
25.401	31.750	0.036
31.751	38.100	0.043
38.101	44.450	0.051
44.451	127.000	0.064
>127.000		0.0005 x d

GD/GV		
FOR d		TOLER.
FROM	TO	±0.05
<25.400	-	-
25.400	88.900	2.38
88.901	104.775	3.18
104.776	127.000	3.97
127.001	152.400	4.76
152.401	171.450	5.56
171.451	190.500	6.35
190.501	212.725	7.14
212.726	234.950	7.94
234.951	254.000	8.73
254.001	276.225	9.53
276.226	295.275	10.32
295.276	317.500	11.11
317.501	336.550	11.91
>336.550	-	12.70

UPSTREAM

NOTE
1. ALL DIMENSIONS ARE IN MM
2. d= ORIFICE BORE DIAMETER , D= INTERNAL DIAMETER OF PIPE

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ORIFICE PLATE AND HOLDER DIMENSIONAL DETAILS FOR FLANGE SIZE ≤ 3"

RING & GROOVE NO.	ASME SIZE (INCH) & RATING 600	900	1500	2500	P +0.18	A +0.20	C +0.20	Q	H +0.4	R +0.2 -0.4
										$R=\frac{(D-GD)}{2}$ $R=\frac{(D-GV)}{2}$
R 16	1	-	1	-	50.8	7.94	5.23	58.7	25.4	
R 18	-	-	-	1	60.3	7.94	5.23	68.3	25.4	
R 20	1 1/2	-	1 1/2	-	68.3	7.94	5.23	76.2	25.4	
R 23	2	-	-	1 1/2	82.6	11.11	7.75	93.7	26.9	
R 24	-	-	2	-	95.3	11.11	7.75	106.4	26.9	
R 26	-	-	-	2	101.6	11.11	7.75	112.7	26.9	
R 31	3	3	-	-	123.8	11.11	7.75	134.9	26.9	
R 32	-	-	-	3	127.0	12.7	8.66	139.7	30.2	
R 35	-	-	3	-	136.5	11.11	7.75	147.6	26.9	

RING & GROOVE NO.	ASME SIZE (INCH) & RATING 600	900	1500	2500	W TOL +0.12 -0.25 ≤315°C	W TOL ±0.25 >315°C	T (NOTE-2,3) TOL +0 -0.25 ≤315°C	T (NOTE-2,3) TOL +0 TOL -0.25 >315°C	F ±0.40	G -0, +5 600	G -0, +5 900	G -0, +5 1500	G -0, +5 2500
R 16	1	-	1	-	3.18	6.35	0.51	NOTE-3	30	88	-	100	-
R 18	-	-	-	1	3.18	6.35	0.51	NOTE-3	30	-	-	-	100
R 20	1 1/2	-	1 1/2	-	3.18	6.35	0.76	NOTE-3	30	88	-	100	-
R 23	2	-	-	1 1/2	3.18	6.35	0.79 FOR 2" 0.76 FOR 1.5"	NOTE-3	30	88	-	-	114 FOR 2" 100 FOR 1.5"
R 24	-	-	2	-	3.18	6.35	0.79	NOTE-3	30	-	-	100	-
R 26	-	-	-	2	3.18	6.35	0.79	NOTE-3	30	-	-	-	114
R 31	3	3	-	-	3.18	6.35	0.79	NOTE-3	30	88	100	-	-
R 32	-	-	-	3	3.18	6.35	0.79	NOTE-3	30	-	-	-	114
R 35	-	-	3	-	3.18	6.35	0.79	NOTE-3	30	-	-	114	-

NOTE
1. ALL DIMENSIONS ARE IN MM
2. FOR BIDIRECTIONAL FLOW BEVELLING SHALL NOT BE PROVIDED.
3. VALUES OF 'T' SHOWN IN THIS STANDARD ARE VALID FOR THE CORRESPONDING "W" AND 'd/D' (BETA) BETWEEN 0.25 AND 0.70 INCLUSIVE.
WHEN THE VALUES ARE NOT SHOWN AND FOR BETA <0.25 AND >0.70, 'T' SHALL BE CALCULATED EVERY TIME AND SHALL NOT BE HIGHER THAN THE SMALLER OF THE VALUES RESULTING FROM THE RATIOS, d/8, D/50, (D-d)/8

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Approved by

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ORIFICE PLATE AND HOLDER DIMENSIONAL DETAILS FOR FLANGE SIZE ≥ 4"

RING & GROOVE NO.	ASME SIZE (INCH) & RATING 600	900	1500	2500	P +0.18	A +0.20	C +0.20	Q	H +0.4	R +0.2 -0.4
R 37	4	4	-	-	149.2	11.11	7.75	160.3	26.9	$R=\frac{(D-GD)}{2}$ $R=\frac{(D-GV)}{2}$
R 38	-	-	-	4	157.2	15.88	10.49	173.1	33.3	
R 39	-	-	4	-	161.9	11.11	7.75	173.0	26.9	
R 45	6	6	-	-	211.1	11.11	7.75	222.2	26.9	
R 46	-	-	6	-	211.1	12.70	8.66	223.8	28.5	
R 47	-	-	-	6	228.6	19.05	12.32	247.7	36.6	
R 49	8	8	-	-	269.9	11.11	7.75	281.0	26.9	
R 50	-	-	8	-	269.9	15.88	10.49	285.8	33.3	
R 51	-	-	-	8	279.4	22.22	14.81	301.6	39.6	
R 53	10	10	-	-	323.9	11.11	7.75	335.0	26.9	
R 54	-	-	10	-	323.9	15.88	10.49	339.8	33.3	
R 55	-	-	-	10	342.9	28.58	19.81	371.5	47.8	
R 57	12	12	-	-	381.0	11.11	7.75	392.1	26.9	
R 58	-	-	12	-	381.0	22.23	14.81	403.2	39.6	
R 60	-	-	-	12	406.4	31.75	22.33	438.2	50.8	

NOTE
1. ALL DIMENSIONS ARE IN MM

Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
1	12-02-21	REVISED & REISSUED	Manoj	JJ	MN	SM
0	19-02-16	ISSUED AS STANDARD	Manoj / RS	MN	RG	SC

Approved by

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ORIFICE PLATE AND HOLDER DIMENSIONAL DETAILS FOR FLANGE SIZE ≥ 4"

RING & GROOVE NO.	SIZE (INCH) & RATING ASME 600	ASME 900	ASME 1500	ASME 2500	W TOL +0.12 -0.25 ≤315°C	W TOL ±0.25 >315°C	T (NOTE 2,3) TOL +0 -0.25 ≤315°C	T (NOTE 2,3) TOL +0 -0.25 >315°C	B -0 +0.2	BB +0 -0.2	E -0 +0.2	EE +0 -0.2	F ± 0.40	G -0, +5 CLASS 600	G -0, +5 CLASS 900	G -0, +5 CLASS 1500	G -0, +5 CLASS 2500
R 37	4	4	-	-	3.18	6.35	1.59	NOTE 3	138.1	136.5	120.7	119.4	40	100	100	-	-
R 38	-	-	-	4	3.18	6.35	1.59	NOTE 3	134.9	133.4	117.5	116.3	40	-	-	-	127
R 39	-	-	4	-	3.18	6.35	1.59	NOTE 3	144.5	142.9	127.0	125.8	40	-	-	114	-
R 45	6	6	-	-	3.18	6.35	1.59	NOTE 3	193.7	192.1	176.2	175.0	40	100	114	-	-
R 46	-	-	6	-	3.18	6.35	1.59	NOTE 3	192.1	190.5	174.6	173.4	40	-	-	114	-
R 47	-	-	-	6	3.18	6.35	1.59	NOTE 3	203.2	200.0	184.2	182.9	40	-	-	-	158
R 49	8	8	-	-	6.35	9.52	3.18	NOTE 3	252.4	249.2	233.4	232.1	40	114	114	-	-
R 50	-	-	8	-	6.35	9.52	3.18	NOTE 3	247.7	244.5	228.6	227.4	40	-	-	127	-
R 51	-	-	-	8	6.35	9.52	3.18	NOTE 3	250.8	247.7	231.8	230.6	40	-	-	-	158
R 53	10	10	-	-	6.35	9.52	3.18	NOTE 3	306.4	303.2	287.3	286.1	40	114	114	-	-
R 54	-	-	10	-	6.35	9.52	3.18	NOTE 3	301.6	298.5	282,6	281.4	40	-	-	140	-
R 55	-	-	-	10	6.35	9.52	3.18	NOTE 3	308.8	304.8	288.9	287.7	40	-	-	-	165
R 57	12	12	-	-	6.35	9.52	3.18	NOTE 3	363.5	360.4	344.5	343.3	40	114	114	-	-
R 58	-	-	12	-	6.35	9.52	3.18	NOTE 3	352.4	349.3	333.4	332.2	40	-	-	140	-
R 60	-	-	-	12	6.35	9.52	3.18	NOTE 3	368.3	365.1	349.3	348.0	40	-	-	-	177

NOTE
1. ALL DIMENSIONS ARE IN MM
2. FOR BIDIRECTIONAL FLOW BEVELLING SHALL NOT BE PROVIDED.
3. VALUES OF 'T' SHOWN IN THIS STANDARD ARE VALID FOR THE CORRESPONDING "W" AND d/D' (BETA) BETWEEN 0.25 AND 0.70 INCLUSIVE.
WHEN THE VALUES ARE NOT SHOWN AND FOR BETA <0.25 AND >0.70, 'T' SHALL BE CALCULATED EVERY TIME AND SHALL NOT BE HIGHER THAN THE SMALLER OF THE VALUES RESULTING FROM THE RATIOS, d/8, D/50, (D-d)/8

Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
					Approved by	
1	12-02-21	REVISED & REISSUED	Manoj	JJ	MN	SM
0	19-02-16	ISSUED AS STANDARD	Manoj / RS	MN	RG	SC

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ORIFICE PLATE AND HOLDER DIMENSIONAL DETAILS FOR FLANGE SIZE ≥ 4"

RING & GROOVE NO.	ASME SIZE (INCH) & RATING 600	900	1500	2500	P +0.18	A +0.20	C +0.20	Q	H	R +0.2 -0.4
R 61	14	-	-	-	419.1	11.12	7.75	430.2	26.9	$R=\frac{(D-GD)}{2}$
R 62	-	14	-	-	419.1	15.88	10.49	435.0	33.2	
R 63	-	-	14	-	419.1	25.40	17.30	444.5	44.4	
R 65	16	-	-	-	469.9	11.12	7.75	481.0	30.2	
R 66	-	16	-	-	469.9	15.88	10.49	485.8	36.5	
R 67	-	-	16	-	469.9	28.58	19.81	498.5	50.8	
R 69	18	-	-	-	533.4	11.12	7.75	544.5	30.2	
R 70	-	18	-	-	533.4	19.05	12.32	552.5	39.6	$R=\frac{(D-GV)}{2}$
R 71	-	-	18	-	533.4	28.58	19.81	562.0	50.8	
R 73	20	-	-	-	584.2	12.70	8.66	596.9	31.8	
R 74	-	20	-	-	584.2	19.05	12.32	603.3	39.6	
R 75	-	-	20	-	584.2	31.75	22.33	616.0	53.8	
R 77	24	-	-	-	692.2	15.88	10.49	708.1	36.5	
R 78	-	24	-	-	692.2	25.40	17.30	717.6	47.8	
R 79	-	-	24	-	692.2	34.93	24.82	727.1	58.7	

NOTE
1. ALL DIMENSIONS ARE IN MM

Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
					Approved by	
1	12-02-21	REVISED & REISSUED	Manoj	JJ	MN	SM
0	19-02-16	ISSUED AS STANDARD	Manoj / RS	MN	RG	SC

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ORIFICE PLATE AND HOLDER DIMENSIONAL DETAILS FOR FLANGE SIZE ≥ 4"

RING & GROOVE NO.	ASME SIZE (INCH) & RATING				W		T (NOTE 2,3)			B	BB	E	EE	F	G -0, +5 SIZE (INCH) & RATING			
	600	900	1500	2500	TOL +0.12 TOL -0.25 ≤315°C	TOL ±0.25 >315°C	TOL +0 TOL -0.25 <315°C	TOL +0 TOL -0.25 >315°C		-0 +0.2	+0 -0.2	-0 +0.2	+0 -0.2	± 0.40	600	900	1500	2500
R 61	14	-	-	-	6.35	9.52	3.18	NOTE 3		401.6	398.5	382.5	381.0	50	114	-	-	-
R 62	-	14	-	-	6.35	9.52	3.18	NOTE 3		396.9	393.7	377.8	376.6	50	-	127	-	-
R 63	-	-	14	-	6.35	9.52	3.18	NOTE 3		387.4	384.2	368.3	367.1	50	-	-	152	-
R 65	16	-	-	-	6.35	9.52	6.35	NOTE 3		452.4	449.3	433.4	432.2	50	127	-	-	-
R 66	-	16	-	-	6.35	9.52	6.35	NOTE 3		447.7	444.5	428.6	427.4	50	-	127	-	-
R 67	-	-	16	-	6.35	9.52	6.35	NOTE 3		435.0	431.8	415.9	414.7	50	-	-	152	-
R 69	18	-	-	-	9.52	12.7	9.52	NOTE 3		515.9	512.8	490.5	487.8	50	127	-	-	-
R 70	-	18	-	-	9.52	12.7	9.52	NOTE 3		508.0	504.8	482.6	479.8	50	-	140	-	-
R 71	-	-	18	-	9.52	12.7	9.52	NOTE 3		498.5	495.3	473.1	470.3	50	-	-	177	-
R 73	20	-	-	-	9.52	12.7	9.52	NOTE 3		565.2	560.4	538.2	535.4	50	127	-	-	-
R 74	-	20	-	-	9.52	12.7	9.52	NOTE 3		558.8	554.0	531.8	529.0	50	-	140	-	-
R 75	-	-	20	-	9.52	12.7	9.52	NOTE 3		546.1	541.3	519.1	516.0	50	-	-	177	-
R 77	24	-	-	-	9.52	12.7	9.52	NOTE 3		669.9	665.2	642.9	640.7	50	140	-	-	-
R 78	-	24	-	-	9.52	12.7	9.52	NOTE 3		660.4	655.6	633.4	630.6	50	-	165	-	-
R 79	-	-	24	-	9.52	12.7	9.52	NOTE 3		650.9	646.1	623.9	621.1	50	-	-	203	-

NOTE
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WHEN THE VALUES ARE NOT SHOWN ANO FOR BETA <0.25 AND >0.70, 'T' SHALL BE CALCULATED EVERY TIME AND SHALL NOT BE HIGHER THAN THE SMALLER OF THE VALUES RESULTING FROM THE RATIOS, d/8, D/50, (D-d)/8

Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
					Approved by	
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0	19-02-16	ISSUED AS STANDARD	Manoj / RS	MN	RG	SC

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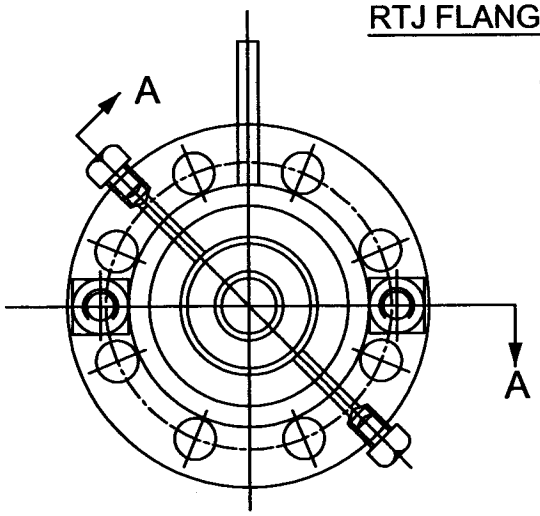
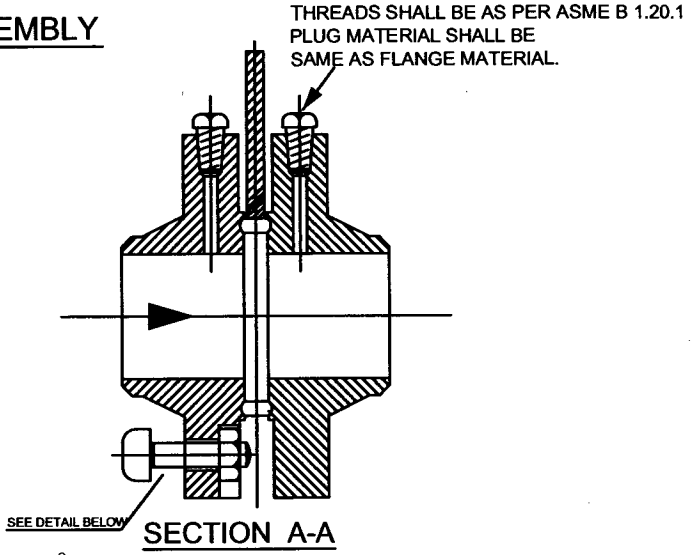
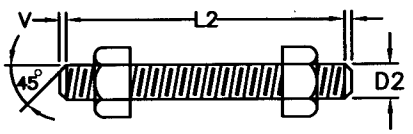
RTJ FLANGE ASSEMBLY

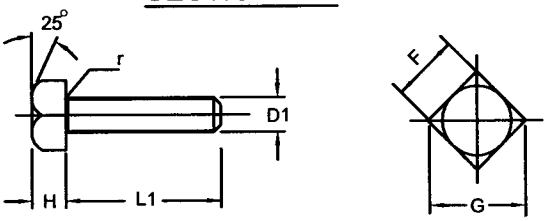




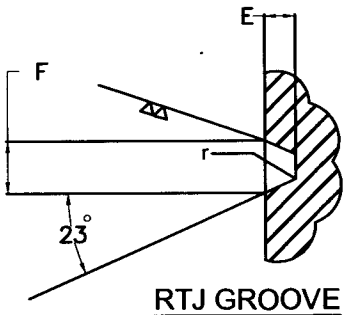
SECTION A-A



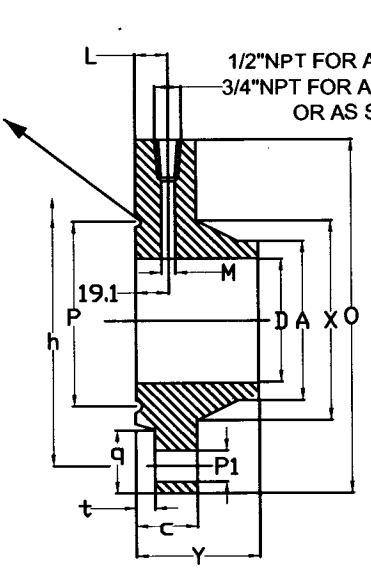
STUD - BOLT



JACK SCREW



RTJ GROOVE



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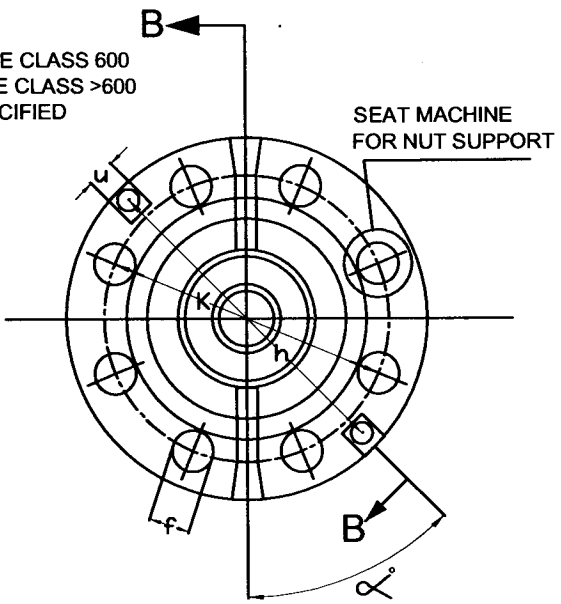

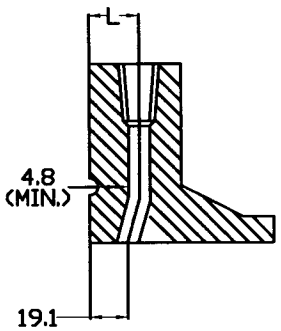

DETAIL WHEN
L>19.1

RTJ FLANGE DIMENSIONS

NOTES:

1. UNLESS OTHERWISE SPECIFIED PRESSURE TAP ORIENTATION SHALL BE AS FOLLOWING:

> FOR TWO TAPS - 90 DEG. APART WITH ONE SET OF TAPS PLUGGED.

> FOR FOUR TAPS - EQUALLY SPACED APART IN THE SAME HALF SECTION OF THE FLANGE WITH TWO SETS OF TAPS PLUGGED.

> PLUG MATERIAL SHALL BE SAME AS FLANGE MATERIAL.

Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
1	12-02-21	REVISED & REISSUED	Manoj	JJ	MN	SM
0	19-02-16	ISSUED AS STANDARD	Manoj / RS	MN	RG	SC

Approved by

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RTJ ORIFICE FLANGE DIMENSIONS (IN mm)

ASME SIZE (INCH) & RATING	A	X	O	K	C	Y	f	NO. OF HOLES	M	L	h	P1	t	q	u	ϒ
600																
1	33.5	54	124	88.9	44.9	88.9	19.1	4	6.4	19.1	102.2	12.7	9.6	21.8	19.1	82°30'
1.5	48.3	69.9	155.5	114.3	44.9	92.1	22.4	4	6.4	19.1	134.2	12.7	9.6	21.8	19.1	82°30'
2	60.5	84.1	165.1	127	46.5	93.7	19.1	8	6.4	19.1	141.2	14.3	11.2	23.8	20.6	45°
3	88.9	117.4	209.6	168.1	46.5	96.9	22.4	8	9.5	19.1	186.2	14.3	11.2	23.8	20.6	45°
4	114.3	152.4	273.1	215.9	46.5	109.6	25.4	8	12.7	19.1	234.7	22.2	19.3	38.3	33.3	45°
6	168.4	222.3	355.6	292.1	56	125.4	28.5	12	12.7	19.1	312.2	25.4	22.5	43.8	38.1	60°
8	219.2	273.1	419.1	349.3	64	141.3	31.8	12	12.7	19.1	375.2	25.4	22.5	43.8	38.1	60°
10	273.1	342.9	508	431.8	71.5	160.4	35.1	16	12.7	19.1	466.2	25.4	22.5	43.8	38.1	67°30'
12	323.9	400.1	558.8	489	75	163.6	35.1	20	12.7	19.1	516.2	25.4	22.5	43.8	38.1	72°
14	355.6	431.8	603.3	527.1	78	173.1	38.1	20	12.7	19.1	561.2	25.4	22.5	43.8	38.1	72°
16	406.4	495.3	685.8	603.3	84.5	185.8	41.2	20	12.7	19.1	635.7	28.6	25.7	49.3	42.9	72°
18	457.2	546.1	743	654.1	91	192.1	44.5	20	12.7	19.1	695.7	28.6	25.7	49.3	42.9	72°
20	508	609.6	812.2	723.9	98.6	200.1	44.5	24	12.7	25.4	765.7	28.6	25.7	49.3	42.9	75°
24	609.6	717.6	939.8	838.2	112.7	214.3	50.8	24	12.7	25.4	890.7	28.6	25.7	49.3	42.9	75°

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1	12-02-21	REVISED & REISSUED	Manoj	JJ	MN	SM
0	19-02-16	ISSUED AS STANDARD	Manoj / RS	MN	RG	SC

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RTJ ORIFICE FLANGE DIMENSIONS (IN mm)

ASME SIZE (INCH) & RATING 900	A	X	O	K	C	Y	f	NO OF HOLES	M	L	h	P1	t	q	u	ϒ
3	88.9	127	241.3	190.5	46.5	109.6	25.4	8	9.5	19.1	208.2	19.2	16	32.8	28.6	45°
4	114.3	158.8	292.1	235	52.5	122.3	31.8	8	12.7	19.1	253.7	22.2	19.3	38.3	33.3	45°
6	168.4	235	381	317.5	64	147.7	31.8	12	12.7	19.1	337.2	25.4	22.5	43.8	38.1	60°
8	219.2	298.5	469.9	393.7	71.5	169.9	38.1	12	12.7	19.1	420.7	28.6	25.7	49.3	42.9	60°
10	273.1	368.3	546.1	469.9	78	192.1	38.1	16	12.7	19.1	495.7	28.6	25.7	49.3	42.9	67°30'
12	323.9	419.1	609.6	533.4	87.5	208	38.1	20	12.7	19.1	560.7	28.6	25.7	49.3	42.9	72°
14	355.6	450.9	641.4	558.8	97	223.8	41.2	20	12.7	25.4	590.7	28.6	25.7	49.3	42.9	72°
16	406.4	508	704.9	616	100	227	44.5	20	12.7	25.4	655.7	28.6	25.7	49.3	42.9	72°
18	457.2	565.2	787.4	685.8	114.6	241.2	50.8	20	12.7	25.4	730.2	31.8	28.9	54.8	47.6	72°
20	508	622.3	857.3	749.3	120.6	260.3	53.9	20	12.7	25.4	800.2	31.8	28.9	54.8	47.6	72°
24	609.6	749.3	1041.4	901.7	155.9	307.9	66.6	20	12.7	25.4	985.2	31.8	28.9	54.8	47.6	72°

Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
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0	19-02-16	ISSUED AS STANDARD	Manoj / RS	MN	RG	SC

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RTJ ORIFICE FLANGE DIMENSIONS (IN mm)

ASME SIZE (INCH) & RATING 1500	A	X	O	K	C	Y	f	NO OF HOLES	M	L	h	P1	t	q	u	∠
1	33.5	52.4	149.2	101.6	44.9	88.9	25.4	4	6.4	19.1	116.2	19.1	16	32.8	28.6	82°30'
1.5	48.3	69.9	177.8	124	44.9	95.3	28.5	4	6.4	19.1	145.2	19.1	16	32.8	28.6	82°30'
2	60.5	104.8	215.9	165.1	46.5	109.6	25.4	8	6.4	19.1	183.2	19.1	16	32.8	28.6	45°
3	88.9	133.4	266.7	203.2	56	125.5	31.8	8	9.5	19.1	228.7	22.2	19.3	38.3	33.3	45°
4	114.3	162.1	311.2	241.3	62	131.8	35.1	8	12.7	19.1	272.7	22.2	19.3	38.3	33.3	45°
6	168.4	228.6	393.7	317.5	92.6	181	38.1	12	12.7	19.1	350.2	25.4	22.5	43.8	38.1	60°
8	219.2	292.1	482.6	393.7	103.5	223.8	44.5	12	12.7	25.4	433.7	28.6	25.7	49.3	42.9	60°
10	273.1	368.3	584.2	482.6	119	265	50.8	12	12.7	25.4	535.7	28.6	25.7	49.3	42.9	60°
12	323.9	450.9	673.1	571.5	138.2	296.8	53.9	16	12.7	25.4	625.7	28.6	25.7	49.3	42.9	67°30'
14	355.6	495.3	749.3	635	149.3	314.3	60.5	16	12.7	28.6	695.2	31.8	28.9	54.8	47.6	67°30'
16	406.4	552.5	825.5	704.9	163.9	328.6	66.6	16	12.7	28.6	764.8	34.9	31.8	60.2	52.4	67°30'
18	457.2	596.1	914.4	774.7	179.4	344.5	73.2	16	12.7	28.6	854.8	34.9	31.8	60.2	52.4	67°30'
20	508	641.4	984.3	831.9	195.4	373	79.3	16	12.7	28.6	924.8	34.9	31.8	60.2	52.4	67°30'
24	609.6	762	1168.4	990.6	224	426.9	92	16	12.7	31.8	1109.8	34.9	31.8	60.2	52.4	67°30'

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0	19-02 -16	ISSUED AS STANDARD	Manoj / RS	MN	RG	SC

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RTJ ORIFICE FLANGE DIMENSIONS (IN mm)

ASME SIZE (INCH) & RATING		A	X	O	K	C	Y	f	NO OF HOLES	M	L	h	P1	t	q	u	∝
2500	1	33.5	57.2	158.8	108	44.9	98.5	25.4	4	6.4	19.1	120.7	22.2	19.3	38.3	33.3	82°30'
	1.5	48.3	79.3	203.2	146.1	52.5	119.1	31.8	4	6.4	19.1	154.7	22.2	19.3	38.3	33.3	82°30'
	2	60.5	95.3	235	171.5	60.6	136.6	28.5	8	6.4	19.1	196.7	22.2	19.3	38.3	33.3	45°
	3	88.9	133.4	304.8	228.6	76.7	177.9	35.1	8	9.5	19.1	255.7	28.6	25.7	49.3	42.9	45°
	4	114.3	165.1	355.6	273.1	87.5	201.5	41.2	8	12.7	25.4	306.7	28.6	25.7	49.3	42.9	45°
	6	168.4	235	482.6	368.3	120.6	285.7	53.9	8	12.7	25.4	422.8	34.9	31.8	60.2	52.4	45°
	8	219.2	304.8	552.5	438.2	141.2	331.7	53.9	12	12.7	25.4	489.8	34.9	31.8	60.2	52.4	60°
	10	273.1	374.7	673.1	539.8	182.9	436.5	66.6	12	12.7	28.6	603.8	41.3	38.2	71.2	61.9	60°
	12	323.9	441.5	762	619.3	201.9	480.9	73.2	12	12.7	28.6	688.8	41.3	38.2	71.2	61.9	60°

Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
					Approved by	
1	12-02-21	REVISED & REISSUED	Manoj	JJ	MN	SM
0	19-02 -16	ISSUED AS STANDARD	Manoj / RS	MN	RG	SC

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RTJ GROOVE DETAILS

ASME SIZE (INCH) & RATING		P	E	F	r(max)	GROOVE NO.
600	1	50.8	6.4	8.7	0.8	R 16
	1.5	68.3	6.4	8.7	0.8	R 20
	2	82.6	7.9	11.9	0.8	R 23
	3	123.8	7.9	11.9	0.8	R 31
	4	149.2	7.9	11.9	0.8	R 37
	6	211.1	7.9	11.9	0.8	R 45
	8	269.9	7.9	11.9	0.8	R 49
	10	323.9	7.9	11.9	0.8	R 53
	12	381	7.9	11.9	0.8	R 57
	14	419.1	7.9	11.9	0.8	R 61
	16	469.9	7.9	11.9	0.8	R 65
	18	533.4	7.9	11.9	0.8	R 69
	20	584.2	9.5	13.5	1.5	R 73
	24	692.2	11.1	16.7	1.5	R 77
900	3	123.8	7.9	11.9	0.8	R 31
	4	149.2	7.9	11.9	0.8	R 37
	6	211.1	7.9	11.9	0.8	R 45
	8	269.9	7.9	11.9	0.8	R 49
	10	323.9	7.9	11.9	0.8	R 53
	12	381	7.9	11.9	0.8	R 57
	14	419.1	11.1	16.7	1.5	R 62
	16	469.9	11.1	16.7	1.5	R 66
	18	533.4	12.7	19.8	1.5	R 70
	20	584.2	12.7	19.8	1.5	R 74
	24	692.2	15.9	27	2.3	R 78

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RTJ GROOVE DETAILS

ASME SIZE (INCH) & RATING		P	E	F	r(max)	GROOVE NO.
1500	1	50.8	6.4	8.7	0.8	R 16
	1.5	68.3	6.4	8.7	0.8	R 20
	2	95.3	7.9	11.9	0.8	R 24
	3	136.5	7.9	11.9	0.8	R 35
	4	161.9	7.9	11.9	0.8	R 39
	6	211.1	9.5	13.5	1.5	R 46
	8	269.9	11.1	16.7	1.5	R 50
	10	323.9	11.1	16.7	1.5	R 54
	12	381	14.3	20.5	1.5	R 58
	14	419.1	15.9	27	2.3	R 63
	16	469.9	17.5	30.2	2.3	R 67
	18	533.4	17.5	30.2	2.3	R 71
	20	584.2	17.5	33.3	2.3	R 75
	24	692.2	20.6	36.5	2.3	R 79
2500	1	60.3	6.4	8.7	0.8	R 18
	1.5	82.6	7.9	11.9	0.8	R 23
	2	101.6	7.9	11.9	0.8	R 26
	3	127	9.5	13.5	1.5	R 32
	4	157.2	11.1	16.7	1.5	R 38
	6	228.6	12.7	19.8	1.5	R 47
	8	279.6	14.3	23	1.5	R 51
	10	342.9	17.5	30.2	2.3	R 55
	12	406.4	17.5	33.3	2.3	R 60

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TOLERANCES ALLOWED ON FLANGES ACCORDING TO ASME B16.36 / B16.5

DIMENSIONS mm (Inches)		TOLERANCES (Inches)
O	≤ 609.6 mm	± 1.59 *
	> 609.6 mm	± 3.18 *
C	NB ≤ 450 (18)	+ 3.18 − 0
	NB > 450 (18)	+ 4.76 − 0
X	≤ 609.6 mm	± 1.59 *
	> 609.6 mm	± 3.18 *
A	NB ≤ 125 (4)	+ 2.38 − 0.79
	NB ≥ 150 (6)	+ 3.96 − 0.79
Y	NB ≤ 250 (10)	± 1.59
	NB ≥ 300 (12)	± 3.18
DRILLING	K	± 1.59
	CENTRES BETWEEN HOLES	± 0.79
R	FOR GV/GD < 6.35 mm	± 0.40
	FOR GV/GD ≥ 6.35 mm	± 0.79
ECCENTRICITY BETWEEN K AND R DIAMETERS		± 0.79
ECCENTRICITY BETWEEN K AND D DIAMETERS		± 0.79 *
ECCENTRICITY BETWEEN R AND D DIAMETERS		± 0.79 *
D	NB ≤ 150 (6)	± 0.12 *
	NB 200 & 250 (8 & 10)	+ 0.12 − 0.25 *
	NB 300 (12)	+ 0.12 − 0.38 *
	NB 350 & 400 (14 & 16)	+ 0.12 − 0.50 *
	NB ≥ 450 (18)	+ 0.12 − 0.76 *
L	NPS ≤ 4	± 0.5
	NPS > 4	± 0.8
t		(-) 0 (*) ± 0.4
E		± 0.4 (-) 0
F		± 0.20

* NOT COVERED BY ASME B16.5

WELD NECK RTJ ORIFICE FLANGES

Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
					Approved by	
1	12-02-21	REVISED & REISSUED	Manoj	JJ	MN	SM
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JACK SCREW DIMENSIONS

ASME SIZE (INCH) & RATING	D1-DIAMETER (inches) AND L1-LENGTH (mm)							
	600		900		1500		2500	
	D1	L1	D1	L1	D1	L1	D1	L1
1	3/8	95	-	-	5/8	110	3/4	115
1 1/2	3/8	95	-	-	5/8	110	3/4	120
2	7/16	100	-	-	5/8	110	3/4	120
3	7/16	100	5/8	110	3/4	120	1	160
4	3/4	115	3/4	120	3/4	135	1	170
6	7/8	135	7/8	140	7/8	165	1 1/4	220
8	7/8	140	1	160	1	185	1 1/4	250
10	7/8	150	1	165	1	210	1 1/2	305
12	7/8	150	1	170	1	235	1 1/2	330
14	7/8	160	1	190	1 1/8	250	-	-
16	1	170	1	190	1 1/4	275	-	-
18	1	185	1 1/8	220	1 1/4	295	-	-
20	1	190	1 1/8	230	1 1/4	320	-	-
24	1	210	1 1/8	265	1 1/4	350	-	-

D1	F	G(max)	G(min)	H	r(max)
3/8	14.3	20.2	19	6.4	0.8
7/16	15.9	22.5	21	7.4	0.8
5/8	23.8	33.7	31.6	10.7	1.5
3/4	28.6	40.4	37.9	12.7	1.5
7/8	33.3	47.1	44.2	15.1	1.5
1	38.1	53.9	50.6	16.7	2.3
1 1/8	42.9	60.6	56.9	19.1	2.3
1 1/4	47.6	67.4	63.2	21.4	2.3
1 1/2	57.2	80.8	75.8	25.4	2.3

Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
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STUD BOLT DETAILS FOR RTJ FLANGES

D2 mm(Inches)	THREAD PITCH		V	2V *
15.9 (5/8)	UNC	2.309	3.46	7
19.0 (3/4)		2.54	3.78	7.5
22.2 (7/8)		2.822	4.23	8.5
25.4 (1)		3.175	4.76	9.5
≥ 28.6 (1 1/8)	8 UN	3.175	4.76	9.5

* APPROXIMATE VALUE OF THE TWO BEVELS

(ALL RATING AS PER ASME CLASS)

DIAMETER (NB,D2) mm (INCHES) & LENGTH–(L2) IN mm (NOTE–1)											
RATING		600		900		1500		2500	
DIM.	N B	D2	L2	D2	L2	D2	L2	D2	L2
25	(1)	15.9 (5/8)	139.7	–	–	22.2 (7/8)	158.75	22.2 (7/8)	158.8
40	(1 1/2)	19.0 (3/4)	139.7	–	–	25.4 (1)	165.1	28.6 (1 1/8)	190.5
50	(2)	15.9 (5/8)	139.7	–	–	22.2 (7/8)	165.1	25.4 (1)	196.9
80	(3)	19.0 (3/4)	146.1	22.2 (7/8)	165.1	28.6 (1 1/8)	184.2	31.8 (1 1/4)	241.3
100	(4)	22.2 (7/8)	165.1	28.6 (1 1/8)	190.5	31.7 (1 1/4)	216	38.1 (1 1/2)	273.1
150	(6)	25.4 (1)	190.5	28.6 (1 1/8)	209.6	34.9 (1 3/8)	279.4	50.8 (2)	368.3
200	(8)	28.6 (1 1/8)	209.6	34.9 (1 3/8)	241.3	41.3 (1 5/8)	311.2	50.8 (2)	406.4
250	(10)	31.7 (1 1/4)	235	34.9 (1 3/8)	254	47.6 (1 7/8)	355.6	63.5 (2 1/2)	514.4
300	(12)	31.7 (1 1/4)	241.3	34.9 (1 3/8)	273.1	50.8 (2)	400.1	69.9 (2 3/4)	571.5
350	(14)	34.9 (1 3/8)	254	38.1 (1 1/2)	292.1	57.1 (2 1/4)	445	–	–
400	(16)	38.1 (1 1/2)	273.1	41.3 (1 5/8)	304.8	63.5 (2 1/2)	482.6	–	–
450	(18)	41.3 (1 5/8)	292.1	47.6 (1 7/8)	349.3	69.8 (2 3/4)	533.4	–	–
500	(20)	41.3 (1 5/8)	317.5	50.8 (2)	374.7	76.2 (3)	571.5	–	–
600	(24)	47.6 (1 7/8)	349.3	63.5 (2 1/2)	470	88.9 (3 1/2)	660.4	–	–

TOLERANCES ON 'L2'

L2–LENGTH mm	≤ 305	310 TO 455	≥ 455
TOLERANCE mm	– 0 + 1.6	– 0 + 3.2	– 0 + 6.4

NOTES :–

1. FOR BOLT DIAMETER 1" (25mm) & ABOVE IN EACH RATING, FOLLOWING SHALL BE CONSIDERED TO TAKE CARE OF BOLT TENSIONING.
   (i) ONE EXTRA NUT SHALL BE CONSIDERED FOR EACH BOLT/STUD.
   (ii) BOLT/STUD LENGTH SHALL BE INCREASED BY ONE DIAMETER.

Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
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0	19-02 -16	ISSUED AS STANDARD	Manoj / RS	MN	RG	SC

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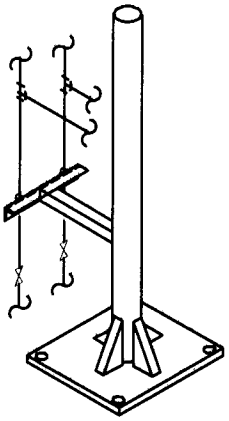
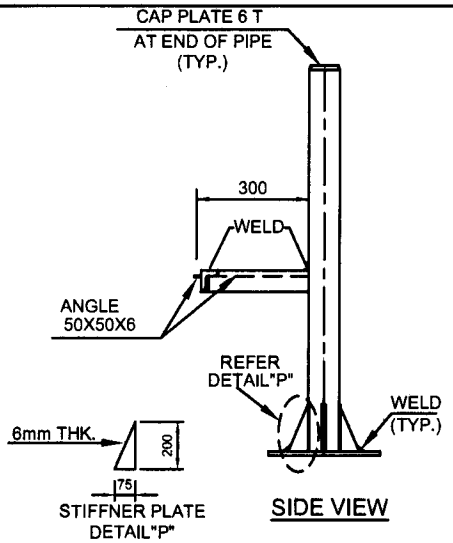
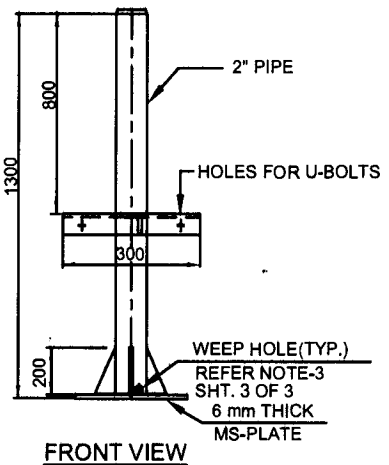
TYPE 11 — SINGLE INSTRUMENT SUPPORT - GENERAL ARRANGEMENT



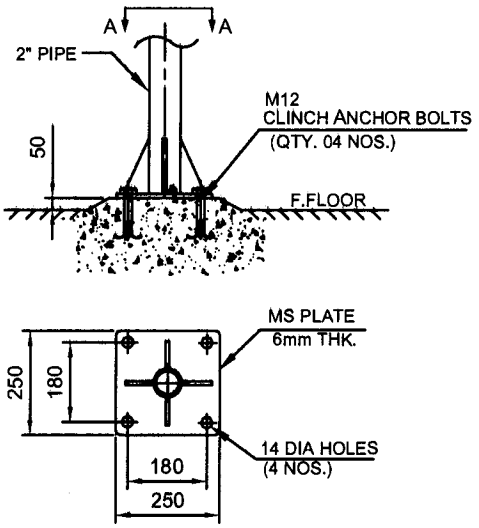


SIDE VIEW



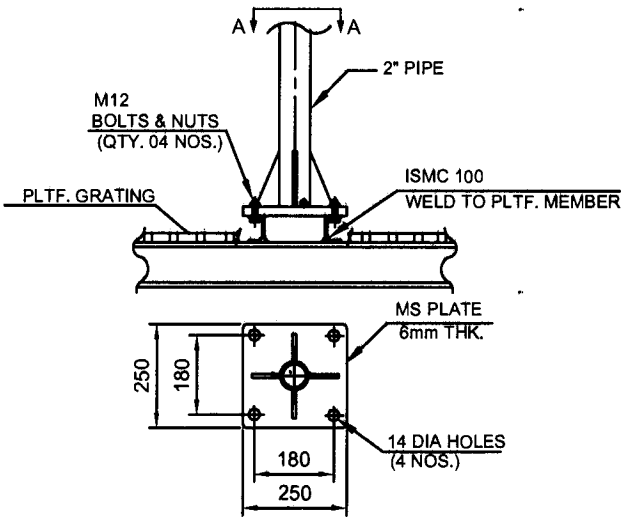
FRONT VIEW

TYPE 11-1



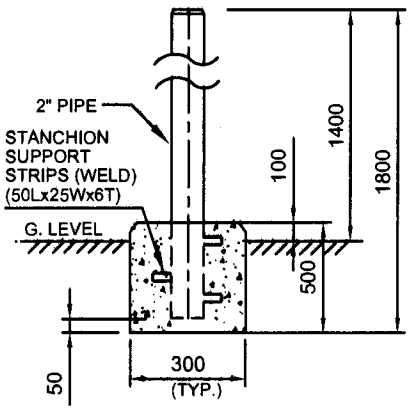
VIEW A-A
PAVED AREA MOUNTING

TYPE 11-2



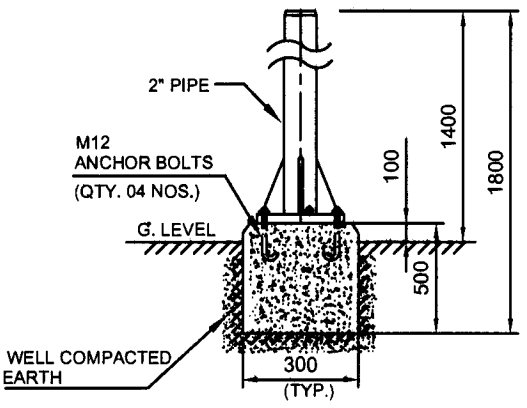
VIEW A-A
PLATFORM MOUNTING

TYPE 11-3



UNPAVED AREA MOUNTING
(WITH INTEGRAL CONC. BLOCK)

TYPE 11-4



UNPAVED AREA MOUNTING
(WITH SEPARATE CONC. BLOCK)

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4	22.03.22	Revised & Reissued	SM / Manoj	AS	MN	SM
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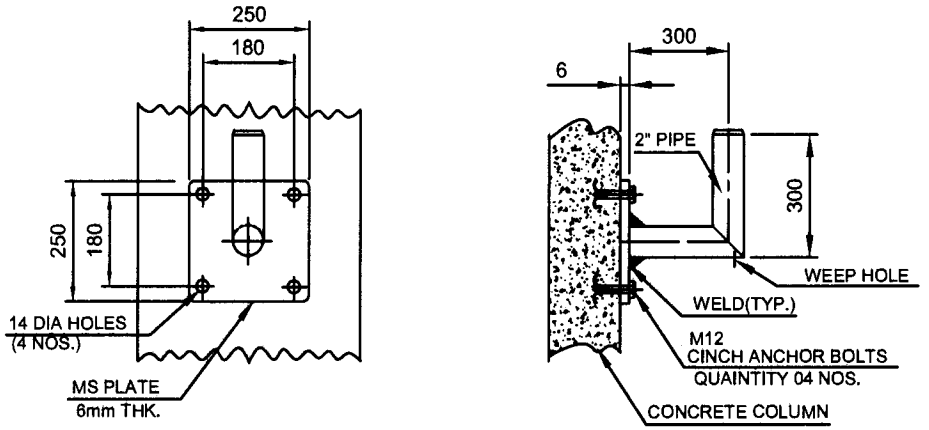
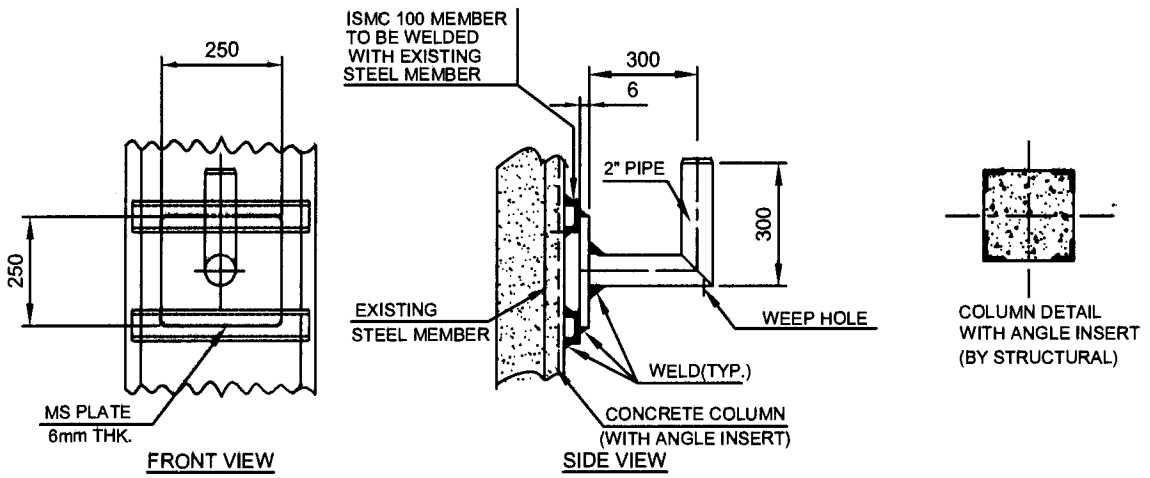
TYPE 12 CONCRETE COLUMN MOUNTING



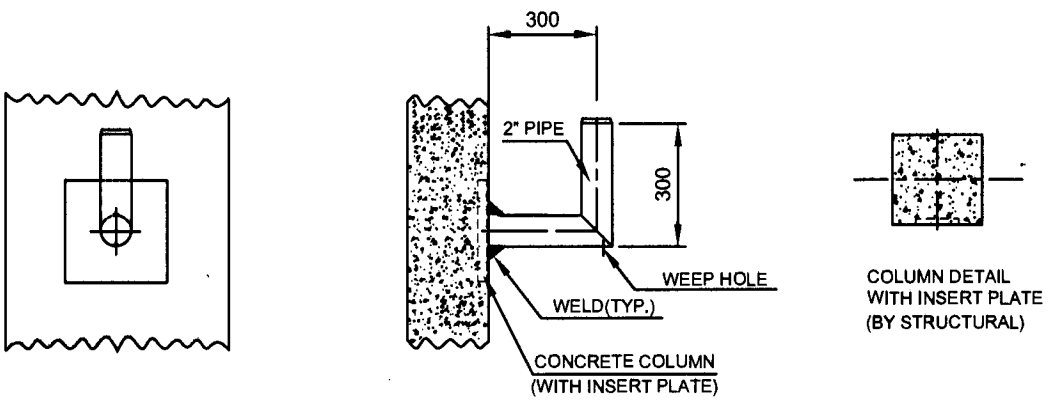
FRONT VIEW SIDE VIEW

TYPE 13 CONCRETE COLUMN (WITH ANGLE INSERT) MOUNTING



FRONT VIEW SIDE VIEW

TYPE-14 CONCRETE COLUMN (WITH INSERT PLATE) MOUNTING



FRONT VIEW SIDE VIEW

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3	28.03.17	Reaffirmed & Reissued	Manoj	MN	RG	RN

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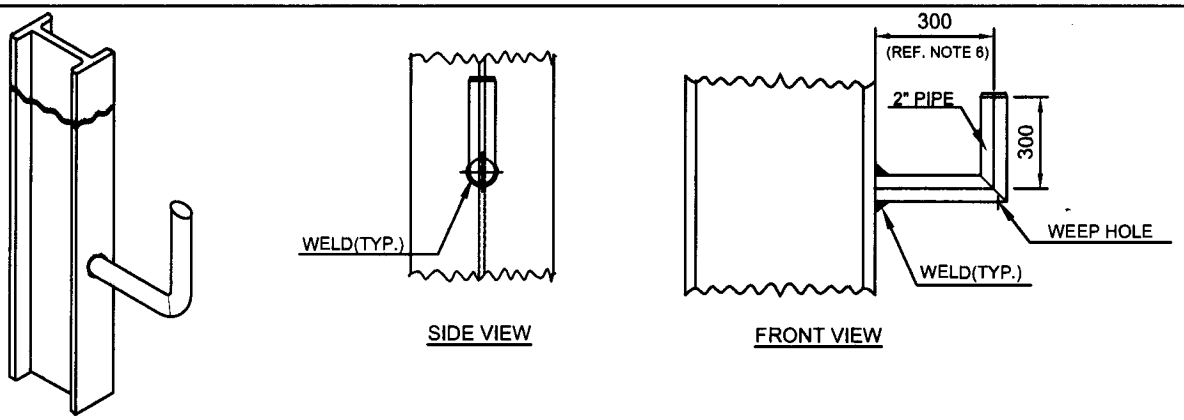
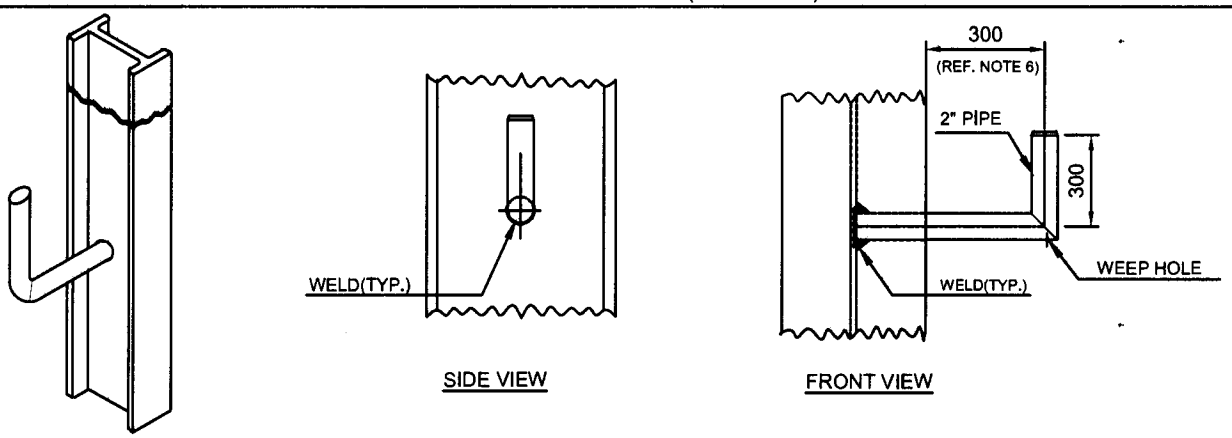
TYPE 15 STEEL COLUMN MOUNTING (FLANGE FACE)

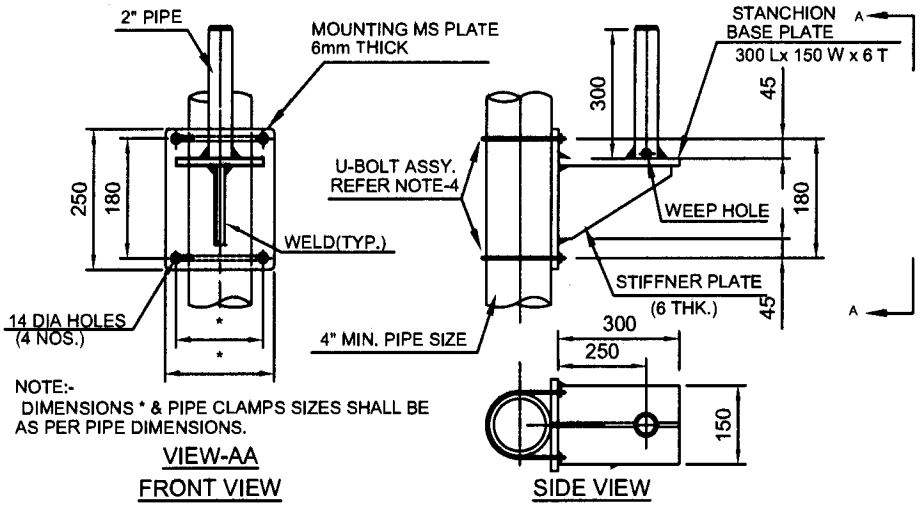


TYPE 16 STEEL COLUMN MOUNTING (WEB FACE)

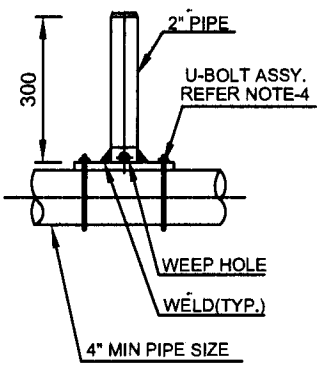


TYPE 17 PIPE BRACKET MOUNTING

TYPE 17.1 (VERTICAL PIPE)



TYPE 17.2 (HORIZONTAL PIPE)



(HORIZONTAL PIPE)

NOTES:-

1. ALL DIMENSIONS ARE IN M.M. UNLESS OTHERWISE SPECIFIED.
2. PIPE MATERIAL SHALL BE IS:1239 HEAVY GRADE AS A MINIMUM.
3. 6 mm DIA WEEP HOLE SHALL BE PROVIDED AT LOW POINT.
4. U-BOLT ASSEMBLY SHALL BE OF MINIMUM M12 SIZE WITH NUTS AND SPRING WASHERS.
5. ALL WELD SHALL BE 3mm FILLET WELD FULL STRENGTH.
6. ADD 50mm WHERE-EVER FIRE INSULATION IS PROVIDED.
7. BOLT SHALL BE TURNED FROM M.S. ROUNDS CONFIRMING TO IS : 432 GRADE 1.
8. NUTS AND WASHERS SHALL CONFIRM TO IS : 1363 AND IS : 3138.
9. GALVANISED PLATES SHAL BE CONSIDERED FOR MOUNTING OF INSTRUMENT SUPPORT ON PIPES.

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Approved by

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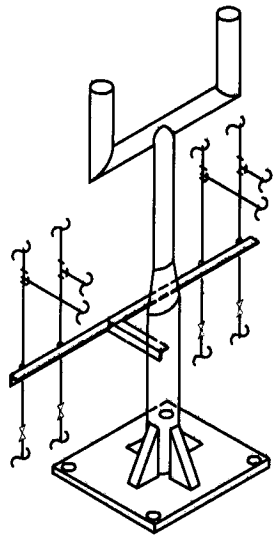
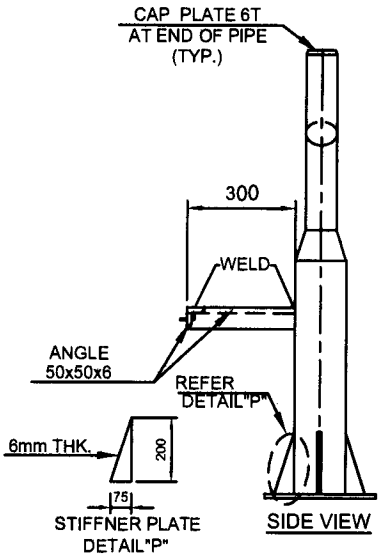
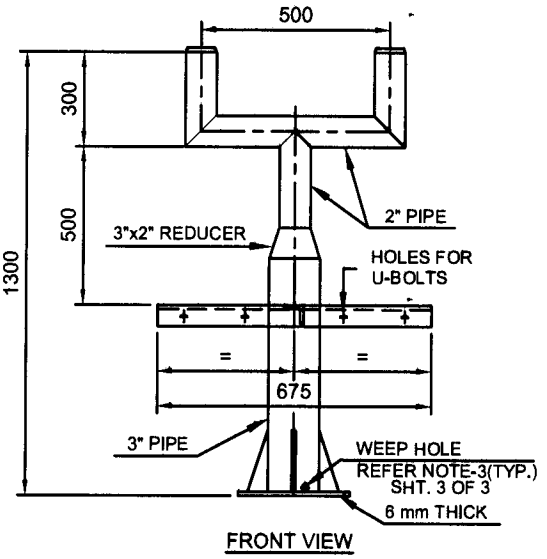
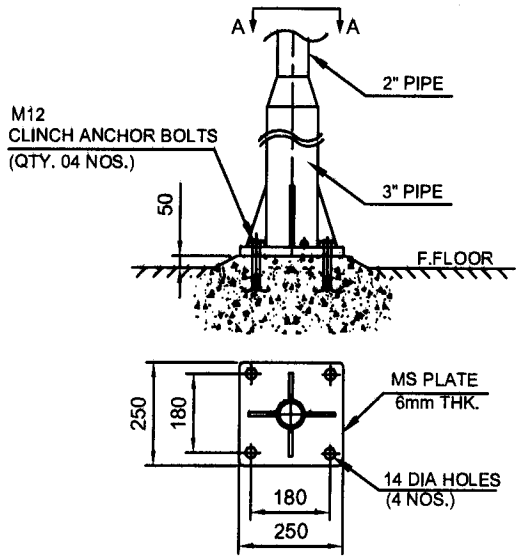
TYPE 21 TWO INSTRUMENTS SUPPORT - GENERAL ARRANGEMENT





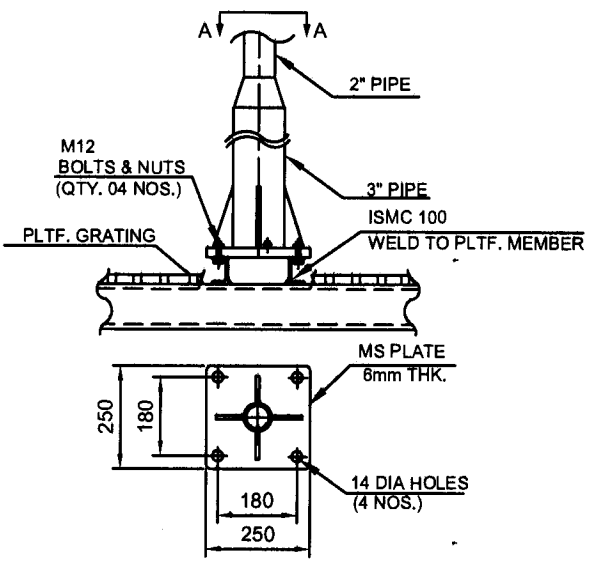


TYPE 21-1



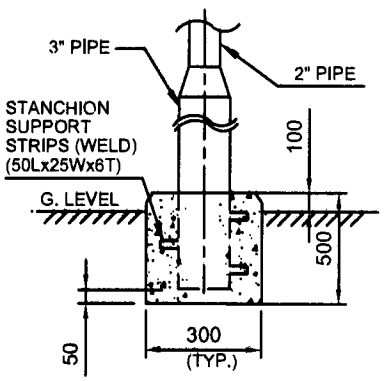
PAVED AREA MOUNTING

TYPE 21-2



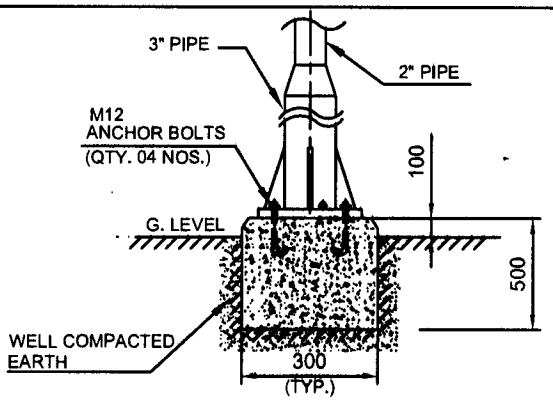
PLATFORM MOUNTING

TYPE 21-3



UNPAVED AREA MOUNTING
(WITH INTEGRAL CONC. BLOCK)

TYPE 21-4



UNPAVED AREA MOUNTING
(WITH SEPARATE CONC. BLOCK)

Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
					Approved by	
4	29.03.22	Reaffirmed & Reissued	SM / Manoj	AS	MN	SM
3	28.03.17	Reaffirmed & Reissued	Manoj	MN	RG	RN

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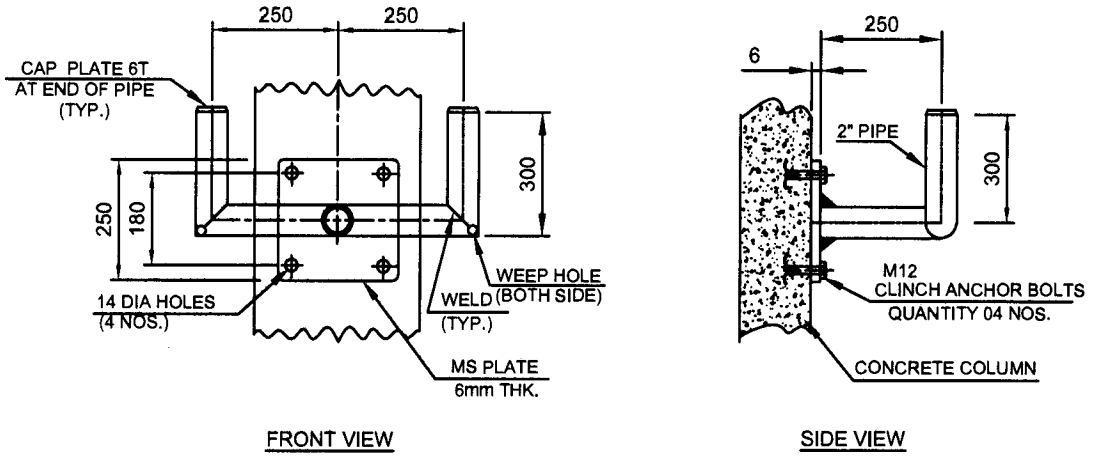
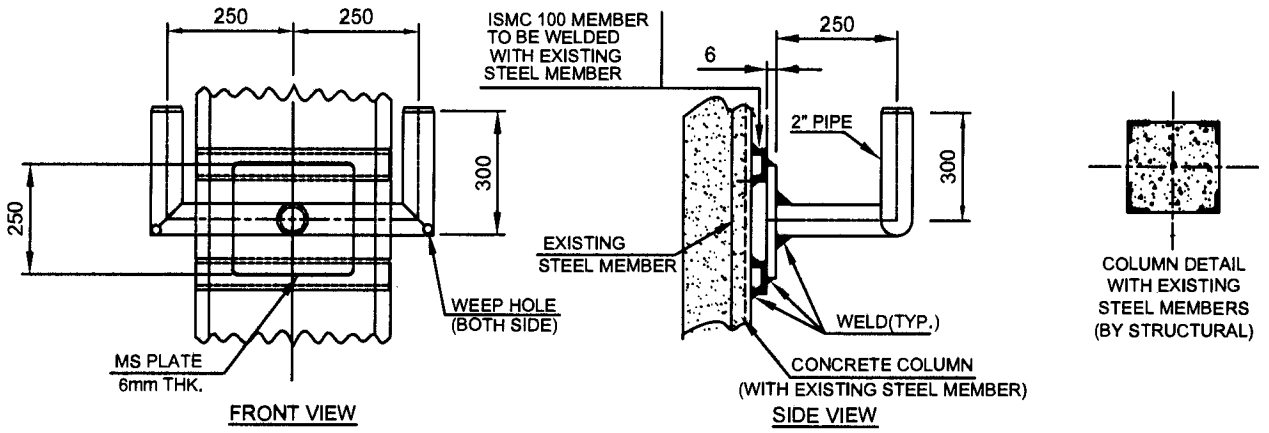
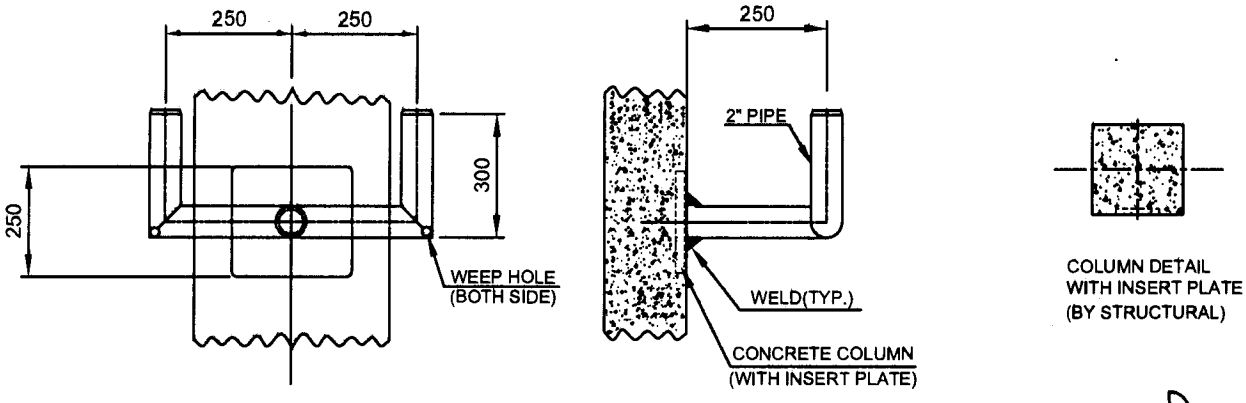
TYPE 22 CONCRETE COLUMN MOUNTING



TYPE 23 CONCRETE COLUMN (WITH ANGLE INSERT) MOUNTING



TYPE 24 CONCRETE COLUMN (WITH INSERT PLATE) MOUNTING



Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
					Approved by	
4	29.03.22	Reaffirmed & Reissued	SM / Manoj	AS	MN	SM
3	28.03.17	Reaffirmed & Reissued	Manoj	MN	RG	RN

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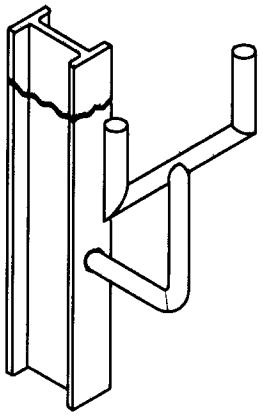
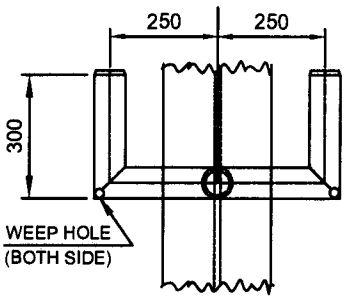
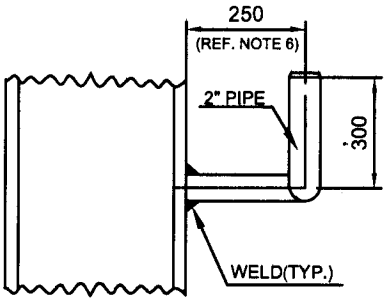
TYPE 25 STEEL COLUMN MOUNTING (FLANGE FACE)



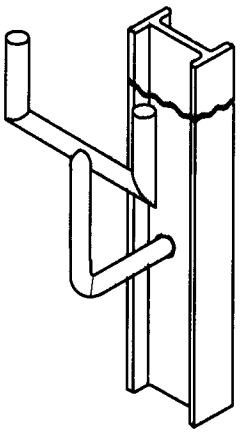


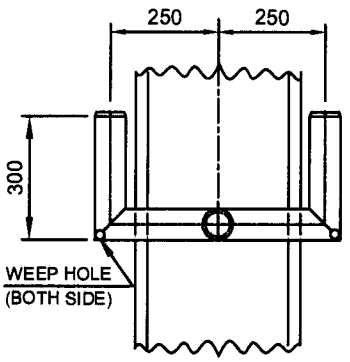
FRONT VIEW



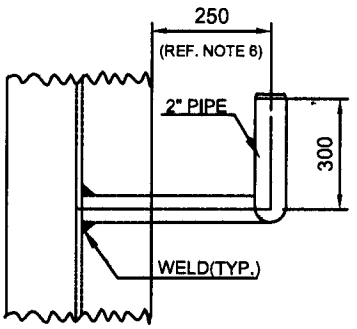
SIDE VIEW

TYPE 26 STEEL COLUMN MOUNTING (WEB FACE)





FRONT VIEW



SIDE VIEW

NOTES:-

1. ALL DIMENSIONS ARE IN M.M. UNLESS OTHERWISE SPECIFIED.
2. PIPE MATERIAL SHALL BE IS:1239 HEAVY GRADE AS A MINIMUM.
3. 6 mm DIA WEEP HOLE SHALL BE PROVIDED AT LOW POINT.
4. U-BOLT ASSEMBLY SHALL BE OF MINIMUM M12 SIZE WITH NUTS AND SPRING WASHERS.
5. ALL WELD SHALL BE 3mm FILLET WELD FULL STRENGTH.
6. ADD 50mm WHERE-EVER FIRE INSULATION IS PROVIDED.
7. BOLT SHALL BE TURNED FROM M.S. ROUNDS CONFIRMING TO IS : 432 GRADE 1.
8. NUTS AND WASHERS SHALL CONFIRM TO IS : 1363 AND IS : 3138.

Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
					Approved by	
4	29.03.22	Reaffirmed & Reissued	SM / Manoj	AS	MN	SM
3	28.03.17	Reaffirmed & Reissued	Manoj	MN	RG	RN

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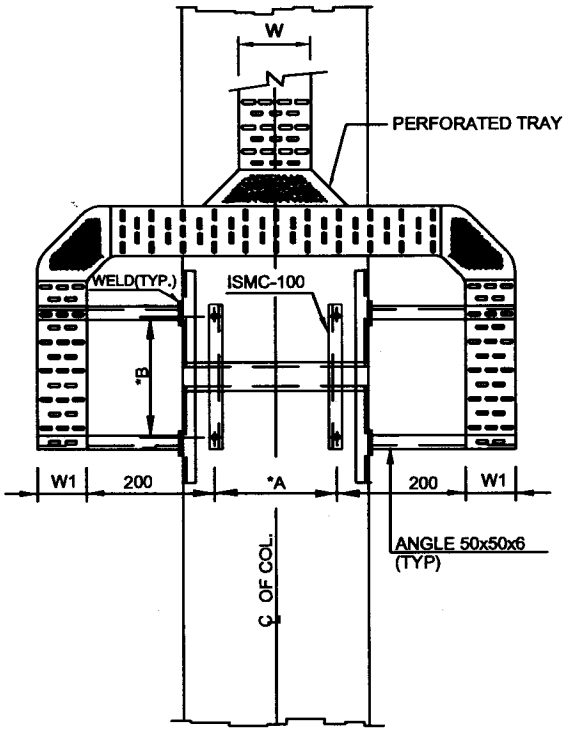
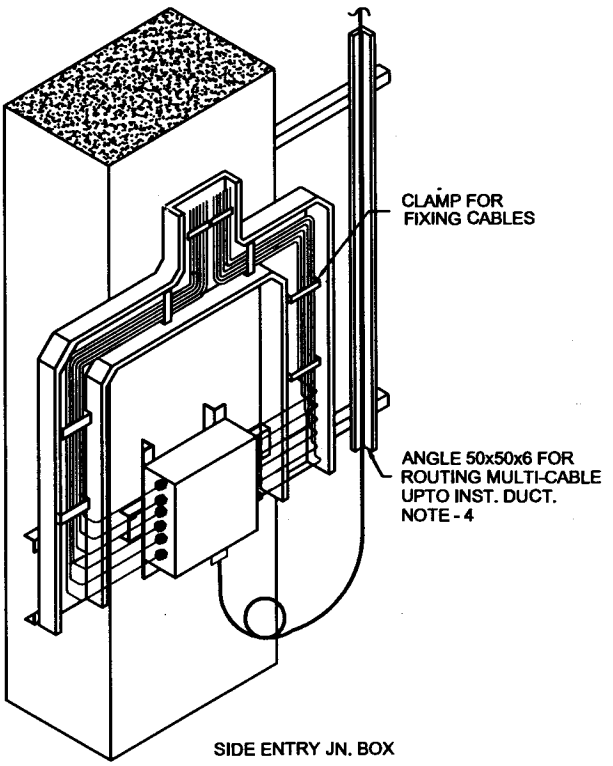
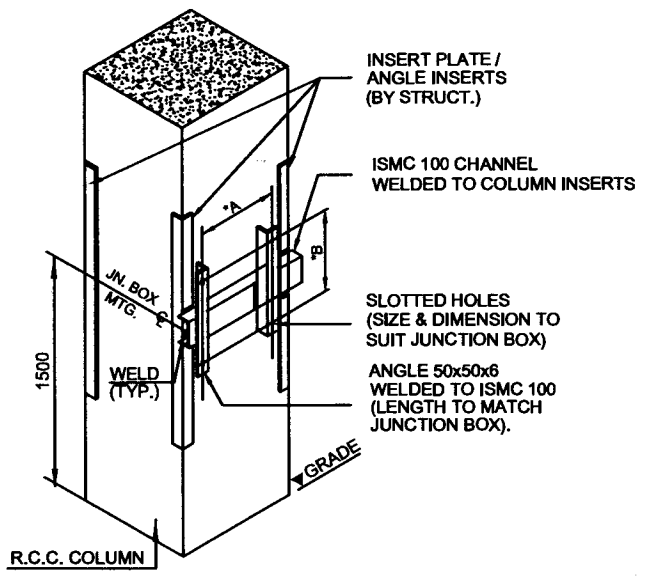
TRAY ARRANGEMENT FOR JUNCTION BOXES



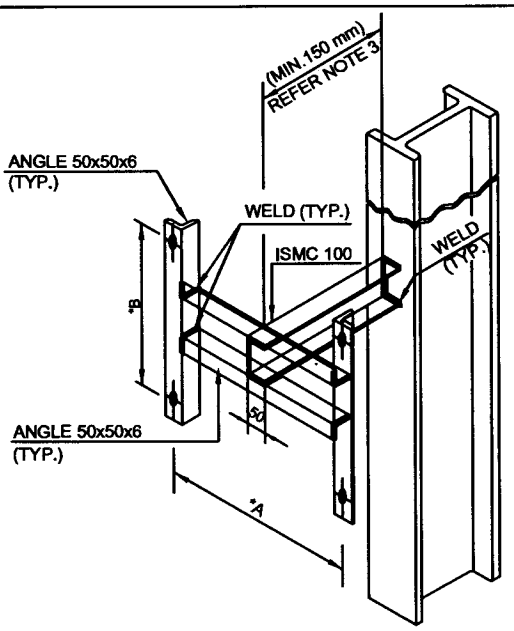
CABLE ROUTING FOR JUNCTION BOXES.



JN. BOX MOUNTING FRAME (R.C.C. COLUMN)



JN. BOX MOUNTING FRAME (STEEL COLUMN)



* DIMENSION 'A and B' TO SUIT JUNCTION BOX.

NOTE:
1. ALL DIMENSIONS ARE IN mm.
2. CLAMP MULTICABLE ON ANGLE WITH 25mm WIDE PVC COVERED ALLUMINIUM STRIP.
3. ADD 50 mm WHERE-EVER FIRE INSULATION IS PROVIDED.
4. COMMON TRAY FOR MULTIPLE MULTICABLE CAN BE USED FOR JBs LOCATED TOGETHER. TRAY HEIGHT SHALL BE MINIMUM 40 mm FOR RUNNING MULTIPAIR.

TRAY WIDTH

JN. BOX	W	W1
12 PAIR	300	150
8 TRIAD	300	150
6 PAIR	150	100

Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
					Approved by	
4	03.11.21	Revised & Reissued	Saurav	~~AJS~~	MN	SM
3	28.03.17	Revised & Reissued	Manoj	MN	RG	RN

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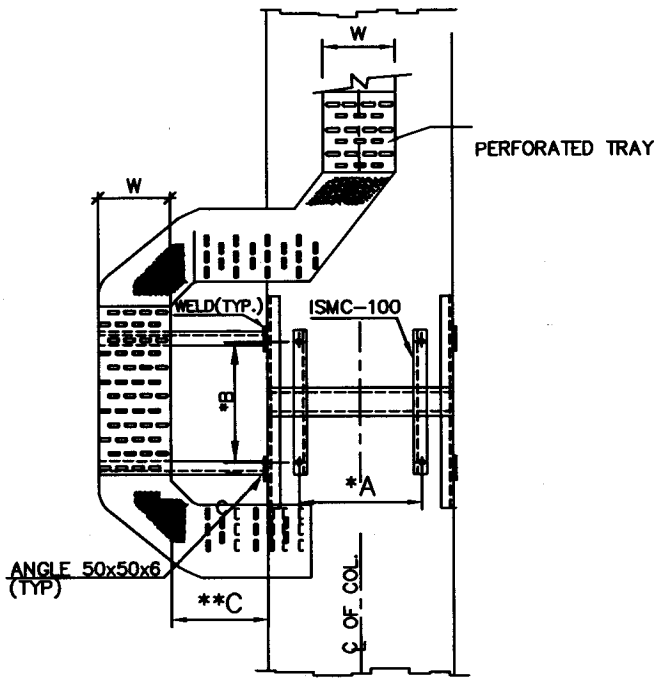
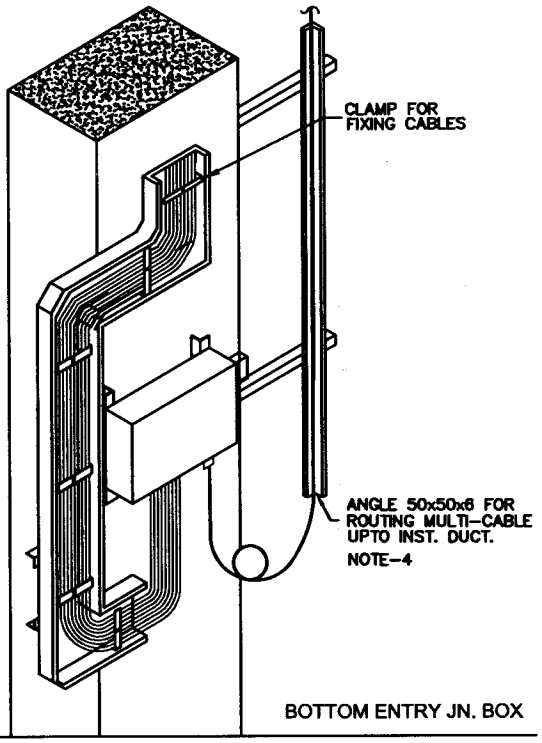
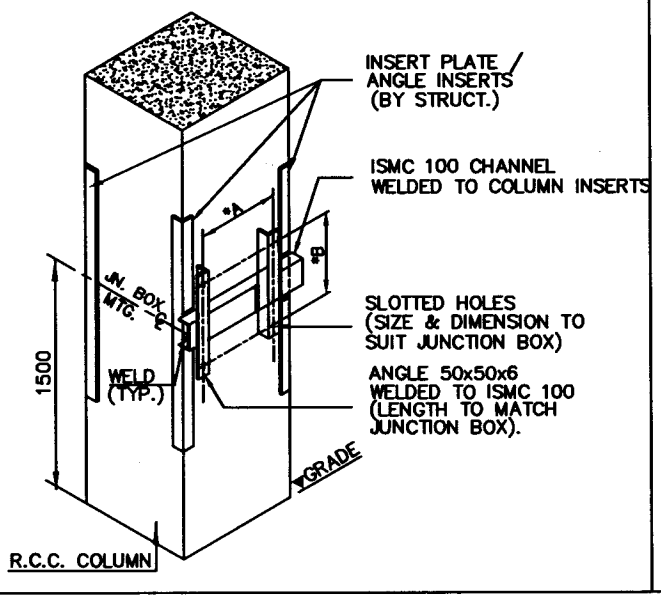
TRAY ARRANGEMENT FOR JUNCTION BOXES



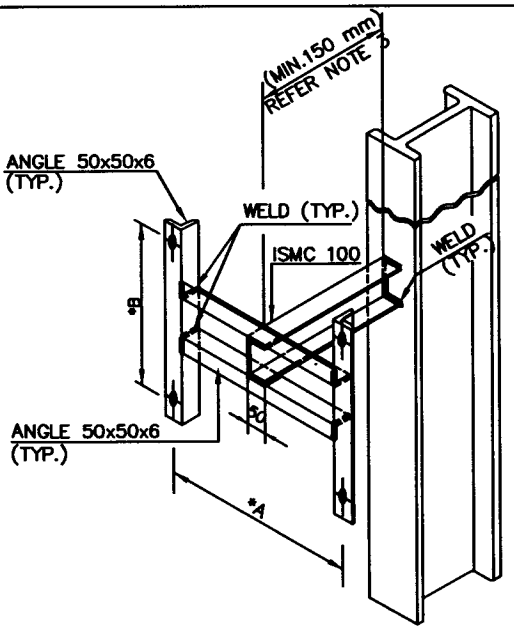
CABLE ROUTING FOR JUNCTION BOXES.



JN. BOX MOUNTING FRAME (R.C.C. COLUMN)



JN. BOX MOUNTING FRAME (STEEL COLUMN)



* DIMENSION 'A and B' TO SUIT JUNCTION BOX.

** DIMENSION 'C' SHALL BE 150 TYPICAL, MAY VARY TO SUIT THE REQUIREMENT.

TRAY WIDTH

JN. BOX	W
12 PAIR	300
8 TRIAD	300
6 PAIR	150

NOTE:
1. ALL DIMENSIONS ARE IN mm.
2. CLAMP MULTICABLE ON ANGLE WITH 25mm WIDE PVC COVERED ALLUMINIUM STRIP.
3. ADD 50 mm WHERE-EVER FIRE INSULATION IS PROVIDED.
4. COMMON TRAY FOR MULTIPLE MULTICABLE CAN BE USED FOR JBs LOCATED TOGETHER. TRAY HEIGHT SHALL BE MINIMUM 40mm FOR RUNNING MULTIPAIR.

Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
4	03.11.21	Revised & Reissued	Saurav	AJS	MN	SM
3	28.03.17	Revised & Reissued	Manoj	MN	RG	RN

Approved by

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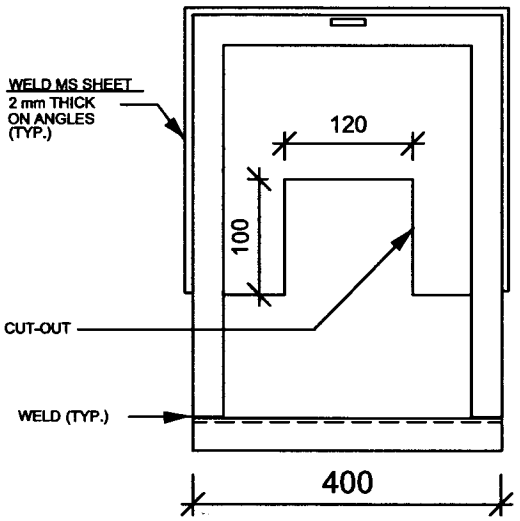
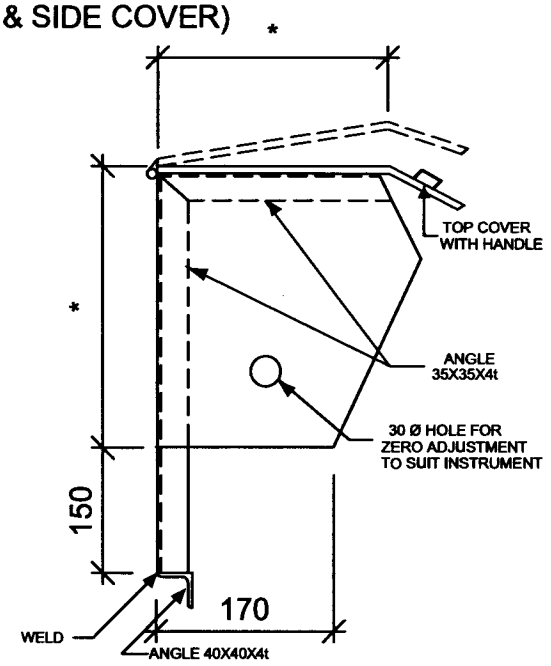
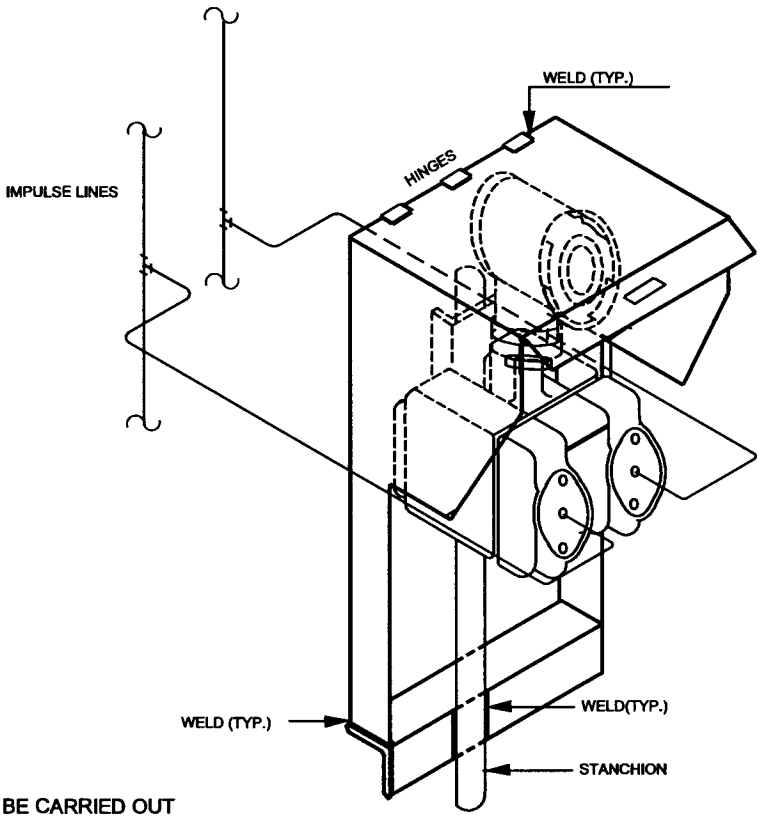
TYPE : MS PAINTED (TOP & SIDE COVER)



TOP VIEW



SIDE VIEW



FRONT VIEW

NOTES :

1. ALL DIMENSIONS ARE IN mm
2. * TO SUIT INSTRUMENT DIMENSIONS
3. HINGES SHALL BE OF STAINLESS STEEL.
4. A MINIMUM OF TWO COATS PAINTING SHALL BE CARRIED OUT AFTER A MINIMUM OF ONE COAT OF RED OXIDE ZINC CHROMATE PRIMER. THE COLOUR OF THE PAINT SHALL BE AS PER IS-5.
5. ALL EDGES/CORNERS SHALL BE PROPERLY SMOOTHENED AND ENSURE THAT NO SHARP EDGES EXIST.

Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
4	17.08.21	Revised & Reissued	Saurav	AJS	MN	SM
3	28.03.17	Reaffirmed & Reissued	Manoj	MN	RG	RN

Approved by

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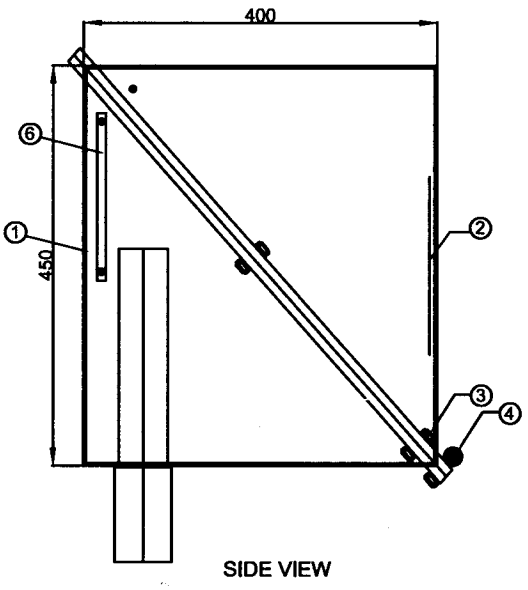
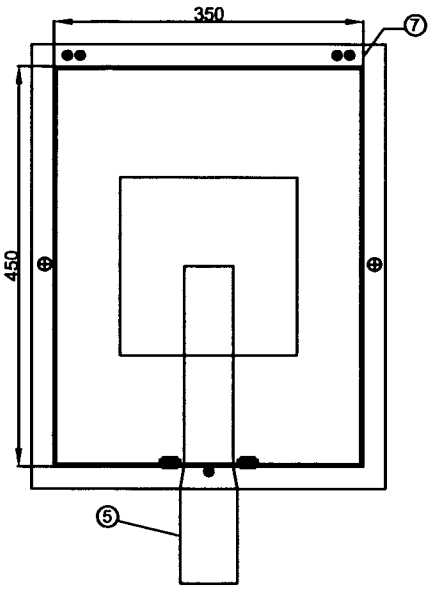
TYPE : FRP CANOPY (ALL SIDE CLOSED) - FIELD INSTRUMENTS

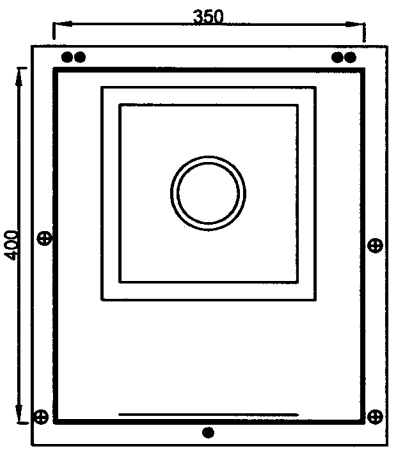


SIDE VIEW



FRONT VIEW

SPECIFICATIONS	
FRP Enclosure	Resin: Iso-phthalic fire retardant UV resistant polyester as per IS-10192
Glass Content	Min. 60%
Flammability	Rating Class I, as per IS 6746
Pigments	Resin pigmented grey
Thickness	3mm, +1.0mm / -0.25mm
Finish	Smooth Outside Finish in Glaze & Gloss
Colour	RAL 7040 PU (GREY)
Window	3mm thick acrylic window for viewing
Others	Canopy shall have chemical resistance, high mechanical strength, antistatic and low moisture absorption.



TOP VIEW

(Canopy bottom Cut-out for entry)

ITEM	DESCRIPTION
①	FRP Canopy of internal size 394mm (D) x 444mm (H) x 344mm (W)
②	Acrylic window of clear size 200mm x 200mm Abrasion Resistant, Impact Anodized
③	SS knob with plastic butterfly grip
④	SS knob
⑤	SS Clamp • ID X L: 56mm x 225mm; Thickness: 2.0mm • ID X L: 64mm x 65mm; Thickness: 2.0mm • Plate Size: 200mm x 200mm x 2.0mm • Holes: For M6 SS Bolts
⑥	Lid holding clamp, SS
⑦	SS hinges with SS screws

NOTE :

1. THIS IS TYPICAL DRAWING. THE DIMENSIONS SHALL BE FIRMED UP WITH THE ACTUAL INSTALLATION OF FIELD INSTRUMENTS.

Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
					Approved by	
4	17.08.21	Revised & Reissued	Saurav	SAJS	MN	SM
3	28.03.17	Reaffirmed & Reissued	Manoj	MN	RG	RN

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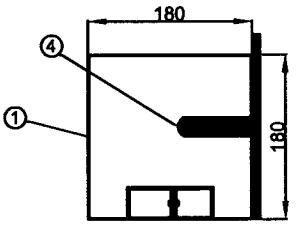
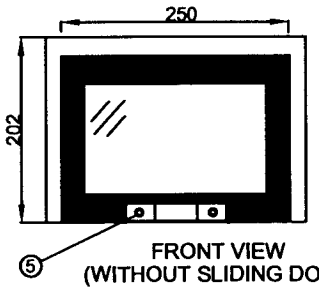
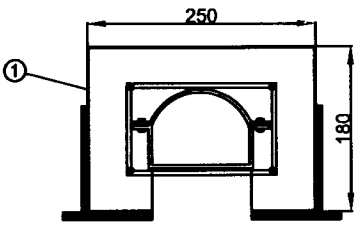
TYPE: FRP CANOPY (ALL SIDE CLOSED) - NECK MOUNTED INSTRUMENTS



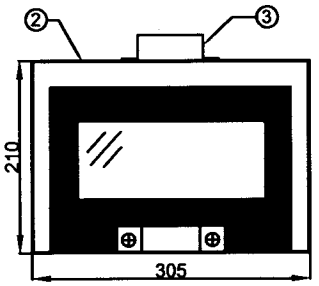
SIDE VIEW
(WITHOUT SLIDING DOOR)



FRONT VIEW
(WITHOUT SLIDING DOOR)



BOTTOM VIEW
(CANOPY BOTTOM SLOT FOR ENTRY WITH SS CLAMP AND SCREW SET)



FRONT VIEW
(WITH SLIDING DOOR)

SPECIFICATIONS	
FRP Enclosure	Resin: Iso-phthalic fire retardant UV resistant polyester as per IS-10192
Glass Content	Min. 60%
Flammability	Rating Class I, as per IS 6746
Pigments	Resin pigmented grey
Thickness	3mm, +1.0mm / -0.25mm
Finish	Smooth Outside Finish In Glaze & Gloss
Colour	RAL 7040 PU (GREY)
Sliding Door	3mm, with smooth aluminium (light grey) sliding channel
Window	3mm thick acrylic window for viewing, 200mm(W) x 100mm(H) Abrasion resistant, Impact Anodized
Dimension	Overall dimesional tolerance shall be +/-6 mm
Others	Canopy shall have chemical resistance, high Mechanical strength. Antistatic and low moisture absorption.

ITEM	DESCRIPTION
①	FRP Canopy of internal size 177mm(D) x 177mm(H) x 244mm(W)
②	FRP Sliding door of external size 25mm(D) x 210mm(H) x 305mm(W)
③	SS handle, riveted to door
④	Neoprene rubber channel gasket, 2 nos , shall confirm to ASTM D395- 18 requirements
⑤	SS Clamp • ID X L: 62mm x 30mm; Thickness:2.0mm • Plate Size: 160mm x 100mm x 1.5mm • Holes: For M6 SS Bolts

NOTE :

1. THIS IS A TYPICAL DRAWING. THE DIMENSIONS SHALL BE FIRMED UP WITH THE ACTUAL INSTALLATION OF FIELD INSTRUMENTS.

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4	17.08.21	Revised & Reissued	Saurav	AJS	MN	SM
3	28.03.17	Reaffirmed & Reissued	Manoj	MN	RG	RN

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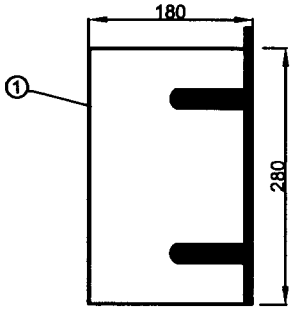
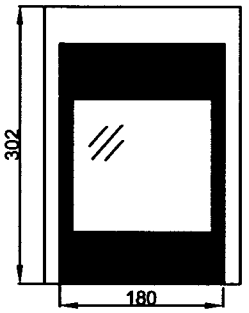
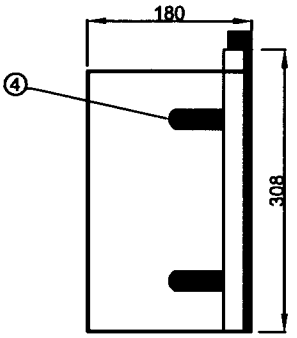
TYPE: FRP CANOPY (ALL SIDE CLOSED) - TEMPERATURE TRANSMITTER AND LOOP POWERED INDICATOR



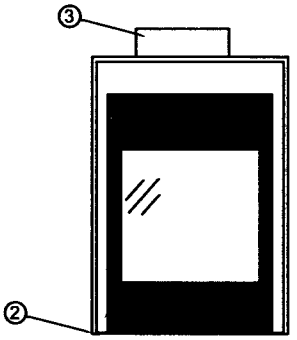
SIDE VIEW
(WITHOUT SLIDING DOOR)



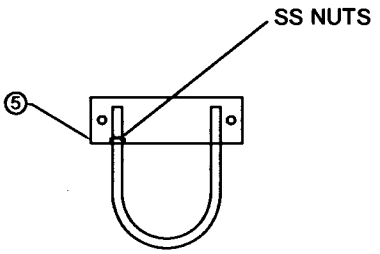
FRONT VIEW
(WITHOUT SLIDING DOOR)



SIDE VIEW
(WITH SLIDING DOOR)



FRONT VIEW - WITH SLIDING DOOR
(CANOPY BOTTOM OPEN FOR
CABLE ENTRY)



SS U- CLAMP
WITH ANGLE

SPECIFICATIONS	
FRP Enclosure	Resin: Iso-phthalic fire retardant UV resistant polyester as per IS-10192
Glass Content	Min. 60%
Flammability	Rating Class I, as per IS 6746
Pigments	Resin pigmented grey
Thickness	3mm, +1.0mm / -0.25mm
Finish	Smooth Outside Finish in Glaze & Gloss
Colour	RAL 7040 PU (GREY)
Sliding Door	3mm, with smooth aluminium sliding channel
Window	3mm thick acrylic window for viewing, 150mm x 150mm Abrasion resistant, Impact Anodized
Dimension	Overall dimesional tolerance shall be +/-6 mm
Others	Canopy shall have chemical resistance, high mechanical strength, antistatic and low moisture absorption.

ITEM	DESCRIPTION
①	FRP Canopy of internal size 177mm(D) x 277mm(H) x 174mm(W)
②	FRP Sliding door of external size 25mm(D) x 310mm(H) x 190mm(W)
③	SS handle, riveted to door
④	Neoprene rubber channel gasket, 2 nos shall confirm to ASTM D395-18 requirements
⑤	SS U- Clamp • ID X L: 60mm x 85mm; Thickness:6.0mm • Angle Size: 30mm x 30mm x 3.0mm • Holes: For M6 SS Bolts 2 SS Hardware for tightening with canopy, M6

NOTE :

1. THIS IS A TYPICAL DRAWING. THE DIMENSIONS SHALL BE FIRMED UP WITH THE ACTUAL INSTALLATION OF FIELD INSTRUMENTS.

Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
4	17.08.21	Revised & Reissued	Saurav	AJS	MN	SM
3	28.03.17	Reaffirmed & Reissued	Manoj	MN	RG	RN

Approved by

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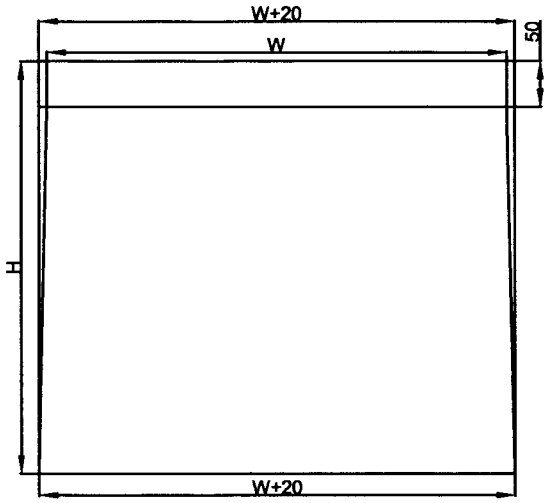
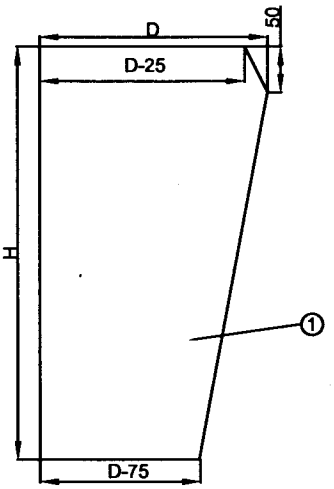
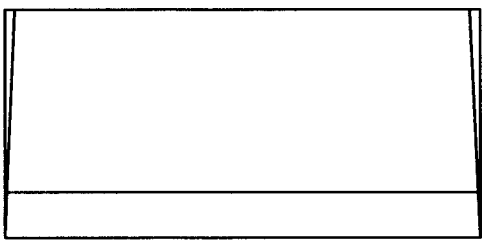
TYPE: FRP CANOPY FOR JUNCTION BOX - FRONT SIDE OPEN



FRONT VIEW



SIDE VIEW



TOP VIEW

SPECIFICATIONS	
FRP Enclosure	Resin: Iso-phthalic fire retardant UV resistant polyester as per IS-10192
Glass Content	Min. 60%
Flammability	Rating Class I, as per IS 6746
Pigments	Resin pigmented grey
Thickness	3mm, +1.0mm / -0.25mm
Finish	Smooth Outside Finish in Glaze & Gloss
Colour	RAL 7040 PU (GREY)
Others	Canopy shall have chemical resistance, high strength, antistatic and low moisture absorption.

ITEM	DESCRIPTION
①	FRP Junction box canopy of size 250mm(D) x 450mm(H) x 500mm(W)
	Cable entry from bottom side
D	250mm
H	450mm
W	500mm

NOTE :

1. THIS IS A TYPICAL DRAWING. THE DIMENSIONS SHALL BE FIRMED UP WITH THE ACTUAL INSTALLATION OF JUNCTION BOX AND ITS SIZE.

Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
					Approved by	
4	17.08.21	Revised & Reissued	Saurav	AJS	MN	SM
3	28.03.17	Reaffirmed & Reissued	Manoj	MN	RG	RN

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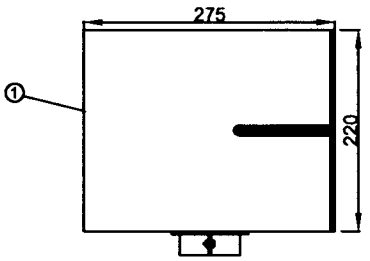
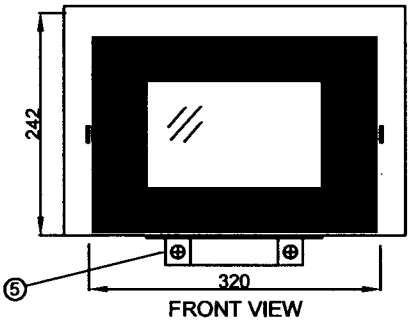
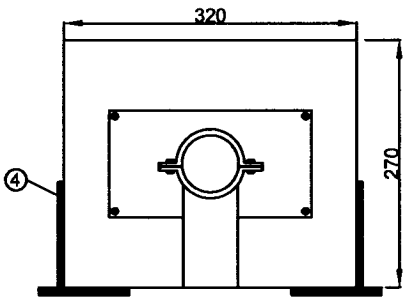
TYPE : FRP CANOPY (ALL SIDE CLOSED) - GUIDED WAVE , MASS FLOW METER



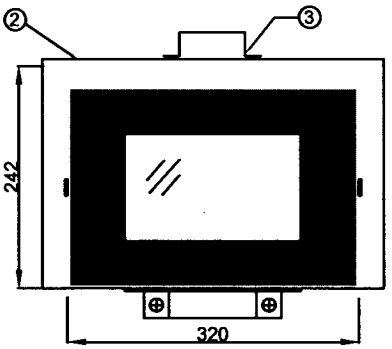
SIDE VIEW
(WITHOUT SLIDING DOOR)



FRONT VIEW
(WITHOUT SLIDING DOOR)



BOTTOM VIEW
(CANOPY BOTTOM SLOT FOR ENTRY
WITH SS CLAMP AND SCREW SET)



FRONT VIEW
(WITH SLIDING DOOR)
(CANOPY BOTTOM SLOT FOR ENTRY)

SPECIFICATIONS	
FRP Enclosure	Resin: Iso-phthalic fire retardant UV resistant polyester as per IS-10192
Glass Content	Min. 60%
Flammability	Rating Class I, as per IS 6746
Pigments	Resin pigmented grey
Thickness	3mm, +1.0mm / -0.25mm
Finish	Smooth Outside Finish in Glaze & Gloss
Colour	RAL 7040 PU (GREY)
Sliding Door	3mm, with smooth aluminium sliding channel
Window	3mm thick acrylic window for viewing, 150mm(W) x 100mm(H) Abrasion Resistant, Impact Anodized
Dimension	Overall dimesional tolerance shall be +/-6 mm
Others	Canopy shall have chemical resistance, high mechanical strength, antistatic and low moisture absorption.

ITEM	DESCRIPTION
①	FRP Canopy of internal size 269mm(D) x 214mm(H) x 314mm(W)
②	FRP Sliding door of external size 25mm(D) x 250mm(H) x 375mm(W)
③	SS handle, riveted to door
④	Neoprene rubber channel gasket, 2 No.s shall confirm to ASTM D395-18 requirements
⑤	SS Clamp • ID X L: 55mm x 25mm; Thickness:2.0mm • Plate Size: 150mm x 100mm x 1.5mm • Holes: For M6 SS Bolts 2 SS bolt set for tightening , M6

NOTE :
1. THIS IS A TYPICAL DRAWING. THE DIMENSIONS SHALL BE FIRMED UP WITH THE ACTUAL INSTALLATION OF INSTRUMENTS.

Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
4	17.08.21	Revised & Reissued	Saurav	AJS	MN	SM
3	28.03.17	Reaffirmed & Reissued	Manoj	MN	RG	RN

Approved by

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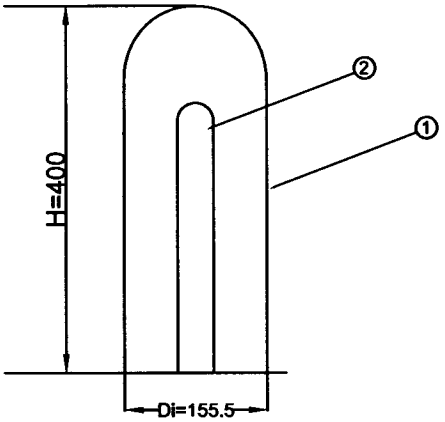
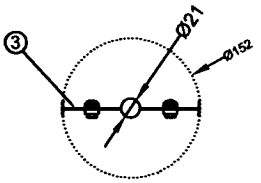
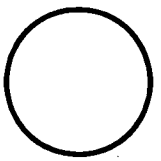
TYPE : FRP CANOPY FOR RTD / THERMOCOUPLE



FRONT VIEW



SS HOLDING CLAMP



BOTTOM VIEW

SPECIFICATIONS	
FRP Enclosure	Resin: Iso-phthalic fire retardant UV resistant polyester as per IS-10192
Glass Content	Min. 60%
Flammability	Rating Class I, as per IS 6746
Pigments	Resin pigmented grey
Thickness	3mm
Finish	Smooth Outside Finish
Colour	Grey, PU, RAL 7040 (GREY)
Dimension	Overall dimensional tolerance shall be +/- 6mm
Quantity	As required
Others	Canopy shall have chemical resistance, high mechanical strength, antistatic and low moisture absorption.

ITEM	DESCRIPTION
①	FRP Canopy of size 161.5mm(OD) x 400mm(H)
②	Neoprene channel type gasket shall confirm to ASTM D395-18 requirements
③	SS clamp • Thickness tolerance of +/- 0.2 mm • Taper maximum 2 Deg. • Size of slot 32mm wide x 300mm

NOTE :

1. THIS IS A TYPICAL DRAWING. THE DIMENSION SHALL BE FIRMED UP WITH THE ACTUAL INSTALLATION OF THERMOCOUPLE / RTD ASSEMBLY.

Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
4	17.08.21	Revised & Reissued	Saurav	AJS	MN	SM
3	28.03.17	Reaffirmed & Reissued	Manoj	MN	RG	RN

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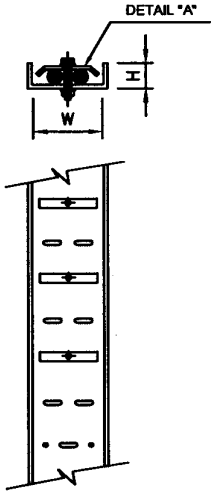
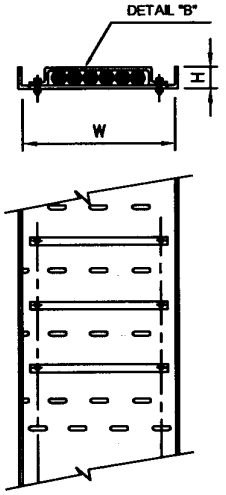
CABLE CLAMPING ON PERFORATED TRAYS (GALVANISED MILD STEEL / ANODIZED ALUMINIUM)

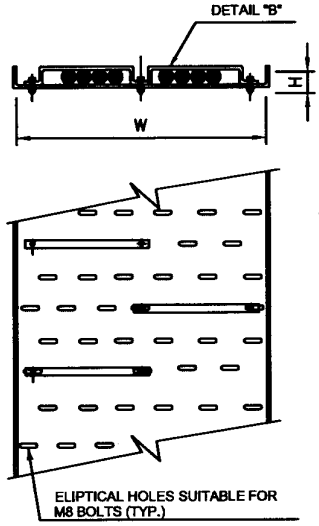
SINGLE CLAMPING FOR TWO CABLES



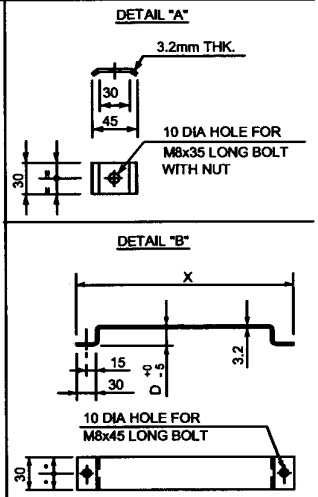
SINGLE CLAMPING FOR MULTIPLE CABLES



DUAL CLAMPING FOR MULTIPLE CABLES



CABLE CLAMPS DETAIL



"WHERE "W" DENOTES THE INSIDE WIDTH OF TRAY

D = CABLE OVERALL DIA.

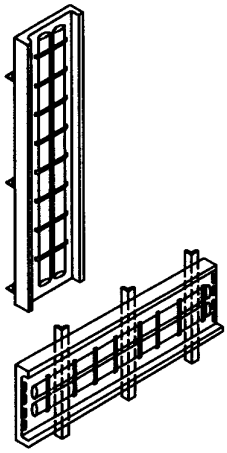
WHERE

X = W-10 FOR SINGLE CLAMPING

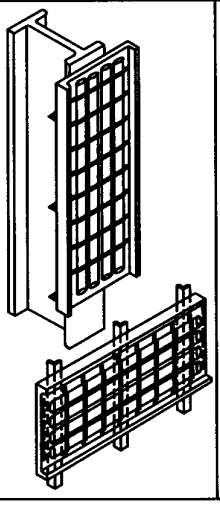
= $\frac{W}{2}$ - 10 FOR DUAL CLAMPING

PERFORATED TRAY - SUPPORTING DETAILS

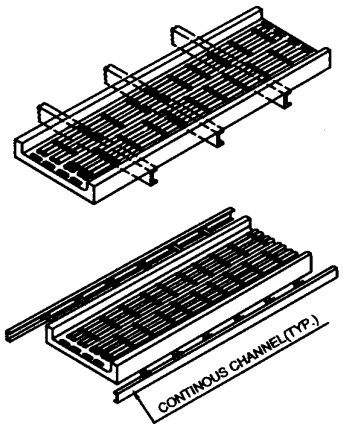
TRAY ROUTING EDGEWISE HOR. / VER. RUNS



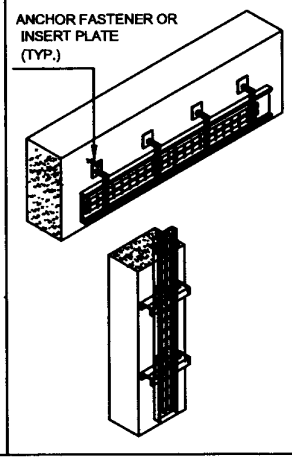
TRAY ROUTING EDGEWISE IN HOR. / VER. RUNS



TRAY ROUTING WIDTHWISE IN HORIZONTAL RUNS



TRAY ROUTING CONCRETE BEAM/COLUMN IN HOR. / VER. PLANE



NOTES :-

1. ALL DIMENSIONS ARE IN mm.
2. PERFORATED TRAYS SHALL BE SUPPORTED AT EVERY 1000 mm (TYP.) INTERVAL FOR HORIZONTAL AS WELL AS VERTICAL RUNS USING MINIMUM ANGLE SIZE AS 50x50x6 OR CONTINOUS CHANNEL SUPPORT MC50
3. CLAMPING OF CABLES ON PERFORATED TRAYS SHALL BE AT EVERY 500 mm ON VERTICAL RUNS AND EVERY 1000 mm ON HORIZONTAL RUNS.
4. PERFORATED TRAYS SHALL BE SUPPLIED WITH CLAMPS, BOLTS/NUTS AND DOUBLE WASHERS OF GALVANISED MILD STEEL DR ALUMINIUM AS PER TRAY MATERIAL.
5. GALVANISING SHALL BE AS PER IS 4759 (66 µm/ 460 g / m2) AND ALUMINIUM ANODIZING SHALL BE MINIMUM 20µm THICK.
6. THE PERFORATED TRAY THICKNESS SHALL BE 2.5 mm.
7. TRAY STANDARD LENGTH SHALL BE 2.5 mtr.

CAPACITY OF PERFORATED TRAYS

TRAY WIDTH (W)	FLANGE HEIGHT (H)	NO. OF CABLES		
		1 PAIR/ 1 TRIAD	6 PAIR/ 6 TRIAD	12 PAIR/ 8TRIAD
60	30	2	1	-
60	40	-	-	1
100	40	4	2	2
150	40	6	4	3
300	40	15	8	6

Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
4	03.11.21	Revised & Reissued	Saurav	JKS	MN	SM
3	28.03.17	Reaffirmed & Reissued	Manoj	MN	RG	RN

Approved by

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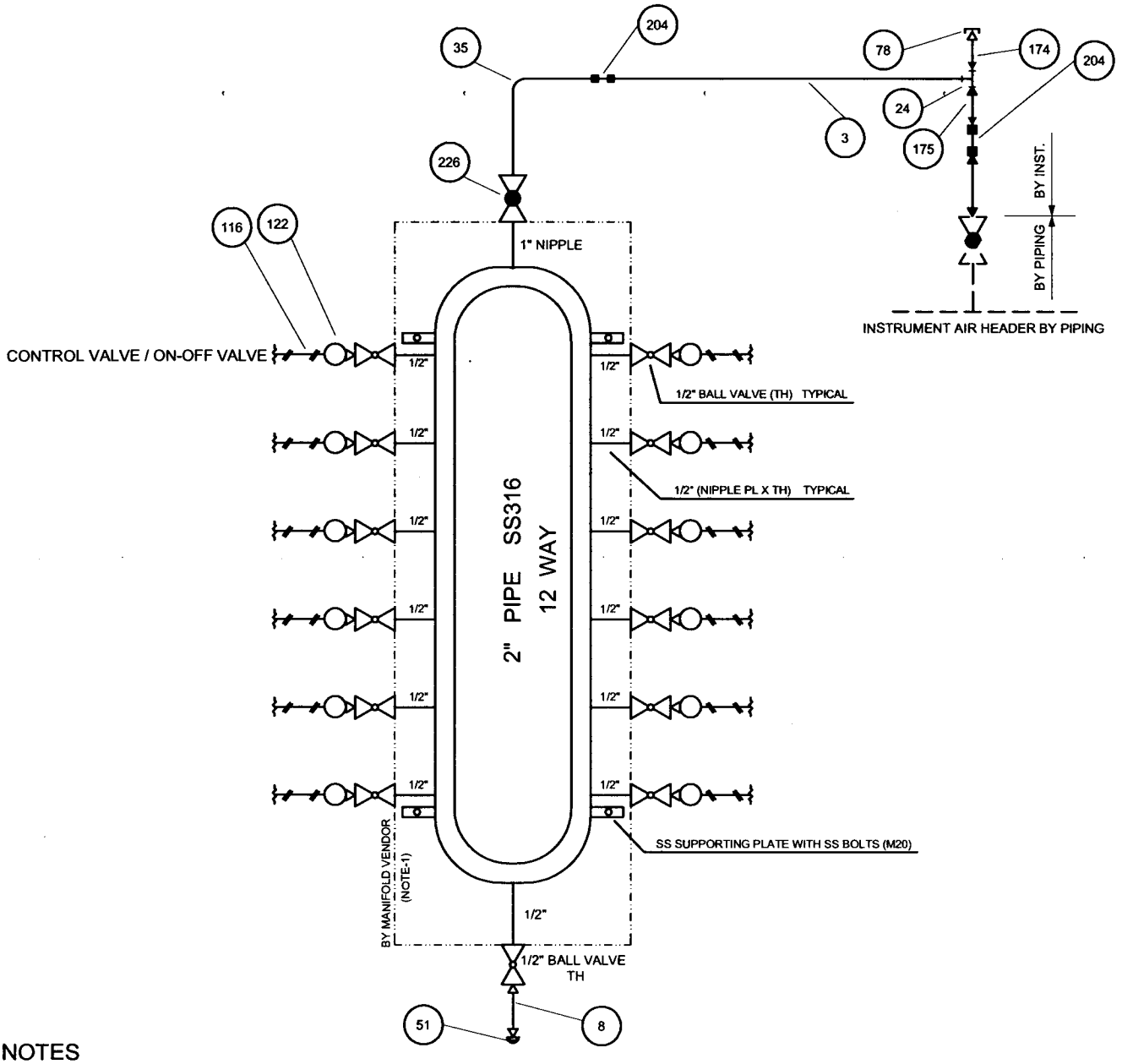

NOTES

1 - PRE-FABRICATED INSTRUMENT AIR MANIFOLD OF SS316 MATERIAL SHALL BE CONSIDERED WITH 2" PIPE.
2 - TUBING PLUG SHALL BE USED AFTER MALE CONNECTOR FOR SPARE TAPPINGS.

P - BY PIPING
I - BY INSTRUMENTATION
* PL x PL NIPPLE SHALL BE FABRICATED FROM PIPE

LIST OF ITEMS

CODE	DESCRIPTION	SIZE	ENDS	QTY.	UNIT	CODE	DESCRIPTION	SIZE	ENDS	QTY.	UNIT
3	PIPE	1"	PL	A/R	m	40	BALL VALVE	1/2"	TH	13	Nø
8	NIPPLE	1/2"	TH X TH	1	Nø	116	TUBE	12mm	OD	A/R	m
24	EQUAL TEE	1"	SW	1	Nø	122	MALE CONNECTOR	1/2" X 12mm	TH X OD	12	Nø
35	ELBOW	1"	SW	4	Nø	138	TUBE UNION	12mm	OD	24	Nø
51	CAP	1/2"	TH	1	Nø	144	TUBING PLUG	12mm	OD	6	Nø
78	CAP	1"	TH	1	Nø						
174	NIPPLE	1"	TH X PL	1	Nø						
175	NIPPLE *	1"	PL X PL	2	Nø						
204	COUPLING	1"	SW	3	Nø						
226	GLOBE VALVE	1"	SW	1	Nø						

Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
0	11.02.2022	Issued As Standard	Manoj/AB	GG/AR	MN	SM

Approved by

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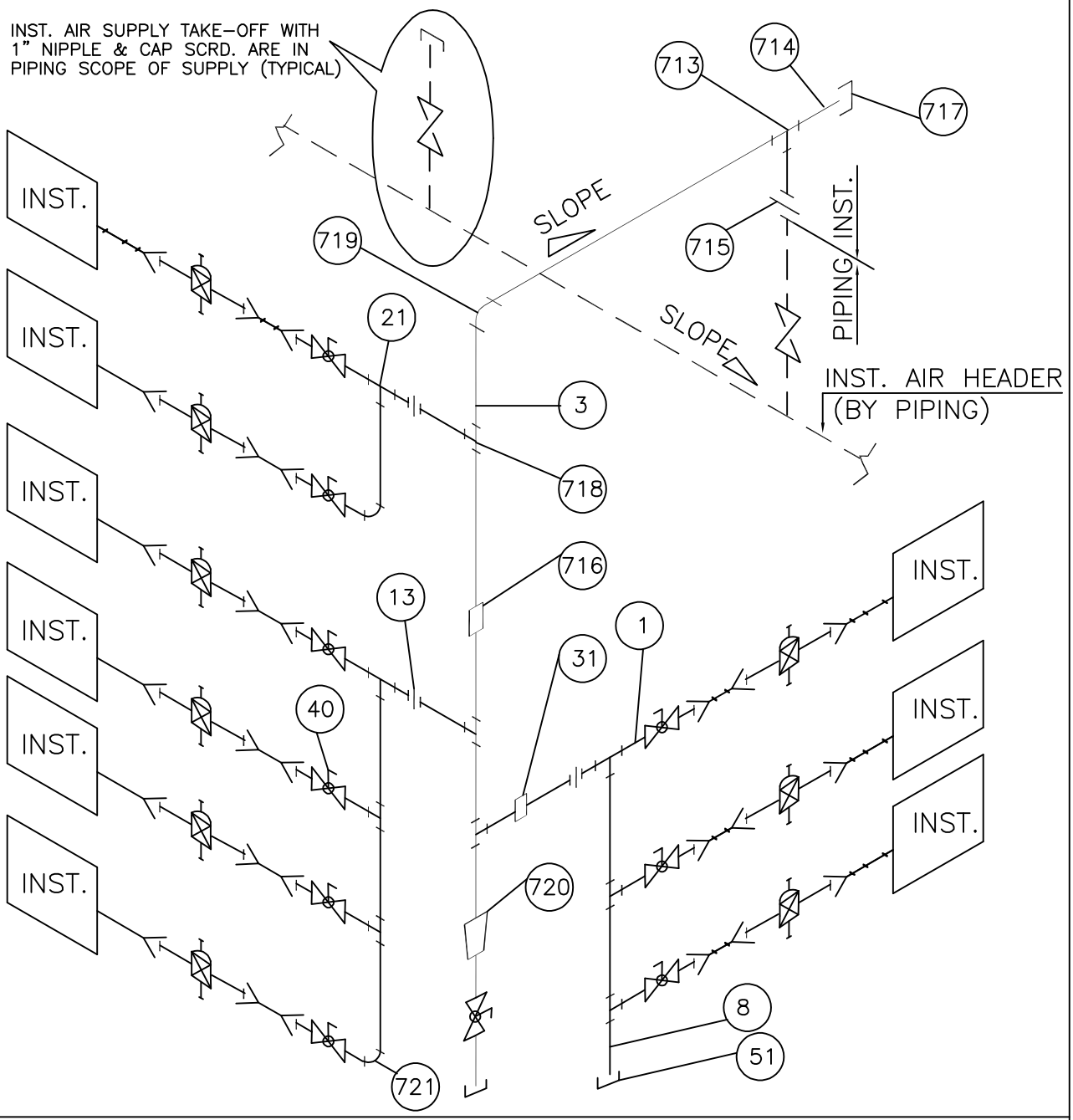
INSTRUMENTATION

NO.	DATE	REVISIONS	BY	CH'K	APPROVALS		
A	20.03.2025	ISSUED WITH BIDS	RK	SKG	NK		



LIST OF MATERIAL

QTY.	ITEM	DESCRIPTION	SIZE	QTY.	ITEM	DESCRIPTION	SIZE
AS REQD	3	PIPE	1"	AS REQD	721	ELBOW SCRD	1/2" X 1/2"
	713	EQ. TEE SCRD.	1"		21	EQ. TEE SCRD.	1/2"X1/2"X1/2"
	714	NIPPLE	1" X 4"LONG		40	BALL VALVE	1/2"
	715	UNION SCR'D	1"		13	UNION SCRD.	1/2"
	716	COUPLING SCRD.	1"		1	PIPE	1/2"
	717	CAP SCRD.	1"		8	NIPPLE	1/2"
	718	UNEQUAL TEE	1"X1"X1/2"		31	COUPLING SCRD.	1/2"
	719	ELBOW SCRD.	1" X 1"		51	CAP SCRD.	1/2"
	720	REDUCER SCRD.	1" X 1/2"				

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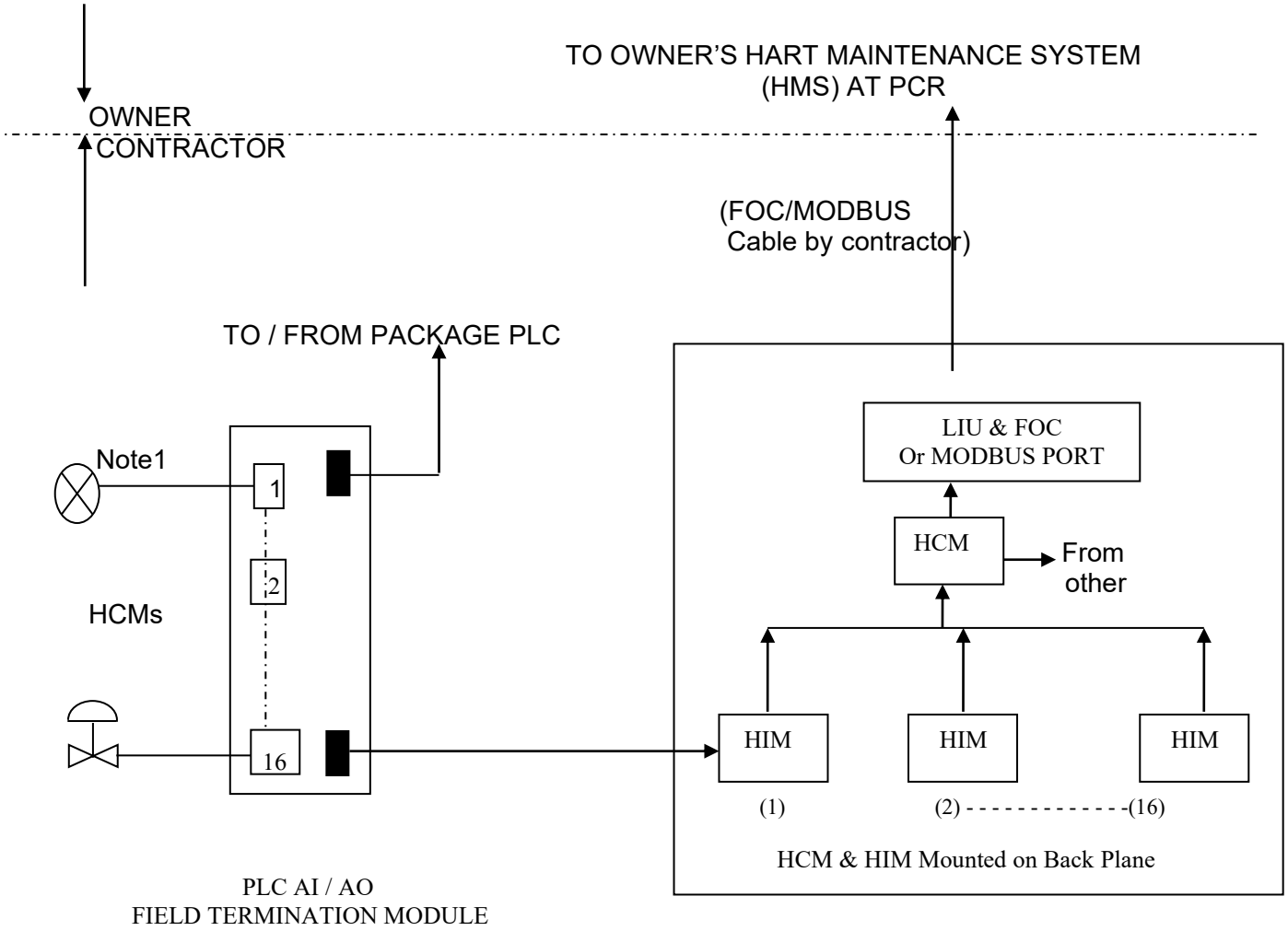
ENGINEERS INDIA LIMITED NEW DELHI	INSTRUMENT AIR SUPPLY DISTRIBUTION SCHEME	JOB STANDARD	REV
		C050-1U68-16-51-IS-91	A



Legends:

HCM: HART COMMUNICATION MODULE
HIM: HART INTERFACE MODULE
FOC: FIBRE OPTIC CABLE
LIU: LINE INTERFACE UNIT
* Exact make & model and No. of HCM & HIM shall be finalized during detailed Engineering after finalization of Owner's HMS

Notes:
1) Typical arrangement of PLC AI/ AO Hook up on HMS modules

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STANDATD SPECIFICATIONS LIST (INSTRUMENTATION) FOR COOLING TOWER PACKAGE TENDER No: C050-1U68-81-45-PB-T-8010

PROJECT : **EPCM SERVICES FOR POLYPROPYLENE UNIT AT NRL**

UNIT/UNIT NO. : **PROPYLENE UNIT (PP) / 1U68**

OWNER : **NUMALIGARH REFINERY LIMITED (NRL)**

CONSULTANT : **M/s ENGINEERS INDIA LTD.**

JOB NO. : **C050**

Rev. No	Date	Purpose	Prepared by	Checked by	Approved by
A	07.08.2025	ISSUED WITH TENDER	SS	RK	NK

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STANDARD SPECIFICATIONS LIST
(INSTRUMENTATION)

S. No.	Description	Document No.	Rev.
1.	Standard specification for instrumentation of package units	6-52-0052	4
2.	Standard specification for programmable logic controllers	6-52-0040	3
3.	Standard specification for electromagnetic flowmeters	6-52-0002	5
4.	Standard specification for Vortex Flowmeters	6-52-0010	5
5.	Standard specification for Ultrasonic Flowmeter	6-52-0011	2
6.	Standard specification for displacer/float operated level instruments	6-52-0013	5
7.	Standard specification for tank level instruments	6-52-0014	5
8.	Standard specification for magnetic level instruments	6-52-0015	3
9.	Standard specification for Pressure Relief Valve	6-52-0026	5
10.	Standard specification for rupture discs	6-52-0027	6
11.	Standard specification for control valves	6-52-0031	5
12.	Standard specification for electronic instruments	6-52-0032	6
13.	Standard specification for Process Stream Analysers	6-52-0035	6
14.	Standard specification for On-Off valves	6-52-0037	3
15.	Standard Specification for desuperheater & PRDS	6-52-0038	3
16.	Standard specification for thermocouples, RTDs and thermowells	6-52-0042	5
17.	Standard specification for Thermocouple Extension Cable	6-52-0045	7
18.	Standard specifications of signal cables	6-52-0046	8
19.	Standard specification for control panel and accessories	6-52-0049	5
20.	Standard specification for instrumentation erection works	6-52-0060	4
21.	Standard specification for fire protection enclosure of valve actuator and accessories	6-52-0061	2
22.	Standard specification for special level instruments	6-52-0071	5
23.	Standard specifications of Mass Flowmeter	6-52-0073	5
24.	Standard specification for self-actuated control valves / regulators	6-52-0079	5
25.	Standard specification for Gas detection system	6-52-0080	5
26.	Standard specification for pH and Conductivity Analyser	6-52-0029	2

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इलेक्ट्रोमैगनेटिक फ्लोमीटरों के लिए मानक विनिर्देश

STANDARD SPECIFICATION FOR ELECTROMAGNETIC FLOWMETERS

Rev. No	Date	Purpose	Prepared by	Checked by	Standards Committee Convenor	Standards Bureau Chairman
					Approved by	
5	16.07.21	Revised and Reissued as Standard Specification	PK	AJS/KS	MN	SM
4	04.04.16	Revised and Reissued as Standard Specification	JJ	MN	RG	RN
3	29.11.10	Revised and Reissued as Standard Specification	RK	RG	TGM/JMS	ND
2	02.05.05	Revised and Reissued as Standard Specification	RSD	TGM	PM	VJN
1	15.01.97	Revised and Reissued as Standard Specification	RK	BRS	RB	AS

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Abbreviations

AARH	:	Arithmetic Average Roughness Height
FISCO	:	Fieldbus Intrinsic Safe Concept
HART	:	Highway Addressable Remote Transducer
LCD	:	Liquid Crystal Display
NPT	:	National Pipe Threads
PA	:	Process Automation
PID	:	Proportional, Integral and Derivative
PTFE	:	Poly Tetra Fluoro Ethylene

Instrumentation Standards Committee

Convener: Mr. Mainak Nandi

Members:
Mr. Arupjyoti Saikia
Mr. Sachin Garg
Mr. Jerry johnson
Mr. Mayank Kaushik
Mr. Sourav Mukherjee
Ms. K.Pratheepa
Mr. R.K Gupta (Projects.)

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3.0 NAMEPLATE 9
4.0 INSPECTION AND TESTING 10
5.0 SHIPPING 10

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1.0 GENERAL

1.1 Scope

1.1.1 This specification, together with the data sheets describes the requirements for the design, materials, nameplate marking, inspection, testing and shipping of electromagnetic flow meter and its accessories.

1.1.2 The related standards referred to herein and mentioned below shall be of the latest edition of the following codes, standard practices and publications unless otherwise specified:-

ASME	American Society of Mechanical Engineers.	
	B 1.20.1	Pipe Threads General Purpose (Inch)
	B 16.5	Pipe Flanges and Flanged Fittings
	B 16.20	Metallic Gaskets for Pipe Flanges
EN	European Standards	
	10204	Inspection Documents for Metallic Products.
IS/IEC	Indian Standards/International Electrotechnical Commission	
	IS/IEC-60079	Electrical Apparatus for Explosive Gas Atmosphere.
	IEC 60085	Electrical Insulation - Thermal Evaluation and Designation
	IS/IEC-60529	Degree of Protection Provided by Enclosures (IP code).
	IEC-61000-4	Electromagnetic Compatibility for Industrial Process Measurement and Control Equipment.
	IEC-61158-1	Industrial Communication Networks - Fieldbus Specifications - Part 1: Overview and Guidance for the IEC 61158 and IEC 61784 series.
	IEC-61158-2	Industrial Communication Networks - Fieldbus Specifications - Part 2: Physical Layer Specification and Service Definition.
	IEC-61508	Functional Safety of Electrical / Electronic / Programmable Electronic safety related system.
IS	Indian Standards	
	1271	Electrical Insulation-Thermal Evaluation and Designation.
ISO	International Organisation for Standardisation	
	20456	Measurement of fluid flow in closed Conduit – Guidance for the use of Electromagnetic Flowmeters for conductive liquids.

1.1.3 In the event of any conflict between this standard specification, job specification/data sheets, statutory regulations, related standards and codes, the following order of priority shall govern:

a) Statutory Regulations

b) Job Specification/ Data Sheets

c) Standard Specification

d) Codes and Standards

1.1.4 In addition to compliance to purchaser's specifications, vendor's extent of responsibility shall include the following:

a) Purchaser's data sheets specify the material for the metering tube, tube liner, electrodes etc. of the magnetic flow meter. Alternate superior material of construction shall also be acceptable provided vendor assumes complete

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responsibility for the selected materials for compatibility with the specified fluid and its operating conditions.

b) Selection of magnetic flow meter of the proper size suitable for the indicated flow rate and turndown.

1.2 Bids

1.2.1 Vendor's quotation shall be strictly as per the bidding instructions to the vendor attached with the Material Requisition.

1.2.2 Vendor's quotation shall include the following;

a) Detailed specification sheet for each item which shall provide the information regarding material of construction, flow range, performance specifications, end connection details etc. The material of specification and the units of measurement, for various parts in vendor's specification sheets shall be to the same standards as those indicated in purchaser's data sheets.

b) Sizing calculation indicating the velocity at which the meter has been sized for each tag number. Sizing calculation shall include accuracy at all the specified flow conditions viz. minimum, normal and maximum as per datasheets.

c) Minimum and maximum fluid velocity permitted through the offered flow meter.

d) Cable specifications and the maximum permissible cable length between the flow meter and associated receiver instruments.

e) Recommended grounding techniques.

f) Upstream and downstream straight length requirements for installation.

g) Proven references for each offered model in line with clause 1.2.3 of this specification.

h) A copy of approval for installation of electromagnetic flow meter in electrically hazardous area, from local statutory authority as applicable such as Petroleum and Explosives Safety Organisation (PESO), Nagpur, India, along with;

i) Test certificate from recognised house Central Institute of Mining and fuel Research (CIMFR) / Electromechanical Regional Testing Laboratory (ERTL) etc for the specified hazardous protection class as per relevant standard for all Indian manufactured equipments

ii) Certificate of conformity from agencies like Laboratorie Central Des Industries Electriques (LCIE), British Approval Service for Electrical Equipment in Flammable Atmospheres (Baseefa), Factory Mutual (FM), Physikalisch-Technische Bundesanstalt (PTB), Canadian Standards Association (CSA), and Underwriter's Laboratory (UL) for compliance to ATEX or other recognised standards for all equipments manufactured outside India.

i) Deviation on technical requirements shall not be generally entertained. In case vendor has some valid technical reason for not complying with the specific requirements due to superior alternatives and materials, tag wise deviation list must be provided along with the technical justification.

j) Catalogues giving detailed technical specifications, model decoding details and other related information for Electromagnetic flow meters covered in the bid.

k) Two years operational spares for each electromagnetic flow meter and its accessories covered in the bid, which shall include electrode, electronic card set, gasket/o-ring set etc. as a minimum.

l) Any special tools needed for maintenance work on the flow meter and its accessories. In case no special tools are necessary for the offered electromagnetic flow meters, vendor must certify in their offer.

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1.2.3 All items, as offered, shall be field proven and should have completed operation for a period of minimum 6 months on the bid due date in the similar application with process conditions similar to those as specified in the purchaser's data sheet. Items with proto-type design or items not meeting provenness criteria specified above shall not be offered.

1.2.4 Whenever specified, vendor must furnish tested values of failure rates, Probability of Failure on Demand (PFD) and test intervals for the Safety Integrity Level (SIL) analysis.

1.2.5 All documentation submitted by the vendor including their quotation, catalogue, drawings, installation manual, operation and maintenance manuals etc., shall be in English language only.

1.3 Drawings and Data

1.3.1 Detailed drawings, data, catalogues and manuals required from the vendor are indicated by the purchaser in vendor data requirement sheets of Requisition.

1.3.2 Final documentation consisting of design data, installation manual, operation and maintenance manual submitted by the vendor after placement of purchase order as per vendor data requirement which shall include the following, as a minimum;

a) Certified drawing for each flow meter which shall provide;
   i) Dimensional details in mm.
   ii) Weight of flow meter in kilograms
   iii) Material of construction
   iv) Installation requirements
   v) Detailed wiring drawing for the whole system including recommended grounding techniques for the offered meters.

b) Clearance required for maintenance work.

c) Installation procedures for electromagnetic flow meter

d) Calibration and maintenance procedure for electromagnetic flow meters including replacement of internal parts, as applicable.

2.0 DESIGN AND CONSTRUCTION

2.1 Flow Meter

2.1.1 Unless otherwise specified, flow meter shall be of in-line mounting design. Insertion type of magnetic flow meter shall not be offered.

2.1.2 Flow direction should be clearly marked on the magnetic tube to ensure correct installation of the flow meter.

2.1.3 Vendor to note that the location and orientation of installation of electromagnetic flow meter in the line shall not affect the calibration, accuracy and performance of the meter.

2.1.4 **End Connection**

2.1.4.1 Flow meter shall be of flanged body construction with material of construction as specified in the purchaser's data sheet. In case of welded end connection design, the weld joint shall be of radiography quality.

2.1.4.2 Unless otherwise mentioned, end connection details shall be as below: -

a) Threaded end connections shall be to NPT as per ASME B 1.20.1

b) Flanged end connections shall be as per ASME B 16.5.

c) Grooves of ring-type joint flanges shall be octagonal as per ASME B16.20.

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d) Flange face finish shall be as per ASME B 16.5. The face finish as specified in the data sheets, shall be as follows:

125 AARH	:	125 to 250 microinch AARH
63 AARH	:	32 to 63 microinch AARH

2.1.5 Unless specified otherwise, the flow meter tube shall have PTFE liner. The liner shall hold tightly and rigidly against the flow meter tube without any air gap.

2.1.6 **Magnetic Coils**

2.1.6.1 The field coils shall operate on an alternating supply voltage as indicated in the purchaser's data sheets. The performance of the flow meter shall not be affected by the following variations in the supply voltage;

a) Voltage variation of ± 10% of nominal value.

b) Frequency variation of ± 3Hz of nominal value.

2.1.6.2 Coil insulation should be class F suitable as per IEC 60085/IS 1271.

2.1.6.3 Unless otherwise specified, the coil housing shall be of carbon steel construction fully welded to the meter body to avoid ingress of moisture, dust and corrosive gases.

2.1.6.4 Coil excitation technique shall be pulsed DC type or dual frequency type. In case of slurry applications, the meters shall have high coil current and high frequency excitation.
In case of slurry applications, grounding ring shall act as lining protector.

2.1.7 **Electrodes**

2.1.7.1 Electrodes shall have good corrosion resistance and shall be welded to meter body. Field replaceable electrode construction shall be offered only when specifically indicated in the purchaser's data sheet.

2.1.7.2 Vendor shall offer on line removable electrodes where cleaning of electrodes, is necessary due to coating characteristics of the process fluid.

2.1.7.3 The vendor shall ensure that for potential equalisation between sensor and liquid, the flow meter shall be provided with two nos. measurement electrodes along with integral earthing reference electrode when installed in non-lined pipe and an earthing plate / ring when installed in lined pipe. Vendor's scope of supply shall also include earthing cables and cable accessories like earthing lugs for interconnection with meter electronics. Unless specifically indicated, earthing electrode shall not be acceptable in place of earthing ring.

2.1.7.4 The electrodes including earthing ring shall be connected in the intrinsically safe circuit for flow meter handling electrically hazardous fluids.

2.1.8 **Sizing Considerations**

2.1.8.1 Meter shall be capable of measuring process fluid of conductivity 5 micromhos / microsiemens per centimetre unless specified otherwise in the data sheet.

2.1.8.2 Following velocity limits shall be considered for meter sizing, unless otherwise specified.

a) Minimum velocity: 0.5 m/s.
Maximum velocity: 3 m/s.

b) Velocity limits for the various flows in the data sheet shall be typically in the above range complying with the accuracy as per clause 2.3 below. Velocity beyond these limits shall not be considered for sizing.

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2.1.9 **Terminal Housing**

2.1.9.1 Following shall apply for both integral as well as for remote meter electronics:

a) All connections shall be terminated on the terminals brought out in the terminal housing located on the flow meter body. Flying leads shall not be provided.

b) All intrinsically safe terminals shall be properly identified and shall be separate from the non-intrinsically safe terminals.

c) Separate cable entry shall be provided in the terminal housing for power and intrinsically safe signals.

d) The flow meter enclosure, housing the electrical parts shall be suitable for the area classification indicated in the purchaser's data sheets. Unless otherwise specified, the enclosure shall conform to the following standards:

Weatherproof housing - IP 65 to IS/IEC-60529.
Flameproof housing - Flame proof / Ex (d) as per IS/IEC-60079.
Flameproof housing shall also be made weatherproof.

2.1.9.2 Proper terminal blocks shall be provided in the transmitter unit for the termination of purchaser's cables. Separate terminal blocks shall be provided for power and signal connections. Power TBs shall be suitable for cable sizes upto 6 mm^2 core diameter.

2.2 Meter Electronics

2.2.1 Meter electronics includes all the associated electronics like pre-amplifiers, transmitter / converters etc. Where the vendor is supplying the complete meter electronics, vendor shall ensure that the input/output signals and performance characteristics of individual item are compatible with each other.

2.2.2 When meter electronics is specified for installation in electrically classified area, the transmitter shall be flameproof with intrinsically safe sensor. Safety barrier as required for the sensor shall be provided by the vendor and shall be part of transmitter enclosure.

2.2.3 The electronic transmitter shall be two (2) wire micro-process based and shall be capable of providing 4 to 20mA analog output superimposed with diagnostic data in digital mode (i.e. HART output). When specified, flow meter shall provide field-bus output conforming to the standard specified in the purchaser's specification sheets.

2.2.4 For smart transmitters with HART output or for field bus based transmitter the following features must be ensured;

a) It shall allow multi-master (primary and secondary) for configuration, calibration, diagnosis and maintenance. The primary could be the control system or host computer, and the secondary could be the hand held communicator.
b) It should be capable of implementing universal commands.

2.2.5 In addition to the requirements specified above, Fieldbus based transmitter shall meet the following requirements;

a) All instruments must satisfy the requirements of the Fieldbus registration laboratory with applicable checkmark like Foundation Fieldbus, Profibus PA, or as specified in the purchaser's data sheets.

b) All instruments shall have two analog input blocks, as a minimum. In addition, when specified the transmitter shall also have PID controller block.

c) All instruments must be interoperable and shall have valid interoperability test clearance for Foundation Fieldbus or equivalent for PA, as applicable.

d) The Fieldbus instruments shall support peer-to-peer communication.

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e) Fieldbus instruments as offered shall not be polarity sensitive.

The Fieldbus instruments in hazardous area shall be certified as per Intrinsic Safe (entity concept) or shall be FISCO approved as per the requirements specified in the purchaser's specification.

2.2.6 Field mounted converters/transmitters shall have an integral output LCD meter. Local indication of the output meter shall be digital with engineering units. When the transmitter detects an empty pipe condition, the display shall be set to zero flow value.

2.2.7 The span of the transmitter shall be field adjustable. In case separate device is required, to make such a change, the same shall be included.

2.2.8 The configurational data for the instrument shall be stored in a non- volatile memory or in a battery backed RAM such that the data remains unchanged because of power fluctuations or power off condition. In case, vendor standard instrument has battery backed RAM vendor to ensure that battery drain alarm is available and shall be provided as maintenance alarm.

2.2.9 When the purchaser's data sheets indicate the presence of permeable solids in the stream (e.g. slurries containing magnetic materials like iron) vendor shall offer a flow meter system whose circuitry compensates for signal changes induced by the presence of permeable solids.

2.2.10 When specified, the meter electronics shall be protected against transients induced by lighting and power supply surges. Transient protection electronics shall preferably be provided in the terminal block.

2.2.11 Where remote mounted converter/ transmitter is offered a minimum of 10 metre of interconnecting cable shall be included for measuring electrode and earthing electrode / plate, unless specified otherwise. The remote mounted transmitter shall be suitable for mounting on 2" NB pipe. Vendor shall provide mounting accessories for the same.

2.2.12 Purchaser shall provide one number of feeder for power supply at the meter electronics i.e. converter / transmitter. Further distribution if any shall be taken care of by vendor. Accessories like cable gland, conduit and junction box as required to interconnect sensor, transmitter signal cable, power supply cables etc., shall be supplied by the vendor.

2.3 Performance Requirements

Unless otherwise specified, the magnetic flow meter shall meet the following performance specifications;

a) Magnetic flow meter accuracy inclusive of linearity, repeatability and hysteresis shall be better than ±0.5% of flow rate.

b) Repeatability of the magnetic flow meter shall be better than ± 0.1% of flow rate.

3.0 NAMEPLATE

Each electromagnetic flow meter and its accessories shall have a stainless steel nameplate attached firmly to it at a visible place, furnishing the following information:

a) Tag number as per purchaser's data sheet.

b) Manufacturers serial number and model number.

c) Manufacturer's name/ trademark.

d) Nominal end connection size and rating in pounds.

e) Tube, tube liner and electrode materials.

f) Calibrated range of flow.

g) Area classification for which the equipment is certified for installation.

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h) Hazardous area certification number and marking

i) Operating power supply voltage and frequency.

j) Specified range and units of measurement for flow.

4.0 INSPECTION AND TESTING

Purchaser reserves the right to inspect and witness testing at vendor's works as per Inspection Test Plan. All these tests shall be completed by the vendor and test reports shall be submitted to Purchaser for scrutiny.

5.0 SHIPPING

5.1 All threaded and flanged openings shall be suitably protected to prevent entry of foreign material. The flow transmitter shall be suitably protected to prevent any damage to its liner during shipment or storage at site.

5.2 The flow transmitter and accessories shall be packed separately.

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STANDARD SPECIFICATION FOR VORTEX FLOW METERS

Rev. No	Date	Purpose	Prepared by	Checked by	Standards Committee Convenor	Standards Bureau Chairman
					Approved by	
5	08.06.21	Revised and Reissued as Standard Specification	KP/BC	RK	MN	SM
4	01.04.16	Revised and Reissued as Standard Specification	SG	SM	RG	RN
3	29.11.10	Revised and Reissued as Standard Specification	MK	RG	TGM/JMS	ND
2	02.05.05	Revised and Reissued as Standard Specification	RSD	TGM	PM	VJN
1	01.10.96	Revised and Reissued as Standard Specification	RK	BRS	RB	AS

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Abbreviations:

AARH	:	Arithmetic Average Roughness Height
FISCO	:	Fieldbus Intrinsic Safe Concept
HART	:	Highway Addressable Remote Transducer
NPT	:	National Pipe Thread
RAM	:	Random Access Memory
EDDL	:	Electronic Device Description Language
FDT / DTM	:	Field Device Tool / Device Type Manager
LAS	:	Link Active Scheduler
SS	:	Stainless Steel

Instrumentation Standards Committee

Convener : Mr. Mainak Nandi

Members : Mr. Arupjyoti Saikia
Mr. Sachin Garg
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Mr. Sourav Mukherjee
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Mr. R.K Gupta (Projects.)

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1.0 GENERAL

1.1 Scope

1.1.1 This specification, together with the data sheets cover the requirements for the design, materials, nameplate marking, inspection, testing and shipping of vortex flow meter and their accessories.

1.1.2 The related standards referred to herein and mentioned below shall be of the latest editions prior to the date of the purchaser's enquiry: -

ASME	American Society Of Mechanical Engineers.	
	B 1.20.1	Pipe Threads General Purpose (Inch)
	B 16.5	Flanges and Flanged Fittings: NPS 1/2 through NPS 24 Metric/Inch Standard
	B 16.20	Metallic Gaskets for Pipe Flanges- Ring Joint, Spiral wound and Jacketed.
	B16.34	Valves Flanged, Threaded and Welding End
EN	European Standards	
	10204	Inspection Documents For Metallic Products
IS/ IEC	Indian Standards/ International Electro technical Commission	
	IS/IEC 60079	Electrical Apparatus for Explosive Gas Atmospheres
	IS/IEC 60529	Degree of Protection Provided by Enclosures. (IP Code)
	IEC 61000-4	Electromagnetic Compatibility for Industrial Process Measurement and Control Equipment
	IEC 60587	Test Method for evaluating resistance to tracking and erosion of electrical insulating materials used under severe ambient conditions
	IEC 61158	Fieldbus Standard for use in Industrial Control System
	IEC 61158-2	Physical Layer Specification and Service Definition for Fieldbus
	IEC 61508	Functional Safety of Electrical/Electronic/Programmable Electronic Safety-related Systems.
ISO	International Organisation for Standardisation	
	12764	Measurement of fluid flow in closed conduits - Flowrate measurement by means of vortex shedding flowmeters inserted in circular cross-section conduits running full

1.1.3 In the event of any conflict between this standard specification, data sheets, statutory regulations, related standards, codes etc. the following order of priority shall govern:

a) Statutory Regulations

b) Data Sheets

c) Standard Specification

d) Codes and Standards

1.1.4 In addition to compliance to purchaser's specifications in totality, vendors' extent of responsibility shall include the following:

a) Purchaser's data sheets specify the minimum acceptable materials of construction for the body and trim of vortex flow meter. Alternate superior material of construction shall also be acceptable provided vendor assumes complete responsibility for the selected materials for their compatibility with the indicated process fluid and its operating conditions and design conditions specified in the data sheets

b) Sizing and selection of vortex flow meter suitable to measure the indicated fluid flow rate over the specified turndown and viscosity with the stated accuracy and the maximum allowable pressure drop specified in the datasheet. Accuracy &

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pressure drop at each of the specified flows viz. Min. / Normal & Maximum shall be indicated clearly.

1.2 Bids

1.2.1 Vendor's quotation shall be strictly as per the bidding instructions to the vendor attached along with the material requisition.

1.2.2 Vendor's quotation shall include the following;

a) Compliance to the Specifications

b) Detailed specification sheet for each item, which shall provide the following information. The material specifications and units of measurement for various parts in vendor's specification sheets shall be to the same standards as those indicated in purchaser's data sheets.

i) Type of sensing element, material of construction for various parts and its accessories.
ii) Adjustable operating range
iii) Flow meter sizing calculation for each flow meter which shall include :-
   a) Sizing sheet with minimum, normal, maximum & meter maximum flow rate at specified accuracy
   b) Pressure drop through the flow meter assembly at maximum & meter maximum flow rate
   c) Minimum detectable/ measurable flow rate meeting stated accuracy.
   d) The lowest value of Reynolds number down to which measurement can be made with stated accuracy.
   e) The lowest value of Reynolds number down to which measurements can be made with derated accuracies. Vendor shall also provide the values of derated accuracies at these Reynolds numbers.
iv) Cable Specification and the maximum permissible cable length between the flow meter and its associated receiver instruments.
v) Measurement at flow values indicated in the datasheets i.e. minimum & maximum flow rates shall be the main criteria for selection of meter size meeting other process parameters & meter which is not able to measure minimum flow or maximum flow with stated accuracy shall not be offered.
vi) Upstream and downstream straight pipe length requirements for installation.

c) Proven references for each offered model inline with clause 1.2.3 of this specification.

d) A copy of approval from local statutory authority, as applicable, such as Petroleum and Explosives Safety Organisation (PESO) or Director General of Mine Safety (DGMS) in India, for the electronic instruments installed in electrically hazardous area along with

i) Test certificate from recognised test house like Central Institute of Mining & Fuel research(CIMFR)/Electronics Regional Testing Laboratory(ERTL) etc. for flame proof enclosure and/or intrinsic safety, as specified in the datasheets, as per relevant Indian Standard for all Indian manufactured equipments or for items requiring DGMS approval.

ii) Certificate of conformity from agencies like Laboratorie Central Des Industries Electriques (LCIE), British Approval Service for Electrical Equipment in Flammable Atmospheres(Baseefa), Canadian Standards Association(CSA), Factory Mutual(FM), Underwriters laboratories(UL) etc. for compliance to ATEX directives or other equivalent standards for all equipment manufactured outside India.

e) Deviation on technical requirements shall not be generally entertained. In case vendor has some valid technical reason for not complying with the specific requirements due to superior alternatives and materials, tag wise deviation list must be provided along with the technical justification.

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f) Catalogues giving detailed technical specifications, model decoding details and other related information for each type of vortex flow meter covered in the bid.

g) Two years' operational spares for each vortex flow meter and its accessories covered in the bid, which shall include bluff body, sensor element, transmitter module etc., as a minimum.

h) Any special tools and tackles needed for maintenance work on the vortex flow meter and its accessories. In case no special tools are necessary for the offered target flow meters, vendor must certify in their offer.

1.2.3 All items, as offered, shall be field proven and should have been operating individually for a period of minimum 6 months on the bid due date in the process conditions/application similar to those as specified in the purchaser's data sheets. Items with prototype design or items not meeting provenness criteria specified above shall not be offered

1.2.4 Whenever specified vendor must furnish tested values of failure rates, probability of failure on demand and test intervals for the safety integrity level analysis inline with SIL level specified in datasheet.

1.2.5 All documentation submitted by the vendor including their quotation, catalogues, drawings, installation manual, operation and maintenance manuals etc shall be in English language only.

1.3 Drawings and Data

1.3.1 Detailed drawings, data, catalogues and manuals required shall be submitted by the vendor as per Vendor data requirement attached with the requisition.

1.3.1 Final documentation consisting of design data, installation manual, operation and maintenance manual submitted by the vendor after placement of purchase order shall include the following, as a minimum;

a) Specification sheet for each flow meter;

b) Certified drawing for each flow meter, which shall provide dimensional details in mm, end connection details, material of construction, wiring and termination details etc.

c) Clearance required for maintenance work

d) Weight of instrument in kilograms.

e) Copy of type test certificates

f) Copy of test certificates for all the tests indicated in clause 4.0 of this specification.

g) Installation procedures for vortex flow meter.

h) Calibration and maintenance procedures for vortex flow meter.

2.0 DESIGN AND CONSTRUCTION

2.1 Flow Meter

2.1.1 Flow meter shall be of in-line mounting design with flow direction clearly marked on the flow meter body to ensure correct installation.

2.1.2 Flow meter design shall ensure that the location and orientation of installation of vortex flow meter in the line shall not affect the calibration, accuracy and performance of the meter.

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2.1.3 Whenever purchaser data sheet specifies the requirement of dual sensor flow meter, the flow meter shall consist of two independent flow sensors, transmitter electronics & output indicators. The housing shall also be separate. However, shedder bar can be common or separate but necessarily part of the same assembly. If two shedder bars are considered the combined pressure drop across the two shedder bars shall be less than the maximum allowable pressure drop indicated. The failure of one sensor / transmitter shall in no way affect the functioning of the other sensor /transmitter.

2.1.4 **End Connection**

2.1.4.1 Flow meter shall be of flanged body construction with material of construction as specified in the purchaser's data sheet. In case of meter design where end flanges are welded to the meter body all weld joints shall be of radiographed quality.

2.1.4.2 Unless otherwise mentioned, the following shall govern;

a) Threaded end connections shall be to NPT as per ASME B 1.20.1

b) Flanged end connections shall be as per ASME B 16.5

c) Grooves of ring-type joint flanges shall be octagonal as per ASME B 16.20 and groove finish shall be as follows:

63 AARH : 32 to 63 microinch AARH

d) When Flanges are Raised Face (RF) type, the face finish shall be as per ASME B16.5 and shall be as follows:

125 AARH : 125 to 250 microinch AARH

2.1.4.3 In case of meter design with SS Flanges of higher rating (to suit the design pressure and temperature specified in datasheet), mating SS flanges of corresponding higher rating, gasket & stud and bolt assembly shall be provided by the vendor. Material of construction for gasket, stud & bolts assembly shall be same as that mentioned in datasheets.

2.1.5 **Terminal Housing**

2.1.5.1 Following shall apply for both integral as well as for remote meter electronics:

a) All connections shall be terminated on the terminals brought out in the terminal housing located on the flow meter body. Flying leads shall not be provided.

b) All intrinsically safe terminals shall be properly identified and shall be separate from the non-intrinsically safe terminals.

c) Separate cable entry shall be provided in the terminal housing for power and intrinsically safe signals.

d) The flow meter enclosure, housing the electrical parts shall be suitable for the area classification indicated in the purchaser's data sheets. Unless otherwise specified, the enclosure shall conform to the following standards, as a minimum:
Weatherproof housing - IP 65 to IS/IEC-60529
Flameproof housing - Flame proof / Ex (d) as per IS/IEC-60079.
Flameproof housing shall also be made weatherproof.

2.1.6 All vortex flow meters in oxygen and chlorine service shall be thoroughly degreased using reagents like trichloroethylene or equivalent non toxic reagent and end connections shall be plugged after degreasing process in order to avoid entrance of grease or oil particles.

2.2 Meter Electronics

2.2.1 Flow meter electronics shall be microprocessor based and shall include pre-amplifier, converter, transmitter electronics and integral output meter. When the vendor is supplying

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the complete meter electronics, vendor shall ensure that the input/ output signal and performance characteristics of individual item are compatible with each other.

2.2.2 Flow meter electronics shall have enclosures suitable for the hazardous area classification indicated in purchaser's data sheets. When area classification is specified as electrically hazardous, flow meter shall have intrinsically safe certified circuitry. Electronic housing shall meet the requirements specified in clause 2.1.5 of this specification. Intrinsically safe isolators as required for the sensors shall be part of transmitter enclosure. However, Flow meter housing can be flameproof (Ex d) certified suitable for the specified area classification instead of intrinsically safe.

2.2.3 The vortex flow meter transmitter shall be 2-wire type, smart type and shall provide 4-20mA analog output superimposed with digital signal for meter diagnostics (HART Output). When specified, flow meter shall be field-bus type (bus powered) output conforming to the standard specified in the purchaser's specification sheets.

2.2.4 For smart transmitters or for fieldbus based transmitters the following features must be ensured;

a) They shall allow multi master (primary and secondary) for configuration, calibration, diagnosis and maintenance. The primary could be the control system or host computer, and the secondary could be the hand held communicator.

b) These shall be capable of implementing universal commands.

2.2.5 In addition to the requirements specified above, field bus based transmitter, wherever specified in the purchaser's data sheet, shall meet the following requirements:

a) All instruments must satisfy the requirements of the fieldbus registration laboratory with applicable checkmark like foundation fieldbus, profibus PA, or as specified in the purchaser's data sheets.

b) All instruments shall have one analog input block, as a minimum. In addition, when specified the transmitter shall also have PID controller block.

c) All instruments must be interoperable and shall have valid interoperability test clearance like ITK latest version for foundation fieldbus or equivalent for profibus PA, as applicable.

d) The fieldbus instruments shall support peer-to-peer communication.

e) All Instruments shall be polarity insensitive. Also, transmitter shall be LAS capable.

f) The fieldbus instruments in hazardous area shall be certified as per entity concept or shall be FISCO approved as per the requirements specified in the purchaser's specification.

g) All instruments shall support EDDL or FDT/DTM requirements, as specified in data sheets

h) Internal Software shall be configured by the vendor including the following information.

- Serial Number
- Device Tag (Tag No.)
- Process service

i) All instruments shall be capable of supporting incremental Device Descriptor (DD) for extra functionality and/or software revisions in Device Memory.

2.2.6 Meter electronics shall also be provided with security lockout feature to disable access to configuration modification features.

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2.2.7 When the transmitter detects an empty pipe condition, the output should be set to zero flow value. The span of the transmitter shall be field adjustable. In case separate device is required, to make such a change, the same shall be included.

2.2.8 Field mounted converter/ transmitter shall have an integral output meter (local indicator). Local indication of the output meter must be digital and in engineering units.

2.2.9 The configurational data of the instrument shall be stored in a non-volatile memory such that this remains unchanged because of power fluctuations or power off condition. In case, vendor standard instrument has battery backed RAM vendor to ensure that battery drain alarm is provided as diagnostic maintenance message.

2.2.10 Flow meter electronics shall be either integral to flow meter or shall be remote mounted type. Where remote mounted electronics is offered a minimum of 10 metres of interconnecting cable shall be included.

2.2.11 The meter electronics along with flow meter shall be pre-calibrated at vendor's works with calibration factor duly established for the flow meter.

2.2.12 Accessories like cable gland, conduit and junction box as required to interconnect sensor, transmitter signal cable, etc., shall be supplied by the vendor.

2.2.13 The design of electronic instruments shall be in compliance with the electromagnetic compatibility requirements as per IEC61000-4.

2.3 Performance Requirements

Unless otherwise specified in the purchaser's datasheets, the vortex flow meters shall meet the following performance specification:

a) The flow meter accuracy inclusive of linearity, repeatability and hysterisis shall be better than ± 0.75% of flow rate for liquid and ± 1.5% of flow rate for gas and steam.

b) Repeatability of the flow meter shall be better than ±0.25% of flow rate.

3.0 NAMEPLATE

Each vortex flow meter and its accessories shall have a Stainless Steel nameplate attached firmly to it at a visible place, furnishing the following information:

a) Tag number as per purchaser's data sheet.

b) Manufacturer's serial number and model number.

c) Manufacturer's name/ trademark.

d) Nominal end connection size and rating in lbs.

e) Body and trim material

f) Area classification in which the equipment can be used.

g) Hazardous area certification number and marking.

h) Standard for body/trim materials (e.g. ASTM/BS etc.)

i) Enclosure type.

j) Specified range and units of measurement for flow.

k) Type of signal, 4-20 mA HART /FF.

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4.0 INSPECTION AND TESTING

Purchaser reserves the right to inspect and witness testing at vendor's works as per Inspection Test Plan and approved quality documents. All these tests shall be completed by the vendor and test reports shall be submitted to Purchaser for scrutiny.

5.0 SHIPPING

5.1 All threaded and flanged openings shall be suitably protected to prevent entry of foreign material.

5.2 The vortex flow meter and its accessories shall be packed separately.

5.3 All vortex flow meters in oxygen and chlorine service shall be separately packed along with a certificate indicating 'CERTIFIED FOR OXYGEN/CHLORINE SERVICE', as applicable.

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STANDARD SPECIFICATION FOR ULTRASONIC FLOW METER

Rev. No	Date	Purpose	Prepared by	Checked by	Standards Committee Convener	Standards Bureau Chairman
					Approved by	
2	28/03/2024	Revised and Reissued as standard specification	GK	AJS/SR	MN	MN
1	18/01/2019	Revised and Reissued as standard specification	RM	SA	RG	RKT
0	27/11/2013	Issued as Standard Specification	SM	RG	RP/JMS	DM

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Abbreviations:

AARH	:	Arithmetic Average Roughness Height
CFD	:	Computational Fluid Dynamics
EDDL	:	Electronic Device Description Language
FDT / DTM	:	Field Device Tool / Device Type Manager
FISCO	:	Fieldbus Intrinsic Safe Concept
HART	:	Highway Addressable Remote Transducer
LAS	:	Link Active Scheduler
MTBF	:	Mean Time Between Failures
MTTR	:	Mean Time To Repair
NIST	:	National Institute of Standards and Technology
NPT	:	National Pipe Thread
PFD	:	Probability of Failure on Demand
PID	:	Proportional, Integral and Derivative
SIL	:	Safety Integrity Level
SS	:	Stainless Steel

Instrumentation Standards Committee

Convener:	Mr. Mainak Nandi
Members:	Mr. Arupjyoti Saikia
	Mr. Sachin Garg
	Ms. Rimpa Saha Chakraborty
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1.0 GENERAL

1.1 Scope

1.1.1 This specification, together with the data sheets cover the requirement for the design, materials, nameplate marking, inspection, testing and shipping of Ultrasonic Flow meters and their accessories.

1.1.2 The standards referred to herein and mentioned below shall be of the latest editions unless otherwise specified:

AGA	American Gas Association, Gas measurement committee	
	Report No. 8	Compressibility and Super-compressibility for Natural Gas and other Hydrocarbon Gas Transmission Measurement
	Report No. 9	Measurement of gas by Multipath Ultrasonic flow meters
	ReportNo.10	Speed of sound in Natural Gas & other Related Hydrocarbon Gases
API	American Petroleum Institute	
	MPMS	Manual of Petroleum Measurement Standards
	Chapter 1	Vocabulary
	Chapter 4	Proving Systems
	Chapter 5	Metering
	Chapter 5.8	Measurement of Liquid Hydrocarbons by Ultrasonic Flow Meters using Transit Time Technology
ASME	American Society of Mechanical Engineers	
	B 1.20.1	Pipe Threads
	B 16.5	Steel Pipe Flanges and Flanged Fittings
	B 16.20	Ring-joint Gaskets and Grooves for Steel Pipe Flanges
	B 16.47-B	Large Diameter Steel Flanges
EN	European Standard	
	60947-5-6	Pulse generator requirements
	10204	Inspection documents for metallic products
	50014	Electrical apparatus for potentially explosive atmospheres – General Requirements
ISA	International Society of Automation	
	RP 31.1	Specification, Installation and Calibration of Turbine Flowmeters
IS/IEC	Indian Standards/International Electro-Technical Commission	
	60079	Permitted protection techniques for equipment in potentially hazardous areas
	60529	Degree of Protection Provided by Enclosures (IP Code)
	61511	Functional Safety for Process Industry Sector
	61508	Functional safety of electrical/electronic/programmable electronic safety-related systems
IEC 61000-4	Electronic compatibility for Industrial Process Measurement and Control Equipment	
IEC 60801	Electronic compatibility for Industrial Process Measurement and Control Equipment.	
ISO	International Organisation for Standardisation	
	2186	Fluid Flow in Closed Conduits - Connections for Pressure Signal Transmissions between Primary and Secondary Elements
	5168	Measurement of Fluid Flow: Estimation of Uncertainty of Ultrasonic Flow meters

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	6551	Cabled transmission of electric and/or electronic pulse data
	6976	Natural gas - Calculation of Calorific Value, Density and Relative Density
	12765	Measurement of Fluid Flow in Closed Conduits – Methods using Transit Time Ultrasonic Flow meters
	17025	Testing and calibration laboratories
OIML	International Organisation of Legal Metrology	
	R 117	Dynamic measuring systems for liquids other than water
	R 137	Gas Meters

1.1.3 In the event of any conflict between this standard specification, data sheets, statutory regulations, related standards and codes, the following order of priority shall govern:

a) Statutory Regulations

b) Job Specifications/Data sheets

c) Standard specifications

d) Codes and Standards

However, it shall be obligatory on the bidder's part to bring to the notice of the Purchaser all such conflicts, wherein the Purchaser's decision shall be final.

1.1.4 In addition to compliance to purchaser's specification in totality, vendor's extent of responsibility includes the following:

a) Purchaser's data sheets indicate the minimum acceptable materials of construction for body, trim and accessories of the Ultrasonic flow meter. Alternative superior material of construction shall also be acceptable provided vendor assumes complete responsibility for proper selection of offered materials for their compatibility with the process fluid and its operating and design conditions specified in the data sheets.

b) Sizing of the Ultrasonic flow meter and indicating the velocity and accuracy at the specified flow conditions in the data sheets.

c) Coordination and approvals from statutory authorities like PESO, weights and measures etc, wherever required.

1.1.5 All the relevant terminology used in Purchaser's data sheets and job specifications are as per AGA for Gas application and API MPMS for Liquid application.

1.2 Bids

1.2.1 Vendor's quotation shall be strictly as per the bidding instructions to vendor attached with the Material Requisition.

1.2.2 A detailed technical offer for each item is required, Vendor's quotation shall include the following:

a) Compliance to the specifications

b) A detailed specification of each Ultrasonic meter having following details as a minimum. All the material specifications and units of measurement for various parts in the vendor's specification sheet shall be to the same standards as those indicated in the purchaser's data sheets.

i) Details regarding type, material of construction etc., for various parts of the Ultrasonic flow meter, meter runs, flow conditioner and its accessories.

ii) Meter sizing sheet indicating all the performance characteristics including meter accuracy, velocity at all flows and minimum detectable flow rate.

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iii) Specification and type of cabling required between the meter and its associated receiver instrument/flow compute/ other field instruments including the maximum permissible cable length.

iv) Maximum pressure loss through the meter and meter runs at maximum flow rate.

v) Upstream and downstream straight pipe length requirement for installation wherever not indicated in the specification by Purchaser.

c) Proven references for the offered model in line with clause 1.2.3 of this specification.

d) Overall dimensions in millimetres of the Ultrasonic flow meter, meter runs, flow conditioner and its accessories.

e) Type test certificate from accredited laboratory.

f) Certificate from regulatory authority for custody transfer application (whenever Custody Transfer application is specified in the data sheets).

g) A copy of approval from local statutory authority, as applicable, such as Petroleum and Explosives Safety Organisation (PESO)/ Chief Controller of Explosives (CCE) in India, for the electronic instruments installed in electrically hazardous area along with

i) Test certificate from recognised test house like Central Institute of Mining & Fuel research (CIMFR)/ Electronics Regional Testing Laboratory (ERTL) / Karandhikar Lab (KLPL) etc. for flame proof enclosure and/or intrinsic safety, as specified in the datasheets, as per relevant Indian Standard for all Indian manufactured equipment's or for items requiring DGMS approval.

ii) Certificate of conformity from agencies like Laboratorie Central Des Industries Electriques (LCIE), British Approval Service for Electrical Equipment in Flammable Atmospheres (Baseefa), Canadian Standards Association (CSA), Factory Mutual (FM), Underwriters laboratories (UL) etc. for compliance to ATEX directives or certificate of conformity from IECEx or other equivalent standards for all equipment manufactured outside India.

h) Deviation on technical requirements shall not be generally entertained. In case vendor has some valid technical reason for not complying with the specific requirements due to superior alternatives and materials only, tag wise deviation list must be provided along with the technical justification.

i) Published catalogues in English giving detailed technical specifications; model decoding details and other information for the type of ultrasonic flow meter and its accessories covered in the bid.

1.2.3 All items, as offered, shall be field proven and should have been operating individually for a period of minimum six (6) months on the bid due date in the similar application as specified in the purchaser's data sheets. Items with prototype design or items not meeting provenness criteria specified above shall not be offered.

1.2.4 Vendor shall also quote for the following:

a) Two years' operational spares for Ultrasonic flow meter and its accessories covered in the bid.

b) Any special tools, if needed for maintenance work on the Ultrasonic flow meter and its accessories, as recommended by vendor. Vendor must confirm in their offer if no special tools are needed for maintenance of the offered Ultrasonic flow meter and its accessories. Online sensor extraction tool shall not be considered as special tool.

c) Unit rate (per meter) for interconnecting cable between sensor unit & transmitter along with SS flexible metallic conduit in case of unarmoured cables

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d) Any Start-up and Commissioning spares, if required, as recommended by vendor.

1.3 Drawings and Data

1.3.1 Detailed drawings, data, catalogues and manuals required shall be submitted by vendor as per vendor data requirements attached with the requisition.

1.3.2 Final documentation consisting of design data, installation manual, operational and maintenance manual etc., submitted by the vendor after placement of purchase order, shall include the following, as a minimum:

a) Specification sheet for each Ultrasonic flow meter, Meter Run including flow conditioner, if required, Meter electronics and its accessories.
b) Meter sizing sheets for each ultrasonic flow meter indicating all the performance characteristics including meter accuracy, repeatability, velocity at all flow and minimum detectable flow rate.
c) Weight in kilograms of each Ultrasonic flow meter and its accessories, meter run with flow conditioners, if required, etc.
d) Certified drawings for each Ultrasonic flow meter, meter runs with flow conditioner, if required, etc., which shall provide dimensional details, internal construction details, material of construction etc.
e) Copy of type test certificates
f) Proving procedure
g) Detailed wiring diagrams
h) Certificate of compliance to purchaser's specification as per clause 3.1 of EN 10204.
i) Graphs of correction factors such as pressure, temperature, density and viscosity.
j) Installation procedure for each ultrasonic flow meter.

2.0 DESIGN AND CONSTRUCTION

2.1 Flow meter Body and Trim

2.1.1 The Ultrasonic flow meter shall be based on transit time difference technology.

2.1.2 The design used shall provide maximum reliability, maximum on-line performance and minimum maintenance. It shall be immune to other impurities in the fluid stream.

2.1.3 The flow meter transducers shall be energized by the integral electronics to transmit and receive ultrasonic waves.

2.1.4 The meter design shall have the facility to remove /replace the transducers in-situ under line operating condition. Failure or removal of one pair of transducers shall not cause the meter to lose all measurement function. Failure of any path shall generate an alarm identifying the affected path. Also transducers ports shall be designed in a way to reduce the possibility of liquid or solid accumulation.

2.1.5 It shall be possible to replace transducers without a change in meter performance. After replacement of transducers and a possible change of the associated software constants, the resulting shift in the meter's performance should not be more than the allowable repeatability of the meter.

2.1.6 The vendor shall comprehensively advise the impact of transducer failure on the performance and accuracy of the Ultrasonic flow meter. Ultrasonic flow meters and the meter runs/flow conditioners shall be rated for the maximum design pressure as indicated in the data sheets.

2.1.7 Ultrasonic flow meter spool inside diameter (ID) shall meet the specified pipe ID and internal surface roughness shall be as per API standard.

2.1.8 The meter shall be suitable for horizontal & vertical mounting. However, the flow direction shall be clearly stamped or cast on the body.

2.1.9 End connections:

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2.1.9.1 Spool piece type Ultrasonic flow meters shall have flanged end connections. Weld joints, if any, shall be of radiographic quality.

2.1.9.2 Unless otherwise mentioned, end connection details shall be as below:

a) Threaded end connections shall be to NPT as per ASME B 1.20.1

b) Flanged end connections shall be as per ASME B 16.5

c) Grooves of ring type joint flanges shall be octagonal as per ASME B 16.20 and groove finish shall be as follows:

63 AARH : 32 to 63 micro inch AARH

d) When Flanges are Raised Face (RF) type, the face finish shall be as per ASME B 16.5 and shall be as follows:

125 AARH : 125 to 250 micro inch AARH

2.1.10 The material of construction of Ultrasonic flow meter internals/wetted parts and body shall be as specified in the respective data sheets.

2.1.11 Meter Sizing:

2.1.11.1 All the calculations and units of measurement shall be in metric standard only.

2.1.11.2 For Flare application, Ultrasonic flow meter shall be suitable for measuring flow with specified accuracy for velocity range from 0.3 m/s to 120 m/s, however, the flow measurement corresponding to 0.03 m/sec shall be detectable without ascertaining the accuracy.

2.1.11.3 For Process application, Ultrasonic flow meter shall be selected ensuring the capability of measuring minimum flow with specified accuracy at a velocity of 0.5 m/sec within the meter body.

2.1.11.4 For cases where sizing and selection of flow meter is to be performed by vendor, vendor shall furnish the sizing calculations to justify the selection of Ultrasonic flow meters considering the density and viscosity of the fluid. Vendor shall ensure that flow meter operates within 85% of their standard range (not extended).

2.1.11.5 Overall pressure loss across the meter assembly including meter runs shall be within the permissible pressure loss specified in data sheet. Pressure drop calculation across the meter shall be furnished.

2.1.11.6 Unless otherwise specified in the data sheets, vendor to ensure the velocity in the Ultrasonic flowmeter and meter run shall not exceed maximum permissible velocity.

2.1.11.7 Vendor shall indicate the range of viscosities over which the measurement accuracy remains within limits.

2.1.11.8 Ultrasonic flowmeters shall be suitable for measuring the flow with the specified accuracy with upstream and downstream straight length of 10D and 5D respectively for both process and flare application.

It shall be vendors responsibility to select adequate number of probes and carry out required calibration analysis / CFD analysis to establish the specified performance and same shall be included in their offer.

2.1.11.9 For Multipath Flowmeter, vendor to provide loss of Path alarm in Control room to prevent display of derated accuracy as per AGA 9.

2.2 Meters in Custody Transfer Applications

2.2.1 The design, construction and operation of Ultrasonic flow meters in Custody transfer applications shall conform to API standard (latest version) for Measurement of liquid Hydrocarbon by Ultrasonic flow meters using transit time technology and AGA Report 9 (latest version) for hydrocarbon Gas service.

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2.2.2 The average velocity of the fluid shall be measured along four acoustic paths as a minimum. Numerical calculation techniques shall then be used to compute the average axial flow velocity and volume flow rate at operating conditions through the meter.

2.2.3 Temperature and Pressure sensing devices shall be installed at 3D and 2D respectively downstream of the meter run to accurately represent the actual metering conditions and any calculation required for compensation of varying density as per AGA 9.

2.2.4 Meter Runs:

2.2.4.1 Unless otherwise specified end connections for the upstream and downstream meter runs shall conform to this specification.

2.2.4.2 Flow Conditioners:

a) Type of flow conditioner (tube or vane type or Flow profiler etc.) shall be as recommended by vendor best suitable for the application. All Ultrasonic flow meters shall be provided with meter run and flow conditioner as per purchaser's datasheet. Minimum upstream and downstream run lengths shall be 10D and 5D respectively, where D is the inside diameter of the meter run.

b) The straightening element shall be made out of a thin walled tube or light gauge metal vane. However, the design shall be rugged enough to resist the forward thrust due to high flows. The element shall have smooth leading and trailing edges.

c) For tube type flow straightener, the length to diameter ratio of each tube shall be at least 10:1

2.3 Meters in Process / Flare Applications

2.3.1 The ultrasonic flow meters shall be supplied in completely assembled condition with all the probes (sensor/transducer), nozzles for installation of these probes ready for installation on a pipeline or duly mounted on a spool piece.

2.3.2 Spool piece type design shall be selected for line sizes up to 16". For higher line sizes, Insertion type design shall be used.

2.3.3 The number of probes required for a particular application and probe configuration shall be decided by the vendor. The same shall be decided such that measurement is considered across two independent acoustic paths as a minimum for process as well as flare applications.

2.3.4 Whenever the sensor / receiver probes are insertion type:

a) The material of construction of all the wetted portions of sensor shall be Titanium and Probe material shall be SS316/SS316L as a minimum. Superior material (if required) of sensor and probe suitable for the specified process conditions as per datasheet can be offered.

b) The probes shall be inserted through flanged nozzles of minimum 2" size to ensure insertion and removal of probes. Threaded nozzles for insertion shall not be acceptable.

c) It shall be possible to insert or retract the probes on-line without process interruption. Suitable retraction assembly shall be supplied for insertion and removal of probes on-line. In case of Flare meters, Vendor shall mandatorily provide full bore ball valve, for isolation, with each probe. The location of probes shall be selected to avoid fouling.

2.3.5 For high temperature application, suitable arrangement shall be provided to protect the sensor from high temperature. Any additional mounting accessory, if necessary, shall be supplied by vendor.

2.3.6 Ultrasonic signal frequency shall be dependent on the application. Accordingly, vendor to select suitable piezo-crystal probes meeting the specified requirements.

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2.4 Clamp-On Ultrasonic Flow meter

2.4.1 The clamp-on ultrasonic flow meters shall be supplied with all the probes (sensor/transducer), special cables, clamping arrangement & accessories ready for installation on a pipeline.

2.4.2 The orientation / installation of clamp-on sensors shall be decided by vendor in such a way that it shall provide easy maintenance access and maximum reliability. For cooling water application all sensor / receiver shall be on the same side of the pipe.

2.4.3 The average velocity of the fluid shall be measured along two (2) independent acoustic paths and two (2) independent pair of sensor / receiver as a minimum.

2.4.4 Ultrasonic Flow Transmitter (Clamp on type) design shall have sensor/transducer of solid couplant design. Gel type substance shall not be used for installation of sensor/transducer.

2.4.5 All the accessories of the Ultrasonic Flow meter to clamp the meter on pipeline shall be supplied by bidder and shall be minimum SS 316.

2.5 Meter Electronics

2.5.1 Ultrasonic flow meter's electronics system including power supplies, microcomputer, signal processing components and ultrasonic transducer excitation circuits, may be housed in one or more enclosures mounted locally or remotely to the meter and is referred to as the Signal Processing Unit (Transmitter). It shall be designed and installed to meet the specified hazardous area classification.

2.5.2 The transmitter/ signal processing unit shall be microprocessor-based electronics suitable for installation in the field under the ambient condition specified. Meter electronics shall be Weather proof to IP 65 and flameproof certified suitable to install in area classification. All field mounted items shall have enclosures suitable for the area classification indicated in purchaser's data sheets.

2.5.3 The transmitter/ signal processing shall have extensive diagnostic capability. Self-diagnostic feature should include monitoring the health of the transducers and signal quality. Meter parameters and factors set into the meter electronics shall be retained in non-volatile memory and shall be secured with password such that un-authorized changes are prohibited. Configuration software and firmware shall be provided.

2.5.4 For meter electronics, vendor shall ensure that the input/output signals and performance characteristics of individual instruments are compatible with each other.

2.5.5 The transmitters shall accept inputs from probes either directly or through pre-amplifier. The number of inputs shall be based on the number of paths selected for particular application.

2.5.6 The flow transmitter shall also accept inputs from pressure, temperature and/or density transmitters for accurate measurement at operating conditions (as applicable).

2.5.7 The cable entry sizes between the transmitter/ signal processing unit and pre-amplifier/transducers shall be decided by vendor. All interconnecting cables (armored type) including accessories like cable glands (weatherproof & flameproof) for signal & power cables etc. between Probe /Transducer and preamplifier, between preamplifier and transmitter shall be supplied by vendor accordingly. Vendor shall consider following cables with cable glands:

a) Between Ultrasonic flow meter element/transducer and Pre-amplifier (min. 20 meters for each transducer) for model where separate pre-amplifier is applicable.

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b) Between Preamplifier and Flowmeter Transmitter (min. 20 metres cable).
c) Cable between Pressure Transmitter and flowmeter transmitter, (min. 20 metres cable).
d) Cable between Temperature transmitter and Flowmeter transmitter, (min. 30 metres cable).

2.5.8 Cable glands shall be Nickel plated brass double compression type certified flameproof to area classification specified. All cable glands shall be provided with PVC hood.

2.5.9 Meter output signals from the meter electronics shall be without flying leads. Purchaser Cable entry for signal cable shall be 1/2" NPT (F) and for power cable shall be 3/4" NPT (F). Suitable adaptor shall be provided by bidder wherever different sizes are used. Number of cable entries shall be as per purchaser's datasheets. Separate terminal blocks shall be provided for power & signal connections.

2.5.10 Meter electronics shall be capable of providing the following output signals (as applicable):

a) At least two nos. of individual 4-20 mA DC outputs (user configurable) for Mass flow rate (Kg/h), Volumetric flow rate (m3/h or Nm3/h), Pressure (Kg/cm2a), Temperature (°C), molecular weight, sound speed (m/s) as per the requirements mentioned in the purchaser's datasheets. The other parameters shall be through serial communication mentioned in clause c) below.

b) High-resolution dual pulse outputs to flow computers configurable for flow rate signals and shall be user selectable to be either same outputs or one signal dedicated to each direction of flow. The transmitters shall comply with the principles of ISO 6551 cabled transmission of electric and/or electronic pulse data. At least security level B as defined by ISO 6551 shall be provided and the checking facility shall be of type P.

c) Digital discrete outputs for direction of flow, trouble alarm. loss of path alarm as mentioned above, and output data validation.

e) RS-485/TCP/IP communication port with MODBUS protocol for communicating with the control room mounted flow computer for measured data, meter diagnostics, test and health data. Vendor shall supply the signal interconnection cables as per purchaser's datasheets for Pulse Outputs and RS 485 serial link (armored cables) including connectors at both ends against each tag for communication between flow meter in field and flow computers mounted on control panel located at respective control room.

2.5.11 Whenever HART transmitters or field-bus based transmitters are mentioned in purchaser's datasheets, the following features must be ensured:

a) It shall allow multi master (primary and secondary) for configuration, calibration, diagnosis and maintenance. The primary could be the control system or host computer, and the secondary could be the hand-held communicator.

b) It should be capable of implementing universal command

2.5.12 In addition to the requirements specified above, field-bus based transmitter, wherever specified in the purchaser's data sheet, shall meet the following requirements:

a) All instruments must satisfy the requirements of the field bus registration laboratory with applicable checkmark like Foundation Field Bus, Profibus NutZer-organisation e.V (PNO), or as specified in the purchaser's data sheets.

b) All instruments shall have one analog input blocks, as a minimum. In addition, when specified the transmitter shall also have PID controller block.

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c) All instruments must be interoperable and shall have valid interoperability test clearance like ITK latest version for foundation field bus or equivalent for profibus PA, as applicable.

d) The field bus instruments shall support peer-to-peer communication.

e) All instruments shall be polarity insensitive. Also transmitter shall be LAS capable.

f) The field bus instruments in hazardous area shall be certified as per entity concept or shall be FISCO approved as per the requirements specified in the purchaser's specification.

g) All instruments shall support EDDL or FDT/DTM requirements, as specified in data sheets.

h) Internal Software shall be configured by the vendor including the following information.
- Serial Number
- Device Tag (Tag No.)
- Process Description

i) All instruments shall be capable of supporting incremental Device Descriptor (DD) for extra functionality and/or software revisions in Device Memory.

2.5.13 Meter electronics shall operate on 110/230 V AC ± 10%, 50 Hz ± 3Hz UPS or 24V DC and shall be protected from overload and from transients. Low power consumption is desired. Supply voltage fluctuation of ± 10 % from the specified value and supply frequency fluctuation of ± 3 Hz from the specified value shall not affect the meter performance.

2.5.14 The design of electronic instruments shall be in compliance with the electromagnetic compatibility requirements as per IEC 61000-4.

2.5.15 The meter transducers shall be intrinsically safe certified suitable for the specified area classification and weather proof to IP65 and vendor shall supply necessary isolating barriers between the transducers and preamplifier/transmitter. However, the transducer/sensor housing can be flameproof (Ex d) certified suitable for the specified area classification instead of intrinsically safe.

2.5.16 The transmitter's enclosure housing the electrical parts shall be suitable for the area classification indicated in the purchaser's data sheets. Unless otherwise specified, the enclosure shall conform to the following standards:

Weather proof housing - IP 65 as per IS/IEC 60529
Flame proof housing - EX (d) as per IS/IEC 60079
Flameproof housing shall also be made weather proof.

2.6 Performance Requirements

Vendor shall meet the accuracy requirements mentioned herein, and indicate the same in the offer with sizing calculations and back-up documentation. The minimum no. of paths, as defined for each application, shall be ensured.

2.6.1 For Custody Transfer and Pipeline Applications:

a) Liquids
   a. Accuracy : Accuracy as per class 0.3 OIML R117
   b. Repeatability : ±0.02% of reading

b) Gases
   a. Accuracy : Accuracy as per class 0.5 OIML R137
   b. Repeatability : ±0.1% of reading

2.6.2 For Process Applications:

a) Liquids
   a. Accuracy : ±0.5% of reading
   b. Repeatability : ±0.3% of reading

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b) Gases

a.	Accuracy	:	±0.5% of reading
b.	Repeatability	:	±0.3% of reading

c) Flare

a.	Accuracy	:	±2-5% of reading
b.	Repeatability	:	±1% of reading

2.6.3 For Clamp-on Type Ultrasonic Flowmeter:

a.	Accuracy	:	±2% of reading
b.	Repeatability	:	±0.5% of reading

2.7 **Certification and Flow Calibration of Ultrasonic Meters**

2.7.1 Meters in Process/Flare Applications:

Each ultrasonic flowmeter in process applications shall be flow calibrated at manufacturer's works for a minimum four points and test reports shall be furnished. For flowmeters in Flare applications, test reports to check the functioning of the probes shall be furnished.

2.7.2 Meters in Custody Transfer and Pipeline Applications:

2.7.2.1 Ultrasonic flow meters used for custody transfer application shall be OIML-CS certified, for both gas and liquid service.

Vendor shall furnish the regulations of the certifying authority considered by him for custody transfer approval. If other instruments of metering system are required to be certified as per the regulation the same shall be complied.

2.7.2.3 Each Ultrasonic flow meter in custody transfer application shall have calibration certificate, duly signed by weights and measure authority.

2.7.2.4 The meter proving system to be used by vendor shall be traceable to international standards and vendor shall furnish certificate indicating the uncertainty of the Meter proving system used for meter flow calibration.

2.7.2.5 Each Liquid Ultrasonic flow meter shall be flow calibrated as follows:

a. Vendor shall calibrate each liquid Ultrasonic flow meter with water at his shop using preferably the mechanical displacement meter prover as detailed out in API MPMS. The proving conditions shall simulate the actual operating conditions as nearly as possible. All the precautions mentioned under paragraph 5.2 of ISA RP 31.1 shall be observed during proving.
b. Vendor shall carryout performance test and certify the meter in combination with its companion electronics. A recognized test facility with traceable reference measurements shall be used. A copy of the ISO/IEC 17025 accreditation certificates of the calibration facility/calibration rig shall be provided. Flow test data at six points covering the minimum to the maximum flow rate shall be obtained for ascertaining the meter linearity and repeatability within the specified limits as defined in API MPMS chapter 5 and error curve shall be obtained. The testing medium shall be water. Flow calibration of each Ultrasonic flow meter shall include the associated upstream meter run with flow conditioner and downstream meter run being supplied with the meter

2.7.2.6 Each gas ultrasonic flow meter shall be flow calibrated as follows:

a. Each Gas Ultrasonic flow meter shall be "zero calibrated" ("dry calibrated") with nitrogen. Test results shall be furnished. In the dry calibration set up, the gas velocity observed on all the acoustic paths shall be zero. The speed of sound of the individual acoustic path in the dry calibration set up shall not exceed ±0.2% of the mean velocity of all the paths.

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b. Vendor shall carry out performance test and certify the meter in combination with its companion electronics. A recognized test facility with traceable reference measurements shall be used. Flow test data at seven points with two point verification covering the minimum to the maximum flow rate, as recommended by AGA Report 9 (latest edition), shall be obtained for ascertaining the meter linearity and repeatability within the specified limits and error curve shall be obtained. Calibration of meter shall be done near operating pressure. Test medium shall be Natural Gas. Flow calibration of each Ultrasonic flow meter shall include the associated upstream meter run with flow conditioner and downstream meter run being supplied with the meter.

c. Accuracy with wet flow calibration shall be demonstrated within ±0.3% for multi path type under the operating flow conditions. Gas metering system integration, testing, validation and including third party "wet calibrations" (only for the ultrasonic flow meters with its associated upstream / downstream meter runs) should be done in flow labs as detailed above.

d. Flow calibration shall be performed at pressure and flow rate close to the operating pressure and flow rate, depending upon the highest pressure and flow rate available with the calibration facility.

3.0 NAMEPLATE

3.1 Each Ultrasonic flow meter and its accessory shall have a SS nameplate attached firmly to it at a visible place. The nameplate shall furnish the following information:

a) Tag number as per purchaser's data sheet.

b) Manufacturers serial no. and model no.

c) Manufacturer's name/trade mark.

d) Nominal end connection size and rating in ASME B16.5 class.

e) Meter Body and Probe material.

f) Calibrated range & units of measurement of flow.

g) Area classification in which the equipment can be used.

h) Hazardous area certification number and marking.

4.0 INSPECTION AND TESTING

Purchaser reserves the right to inspect and witness testing at vendors works in-line with the Inspection Test Plan for Ultrasonic Flowmeter and approved quality documents. All these tests shall be completed by vendor and test reports shall be submitted to purchaser for scrutiny.

5.0 SHIPPING

5.1 All threaded and flanged openings shall be suitably protected to prevent entry of foreign material.

5.2 The ultrasonic flow meter and accessories shall be packed separately.

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डिसप्लेसर/फ्लोट संचालित लैवल इंस्ट्रुमेंटों के लिए मानक विनिर्देशन

STANDARD SPECIFICATION FOR DISPLACER/FLOAT OPERATED LEVEL INSTRUMENTS

Rev. No	Date	Purpose	Prepared by	Checked by	Standards Committee Convenor	Standards Bureau Chairman
					Approved by	
6	08.07.25	Revised and Reissued as Standard Specification	SK/SKG	SM	MN	MN
5	24.11.20	Revised and Reissued as Standard Specification	ANS	RK/SKG	MN	SM
4	30.06.15	Revised and Reissued as Standard Specification	JS/ RK	MN	RG	SC
3	27.10.10	Revised and Reissued as Standard Specification	SB	RG	TGM/JMS	ND
2	02.05.05	Revised and Reissued as Standard Specification	SM	AKG	PM	VJN

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Abbreviations:

AARH	:	Arithmetic Average Roughness Height
DC	:	Direct Current
EMI	:	Electromagnetic Interference
FISCO	:	Fieldbus Intrinsically Safe Concept
HART	:	Highway Addressable Remote Transducer
LCD	:	Liquid Crystal Display
NPT	:	National Pipe Threads
PID	:	Proportional, Integral and Derivative.
RAM	:	Random Access Memory
RFI	:	Radio Frequency Interference

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1.0 GENERAL

1.1 Scope

1.1.1 This specification, together with the datasheets, describes the requirement for design, manufacture, material, nameplate marking, inspection, testing and shipping of displacer/float operated level instruments.

1.1.2 The related standards referred to herein and mentioned below shall be of the latest edition of the following codes, standard practices and publications, unless otherwise specified:

ASME	American Society of Mechanical Engineers.	
	B 1.20.1	Pipe Threads.
	B 16.5	Pipe Flanges and Flanged Fittings: NPS 1/2 through NPS 24 Metric/ Inch Standard.
	B 16.20	Ring Joint Gaskets and Grooves for Steel Pipe Flanges.
	B16.34	Valves Flanged, Threaded and Welding End
EN	European Standards	
	10204	Metallic Products-Types of Inspection Documents
IBR	Indian Boiler Regulation	
IS/IEC	Indian Standards/ International Electro technical Commission.	
	60079	Electrical Apparatus for Explosive Gas Atmosphere.
	60529	Degrees of protection provided by enclosures (IP Code).
	60587	Electrical insulating materials used under severe ambient conditions - Test methods for evaluating resistance to tracking and erosion.
	61000-4	Electromagnetic Compatibility for Industrial Process Measurement and Control Equipment.
	61158	Industrial Communication Networks-Fieldbus Specifications
	61508	Functional Safety of Electrical/ Electronic/ Programmable Electronic safety related systems.

1.1.3 In the event of any conflict between this standard specification, data sheets, statutory regulations, related standards, codes etc., the following order of priority shall govern:

a) Statutory Regulations
b) Datasheets
c) Standard Specification
d) Codes and Standards

1.1.4 In addition to compliance to purchaser's specifications in totality, vendor's extent of responsibility includes the following:

Purchaser's datasheets indicate minimum requirement for material of wetted parts such as float/ displacer, torque tube assembly. Alternate superior materials of construction shall also be acceptable with the consent of the purchaser, provided vendor assumes complete responsibility for the selected materials for their compatibility with the specified process fluid and its operating conditions.

1.2 Bids

1.2.1 Vendor's quotation shall be strictly as per the bidding instructions to vendor attached with the Requisition.

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1.2.2 Vendor shall quote for two years operational spares for each level instrument and its accessories, which shall include torque tube, electronic module, output meter, gaskets/ o-ring etc. as a minimum.

1.2.3 All items, as offered, shall be field proven and should have been operating individually for a period of minimum 6 months on the bid due date in the similar application as specified in the purchaser's data sheets. Items with proto-type design or items not meeting provenness criteria specified above shall not be offered. Whenever any bought out item is offered to meet the configurational requirements specified in the Requisition, it shall also be proven in use to meet the functional requirements.

1.2.4 Whenever specified, vendor must furnish tested values of 'Failure Rates' and 'Test intervals' for the safety integrity level (SIL) analysis from third party certification agency.

1.2.5 All documentation submitted by vendor including their quotation, catalogues, drawings, installation manual, operation and maintenance manuals etc. shall be in English language only.

1.3 Drawings and Data

1.3.1 Detailed drawings, data, catalogues and manuals required from the vendor are indicated by the purchaser in vendor data requirement sheets.

1.3.2 Final documentation consisting of design data, installation manual, operation and maintenance manual etc submitted by vendor after placement of purchase order shall include the following, as a minimum:

a) Specification sheet for each level instrument and its accessories

b) Certified drawing for each level instrument which shall provide following details;

i) Distance between centre lines of connecting flanges.
ii) Overall dimensions of the completely assembled instrument in millimetres.
iii) Displacer/float dimensions.
iv) Insertion depth.
v) Displacer extension length, if any
vi) Dimensions of clearance space required for maintenance work.
vii) Weight of level instrument.
viii) Material of Construction.

c) Copy of the type test certificates

d) Copy of the test certificate for all tests indicated in clause 4.0 of this specification.

e) Installation procedure for level instruments

f) Calibration and maintenance procedure including replacement of its parts/ internals wherever it is applicable.

2.0 DESIGN AND CONSTRUCTION

2.1 Body

2.1.1 The level instruments shall be suitable for the design pressure and temperature of corresponding ASME rating specified for each item.

2.1.2 When external mounting type of level instruments is specified, the instruments shall be supplied with the external cage. The length of the cage shall be selected by vendor based on the range specified in the purchaser datasheets.

2.1.3 The external cage of level instruments shall be fabricated out of seamless pipe, in general. Forged or cast cage construction shall also be acceptable.

2.1.4 All level instruments with head mounted local indicator / controller shall have rotatable head construction.

2.1.5 Cage closure shall be of flanged end construction and shall meet the following requirements;

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a) The size of the closure flange shall allow easy removal and insertion of displacer/ float.

b) Type and rating of the closure flange shall be same as that of end connection flanges.

c) The nut and bolt shall be suitable for the specified service conditions.

d) The gasket used shall be suitable for the specified service conditions and shall be asbestos free.

2.1.6 Mid range position of the float or displacer shall be permanently marked on to the float/ displacer cage.

2.1.7 Cage shall be provided with ¾" NPT drain and vent connection. These connections shall be plugged.

2.1.8 Instrument shall not be sensitive to pressure variations inside measuring chamber.

2.1.9 Unless otherwise mentioned, the following shall govern;

a) Threaded end connections shall be to NPT as per ASME B 1.20.1

b) When Flanges are Raised Face (RF) type, flanged end connections shall be as per ASME B 16.5 and the face finish as per ASME B 16.5 shall be as follows:

125 AARH : 125 to 250 microinch AARH

63 AARH : 32 to 63 microinch AARH

c) Grooves of ring type joint flanges shall be octagonal as per ASME B 16.20 and groove finish shall be as follows:

63 AARH : 32 to 63 microinch AARH

2.2 Displacer / Float and Torque Tube

2.2.1 Displacer / float shall be designed considering the following:

a) Specific gravity of upper and lower fluids.

b) Withstand maximum pressure / temperature conditions specified in the datasheets.

2.2.2 In case of internal displacer float level instruments, the design shall ensure the following:

a) Diameter of displacer / float is less than the internal diameter of the equipment nozzle.

b) The insertion of displacer shall be field adjustable.

2.2.3 The level instruments (indicator / controller / transmitter) shall have torque tube design. Unless specified otherwise, torque tube material shall be Inconel as a minimum.

2.2.4 Level instrument in fluid temperature greater than 200°C shall be supplied with heat insulator or cooling fins.

2.2.5 Displacer chamber and mechanism chamber shall be separable with a flange connection in case of level transmitter.

2.2.6 The float shall be 'Ball' type with a float cum shaft and lever arm having an adjustable balancing weight.

2.3 Indicating / Transmitting Mechanism

2.3.1 Electronics Instrument

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2.3.1.1 The design of electronic instruments shall be in compliance with the electromagnetic compatibility requirements as per IEC 61000-4 and shall be immune to RFI and EMI radiation.

2.3.1.2 Whenever specifically indicated in purchaser's datasheets, the meter electronics shall be provided with in-built lightning and power supply surge protectors. The transient protection shall meet the requirements specified in IEC 60587. Proper terminal blocks shall be provided in the transmitter unit for termination of purchaser's cables. Flying leads shall not be provided.

2.3.1.3 The electronic transmitter shall be two (2) wire microprocessor based and shall be capable of providing 4 to 20mA analog output superimposed with diagnostic data in digital mode (i.e. HART output). Electronic transmitter shall generally operate at nominal voltage of 24V DC and shall be protected against short circuit and reverse voltage. Electronic transmitters with two-wire system shall be suitable for delivering rated current to an external loop resistance of at least 600ohm when powered with 24 V DC. When specified, transmitter shall provide Fieldbus output conforming to the standard specified in the purchaser's specification sheets.

2.3.1.4 For smart transmitters with HART output or for Fieldbus based transmitter the following features must be ensured:

a) It shall allow multi master (primary and secondary) for configuration, calibration, diagnosis and maintenance. The primary could be the control system or host computer, and the secondary could be the hand-held communicator.

b) It shall be capable of implementing universal command.

c) Transmitter shall also run complete diagnostic subroutines and shall provide diagnostic alarm messages for transmitter healthiness.

d) The configurational data of the instruments shall be stored in a non-volatile memory such that this remains unchanged because of power fluctuations or power off condition. In case vendor standard instrument has battery backed RAM, vendor to ensure that battery drain alarm is provided as diagnostic maintenance message.

2.3.1.5 It shall be possible to perform routine configuration, calibration, display process variable, diagnostics etc. from a hand-held portable configurator/ tester, which can be connected at any location in the transmitter loop. It shall be possible to perform all the above functions on-line. The loop function shall remain unaffected while communication is going on between transmitter and the field communicator.
There should be no interruption on the output while communicating with the transmitter.

2.3.1.6 In addition to the requirements specified above, Fieldbus based transmitters shall meet the following requirements:

a) All instruments must satisfy the requirements of the Fieldbus registration laboratory with applicable checkmark like Foundation Fieldbus, Profibus PA, or as specified in the purchaser's datasheets.

b) All instruments shall have two analog input blocks, as a minimum. In addition, when specified the transmitter shall also have PID controller block.

c) All instruments must be interoperable and shall have valid interoperability test clearance like ITK latest version for foundation Fieldbus or equivalent for Profibus NutZerorganisatione.v (PNO), or as specified in the purchaser's data sheets.

d) The Fieldbus instruments shall support peer-to-peer communication.

e) Fieldbus instruments as offered shall not be polarity sensitive.

f) Each instrument shall be provided with integral LCD meter, unless otherwise specified.

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g) The intrinsically safe Fieldbus instruments in hazardous area shall be certified as per entity concept or shall be FISCO approved as per the requirements specified in the purchaser's specification.

h) All instruments shall be capable of supporting incremental Device Descriptor (DD) for extra functionality and/or software revisions in Device Memory.

2.3.1.7 Transmitter shall have facility to make correction for specific gravity variation.

2.3.1.8 Supply voltage fluctuation of ±10 percent from the specified value and supply frequency fluctuation of ±3% from the specified value shall not affect the instrument performance.

2.3.1.9 Wherever transmitter is used, a copy of approval for intrinsically safe/flameproof enclosure, whenever specified, shall be provided as per following:

i) For all electrical items manufactured in India, the testing shall be carried out & test report issued by Indian test laboratory recognized by the Chief Controller of Explosives and valid copy of BIS license (only for Ex Electric Apparatus having flameproof type protection) or IECEx Certificate of Conformity, valid copy of IECEx Quality Assessment Report (summary) and IECEx Test Report.

ii) For all electrical items manufactured outside India, Test report issued by Indian test laboratory recognized by the Chief Controller of Explosives and valid copy of BIS license or IECEx Certificate of Conformity, valid copy of IECEx Quality Assessment Report (summary) and IECEx Test Report. OR EU Type Examination Certificate (Applicable for manufacturers having manufacturing locations in countries covered under the European Union), valid copy of Production Quality Assessment / Assurance Notification.

iii) For installations in India, additionally a copy of approval for intrinsically safe/flameproof enclosure from local statutory authority i.e., 'Petroleum and Explosives Safety Organization (PESO), Nagpur in India' shall also be provided based on above.

2.3.2 Instrument Enclosure

2.3.2.1 The transmitter's enclosure, housing and electrical parts shall be certified for the area classification indicated in the purchaser's datasheets. Unless otherwise specified, the enclosure shall conform to the following standards, as a minimum:

Weatherproof housing - IP 65 as per IS/IEC 60529.

Flameproof housing - Flame proof/ Ex (d) as per IS/IEC 60079.

Flameproof housing shall also be made weatherproof.

2.4 All level instruments in oxygen and chlorine service shall be thoroughly degreased using reagents like trichloro-ethylene or equivalent non-toxic reagents and end connections shall be plugged/ blinded after degreasing process in order to avoid entrance of grease or oil particles.

2.5 Performance Requirements

Unless specified otherwise in the purchaser's datasheets, the performance requirements for electronic level instruments shall be as follows:

2.5.1 Accuracy inclusive of repeatability and hysteresis shall be ± 0.5% of full scale.

2.5.2 Repeatability of level instrument shall be ± 0.3% of full scale.

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3.0 NAMEPLATE

Each level instrument shall have a stainless steel nameplate attached firmly to it at a visible place, furnishing the following information:

a) Instrument tag number as per purchaser's datasheet.

b) Manufacturers name, model number and serial number.

c) Nominal end connection in inches and rating in pounds.

d) Material of construction for body, displacer/float and torque tube.

e) Calibrated range.

f) Output Type.

g) Area classification in which the instrument can be used.

4.0 INSPECTION AND TESTING

Purchaser reserves the right to inspect and witness testing of all the items at vendor's works as per Inspection Test Plan and approved quality documents. All these tests shall be completed by the vendor and test reports shall be submitted to Purchaser for scrutiny.

5.0 SHIPPING

5.1 The level instrument and its accessories shall be supplied pre-assembled.

5.2 All threaded and flanged openings shall be suitably protected to prevent entry of foreign material.

5.3 The displacer/float shall be secured with a shipping clamp for protection. A warning label shall be attached to inform the operator that the clamp should be removed prior to start-up.

5.4 All level instruments in oxygen and chlorine service shall be separately packed along with a certificate indicating 'SUITABLE FOR OXYGEN / CHLORINE SERVICE', as applicable.

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टैंक लैवल इंस्ट्रूमेंटों के लिए मानक विनिर्देश

STANDARD SPECIFICATION FOR TANK LEVEL INSTRUMENTS

Rev. No	Date	Purpose	Prepared by	Checked by	Standards Committee Convenor	Standards Bureau Chairman
					Approved by	
5	20.10.22	Revised and Reissued as Standard Specification	GS/ JJ	SA	MN	SM
4	27.03.17	Revised and Reissued as Standard Specification	RK	AA	RG	RN
3	12.12.11	Revised and Reissued as Standard Specification	RSD	RG	RP/JMS	DM
2	31.03.06	Revised and Reissued as Standard Specification	AM	TGM	PM	VJN
1	15.01.97	Revised and Reissued as Standard Specification	RK	BRS	RB	AS

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Abbreviations:

AARH	:	Arithmetic Average Roughness Height
DCS	:	Distributed Control System
DPDT	:	Double Pole Double Throw
FMCW	:	Frequency Modulated Continuous Waves
MAWP	:	Maximum Allowable Working Pressure
MgO	:	Magnesium Oxide
NPT	:	National Pipe Thread
PTFE	:	Poly Tetra Fluoro Ethylene
RIU	:	Remote Interface Unit
RTD	:	Resistance Temperature Detector
SPDT	:	Single Pole Double Throw
SS	:	Stainless Steel
TFMS	:	Tank Farm Management System

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1.0 GENERAL

1.1 Scope

1.1.1 This specification, together with the data sheets describes the requirements for the design, materials, nameplate marking, documentation, inspection, testing and shipment of tank level instruments complete with accessories.

1.1.2 The related standards referred herein and mentioned below shall be of the latest edition of the following codes , standard practices and publications unless otherwise specified:

ASME	American Society of Mechanical Engineers	
	B 1.20.1	Pipe Threads General Purpose (Inch)
	B 16.5	Pipe Flanges and Flanged Fittings
	B 16.20	Metallic Gaskets for Pipe Flanges
	B 16.34	Valves - Flanged, Threaded and Welding ends
API	American Petroleum Institute	
	MPMS	Manual of Petroleum Measurement Standards- Chapter 7.4 Temperature Determination: Section 4- Dynamic Temperature Measurement Manual of Petroleum Measurement Standards- Chapter 3.1B Standard Practice for Level Measurement of Liquid Hydrocarbons in Stationary Tanks by Automatic Tank Gauging Manual of Petroleum Measurement Standards- Chapter 3.3 Standard Practice for Level Measurement of Liquid Hydrocarbons in Stationary Pressurized Storage Tanks by Automatic Tank Gauging
EN	European Standards	
	10204	Inspection Documents For Metallic Products
IS/IEC	Indian Standards/ International Electrotechnical Commission	
	IS/IEC 60079	Electrical Apparatus for Explosive Gas Atmospheres
	IS/IEC 60529	Degree of Protection Provided by Enclosures (IP Code)
	IEC 60587	Electrical insulating materials used under severe ambient conditions-Test methods for evaluating resistance to tracking and erosion
	IEC 61000-4	Electromagnetic Compatibility (EMC) for Industrial Process Measurement and Control Equipment
	IEC 61158-1	Industrial communication networks- Fieldbus specifications Part 1: Overview and Guidance for the IEC 61158 and IEC 61784 series
	IEC 61158-2	Industrial communication networks- Fieldbus specifications- Part 2: Physical layer specification and service definition
	IEC 61508	Functional Safety of Electrical/Electronic/Programmable Electronic Safety related Systems
	IEC 61511	Functional safety instrumented system for the process industry sector
OIML	International Organization Legal Meteorology	

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R85-1 & 2 Automatic level gauges for measuring the level of liquid in stationary storage tank. Part 1: Metrological and technical requirements. Part 2: Metrological control & tests

1.1.3 In the event of any conflict between this standard specification, Job Specifications/ data sheets, statutory regulations, related standards, codes etc., the following order of priority shall govern:

a) Statutory Regulations

b) Job Specifications/ Data Sheets

c) Standard Specification

d) Codes and Standards

1.1.4 In addition to compliance to purchaser's specification in totality, vendors extent of responsibility shall include the following:

a) Purchaser's data sheets specify the minimum acceptable materials for the wetted parts such as gauge head, float/ displacer, antenna, temperature element sensor/ water cut probe, Isolation ball valve, calibration chamber, etc. Alternate superior material of construction shall also be acceptable with the consent of purchaser provided vendor assumes complete responsibility for the selected materials for their compatibility with the specified fluid and its operating conditions.

b) Selection of proper type of antenna for radar type of tank level instruments based on the service and specified operating conditions.

c) Purchaser's data sheets specify the provision of still-well wherever envisaged. It shall be vendor's responsibility to verify the adequacy of still-well for the offered tank level instrument. Vendor shall also indicate the requirement of still-well for tanks/equipments where this is not indicated in the purchaser's data sheet.

1.2 Bids

1.2.1 Vendor's quotation shall be strictly as per the bidding instructions to vendor attached with the Material Requisition.

1.2.2 Vendor's quotation shall include the following:

a) Detailed specification sheets for each tank level instrument, which shall provide information regarding type, material of construction for body/ displacer/ float, type of antenna, specification of transmitter/ switch and accessories like ball valve, calibration chamber, multipoint temperature element, water cut probe, tank side indicator, remote interface unit, etc. as applicable. The material specifications and the units of measurement for various parts in vendor's specification sheet shall be to the same standards as those indicated in purchaser's data sheet.

b) Special cable required, if any, along with cable specifications and maximum allowable cable length between tank level instrument and remote interface unit.

c) Proven references for each offered model of tank level instrument in line with clause 1.2.3 of this specification.

d) A copy of approval from local statutory authority, as applicable such as Petroleum & Explosives Safety Organisation (PESO), Nagpur, India, for the electronic instruments installed in electrically hazardous area along with:

i) Test certificate from recognised test house like Central Institute of Mining and Fuel Research (CIMFR)/ Electronics Regional Testing Laboratory (ERTL) etc. for the specified hazardous protection class, as per relevant standard for all Indian manufactured equipments.

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ii) Certificate of conformity from agencies like Laboratorie Central Des Industries Electriques (LCIE), British Approval Service for Electrical Equipment in Flammable Atmospheres (Baseefa), Factory Mutual (FM), Physikalisch-Technische Bundesanstalt (PTB) , Canadian Standards Association (CSA), Underwriters Laboratories (UL) etc. for compliance to ATEX or other equivalent standards for all equipments manufactured outside India

e) Deviations on technical requirements, generally, shall not be entertained. In case vendor has any valid technical reason to deviate, they must include a list of deviations tag number wise, summing up all the deviations from the purchaser's data sheets and other technical specifications along with the technical reasons for each of these deviations.

f) Catalogues giving detailed technical specifications, model decoding details and other related information for each type of tank level instrument covered in the bid. In case catalogues do not provide all such technical details, vendor shall submit supplementary technical literature.

g) Two years operational spares for each level instrument and its accessories, which shall include electronic modules, output meter, antenna, temperature element, measuring wire/ tape, gaskets/o-ring, fuses etc. as a minimum.

h) Unit rate of any special cable.

i) Any special tools and tackles needed for maintenance work. In case no special tools are necessary for maintenance for the offered level instruments, vendor must certify the same in their offer.

1.2.3 All items, as offered, shall be field proven and should have completed operation for a period of minimum 6 months on the bid due date in the similar application with the process conditions similar to those as specified in the purchaser's data sheets. Items with proto-type design or items not meeting provenness criteria specified above shall not be offered.

1.2.4 All documentation submitted by vendor including their quotation, catalogues, drawings, installation, operation and maintenance manuals etc. shall be in English language only.

1.2.5 Whenever specified, vendor must furnish certified values of failure rates, Probability of failure on demand (PFD) with test intervals for offered items for safety integrity level (SIL) analysis.

1.3 Drawings and Data

1.3.1 Detailed drawings, data, catalogues and manuals required shall be submitted by the vendor as per vendor data requirements attached with the requisition.

1.3.2 Final documentation consisting of design data, installation manual, operation and maintenance manual, etc. shall be submitted by vendor after placement of purchase order as per vendor data requirements, shall include the following as a minimum:

a) Specification sheet for each level instrument and its accessories.

b) Certified drawing and technical catalogues for each level instrument which shall provide following details:

i) Orientation and distance between centre lines of connecting flanges (in case of mechanical float operated tank level instrument).

ii) Overall dimensions of the complete top work instrument in millimetres.

iii) Dimensions of displacer/ float/ antenna, water interface probe, temperature element, isolation ball valve and calibration chamber in millimetres.

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iv) Dimensions and mounting details of tank side instrument i.e. tank side indicator, power on-off switch, etc.

v) Still-well details, wherever required.

vi) Clearance space required for maintenance work.

vii) Wiring diagram for the complete assembly including terminal numbers and cable type.

c) Copy of type test certificates.

d) Copy of the test certificates for all tests indicated in clause 4.0 of this specification.

e) Installation procedure for tank level instruments and its accessories.

f) Calibration and maintenance procedure including replacement of internal parts wherever applicable.

2.0 DESIGN AND CONSTRUCTION

2.1 General requirements

2.1.1 The type of tank level instrument shall be as specified in purchaser's data sheet and shall be supplied with transmitter and tank side indicators.

2.1.2 The tank level instrument shall be suitable for the design pressure and temperature specified in the purchaser's data sheets.

2.1.3 Purchaser's data sheet specifies the size of still-well provided along with the tank equipment. Vendor shall include the supply of still-well in their scope (if specified in the Purchaser's datasheet) along with all mounting accessories, as necessary. Vendor to ensure guaranteed operational accuracy for the same.

2.1.4 Unless specifically indicated otherwise in the purchaser's data sheet, the material of construction of tank level instrument shall be as follows as a minimum:

a) All wetted metallic parts like float, displacer, tape, wire, etc. shall be of 316 SS and soft parts like seals, etc. shall be of PTFE.

b) Instrument top work consisting of instrument flange and measuring chamber shall be of stainless steel. Expander/ Reducer assembly, if required, shall also be of stainless steel.

c) Electronics housing shall be metallic only, e.g. of anodised aluminium.

2.1.5 Unless otherwise specified, the local digital readout provided at the gauge head and at tank side shall read in millimetre. All digital indicators shall have a test push button to check the illumination of all the seven segments of the indicator.

2.1.6 Each level instrument shall be provided with a power on-off switch, which shall be located near the tank side indicator.

2.1.7 In general, tank level instrument shall be configurable either from gauge head/ tank side indicator/ RIU or from a separate configurator/ Universal Hand Held communicator.

In case Vendor's offered instruments are not able to accept commands from Purchaser's Universal Hand Held communicator and Vendor has his own proprietary communicator, vendor shall supply minimum one number of configurator unless otherwise specified in the purchaser's datasheets. This requirement shall not be applicable for float operated tank level instruments.

2.1.8 The design of electronic instruments shall be in compliance with the electromagnetic compatibility requirements as per IEC 61000-4.

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Whenever specifically indicated in purchaser's datasheets, the meter electronics shall be provided with in-built lightning and power supply surge protectors. The transient protection shall meet the requirements specified in IEC 60587.

2.1.9 End Connection

2.1.9.1 Tank level instruments shall be flanged type with size and rating as specified in purchaser's data sheet.

2.1.9.2 In case end connection of vendor's standard instrument is different than that specified in the purchaser's data sheet, vendor shall include the required expander/ reducer assembly in their scope of supply.

2.1.9.3 Unless otherwise specified, end connection details shall be as below:

a) Threaded end connections shall be to NPT as per ASME B1.20.1.

b) Flanged end connections shall be as per ASME B 16.5.

c) Flange face finish shall be as per ASME B16.5. The face finish shall be as follows:

125 AARH : 125 to 250 micro inch AARH

63 AARH : 32 to 63 micro inch AARH

2.1.10 Power Supply

a) Unless otherwise specified, the tank level instrument shall be suitable to operate at power supply level of 110V AC/ 240V AC, 50Hz UPS.

b) The supply voltage fluctuation of ±10% and supply frequency fluctuation of ±3Hz from the specified value, shall not affect the instrument performance.

c) Two wire 24V DC loop powered, Intrinsically Safe level transmitters are also acceptable. In case 24V DC loop powered intrinsically safe radar level instruments are provided, separate power supply will not be provided by Purchaser.

2.1.11 Whenever the purchaser's data sheet indicates the requirement of switch assembly, it shall meet the following requirements:

a) The switch assembly shall be integral to the gauge head/ tank side indicator.

b) The switch assembly shall provide one set of DPDT (or two sets of SPDT) contacts.

c) Unless otherwise specified, the contacts shall be rated as follows:

For explosion proof application: 2A, 110V DC

For Intrinsically safe application: 0.5A, 30V DC

All switch contacts shall be Silver plated. Switch contacts in intrinsically safe circuit shall be suitable for the application.

d) The alarm set points shall be freely configurable.

2.1.12 Terminal Housing

a) The terminal housing shall be suitable for the area classification indicated in the purchaser's data sheets. Unless otherwise specified, the enclosure shall comply with the following requirements as a minimum:

Weather proof housing: IP 65 as per IS/IEC-60529

Intrinsic Safe: IS/IEC-60079

Flameproof housing: Flameproof/ Ex (d) as per IS/IEC-60079

Flameproof housing shall also be made weather proof.

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b) All cables shall terminate on the terminal blocks in all vendor supplied equipments including gauge head, tank side indicator, power switch, temperature element, water probe, transmitter etc. Separate terminal blocks shall be provided for power and signal cables. Unless otherwise specified, terminals shall be suitable for terminating following conductor sizes, as a minimum:

Signal cables : 2.5 sq. mm

Power cables : 6 sq. mm

Separate terminal box shall be provided in case instrument terminals available as standard are not suitable to accommodate the specified conductor sizes.

2.1.13 Accessories and Interconnections

a) All accessories including mounting brackets required for installation of tank gauges and tank side indicator shall be supplied by vendor.

b) All signal cables/ power cable and related accessories like junction boxes, cable glands, etc., required for interconnection between gauge head, tank side indicator, power on-off switch, multipoint temperature element and water probe, calibration facility, etc. shall be supplied by the vendor. Unless specified otherwise, Signal or Power Cable of length equal to Range/ Height of the tank to be measured as indicated in the respective data sheet + Circumference of the respective tank + 15 meter shall be supplied by the vendor.

c) All junction/ terminal boxes, power on-off switches, cables glands etc. shall meet the requirements specified in the clause no. 2.1.12 (a) of this specification.

2.2 Float Operated Tank Level Instruments

2.2.1 Unless otherwise specified, float type tank level instrument shall have level accuracy of ±2 mm.

2.2.2 Purchaser shall provide three (3) numbers of nozzles on the tank top each of 1½" flanged with rating as specified in the purchaser's data sheet. Vendor supplied instrument shall suit the above nozzle sizes.

2.2.3 The anchor bar shall be welded to the tank bottom. Instrument designed with unwelded solid Weights holding the guide wires taut at the tank bottom shall not be supplied.

2.2.4 Springs of spring housing assemblies shall be cadmium or nickel plated, as a minimum.

2.2.5 Where liquid seals have been specified, vendor shall select a suitable fill fluid which is compatible with the process fluid.

2.2.6 For tank level measurements in pressurised tanks/ equipments where purchaser's data sheet does not specify liquid seal, the tank side indicator shall have inbuilt sealing to avoid ingress of process vapours in the tank side indicator.

2.2.7 Vendor shall be responsible to supply complete pipe work and related fittings from tank top to tank side indicator. The pipes shall be hot dip galvanised, as a minimum.

2.2.8 Unless otherwise specified, the transmitter shall provide 4-20 mA output from the tank side indicator.

2.2.9 Float of tank level instrument shall be designed considering:

a) The specific gravity of upper and lower fluids.

b) Design pressure/ temperature condition specified in the data sheets.

c) Internal diameter of the equipment nozzle and still-well.

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2.3 Servo Operated Tank Level Instruments

2.3.1 All servo operated tank level instruments shall be installed on a 6" flanged equipment nozzle with still-well of size 12". Still-well shall be having 20mm diameter hole and every hole turned 180 deg with 500mm equal space between 2 holes for entire pipe length. Vendor to ensure guaranteed operation accuracy for the same. The flange rating of the equipment flange shall be as per purchaser's data sheet.

2.3.2 The requirement and specifications of isolation ball valve shall be specified in the respective data sheets. For pressurized equipment, isolation ball valve shall be considered. Unless specified otherwise, the isolation valve shall be full bore ball type of 6" size. Minimum Body Wall Thickness shall not be less than as specified in ASME B16.34.

2.3.3 Material of construction of drum housing/ drum chamber compartment shall be stainless steel, as a minimum.

2.3.4 Each servo level instrument shall be provided with a calibration chamber with a viewable window of blast proof glass. The calibration chamber can be either integral to the instrument or separate. Whenever calibration chamber is separate i.e. not integral to the tank level instrument, the material of construction of calibration chamber shall be stainless steel. The calibration chamber shall also permit insertion/ removal of displacer for maintenance without removing the instruments.

2.3.5 Raising or lowering of displacer for calibration shall be possible on-line with the design of still-well indicated in the material requisition.

2.3.6 As a standard, high and low level limit stop shall be provided to prevent the level sensor from being driven beyond the working range.

2.3.7 The instrument measurement shall not be sensitive to pressure variation seen by the instrument in the measuring chamber.

2.3.8 It shall be possible to raise or lower the displacer remotely i.e. from tank side indicator. Where the level instrument is serially interfaced to remote interface unit, this facility shall also be available at the remote interface unit.

2.3.9 The servo type tank level transmitter shall be capable of providing the following outputs,

a) Serial output as per vendor standard protocol for communication to vendor supplied RIU.

b) 1 No. of Analogue 4-20 mA DC current output and 1 No. of Relay output.

However, the output as required from the servo type level instrument shall be as specified in purchaser's data sheet.

2.3.10 The tank level instrument shall be capable of accepting input from multi element tank temperature sensors (either thermocouple or resistance temperature detectors), water cut probes (to measure water interface level) and transmit the same as a part of serial signal from the transmitter.

The tank level instrument electronics shall automatically determine the average termperature by identifying;

a) All the submerged elements in case of spot type sensors.

b) Longest fully submerged temperature element in case of variable length type sensor.

In case, the vendor standard tank level instrument does not meet this requirement separate field mounted electronics shall be offered to meet this requirement.

2.3.11 The servo level instrument shall be capable of measuring product density. This data whenever required shall be transmitted as per user selection as a part of serial signal.

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2.3.12 Performance Requirements

The accuracy of servo type of tank level instrument inclusive of linearity, repeatability and hysteresis shall be as follows:

a) Level accuracy shall be ± 3mm for process vessels/ storage tanks over the entire vessel/ tank height.

b) Level accuracy shall be ± 1 mm for TFMS/ custody transfer applications over the entire tank height.

c) Density accuracy shall be ±0.005 gm/cc over the complete set density range.

2.3.13 Displacer of tank level instrument shall be designed considering:

a) The specific gravity of upper and lower fluids.

b) Design pressure/ temperature condition specified in the data sheets.

c) Internal diameter of the equipment nozzle and still-well.

2.4 Radar type Tank Level Instrument

2.4.1 Vendor shall select suitable type of antenna for the specified process conditions including pressure, temperature, dielectric constant, viscosity and performance requirements.

2.4.2 For TFMS application, radar type level instruments shall be based on FMCW (Frequency Modulated Continuous Waves) principle.

2.4.3 Purchaser's data sheet indicates the nozzle size and rating of the equipment for radar type of level instrument. The size and rating of the tank level instrument shall be same as the tank nozzle requirement specified in the purchaser's data sheet.

2.4.4 The radar type tank level transmitters shall be capable of providing following outputs:

a) Serial output as per vendor standard protocol for communication to vendor supplied RIU.

b) 1 No. of Analogue 4-20 mA DC current output and 1 No. of Relay output.

c) The radar type tank level instrument shall be suitable for measuring the entire tank height indicated in the data sheets.

However, the output as required shall be specified in the purchaser's data sheets.

2.4.5 The tank level instrument shall be capable of accepting inputs from averaging type of tank temperature sensors (either thermocouple or resistance temperature detectors), water cut probes (to measure water interface level) and transmit the same as part of serial signal from the transmitter.

The tank level instrument electronic shall automatically determine the average temperature by identifying;

a) All the submerged elements in case of spot type sensors.

b) Longest fully submerged temperature element in case of variable length type sensor.

In case, the vendor standard tank level instrument does not meet this requirement separate field mounted electronics shall be offered to meet this requirement.

In addition to temperature sensor inputs, the transmitter shall also be capable of accepting water probe input and pressure transmitter input, carry-out calculations and transmit the signals as required, as part of serial interface.

2.4.6 For pressurised liquefied gas level measurement, the tank level instrument having built-in pressure transmitter in place of separate pressure transmitter is also acceptable. Calibration facility shall be provided for the on-line verification of the level instrument.

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2.4.7 Performance Requirements

The accuracy of radar type of tank level instruments inclusive of linearity, repeatability and hysteresis shall be as follows:

a) Level accuracy shall be ± 3 mm for process vessels/ storage tanks over the entire vessel/ tank height.

b) Level accuracy shall be ± 1 mm for TFMS/ custody transfer applications over the entire tank height.

2.4.8 Non-Contact Radar Instrument process connections shall be as follows:

Process Vessels: For process vessels, instruments shall have process connection of 6" size with still-well (if required) of size 4", Sch. 40, SS metallurgy. Vendor to provide long studs & nuts as per purchaser's data sheets for mounting of Radar level instruments.

Atmospheric tanks (clean service): For atmospheric tanks with clean service, instruments shall have process connection of 8" size with still-well of size 8", Sch.60 (for tanks having corrosion allowance of 1 mm)/ Sch.80 (for tanks having corrosion allowance of 3 mm), CS metallurgy. Still-well shall be having 20mm diameter holes and every hole turned 180 deg with 500mm equal space between 2 holes for entire pipe length. For tanks with metallurgy other than CS, still-well shall be provided with metallurgy as per tank metallurgy.

Pressurized equipment (mounded bullets/ spheres): For Pressurized equipment, instruments shall have process connection of 8" size with still-well of size 6" or 4", Sch.40, SS metallurgy. Still-well shall be having 20mm or 5mm diameter hole on one side of still-well with 500mm equal space between 2 holes for the entire length of the still-well. Still-well size and diameter of holes shall be as per Radar instrument vendor specific requirements. Vendor to provide long studs & nuts as per purchaser's data sheets for mounting of Radar level instruments.

Tanks with viscous service: For tanks with viscous service with design temperature above 110 degC, instruments shall have process connection of 24" size. In case instrument end connection size offered by Radar vendor differs from the process connection size of 24", then suitable assembly matching with purchaser's process nozzle connection size shall be provided by Radar vendor.

Vendor to ensure guaranteed operation accuracy for the above.

2.4.9 For Radar instruments on atmospheric tanks, Isolation ball valves are not a mandatory requirement. However, for Radar instruments on pressurized equipments, Isolation ball valves shall be provided by the radar instrument vendor.

The performance of the radar instrument shall not be affected due to the isolation ball valve.

2.5 Remote Interface Unit (RIU)

2.5.1 Remote interface unit shall be microprocessor based programmable device capable of accepting data from the tank level instruments over a serial network.

2.5.2 The remote interface unit shall have a display unit and a keyboard for operation, maintenance and configurational requirements of tank level instrument.

2.5.3 Remote interface unit shall facilitate the following operational requirements;

a) Communication between field level instruments and purchaser's host system.

b) Ensure data integrity through data security control.

c) Provide to display for the following:

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i) Process parameters like level, temperature, density and water interface as applicable.

ii) Diagnostic alarms of tank level instruments.

iii) Command display for tank level instruments.

iv) Mode display.

Separate personal computer shall be provided if the interface unit does not have built-in display and/ or keyboard as per specifications.

d) Hoisting mechanism for servo type tank level instruments for verification of level calibration, density measurement and interface level measurement.

e) Calibration of any level instrument connected to the interface units.

2.5.4 Interface unit shall provide a redundant serial output with MODBUS RTU RS-485/ MODBUS TCP-IP protocol for interface with host. All remote interface units shall be hot standby redundant.

2.5.5 Interface unit shall be supplied complete with all hardware and software capable of monitoring and system diagnostics. Zero checking of the level instruments shall also be possible from remote interface unit. Vendor shall provide at least 20% (minimum one) spare port in each remote interface unit.

2.5.6 The remote interface units shall be supplied pre-installed and pre-wired in free standing interface unit cabinets unless specified otherwise in the material requisition.

2.6 Tank-side Indicator

2.6.1 Tank-side indicator shall provide a digital LED/ LCD display and shall display the following information:

a) Display for level, density and interface level, as applicable in specified engineering units, for the type of tank level instrument.

b) Average tank temperature when multipoint temperature elements are also installed along with the tank level instrument.

c) Status of tank level instruments including diagnostics information.

The parameter to be displayed shall be selectable from the tank side indicator or through separate hand held terminal.

2.6.2 A test switch shall be available with tank side indicator to test the integrity of display. Where no switch is provided, the testing should be possible from a hand held terminal.

2.6.3 Unless specifically indicated otherwise, both certified intrinsically safe or explosion proof tank side indicator shall be acceptable for hazardous area installation.

2.6.4 Tank side indicator shall be located at grade (tank side) and suitable for 2" pipe mounting. Accessories required for pipe installation shall be supplied by the vendor.

2.7 Water Interface Sensor

2.7.1 Whenever specified, vendor shall offer an independent water interface sensor which shall be capable of measuring interface between water and oil. An integrated water interface-cum-temperature probe shall be offered when specified.

2.7.2 The water interface sensor/ probe shall be suitable for the pressure and temperature conditions specified in the purchaser's data sheet.

2.7.3 The length of water interface level probe shall be as specified in the data sheet.

2.7.4 Unless otherwise specified, the material of construction of wetted parts i.e. sensor/ probe, insertion rope/ wire etc. shall be SS 316, as a minimum.

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2.7.5 The water interface probe shall be top mounted with end connections as 3" flanged. The rating and type of flange shall be as specified in the data sheet.

2.7.6 The sensor/ probe shall have suitable anchoring facility to it straight and avoid its transverse movement.

2.7.7 The sensor shall be connected to either tank level instrument electronics or to a separate electronics as per vendor standard product.

2.7.8 Performance Requirements:

The water interface measurement shall meet the following performance requirements:

Accuracy: ± 0.3% of full scale

Repeatability: ± 0.1% of full scale.

2.8 Multi-Element Tank Temperature Sensor

2.8.1 Multi-element tank temperature sensor, when specified, shall be used for measurement of average temperature in the equipment/ tank. An integrated water interface level-cum-temperature element shall be offered when specified.

2.8.2 The multi-element temperature element shall be multiple spot type with type of temperature elements as RTD type Pt100 or Thermocouple type 'E' or combination of RTD & Thermocouple.

Other type of elements can also be offered provided they meet the performance requirements specified in clause 2.8.8 of this specification.

2.8.3 The length of the multi element temperature sensor shall be decided based on the equipment/ tank height. However number of elements within the temperature sensor shall meet the following requirements.

2.8.3.1 Unless otherwise specified in the purchaser's data sheets, the number of temperature elements in case of spot type multi-element temperature sensor shall be as follows:

a) The first element i.e. the bottom most element shall not be placed more than 1000 mm above the tank bottom.

b) All elements, other than the first element, shall be located typically at every 10% of the tank height with minimum and maximum distance between two successive elements as 1000 mm and 3000 mm respectively.

2.8.3.2 Unless otherwise specified in purchaser's data sheets, the number of elements in case of variable length type temperature sensor shall be provided based on the lengths indicated in Table 2 of API MPMS chapter 7.4.

2.8.4 Each temperature element shall be MgO filled with SS sheath. All elements within the temperature sensor shall be bundled together within a flexible protection tube. The material of construction of protection tube shall be SS 316, unless otherwise specified.

2.8.5 The end connections for the installation of temperature element on the equipment/ Tank shall be 3" flanged, unless otherwise specified, with rating and type as indicated in purchaser's data sheet. The flange material shall be SS 316, unless otherwise specified.

Provision of anchoring the free-end of the temperature element shall be provided either by providing

a) Anchoring weights of suitable size. The material of construction of weights shall be SS 316, as a minimum.

b) Bolted anchor, when specifically indicated or whenever integrated water interface-cum-temperature sensor is specified.

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2.8.6 For atmospheric tanks (clean service), temperature element shall be installed in a Still-well of size 3", Sch.80, CS metallurgy. Still-well shall be having 20mm diameter holes and each hole turned 180 deg with 500mm equal space between 2 holes for entire pipe length. For tanks with metallurgy other than CS, still-well shall be provided with metallurgy as per tank metallurgy.

For pressurized tanks, temperature element shall be installed in a Still-well of size 3", Sch.40, SS metallurgy. Still-well shall be closed (without any holes) up to bottom.

Vendor to ensure guaranteed operation accuracy for the same.

Wherever an integrated water interface level-cum-temperature element has been specified, end connection flange and still-well shall be common for water interface sensor/ probe and multi-element temperature sensor.

2.8.7 The multi-element temperature sensor shall be connected to either tank level instrument electronics or to a separate electronics as per vendor standard product.

2.8.8 Performance Requirements

Unless otherwise specified the multi-element temperature sensor shall have a measurement accuracy of ±0.5°C throughout its measurement range.

3.0 NAMEPLATE

Each tank level instrument & its accessories shall have a stainless steel nameplate attached firmly to it at a visible place, furnishing the following information:

a) Tag number as per purchaser's data sheet.

b) Item Description (E.g. "LEVEL INSTRUMENT")

c) Manufacturer's serial number and model number.

d) Manufacturer's name/trade mark.

e) Range of level measurement in millimetres.

f) Nominal end connection size in inches and rating.

g) Area classification for which the equipment is certified for installation.

h) Hazardous area certification number & marking.

i) Operating Power supply voltage and frequency.

4.0 INSPECTION AND TESTING

Purchaser reserves the right to inspect and witness testing at vendor's works as per Inspection Test Plan for Tank level instruments. All these tests shall be completed by the vendor and test reports shall be submitted to Purchaser and inspection agency for scrutiny.

5.0 SHIPPING

5.1 All threaded and flanged openings shall be suitably covered and protected to prevent entry of foreign material.

5.2 All the items comprising a tank level indicator system shall be individually packed and shipped in the same crate.

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मैगनेटिक लैवल यन्त्रों के लिए मानक विनिर्देशन

STANDARD SPECIFICATION FOR MAGNETIC LEVEL INSTRUMENTS

Rev. No	Date	Purpose	Prepared by	Checked by	Standards Committee Convenor	Standards Bureau Chairman
					Approved by	
3	11.11.21	Revised and Reissued as Standard Specification	IJS/ SKG	RS	MN	SM
2	21.03.17	Revised and Reissued as Standard Specification	SG	RS	RG	RN
1	15.11.11	Revised and Reissued as Standard Specification	SM	RG	RP/JMS	DM
0	07.03.06	Issued As Standard Specification	NPG	RKA	PM	VJN

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Abbreviations:

AARH	Arithmetic Average Roughness Height
HART	Highway Addressable Remote Transducer
NPT	National Pipe Thread

Instrumentation Standards Committee

Convenor : Mr. Mainak Nandi

Members :
Mr. Arupjyoti Saikia
Mr. Sachin Garg
Mr. Jerry Johnson
Mr. Mayank Kaushik
Mr. Saurav Mukherjee
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Mr. R.K. Gupta (Projects)

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1.0 GENERAL

1.1 Scope

1.1.1 This specification, together with the data sheets, covers the requirements for design, materials, nameplate marking, inspection, testing and shipping of magnetic level instruments and its accessories.

1.1.2 The related standards referred to herein and mentioned below shall be of the latest editions prior as on the date of purchaser's enquiry:

ASME	American Society of Mechanical Engineers.	
	B 1.20.1	Pipe Threads, General Purpose (Inch).
	B 16.5	Pipe Flanges and Flanged Fittings.
	B 16.20	Metallic Gaskets for Pipe Flanges
	B 16.34	Valves - Flanged, Threaded and Welding ends
	B 31.3	Standards of Pressure Piping, Process Piping
ANSI / NACE	American National Standards Institute / National Association of Corrosion Engineers	
	MR0175 / ISO-15156	Petroleum and natural gas industries-Materials for use in H2S containing environments in oil and gas production
EN	European Standards	
	10204	Inspection Documents for Metallic Products
IS/IEC	Indian Standards/ International Electro technical Commission	
	60079	Electrical Apparatus for Explosives Gas Atmosphere.
	60529	Degree of Protection Provided by Enclosures. (IP Code)
	61000-4	Electromagnetic Compatibility (EMC) for Industrial Process Measurement and Control Equipment.
	61158	Fieldbus Standard for use in Industrial Control System
	61158-2	Physical Layer Specification and service definition for Fieldbus
	61508	Functional Safety of Electrical / Electronic / Programmable Electronic safety related system.
IBR	Indian Boiler Regulation	

1.1.3 In the event of any conflict between this specification, data sheets, related standards and codes, the following order of priority shall govern:

a) Statutory Regulations

b) Job Specifications/ Data Sheets

c) Standard Specification

d) Codes and Standards

1.1.4 In addition to compliance to purchaser's specifications in totality, vendors' extent of responsibility shall include the following:

a) Purchaser's data sheets indicate the materials of chamber, float and accessories. Alternate superior material of construction shall also be acceptable with the consent of purchaser, provided vendor assumes complete responsibility for the selected materials for their compatibility with the specified fluid and its operating conditions.

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1.2 Bids

1.2.1 Vendor's quotation shall be strictly as per the bidding instructions to the vendor attached with the material requisition.

1.2.2 All items, as offered, shall be field proven and should have completed operation for a period of minimum 6 month on the bid due date in the similar application with the process conditions similar to those as specified in the purchaser's data sheets. Items with proto-type design or items not meeting proven ess criteria specified above shall not be offered.

1.2.3 Whenever specified, vendor must furnish tested values of failure rates, probability of failure detection and test interval for the safety integrity level analysis.

1.2.4 All documentation submitted by the vendor including their quotation, catalogues, drawings, installation, operation and maintenance manuals, etc shall be in English language only.

1.2.5 Vendor shall also quote for two-year operational spares for each model of instruments offered in the bid, which shall include float, magnets, followers, electronic module, local indicator, o-ring/gasket set etc., as a minimum.

1.3 Drawings and Data

1.3.1 Detailed drawings, data, catalogues and manuals required shall be submitted by the vendor as per Vendor data requirement attached with the requisition

1.3.2 Final documentation consisting of design data, installation manual, operation and maintenance manual, etc submitted by the vendor after placement of purchase order shall include the following, as a minimum:

a) Specification sheet for each magnetic level instrument and its accessories.

b) Certified drawing sheets for each magnetic level instruments which shall provide following details;

i) Overall dimensions of the completely assembled instrument in millimetres.

ii) Distance between centre lines of connecting flanges.

iii) Dimensions of clearance space required for maintenance work.

iv) Float dimensions

v) Weight of magnetic level instrument.

c) Copy of type test certificates.

d) Copy of test certificates for all the tests as indicated in clause 4.0 of this specification.

e) Installation procedure for each magnetic level instrument.

f) Calibration and maintenance procedure including replacement of parts/internals, wherever it is applicable.

2.0 DESIGN AND CONSTRUCTION

2.1 General

2.1.1 Instruments shall be supplied in ready to install condition. No hot work/welding shall be carried out on the instrument at site.

2.1.2 Centre-to-centre length of magnetic level instrument is specified in the purchaser's data sheet. Vendor shall select the length of the magnetic level instrument based on the specified centre-to-centre distances.

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2.1.3 Any gasket used in the assembly of the instruments shall be spiral wound type only with suitable filler material. Compressed asbestos fibre (CAF) gaskets shall not be used.

2.1.4 Orientation of measurement scale for the offered magnetic level instruments shall be site adjustable to any angle without any hot work/welding.

2.1.5 The design shall ensure that the magnetic properties of the applicable parts of the magnetic level instruments shall not degrade under the influence of the design temperatures given on the data sheets.

2.2 Body

2.2.1 Unless otherwise mentioned, end connection details shall be as below:

a) Threaded end connections shall be to NPT as per ASME B 1.20.1.

b) Flanged end connections shall be as per ASME B 16.5.

c) Grooves of ring type joint flanges shall be octagonal as per ASME B16.20.

d) Flanged face finish shall be as per ANSI B 16.5. The face finish shall be as follows:

125 AARH : 125 to 250 microinch AARH

63 AARH : 32 to 63 microinch AARH

2.2.2 Gaskets, bolts and nuts shall be suitable for the service conditions indicated.

2.2.3 Where the magnetic level instrument is specified as external mounting type, the instrument shall be provided complete with the external cage (float chamber). Chamber shall be designed as per ANSI B31.3.

2.2.4 Whenever the float chamber (cage) is fabricated out of pipe, only seamless pipe shall be used.

2.2.5 The float chamber shall be SS316, unless the service requires additional corrosion protection.

2.2.6 With SS316 chamber, stainless steel flanges shall be used or of material required by the applicable piping material specification.

2.2.7 Process connection shall be 2" or 3" flanged as per data sheet. C-to-C length of single magnetic level gauge shall not be more than 2500 mm, unless otherwise specified in the datasheet.

2.2.8 Whenever steam jacketing requirement is specified in requisition, the steam inlet and outlet flange connection shall be as per respective datasheets of the requisition.

2.2.9 Float chamber (or cage) shall be provided with ¾" NPT(F) vent and drain connections shall be provided with metallic plug on end cover flanges. The design shall also facilitate float removal.

2.2.10 For 900# and above rating, threaded fitting end for drain and vent shall be suitable for specified temperature and pressure as indicated in datasheets.

2.3 Float

2.3.1 The float and chamber material shall be non-magnetic type. Actual material of construction shall be as specified in data sheets, as a minimum.

2.3.2 Titanium float instead of SS316/ SS316L/ SS321/ SS347 float can be provided by the vendor provided it is suitable for the process fluid and conditions.

2.3.3 Float chamber shall be provided with travel stops at both end of travel to ensure no mechanical damage to the float.

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2.3.4 Float design i.e. its type, size and material requirements shall consider worst case process conditions also, like specific gravity, temperature and pressure specified in the data sheet.

2.3.5 Mechanism to prevent float rotation and float damage due to rubbing against the chamber wall shall be provided.

2.3.6 The floats shall be stamped with same tag number as level gauge along with the density of the float.

2.4 Indicating/Transmitting Mechanism

2.4.1 For external mounted magnetic level instruments, the rolling magnet type of indication with red and white colour (with red colour indicating the level) shall be preferred for instrument indication. Ball-follower type of indicator shall be provided when specified. Measuring scale shall be linear type.

2.4.2 For internal mounted magnetic level instruments, dial type top mounted indicator (minimum 150mm diameter) shall be preferred. However, other type of indication i.e. rolling magnet or ball follower type shall be provided, when specified.

2.4.3 For internal mounted magnetic level instruments, float chamber and mechanism chamber shall be separable with a flange connection.

2.4.4 Electronic transmitter shall be two (2) wire microprocessor based and shall be capable of providing 4-20 mA analog output superimposed with diagnostic data in digital mode (i.e. HART output). It shall be protected against short circuit and reverse voltage. Output indicator shall be calibrated for 0-100 linear scale. When specified, magnetic level transmitter shall provide field bus output conforming to the standard specified in the Purchaser's specification sheet.

2.4.5 For smart transmitters with HART output or for fieldbus based transmitter the following features must be ensured:

i) It shall allow multi master (primary and secondary) for configuration, calibration, diagnosis and maintenance. The primary could be the control system or host computer, and the secondary could be the hand-held communicator.

ii) It shall be capable of implementing universal command.

2.4.6 It shall be possible to perform routine configuration, calibration, display process variable, diagnostics etc. from a hand-held portable configurator / tester, which can be connected at any location in the transmitter loop. It shall be possible to perform all the above functions on-line. The loop function shall remain unaffected while communication is going on between transmitter and the field communicator.

There should be no interruption on the output while communicating with the transmitter.

2.4.7 The design of electronic instruments shall be in compliance with the electromagnetic compatibility requirements as per IEC 61000-4 and shall be immune to RFI and EMI radiation.

2.4.8 Unless otherwise specified, transmitters shall be intrinsically safe type. Transmitter's enclosure shall be metallic and shall have corrosion protection coating. Instrument enclosure shall be suitable for the area classification indicated in the purchaser's data sheets. All electronic boards/ cards shall have conformal coating suitable for corrosion protection normally prevalent in refinery. The enclosure shall meet the following standards:

Weatherproof housing : IP-65 to IS/IEC-60529

Flameproof housing : Flameproof/ Ex (d) as per IS/IEC-60079

Flameproof housing shall also be made weatherproof.

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2.4.9 Wherever transmitter is used, a copy of approval from local statutory authority, as applicable, shall be furnished, such as Petroleum & Explosives Safety Organisation (PESO) in India, for the electronic instruments installed in electrically hazardous area along with:

i) Test certificate from recognised test house like Central Institute of Mining and Fuel Research (CIMFR) / Electronics Regional Testing Laboratory (ERTL) etc. for flameproof enclosure/intrinsic safety, as specified in the data sheet, as per relevant standard for all Indian manufactured equipments.

ii) Certificate of conformity from agencies like Laboratorie Central Des Industries Electriques (LCIE), British Approval Service for Electrical Equipment in Flammable Atmospheres (Baseefa), Factory Mutual (FM), Physikalisch-Technische Bundesanstalt (PTB), Canadian Standards Association (CSA), Underwriters Laboratories (UL) etc. for compliance to ATEX directives or other equivalent standards for all equipments manufactured outside India

2.4.10 Performance Requirements

Unless specified otherwise the measurement accuracy and scale resolution shall be better than ± 10 mm.

3.0 NAME PLATE

3.1 Each special level instrument shall have a stainless-steel nameplate attached firmly to it a visible place, furnishing the following information:

a) Instrument Tag number as per purchaser's data sheet.

b) Manufacturer's name, model number and serial number.

c) Nominal end connection in inches and rating in pounds.

d) Material of construction for chamber, float and magnet.

e) Measurement range.

f) Output type.

g) Certificate for area classification.

4.0 INSPECTION AND TESTING

4.1 Purchaser reserves the right to inspect and witness testing of all the items at the vendor's works in line with the inspection test plan and approved quality documents for magnetic level instruments. All these tests shall be completed by the vendor and test reports shall be submitted to Purchaser for scrutiny.

5.0 SHIPPING

5.1 The magnetic level instrument and its accessories if any, shall be supplied pre-assembled.

5.2 All threaded and flanged openings shall be suitably protected to prevent entry of foreign material.

5.3 The float shall be secured with a shipping clamp for protection. A warning label shall be attached to operator that the clamp should be removed prior to start-up.

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प्रैशर रिलीफ वॉल्वों के लिए मानक विनिर्देश

STANDARD SPECIFICATION FOR PRESSURE RELIEF VALVES

Rev. No	Date	Purpose	Prepared by	Checked by	Standards Committee Convenor	Standards Bureau Chairman
					Approved by	
5	06.09.21	Revised and Reissued as Standard Specification	ASG/MK	NK	MN	SM
4	25.07.16	Revised and Reissued as Standard Specification	MK	SB	RG	RN
3	29.11.10	Revised and Reissued as Standard Specification	RK	RG	TGM/JMS	ND
2	02.05.05	Revised and Reissued as Standard Specification	RP	HCJ	PM	VJN
1	15.09.97	Revised and Reissued as Standard Specification	RK	BRS	RB	AS

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Abbreviations:

AARH	:	Arithmetic Average Roughness Height
NPT	:	National Pipe Thread

Instrumentation Standards Committee

Convener : Mr. Mainak Nandi

Members :
Mr. Arupjyoti Saikia
Mr. Sachin Garg
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1.0 GENERAL

1.1 Scope

1.1.1 This specification, together with the data sheets describes the requirements for the design, materials, fabrication, documentation, nameplate marking, inspection, testing and shipment of pressure relief valves.

1.1.2 The related standards referred herein and mentioned below shall be of the latest edition of the following codes, standard practices and publications, unless otherwise specified-

ANSI/NACE	American National Standard Institute/ National Association for Corrosion Engineers	
	MR0175/ ISO-15156	Petroleum and natural gas industries-Materials for use in H2S-containing environments in oil and gas production
API	American Petroleum Institute	
	520	Sizing, Selection and Installation of Pressure Relieving Devices in Refineries. Part I Sizing & Selection Part II Installation
	521	Guide for Pressure Relieving and Depressurising Systems.
	526	Flanged Steel Pressure Relief Valves.
	527	Seat Tightness of Pressure Relief Valves.
ASME	American Society of Mechanical Engineers.	
	B 1.20.1	Pipe Threads General Purpose (Inch).
	B 16.5	Pipe Flanges and Flanged Fittings
	B 16.20	Metallic Gaskets for Pipe Flanges
	B 16.34	Valves- Flanged, Threaded and Welding End
	Sec-VIII	Boiler and Pressure Vessels Code Section VIII 'Pressure Vessels'
	Sec-XIII	Boiler and Pressure Vessels Code Section XIII 'Overpressure Protection'
	Sec-I	Boiler and Pressure Vessels Code. Section-I 'Power Boilers'
EN	European Standards	
	10204	Inspection Documents For Metallic Products.
IBR	Indian Boiler Regulations	

1.1.3 In the event of any conflict between this specification, data sheets, related standards and codes, the following order of priority shall govern:

a) Statutory Regulations

b) Data Sheets

f) Standard Specification

g) Codes and Standards

1.1.4 In addition to compliance to purchaser's specifications in totality, vendor's extent of responsibility shall include the following;

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a) Purchaser's data sheets indicate the type, size, relieving area etc. of the selected valve. However, vendor shall be responsible to size and select the proper valve with orifice relieving area meeting the indicated operating conditions.

b) Purchaser's data sheets specify the acceptable materials for body, bonnet, disc, nozzle, spring, bellows etc. Alternate superior material of construction shall also be acceptable provided vendor assumes complete responsibility for the selected materials for their compatibility with the specified fluid and its operating conditions.

1.2 Bids

1.2.1 Vendor's quotation shall be strictly as per the bidding instructions to vendor attached with the Material Requisition.

1.2.2 Vendor's quotation shall include the following:

a) Detailed specification sheet for each item which shall provide information regarding type, construction materials, sizing code, inlet and outlet type, size and rating, relieving area, relieving capacity, orifice letter designation, overpressure, blow down, operating pressure etc. and any other valve accessories. The material specifications and units of measurement for various items in vendor's specification sheets shall be to the same standards as those indicated in purchaser's data sheets.

b) ASME certificate for discharge co-efficient or ASME certified capacity curves to be submitted along with offer.

c) Proven references in line with clause 1.2.3 of this specification whenever specifically indicated in purchaser's specifications.

d) Deviations on technical requirements shall not be entertained. In case vendor has any valid technical reason to deviate, they must include a list of deviations tag number wise, summing up all the deviations from the purchaser's data sheets and other technical specification along with the technical reasons for each of these deviations.

e) Catalogues giving detailed technical specifications (i.e. available sizes, ratings, sizing codes, approvals & certifications, MOC, etc), model decoding details and other related information for each type of pressure relief valve covered in the bid. In case catalogues do not provide all such technical details, vendor shall submit supplementary technical literature.

f) Two years' operational spares for each pressure relief valve and its accessories which shall include nozzle, disc insert, guide, pilot etc. as a minimum.

g) Any special tools and tackles needed for maintenance work. In case no special tools are necessary for the offered pressure relief valve, vendor must certify in their offer.

1.2.3 All items, as offered, shall be field proven and should have completed trouble free satisfactory operation for a period of minimum six months on the bid due date in the similar application with process conditions similar to those as specified in the purchaser's data sheet. Items with proto-type design or items not meeting provenness criteria specified above shall not be offered.

1.2.4 All documentation submitted by the vendor including their quotation, catalogues, drawings, installation, operation and maintenance manuals etc. shall be in English language only.

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1.3 Drawings and Data

1.3.1 Detailed drawings, data, catalogues and manuals required shall be submitted by the vendor as per vendor data requirements attached with the requisition.

1.3.2 Final documentation consisting of design data, installation manual, operation and maintenance manual etc. shall be submitted by vendor after placement of purchase order which shall include the following as a minimum:

a) Specification sheet for each pressure relief valve and its accessories

b) Certified drawings and technical catalogues for each pressure relief valve and accessories, which shall provide dimensional details, internal construction details, end connection details, weight, materials of construction, sizing codes, approvals & certifications.

c) Copy of type test certificates.

d) Copy of test certificates for all the tests indicated in clause 4.0 of this specification.

e) Installation procedure for Pressure relief valve and its accessories.

f) Calibration and maintenance procedure including replacement of internals wherever applicable.

2.0 DESIGN AND CONSTRUCTION

2.1 Valve Design

2.1.1 The definitions of various terminologies used in purchaser's data sheets are as per API RP 520 part I.

2.1.2 Unless specified otherwise, all pressure relief valves shall be full nozzle full lift type and all relief valves in thermal safety application shall be modified nozzle or full nozzle type.

2.1.3 For flanged pressure relief valves, the valve inlet and outlet size, rating, the orifice designation and corresponding relieving area shall be as per API 526.

2.1.4 The design of pressure relief valves in steam service under IBR design code shall be governed by Regulation 294 and regulation 295 of IBR. However where design code is specifically indicated as ASME Section I, the valve design shall meet the pressure relief valve requirements specified in ASME Section I.

2.2 Valve Sizing

2.2.1 Sizing shall be carried out using the formulae mentioned in the following standards whenever the sizing code mentioned in the purchaser's data sheets refers to these;

Sizing Code	Standard
API	API RP 520 Part I API RP 521
ASME	Boiler and Pressure vessels code Section VIII 'Pressure Vessels'. Boiler and Pressure Vessels Code Section XIII 'Overpressure Protection' Boiler and Pressure vessels code Section-I - 'Power Boilers'

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IBR Indian Boiler Regulations, paragraph – 293

2.2.2 Discharge Co-efficient

Following discharge coefficient values shall be used for sizing of pressure relief valves;

a) For all valves with design code as ASME Sec VIII, discharge co-efficient (Kd) of 0.975 in gas or vapour service and 0.65 in liquid service shall be used as per API 520. Additionally, clause 2.2.4 shall be complied for final selection using the ASME certified discharge co-efficient.

b) For all valves in steam service covered under IBR design code, discharge co-efficient shall either be selected as per Regulation 293 or as tested and certified by IBR as per Appendix 'L' of IBR. For all valves in steam service with design code as ASME Section-I, certified discharge co-efficient / certified discharge capacity as per ASME section-I shall be used.

2.2.3 For the selected orifice letter designation and inlet and outlet size of the pressure relief valve, relieving area of the valve offered by vendor shall meet those in API-526.

2.2.4 For valves having ASME certified discharge coefficient / capacity curves and sizing code mentioned in purchaser's datasheet as API, vendor shall select the valve as per API-526 standard orifice area and designation by considering the following effective area :-
Effective area = ASME calculated area x (ASME Kd /API Kd)
In any case, the orifice designation of the selected valve shall not be lower than the orifice designation specified in purchaser's datasheet.
In case non API valves are specified as per purchaser's datasheets, vendor shall select non-API valves that have discharge coefficient / capacity curves certified as per ASME. For these non-API valves also, the effective area for valve selection shall be determined with the same methodology as stated above for API valves.

2.2.5 For pressure relief valve covered under ASME Sec-I design code, the valve design shall conform to ASME Section I requirements with selected area higher of the area calculated as per ASME Section I requirements and that calculated as per regulation 293 of IBR.

2.3 Valve Construction

2.3.1 Body

2.3.1.1 Body rating shall be as per API-526 / ASME B16.34.

2.3.1.2 Unless otherwise mentioned, end connection details shall be as below:

a) Threaded end connections shall be to NPT as per ASME B 1.20.1.

b) Flanged end connections shall be as per ASME B 16.5.

c) Flanged face finish shall be as per ASME B 16.5.The face finish as specified in the data sheets, shall be as follows;

125 AARH : 125 to 250 microinchAARH

63 AARH : 32 to 63 microinchAARH

2.3.1.2 For flanged valves, inlet and outlet sizes and ratings and centre to flange face dimensions shall be in accordance with API-526 / ASME B 16.34 (as applicable). Dimensional tolerance shall be as mentioned therein.

2.3.1.3 Pressure relief valves shall be self-draining type or shall have body drain plugs.

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2.3.1.4 For the pilot operated pressure relief valves, where vendor's standard model provides only semi nozzle design (i.e. the body is part of the inlet flow path), body material and nozzle material shall be same and as specified in purchaser's data sheets, as a minimum.

2.3.2 **Trim**

2.3.2.1 The term 'trim' covers all the parts of the valves exposed to and in contact with the process fluid except for the body and bonnet assembly i.e. nozzle, disc, disc holder, stem etc. In case cast nozzle is offered, the nozzle shall be radiographically tested irrespective of the pressure relief valve rating.

2.3.2.2 Valves shall be of the full nozzle type of design with the exception as per clause 2.3.1.4 and valves in thermal relief application as per clause no 2.1.2.

2.3.2.3 Wherever stelliting of disc and nozzle has been specified, it stands for stelliting of the seat joint and the entire disc contour, unless otherwise mentioned.

2.3.2.4 For high temperature application, the materials for the internals shall be selected to avoid galling.

2.3.2.5 Pressure relief valves in steam drum/boiler application with design as per ASME Section I, shall have two adjustable rings to adjust valve over-pressure and blow down.

2.3.2.6 Resilient seat, seals or o-rings wherever used shall be suitable for pressure and temperature conditions specified.

2.3.2.7 Gaskets wherever used shall be metallic type. Gaskets with asbestos filler or with asbestos bearing material shall not be used.

2.3.2.8 Selection of material of construction for guide and rings compatible with specified nozzle & disc material and meeting process and design conditions is the vendor's responsibility.

2.3.3 **Bonnet and Spring**

2.3.3.1 All valves shall be provided with a cap over the adjusting bolt. Cap shall be of either bolted type or screwed type.

2.3.3.2 Lifting lever shall be provided for temperature exceeding 60°C whenever the fluid to be relieved is steam, air or water.

2.3.3.3 Valve spring shall be selected such that the set pressure falls in the adjustable range of the spring.

2.3.3.4 Carbon steel springs shall be made corrosion resistant through plating/coating as per manufacturer's standard design or as specified in the purchaser's data sheets.

2.3.3.5 The allowable tolerance in set pressures is as below:

a) ±0.14 kg/cm² g for set pressure upto and including 5kg/cm² g.

b) ±3% for set pressure above 5kg/cm² g.

2.3.3.6 Bonnet shall be of the closed type for all process applications in general. For valves discharging to atmosphere, open type bonnet can be used only for steam, non-hazardous/ non-toxic and non-hydrocarbon fluids. Closed bonnet can be used in place of open bonnet in case

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the pressure relief valve is suitable for design conditions. For all steam applications under design code IBR or ASME Section I with open bonnet design, weather protection cover shall be provided.

2.3.4 **Pilot Design**

2.3.4.1 For pilot operated valves, the pilot design shall be of inherently fail safe.

2.3.4.2 Unless specified otherwise, pilot shall be non-flowing type.

2.3.4.3 All accessories like back flow preventer, pilot filter etc. required for proper operation of pilot operated valves as per indicated service conditions shall be included.

2.3.4.4 Material of construction of pilot shall be same as that of main valve nozzle as a minimum.

2.3.4.5 The o-ring and diaphragm material of pilot shall be suitable for the pressure and temperature conditions specified in the data sheet.

2.3.5 **Minimum acceptable materials**

2.3.5.1 Minimum acceptable materials of construction to be considered by vendor for valve components are already specified in datasheets.

However, alternate superior materials may be provided if they meet all process conditions (operating, design, fluid properties, corrosion, etc), testing (ASME, API, radiography, etc) and statutory requirements (ASME, API, IBR, NACE, etc) specified by purchaser. Accordingly, the following alternate materials can be accepted:

a) Body & bonnet: ASTM A 105, ASTM A 216 gr. WCB / WCC in place of carbon steel.

b) Nozzle & disc: SS 316L in place of SS 316.

c) Spring: Inconel, chrome alloy steel and 17-4 PH in place of carbon steel. High temperature alloy steel in place of tungsten alloy steel.

d) Bellows: Inconel in place of SS 316L.

e) For NACE service, following minimum material shall be provided:-

i) For conventional type pressure relief valves, spring material shall be inconel with nozzle and disc material as SS 316L.

ii) For bellows type pressure relief valves, bellows material shall be inconel with spring/nozzle/disc material as SS 316L.

iii) For pilot operated relief valves, the pilot valve spring (and main valve retaining spring, if applicable) shall be of inconel with nozzle and disc material as SS 316L.

2.4 All pressure relief valves in oxygen and chlorine service shall be thoroughly degreased using reagents like trichloro-ethylene or carbon tetrachloride. End connections shall be blinded / plugged after this degreasing process to avoid images of oil particles.

3.0 NAMEPLATE

3.1 Each pressure relief valve shall have a stainless steel nameplate attached firmly to it at a visible place, furnishing the following information: -

a) Tag number as per purchaser's data sheet.

b) Manufacturer's serial number and/or model number.

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c) Manufacturer's name/trade mark.

d) Nominal flange size in inches and rating in pounds for both inlet and outlet.

e) Orifice letter designation.

f) Valve set pressure.

g) Cold bench test set pressure.

3.2 For the above, pressures shall be marked in the same units as those followed in purchaser's data sheets.

4.0 INSPECTION AND TESTING

Purchaser reserves the right to inspect and witness testing at vendor's works as per Inspection Test Plan. All these tests shall be completed by the vendor and test reports shall be submitted to Purchaser for scrutiny.

5.0 SHIPPING

5.1 Valves shall be supplied as a whole, complete with all the accessories like cap, lifting lever, test gag etc.

5.2 All threaded and flanged openings shall be suitably protected to prevent entry of foreign material.

5.3 All pressure relief valves in oxygen and chlorine service shall be separately packed along with a certificate indicating 'CERTIFIED FOR OXYGEN/CHLORINE SERVICE', as applicable.

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रैपचर डिस्कस के लिए मानक विनिर्देश

STANDARD SPECIFICATION FOR RUPTURE DISKS

Rev. No	Date	Purpose	Prepared by	Checked by	Standards Committee Convenor	Standards Bureau Chairman
					Approved by	
6	04.07.25	Revised and Reissued as Standard Specification	TRJ	RS	MN	MN
5	14.07.20	Revised and Reissued as Standard Specification	SKS	PKS	RG	SKS
4	15.06.15	Revised and Reissued as Standard Specification	GK	MN	RG	SC
3	21.10.10	Revised and Reissued as Standard Specification	RK	RG	TGM/JMS	ND
2	02.05.05	Revised and Reissued as Standard Specification	SN	HCJ	PM	VJN

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Abbreviations:

AARH	:	Arithmetic Average Roughness Height
NPT	:	National Pipe Thread

Instrumentation Standards Committee

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1.0 GENERAL

1.1 Scope

1.1.1 This specification, together with the data sheets covers the requirements for the design, materials, nameplate marking, inspection, testing and shipping of rupture disk assemblies.

1.1.2 The related standards referred to herein and mentioned below shall be of the latest editions prior to the date of the purchaser's enquiry:

ASME	American Society of Mechanical Engineers.
	B 1.20.1 Pipe Threads General purpose (Inch).
	B 16.5 Pipe Flanges and Flanged Fittings: NPS 1/2 through NPS 24 Metric / Inch Standard
	B16.47 Large Diameter Steel Flanges: NPS 26 through NPS 60 Metric/Inch Standard
	B 16.20 Metallic Gaskets for Pipe Flanges
ASME	Boiler and Pressure Vessel Code.
	Section XIII – Overpressure Protection
API	American Petroleum Institute
	520 Sizing, selection and installation of pressure relieving devices in Refinery (PART 1 & 2).
BS EN	European Standards
	10204 Metallic Products, Types of Inspection Documents

1.1.3 In the event of any conflict between this Standard Specification, Data Sheets, Statutory Regulations, related Standards, Codes etc., the following order of priority shall govern:

a) Statutory Regulations

b) Data Sheets

c) Standard Specification

d) Codes and Standards

1.1.4 Vendors extent of responsibility includes the following:

a) Purchaser's data sheets specify the materials for the disk, disk holders and other parts. Alternate superior materials of construction shall also be acceptable, provided vendor assumes complete responsibility for the selected materials for their compatibility with the process fluid and its operating conditions.

b) Sizing of the rupture disk for the indicated service conditions.

1.2 Bids

1.2.1 Vendor's quotation shall be strictly as per the bidding instructions to vendor attached with the material requisition.

1.2.2 Vendor's quotation shall include the following:

a) Detailed specification sheet for each item which shall provide information regarding size, type, material of construction, rating, make, model etc. The material specification and units of measurement for various items in vendor's specification sheet shall be to the same standards as those indicated in purchaser's data sheets.

b) Proven references for each offered model in line with the clause 1.2.3 of this specification, whenever specifically indicated in purchaser's specifications.

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c) A detailed dimensional drawing for each rupture disk giving dimensions in millimetres.

d) Detailed sizing calculations for each rupture disk.

e) In case test temperature for burst test followed by vendor is different from relieving temperature then vendor to provide the following:

i. The test temperature for burst test and estimated burst pressure at that temperature.

ii. A chart of pressure correction factors vs temperature to determine the bursting pressure of the disk supplied at elevated or cold temperature.

f) Deviation on technical requirements shall not be entertained. In case vendor has any valid reason to deviate, they must include a list of deviations tag number wise, summing up all the deviation, from the purchaser's data sheets and other technical specifications along with the technical reasons for each of these deviations.

g) Catalogues giving detailed technical specifications, model decoding details and other related information for each type of rupture disk covered in the bid.

h) Two years operational spares for each tag and its accessories, which shall include gaskets, disks, etc.

i) Any special tools and tackles needed for maintenance work. In case no special tools are necessary for the offered rupture disk, vendor must certify in his offer.

1.2.3 All items, shall be field proven and should have completed trouble free satisfactory operation for a period of minimum 6 months on the bid due date in the similar application with process conditions similar to those as specified in the purchaser's data sheet. Items with proto-type design or items not meeting provenness criteria specified above shall not be offered.

1.2.4 All documentation submitted by vendor including their quotation, catalogues, drawings, installation, operation and maintenance manuals etc. shall be in English language only.

1.3 Drawings and Data

1.3.1 Detailed drawings, data, catalogues and manuals required from the vendor are indicated by the purchaser in vendor data requirement sheets.

1.3.2 Final documentation consisting of design data, installation manual and operation and maintenance manual etc. submitted by the vendor after placement of purchase order shall include the following, as a minimum:

a) Specification sheet for each rupture disk and its accessories.

b) Sizing sheets for each rupture disk.

c) Certified drawings for each rupture disk and its accessories, which shall provide dimensional details and materials of construction details.

d) Copy of the capacity certificate.

e) Copy of the test certificates for all tests indicated in clause 4.0 of this specification.

f) Installation procedures including bolting torque data and bolting procedures.

g) Maintenance procedure for the rupture disk and its accessories i.e cleaning and replacement procedures.

2.0 DESIGN AND CONSTRUCTION

2.1 The design of rupture disk shall be as per the following:

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a) Sizing, selection and installation shall be as per API-520.

b) Testing and certification shall be as per ASME Section XIII.

2.2 Unless specified otherwise, rupture disk shall be reverse buckling type with scored surface design.

2.3 The bursting pressure tolerance of the disk at the coincident disk temperature shall be as below:

a) For bursting pressure of 1 bar (14.5 psi) and above, up to and including 40 psi, tolerance shall not exceed ±2 psi.

b) For bursting pressures above 40 psi, tolerance shall not exceed ± 5% of the specified bursting pressure.

c) For bursting pressures below 1 bar (14.5 psi), manufacturer's standard bursting tolerance shall be considered.

2.4 Unless specified otherwise in the purchaser's data sheet, the manufacturing design range of the rupture disk shall be 0%.

2.5 The rupture disk assembly shall consist of;

a) A pre-torque assembly Complete with disk holders.

b) J-bolt to facilitate aligned installation.

c) Jack-screw assembly

d) Bolting to span two line flanges and rupture disk assembly.

2.6 Purchaser's data sheet shall indicate J-bolt for installation alignment. Vendor may indicate an alternate provision to avoid any inadvertent misaligned installation, if J-bolt is not available with them as standard.

2.7 When specified in the purchaser's data sheets, the rupture disk assembly shall be provided with companion flanges along with two gaskets complete with jackscrew. Where vendor is supplying the disk assembly without flanges, vendor shall include the supply of stud-bolt and nuts of required length in their scope. The material of construction of stud-bolts and nuts shall be as per datasheet.

2.8 When vacuum services are encountered or specified in the data sheet, the rupture disk assembly shall be provided with vacuum supports. Retainer ring shall also be provided to hold the vacuum support and the rupture disk in place.

2.9 If back pressure builds up due to leakage developed in the rupture disk because of corrosion or any other cause, Rupture disk will not burst at its burst pressure. To prevent this risk, Tell-tale assembly shall be provided. Tell-tale assembly shall be supplied complete with pressure gauge (Element material SS316 as a minimum), excess flow check valve (Trim & wetted part material SS316L as a minimum) and associated piping. Each Tell-Tale assembly shall also be provided with a spare ½" NPT (F) plugged connection, which can be used by purchaser for connecting pressure transmitter (Pressure Transmitter not in vendor's scope).

2.10 Vendor shall supply five (5) disks along with each rupture disk assembly ordered (i.e. one installed, one inspection & testing and three spare disks).

a) Unless specified otherwise, the following shall govern;

b) Threaded end connection shall be to NPT as per ASME B1.20.1.

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c) Flanged end connections shall be as per ASME B 16.5 for line size up to 24" and ASME B 16.47 for line size above 24".

d) Grooves of ring-type joint flanges shall be octagonal as per ASME B16.20.

e) Flanged face finish shall be serrated concentric to ASME B 16.5. The flange face finish as specified in data sheets shall be as follows:

125 AARH : 125 to 250 microinchAARH

63 AARH : 32 to 63 microinchAARH

2.11 Rupture Disk Mounting direction shall be clearly marked on the disk holder.

2.12 Vendor shall furnish the capacity certification whenever sizing calculation of Rupture Disk is carried out using ASME stamped capacity co-efficient.

2.13 All rupture disks and assemblies in oxygen and chlorine service shall be thoroughly degreased using reagents like trichloro-ethylene or carbon tetrachloride. End connections shall be blinded / plugged after this degreasing process in order to avoid entrance of grease or oil particles.

3.0 NAMEPLATE

3.1 Each rupture disk shall have a stainless steel nameplate attached firmly to it and shall be clearly visible upon assembly of the disk with the flanges. The nameplate shall furnish the following information:-

a) Tag number as per purchaser's data sheets.

b) Manufacturer's serial number / model number.

c) Manufacturer's name/trademark.

d) Rupture disk size.

e) Rupture disk material.

f) Bursting pressure at relieving temperature.

3.2 Each flange shall have the following information punched on it at a visible place: -

a) Tag number as per purchaser's data sheets.

b) Material of the flange.

c) Nominal size and pressure rating.

4.0 INSPECTION AND TESTING

Purchaser reserves the right to inspect and witness testing at vendor's works as per Inspection Test Plan and approved quality documents. All these tests shall be completed by the vendor and test reports shall be submitted to Purchaser for scrutiny.

5.0 SHIPPING

5.1 All threaded and flanged openings shall be suitably covered to prevent entry of foreign material.

5.2 Stud bolts and nuts, shall be free running and lubricated with light oil.

5.3 All rupture disks and assembly in oxygen and chlorine service shall be separately packed alongwith a certificate indicating 'CERTIFIED FOR OXYGEN / CHLORINE SERVICE', as applicable.

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पीएच एंव कंडक्टिविटी विश्लेषकों के लिए मानक विनिर्देशन

STANDARD SPECIFICATION FOR pH AND CONDUCTIVITY ANALYSER

Rev. No	Date	Purpose	Prepared by	Checked by	Standards Committee Convenor	Standards Bureau Chairman
					Approved by	
2	23.02.23	Revised and Reissued as Standard Specification	JSD	ASD	MN	SM
1	08.08.17	Revised and Reissued as Standard Specification	RSM	MN	RG	RN
0	13.02.12	Issued as Standard Specification	AR	RG	RP/JMS	DM

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Abbreviations:

AARH	:	Arithmetic Average Roughness Height
EDDL	:	Electronic Device Description Language
EMF	:	Electro Magnetic Force
FISCO	:	Fieldbus Intrinsic Safety Concept
FF	:	Foundation Fieldbus
NPT	:	National Pipe Thread
FDT/ DTM	:	Field Device Tool / Device Tool Manager

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Convener : Mr. Mainak Nandi

Members : Mr. Arupjyoti Saikia
Mr. Sachin Garg
Mr. Jerry Johnson
Mr. Mayank Kaushik
Ms. K Pratheepa
Mr. Sourav Mukherjee
Mr. Ravindra Kumar Gupta (Proj.)

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1.0 GENERAL

1.1 Scope

1.1.1 This specification, together with the data sheets, covers the requirements for the complete design, materials, nameplate marking, inspection, testing and shipping of pH and conductivity analysers.

1.1.2 The related standards referred to herein and mentioned below shall be of the latest editions of the following codes, standard practices and publications, unless otherwise specified:

ASME	American Society of Mechanical Engineers.	
	B 1.20.1	Pipe Threads. General Purpose (Inch)
	B 16.5	Pipe Flanges and Flanged Fittings NPS1/2 through NPS24 Metric / inch Standard
	B 16.20	Metallic Gaskets for Pipe Flanges
API	American Petroleum Institute	
	RP 555	Process analysers
EN	European standards	
	10204	Inspection documents for Metallic Products
IS/IEC	Indian Standard / International Electro technical Commission	
	60079	Electrical Apparatus for Explosive Gas Atmosphere.
	60529	Degree of Protection Provided by Enclosures. (IP Code)
	61000-4	Electromagnetic Compatibility (EMC) for Industrial Process Measurement and Control Equipment
	61158	Fieldbus Standard for use in Industrial Control Systems
	61158-2	Physical Layer Specifications and service definition for Fieldbus
	61508	Functional safety of Electrical/Electronic/Programmable Electronic Safety related systems
	61804-3	Functional blocks (FB) for process control-Electronic Device Description Language (EDDL)
	IS 13673-1 (IEC 60746-1)	Expression of performance of electrochemical analysers – Part 1: General
	IS 13673-2 (IEC 60746-2)	Expression of performance of electrochemical analysers – Part 2: pH
	IS 13673-3 (IEC 60746-3)	Expression of performance of electrochemical analysers – Part 3: Electrolytic Conductivity
ISA	International Society of Automation	
	51.1	Process Instrumentation Terminology
	50.00.01	Compatibility of Analog Signals for Electronic Industrial Process Instruments
ITK	Interoperability Test Kit (latest version)	

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1.1.3 In the event of any conflict between this standard specification, Job Specification / Data sheets, statutory regulations, related standards, codes etc., the following order of priority shall govern:

a) Statutory Regulations
b) Job Specification / Datasheets
c) Standard Specification
d) Codes and Standards

1.1.4 In addition to compliance to purchaser's specification in totality, vendors' extent of responsibility shall include the following:

a) Purchaser's datasheets indicate the type of analyser and the minimum sampling system requirements. Vendor shall be responsible for the selection of proper analyser and design of the sampling system to measure the components of interest within the stated performance requirements.

b) Purchaser's datasheets specify the material of construction (MOC) for the analysers and its sampling system. Alternate superior material of construction shall also be acceptable provided vendor assumes complete responsibility for the selected materials of all parts of the analyser system for compatibility with the specified process stream and its operating conditions and surrounding atmosphere as per purchaser's datasheets.

1.2 Bids

1.2.1 Vendor's quotation shall be strictly as per the bidding instruction to vendor attached with the material requisition.

1.2.2 Whenever a detailed technical offer is required, vendor's quotation shall include the following:

a) Whenever specifically indicated, a detailed specification sheet for each item, which shall provide information regarding type, materials of construction and accessories of analyser. The material specification and units of measurement for various parts in vendor's specification sheets shall be to the same standards as those indicated in purchaser's datasheets. All the relevant terminology used in purchaser's datasheets and standard specifications is as per ISA 51.1.

b) Detailed drawing showing various components and interconnecting wiring diagram for the complete analyser system showing locations (e.g. field, control room etc.) and the required utilities.

c) Cable parameters (Capacitance, inductance, L/R ratio) for interconnection cable between field and control room mounted units, in case of intrinsically safe system.

d) Sample flow rates and recommended length and size of the sampling tube between process tap and sampling system. Proven references for each offered model of analyser inline with clause 1.2.3 of this specification.

e) A copy of approval from local statutory authority, as applicable such as Petroleum & Explosives Safety Organisation (PESO) Nagpur India, for the electronic instruments installed in electrically hazardous area along with:

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i) Test certificate from recognised test house like Central Institute of Mining and Fuel Research (CIMFR) / Electronics Regional Testing Laboratory (ERTL) etc. for flameproof enclosure and/ or intrinsic safety, as specified in the data sheet, as per relevant Indian Standard for all Indian manufactured equipments.

ii) Certificate of conformity from agencies like Laboratorie Central Des Industries Electriques (LCIE), British Approval Service for Electrical Equipment in Flammable Atmospheres (Baseefa), Factory Mutual (FM), Physikalisch-Technische Bundesanstalt (PTB) , Canadian Standards Association (CSA), Underwriters Laboratories (UL) etc. for compliance to ATEX directives or Certificate of Conformity from IECEx or equivalent recognised standards for all equipments manufactured outside India.

f) Utility requirements (i.e. flow, pressure, temperature etc. of cooling medium and power consumption).

g) Deviations on technical requirements shall not be entertained. In case vendor has any valid technical reason to deviate, they must include a list of deviations tag number wise, summing up all the deviations from the purchaser's data sheets and other technical specifications along with the technical reasons for each of these deviations.

h) Catalogues giving detailed technical specifications, model decoding details for selected model and other related information for each type of analyser and accessories covered in the bid. For Fieldbus Instruments, information shall include, but not limited to product certifications, dimensional drawings, Transient protection, range limits, power supply, Current draw, vibration effect, power supply effect, Electromagnetic compatibility. Fieldbus parameters like available standard function blocks/ Advanced function blocks and their execution time for each block, Device type, number of link objects, virtual communication Relationships, Basic and advanced diagnostic features, transmitter failure mode, physical profile type etc.

i) Whenever specified, vendor must furnish certified values of failure rates, probability of failure on demand and test interval for the safety integrity level analysis.

j) Vendor shall furnish sample transport time calculations for pH control applications.

1.2.3 All items, as offered, shall be field proven and should have completed trouble free satisfactory operation for a period of minimum 6 months on the bid due date in the similar application with the process conditions similar to those as specified in the purchaser's data sheets. Items with proto-type design or items not meeting provenness criteria specified above shall not be offered.

1.2.4 All documentation submitted by the vendor including their quotation, catalogues, drawings, installation, operation and maintenance manuals, etc shall be in English language only.

1.2.5 Vendor shall also quote for the following: -

a) Supply of complete reference and calibration kit as required including electrolyte, minimum two buffer solutions for pH analysers and calibration solutions (for conductivity analyser) to cover the analyser range etc. required for a period of one year.

b) Start up and commissioning spares as per vendor's recommendation.

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c) Special instruments and tools needed for testing, calibration and maintenance work on the analyser.

d) Two years operational and maintenance spares for each analyser and its accessories as recommended by vendor.

1.3 Drawing and Data

1.3.1 Detailed drawing, data, catalogues and manuals required from the vendor are indicated by the purchaser in the vendor data requirement sheets attached with the enquiry.

1.3.2 Final documentation consisting of design data, installation, operation and maintenance manual etc., submitted by the vendor after placement of purchase order as per vendor data requirement (VDR) shall include the following, as a minimum;

a) Certified drawing sheets for each analyser and its accessories, tag number wise, which shall provide the following information:

i) Overall dimensions in SI units.

ii) Sampling system details identifying each component with make and model number, process connection, utility connection, calibration samples/gases connection, heat tracing requirements, sample vent etc. The flow, pressure and temperature at interface for purchaser connection and other appropriate location must be shown in the sampling system drawing.

iii) Detailed interconnection drawing of each analyser identifying each component with terminal number, cable type and size and cable entry details. The interface for purchaser connection details shall be clearly identified in the drawing.

iv) Grounding details.

b) Calibration curves or data as required for each analyser.

c) Programming/configuration data for each analyser, as applicable.

d) Calibration procedures including replacement of its parts/internals wherever applicable.

e) Device Descriptor (DD) Files for configuring the device parameters (Soft copy).

f) Common File Format (CFF) files for integrating the device into the system (Soft copy).

2.0 DESIGN AND CONSTRUCTION

2.1 Analyser Requirements

2.1.1 The analyser shall consist of:

a) Sample probe and sampling system, as applicable.

b) Analyser consisting of detector, transmitter/ pre-amplifier and associated equipments.

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c) Calibration and maintenance equipment

Type of detector, sensor, sampling system, analyser output etc. shall be as specified in the Purchaser's datasheets/ job specifications.

2.1.2 a) Unless otherwise specified, the material of construction of all components wetted by the sample shall be 316 Stainless Steel, as a minimum. Vendor must ensure the compatibility of material of each component with the process fluid.

b) Unless otherwise specified, the material of construction of enclosure for preamplifier and transmitter shall be cast aluminium epoxy coated or SS as a minimum.

2.1.3 Analyser shall be microprocessor based with state-of-the-art technology, which shall be capable of being configured from analyser front panel locally using analyser keyboard. Whenever specified, it shall be possible to configure the analyser from remote through a separate terminal.

2.1.4 The configuration related data of the analyser including set range shall be stored in a non-volatile memory such that this remains unaffected by power fluctuations or power off condition. In case vendor standard instrument has battery backed RAM, analyser shall have facility to provide battery drain alarm as diagnostic maintenance message.

2.1.5 The span of the analyser shall be field adjustable from the analyser front without opening the analyser enclosure. In case, separate device is required to make such a change the same shall be included.

2.1.6 Analyser shall have an integral output meter with digital readout in engineering units.

2.1.7 Analyser shall run diagnostic subroutines on continuous basis and shall be able to provide various diagnostic alarms related to the analyser, detector and electronics, low flow, temperature control failure and purge failure. Whenever serial option is specified in the Purchaser's data sheets, the above alarms shall be made available through serial output as a minimum.

2.1.8 The analyser shall be capable of providing the following outputs:

a) Isolated 4-20 mA DC current output for analysed component. SMART or fieldbus, output shall be provided when specifically indicated in the purchaser's data sheets. The transmitter output shall be linear for pH analysers.

b) Serial output (RS 485 or RS 232C) with MODBUS RTU protocol, whenever specifically indicated in the purchaser's data sheets.

2.1.9 The analyser transmitter with two-wire system shall be suitable for delivering rated current to an external loop resistance of at least 600 ohm when powered with 24 V DC.

2.1.10 Analyser and its related equipments directly connected to process line shall be capable of withstanding line pressure and temperature conditions specified in the data sheet.

2.1.11 Unless otherwise specified, the following shall govern:

a) Threaded end connections shall be to NPT as per ASME B1.20.1.

b) Flanged end connections shall be as per ASME B 16.5.

c) Flange face finish shall be as per ASME B16.5. The face finish shall be as follows:

125 AARH : 125 to 250 micro inch AARH

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63 AARH : 32 to 63 micro inch AARH

d) Grooves of ring type joint flanges shall be octagonal as per ASME B 16.20.

2.1.12 The design of electronic instruments shall be in compliance with the electromagnetic compatibility requirements as per IEC 61000-4.

2.1.13 For Non-intrinsically safe analyser transmitters, analyser enclosures and accessories shall be suitable for the electrical area classification indicated in purchaser's data sheets. Unless otherwise specified, the enclosures shall comply with the requirements to the following standards:

Weather proof housing : IP 65 as per IS/IEC-60529
Flame proof housing : Flame proof Ex (d) as per IS/IEC-60079
Flameproof equipment shall also be made weatherproof.

2.1.14 For intrinsically safe analyser transmitters, the Analyser transmitters shall be certified intrinsically safe. In addition to meeting weatherproof requirements specified in clause 2.1.13 of this specification intrinsically safe analysers shall meet the requirements specified in IEC 60079 and shall be certified for the area classification specified in the purchaser's data sheets.

2.1.15 Separate cable entries shall be available in the analyser for power and signal cable. Unless otherwise specified, following shall apply:

a) Cable entry for power cable shall be ¾" NPT (F).
b) Cable entry for serial cable, signal cables (Single output) shall be ½" NPT (F).
c) Cable entry for signal cables (Multiple outputs) shall be 1½" NPT (F).

2.2 Electrode Assembly

2.2.1 The electrode assembly shall be of rugged construction and shall be designed as per process conditions specified in purchaser's datasheets. The assembly shall be highly resistant to abrasion, coating and chemicals present in the process field.

2.2.2 The electrode assembly shall essentially have the following:

a) Flow through, Insertion or submersible type assemblies as specified in purchaser's data sheet. (Electrode length shall be selected such that recommended minimum insertion length falls below the centreline of the pipe / flowcell outlet).

b) Cables as required for connection of sensor to pre-amplifier/ transmitter. The sensor to cable connection shall be suitable for ease of sensor replacement. Wherever flexible cables are provided between sensors and pre-amplifier/ transmitter, the same shall be with suitable conduits for cable protection.

2.2.3 It shall be possible to insert or remove the electrodes 'On-line' without interrupting the process.

2.2.4 pH electrode assembly shall meet the following requirements:

a) The assembly shall be a combination electrode having measurement, reference and temperature sensors.

b) Flow chamber material shall be of SS 316 as a minimum. Measuring electrode shall be of suitable type of glass as governed by the process conditions indicated in the purchaser's datasheets.

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c) Reference electrode shall be 'non-flowing type'. The electrode with electrolyte replenishment or external pressurisation type shall not be used.

d) Resistance temperature detector element for automatic temperature compensation.

e) Jet spray wash type cleaning assembly shall be provided for on-line cleaning wherever specified. The system shall include timer unit and necessary interconnection tubing and cabling.

2.2.5 Conductivity electrode assembly shall meet the following requirements:

a) The conductivity cell shall be of fail-safe construction with a guarded electrode.

b) Cell constant of the offered conductivity cell shall be selected based on the range of fluid conductivity.

c) The conductivity cell and electrode material selected by vendor shall be suitable for the process conditions/ conductivity range specified in the Purchaser's datasheet. The material shall be Titanium, as a minimum.

2.3 Pre-amplifier and Transmitter

2.3.1 Pre-amplifier and transmitter shall be microprocessor based with automatic temperature compensation.

2.3.2 The pre-amplifier can be supplied as a common unit in the electrode assembly or included in the transmitter. In case pre-amplifier is to be furnished as a separate unit, all cables as necessary between the electrode assembly, pre-amplifier and transmitter shall be in vendor's scope of supply.

2.3.3 The following performance characteristics shall be met as a minimum:

Accuracy:	± 0.01 pH (for pH transmitter) ± 1 % of reading (for conductivity transmitter)
Repeatability:	± 0.02 pH (for pH transmitter) ± 1 % of reading (for conductivity transmitter)

2.3.4 Smart and Fieldbus based transmitters shall be two wire microprocessor based type. These shall have a non-volatile memory, storing, complete sensor characterisation and configuration data of the transmitter. All necessary signal conversions and output generation with required protocol shall be carried out in the transmitter electronics. An integral output meter shall be provided with each transmitter, the meter shall be graduated in actual measurement units. In addition to measured parameters and diagnostic alarm, the analyser local display function shall include temperature, EMF, slope of cell electrode impedance as applicable as per Purchaser's data sheet.

2.3.5 Transmitter shall also run complete diagnostic subroutines and shall provide diagnostic alarm messages for sensor as well as transmitter healthiness. In the event of detection failure, the output shall be driven to a predefined value, which shall be field configurable.

2.3.6 In addition to the requirements specified above, fieldbus based transmitter shall meet the following requirements:

a) All instruments must satisfy the requirements of the fieldbus registration laboratory with applicable checkmark like foundation fieldbus, profibus NutZeroorganisation e.v (PNO) or as specified in the purchaser's datasheets.

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b) All instruments shall be polarity insensitive.

c) All instruments shall have one no. Analog Input (AI) block as a minimum.

d) All instruments must be interoperable and shall have valid interoperability test clearance like ITK latest version for foundation fieldbus or equivalent for profibus PA, as applicable.

e) The fieldbus instrument shall support peer to peer communication.

f) The fieldbus instrument in hazardous area shall be certified as per entity concept or shall be FISCO approved as per the requirements specified in the purchaser's specification.

g) All instruments shall support EDDL or FDT/DTM requirements, as specified in datasheets.

h) Internal Software shall be configured by the vendor including the following information.

i) Serial Number
ii) Device Tag (Tag No.)
iii) Process Description

i) For fieldbus analysers, the bus terminals shall be suitable for intrinsic safe fieldbus segment i.e. the bus terminals must remain passive (shall not be source of energy to the system except for a leakage current not greater than 50 micro A). The bus terminal must be galvanically isolated from power supply.

j) All instruments shall be capable of supporting incremental Device Descriptor (DD) for extra functionality and / or software revisions in Device Memory.

2.3.7 All FF devices shall be shipped in "Ready to Run mode" including following details of Foundation Field Bus:

Device descriptor (DD) files for configuring the device parameters and common File Format (CFF) files for integrating the device into the system for offline configuration in Purchaser's DCS & the same shall be matched with the device configuration details of the analyser as specified in the Purchaser's data sheet/ specification. Fieldbus, DD files and device support files shall be submitted in native format.

2.4 Sampling System

2.4.1 In general, sampling systems shall be designed and constructed in accordance with API-RP-555 .

2.4.2 Process stream sampling shall be continuous. Analyser shall be located as near as possible to the sample take-off point. Design shall ensure that the sample drawn is true representative of the process stream to be analysed.

2.4.3 Unless otherwise specified, material of all components wetted by sample shall be suitable for the process fluid and sample process condition specified in purchaser's datasheet. The material shall be SS 316, as a minimum.

2.4.4 The sampling system shall be designed either as an integral part of analyser or shall be separately fabricated. If separate sampling system is furnished, it shall be designed for easy integration with the analyser.

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The design of sample handling system shall consider the following factors, as a minimum:

a) The pressure-temperature conditions required for the analyser.
b) Interfering components in the process sample.
c) Normal and abnormal sample compositions.
d) Sample return pressure-temperature conditions.
e) Fouling sample conditions e.g. polymer formation or presence of solids etc.
f) Transportation time requirements.
g) Utilities available and their process conditions.

2.4.5 Sampling system shall include all elements as necessitated by the process conditions indicated in the purchaser's datasheets to make the sample suitable for the analysis.

This shall include but not limited to components like pressure reducing station with pressure reducing valve, upstream and downstream pressure gauges, sample coolers, safety relief valve, non-return valve etc. as governed by the process conditions indicated on the purchaser's data sheets.

Analyser and each component of sampling system shall be capable of being removed without dis-assembling the entire system.

2.4.6 Filters shall always be provided in dual configuration. It shall be possible to replace the filter without upsetting the operation of the analyser.

2.4.7 Analyser rack /cabinet

a) The analyser shall be supplied in pre-assembled, pre-tubed and pre-wired condition complete with sample handling system. The primary sample conditioning components i.e. conditioning at sample tap-off point, shall be supplied separately.

b) When specified in purchaser's datasheets, the analyser and sample handling system shall be supplied installed in an open rack with canopy to protect the analyser from direct sunlight and rain.

c) When specifically indicated in the purchaser's datasheets, analyser and sample handling system shall be supplied in free standing closed rack analyser cabinet. Unless otherwise specified, the analyser cabinet shall be located outdoor. All items including analyser installed within the cabinet shall be suitable for the maximum possible temperature likely to be attained with all items powered-on within the cabinet.

Purchaser's datasheet shall also specify the requirement of heating and/or cooling wherever required. Vendor shall provide cooling/heating additionally in case:

i) The temperature induced measurement error exceeds ± 1% of full scale in the worst temperature conditions.

ii) The maximum allowable ambient temperature condition of any component within the cabinet exceeds its limits.

Cabinet shall be fabricated out of 2.0 mm Cold Rolled Cold Annealed Stainless Steel reinforced with angles of suitable sizes. Anchor bolts required for installation of cabinet shall also be supplied by vendor.

d) All interconnecting wiring shall be colour coded and numbered. The terminal blocks and terminals shall be clearly identified.

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3.0 NAMEPLATE

Each analyser and its accessory shall have a stainless steel nameplate firmly attached to it at a visible place, furnishing the following information as applicable:

a) Tag number as per purchaser's data sheets.
b) Manufacturer's serial number and model number.
c) Manufacturer's name/trade mark.
d) Range.
e) Area classification in which the equipment can be used.

4.0 INSPECTION AND TESTING

Purchaser reserves the right to inspect and witness testing all the items at the vendor's works in line with the inspection test plan. All these tests shall be completed by the vendor and test reports shall be submitted to purchaser for scrutiny.

5.0 SHIPPING

5.1 All threaded and flanged openings shall be suitably covered to prevent entry of foreign material.

5.2 Each major part shall be sealed in thick plastic bags. Suitable moisture absorbent shall be provided for electronic components.

5.3 All glass components shall be packed in a container of suitable design to withstand normal shipping, handling and storage. Proper identification marks shall be provided on such containers.

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कन्ट्रोल वाल्वों के लिए मानक विनिर्देशन

STANDARD SPECIFICATION FOR CONTROL VALVES

Rev. No	Date	Purpose	Prepared by	Checked by	Standards Committee Convenor	Standards Bureau Chairman
					Approved by	
5	11.11.21	Revised and Reissued as Standard Specification	HMX /AJS	AR	MN	SM
4	27.03.17	Revised and Reissued as Standard Specification	AM	ADB	RG	DM
3	11.04.11	Revised and Reissued as Standard Specification	MN	RG	RP/JMS	DM
2	15.02.07	Revised and Reissued as Standard Specification	SM	TGM	HCJ	VC
1	01.11.96	Revised and Reissued as Standard Specification	RK	BRS	RB	AS

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Abbreviations:

AARH	:	Arithmetic Average Roughness Height
CIMFR	:	Central Institute of Mining and Fuel Research
EDDL	:	Electronic Device Description Language
ERTL	:	Electronics Regional Testing Laboratory
FCRI	:	Fluid Control Research Institute
FDT/DTM	:	Field Device Tool/Device Type Manager
FF	:	Fieldbus Foundation
FISCO	:	Fieldbus Intrinsic Safety Concept
HART	:	Highway Addressable Remote Transducer
HHT	:	Hand Held Terminal
NACE	:	National Association of Corrosion Engineers
NPS	:	Nominal Pipe Size
NPT	:	National Pipe Thread
PID	:	Proportional, Integral and Derivative
PTFE	:	Poly Tetra Fluoro Ethylene
SS	:	Stainless Steel
TSO	:	Tight Shutoff

Instrumentation Standards Committee

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ANNEXURE – 2: GASKET MATERIAL REQUIREMENT

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1.0 GENERAL

1.1 Scope

1.1.1 This specification, together with the data sheets describes the requirements for the design, materials, fabrication, documentation, nameplate marking, inspection, testing and shipping of control valves.

1.1.2 The related standards referred herein and mentioned below shall be of the latest edition of the following codes, standard practices and publications, unless otherwise specified.;

ASME American Society of Mechanical Engineer.

B 1.20.1	Pipe Threads, General Purpose (Inch)
B 16.5	Pipe Flanges and Flanged Fittings
B 16.20	Metallic Gaskets for Pipe Flanges
B 16.34	Valves – flanged, Threaded and Welding End.
B 16.47	Large Diameter Steel Flanges: NPS 26 through NPS 60 Metric/Inch Standard

ANSI/FCI American National Standard Institute/Fluid Control Institute

FCI 70-2	Control Valve Seat Leakage

API American Petroleum Institute

6 D	Specification for Pipeline and Piping Valves
598	Inspection Requirements
609	Lug and wafer type, Butterfly valves.
624	Type Testing of Rising Stem Valves Equipped with Graphite Packing for Fugitive Emissions

AWWA American Water Works Association

C207 CL.D	Steel Pipe Flanges for Water Works Services

BS British Standards

6364	Valves in cryogenic service

EN European Standards

10204	Inspection Documents For Metallic Products.

IBR Indian Boiler Regulation.

IS/IEC Indian Standards/International Electro-Technical Commission

IS/IEC 60079	Electrical Apparatus for Explosive Gas Atmosphere.
IS/IEC 60529	Degree of Protection Provided by Enclosures (IP Code).
IEC 60534-3-2	Face to Face dimension of rotary valves except butterfly valves.
IEC 60534-4	Inspection & Routine Testing
IEC 60534-8-3	Industrial process control valves, noise consideration, control valve aerodynamic noise prediction method
IEC 60534-8-4	Industrial process control valves, noise consideration, prediction of noise generated by hydrodynamic flow
IEC-61158	Fieldbus Standard for use in Industrial Control System
IEC-61158-2	Physical layer specification and Service definition for Fieldbus

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	FF 890	Function Block Application Process Part 1
	FF 891	Function Block Application Process Part 2
	FF 892	Function Block Application Process Part 3
	FF 893	Function Block Application Process Part 4
	FF 894	Function Block Application Process Part 5
	IEC 61508	Functional Safety of Electrical/Electronic/Programmable Electronic Safety related Systems.
	IEC-61511	Functional safety instrumented system for the process industry sector
	IEC-61804	Function Blocks (FB) for Process Control: Electronic Device Description
ISA	International Society of Automation	
	75.01.01	Flow equation for sizing control valves.
	75.02	Control valve capacity test procedure.
	TR75.04	Control Valve positioner stability
	75.05.01	Control Valve terminology
	75.07	Laboratory measurement of aerodynamic noise generated by control valves
	75.08.01	Face to face dimensions for integral flanged Globe-style control valve bodies (ASME Class 125,150,300 and 600)
	75.08.02	Face to face dimensions for flangeless control valve (ASME Class 150,300 and 600)
	75.08.04	Face to face dimensions for Buttweld-end globe style control valve (ASME Class 4500)
	75.08.05	Face to face dimensions for Buttweld-end globe style control valve (ASME Class 150,300, 600, 900, 1500 and 2500)
	75.08.06	Face to face dimensions for flanged Globe-style control valve bodies (ASME Class 900, 1500 and 2500)
	75.11.01	Inherent flow characteristic and Rangeability of control valves.
	75.19.01	Hydrostatic testing of control valves.
	75.22	Face to centre-line dimensions for flanged Globe-style Angle control valve bodies (ASME Class 150,300 and 600)
	75.25.01	Test Procedure for Control valve response measurement for step inputs
	TR 75.25.02	Control valve response measurement for step inputs
	75.13	Method of evaluating the performance of positioners with analog input signals and pneumatic output.
	75.17	Control valve aerodynamic noise prediction.
	RP75.23	Considerations for evaluating control valve cavitation
ISO	International Organization for Standardization	
	15848-1	Industrial valves — Measurement, test and qualification procedures for fugitive emissions
ITK	Interoperability Test Kit (latest version)	
MSS	Manufacturer's Standardisation Society	
	SP25	Standard Markings System for Valves, Fittings, Flanges and Unions

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NACE National Association of Corrosion Engineers

MR0103 Materials Resistant to Sulphide stress cracking in Corrosive Petroleum Refinery Environments

OSHA Occupational Safety and Health Authority

1.1.3 In the event of any conflict between this standard specification, job specifications/data sheets, statutory regulations, related standards, codes etc., the following order of priority shall govern:

a) Statutory regulations

b) Job Specifications/Data Sheets

c) Standard specification

d) Codes and standards

1.1.4 In addition to meeting purchaser's specifications in totality, vendors' extent of responsibility shall also include the following:

a) Purchaser's data sheets specify the minimum acceptable materials for the control valve body and trim. Alternate superior materials of construction shall also be acceptable with consent of purchaser provided vendor assumes complete responsibility for proper selection of material for these parts for their compatibility with the process fluid and its operating conditions.

b) Purchaser's data sheets specify the control valve size, flow coefficient (Cv) and required flow rangeability. Vendor shall be responsible for selecting their standard valve flow coefficient suitable for the specified service and process conditions specified in the purchaser's data sheets.

c) Selection of actuator to meet the shut off differential pressure indicated in the purchaser's data sheets.

d) Checking for cavitation, flashing and noise generated and provide suitable trim and treatment to limit these within appropriate limits.

1.2 Bids

1.2.1 Vendor's quotation shall be strictly as per the bidding instructions to vendor attached with the Material Requisition.

1.2.2 Whenever a detailed technical offer is required, vendor's quotation shall include the following:

i) Compliance to the specifications.

ii) Whenever specifically indicated, a detailed specification sheet for each control valve which shall provide information regarding type, material of construction, capacity sizing code, inlet and outlet type, size and rating, etc. of the control valve and its valve accessories. The material specifications and units of measurement indicated in the specification sheet shall be to the same standards as those in purchaser's data sheet.

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iii) Whenever the requirement of sizing calculation is specifically indicated in the materials requisition, vendor shall furnish sizing calculation for each tag number clearly highlighting the standard used for calculation, noise level, cavitation or flashing, Cv selected, percentage opening at minimum, normal and maximum flow, inlet and outlet velocity etc.

iv) Proven references in line with clause no. 1.2.3 of this specification specifically for valves with ASME Class 600 and above, temperature more than 250°C and below -29°C, pressure drop greater than 50 kg/cm² and special application like hydrogen, NACE ,Cryogenic etc.

v) A copy of approval for items such as limit switches, solenoid valves, electro-pneumatic converters, electro-pneumatic positioners, smart positioners, Fieldbus positioners from local statutory authority, as applicable, such as Petroleum and Explosives Safety Organization (PESO) in India, along with:

i) Test certificate from recognised test house like Central Institute of Mining and Fuel Research (CIMFR) / Electronics Regional Testing Laboratory (ERTL) etc. for flameproof enclosure and/ or intrinsic safety, as specified in the data sheets as per relevant Indian Standard for all Indian manufactured equipments.

ii) Certificate of conformity from agencies like Laboratorie Central Des Industries Electriques (LCIE), British Approval Service for Electrical Equipment in Flammable Atmospheres (Baseefa), Factory Mutual (FM), Physikalisch-Technische Bundesanstalt (PTB), Canadian Standards Association (CSA), Underwriters Laboratories (UL) etc., for compliance to ATEX directives or equivalent recognised standards for all equipments manufactured outside India.

vi) Limitation, if any, in changing actuator orientation at site.

vii) Deviations on technical requirements shall not be entertained. In case vendor has any valid technical reason, they must include a list of deviations tag number wise, summing up all the deviations from the purchaser's data sheets and other technical specification along with the technical reasons for each of these deviations.

viii) Published catalogues giving detailed technical specifications (i.e. available sizes, ratings, sizing codes, approvals & certifications, MOC, etc), model decoding details and other information for each type of control valve and accessories covered in the bid. For fieldbus positioners, information shall include, but not limited to, product certification, power supply, current drawn, Standard/Advanced/Enhanced function blocks available and the execution time for each block, device type, number of link objects, Virtual Communication Relationships, Basic and advanced diagnostic features, failure mode etc. In case catalogues do not provide all such technical details, vendor shall submit supplementary technical literature.

1.2.3 For valves in cryogenic service, vendor shall meet the following acceptance criteria:

a) Vendor shall furnish, along with the offer, type test certificate, duly witnessed by Third Party Inspection agency like M/S LRIS, DNV BV, TUV, CEIL etc. of having successfully conducted the cryogenic test as per BS 6364 on the offered valves (same model, size, rating and material) in cryogenic service. Further vendor to note the following:

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i) Test temperature shall be -45°C for LTCS and -196°C for all grades of austenitic Stainless Steel.

ii) Test carried out on a particular size of one type of valve, pressure rating and material shall qualify all sizes equal to and below the test valve size for the same type, pressure rating and material. In case of austenitic Stainless Steel any one grade would qualify for other grades of austenitic Stainless Steel.

b) In case vendor does not have cryogenic type test certificate for the offered valves as mentioned above, vendor shall confirm to conduct the cryogenic test on the offered valves and furnish cryogenic test report meeting requirements specified in Clause 1.2.3 a) above with the following as a minimum:-.

i) Vendor must have proven references as per clause 1.2.4 of this specification for each of the offered valves (same model, size, rating and material) in cryogenic service. The references with details shall be furnished with the offer.

ii) Cryogenic test shall be conducted at maximum operating pressure specified in Purchaser's datasheets.

iii) In case the vendor fails to conduct cryogenic test(s) within 12 weeks or failure in the test(s) conducted after receipt of order, the purchaser reserves the right to invoke any of the provisions of the purchase order including cancellation of the Purchase Order at the risk and cost of vendor.

1.2.4 All items, as offered, shall be field proven and should have been operating individually for a period of minimum six (6) months on the bid due date in the process conditions similar to those as specified in the purchaser's data sheets. Items with proto-type design or items not meeting provenness criteria specified above shall not be offered.

1.2.5 Whenever specified, vendor must furnish certified values of failure rates, probability of failure on demand (PFD) and test intervals for the safety integrity level (SIL) analysis.

1.2.6 All documentation submitted by the vendor including their quotation, catalogues, drawings, installation, operation and maintenance manuals etc., shall be in English language only.

1.2.7 Vendor shall specifically note that the quote for control valves shall include the following:

a) One extra set of packing and bonnet gasket with each tag.

b) One extra set of stem seal O-ring for each actuator and piston O-ring additionally for each piston actuated valve.

c) Line bolting (set of studs and nuts) and set of gasket, in case of flangeless valves as per material given in Annexure-1 and Annexure-2 with each such tag number.

1.2.8 Vendor shall separately quote for the following:

a) Control valve diagnostic package for seat ring, gland packing and actuator diagnostic with smart positioner.

b) Two years' operational spares for offered control valve and its accessories, which shall include plug, seat ring, gasket set, packing set, diaphragm/o-ring set etc. as a minimum.

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c) Any special tools needed for maintenance work. Vendor must certify in their offer in case no special tools are necessary for the offered control valves and their accessories.

d) Required software for operation and diagnosis of the control valve shall be provided separately in the physical device such as CD/DVD.

1.3 Drawing and Data

1.3.1 Detailed drawings, data, catalogues and manuals required shall be submitted by the vendor as per Vendor Data Requirements (VDR) attached with the requisition.

1.3.2 Final documentation consisting of design data, installation manual, operation and maintenance manual etc. shall be submitted by vendor after placement of purchase order which shall include the following as a minimum:

a) Specification sheet for each control valve, positioner and other accessories and sizing calculation.

b) Certified drawings and technical catalogues for each control valve and its accessories, which shall provide dimensional details (face-to-face and height of completely assembled valve). Dimensions of clearance space for maintenance work, weight of completely assembled valve, internal constructional details, materials of construction of actuator, wiring diagram, installation procedure for control valves and their accessories, orientation with respect to flow direction marked on the body, sizing codes, approvals & certifications.

c) Copy of the type test certificates and the test certificates for all tests indicated in Inspection Test Plan.

d) Calibration, configuration and maintenance procedures including replacement of its parts/ internals wherever applicable.

e) Control valve operating signatures whenever smart positioners or Fieldbus based positioners are specified.

f) Device Descriptor (DD) Files for configuring Smart positioner /Fieldbus parameters

g) Common File Formats (CFF) for integrating the Fieldbus positioner into the control system.

2.0 DESIGN AND CONSTRUCTION

2.1 Body

2.1.1 Control valves shall have flanged end connections integral to the valve body. Split body type valve design shall not be offered unless specifically indicated in the purchaser's data sheets. Whenever flangeless control valve body design is specified in the purchaser's data sheet, following shall apply:

a) Wafer type or lug type body design for control valves body size up to 6 inches.

b) Lug type body design for butterfly type of control valve body size more than 6 inches.

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2.1.2 The minimum control valve body size shall be 1 inch. Control valve body size of less than 1 inch shall be offered only when specifically indicated in the purchaser's data sheet. The control valve body size shall be adhered to the size mentioned in the data sheet, if due to process condition and other parameters the same size is not suitable than higher size can be offered with reason. Only after acceptance of offered higher size by client/EIL, vendor shall proceed. In general, Control Valve size shall neither be more than the inlet line size nor be less than half the inlet line size unless specified otherwise in datasheets.

2.1.3 The valve body rating shall be equal to or higher than the flange rating specified in the data sheets. As a minimum, control valve body shall be rated for ASME Class 300. However, end connection shall be as specified in purchaser's data sheet.

2.1.4 The control valves shall be suitable for installation in horizontal as well as in vertical lines.

2.1.5 For all applications, where full port valves are specified in on-off service, following shall apply:

a) Port size shall be equal to line size for rating up to ASME Class1500.

b) Port size shall not be smaller than one size lower than that of the line size for body rating ASME Class 2500 and above.

2.1.6 Vendor to note that there shall not be any price or time implications in case the valve port size need to be changed to accommodate minor process changes while keeping the valve size and other specifications same during detailed engineering.

2.1.7 Flow Direction

2.1.7.1 In general, flow direction shall be as below:

a) Flow tending to open for single seated unbalanced valve design.

b) Flow entering between the seats for double seated valves.

c) Flow entering at the side and leaving at the bottom for angle valves.

For valves design other than those specified above, flow direction shall be as per manufacturer standard.

2.1.7.2 Flow direction shall be clearly marked on the control valve body.

2.1.7.3 For 3-way control valves, service like mixing or diverting, shall be clearly identified with inlet and outlet end connection clearly marked on the control valve body.

2.1.8 End Connections

2.1.8.1 Unless otherwise specified, the following shall govern:

a) Threaded end connections shall be to NPT as per ASME B1.20.1.

b) Flanged end connections shall be as per ASME B 16.5/ B 16.47B/ AWWAA C207 CL.D.

c) Flange face finish shall be as per ASME B16.5. The face finish shall be as follows:

125 AARH : 125 to 250 micro inch AARH

63 AARH : 32 to 63 micro inch AARH

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d) Grooves of ring type joint flanges shall be octagonal as per ASME B 16.20

2.1.8.2 Face-to-face dimensions of globe type control valves shall be in accordance with ISA 75.08.

2.1.8.3 Where provided, control valve bottom drains shall be blind flanged. Flange dimensions and rating shall correspond to ASME B16.5.

2.1.9 Material of Construction

2.1.9.1 The material of construction of control valves body shall be as specified in the data sheet. No material shall be substituted by vendor without specific written approval from purchaser.

2.1.9.2 Control valve body, bonnet, bottom flange, line flanges and other pressure containing assemblies shall be of the same material of construction as specified for valve body in the purchaser's data sheets.

2.1.9.3 The bonnet flange and bottom flange shall have metallic spiral wound gaskets suitable for the specified service. The gaskets with asbestos bearing fillers shall not be used.

2.1.9.4 Vendor shall be responsible for selecting proper material for the internal parts of control valve. All such materials shall have the same or better specification than specified in the purchaser's data sheets.

2.1.9.5 The material of construction of silencers, diffuser plates, diffuser plate assembly etc shall be as per the body material specified in the purchaser's data sheets, as a minimum.

2.2 Trim

2.2.1 The term 'trim' covers those parts of valve assembly (excluding the body, bonnet and bottom flange) which are exposed to and are in contact with the line medium consisting of but not limited to the seat ring, valve stem, valve plug, valve plug guide, guide bushing and cage.

In case of rotary type of control valves like butterfly, ball, segmental ball, rotary plug, eccentric disc and rotary disc, the term trim covers disc/ball, seat ring, shaft and bearing.

2.2.2 Guiding

2.2.2.1 Single seated globe and angle type control valves shall have heavy top plug guiding or cage guided design as per data sheets. The cage shall provide a continuous plug guiding

2.2.2.2 Double seated valves shall have top and bottom or cage guiding and shall be of the pressure balanced type.

2.2.2.3 Whenever cage type control valves are specified, top guided or top and bottom guided control valves can be offered provided it meets all other process and functional requirements. But whenever top or top and bottom type of guiding is specified, cage type control valves shall not be offered. However, if the service requires the anti-cavitation trim or low noise trim then in place of top or top and bottom guiding the cage type control valve can be accepted only after reviewing the control valve sizing.

2.2.2.4 Rotary control valves like butterfly, segmental ball, eccentric rotary plug etc shall have blowout proof shaft guiding design.

2.2.3 Trim Design

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2.2.3.1 Control valve manufacturer/vendor shall be responsible for trim selection and trim design of the control valve. However it must meet the following minimum requirements:

a) Control valve trim design shall suit the type of guiding specified in the data sheet.

b) The trim design and material of construction shall be selected to minimize the risk of galling particularly in case of cage guided valves. Vendor shall select proper material pairs, surface finish, hardness and clearances wherever possibility of galling exist.

c) Under extreme temperature conditions, vendor shall consider increased clearances at room temperature and seal welding of threaded seat rings etc. Hard facing of trim shall be used in high temperatures. For very low temperature application, material used shall have adequate cold impact strength.

d) For globe/angle/3-way type of control valves, stem and plug shall be detachable and shall be attached together by suitable threaded design secured with a pin to avoid plug rotation during operation.

e) For top and bottom guided control valves with sizes above 8", post and guide bushing design shall be used to prevent rotation of plug and stem.

f) Whenever cavitation conditions are expected, vendor shall select a special anti-cavitation trim design and shall use trim material of sufficiently high hardness.

g) Whenever the possibility of aerodynamic noise in a control valve exists under any operating condition specified in purchaser's data sheet, vendor shall select a special low noise trim for that application.

h) For control valves with anti-cavitation or low noise trim, the no. of stages shall be decided by vendor ensuring that the selected number of stages can sufficiently withstand the dynamic fluid forces to avoid vibration of stem and plug during normal continuous operation. Vendor shall ensure trim design to account for worst case dynamic force / power generated by the process fluid under maximum operating conditions with a 10% safety margin.

2.2.3.2 The plug inherent characteristics shall be as indicated in the purchaser's data sheet. However, following shall be followed unless otherwise specified:

a) Control valves with low noise and anti-cavitation trim design shall have modified equal percentage or linear characteristics.

b) Rotary type control valves shall have modified equal percentage or equal percentage characteristics.

c) Control valves with flow co-efficient less than 0.4 shall have equal percentage or linear characteristics.

d) All other control valves shall have equal percentage characteristics, unless linear characteristic is specified in Purchaser's data sheets or required to meet the valve percentage opening limits within the process operating conditions.

Whenever linear or modified equal percentage characteristics are specified, equal percentage characteristics shall also be acceptable. Characterized positioner cam design to meet specified inherent control valve characteristics shall not be offered.

2.2.3.3 Trim Material

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2.2.3.3.1 Whenever stellited or hardened trim is specified in the data sheets following material of construction for the trim parts shall be acceptable.

a)	Plug and seat	Stellite sheathing/hard alloy coating or solid stellite
b)	Cage	Nitrided or stellite sheathing/hard alloy coating or solid stellite.
c)	Guide bushing	Stellite coating/sheathing or solid stellite
d)	Valve stem	Hardened SS /Inconel X-760

In case of steam, water, air and other non-hydrocarbon utility services 17-4 PH SS or 440C is also acceptable.

Special material requirements, if specified in the datasheets, shall supersede the above mentioned requirements.

2.2.3.3.2 Minimum acceptable hardness in case of stellited or hardened trim shall be of the order of RC 38 (BHN 352) to RC 45 (BHN 429).

2.2.3.4 Leakage class

a) Leakage class as per ANSI FCI 70.2 shall be specified in the purchaser's data sheet for each control valve. Where no leakage class is specified, the same shall be considered as Class III for Top-bottom Guided valves and Class IV for all other type of valves. Higher leakage class shall be provided wherever indicated in purchaser's data sheet.

b) For control valves specified with Class VI leakage class, vendor shall select the soft seat (elastomer) material suitable for the process conditions i.e., shut off pressure, maximum temperature and process fluid.

2.2.3.5 Control valve experiencing cavitation, flashing and noise are generally identified in the purchaser's data sheet. Same must be offered without exception. In case in any valve, vendor's calculation show occurrence of cavitation, flashing or noise under any of the specified process condition, vendor shall select proper type of valve trim to suit such process conditions even if the same is not explicitly specified in the Purchaser's data sheets.

2.2.3.6 Minimum acceptable materials of construction to be considered by vendor for valve components are specified in Purchaser's datasheets.
However, alternate superior materials may be provided if they meet all process conditions (operating, design, fluid properties, corrosion, etc), testing (ASME, API, radiography, etc) and statutory requirements (ASME, API, IBR, NACE, etc) specified by purchaser. Accordingly, the following alternate materials can be accepted: Body & bonnet: ASTM A105, ASTM A 216 gr. WCB / WCC in place of carbon steel.

2.3 Sizing

2.3.1 The control valve capacities in terms of flow coefficient (Cv) shown in the purchaser's data sheets have been calculated based on the formulae given in the standard ISA 75.01 "Control valve sizing equations".

All factors used while arriving at the sizing are also as per ISA 75.01. Vendor must resize the control valves considering various factors specific to the offered valves.

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2.3.2 Purchaser's data sheet indicates calculated flow co-efficient values at minimum, normal and maximum operating conditions. Vendor shall calculate this co-efficient as per the offered control valve and select the size considering valve openings as under:

At maximum flow	-	less than 90% open
At normal flow	-	typically 75% open
At minimum flow	-	more than 10% open

2.3.3 Rangeability of globe type of valves shall be 30:1, as a minimum. Vendor shall ensure that the actual rangeability of offered valves shall meet these requirements. For other types of offered control valves, vendor to specify that the available rangeability of the offered valves meet the requirements specified in the purchaser's data sheets.

2.3.4. Wherever butterfly valves are specified, these shall be high performance type with maximum valve opening of 90°.

2.3.5. Vendor shall offer valves with standard Cv as per their catalogue. However in case it is unavoidable due to percentage opening or any other technical sizing criteria to offer valve Cvs which are not indicated in standard product catalogue, vendor shall ensure that capacity test certificate is made available for the valves from independent test laboratory like FCRI, etc. clearly indicating the capacity in terms of Cv values (as per ISA 75-01) and valves shall be provided accordingly.

2.3.6 Vendor to note that wherever more than one case is specified in data sheet, vendor to size the control valves for all cases and select the valve based on the governing case.

2.4 Noise

2.4.1 Vendor shall examine each control valve for noise generation possibilities. The noise level shall be calculated as per ISA 75.17 or any other equivalent standard.

2.4.2 Noise generated by control valve during operation shall be limited to OSHA specified levels i.e. the maximum allowable noise shall be less than 85 dBA, when measured at a distance governed by ISA 75.17.

2.4.3 If the predicted noise level is found to exceed 85 dBA SPL, control valve shall be treated for noise. Source treatment for noise shall be resorted to. When source treatment for noise is not sufficient to reduce the noise level below 85 dBA, vendor shall provide path treatment like diffuser plate (silencer) etc in addition to source treatment so as to reduce the level below 85dBA. Whenever additional path treatment is recommended, the maximum differential pressure across the diffuser plate shall not exceed 40% of the specified differential pressure. Where path treatment is required for noise, suitable baffle / diffuser plates shall be provided installed within expander assembly with flanged ends.

2.4.4 Vendor shall also furnish noise calculations with and without the use of these devices and the noise abatement achieved in individual components.

2.4.5 Whenever Diffuser plate is provided by the vendor as part of path treatment of noise, Diffuser plate shall be inserted between control valve body and pipe flanges. Vendor shall supply long studs and nuts along with a pair of gaskets on the downstream side with material as per Annexure-1 and Annexure-2 attached with this specification.

In cases where the diffuser plate size is higher than the valve body size or there is a need of multiple diffuser plates, vendor shall supply the complete diffuser assembly with eccentric

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expander and flanged end connections for mating with the upstream control valve flange and downstream line size, unless otherwise specified in the Requisition.

2.5 Packing Box, Bonnet and Stem

2.5.1 Packing Box

2.5.1.1 The packing box shall be flanged bolted to the bonnet and shall meet the requirements specified in purchaser's data sheet.

2.5.1.2 Generally low friction type packing like braided PTFE will be used wherever operating conditions permit. For high temperature application (with design temperature above 200°C), Grafoil or equivcbalent gasket suitable for the specified service shall be selected. Asbestos based packing material shall not be used.

2.5.1.3 Where specifically indicated, control valve shall have its packing box drilled and tapped to 1/4" NPT (F) for connecting external lubricator. When external lubricator is not provided, this hole shall be plugged.

2.5.1.4 An isolating valve shall be provided with all valves having external lubrication provision. Vendor shall specify the lubricator stick material used in each case.

2.5.1.5 Fugitive Emission Requirements

a) Unless otherwise specified, all Control valves shall comply with the following performance class requirement as per ISO-15848-1:

Service	Tightness Class	Endurance Class	Temperature Class
H2, H2S and Benzene	AH / AM	CC1	t200 °C
All other services	CH / CM	CC1	t200 °C

b) Type test certificates shall be provided by vendor with the offer clearly indicating the extension of qualification to untested valves. All valves supplied by vendor shall fall within this extended qualification criteria.

c) In case any valve supplied by vendor is not covered under the extended qualification criteria of type test certificates, vendor shall test the valve as per ISO-15848-1, prove compliance to performance class requirement as per clause 2.5.1.5 a), furnish the test reports for purchaser's review as part of vendor document submission before inspection and only then proceed for dispatching the valve to site.

d) Alternatively, Control valves with type test qualification as per API 624 are also acceptable in place of Class CH / CM of ISO-15848-1.

2.5.1.6 For application in vacuum service, vendor to provide inverted packing design suitable for vacuum service. For pressure-cum-vacuum service, the control valve shall have dual packing design suitable for the application and Fugitive emission requirement is not mandatory for such application.

2.5.2 Bonnet

2.5.2.1 The bonnet shall be flanged bolted to the body. Threaded bonnets are not permitted.

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2.5.2.2 Wherever the operating temperature of the fluid is above 200°C, extension or radiation finned bonnet shall be provided. Vendor standard bonnet design shall also be acceptable if these are suitable for higher temperatures.

2.5.2.3 For the operating temperature below 0°C, vendor shall provide extended bonnet design. Vendor standard bonnet design shall also be acceptable if these are suitable for lower temperatures. For valves in cryogenic application bonnet extension shall be as per BS-6364 as a minimum.

2.5.2.4 For valves with Bellow seal type bonnet, Vendor's standard proven design considering extra gland packing with equivalent sealing characteristics for minimizing the leakage to the external environment from the valve bonnet is also acceptable.

2.5.3 Stem

2.5.3.1 The stem surface finish shall be fine. Extra fine surface finish shall be provided wherever the packing material is PTFE.

2.5.3.2 The stem/shaft shall be designed for the maximum thrust of the actuator without any measurable deflection.

2.5.3.3 The valve stem/shaft shall be connected to the actuator stem/shaft by suitable arrangement to avoid backlash problem.

2.6 Actuator

2.6.1 Pneumatic Actuator

2.6.1.1 Actuator shall be sized for the shut-off differential pressure indicated in purchaser's data sheets. However, for 3-way type control valve, the actuator shall be sized for maximum differential pressure, unless specifically indicated otherwise.

2.6.1.2 The actuator shall be designed to move the valve to the failure position specified in the purchaser's data sheet. For failure position specified as 'fail-locked' (with Drift close or Drift open), vendor shall provide fail-lock relays to meet the requirement.

2.6.1.3 Actuator casing shall be made of pressed steel or anodised aluminium. Non-metallic actuator casings shall not be offered.

2.6.1.4 Springs shall be corrosion-resistant and shall be cadmium or nickel-plated. Alternately vendor standard coating shall also be acceptable. These shall be of the enclosed type. The compression of the springs shall be adjustable.

2.6.1.5 In general, an actuator operating range of 0.2-to 1.0 kg/cm^{2}g is preferred. However when vendor standard actuator model is not able to meet the specified shutoff pressure, higher actuator operating range may be offered.

2.6.1.6 In general, spring opposed diaphragms type actuators shall be used. Only when this type of actuator becomes extremely unwieldy, based on the data specified in the purchaser's datasheet, should a piston and cylinder type of actuator be considered.

2.6.1.7 Whenever piston and cylinder actuator is considered, single acting spring return type shall be used.

2.6.1.8 Whenever double acting springless type of actuator is specified in Purchaser's valve data sheet or offered by the vendor, all accessories like pilot valves, booster relays, non-return valve, pressure gauge, volume tank etc. shall be provided to ensure desired action on air

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failure. Volume tank is not required when failure position in Purchaser's data sheet is specified as 'Fail lock' only.

2.6.1.9 Volume Tanks (Volume bottles / Air reservoirs), required for double acting springless type actuator or where ever specified in Purchaser's valve data sheet shall be provided by vendor with all required accessories including PG, PSV, NRV, etc. in 316 Stainless steel construction as a minimum. The volume tank shall be sized at the minimum air supply pressure for a minimum of three full strokes. Volume tanks shall be painted with same colour as that of the corresponding actuator. The volume tanks when provided shall be free standing equipment and not mounted on valve actuator. Volume tanks shall be of SS304 construction and shall be designed as per ASME Sec VIII Div. I with a design pressure of 10.5 Kg/cm2g with a minimum thickness of 6mm. Unless otherwise specified, vendor shall supply minimum 10 m of interconnecting tubing between the Volume Bottles / Volume tanks and actuator assembly. Volume bottle shall be tagged with the associated control valve tag number by the vendor

2.6.1.10 For actuator casing design, vendor shall consider at least any one of the following:-

- Actuator casing shall be suitable for 1.5 times the maximum pneumatic operating pressure

- Actuator provided with upstream safety valve set at "Actuator Casing suitable pressure less 0.2 kg/sq.cm.g"

- Actuator provided with Positioner having Overpressure Limit feature and set for the "Actuator Casing suitable pressure less 0.2 kg/sq.cm.g"

2.6.1.11 Valve stem position indicator shall be provided for every control valve. The position indicator scale shall be marked from 0 to 100% in steps of 10%.

2.6.1.12 In general, side-mounted hand-wheel shall be provided whenever specified in Purchaser's data sheet. Hand-wheel shall provide manual control in both opening and closing directions independent of spring action. Hand-wheels shall be of non-rising type suitable for accurate valve positioning .The hand-wheel actuator shall be sized to provide the required thrust for valve positioning with 178N force applied to the hand-wheel.

2.6.1.13 Actuator orientation shall be as per purchaser's requirements, in general. When, no requirements are indicated by purchaser, vendor shall provide recommended actuator orientation. It shall be possible to change this orientation at site for the offered valve-actuator combination in case it is found necessary.

2.6.1.14 The failure position of valves shall be indicated in the data sheet, vendor to note that change in failure position if intimated by Purchaser during review of engineering drawings in the order execution phase shall not have any implication.

2.6.1.15 All the control valves shall be provided with rain protection for diaphragm vent ports. 1/4 inch SS tube formed to inverted U shape with necessary fitting shall be provided for this purpose.

2.6.2 Actuator Sizing

2.6.2.1 Vendor shall be fully responsible for the sizing and selection of the correct actuator for the specified control valve. Any change in actuator model number necessary to meet requisition requirements after placement of order shall be taken care of by vendor without any price or time implication. While sizing the actuator, vendor shall ensure that the actuator is able to develop sufficient thrust to properly seat the control valve plug/disc at a pressure which is at least 0.5 units less than the minimum air supply pressure specified in purchaser's datasheet and the specified shut-off conditions.

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2.6.2.2 While sizing the actuator, vendor must ensure that the sizing factors indicated below are fully complied. Higher sizing factor may be considered if found necessary by vendor.

a) For control valves with leakage class IV and below, the actuator shall be sized considering actuator thrust at least 1.3 times the total force induced by shut-off conditions specified in the data sheet and the force required to overcome packing friction. Vendor shall utilize this factor as 1.5 in case the control valve is operating between 80% to 90% or 10% to 20% in any of the specified conditions.

b) For control valves with leakage class V and above, the actuator shall be sized considering actual thrust at least 1.5 times the total force induced by specified shut-off conditions in the purchaser's data sheet and the force required to overcome packing friction.

2.6.2.3 Vendor shall indicate the recommended actuator orientation. In addition other allowable orientations shall also be provided along with the offer. The orientation of the actuator may be changed after order during detail engineering. The vendor shall do the same without any price or time implication.

2.7 Accessories

2.7.1 Positioners

2.7.1.1 Positioners shall be of force-balance type or smart digital type or fieldbus type as specified in the purchaser's datasheet. They shall be direct acting, with an adjustable gain unless otherwise specified.

2.7.1.2 The pneumatic positioner shall be provided with an integral by-pass switch whenever the operating range of the actuator is the same as that of the control signal.

2.7.1.3 Every positioner shall have two pressure gauges mounted on it, one each for air supply and for positioner output to actuator. In addition, pneumatic positioner shall have a third pressure gauge for control signal.

2.7.1.4 Pneumatic connections shall be ¼" NPT (F) / ½" NPT (F) as per vendor's requirement and cable entry shall be ½" NPTF. If connection for cable entry is different than that specified, suitable adapters shall be provided.

2.7.1.5 Positioners shall be side-mounted on control valves and shall be Linkage-less / contact less type. Alternatively positioners with SS linkages is also acceptable. Any applicable links shall be of corrosion resistant Stainless steel linkages and with rugged brackets. All control valve positioners shall have metallic casing.

2.7.1.6 All positioners in Electrical Gas Group IIC area as specified in Purchaser's datasheet shall be dual certified. i.e certified intrinsically safe Ex'i' and Flameproof Ex'd'.

2.7.1.7 Valve position shall be available through HART/FF signal as a default. Additionally, Positioners shall be provided with 4-20mA hardwired output signal for position transmission if specifically indicated in Purchaser's data sheet.

2.7.1.8 The Software necessary for advance control valve diagnostics like seat ring condition, gland packing condition, actuator leakage, device checks, maintenance etc. shall be supplied by vendor. Any such diagnostic software related to Smart or fieldbus positioner shall be of "plug-in" type and the software shall be easily integrated with Asset Management System Platform of purchaser. These advance diagnostic software shall be of latest release or version with advanced features

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2.7.1.9 Vendor shall also ensure that all electric & pneumatic entries to be suitably plugged before dispatch to site and metallic plug shall be provided.

2.7.2 Smart type and fieldbus type positioners

2.7.2.1 Digital smart positioners or fieldbus type of positioners with diagnostic capabilities shall be supplied whenever specified in the purchaser's data sheets. These shall meet the following minimum requirements:

a) The positioner sensor and sensing mechanism shall be rugged and shall not be affected by the line/valve vibration. The performance of the positioners shall be immune to above vibration.

b) The positioner's output and input range shall be field adjustable without any hardware modification. The output from the positioners shall be available for both single acting as well as double acting actuator.

c) Each positioner shall be operable, configurable and accessible through HART compatible hand held configurator/fieldbus configurator as applicable.

d) The positioner shall be a two-wire device, which shall operate on two-way digital communication mode. All engineering, configuration, diagnostic and maintenance related data shall be provided by the positioner.

e) The smart positioner shall provide HART protocol of latest version and shall be capable of implementing commands from Instrument Asset Management System / hand-held HART configurator.

f) Positioners with fieldbus output shall meet the following requirements:

i) All positioners must satisfy the requirements of the fieldbus registration laboratory with applicable checkmark like FieldBus Foundation, Profibus Nutzerorganisation e.v (PNO) or as specified in the purchaser's data sheets.

ii) All positioners shall have analog output (AO) and controller blocks (PID).

iii) All positioners must be interoperable and shall have valid interoperability test clearance like ITK latest version for foundation fieldbus or equivalent for profibus PA, as applicable.

iv) The fieldbus positioners shall support peer-to-peer communication with two wire communicator and bus powered supply.

v) Fieldbus positioners as offered shall not be polarity sensitive.

vi) The fieldbus positioners in hazardous area shall be certified as per entity concept or shall be FISCO approved as per the requirements specified in the purchaser's specification.

vii) Internal software shall be configured by the vendor including the following information:

-Serial Number

-Device tag (Tag No.)

-Process Description/service

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viii) Positioners shall be capable of supporting incremental Device Description (DD) for extra functionality and/or software revisions in Device memory.

g) The positioners shall be suitable to operate with commercially available asset management software and shall support the following features, as a minimum:

i) It shall allow multi-master for configuration, calibration, diagnosis and maintenance. The primary could be a host computer and secondary could be a hand held communicator.

ii) It shall be capable of implementing universal commands. It shall be possible to communicate all commands of commercially available asset management system to/ from smart positioner.

h) The offered positioners shall meet the following performance characteristics: -

i) Overall control accuracy shall be better that ±0.5% of span.

ii) Repeatability shall be less than ± 0.25% of span.

iii) Hysteresis shall be less than ± 0.5% of span.

iv) Vendor shall supply the valve's operating signatures in the form of hard copy and soft copy for each control valve supplied with smart positioners. The necessary software for advanced control valve diagnostics like seat ring condition, gland packing condition, actuator leakage etc. shall also be included.

i) All positioners shall have metallic casing and cover either of stainless steel or of anodized aluminium.

j) Fieldbus positioners shall support EDDL requirements as per IEC 61804/FDT/DTM requirements, as specified in job specifications.

k) Acceptance criteria for Performance/Calibration of Valves with Smart / FF Positioners shall be 1% of span.

2.7.3 Electro-Pneumatic Converter

2.7.3.1 Electro-pneumatic converter shall be of electronic feedback type unless specified otherwise and shall be yoke mounted.

2.7.3.2 It shall have an integral terminal housing. Electro pneumatic converter with flying leads shall not be acceptable.

2.7.3.3 Unless otherwise mentioned, it shall be intrinsically safe.

2.7.3.4 Pneumatic connections shall be ¼" NPT (F) / ½" NPT (F) as per vendor requirement. The electrical connections shall be 1/2" NPT (F). If they are different, suitable adapters shall be provided.

2.7.3.5 The overall accuracy of the electro-pneumatic converter shall be better than ±0.3%.

2.7.3.6 Acceptance criteria for Performance/Calibration of Valves shall be 1.5% of span.

2.7.4 Air Filter Regulator

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2.7.4.1 Vendor shall supply air filter regulator with each positioner complete with an integral output gauge.

2.7.4.2 Air filter regulator shall be sized considering the air supply pressure and flow required to meet requirements specified in the purchaser's data sheets.

2.7.4.3 Filter material shall be sintered bronze. Filter size shall be maximum 5 microns. However, lower filter mesh size shall be considered to suit the electro pneumatic converter vendor's requirement.

2.7.5 Valve Jacketing

2.7.5.1 The jacketed valves shall have steam inlet/outlet connections as flanged.

2.7.5.2 The valve end connections shall be one size higher than the normal valve connections for jacketed valve.

2.7.6 Hand held configurator for Smart Instruments

Hand Held configurator shall be universal type and shall be able to communicate with all make and models of smart instruments with HART output like transmitters, smart positioners etc., and shall be capable of carrying out all engineering functions like calibration, configuration and diagnostics. The hand held configurator shall be certified intrinsically safe when used in hazardous area. Carrying case shall be supplied with each configurator.

2.7.7 Fieldbus configuration :

The fieldbus configuration, whenever specified in datasheet, shall be provided with hardware and software for configuration and maintenance of fieldbus devices and also to perform diagnostics and troubleshooting of the fieldbus segments.

2.7.8 Battery charger

Both Fieldbus and HART configurations shall be supplied with battery charger for battery charging. Unless otherwise specified, battery charger shall operate at 230V 50Hz supply.

2.7.9 Wherever solenoid valves have been asked for control valves in modulating service, the control valves are for modulating cum shutdown application. For all such cases, solenoid valve shall be installed between positioner output and actuator. The de-energisation of solenoid valve shall bring the control valve to failure position by venting the actuator

2.8 Control valve accessories like Air Filter Regulators (AFR), Smart Positioners, Foundation Fieldbus Positioners , Solenoid valves, Limit switches, handwheel, Pneumatic lock relay etc. (Wherever applicable) shall be supplied in fully assembled conditions with minimum of ¼" / 6.0mm or 8.0mm OD with 0.04"/ 1 mm wall thickness SS316L air tubing. Material for mounting part/bracket shall be SS as minimum. Tube fittings shall be of flareless compression type of SS316 material. The fitting/ ferrule hardness shall be in the range of RB 85-90 so as to ensure a minimum difference of RB 5 to 10 between tube and fitting. The ferrule shall also be made of stainless steel (SS 316). Tubing of higher size like ½" / 12.0mm OD or higher, min 0.049"/ 1.2mm thick (if required) for proper actuation of actuator / control valve shall be provided by vendor. Accessories like AFR shall be selected to match the air tubing requirements.

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2.9 **Special Service Valves**

All control valves in oxygen and chlorine service shall be thoroughly degreased using reagents like trichloro-ethylene or carbon tetra-chloride. End connections shall be blinded / plugged after this degreasing process in order to avoid entrance of grease and oil particles.

2.10 **Finish**

2.10.1 The body shall be painted as below:

Carbon steel body	-	Light grey (RAL -7035)
Alloy steel body	-	Canary yellow (RAL-1003)
Stainless steel body	-	Natural
Above 150°C Operating Temp.	-	Aluminium white (RAL – 9006)

Items like silencers, diffuser plate assemblies etc., shall be painted as per respective control valve body requirements.

2.10.2 The actuator shall be painted as below:

Direct action (open on air failure including fail lock drift open) valves - Green (RAL-6024)

Reverse acting (close on air failure including fail lock drift close) valve- Red (RAL-3001)

Fail Lock / Fail Last (Stay-put on air failure) valve -Yellow(RAL-1004)

Items like air volume tanks etc., supplied as an accessory along with the actuators, shall be painted as per corresponding actuator.

2.10.3 Valve Body, Actuator and accessory Paint colours complying to equivalent BIS Standard IS-5 in place of specified RAL Codes mentioned above are also acceptable.

3.0 NAMEPLATE

Each control valve shall have a stainless steel nameplate attached firmly to it at a visible place, furnishing the following information:

a) Tag number as per purchaser's data sheet.

b) Body and port sizes in inches.

c) Valve flow coefficient (C_V).

d) Stem travel in millimetres.

e) Action on air failure.

f) Spring range.

g) Air supply pressure.

h) Manufacturer's model number for the valve body, actuator and positioner.

4.0 INSPECTION AND TESTING

Purchaser reserves the right to inspect and witness testing at vendor's works as per Inspection Test Plan. All these tests shall be completed by the vendor and test reports shall be submitted to purchaser for scrutiny.

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5.0 SHIPPING

5.1 The control valve and its accessories shall be supplied pre-assembled and pre-tubed.

5.2 All threaded and flanged openings shall be suitably protected to prevent entry of foreign material.

5.3 Valves with external lubricators shall be lubricated prior to shipment.

5.4 Valves in oxygen and chlorine service shall be packed separately along with a certificate indicating 'CERTIFIED FOR OXYGEN / CHLORINE SERVICE', as applicable.

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Sr. No.	Piping Classes	Nut and Bolt Material
1	A1A, A2A, A5A, A6A, A7A, A8A, A9A, A10A, A11A, A13A, A14A, A15A, A19A, A20A, A32A, A33A, A1K, A6K, A1M, A1N, B1A, B2A, B5A, B6A, B9A, B13A, B18A, B19A, B32A, B1K, B6K, B18K, B1M, B3M, B5M, B1N, B6N, D1A, D2A, D5A, D18A, D1K, D18K, D18P, E1A, E2A, E5A, E5E, F5A	A-193 Gr. B7 A-194 Gr. 2H
2	A16A, B16A	A-193 Gr. B7M A-194 Gr. 2HM
3	A1B, A1D, A4F, A4G, B1B, B1D, B5D, B1E, B3F, B4F, B4G, D1B, D2B, D1D, D2D, D5D, D5E, F2D	A1-193 Gr. B16 A-194 GR. 4
4	A2K, B2K, D2K	A-320 Gr. B8 CL.2 A-194 Gr. 8
5	A4A, A1H, B4A, B1H, D4A, D1H	A-320 Gr. L7 A-194 Gr. 4
6	A3Y	A-307 Gr. B A-563 Gr. B
7	A3A, A3K, A3Y, A4Y, J3A	A-307 Gr. B A-563 Gr. B
8	A1Z, A4Z, A5Y, A5Z, J2A, J5A	A-307 Gr. B (Galv) A-563 Gr. B (Galv)
9	B4K, B5K	A-193 Gr. B8 M C11 A-194 Gr. 8 MA
10	A32Y	A-193 Gr. B (Galv) A-194 Gr. 2H (Galv)
11	B3M, B4K, B5K, B5M	A-453 Gr. 660 CL.A A-453 Gr. 660 CL.A

Note : Bolts & Nuts material mentioned above is applicable for loose supply of nuts/bolts.

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Sr. No.	Piping Classes	Gasket Material
1	A1A, A6A, A9A, A10A, A11A, A13A, A14A, , A19A, A1B, A1D, A1H, A1K, A1M, A4A, A4F, A4G, B1A, B1H, B2A, B4A, B6A, B9A, B13A, B18A, B19A, B32A, B18K, D1A, D2A, D1H, D1K, D4A, D18A, D18K, D18P	SP.WND SS316+GRAFIL+ I Ring
2	B5M	SP WND SS316H+ GRAFIL + I RING
3	A2K, B2K, D2K	SP WND SS 316+GRAFIL+SS 316 I/O RING
4	B1N	SP WND SS 316L+GRAFIL + I RING
5	B6N	SP WND SS 316L + GRAFIL
6	A1Z, A3Y, A4Y, A4Z, J2A	BUTYL RUBBER
7	E1A, E2A, E5A, F5A	SOFT IRON
8	E5E, F2D	5% CR, 0.5% MO
9	B4K, B5K	SS 316H+GRAFIL+I RING SS 316 O RING
10	A5Z	BS 7531 GR X (PTFE JACKETED)
11	A5Y, A8A, A15A, A32Y, A33Y	IS 2712 Gr. A/1
12	B3M	SP WND SS 321+GRAFIL+I RING
13	A1N, A6K, A16A, B16A	SP.WND SS316L+GRAFIL+ I Ring
14	A3A, A3K, A33A, J3A, J5A, A32A, A20A	NON ASBESTOS BS 7531 GR X
15	A2A	SP.WND SS316L+GRAFIL+ I Ring
16	B5A, D5A	SP.WND SS316L+GRAFIL+ I Ring
17	A7A, B1B, B1D, B1E, B1K, B3F, B4F, B4G,B5D, D1B, D1K, D2B, D1D, D2D, D5D, D5E	SP WND SS 316 + GRAFIL + I RING
18	B6K, B1M	SS 316 + GRAFIL

1. The gaskets material shall be applicable for loose supply of gaskets.

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इलेक्ट्रॉनिक उपकरणों के लिए मानक विनिर्देशन

STANDARD SPECIFICATION FOR ELECTRONIC INSTRUMENTS

Rev. No	Date	Purpose	Prepared by	Checked by	Standards Committee Convenor	Standards Bureau Chairman
					Approved by	
6	14.03.23	Revised and Reissued as Standard Specification	MG/AJS	KKP	MN	SM
5	14.11.17	Revised and Reissued as Standard Specification	GK	SMK	RG	RN
4	12.03.12	Revised and Reissued as Standard Specification	MN	RG	RP/JMS	DM
3	15.02.07	Revised and Reissued as Standard Specification	AR	TGM	HCJ	VC
2	05.08.05	Revised and Reissued as Standard Specification	KI	TGM	PM	VJN

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Abbreviations:

AARH	:	Arithmetic Average Roughness Height
EDDL	:	Electronics Device Description Language
FISCO	:	Fieldbus Intrinsic Safety Concept
FDT/DTM	:	Field Device Tool/ Device Type Manager
FF	:	Fieldbus Foundation
HART	:	Highway Addressable Remote Transducer
LAS	:	Link Active Scheduler
LCD	:	Liquid Crystal Display
NPS	:	Nominal Pipe Size
NPT	:	National Pipe Thread
RAM	:	Random Access Memory
WC	:	Water Column

Instrumentation Standards Committee

Convener: Mr. Mainak Nandi

Members:
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1.0 GENERAL

1.1 Scope

1.1.1 This specification, together with the data sheets attached herewith describes the requirements for the design, materials, nameplate marking, inspection, testing and shipping of electronic instruments.

1.1.2 The related standards referred to herein and mentioned below shall be of the latest edition prior to the date of the purchaser's enquiry: -

ASME	American Society of Mechanical Engineers		
	B 1.20.1	:	Pipe Threads General Purpose (Inch)
	B 16.5	:	Pipe Flanges and Flanged Fittings: NPS 1/2 through NPS 24 Metric/Inch Standard
	B 16.20	:	Metallic Gaskets for Pipe Flanges, Ring Joint, Spiral wound and Jacketed.
EN	European Standards		
	10204	:	Inspection Documents for Metallic Products
IS/IEC	Indian Standards/ International Electrotechnical Commission		
	IS/IEC 60079	:	Electrical Apparatus for Explosive Gas Atmospheres.
	IS/IEC 60529	:	Degree of Protection Provided by Enclosures (IP Code).
	IEC 61158	:	Fieldbus Standard for use in Industrial Control System
	IEC 61158-2	:	Physical Layer Specification and service definition for Fieldbus
	IEC 61326	:	Electrical equipment for measurement, control and laboratory use - EMC requirements
	IEC 61508	:	Functional Safety of Electrical/ Electronic/ Programmable Electronic Safety related Systems.
	IEC 61511	:	Functional safety instrumented system for the process industry sector
	IEC 61804	:	Function blocks (FB) for process control – Electronic Device Description
	IEC 61518	:	Mating dimensions between differential pressure (type) measuring instruments and flanged-on shut-off devices up to 413 bar (41.3 MPa)
ISA	International Society of Automation		
	S50.00.01	:	Compatibility of Analog Signals for Electronic Industrial Process Instruments.
ITK	Interoperability Test Kit (latest version)		

1.1.3 In the event of any conflict between this standard specification, job specification/data sheets, statutory regulations, related standards and codes, the following order of priority shall govern:

a) Statutory Regulations
b) Job Specifications / Data Sheets
c) Standard Specification
d) Codes and Standards

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1.1.4 In addition to compliance to purchaser's specifications in totality, vendor's extent of responsibility shall include the following:

a) Purchaser's data sheets specify the minimum acceptable material of construction of body, measuring element and accessories. Alternate superior material of construction shall also be acceptable provided vendor assumes complete responsibility for the selected materials for their compatibility with the process fluid and its operating conditions.
b) Selection of correct model number to meet the specifications in totality.
c) Selection of suitable sealant liquid for diaphragm seal instruments compatible with the process fluid and its operating temperature.

1.2 Bids

1.2.1 Vendor's quotation shall be strictly as per the bidding instructions to the vendor attached with the material requisition.

1.2.2 Vendor's quotation shall include the following:

a) Compliance to the specifications.

b) A detailed specification sheet for each item providing information regarding type, material of construction, performance specification, model number etc. of the offered electronic instruments. The material specification and the units of measurement for various parts in vendor's specification sheets shall be to the same standards as those indicated in purchaser's data sheets. Selection of correct Model number to meet the specifications shall be vendor's responsibility and vendor shall replace with the correct model if at any stage, the selected model is found deficient in meeting the specifications.

c) Proven references for each offered model number in line with clause 1.2.3 of this specification.

d) A copy of approval from local statutory authority, as applicable such as Petroleum & Explosives Safety Organisation (PESO) / Chief Controller of Explosives (CCE), Nagpur or Director General of Mines Safety (DGMS) in India, for the electronic instruments installed in electrically hazardous area along with:

i) Test certificate from recognized test house like Central Institute of Mining and Fuel Research (CIMFR) / Electronics Regional Testing Laboratory (ERTL) etc. for flameproof enclosure/intrinsic safety, as specified in the data sheet, as per relevant standard for all Indian manufactured equipments or for items requiring Director General of Mines Safety DGMS approval and a valid BIS approval.

ii) Certificate of conformity from agencies like Laboratorie Central Des Industries Electriques (LCIE), British Approval Service for Electrical Equipment in Flammable Atmospheres (Baseefa), FactoryMutual (FM), Physikalisch-TechnischeBundesanstalt (PTB), Canadian Standards Association (CSA), Underwriters Laboratories (UL) etc. for compliance to ATEX directives or certificate of conformity from IECEx or other equivalent recognized standards for all equipment manufactured outside India.

e) Deviations on technical requirements shall not be entertained. In case vendor has any valid technical reason, they must include a list of deviations tag number wise,

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summing up all the deviations from the purchaser's data sheets and other technical specifications along with the technical reasons for each of these deviations.

f) Catalogues giving detailed technical specifications, model decoding details and other related information for each type of electronic instruments covered in the bid. Information shall include, but not limited to product certifications, dimensional drawings, transient protection, range limits, power supply, current draw, vibration effect, power supply effect, electromagnetic compatibility. For Fieldbus instruments, information shall also include Fieldbus parameters like available standard function blocks/advanced function blocks and their execution time for each block, device type, number of link objects, virtual communication relationships, basic and advanced diagnostic features, transmitter failure mode, physical profile type etc.

1.2.3 All items, as offered, shall be field proven and should have completed minimum 6 months of operation after commissioning on the bid due date in the similar application with the process conditions similar to those as specified in the purchaser's data sheets. Items with proto-type design or items not meeting provenness criteria shall not be offered.

1.2.4 Wherever specified, vendor must furnish certified values of failure rates, probability of failure on demand (PFD) and test intervals for offered items for Safety Integrity Level (SIL) analysis. For diaphragm seal instruments, same shall be furnished for both transmitter as well as the seal system.

1.2.5 All documentation submitted by the vendor including their quotation, catalogues, drawings, installation, operation and maintenance manuals, etc shall be in English language only.

1.2.6 Vendor shall also quote for the following:

a) Stud bolts, nuts, gaskets as per annexure with diaphragm seal instruments.

b) Two-year operational spares for each model of instruments offered in the bid, which shall include electronic module, local indicator, o-ring/gasket set etc. based on vendor's recommendations.

c) Any special tool other than those covered under 1.2.6 (a) and (b). In case any special tools are needed for maintenance of offered instruments, vendor must certify in their offer.

1.3 Drawing and Data

1.3.1 Detailed drawing, data, catalogues and manuals required from the vendor are indicated by the purchaser in the vendor data requirement sheets attached with the requisition.

1.3.2 Final documentation consisting of design data, installation manual, operation and maintenance manual, etc submitted by the vendor after placement of purchase order shall include the following, as a minimum;

a) Specification sheet and catalogues for each electronic instrument and their accessories.

b) Certified drawing for each instrument, which shall provide dimensional detail, internal construction and part list, material of construction etc.

c) Calculations for integral orifice / conditioning orifice.

d) Copy of all test certificates

e) Installation procedure for electronic instrument and its accessories.

f) Calibration, Configuration and Maintenance procedures including replacement of its internal parts.

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g) Device Descriptor (DD) Files for configuring the FF device parameters and Common File Format (CFF) files for integrating the device into the system shall be provided (soft copy) by vendor for offline configuration by DCS vendor and the same shall match with the device configuration details of the transmitter.

h) Vendor shall furnish a list of all instruments in excel format as per annexure-3 enclosed with the specification including the following information for Fieldbus instruments.

i) Tag Number
ii) FF registered product code
iii) Device Type
iv) Manufacturer ID number
v) ITK Revision
vi) Firmware Revision
vii) Device Revision
viii) DD File Revision
ix) CF File Revision
x) HIST Test Completion
xi) Backup LAS functionality shall be disabled at the time of shipment. All FF device shall be shipped in the 'Ready to Run'.

All Fieldbus transmitters shall be suitable for operating between voltage of 9-32 V.

2.0 DESIGN AND CONSTRUCTION

2.1 General Requirements

2.1.1 All instruments shall be of state-of-the-art technology and shall be in compliance with the electromagnetic compatibility requirements specified in IEC-61326 standard.

2.1.2 Electronic instruments shall generally operate on nominal voltage of 24 V DC and shall be protected against short circuit and reverse voltage.

2.1.3 Electronic transmitters with two-wire system shall be suitable for delivering rated current to an external loop resistance of at least 550 ohms when powered with 24 V DC.

2.1.4 All Field transmitters shall have double compartment housing with metallic separation between the two compartments.

2.1.5 All Field transmitters shall have metallic housing.

2.1.6 Unless otherwise specified, transmitters shall be intrinsically safe type.

2.1.7 The instrument enclosure shall be metallic and shall have corrosion protection coating. Instrument enclosure shall be suitable for the area classification indicated in the purchaser's data sheets. All electronic boards/ cards shall have conformal coating suitable for corrosion protection normally prevalent in refinery. The enclosure shall meet the following standards:

Weatherproof housing	:	IP-65 to IS/IEC-60529
Flameproof housing	:	Flameproof/ Ex (d) as per IS/IEC-60079

Flameproof housing shall also be made weatherproof.

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2.1.8 The range of instruments shall be selected by vendor based on the set range indicated in the purchaser's data sheet. Where no set range is indicated, vendor may select the same as per the following guidelines;

a) The set range shall be 1.1 times the maximum process value or 1.4 times the operating process value whichever is higher rounded to the nearest ten.

b) The process variable shall preferably be in the middle third of the set range.

2.1.9 Measuring element in vacuum service shall have under range protection down to full vacuum, without undergoing a change in calibration or permanent set.

2.1.10 The type of electronic instruments shall be as specified in the purchaser's data sheet. Body & wetted part material shall be SS316 & SS316L respectively as a minimum. Transmitter vent/ drain material shall be same as wet part material.

2.1.11 For hydrogen service, transmitter sensing diaphragm shall be SS316L with gold plating. Gold plated Passivated Hastelloy C is also acceptable subject to max process design temperature of 200 deg C.

2.1.12 For chlorine service, the material of the sensor shall be Tantalum.

2.1.13 Diaphragm seal instrument shall meet the following requirements;

a) Diaphragm seal (flanged type) shall be integral with the instrument. In case wafer type diaphragm seal is provided, companion flanges shall be supplied by vendor. For diaphragm seal instruments long studs, nuts and gasket shall be provided by vendor.

b) Vendor shall include supply of long studs, nuts and gasket as per the materials specified in the purchaser's data sheet. In case purchaser's datasheet does not specify the MOC of long studs, nuts and gasket, refer Annexure – 1& 2 attached with this specification.

c) The sealant shall be an inert liquid, compatible with the process fluid and process operating as well as design temperature & pressure indicated in the purchaser's data sheets. Sealant shall be inert oil or equivalent for all diaphragm seal instruments in oxygen service.

d) When specified in purchaser's data sheet, spacer ring shall be supplied. The MOC of spacer ring shall be 316 Stainless Steel as a minimum. The spacer ring shall be provided with plugged vent/ drain connection of ½" NPTF. Suitable metallic plugs shall be provided by the vendor for the spacer ring vent/ drain connection.

e) The span of the offered model shall be selected to ensure zero elevation/zero suppression equal to the head created by the fill fluid for the specified capillary length in the data sheet.

f) The material of diaphragm seal flange shall be SS as a minimum and rating suitable for process conditions.

g) For full vacuum service, diaphragm seal instruments shall be all welded construction. The selection of seal fill fluid shall be decided by vendor. The diaphragm seal capillary armour shall be SS with PVC protection sleeve.

h) In place of capillary diaphragm seal differential pressure / level transmitter, remote sensor type differential pressure transmitter based on digital calculation shall be used

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wherever total capillary length combining both the legs is greater than 10 meters unless otherwise specified in the purchaser's datasheet. The model selection of the instrument shall be based upon the inlet pressure conditions.

i) The diaphragm seal models shall be part of vendor's published technical catalogue.

2.1.14 Wherever purchaser data sheet specifies integral flow transmitter, vendor shall supply complete assembly consisting of integral orifice, upstream and downstream meter runs with end flanges, isolation valves for transmitters meeting the following requirements:

a) Three nos. of integral orifice plates shall be supplied i.e., one is installed and two are spares.

b) Unless otherwise specified, material of construction shall be 316 Stainless Steel for integral orifice and meter run with flanges.

2.1.15 End connection details shall be as below: -

a) Threaded end connections shall be to NPT as per ASME B 1.20.1.

b) Flanged end connections shall be as per ASME B 16.5.

c) Grooves of ring type joint flanges shall be octagonal as per ASME B16.20.

d) Flanged face finish shall be as per ANSI B 16.5. The face finish shall be as follows:

125 AARH	:	125 to 250 microinch AARH
63 AARH	:	32 to 63 microinch AARH

2.1.16 All instruments in oxygen and chlorine service shall be thoroughly degreased using reagents like trichloro-ethylene. End connection shall be blinded / plugged after the degreasing process in order to avoid entrance of grease or oil particles.

2.1.17 Yoke mounted instruments shall be supplied with universal mounting bracket, U-bolt and nuts suitable for mounting the instruments on a 50 mm (nominal bore) pipe stanchion (horizontal or vertical). Also mounting brackets shall be suitably selected to ensure sufficient space is available at transmitter rear to terminate the field cable, operate the vent/ drain. Material of construction of mounting bracket shall be SS as a minimum.

2.1.18 All flow transmitters shall confirm to the latest edition of IEC 61518: 'Mating Dimension between differential pressure type measuring instruments'.

2.1.19 Plug-in circuit boards shall be designed and manufactured such that reverse insertion or insertion of the wrong card is prevented.

2.1.20 Terminals for electrical connections shall be clearly identified, and polarity shall be permanently marked.

2.1.21 Peak to peak ripple and total noise level in the analogue output signal shall not exceed 0.25% of the maximum signal.

2.1.22 Electrical cable entries shall have internal ½" NPT threads.

2.1.23 Span of the offered model shall be selected to ensure zero elevation/zero suppression equal to minimum 100% of the calibrated range.

2.1.24 Integral Output meter of each electronic transmitter shall have a freely configurable LCD display. The display shall be as follows:

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a) For Pressure, Differential Pressure, Flow & Temperature - Engineering Units
b) For Level – 100 % Linear

2.1.25 The performance of the transmitter shall not be affected by addition or removal or malfunction of integral output meter.

2.1.26 Wherever wetted parts material is specified as SS316/SS316L/SS321, Hastelloy-C is also acceptable.

2.1.27 For differential pressure transmitter, all integral parts of the transmitter shall be suitable for the differential over- range in either direction equal to the full rated pressure of the body with the opposite side vented to atmosphere without permanent distortion or calibration error.

2.1.28 Soft copy of the Device Descriptor (DD) files for configuring the transmitter parameters and Common File Format (CFF) files for integrating the device into the system shall be provided for offline configuration by system vendor.

2.2 Transmitters

2.2.1 Smart Transmitters

2.2.1.1 Smart transmitters in all conventional loops shall be smart (4-20 mA DC + HART) type only. Smart transmitters for flow, pressure, temperature, differential pressure and level applications shall be yoke mounted type unless specified otherwise. Meter electronics used for flow measurement etc. shall include all the associated items like preamplifier, converter, transmitter, integrator, integral output meter etc.

2.2.1.2 Smart transmitters shall be two wire microprocessor based type. These shall have a non-volatile memory, storing complete sensor characterisation and configuration data of the transmitter. All necessary signal conversions and output generation with the required protocol shall be carried out in the transmitter electronics. Integral output meter with LCD display shall be provided for all transmitters.

2.2.1.3 Transmitter shall also run complete diagnostic subroutines and shall provide diagnostic alarm messages for sensor as well as transmitter healthiness. In the event of detection of failure, the output shall be driven to a predefined value, which shall be field configurable.

2.2.1.4 Whenever specifically indicated in purchaser's data sheets, the meter electronics shall be provided with in-built protection against power supply & lightning surges.

2.2.1.5 The configurational data of the instruments shall be stored in a non-volatile memory such that this remains unchanged because of power fluctuations or power off condition. In case vendor standard instrument has battery backed RAM, vendor to ensure that battery drain alarm is provided as diagnostic maintenance message.

2.2.1.6 Accuracy of smart transmitters shall be as follows:

Type of Transmitter	Range of Transmitter	Accuracy
Direct	760 mm WC and above	Equal to or better than ±0.065% of range
Direct	Less than 760 mm WC	Equal to or better than ±0.15% of range
Diaphragm seal	500 mm WC and above	Equal to or better than ±0.25% of range
Diaphragm seal	Less than 500 mm WC	Equal to or better than ±0.5% of range

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The accuracy is defined as the combined effect of repeatability, linearity and hysteresis.

The rangebility of the transmitter for above mentioned accuracy shall be 1: 10.

2.2.1.7 The stability of the transmitters shall be as follows:

Range of Transmitter	Stability
760 mm WC and above	±0.2% of URL for a period of minimum 5 year
Less than 760 mm WC	±0.2% of URL for a period of minimum 1 year

2.2.1.8 Transmitter shall update the output at least 8 times a second.

2.2.1.9 Minimum transmitter response time shall be as follows:

a) For transmitter range of 760 mm WC and above, the response time shall be equal to or better than 500 milliseconds.

b) For transmitter range below 760mm WC, the response time shall be equal to or better than 1 second.

The response time of the transmitter shall be considered as the sum of dead time and 63.2% step response time of the transmitter.

2.2.1.10 Minimum over-range/static pressure protection of the transmitter shall be as follows:

Range of Transmitter ®	OVER RANGE / STATIC PRESSURE (*)	
	Pressure Transmitter Kg/Cm2	Differential Pressure Transmitter Kg/Cm2
0 < ® =< 250 mmWC	20	20
250 < ® =< 1000 mmWC	40	100
1000 mmWC< ® =< 10 Kg/cm2	40	160
10Kg/cm2< ® =<25 Kg/cm2	52	160
25Kg/cm2< ® =<100 Kg/cm2	160	160
® > 100 Kg/cm2	200	210

(*) However, if the over range/static pressure valve specified above is less than the maximum/design pressure of service conditions specified in the datasheets, offered instrument shall be suitable for the maximum/design pressure specified.

2.2.1.11 The 'WRITE' option shall be protected through password.

2.2.1.12 Temperature transmitters shall meet the following requirements as a minimum:

a) Temperature transmitter shall be universal type, able to accept input from resistance temperature detector (RTD) or thermocouple (T/C) of any type and range.

b) Temperature transmitters shall be freely programmable i.e., element type and range shall be programmable without any change in hardware / software.

c) Temperature transmitter shall be remote mounted type, in general. Head mounted transmitters shall be supplied when specifically indicated in purchaser's data sheets.

d) Temperature transmitters shall have dual input capability with automatic transfer to back-up sensor on failure of the primary sensor with alarm.

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e) Burn out protection must be provided with temperature transmitters. Upscale or downscale protection shall be decided based on its application to ensure fail-safe operation.

f) Temperature transmitters shall have a built-in linearising function to produce an output linear to temperature range.

g) The accuracy of the temperature transmitter with RTD element shall be as follows:

- For temperature above 350° C, ±0.075%.
- For temperature between 350° C to 150° C, ±0.15%.
- For temperature below 150° C, ±0.25%.

h) The accuracy of temperature transmitter with cold junction compensation for Thermocouple element shall be as follows;

- For temperature above 350° C, ±0.25%.
- For temperature between 150°C to 350°C, ±0.5%.
- For temperature between 120°C to 150°C, ±0.75%.
- For temperature below 120°C, ±1.0%.

2.2.1.13 When HART protocol is specified, the following features must be ensured;

a) It shall allow multi masters (minimum two, primary and secondary) for configuration, calibration, diagnostics and maintenance. The primary could be the control system or host computer and the secondary could be the hand-held communicator.
b) It shall be capable of implementing universal commands from either of these locations.
c) All HART transmitters shall be configurable for under current and over current.
d) All HART transmitters shall compliant to NAMUR NE 43 recommendations.

2.2.1.14 When Fieldbus is specified, transmitter shall meet the following requirements in addition to requirements specified in 2.2.1.13a & b;

a) All instruments must satisfy the requirements of the Fieldbus registration laboratory with applicable checkmark like Foundation Fieldbus, ProfibusNutZerorganisatione.v (PNO), or as specified in the purchaser's data sheets.

b) All instruments shall be polarity insensitive. Also, transmitter shall be LAS capable and provided with line plugging detection, whenever specified in data sheet.

c) All instruments shall have one no. of Analog Input (AI) block and One no. of Proportional, Integration and Differential (PID) control block, as a minimum.

d) All instruments must be interoperable and shall have valid interoperability test clearance like ITK latest version for Foundation Fieldbus or equivalent for Profibus PA, as applicable.

e) The Fieldbus instruments shall support peer to peer communication with two wire communication and bus power supply.

f) Fieldbus instruments shall have facility to detect plugged impulse lines, whenever specifically indicated in purchaser's data sheets.

g) The Fieldbus instruments in hazardous area shall be certified as per entity concept or shall be FISCO approved as per the requirements specified in the purchaser's specification.

h) All instruments shall support EDDL or FDT/DTM requirements, as specified in data sheets.

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i) Internal Software shall be configured by the vendor including the following information.

- Serial Number
- Device Tag (Tag Number)
- Process Description

j) All instruments shall be capable of supporting incremental Device Descriptor (DD) for extra functionality and/or software revisions in device memory.

k) Fieldbus based indicator shall be able to indicate all signals available in the Fieldbus segment, selectively.

2.3 Accessories

2.3.1 Field Universal Communicator:

2.3.1.1 Field communicator shall meet the following requirements:

a) Communicator shall be universal type and shall be compatible with all make and models of smart transmitters/positioners, with all engineering capability like calibration, diagnostics, configuration, inhibition of HART/Fieldbus signal, etc.

b) It shall be possible to connect the communicator at any of the following locations for purpose of digital communication;

i) Marshalling cabinet serving the transmitter, in safe area.
ii) Junction box serving the transmitter, in hazardous area.
iii) Directly at the transmitter, in hazardous area.

Plug-in type connections shall be provided with field communicator. Necessary interconnection accessories shall be supplied by the vendor.

c) Offered communicator shall be hand held, dust-proof, certified intrinsically safe and suitable for outdoor location. Carrying case shall be supplied with each communicator.

d) They shall be battery powered with replaceable and rechargeable batteries, suitable for recharging with 240 V AC, 50 Hz. In case vendor's standard design does not make use of rechargeable batteries, then vendor to provide 2 sets of spare batteries.

e) There should be no interruption on the output while communicating with the transmitter.

2.3.2 Remote Output Meter

2.3.2.1 Remote output meter shall be electronic with freely configurable LCD display. The display shall be as follows:

c) For Pressure, Differential Pressure, Flow & Temperature - Engineering Units
d) For Level – 100 % Linear

2.3.2.2 The indicator electronics shall be able to perform square root extraction for flow measurement.

2.3.2.3 This Fieldbus based field indicator shall be 2 wire segment powered and shall be able to indicate minimum of 8 signals available in the Fieldbus segment, selectively.

2.3.2.4 Offered indicators shall be certified intrinsically safe/FISCO, when used in hazardous area as specified in Data sheet.

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2.3.2.5 The performance of the transmitter shall not be affected by addition or removal or malfunction of remote output meter.

2.3.3 Valve Manifold

2.3.3.1 Wherever manifold has been specified as per data sheet, it shall be supplied fully assembled condition with the transmitter and the manifold material shall be same as the instrument wet part material specified in the data sheet.

2.3.4 Battery Charger

2.3.4.1 Battery charger shall be supplied with all necessary accessories and shall be universally type suitable for 110 to 240V ±10%, 50-60 Hz±3Hz, unless otherwise specified.

3.0 NAMEPLATE

3.1 Local mounted instruments shall have a stainless steel nameplate attached firmly to it at a visible place, furnishing the following information:

a) Tag number as per purchaser's data sheets.
b) Manufacturer's serial number and /or model number
c) Manufacturer's name/trade mark.
d) Body material.
e) Measuring element material.
f) Range of measurement.
g) Ingress Protection (IP) Class/Area classification in which the equipment can be used, this shall be to the same code as per purchaser's data sheets.
h) Dia. seal Flange rating & size (for Diaphragm seal transmitters)

4.0 INSPECTION AND TESTING

Purchaser reserves the right to inspect and witness testing at vendor's works as per Inspection Test Plan. All these tests shall be completed by the vendor and test reports shall be submitted to Purchaser for scrutiny.

5.0 SHIPPING

5.1 All threaded and flanged openings shall be suitably protected to prevent entry of foreign material.

5.2 Instruments shall be supplied individually, in suitably sealed packing.

5.3 All electronic instruments in oxygen and chlorine service shall be separately packed along with a certificate indicating 'CERTIFIED FOR OXYGEN / CHLORINE SERVICE', as applicable.

5.4 Loose supplied accessories (Companion flanges, spacer rings, stud-bolts, nuts and gaskets etc.) shall be packed with proper tag numbers of their respective instruments.

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Sr. No.	Piping Classes	Nut and Bolt Material
1	A1A, A2A, A5A, A6A, A7A, A8A, A9A, A10A, A11A, A13A, A14A, A15A, A19A, A20A, A32A, A33A, A1K, A6K, A1M, A1N, B1A, B2A, B5A, B6A, B9A, B13A, B18A, B19A, B32A, B1K, B6K, B18K, B1M, B3M, B5M, B1N, B6N, D1A, D2A, D5A, D18A, D1K, D18K, D18P, E1A, E2A, E5A, E5E, F5A	A-193 Gr. B7 A-194 Gr. 2H
2	A16A, B16A	A-193 Gr. B7M A-194 Gr. 2HM
3	A1B, A1D, A4F, A4G, B1B, B1D, B5D, B1E, B3F, B4F, B4G, D1B, D2B, D1D, D2D, D5D, D5E, F2D	A1-193 Gr. B16 A-194 GR. 4
4	A2K, B2K, D2K	A-320 Gr. B8 CL.2 A-194 Gr. 8
5	A4A, A1H, B4A, B1H, D4A, D1H	A-320 Gr. L7 A-194 Gr. 4
6	A3Y	A-307 Gr. B A-563 Gr. B
7	A3A, A3K, A3Y, A4Y, J3A	A-307 Gr. B A-563 Gr. B
8	A1Z, A4Z, A5Y, A5Z, J2A, J5A	A-307 Gr. B (Galv) A-563 Gr. B (Galv)
9	B4K, B5K	A-193 Gr. B8 M C11 A-194 Gr. 8 MA
10	A32Y	A-193 Gr. B (Galv) A-194 Gr. 2H (Galv)
11	B3M, B4K, B5K, B5M	A-453 Gr. 660 CL.A A-453 Gr. 660 CL.A

Note : Bolts & Nuts material mentioned above is applicable for loose supply of nuts/bolts.

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Sr. No.	Piping Classes	Gasket Material
1	A1A, A6A, A9A, AIOA, Al IA, AI3A, A14A,, A19A, A1B, AID, A1H, AIK, AIM, A4A, A4F, A4G, B1A, BIH, B2A, B4A, B6A, B9A, BI3A, B18A, BOA, B32A, 1318K, DIA, D2A, DIH, DIK, D4A, D18A, DI8K, D18P	SP.WND SS316+GRAFIL+ I RING
2	B5M	SP WND SS316H+ GRAFIL + I RING
3	A2K, B2K, D2K	SP WND SS 316+GRAFIL+SS 316 I/O RING
4	B1N	SP WND SS 316L+GRAFIL + I RING
5	B6N	SP WND SS 316L + GRAFIL
6	A1Z, A3Y, A4Y, A4Z, J2A	BUTYL RUBBER
7	E1A, E2A, E5A, F5A	SOFT IRON
8	E5E, F2D	5% CR, 0.5% MO
9	B4K, B5K	SS 316H+GRAFIL+I RING SS 316 O RING
10	A5Z	BS 7531 GR X (PTFE JACKETED)
11	A5Y, A8A, A15A, A32Y, A33Y	IS 2712 Gr. A/1
12	B3M	SP WND SS 321+GRAFIL+I RING
13	A1N, A6K, A16A, B16A	SP.WND SS3I6L+GRAFIL+ I RING
14	A3A, A3K, A33A, J3A, J5A, A32A, A20A	NON-ASBESTOS BS 7531 GR X
15	A2A	SP.WND SS3I6L+GRAFIL+ I RING
16	B5A, D5A	SP.WND SS3I6L+GRAFIL+ I RING
17	A7A, B1B, B1D, B1E, B1K, B3F, B4F, B4G, B5D, D1B, D1K, D2B, D1D, D2D, D5D, D5E	SP WND SS 316 + GRAFIL + I RING
18	B6K, B1M	SS 316 + GRAFIL

Note: Gasket material mentioned above is applicable for loose supply of gasket.

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Basic Function Blocks

☐	Analog Input(AI)	_____ No.	
	_____	Execution Time(msec)	
☐	Descrite Input(DI)	_____ No.	
	_____	Execution Time(msec)	
☐	Bias(B)	_____ No.	
	_____	Execution Time(msec)	
☐	Manual Loader(ML)	_____ No.	
	_____	Execution Time(msec)	
☐	PID	_____ No.	
	_____	Execution Time(msec)	
☐	Analog Output(AO)	_____ No.	
	_____	Execution Time(msec)	
☐	Descrite Output(DO)	_____ No.	
	_____	Execution Time(msec)	
☐	Control Selector(CS)	_____ No.	
	_____	Execution Time(msec)	
☐	Proportional/Derivative	(PD) _____ No.	
	_____	Execution Time(msec)	
☐	Ratio(R) _____	Execution Time(msec)	
	Advance Function Blocks		
☐	Pulse Input(PI) _____	Execution Time(msec)	
☐	Complex Descrete o/p	(CDO)	
	_____	Execution Time(msec)	
☐	Device Control(DC)		
	_____	Execution Time(msec)	
☐	Integrator (I) _____	Execution Time(msec)	
☐	Analog human Interface	(AHI)	
	_____	Execution Time(msec)	
☐	Input Selector(IS)		
	_____	Execution Time(msec)	
☐	Lead Lag Controller(LL)		
	_____	Execution Time(msec)	
☐	Signal Splitter(SS)		
	_____	Execution Time(msec)	
☐	Timer(T) _____	Execution Time(msec)	

☐	Arithmetic(A) _____	Execution Time(msec)	
☐	Digital Alarm(DA) _____	Execution Time(msec)	
☐	Calculate(C) _____	Execution Time(msec)	
☐	Analog Alarm(AA) _____	Execution Time(msec)	
☐	Dead Time(D) _____	Execution Time(msec)	
☐	Complex Analog o/p(CAO) _____	Execution Time(msec)	
☐	Step o/p PID(SOPID) _____	Execution Time(msec)	
☐	Set Pt Ramp generator _____	Execution Time(msec)	
☐	Signal Characterizer(SC) _____	Execution Time(msec)	
☐	Digital Human Interface	(DHI)	
	_____	Execution Time(msec)	

Device :

Segment # :

Note: Vendor to Fill up Data for all available Function Blocks

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Sl.No	Make (Vendor Name)	Model no	Device ID	Device Tag	Node Address	Device Type	Device Class	Device Revision	DD Revision	CFF Revision	PID function required (yes/no)	FF transducer HI	FF transducer LO	FF transducer Unit	L- Type
1				11FT1502	0x16	0x000C	Link Master	0x03	0x01	0x02	no	2500	0	mmWC	Indirect Sq.root
2															
3															
4															
5															
6															
7															
8															
9															
10															
11															
12															
13															
14															
15															
16															
17															
18															
19															
20															

Note : Node Address data will be available after finalization of segment loading and same will be uploaded in devices at site.

Device Type :- Manufacturer's model number associated with the resource - used by Interface devices to locate the OD file for the resource

Device Revision :- Manufacturer revision number associated with the resource - used by an interface device to locate the DD file for the resource

DD Revision :- Revision of the OD associated with the resource - used by an interface device to locate the OD file for reference.

L-Type :- Determines if the values passed by the transducer block to the AI block may be used directly **(Direct)** or if the value is in different units and must be converted linearly **(Indirect)** , or with square root **(IND Sqr Root)**, using the input range defined by the transducer and the associated output range.

Transducer HI,LO Scale & Unit :- The high and low scale, engineering units code, and the number of digits to the right of the decimal point used with the value obtained from the transducer for a specified channel.

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प्रोसेस प्रवाह विश्लेषक के लिए मानक विनिर्देशन

STANDARD SPECIFICATION FOR PROCESS STREAM ANALYSER

Rev. No	Date	Purpose	Prepared by	Checked by	Standards Committee Convenor	Standards Bureau Chairman
					Approved by	
6	27.02.23	Revised and Reissued as Standard Specification	JS	AKS	MN	SM
5	31.10.17	Revised and Reissued as Standard Specification	IS	KS	RG	RN
4	30.03.12	Revised and Reissued as Standard Specification	CS	RG	RP/JMS	DM
3	27.09.06	Revised and Reissued as Standard Specification	RP	TGM	PM	VC
2	01.11.96	Revised and Reissued as Standard Specification	RK	BRS	RB	AS

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Abbreviations:

AARH	Arithmetic Average Roughness Height
DC	Direct Current
DCS	Distributed Control System
EMI	Electro Magnetic Interference
HART	Highway Addressable Remote Transducer
HVAC	Heating Ventilation and Air conditioning
LCD	Liquid Crystal Display
LED	Light Emitting Diodes
NPT	National Pipe Thread
PTFE	Poly Tetra Fluoro Ethylene
RAM	Random Access Memory
RFI	Radio Frequency Interference
SPDT	Single Pole Double Throw
SS	Stainless Steel
CS	Carbon Steel
Al	Aluminium

Instrumentation Standards Committee

Convener : Mr. Mainak Nandi

Members : Mr. Arupjyoti Saikia
Mr. Sachin Garg
Mr. Jerry Johnson
Mr. Mayank Kaushik
Mr. Sourav Mukherjee
Ms. K.Pratheepa
Mr. R.K Gupta (Proj.)

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1.0 GENERAL

1.1 Scope

1.1.1 This specification, together with the data sheets, covers the requirements for the complete design, materials, fabrication, nameplate marking, inspection, testing and shipment of process stream analysers and accessories. This standard specification shall be applicable for all types of process stream analysers irrespective of whether separate specifications are included or not in this specification.

1.1.2 The related standards referred to herein and mentioned below shall be of the latest editions prior to the date of the purchaser's enquiry:

ASME	American Society of Mechanical Engineers.	
	B 1.20.1	Pipe Threads, General Purpose (Inch).
	B 16.5	Pipe Flanges and Flanged Fittings.
	B 16.20	Metallic Gaskets for Pipe Flanges.
	B 16.34	Valves – Flanged, Threaded and Welding End.
	B 31.3	Process Piping
API	American Petroleum Institute	
	RP 551	Process Measurement Instrumentation
	RP 552	Transmission Systems
	RP 554	Process Control Systems
	RP 555	Process Analyzers
ASTM	American Society for Testing and Materials	
	G93	Standard Practice for cleaning methods and cleanliness levels for material and equipment used in oxygen-enriched environments.
EN	European Standards.	
	EN 10204	Inspection Documents for Metallic Products.
IS/IEC	Indian Standards/ International Electro Technical Commission.	
	IS/IEC 60079	Explosive Atmosphere -Part 0: Equipment - General Requirements.
	IS/IEC 60529	Degree of Protection Provided by Enclosures. (IP Code)
	IS/IEC 61000-4	Electromagnetic Compatibility (EMC) for Industrial Process Measurement and Control Equipment.
	IS/IEC 61285	Industrial Process Control - Safety of Analyzer Houses
	IS/IEC 60825-1	Safety of Laser Products Part-1.
	IS/IEC 60746	Expression of performance of Electrochemical Analyzers.
	IS/IEC 61115	Expression of Performance of Sample Handling Systems for Process Analyzers.
NFPA 496	National Fire Protection Associations – Purged and Pressurized Enclosures for Electrical Equipments.	

1.1.3 In the event of any conflict between this standard specification, job specification/data sheets, statutory regulations, related standards and codes, the following order of priority shall govern:

a) Statutory Regulations
b) Datasheets
b) Job Specification (Including Special Instructions)
c) Standard Specification
d) Codes and Standards

1.1.4 In addition to meeting the purchaser's specification in totality, vendor's extent of responsibility shall include the following:

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a) Purchaser's data sheet indicates the type of analyser and the minimum sample conditioning system requirements. Vendor shall be responsible for the selection of proper analyser and design of the sample conditioning system to analyse the component/components of interest within the stated performance requirements.

b) Vendor shall carry out complete application engineering of the process stream analyser so as to achieve the desired analysis within stated performance requirements.

c) Vendor shall provide all hardware and software, as necessary, to meet the functional requirements specified in the purchaser's specifications.

d) Vendor shall provide complete data to purchaser for successfully providing serial communication with purchaser's host system i.e. DCS when specified in the purchaser's specification as per required format.

e) Purchaser's data sheets indicate the minimum requirements of material of construction for the analyser and its sample conditioning system. Alternate superior material of construction shall also be acceptable provided vendor assumes complete responsibility of the selected material for any part of the analyser system so as to be compatible with the process stream and its operating conditions and surrounding atmosphere as specified in purchaser's data sheet.

f) Vendor's recommendation regarding Regular Maintenance for long term smooth functioning of Analysers at site shall be furnished along with offer.

1.2 Bids

1.2.1 Vendor's quotation shall be strictly as per the bidding instruction to vendor attached with the material requisition.

1.2.2 Whenever a detailed technical offer is required, vendor's quotation shall include the following:

a) Compliance to the specifications.

b) A detailed specification sheet for each analyser, which shall provide information regarding type, materials of construction, performance specification and accessories of analyser. The material specification and units of measurement for various parts in vendor's specification sheets shall be to the same standards as those indicated in purchaser's data sheets.

c) A detailed drawing showing various components of sample conditioning system and their piping/tubing hook-up arrangement including sample return, vent, utilities connection and requirement of heat tracing (i.e electrical or steam tracing), as necessary.

d) Sample transportation time calculations for the specified distance between sample point and analyser indicating sample flow rate and the recommended size of the sampling tube. Transportation time calculation shall be carried out ensuring the following:

i) No deterioration of sample takes place.
ii) No condensation shall occur in the sample line.
iii) Response time specified in datasheet is met.

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e) Calibration gas cylinder calculations considering six months of continuous operation with once a week calibration. The calculation sheet shall indicate the rate of gas consumption and specification of gases including composition, concentration, accuracy and shelf life of calibration blend.

f) References gas cylinder calculations considering six months of continuous operation. The calculation sheet shall indicate the rate of gas consumption and specifications of the reference gas.

g) Proven references for each offered model of analyser inline with clause 1.2.3 of this specification.

h) A copy of approval for intrinsically safe/flameproof enclosure, whenever specified, from local statutory authority, as applicable, such as Petroleum and Explosives Safety Organisation (PESO), Nagpur in India, along with:

i) Test certificate from recognised house like Central Institute of Mining & Fuel Research (CIMFR)/ Electronics Regional Testing Laboratory (ERTL) etc. for flameproof enclosure and/or intrinsic Safety, as specified in the datasheet, as per relevant Indian Standard for all Indian manufactured equipments.

ii) Certificate of conformity from agencies like Laboratorie Central Des Industries Electriques (LCIE), British Approval Service for Electrical Equipment in Flammable Atmospheres (Baseefa), Factory Mutual (FM), Physikalisch-Technische Bundesanstalt (PTB), Canadian Standards Association (CSA), Underwriters Laboratories (UL) etc. for compliance to ATEX directives or certificate of conformity from IECEx or other equivalent recognised standards for all equipment manufactured outside India.

i) Utility requirements and their consumption i.e. instrument air, cooling water, steam etc. along with their process conditions like flow, pressure and temperature.

j) Power consumption for each analyser and its accessories for 110 V / 240 V AC UPS, & 415 V / 240 V AC non-UPS.

k) HVAC requirements i.e. heat load, humidity particulate/chemical filtration etc.

l) Deviations on technical requirements shall not be entertained. In case vendor has any valid technical reason, they must include a list of deviations tag number wise, summing up all the deviations from the purchaser's data sheets and other technical specifications along with the technical reasons for each of these deviations.

m) Catalogues giving detailed technical specifications, model decoding details and other related information for each type of analyser and accessories covered in the bid.

1.2.3 All items, as offered, shall be field proven and should have completed operations individually for a period of minimum 6 months on the bid due date in similar application with the process conditions similar to those as specified in the purchaser's data sheets. Items with prototype design or items not meeting provenness criteria specified above shall not be offered.

1.2.4 Whenever specified, vendor must furnish certified values of failure rates, probability of failure on demand and test interval for the safety integrity level analysis.

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1.2.5 All documentation submitted by the vendor including their quotation, catalogues, drawings, installation, operation and maintenance manuals, etc shall be in English language only.

1.2.6 Vendor shall also quote for the following: -

a) Complete calibration kit consisting of calibration gas cylinders with material of Construction SS or Al (for carrier (continuous) gas cylinders, CS is also acceptable), pressure regulators, gauges, cylinder gas piping manifolds and driers, (as required) etc. as a minimum, for each analyser. In case of dual range analyser, separate calibration standards shall be provided for each range. For the purpose of calculating requirement of zero and span calibration samples/gases, consider calibration time of 30 minutes every week for each analyser for a period of six (6) months of continuous operation.

b) Complete reference gas kit consisting of Reference gas cylinders, pressure regulators, gauges, cylinder gas piping manifold and drier etc as a minimum separately for each analyser as applicable. The reference gas cylinders shall be supplied for a period of six (6) months of continuous operation.

c) Consumable spares for the duration of six (6) months with list of items as per vendor recommendations for each analyser system, unless otherwise specified in purchaser's specification.

d) Start up and commissioning spare parts for each analyser/analyser system as per vendor's recommendations. However this list of spare parts must include 5% or minimum one no. of each type of following spare parts:

- Solenoid valve
- Pressure regulator
- Filters
- Temperature controller
- IR/UV Source (lamp)
- Peristaltic pump
- Set of fuses
- Set of o-rings
- Tubing and tube fittings (sizes smaller than 6 mm or ¼").

Additional spare parts, if required, during start-up and commissioning, even though not listed in the list of start-up and commissioning spares, shall be supplied by the vendor without any implication.

e) Any special instrument or tool needed for testing, calibration and maintenance of the analyser such as spanner set (for tubes smaller than 6 mm or ¼"), non-magnetic tools, bubble variable area flowmeter etc.

f) Training at vendor works and at site as specified in purchaser's specifications.

g) Two years operational and maintenance spares for each analyser and its accessories as per vendor recommendations, which shall include spare parts like electronic modules, temperature controller, power supply module, flow meter, solenoid valve, pressure regulator, local indicator, tubes, fan assembly, sample cell, detector assembly, UV/IR source/lamps, set of o-rings, set of fuses etc.

1.3 Drawing and Data

1.3.1 Detailed drawing, data, catalogues and manuals required from the vendor are indicated by the purchaser in the vendor data requirement sheets attached with the requisition.

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1.3.2 Final documentation consisting of design data, installation, operation and maintenance manual, calibration procedures etc., submitted by the vendor after placement of purchase order shall include the following, as a minimum:

a) Specification sheet for each analyser and its accessories.

b) Certified drawings for each analyser and its accessories, tag number wise, which shall provide the following information:

i) Overall dimensions in millimetres.

ii) Sampling system details identifying each component with make and model number, process connection, utility connection, calibration sample/gas connection, heat tracing requirements, sample vent and fast loop details etc. The flow, pressure and temperature at interface and other appropriate location must be shown in the sampling system drawing.

iii) Detailed interconnection drawing of each analyser identifying each component with terminal number, cable type, cable size and cable entry details. The interface details shall be clearly identified in the drawing.

iv) Grounding details.

v) Power supply distribution details.

c) Programming/configuration data for each analyser, as applicable.

d) Serial interface specification including its configurational data (addresses) for host communication.

e) Power consumptions and utility requirements.

f) Calibration curves and calibration data for each analyser.

g) Zero and span calibration gas specification including composition, shelf life time and accuracy.

h) Copy of type test certificates and the test certificates of all the tests indicated in clause 4.0 of this specification.

1.4 Definitions

1.4.1 The following definitions shall apply for analysers and their accessories:

a) Transportation time

Transportation time is the time interval between a step change in the process fluid composition in the process line and the initial analyser response (excluding analyser response time).

b) Response Time

The time interval between the initial response of the analyser and the time required for the analyser output to reach a value of 90% of the final output value for a step change in sample quality.

c) Time Constant

The analyser response to reach a value of 63% of the final output value for a step change in sample quality is called the analyser time constant.

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d) Repeatability

Repeatability of a measurement is the band of values within which an analyser repeats its measurement when the same sample is applied to it. The short termed repeatability is generally determined by multiple readings of a sample during calibration and is usually true random error over short period of time if external influences like pressure and temperature etc remain constant.

It is also defined as the difference between two successive analyser results that would be exceeded in the long run in only one (1) case in twenty (20) when a single analyser system is operated on a flowing sample of uniform quality.

e) Sensitivity

The sensitivity of an analyser is a measure of an analyser's ability to detect a least change in concentration of a measured component that is not masked by the background noise.

f) Accuracy

Accuracy of a measurement is the measure of how close the measured value is to the true value of the sample. For all type of analysers, accuracy is primarily a function of the accuracy of the standards used for calibration.

g) Analyser Rack

An open analyser mounting structure with/without canopy used for mounting analysers, sample handling system and their accessories individually or together in combination.

h) Analyser Cabinet

Small housing in which analysers are installed individually or grouped together. Maintenance is performed from outside the cabinet with door (s) open.

2.0 DESIGN AND CONSTRUCTION

2.1 Analyser Requirements

2.1.1 The type of analyser and its measuring principle is specified in the purchaser's data sheet. Accessories and equipments as required to make online analysis complete are also specified in the data sheet. In general, the scope shall include the following:

a) Sample probe and sampling system (primary or secondary), as applicable.

b) Analyser complete with all hardware and software consisting of detector, transmitter and associated equipments.

c) Fast loop and Sample return system, as applicable

d) Calibration and maintenance equipment.

e) Gas cylinders for zero and span calibration.

Unless otherwise specified the scope shall also include supply of all interconnecting tubing, piping, fittings, heat tracing equipment etc., excluding sample return piping from analyser battery limit to sample return header.

In-situ analysers when specified may not include items 2.1.1(a) and (c)

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2.1.2 Analysers and its related equipments directly connected to process line and In-situ analysers shall be capable of withstanding line pressure and temperature conditions specified in the purchaser's data sheet.

2.1.3 The analyser design and design of sample handling system shall be such that components or any sub-assembly that requires removal shall be possible without any need to disassemble any other component. Such components shall include items like stream selector valves, filters, pressure regulators, flow-indicator, detector, electronic modules etc.

2.1.4 Analyser shall be microprocessor based with state-of-the-art technology and shall be capable of being configured from analyser front panel locally using built-in keyboard. When specified, it shall also be possible to configure the analyser from remote through a separate terminal.

2.1.5 The configuration related data of the analyser including set range shall be stored in a non-volatile memory such that this data remains unaffected by power fluctuations or power off condition. In case vendor's standard product stores configuration data in battery backed RAM, analyser shall have facility to provide battery drain alarm as diagnostic maintenance message.

2.1.6 The span of the analyser shall be field adjustable from the analyser front without opening the analyser enclosure. In case, separate device is required to make such a change, the same shall be included, by vendor in their scope of supply.

2.1.7 Analyser shall run diagnostic subroutines on continuous basis and shall be able to provide diagnostic alarms related to analyser optics, detector and electronics, as and when any failure/malfunction is detected.

2.1.8 Analyser shall have an integral output meter with digital readout in engineering units.

2.1.9 All interconnecting wiring shall be colour coded/numbered and terminal blocks be clearly identified.

2.1.10 The analyser shall be capable of providing the following outputs:

a) Isolated 4-20 mA DC current output for each analysed component. Smart or field bus output shall be provided when specifically indicated in the purchaser's data sheet.

b) RS 485 / TCP/IP serial output with MODBUS (RTU) protocol, whenever serial output is specifically indicated in the purchaser's data sheet. The serial output signal shall contain analyser data of component of interest and diagnostic alarms, as a minimum.

c) SPDT contact outputs for various following diagnostic alarms, whenever specified, shall be provided:

i) High or low set point alarm as measurement

ii) Analyser failure

iii) Low sample flow

iv) Temperature control failure

v) Purge failure

Any other alarm contact, either specifically indicated in purchaser's data sheet or available as standard with the analyser, shall also be provided.

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Unless specified otherwise, all contacts shall be normally closed type (contact open in alarm) and shall be rated for 24V DC, 2 Amperes.

Whenever serial interface/ HART option is specified in the purchaser data sheet, the above alarms shall be made available through serial/ HART output as a minimum.

2.1.11 The design of electronic components of analyser system shall be in compliance with the electromagnetic compatibility requirements as per IEC 61000-4 or equivalent EN standard and shall be immune to RFI and EMI radiation.

2.1.12 **Material of Construction**

2.1.12.1 The material of construction of all components wetted by the sample shall be SS316, as a minimum. Vendor must ensure the compatibility of material of each component with the process fluid.

2.1.12.2 For applications where SS cannot be used due to process stream & conditions, other materials such as Monel, Hastelloy or Incoloy can be considered. For materials, other than specified in this clause, if used, must have provenness and approval of the principal/ OEM (Original Equipment Manufacturer) as well as from Purchaser.

2.1.12.3 Material of all soft parts like diaphragms and o-rings shall be of PTFE. Other vendor standard materials can also be acceptable provided these are compatible with the specified process condition.

2.1.12.4 The material of construction of all non-wetted parts shall be as per manufacturer's standard. However non-metallic materials for casings, enclosures and instrument covers shall be avoided.

2.1.13 **Power Supply**

2.1.13.1 Unless indicated otherwise, the analyser including the sample handling system shall operate at 110V / 240 AC, 50Hz UPS power supply.

2.1.13.2 The analyser performance shall be within the specified limits when the supply voltage varies by ± 10% of specified value and supply frequency varies by ±3 Hz of specified value.

2.1.13.3 Electrical tracing when specified, shall operate at 240V, 50 Hz Non-UPS supply. 240V, 50Hz Non-UPS power supply shall also be used for analyser cabinet/panel lighting and air conditioning unit, when specified.

The maintenance temperature (i.e. minimum temperature that is required to be maintained in the line to avoid congeal or condensation inside the tube/line) shall be as follows:

a) The maintenance temperature shall be 10°C higher than the highest expected pour point for congealing service or the operating temperature, whichever is minimum.

b) The maintenance temperature shall be minimum 5°C higher than the highest expected condensation temperature for the condensing service or the operating temperature, whichever is minimum.

2.1.14 **End Connection**

2.1.14.1 Unless otherwise mentioned, end connection details shall be as below:

a) Threaded end connections shall be to NPT as per ASME B 1.20.1.

b) Flanged end connections shall be as per ASME B 16.5.

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c) Grooves of ring type joint flanges shall be octagonal as per ASME B16.20.

d) Flanged face finish shall be as per ANSI B 16.5. The face finish shall be as follows:

125 AARH : 125 to 250 microinch AARH

63 AARH : 32 to 63 microinch AARH

2.1.14.2 Gaskets, bolts and nuts shall be suitable for the service conditions indicated.

2.1.14.3 End connection of sizes 6 mm or below shall be suitably protected against damage.

2.1.14.4 All end connections shall be clearly identified by attaching labels or stainless steel plate of suitable size.

2.1.15 **Enclosure Type**

2.1.15.1 Analyser enclosures and related accessories shall be suitable for the electrical area classification indicated in purchaser's data sheets. The enclosures shall comply to the following standards:

Weatherproof housing	IP-65 to IS/IEC-60529
Intrinsic Safe	IS/IEC-60079
Flameproof housing	Flameproof/Ex (d) as per IS/IEC-60079
Purged Enclosure	NFPA 496

Flameproof and purged equipment shall also be made weatherproof. Vendor shall offer the Analyser purged enclosures only when other types of protection are not available.

2.1.15.2 Analyser where air/nitrogen purge is provided, purge shall be as per NFPA 496. For Panels located in IEC Zone 2, hazardous area Type Z purging shall be used with a purge fail alarm in control room. In case, Panel is located in IEC Zone 1, the power shall be cut-off on pressurization failure with a purge fail alarm in control room as per Type X purge requirements of NFPA 496.

Certification for Purge controller to be provided for Type X or Type Z as per applicable area classification.

Additionally, Local Purge Failure Alarm indication shall also be provided as per NFPA 496.

2.1.15.3 Separate cable entries shall be available in the analyser/enclosure for power and signal cable. Unless otherwise specified, following shall apply:

a) Cable entry and terminal size for power cable shall be informed during detail engineering. Explosion proof 3way junction box with cable glands shall be supplied, if required.

b) Cable entry for Serial cable/signal cables (Signal output) shall be ½" NPT (F).

c) Cable entry for multi-pair signal cables (Multiple outputs) shall be 1½" NPT (F).

2.1.15.4 All enclosure entries including sample, utilities, cables etc. shall be clearly identified by attaching label or stainless steel plate of suitable size.

2.1.16 **Analyser rack and cabinet**

2.1.16.1 The analyser shall be supplied in pre-assembled, pre-tubed and pre-wired condition complete with sample handling system. The primary sample-conditioning unit i.e. conditioning at sample tap-off point, shall be supplied separately.

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2.1.16.2 When open rack mounted installation is specified in purchaser's data sheet, the analyser and sample handling system shall be supplied installed in an open rack with canopy to protect the analyser from direct sunlight and rain. The open rack shall be fabricated using channels/pipes of suitable size. The material of construction shall be stainless steel. The canopy shall also be fabricated out of SS plate of 1.2 mm thick. The canopy shall have overhang of 500 mm in all the direction.

2.1.16.3 Whenever closed cubical mounted installation is specifically indicated in the purchaser's data sheets, analyser and sample handling system shall be supplied pre-installed in freestanding closed analyser cabinet. The analyser cabinet shall be suitable for outdoor installation and shall be provided with a key lock. Cabinet shall also be provided with pre-fabricated SS canopy. Canopy plate shall be 1.2mm thick.

2.1.16.4 Cabinet shall be fabricated out of 2.0mm SS sheet reinforced with angles of suitable sizes. Fittings and hinges shall be of stainless steel. Anchor bolts required for installation of cabinet shall also be supplied by vendor.

Cabinet shall have suitable arrangements for Internal Lighting, Utility sockets, Ventilation, earthing , lifting lugs , nameplate etc.

2.1.16.5 A power isolation switch with suitable circuit breaker or fuse shall be provided for the incoming power supply.

2.1.16.6 All items including analyser installed within the cabinet shall be suitable for the maximum possible temperature likely to be attained within the cabinet (i.e. at maximum ambient temperature with all items fully powered-on within the cabinet) and area classification specified in the purchaser's data sheet.

2.1.16.7 Heating/cooling of analyser cabinet shall be provided either when purchaser's data sheet specifies the requirement of heating and/or cooling or recommended by the analyser manufacturer to meet following requirements:

i) The temperature induced measurement error exceeds ± 1% of full scale in the worst temperature conditions.

ii) The maximum allowable ambient temperature condition of any component within the cabinet exceeds its limits.

2.1.16.8 Whenever cooling is specified or found necessary, Sub-systems or system components which are installed outdoor shall be suitable to continuously operate at ambient temperature and humidity specified under ambient conditions. The heat generation effect of current carrying for the electronic modules shall also be considered. For this purpose the system shall be rated for minimum 5 degC more than the maximum ambient temperature specified.

In case the system is not suitable for the above conditions, Cabinet mounted air conditioner in 1 working + 1 standby configuration, certified for the specified area classification shall be provided.

2.1.16.9 The maximum height of rack/cabinet shall be limited to 2100 mm. Cabinet shall be suitable for side and bottom cable entry.

2.1.16.10 Power supply cable entry and terminal size shall be as defined during detail engineering by purchaser.

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2.2 Sample Handling System

2.2.1 The sample handling system shall consist of primary sample conditioning near sample take off point, sample transportation line, secondary sample conditioning near the analyser, sample return, sample/analyser vent and sample drain/recovering system, as applicable.

The primary sample-conditioning unit shall be a fabricated assembly and shall be mounted on a stainless steel plate suitable for surface mounting.

Secondary sample conditioning shall also be a fabricated assembly and shall be either mounted on a stainless steel plate or within an enclosed cabinet/box with a viewing window. In case the temperature is required to be maintained at primary and secondary sample conditioning, both these conditioning units shall be installed in the heated box/cabinet.

2.2.2 Process Stream sampling shall be continuous and vendor shall design the sample fast loop (bypass loop) as part of sampling system. Design shall ensure that the sample drawn is true representative of the process stream to be analysed.

2.2.3 In general, sampling systems shall be designed and constructed in accordance with API-RP-555. The design of sample handling system shall consider the following factors, as a minimum:

a) The pressure-temperature conditions required for the analyser.

b) Interfering components in the process sample.

c) Normal and abnormal sample compositions.

d) Sample return pressure-temperature conditions.

e) Fouling sample conditions e.g. polymer formation or presence of solids etc.

f) Transportation time requirements.

g) Utilities available and their process conditions.

2.2.4 Sampling system shall include all elements as necessitated by the process conditions indicated in the purchaser's data sheets, to make the sample suitable for the analysis. This shall include but not limited to filters (coarse and fine), pressure regulators, relief valves, flow indicators, flow controllers, temperature indicators, moisture separators, scrubbers, heaters, coolers, dryers, sample pumps, aspirators etc.

Each sampling system element shall be capable of being removed without disassembling the entire system.

2.2.5 Sample probe shall be provided by the vendor to obtain representative sample from the line. The sample probe shall be inserted in the pipe through a ball valve, which shall be part of vendor's scope of supply. Minimum Body wall thickness for ball valves shall not be less than specified ASME B 16.34. The probe design shall ensure the following:

a) On-line removal and insertion of the probe with non-fly-off design. Whenever specifically indicated in the purchaser data sheet, the on-line probe removal facility shall also include depressurising / pressure relieving mechanism.

b) Unless otherwise specified, end connection for installation in the line shall be 1½" flanged with type and rating as specified in purchaser's data sheet. The line isolation valve shall also be of the same size and rating as probe end connection.

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c) The probe diameter shall be such that it can be easily inserted or removed through the line isolation valve when in fully open condition.

d) The length of the probe shall be selected considering its insertion of 30% to 50% of the pipe. For the purpose of calculating probe length, nozzle length shall be considered as 200 mm.

e) Sample Probe requirement & type shall be as per following philosophy.

Line Size	Normal Operating pressure	Sample Phase	Requirement of Probe	Type of Probe
≥ 3 inch	≥10 kg/cm2(g)	Liquid or Vapor	Yes	Retractable type probe having non- fly off design with hydraulic or other proven depressurisation mechanism
≥ 3 inch	<10 kg/cm2(g).	Liquid or Vapor	Yes	Manual Retractable type probe with non-fly off design.
Process connections from Equipments like vessels / Reactors / Columns		Liquid or Vapor	Yes	Sample probe shall be fabricated from SS316L tube with isolation valve without any retracting mechanism.

f) Sample probe shall be self draining type.

2.2.6 Sampling system shall include a sample block valve on all process sample line.

The block valve shall be provided meeting the following requirements:

a) The block valve shall be located immediately after the sample probe.

b) Where purchaser's data sheet does not indicate the requirement of sample probe, the block valve shall be provided in the sample line as a part of primary sample conditioning unit.

c) The size of the sample block valve shall be as per the sample line size while the rating shall be as specified in the purchaser's data sheet.

d) The design pressure of components and tubing shall be in accordance with ASME B 31.3. Relief Valves shall be installed to protect those components installed in a system which have a limited pressure rating. The relief valve shall be connected to a vent or a drainage system, as required.

e) Variable Area Flow Meters, in Sample Conditioning System shall have a metal metering tube. However, in case glass tube is used due to low flow range, same shall be made of toughened borosilicate glass with metal side plates to prevent damage to the metering tube.

2.2.7 The size of the sample tubing shall be decided by the vendor considering:

a) The distance between sample take off and analyser specified in purchaser's data sheet.

b) The specified sample transportation time.

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Where no transportation time is specified in the purchaser's data sheets, vendor shall consider the sample transportation time as 60 seconds.

c) Pressure at the sample take-off point.

2.2.8 Where sample is required to be transported in hot condition, sample shall be drawn using pre-fabricated heated tubes. The heated medium shall be electric power unless otherwise specified in purchaser's data sheet.

Heating shall be controlled such that the sample temperature is maintained typically around +20°C above the sample dew point.

An auto cut-in / auto cut-off and temperature monitoring device shall be supplied duly installed in the sample handling box.

2.2.9 When fast loop is specified or recommended by vendor, vendor shall provide flow meter for sample bypass flow. Sample return line to process shall be provided with isolation valve and check valve. Fast loop pumps shall always be considered in redundant configuration. Vendor shall ensure that return pressure of the sample shall be higher than the pressure of the process return point specified in purchaser's data sheet.

Samples should be returned back to process stream with back pressure and connection size as specified in data sheet. For those applications where other arrangements are required, the samples should be directed to:

i) Flare system: - As the flare system operates at a varying pressure, the maximum operating pressure shall be considered for design of the sampling system.

ii) Recovery system: - HC liquid, which cannot be returned directly to the process, shall be discharged either to the HC recovery system or drained to Closed Blow down as per the philosophy specified in the data sheet. While designing the same, it shall be ensured that the total quantity of liquid disposed is limited to the minimum necessary for adequate sampling. Suitable arrangement with dual pump configuration shall be considered for the recovery system to prevent overflow from the system.

iii) Analyser Vent: - Analyser Vent shall be suitably routed at Safe Height and not left locally at analyser itself. Suitable arrangement with Pipe/ Tube of adequate length as per Purchaser specification along with NRV (Non-Return Valve), Flame Arrester etc. shall be considered for the Analyser safe venting.

2.2.10 Sampling system shall include provision for connecting calibration sample/gases in auto or in manual configuration as specified in purchaser's data sheet.

Whenever auto-calibration requirement is specified in the purchaser's data sheet, it shall be possible to initiate auto calibration cycle at preset time interval defined by user either manually via the analyser keyboard or remotely through an external contact.

The sample handling system shall be designed to include all hardware and/or software to meet this requirement. The analysed component concentration output shall remain at the last good measured value during auto calibration cycle.

2.2.11 In case of multi stream analyser, the sample handling system shall utilize double block and bleed configuration to prevent cross-contamination of samples. All stream selection valves shall have bubble tight shut off. The block valves shall be fail-close type while bleed valve shall be fail-open type.

2.2.12 Filters shall always be provided in dual configuration. It shall be possible to replace the filter without upsetting the operation of the analyser.

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2.2.13 DP transmitter across the filter/ Flow Switch in filter Inlet line shall be provided with indication to control room to warn the operator against choking of filter.

2.2.14 The sampling system shall be designed to consider plugging of sample lines under following conditions, if applicable:

a) Failure of heat tracing

b) Failure of sample pump

c) Failure of instrument air, particularly when sample dilution technique is adopted for sample.

d) Upset or start-up conditions, if excessive solids/solid particles are expected under these operating conditions.

2.2.15 Sample lines and sample return headers used for carrying samples, for more than one analyser, shall be provided with sample pumps in dual configuration. It shall be possible to remove or insert the pump without upsetting the sampling system. In case common sample handling system is asked for in the purchaser data sheet for more than one analyser, isolation for maintenance each analyser shall be provided.

2.2.16 A suitable restriction orifice shall be provided in each sample line to limit the sample flow exceeding thrice the normal flow in the event of tube rupture or opening of tube down the line.

2.2.17 All sample pumps shall be provided with Running/ Status indication in control room. Necessary provision shall be considered to prevent dry run of pumps resulting in pump failure.

2.3 Calibration Gas and Reference Gas Cylinders

2.3.1 Each analyser shall be supplied with following gases with stainless steel or Aluminium cylinders;

a) Reference gas dual cylinder with manifold where required. The reference gas system shall be dedicated, one for each analysers, where required along with automatic switchover to standby cylinder when the first cylinder is exhausted.

b) Certified calibration gases. In case of dual range of measurement, separate calibration gas for each range shall be provided.

2.3.2 Each of the gas cylinders shall be provided with two stage pressure regulator. Manifold shall be provided for reference gas with dual cylinder configuration.

2.3.3 All gas cylinders shall be located near the analyser and shall be supplied with gas cylinder rack with free standing support.

2.3.4 In case the calibration gas deteriorates or depletes with time, vendor may either supply calibration gas cylinders with deferred delivery or supply alternate devices for preparing calibration blend.

2.4 Infra-Red/ Ultra-Violet (IR/UV) Analysers

2.4.1 IR/UV analyser shall preferably be non-dispersive type.

2.4.2 Analyser cell length shall be selected as per specified analyser component range. In case of dual range analysers, the selected cell length shall be suitable for both the ranges.

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2.4.3 The analyser cell material and window material shall be suitable for the specified process condition. Unless otherwise specified or required otherwise by pressure-temperature conditions, the o-ring material shall be PTFE.

2.4.4 The analyser design shall be such that it is insensitive to source fluctuations or degradation or partial cloudiness of cell window.

2.4.5 Special filters shall be offered to minimise the interference of background components, which are of least interest in process stream.

2.4.6 Unless otherwise specified, analyser shall meet the following performance requirements:

Repeatability	:	± 1% of full scale
Zero drift	:	± 1% full scale per 24 hours.
Response Time	:	5 seconds for 90% of final reading.

2.5 Thermal Conductivity Analyser

2.5.1 Thermal conductivity analyser shall be suitable for measuring specific components in a gas mixture.

2.5.2 Analyser shall have precise temperature controller which shall be able to maintain temperature within ± 0.1°C to ensure stable detector operation.

2.5.3 Analyser cell shall have flowing reference gas or sealed in (non-flowing) reference as per manufacturer's standard product.

2.5.4 The analyser sensor cell material shall be suitable for the specified process conditions, unless otherwise specified or required by temperature condition, o-ring material shall be PTFE.

2.5.5 Performance specification

Unless otherwise specified, Analyser shall meet the following performance specifications:

Accuracy	:	± 1% of FSR
Repeatability	:	± 1% of FSR in 24 hours
Response time	:	Maximum 20 seconds for 90% response

2.6 Moisture Analyser/ Dew Point

2.6.1 The requirements of moisture analyser for corrosive as well as non-corrosive applications are specified in this clause. Vendor shall offer the type of analyser as specified in the purchaser's data sheet.

Whenever, the type of analyser is not indicated in the purchaser's data sheet, vendor shall select the type of moisture analyser as per the specified process conditions.

2.6.2 Moisture analyzer for non-corrosive application.

2.6.2.1 The probe shall be in-line mounted (i.e. shall be located at the point of measurement) in general and shall not be damaged by severe shock and line abrasion conditions.

2.6.2.2 The pressure and temperature rating of the probe shall be suitable for the process condition specified in the data sheet.

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2.6.2.3 When mounted remote, the probe shall be installed in a sample cell. The end connections of sample cell shall be flanged with ASME rating as specified in the purchaser's data sheets.

2.6.2.4 Unless otherwise specified or found necessary by vendor, no sample handling system shall be required. However, whenever the sample handling system is specified, the design shall ensure the integrity of sample i.e. moisture contents integrity shall be maintained.

2.6.2.5 The probe shall have Aluminium oxide moisture sensor. Alternate type moisture probe shall also be acceptable, if this meets the performance requirements specified in the purchaser's data sheet.

2.6.2.6 Each probe shall be supplied as pre-calibrated and shall be supplied with its own calibration curve. The calibration shall be valid for a period of minimum six (6) months from the date of supply, as a minimum.

2.6.2.7 Performance specification

The moisture probe shall meet the following requirements as a minimum:

Accuracy:	±2°C within a range of -60°C to 20°C (Dew point)
	± 3°C within a range of –110°C to –60°C (Dew Point)
Repeatability:	± 0.5°C in range of -60°C to 20°C (Dew Point)
	± 1.0°C in range of –110°C to –60°C (Dew Point)
Life span:	One year
Time Constant:	5 seconds for 63% of steady state value.

2.6.3 Moisture analyser for corrosive application.

2.6.3.1 The moisture probe shall be hygroscopically sensitised quartz crystal or equivalent suitable for the specified process samples containing unsaturated hydrocarbon, chlorides, oils etc.

2.6.3.2 Sample shall be conditioned in a sample handling system which shall include filters, condensate trap, dryer, pressure regulator (with or without heating as required) etc., however the design shall ensure that moisture integrity is maintained by the sample handling system.

2.6.3.3 The system shall incorporate a dried reference gas cycle after each sample gas measurement in order to strip volatile contaminants from the detector during reference gas cycle.

2.6.3.4 In order to ensure accuracy and reliability of the moisture analyser, the system shall incorporate a moisture generator, consisting of temperature controlled water reservoir and a permeation tube. The moisture generator shall generate a known moisture sample against which calibration of the analyser can be verified.

2.6.3.5 Performance Specification

The moisture probe shall meet the following performance requirements, as a minimum:

Accuracy:	± 5% of reading
Repeatability:	± 1% of reading
Response time:	max. 60 seconds for 90% of steady state value

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Digitally signed by MD MAZHER ALI
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