

# PIPING MATERIAL SPECIFICATION (PMS)



GAIL (INDIA) LTD  
NEW DELHI

PIPING MATERIAL SPECIFICATION

SPECIFICATION

GAIL/PMS/SP-01

REV-0

Page 1 of 27

## TABLE OF CONTENTS

<b>1.0</b>	<b>SCOPE</b>
<b>2.0</b>	<b>CODES AND STANDARDS</b>
<b>3.0</b>	<b>MATERIAL SPECIFICATIONS</b>
<b>4.0</b>	<b>PIPELINE</b>
<b>5.0</b>	<b>PIPES</b>
<b>6.0</b>	<b>FITTINGS</b>
<b>7.0</b>	<b>BENDS</b>
<b>8.0</b>	<b>FLANGES</b>
<b>9.0</b>	<b>GASKETS</b>
<b>10.0</b>	<b>BOLTING AND THREADS</b>
<b>11.0</b>	<b>THREAD SEALANT</b>
<b>12.0</b>	<b>VALVES</b>
<b>13.0</b>	<b>QUICK OPENING END CLOSURE</b>
<b>14.0</b>	<b>HYDROTESTING VENTS AND DRAINS</b>
<b>15.0</b>	<b>PIPELINE SPECIALITY ITEMS</b>
<b>ATTACHMENTS</b>	
<b>ANNEXURE A- PMS 150# CLASS</b>	
<b>ANNEXURE B- PMS 300# CLASS</b>	
<b>ANNEXURE C- PMS 600# CLASS</b>	



## 1.0 SCOPE

- 1.1 M/s GAIL (India) Ltd., Delhi proposes to procure Metering Skids of different capacities for installations at various locations (customers' ends) to measure the quantity of Natural Gas supplied to the individual consumer installations. The metering skid and its associated pipeline shall be designed to handle regasified LNG/ Natural Gas at specified operating parameters.

This document covers minimum requirements for various piping materials necessary for the design of the piping/ pipeline and metering skid facilities coming under the project. This specification shall be read in conjunction with various Codes and Standards of latest edition, as applicable.

## 2.0 CODES AND STANDARDS

- 2.1 Pipeline and pipeline terminal facilities envisaged as part of this project shall be designed and engineered primarily in accordance with the provisions of the latest edition of the following codes:

- (i) ASME B31.8 - Gas transmissions and Distribution Piping System
- (ii) ASME B31.3 - Chemical Plant and Petroleum Refinery Piping
- (iii) OISD Standard 141 - Design and Construction Requirements for Cross Country Hydrocarbon Pipelines.

- 2.2 All codes, standards and specifications referred herein shall be the latest edition of such documents.

- 2.3 For sake of brevity the initials of the society to which the codes are referred may be omitted in the specifications, for example, B16.5 is a code referring to ASME; A106 is a code referring to ASTM.

- 2.4 In addition, GAIL specifications and standards for various piping and pipeline materials shall also be applicable.

## 3.0 MATERIAL SPECIFICATIONS

Individual piping class has been generally designed to cover a set of service operating within pressure-temperature consideration as per ASME B16.5/ B16.34 or part of it. Deviations of material from class specifications may occur due to specific design conditions and/ or availability. These deviations are permissible if they equal or better the individual class requirements and shall be subjected to approval on case-to-case basis. All materials shall conform to detailed specifications / data sheets for items as applicable.

## 4.0 PIPELINE

- 4.1 Line pipe material grade and wall thickness details are indicated in Annexure-I.

## 5.0 PIPES

- 5.1 Carbon steel pipe shall be made by open hearth, electric furnace or basic oxygen process only. The steel used shall be fully killed and made with fine grain structure. The grade and wall thickness of various sizes of pipes shall be as per piping material specification for the applicable class.

- 5.2 Pipe dimensions shall be in accordance with ASME B 36.10 for carbon steel ASTM standard pipes; & API 5L for carbon steel API 5L grade pipes.

- 5.3 All pipe threads shall conform to American Standard taper as per ASME B1.20.1 NPT, unless otherwise specified.



5.4 For butt weld end, bevel shall be in accordance with API specification 5L or ASME B 16.25 as applicable.

## 6.0 FITTINGS

6.1 Fully killed carbon steel shall be used in the manufacture of fittings. The fitting shall have carbon equivalent not exceeding 0.45, based on check analysis.

6.2 Threaded joints, if used, shall conform to American Standard taper as per ASME B1.20.1 NPT.

6.3 Dimensions of socket welded/ screwed fittings shall conform to ASME B 16.11. Swage shall be as per BS 3799.

6.4 Dimensions of steel butt welded fittings shall be as per ASME B 16.9.

6.5 Bore of socket welded fittings shall suit outside diameter (OD) of pipe and its thickness.

6.6 Butt welding ends shall conform to API specification 5L or ASME B 16.25 as applicable. In case of difference in thickness of matching ends, requirements of ASME B 31.8 shall apply.

6.7 Integrally reinforced forged branch fittings such as Sockolet, Weldolet etc. shall be as per MSS-SP-97. Fittings not covered in ASME B16.9 and MSS-SP-97 shall conform to manufacturer's standard.

6.8 Fittings thickness tolerances shall match pipe thickness tolerance.

## 7.0 BENDS

7.1 Unless otherwise specified for process piping, elbow of radius  $R = 1.5 D$  shall only be used.  
Minimum Bend Radius  $D = \text{Specified Outside Diameter}$

7.2 In order to accommodate changes in vertical and horizontal alignment in piggable section of pipeline, Elastic bends/ Cold field bends/ Hot formed long radius bends shall be used. Long Radius Bend shall be used only when indicated in the drawing.

7.3 Mitters shall not be used.

## 8.0 FLANGES

8.1 Pressure Temperature rating of flanges shall conform to B16.5/ MSS-SP44/ B16.47 Series A, as applicable.

8.2 Dimensions of flanges shall be in accordance with B16.5/ MSS-5P44/ B16.47 Series A, as applicable.

8.3 Neck of weld neck (WN) flanges shall suit pipe bore and thickness.

8.4 Bore of socket welded (SW) flanges shall suit pipe O.D. and its thickness.

8.5 Threads for screwed flanges, if used, shall conform to American Standard taper as per ASME B 1.20.1 NPT.

8.6 Sizes for blind flanges shall be indicated by nominal pipe size.

8.7 Unless specified otherwise in Piping Material Specification the flange face finish shall be as per ASME B16.5.



- 8.8 Butt welding ends of WN flanges shall conform to ASME B 16.25.
- 8.9 Spectacle blind/ spacer & blinds shall be in accordance with ASME B16.48/ manufacturer's standard.
- 8.10 Two jack screws, 180<sup>0</sup> apart shall be provided in spectacle blind or spacer & blind assemblies as per GAIL standards.

**9.0 GASKETS**

- 9.1 Spiral wound metallic gasket with compressed asbestos filler shall conform to ASME B16.20/ API 601. All spiral wound gaskets shall be provided with stainless steel centering ring.
- 9.2 Spiral wound gasket shall be self-aligning type.

**10.0 BOLTING & THREADS**

- 10.1 Nuts for stud bolts shall be American Standard Hexagon Heavy Series and double chamfered.
- 10.2 Dimension and tolerances for stud bolts and nuts shall be as per ASME B18.2.1 and 18.2.2 with full threading to ASME B 1.1 Class 2A thread for bolts and Class 2B for nuts. Diameter and length of stud bolts shall be as per ASME B 16.5/ ASME B16.47 with full threading.
- 10.3 Threads for nuts shall be as per ASME B 1.1

Nuts for stud bolts dia ¼“ to 1” : UNC-2B  
 Nuts for stud bolts dia 1½ %” to ¾ : 8UN-2B

- 10.4 Threads for stud bolts shall be as per ASME B 1.1, as follows:

Stud bolts dia ¼“ to 1” : UNC-2A  
 Stud bolts dia 1½ %” to ¾ : 8UN-2A

- 10.5 Threads for threaded pipe, fitting, flanges and valve shall be in accordance with B1.20.1 taper threads, unless specified otherwise.
- 10.6 Heads of jack screws shall be heavy hexagonal type. Jack screw end shall be rounded. Stud bolts shall be fully threaded with two hexagonal nuts.

**11.0 THREAD SEALANT**

- 11.1 Threaded joints shall be made with 1” wide PTFE jointing tape.

**12.0 VALVES**

- 12.1 Valve ends shall be as per valve data sheets (enclosed in Annexure-II) for various piping class.
- 12.2 Sectionalizing valves, Block valves and other isolation valves installed on the main pipeline shall be ball valves with butt welding ends. All inline isolation valves on the mainline (pipeline) shall be full bore valves to allow smooth passage of cleaning as well as intelligent pigs.
- 12.3 All buried valves shall be provided with stem extension, sealant, vent/drain and shall have butt welded ends as per relevant specification/ data sheet.



- 12.4 Flange dimensions and face finish of flanged end valves shall conform to clause 9.0 of this specification.
- 12.5 Butt welding ends of Butt Welded valves shall conform to ASME B 16.25.
- 12.6 Face to face and end to end dimensions shall conform to applicable standards.
- 12.7 Valves shall conform to following standards unless specified otherwise in piping material specification for various piping class.

**Flanged/ Socket Welded end valves (1½” and below)**

**Design STD. for Process lines**

Gate Valves	:	API 602
Globe Valves	:	BS 5352
Ball Valves	:	BS 5351
Plug Valves	:	B55353

**Flanged/ Butt Welded end valves (2” and above)**

**Design STD. for Process Lines**

Gate Valves	:	API 6D
Globe Valves	:	BS 1873
Check Valves	:	API 6D
Ball Valves	:	API 6D
Plug Valves	:	API 6D

- 12.8 All manual operated valves shall be provided with wrench / hand wheel or gear operator as specified here in below.

**12.8.1 Gate Valves**

For ANSI class 150 and 300	:	Hand wheel operated for size $\leq 12$ ” NB. Gear operated for size $\geq 14$ ” NB.
For ANSI class 600	:	Hand wheel operated for size $\leq 10$ ” NB. Gear operated for size $\geq 12$ ” NB

**12.8.2 Globe Valves**

For ANSI class 150, 300, 600 and 900 - Hand Wheel operated for all size

**12.8.3 Ball valves & Plug Valves**

For all ANSI class	:	Wrench operated for size $\leq 4$ ” NB. Gear operated for size $\geq 6$ ” NB.
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**12.8.4 Gas Actuated Valves**

Gas actuated valves shall be as per P & IDs. The actuator shall have provision for remote operation as per P & IDs. All gas actuated valves shall have additional provision of hand wheel operation.



### 13.0 QUICK OPENING END CLOSURE

Quick opening end closure to be installed on scraper traps shall be designed in accordance with Section VIII of ASME Boiler and Pressure Vessel Code and equipped with safety locking devices in compliance with Section VIII, division 1. UG-35.2 of ASME Boiler and Pressure Vessel Code.

### 14.0 HYDROTESTING VENTS AND DRAINS

In terminal piping, high point vents and low point drains required for the purpose of hydrotesting shall be of size 0.75". These vents & drains shall consist of gate valves with blind flange assembly.

### 15.0 PIPELINE SPECIALTY ITEMS

Pipeline specialty items viz, scraper traps, flow tees, insulating joints, LR bends etc. shall be as per specifications attached elsewhere.



**ANNEXURE A**  
**PIPING MATERIAL SPECIFICATION**  
**(CLASS 150#)**



GAIL (INDIA) LTD  
NEW DELHI

PIPING MATERIAL SPECIFICATION

SPECIFICATION

GAIL/PMS/SP-01

REV-0

Page 8 of 27

**PIPING CLASS** : **150 #**

**BASE MATERIAL** : **CARBON STEEL**

**CORROSION ALLOWANCE** : **1.5 MM**

**SPECIAL REQUIREMENT** : **NON IBR**

**TEMP. (°C)** : **-29 TO 65**

**PRESS. (kg/cm2)** :

**SERVICE**

NON CORROSIVE PROCESS - FLAMMABLE / NON FLAMMABLE, NON LETHAL-HYDROCARBONS, AMMONIA, STEAM & GAS CONDENSATE (NON- IBR), UTILITIES (WATER, INST, AIR, NITROGEN, CARBON DIOXIDE) AND LUBE OIL BEFORE THE FILTER.

**NOTES**

1. ALL VENTS AND DRAINS SHALL BE PROVIDED WITH GATE VALVE WITH BLIND FLANGE ASSEMBLY UNLESS OTHERWISE INDICATED IN P&ID.
2. NDT OF WELDS SHALL BE AS FOLLOWS:
 

RADIOGRAPHY	:	ALL BUTT WELDS	-	100%
MPI	:	SOCKET WELDS	-	100%
3. PIPING DESIGN AS PER ASME B 31.8 & OISD 141.
4. FLANGES OF SIZE 22" SHALL BE AS PER MSS-SP-44.
5. CHARPY V-NOTCH TEST & HARDNESS TEST SHALL BE CONDUCTED FOR PIPE, FITTINGS AND FLANGES.
6. ALL BRANCH CONNECTIONS INCLUDING VENT, DRAIN, PRESSURE AND TEMPERATURE CONNECTION SHALL BE AS PER BRANCH CONNECTION TABLE GIVEN ON NEXT PAGE. THE BRANCH DETAILS INDICATED IN APPLICABLE STANDARD SHALL BE IGNORED.

**SPECIAL NOTES**

ITEM	SIZE	DESCRIPTION
MAINTENANCE JOINTS	ALL	FLANGED TO BE KEPT MINIMUM
PIPE JOINTS	1.5" & BELOW	SW COUPLING
	2.0" & ABOVE	BUTT WELDED
DRAINS	ON LINES ≤1.5"	REFER GAIL STD.
	ON LINES ≥2.0"	AS PER P&ID OR 0.75"
VENTS	ON LINES ≤1.5"	REFER GAIL STD
	ON LINES ≥2.0"	AS PER P&ID OR 0.75"
TEMP. CONN	1.5"	FLANGED, INSTALLATION AS PER GAIL STD.





<u>CODE</u>	<u>DESCRIPTION</u>		
<b>F</b>	SADDLE FUSED JT	<b>T</b>	TEES
<b>H</b>	H.COUPLING	<b>W</b>	WELDOLETS
<b>P</b>	PIPE TO PIPE	<b>I</b>	INSTRUMENT TEE
<b>R</b>	REINFORCED	<b>X</b>	REFER NOTES
<b>S</b>	SOCKOLETS	<b>L</b>	SWEEPOLET

Item Type	Lower Size (Inch)	Upper Size (Inch)	Sch./ Thk	Dim. STD	Material	Description
<b>Pipe Group</b>						
PIPE	00.500	00.750	S160	B 36.10	ASTMA 106 GR.B	PE, SEAMLESS
PIPE	01.000	01.500	XS	B 36.10	ASTMA 106 GR.B	PE, SEAMLESS
PIPE	02.000	02.000	XS	B 36.10	ASTMA106 GR.B (CHARPY)	BE, SEAMLESS
PIPE	02.500	02.500	XS	B 36.10	ASTMA106 GR.B (CHARPY)	BE, SEAMLESS
PIPE	03.000	06.000	STD	B 36.10	ASTMA106 GR.B (CHARPY)	BE, SEAMLESS
PIPE	08.000	08.000	8.2	API 5L	API 5L GR.B PSL2	BE, SEAMLESS
PIPE	10.000	10.000	9.3	API 5L	API 5L GR.B PSL2	BE, SEAMLESS
NIPPLE	00.500	00.750	M	B 36.10	ASTMA 106 GR.B	PBE, SEAMLESS
NIPPLE	01.000	01.500	M	B 36.10	ASTMA 106 GR.B	PBE, SEAMLESS
<b>Flange Group</b>						
FLNG.WN	00.500	01.500	M	B-16.5	ASTM A 105	150, RF/125AARH
FLNG.WN	02.000	10.000	M	B-16.5	ASTM A 105 (CHARPY)	150, RF/125AARH
FLNG.BLIND	00.500	01.500		B-16.5	ASTM A 105	150, RF/125AARH
PLNG.BLIND	02.000	10.000		B-16.5	ASTM A105 (CHARPY)	150, RF/125AARH
FLNG.FIG8	00.500	01.500		B-16.48	ASTM A 105	150, RF/125AARH
FLNG.FIG8	02.000	08.000		B-16.48	ASTM A105 (CHARPY)	150, RF/125AARH
SPCR &BLIND	10.000	10.000		B-16.48	ASTM A105 (CHARPY)	150, RF/125AARH
<b>Fitting Group</b>						



ELBOW.90	00.500	0..750		B-16.11	ASTM A 105	SW, 6000
ELBOW.90	01.000	1.500		B-16.11	ASTM A 105	SW, 3000
ELBOW.90	02.000	10.000		B-16.9	ASTM A 234,GR. WPB (CHARPY)	BW, 1.5D
ELBOW.45	00.500	00.750		B-16.11	ASTM A 105	SW, 6000
ELBOW.45	01.000	01.500		B-16.11	ASTMA 105	SW, 3000
ELBOW.45	02.000	10.000	M	B-16.9	ASTM A234,GR. WPB (CHARPY)	BW, 1.5D
T.EQUAL	00.500	00.750		B 16.11	ASTM A 105	SW, 6000
T.EQUAL	01.000	01.500		B 16.11	ASTM A 105	SW, 3000
T.EQUAL	02.000	10.000	M	B-16.9	ASTM A234,GR.WPB (CHARPY)	BW
T.RED	00.500	00.750		B-16.11	ASTM A 105	SW, 6000
T.RED	01.000	01.500		B-16.11	ASTMA 105	SW, 3000
T.RED	02.000	10.000	M, M	B-16.9	ASTM A234,GR. WPB (CHARPY)	BW
REDUC.CONC	02.000	16.000	M,M	B-16.9	ASTM A234,GR. WPB (CHARPY)	BW
REDUC.ECC	02.000	10.000	M,M	B-16.9	ASTM A234,GR. WPB (CHARPY)	BW
SWAGE.CONC	00.500	03.000	M,M	BS-3799	ASTM A 105 (CHARPY)	PBE
SWAGE.ECC	00.500	03.000	M,M	BS-3799	ASTM A 105 (CHARPY)	PBE
CAP	00.500	00.750		B-16.11	ASTMA 105	SCRF, 6000
CAP	01.000	01.500		B-16.11	ASTMA 105	SCRF, 3000
CAP	02.000	10.000	M	B-16.9	ASTM A234,GR. WPB (CHARPY)	BW
CPLNG.FULL	00.500	00.750		B-16.11	ASTM A 105	SW, 6000
CPLNG.FULL	01.000	01.500		B-16.11	ASTM A 105	SW, 3000
CPLNG-HALF	00.500	00.750		B-16.11	ASTM A 105	SW, 6000
CPLNG.HALF	01.000	01.500		B-16.11	ASTM A 105	SW, 3000
CPLNG.LH	00.500	00.750		B-16.11	ASTM A 105	SW, 6000
CPLNG.LH	01.000	01.500		B-16.11	ASTM A 105	SW,3000



CPLNG.RED	00.500	00.750		B-16.11	ASTM A 105	SW, 6000
CPLNG.RED	01.000	01.500		B-16.11	ASTM A 105	SW, 3000
<b>O'let Group</b>						
SOCKOLET	00.500	0.750		MSS-SP97	ASTM A 105	SW, 6000
SOCKOLET	01.000	01.500		MSS-SP97	ASTM A 105	SW, 3000
WELDOLET	02.000	03.000	M, XXS	MSS-SP97	ASTMA 105 (CHARPY)	BW
<b>Valves Group</b>						
VLV.GATE	00.500	01.500		API-602	BODY-ASTM A 105, TRIM-STELLITED, STEM13%CR. STEEL	SW,800, 3000,B-16.11
VLV.GLOBE	00.500	01.500		BS-5352	BODY-ASTM A 105,TRIM-STELLITED, STEM13%CR STEEL	SW,800, 3000,B-16.11
VLV.CHECK	00.500	01.500		BS-5352	BODY-ASTMA 105,TRIM-STELLITED	SW,800, 3000, B-16.11
<b>Bolt Group</b>						
BOLT.STUD	00.500	10.000		B18.2	BOLT: 193 GR.B7,NUT: A194 GR. 2H	
<b>Gasket Group</b>						
GASKET	00.500	10.000		B16.20-ANSI B 16.5	SP,WND, SS316+CAF	SPIRAL, 150



# ANNEXURE B

## PIPING MATERIAL SPECIFICATION (CLASS 300#)



GAIL (INDIA) LTD  
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PIPING MATERIAL SPECIFICATION

SPECIFICATION

GAIL/PMS/SP-01

REV-0

Page 14 of  
27

**PIPING CLASS** : **300 #**  
**BASE MATERIAL** : **CARBON STEEL**  
**CORROSION ALLOWANCE** : **1.5 MM**  
**SPECIAL REQUIREMENT** : **NON IBR**  
**TEMP. (°C)- Design** : **-29 TO 65**  
**PRESS.-Min/ Max** :

**SERVICE**

NON CORROSIVE PROCESS- FLAMMABLE / NON FLAMMABLE, NON LETHAL-HYDROCARBONS, AROMATICS, AMMONIA, SWEET GAS, FLUSHING OIL AND OTHER UTILITIES -MP CONDENSATE, INSTRUMENT AIR, PLANT AIR, NITROGEN, AMMONIA GAS ETC.

**NOTES**

1. ALL VENTS AND DRAINS SHALL BE PROVIDED WITH GATE VALVE WITH BLIND FLANGE ASSEMBLY UNLESS OTHERWISE INDICATED IN P&ID.
2. NDT OF WELDS SHALL BE AS FOLLOWS:
 

RADIOGRAPHY	:	ALL BUTT WELDS	-	100%
MPI	:	SOCKET WELDS	-	100%
3. PIPING DESIGN AS PER ASME B 31.8 & OISD 141
4. FLANGES OF SIZE 22" SHALL BE AS PER MSS-SP-44.
5. CHARPY V-NOTCH TEST & HARDNESS TEST SHALL BE CONDUCTED FOR PIPE, FITTINGS AND FLANGES.
6. ALL BRANCH CONNECTIONS INCLUDING VENT, DRAIN, PRESSURE AND TEMPERATURE CONNECTION SHALL BE AS PER BRANCH CONNECTION TABLE GIVEN ON NEXT PAGE. THE BRANCH DETAILS INDICATED IN APPLICABLE STANDARD SHALL BE IGNORED.

ITEM	SIZE	DESCRIPTION
MAINTENANCE JOINTS	ALL	FLANGED, TO BE KEPT MINIMUM
PIPE JOINTS	1.5" & BELOW	SW COUPLING
	2.0" & ABOVE	BUTT WELDED
DRAINS	ON LINES ≤1.5"	REFER GAIL STD.
	ON LINES ≥2.0"	AS PER P&ID OR 0.75"
VENTS	ON LINES ≤1.5"	REFER GAIL STD.
	ON LINES ≥2.0"	AS PER P&ID OR 0.75".
TEMP. CONN	1.5"	FLANGED, INSTALLATION AS PER GAIL STD.
PRESS. CONN	0.75"	SW NIPPLE WITH GATE VALVE TO SPEC AS PER STD.





Item Type	Lower Size (Inch)	Upper Size (Inch)	Sch./ Thk	Dim. STD	Material	Description
<b>Pipe Group</b>						
PIPE	00.500	00.750	S160	B 36.10	ASTMA 106 GR.B	PE, SEAMLESS
PIPE	01.000	01.500	XS	B 36.10	ASTMA 106 GR.B	PE, SEAMLESS
PIPE	02.000	02.000	XS	B 36.10	ASTMA106 GR.B (CHARPY)	BE, SEAMLESS
PIPE	02.500	02.500	XS	B 36.10	ASTMA106 GR.B (CHARPY)	BE, SEAMLESS
PIPE	03.000	03.000	STD	B 36.10	ASTMA106 GR.B (CHARPY)	BE, SEAMLESS
PIPE	04.000	06.000	STD	B 36.10	ASTMA106 GR.B (CHARPY)	BE, SEAMLESS
PIPE	08.000	08.000	8.2	API 5L	API 5L GR.B PSL2	BE, SEAMLESS
PIPE	10.000	10.000	9.3	API 5L	API 5L GR.B PSL2	BE, SEAMLESS
PIPE	12.000	14.000	9.5	API 5L	API 5L GR.B PSL2	BE, SEAMLESS
PIPE	16.000	18.000	10.3	API 5L	API 5L GR.B PSL2	BE, SAW
PIPE	18.000	18.000	8.7	API 5L	API 5L GR.X-52 PSL2	BE, SAW
PIPE	20.000	20.000	9.5	API 5L	API 5L GR.X-52 PSL2	BE, SAW
PIPE	22.000	22.000	10.3	API 5L	API 5L GR.X-52 PSL2	BE, SAW
PIPE	24.000	24.000	11.1	API 5L	API 5L GR.X-52 PSL2	BE, SAW
PIPE	26.000	26.000	11.1	API 5L	API 5L GR.X-52 PSL2	BE, SAW
NIPPLE	00.500	00.750	M	B 36.10	ASTM A 106 GR.B	PBE, SEAMLESS
NIPPLE	01.000	01.500	M	B 36.10	ASTM A 106 GR.B	PBE, SEAMLESS
<b>Flange Group</b>						
FLNG.SW	00.500	01.500	M	B-16.5	ASTM A 105	300, RF/125AARH
FLNG.WN	02.000	16.000	M	B-16.5	ASTM A 105 (CHARPY)	300, RF/125AARH
FLNG.WN	18.000	24.000	M	B-16.5	ASTM A 694 GR. F-52 (CHARPY)	300, RF/125AARH
FLNG.WN	26.000	26.000	M	B-16.5	ASTM A 694 GR. F-52 (CHARPY)	300, RF/125AARH
FLNG.BLIND	00.500	01.500		B-16.5	ASTM A 105	300, RF/125AARH
PLNG.BLIND	02.000	24.000		B-16.5	ASTM A105 (CHARPY)	300, RF/125AARH



PLNG.BLIND	26.000	26.000		B-16.47 A	ASTM A105 (CHARPY)	300, RF/125AARH
FLNG.FIG8	00.500	01.500		B-16.48	ASTM A 105	300, RF/125AARH
FLNG.FIG8	02.000	08.000		B-16.48	ASTM A105 (CHARPY)	300, RF/125AARH
SPCR &BLIND	10.000	24.000		B-16.48	ASTM A105 (CHARPY)	300, RF/125AARH
SPCR &BLIND	26.000	26.000		B-16.48	ASTM A105 (CHARPY)	300, RF/125AARH
<b>Fitting Group</b>						
ELBOW.90	00.500	0..750		B-16.11	ASTM A 105	SW, 6000
ELBOW.90	01.000	1.500		B-16.11	ASTM A 105	SW, 3000
ELBOW.90	02.000	16.000	M	B-16.9	ASTM A 234,GR. WPB CHARPY)	BW, 1.5D
ELBOW.90	18.000	26.000	M	MSS- SP75	MSS-SP75 GR.WPHY-52	BW, 1.5D
ELBOW.45	00.500	00.750		B-16.11	ASTM A 105	SW, 6000
ELBOW.45	01.000	01.500		B-16.11	ASTM A 105	SW, 3000
ELBOW.45	02.000	16.000	M	B-16.9	ASTM A234, GR. WPB CHARPY)	BW, 1.5D
ELBOW.45	18.000	26.000	M	MSS- SP75	MSS-SP75 GR.WPHY-52	BW, 1.5D
T.EQUAL	00.500	00.750		B 16.11	ASTM A 105	SW, 6000
T.EQUAL	01.000	01.500		B 16.11	ASTM A 105	SW, 3000
T.EQUAL	02.000	16.000	M	B-16.9	ASTM A234,GR.WPB (CHARPY)	BW
T.EQUAL	18.000	26.000	M	MSS- SP75	MSS-SP75 GR.WPHY-52	BW
T.RED	00.500	00.750		B-16.11	ASTM A 105	SW, 6000
T.RED	01.000	01.500		B-16.11	ASTM A 105	SW, 3000
T.RED	02.000	16.000	M, M	B-16.9	ASTM A234,GR. WPB(CHARPY)	BW
T.RED	18.000	26.000	M, M	MSS- SP75	MSS-SP75 GR.WPHY-52	BW
REDUC.CONC	02.000	16.000	M,M	B-16.9	ASTM A234,GR. WPB(CHARPY)	BW
REDUC.CONC	18.000	26.000	M,M	MSS- SP75	MSS-SP75 GR.WPHY-52	BW
REDUC.ECC	02.000	16.000	M,M	B-16.9	ASTM A234,GR. WPB(CHARPY)	BW
REDUC.ECC	18.000	26.000	M,M	MSS- SP75	MSS-SP75 GR.WPHY-52	BW



SWAGE.CONC	00.500	03.000	M,M	BS-3799	ASTM A 105 (CHARPY)	PBE
SWAGE.ECC	00.500	03.000	M,M	BS-3799	ASTM A 105 (CHARPY)	PBE
CAP	00.500	00.750		B-16.11	ASTM A 105	SCRF, 6000
CAP	01.000	01.500		B-16.11	ASTM A 105	SCRF, 3000
CAP	02.000	16.000	M	B-16.9	ASTM A234,GR. WPB (CHARPY)	BW
CAP	18.000	26.000	M	MSS-SP75	MSS-SP75 GR.WPHY-52	BW
PLUG	00.500	00.750		B 16.11	ASTM A 105	SCRM, 6000
PLUG	01.000	01.500		B 16.11	ASTM A 105	SCRM, 3000
CPLNG.FULL	00.500	00.750		B-16.11	ASTM A 105	SW, 6000
CPLNG.FULL	01.000	01.500		B-16.11	ASTM A 105	SW, 3000
CPLNG-HALF	00.500	00.750		B-16.11	ASTM A 105	SW, 6000
CPLNG.HALF	01.000	01.500		B-16.11	ASTM A 105	SW, 3000
CPLNG.LH	00.500	00.750		B-16.11	ASTM A 105	SW, 6000
CPLNG.LH	01.000	01.500		B-16.11	ASTM A 105	SW,3000
CPLNG.RED	00.500	00.750		B-16.11	ASTM A 105	SW, 6000
CPLNG.RED	01.000	01.500		B-16.11	ASTM A 105	SW, 3000
<b>O' let group</b>						
SOCKOLET	00.500	0.750		MSS-SP97	ASTM A 105	SW, 6000
SOCKOLET	01.000	01.500		MSS-SP97	ASTM A 105	SW, 3000
WELDOLET	02.000	10.000	M,XXS	MSS-SP97	ASTMA 105 (CHARPY)	BW
<b>Valves Group</b>						
VLV.GATE	00.500	01.500		API-602	BODY-ASTM A 105, TRIM-STELLITED, STEM13%CR. STEEL	SW,800, 3000,B-16.11
VLV.GATE	02.000	12.000		API-6D	BODY-ASTM A 216 GR. WCB TRIM-STELLITED, STEM 13% CR. STEEL	FLGD, 300, B-16.5, RF/ 125 AARH
VLV.GLOBE	00.500	01.500		BS-5352	BODY-ASTM A 105,TRIM-STELLITED, STEM13%CR STEEL	SW,800, 3000,B-16.11
VLV.GLOBE	02.000	12.000		BS-1873	BODY-ASTM A 216 GR. WCB TRIM-STELLITED, STEM 13%	FLGD, 300, B-16.5, RF/ 125



					CR. STEEL	AARH
VLV.CHECK	00.500	01.500		BS-5352	BODY-ASTMA 105,TRIM-STELLITED	SW,800, 3000, B-16.11
VLV.CHECK	2.000	12.000		API -6D	BODY-ASTM A 216 GR. WCB TRIM-STELLITED, STEM 13% CR. STEEL	FLGD, 300, B-16.5, RF/ 125 AARH
VLV.BALL	00.500	01.500		BS-5351	BODY-ASTM A 105,TRIM-SEAT RPTFE	FLGD, 300, B-16.5, RF/ 125 AARH
VLV.BALL	02.000	12.000		API-6D	BODY-ASTM A 216 GR. WCC/ A234 GR WPC, TRIM-SEAT AISI 4140+0.003" ENP/ AISI 410	FLGD, 300, B-16.5, RF/ 125 AARH
VLV.BALL	02.000	02.000		API-6D	BODY-ASTM A 216 GR. WCC/ A234 GR WPC, TRIM-SEAT AISI 4140+0.003" ENP/ AISI 410	BW, 300, B-16.25, RF/ 125 AARH
VLV.PLUG	00.500	01.500		BS-5353	BODY-ASTM A 105, PLUG-A 105 +0.003" ENP	SW,800 3000, B-16.11
VLV.PLUG	02.000	12.000		API-6D	BODY-ASTM A 216 GR. WCB PLUG-A 216 GR. WCB+0.003" ENP	FLGD, 300, B-16.5, RF/ 125 AARH
<b>Bolt Group</b>						
BOLT.STUD	00.500	26.000		B18.2	BOLT: 193 GR.B7,NUT: A194 GR. 2H	
<b>Gasket Group</b>						
GASKET	00.500	24.000		B16.20-ANSI B 16.5	SP,WND, SS316+CAF	SPIRAL, 300
GASKET	26.000	26.000		B16.20-ANSIB 16.47A	SP,WND, SS316+CAF	SPIRAL, 300



# ANNEXURE C

## PIPING MATERIAL SPECIFICATION (CLASS 600#)



GAIL (INDIA) LTD  
NEW DELHI

PIPING MATERIAL SPECIFICATION

SPECIFICATION

GAIL/PMS/SP-01

REV-0

Page 21 of  
27

**PIPING CLASS** : **600 #**  
**BASE MATERIAL** : **CARBON STEEL**  
**CORROSION ALLOWANCE** : **1.5 MM**  
**SPECIAL REQUIREMENT** : **NON IBR**  
**TEMP. (<sup>0</sup>C)- Design** : **-29 TO 65**  
**PRESS.-Min/ Max** :  
**SERVICE - REGASIFIED LNG (R-LNG) / Natural Gas**

**NOTES**

7. ALL VENTS AND DRAINS SHALL BE PROVIDED WITH GATE VALVE WITH BLIND FLANGE ASSEMBLY UNLESS OTHERWISE INDICATED IN P&ID.
8. BALL VALVE TO BE USED IN MAIN LINE SHALL HAVE BUTT WELDED ENDS.
9. FLOW TEE SHALL BE WELDED TYPE FOR USE IN MAINLINE ONLY. MATERIAL SHALL BE ASTM A 694 GR. F70.
10. IJ SHALL BE MONOBLOCK TYPE, ASTM A 694 GR. F70/ A 105 FOR USE IN MAINLINE ONLY.
11. NDT OF WELDS SHALL BE AS FOLLOWS:
 

RADIOGRAPHY	:	ALL BUTT WELDS	-	100%
MPI	:	SOCKET WELDS	-	100%
12. PIPING DESIGN AS PER ASME B 31.8 & OISD 141
13. FLANGES OF SIZE 22" SHALL BE AS PER MSS-SP-44.
14. CHARPY V-NOTCH TEST & HARDNESS TEST SHALL BE CONDUCTED FOR PIPE, FITTINGS AND FLANGES.
15. ALL BRANCH CONNECTIONS INCLUDING VENT, DRAIN, PRESSURE AND TEMPERATURE CONNECTION SHALL BE AS PER BRANCH CONNECTION TABLE GIVEN ON NEXT PAGE. THE BRANCH DETAILS INDICATED IN APPLICABLE STANDARD SHALL BE IGNORED.

**SPECIAL NOTES**

ITEM	SIZE	DESCRIPTION
MAINTENANCE JOINTS	ALL	FLANGED, TO BE KEPT MINIMUM
PIPE JOINTS	1.5" & BELOW	SW COUPLING
	2.0" & ABOVE	BUTT WELDED
DRAINS	ON LINES ≤1.5"	REFER GAIL STD.
	ON LINES ≥2.0"	AS PER P&ID OR 0.75"
VENTS	ON LINES ≤1.5"	REFER GAIL STD.
	ON LINES ≥2.0"	AS PER P&ID OR 0.75"
TEMP. CONN	1.5"	FLANGED, INSTALLATION AS PER GAIL STD.





<u>CODE</u>	<u>DESCRIPTION</u>		
F	SADDLE FUSED JT	T	TEES
H	H.COUPLING	W	WELDOLETS
P	PIPE TO PIPE	I	INSTRUMENT TEE
R	REINFORCED	X	REFER NOTES
S	SOCKOLETS	L	SWEEPOLET

Item Type	Lower Size (Inch)	Upper Size (Inch)	Sch./Thk	Dim. STD	Material	Description
<b>Pipe Group</b>						
PIPE	00.500	00.750	S160	B 36.10	ASTM A 106 GR.B	PE, SEAMLESS
PIPE	01.000	01.500	XS	B 36.10	ASTM A 106 GR.B	PE, SEAMLESS
PIPE	02.000	02.000	XS	B 36.10	ASTM A106 GR.B (CHARPY)	BE, SEAMLESS
PIPE	03.000	03.000	STD	B 36.10	ASTM A106 GR.B (CHARPY)	BE, SEAMLESS
PIPE	04.000	06.000	XS	B 36.10	ASTM A106 GR.B (CHARPY)	BE, SEAMLESS
PIPE	08.000	08.000	XS	API 5L	API 5L GR.B PSL2	BE, SEAMLESS
PIPE	10.000	10.000	14.3	API 5L	API 5L GR.B PSL2	BE, SEAMLESS
PIPE	12.000	12.000	15.9	API 5L	API 5L GR.B PSL2	BE, SEAMLESS
PIPE	14.000	14.000	17.5	API 5L	API 5L GR.B PSL2	BE, SEAMLESS
PIPE	16.000	16.000	19.1	API 5L	API 5L GR.B PSL2	BE, SAW
PIPE	18.000	18.000	15.9	API 5L	API 5L GR.X-52 PSL2	BE, SAW
PIPE	20.000	20.000	17.5	API 5L	API 5L GR.X-52 PSL2	BE, SAW
PIPE	22.000	22.000	17.5	API 5L	API 5L GR.X-52 PSL2	BE, SAW
PIPE	24.000	24.000	19.1	API 5L	API 5L GR.X-52 PSL2	BE, SAW
PIPE	26.000	26.000	20.6	API 5L	API 5L GR.X-52 PSL2	BE, SAW
PIPE	28.000	28.000	22.2	API 5L	API 5L GR.X-52 PSL2	BE, SAW
PIPE	30.000	30.000	23.8	API 5L	API 5L GR.X-52 PSL2	BE, SAW
NIPPLE	00.500	00.750	M	B 36.10	ASTM A 106 GR.B	PBE, SEAMLESS
NIPPLE	01.000	01.500	M	B 36.10	ASTM A 106 GR.B	PBE, SEAMLESS
<b>Flange Group</b>						
FLNG.SW	00.500	01.500	M	B-16.5	ASTM A 105	600,



						RF/125AARH
FLNG.WN	02.000	16.000	M	B-16.5	ASTM A 105 (CHARPY)	600, RF/125AARH
FLNG.WN	18.000	24.000	M	B-16.5	ASTM A 694 GR. F-52 (CHARPY)	600, RF/125AARH
FLNG.WN	26.000	30.000	M	B16.47A	ASTM A 694 GR. F-52 (CHARPY)	600, RF/125AARH
FLNG.BLIND	00.500	01.500		B-16.5	ASTM A 105	600, RF/125AARH
PLNG.BLIND	02.000	24.000		B-16.5	ASTM A105 (CHARPY)}	600, RF/125AARH
PLNG.BLIND	26.000	30.000		B16.47A	ASTM A105 (CHARPY)}	600, RF/125AARH
FLNG.FIG8	00.500	01.500		B-16.48	ASTM A 105	600, RF/125AARH
FLNG.FIG8	02.000	08.000		B-16.48	ASTM A105 (CHARPY)	600, RF/125AARH
SPCR &BLIND	10.000	24.000		B-16.48	ASTM A105 (CHARPY)	600, RF/125AARH
SPCR &BLIND	26.000	30.000		B-16.48	ASTM A105 (CHARPY)	600, RF/125AARH
<b>Fitting Group</b>						
ELBOW.90	00.500	0.750		B-16.11	ASTM A 105	SW, 6000
ELBOW.90	01.000	1.500		B-16.11	ASTM A 105	SW, 3000
ELBOW.90	02.000	16.000	M	B-16.9	ASTM A 234,GR. WPB (CHARPY)	BW, 1.5D
ELBOW.90	18.000	30.000	M	MSS-SP75	MSS-SP75 GR.WPHY-52	BW, 1.5D
ELBOW.45	00.500	00.750		B-16.11	ASTM A 105	SW, 6000
ELBOW.45	01.000	01.500		B-16.11	ASTM A 105	SW, 3000
ELBOW.45	02.000	16.000	M	B-16.9	ASTM A234, GR. WPB (CHARPY)	BW, 1.5D
ELBOW.45	18.000	30.000	M	MSS-SP75	MSS-SP75 GR.WPHY-52	BW, 1.5D
T.EQUAL	00.500	00.750		B 16.11	ASTM A 105	SW, 6000
T.EQUAL	01.000	01.500		B 16.11	ASTM A 105	SW, 3000
T.EQUAL	02.000	16.000	M	B-16.9	ASTM A234,GR.WPB (CHARPY)	BW
T.EQUAL	18.000	30.000	M	MSS-SP75	MSS-SP75 GR.WPHY-52	BW
T.RED	00.500	00.750		B-16.11	ASTM A 105	SW, 6000
T.RED	01.000	01.500		B-16.11	ASTM A 105	SW, 3000
T.RED	02.000	16.000	M, M	B-16.9	ASTM A234,GR. WPB(CHARPY)	BW



T.RED	18.000	30.000	M, M	MSS-SP75	MSS-SP75 GR.WPHY-52	BW
REDUC.CONC	02.000	16.000	M,M	B-16.9	ASTM A234,GR. WPB(CHARPY)	BW
REDUC.CONC	18.000	30.000	M,M	MSS-SP75	MSS-SP75 GR.WPHY-52	BW
REDUC.ECC	02.000	16.000	M,M	B-16.9	ASTM A234,GR. WPB(CHARPY)	BW
REDUC.ECC	18.000	30.000	M,M	MSS-SP75	MSS-SP75 GR.WPHY-52	BW
SWAGE.CONC	00.500	03.000	M,M	BS-3799	ASTM A 105 (CHARPY)	PBE
SWAGE.ECC	00.500	03.000	M,M	BS-3799	ASTM A 105 (CHARPY)	PBE
CAP	00.500	00.750		B-16.11	ASTM A 105	SCRF, 6000
CAP	01.000	01.500		B-16.11	ASTM A 105	SCRF, 3000
CAP	02.000	16.000	M	B-16.9	ASTM A234,GR. WPB (CHARPY)	BW
CAP	18.000	30.000	M	MSS-SP75	MSS-SP75 GR.WPHY-52	BW
PLUG	00.500	00.750		B 16.11	ASTM A 105	SCRM, 6000
PLUG	01.000	01.500		B 16.11	ASTM A 105	SCRM, 3000
CPLNG.FULL	00.500	00.750		B-16.11	ASTM A 105	SW, 6000
CPLNG.FULL	01.000	01.500		B-16.11	ASTM A 105	SW, 3000
CPLNG-HALF	00.500	00.750		B-16.11	ASTM A 105	SW, 6000
CPLNG.HALF	01.000	01.500		B-16.11	ASTM A 105	SW, 3000
CPLNG.LH	00.500	00.750		B-16.11	ASTM A 105	SW, 6000
CPLNG.LH	01.000	01.500		B-16.11	ASTM A 105	SW,3000
CPLNG.RED	00.500	00.750		B-16.11	ASTM A 105	SW, 6000
CPLNG.RED	01.000	01.500		B-16.11	ASTM A 105	SW, 3000
<b>O' let group</b>						
SOCKOLET	00.500	0.750		MSS-SP97	ASTM A 105	SW, 6000
SOCKOLET	01.000	01.500		MSS-SP97	ASTM A 105	SW, 3000
WELDOLET	02.000	10.000	M, XXS	MSS-SP97	ASTMA 105 (CHARPY)	BW
<b>Valves Group</b>						
VLV.GATE	00.500	01.500		API-602	BODY-ASTM A 105, TRIM- STELLITED, STEM13%CR. STEEL	SW,800, 3000,B- 16.11
VLV.GLOBE	00.500	01.500		BS-5352	BODY-ASTM A 105,TRIM- STELLITED, STEM13%CR STEEL	SW,800, 3000,B- 16.11



VLV.CHECK	00.500	01.500		BS-5352	BODY-ASTMA 105,TRIM-STELLITED	SW,800, 3000, B- 16.11
VLV.BALL	00.500	01.500		BS-5351	BODY-ASTM A 105,TRIM-SEAT RPTFE	FLGD, 600, B- 16.5, RF/ 125 AARH
VLV.BALL	02.000	24.000		API-6D	BODY-ASTM A 216 GR. WCC/ A234 GR WPC, TRIM-SEAT AISI 4140+0.003" ENP/ AISI 410	FLGD, 600, B- 16.5, RF/ 125 AARH
VLV.BALL	26.000	30.000		API-6D	BODY-ASTM A 216 GR. WCC/ A234 GR WPC, TRIM-SEAT AISI 4140+0.003" ENP/ AISI 410	BW, 600, B- 16.25, RF/ 125 AARH
VLV.BALL	02.000	30.000		API-6D	BODY-ASTM A 216 GR. WCC/ A234 GR WPC, TRIM-SEAT AISI 4140+0.003" ENP/ AISI 410	BW, 600, B- 16.25, RF/ 125 AARH
VLV.PLUG	00.500	01.500		BS-5353	BODY-ASTM A 105, PLUG-A 105 +0.003" ENP	SW, 800 3000, B- 16.11
VLV.PLUG	02.000	24.000		API-6D	BODY-ASTM A 216 GR. WCB PLUG-A 216 GR. WCB+0.003" ENP	FLGD, 600, B- 16.5, RF/ 125 AARH
VLV.PLUG	02.000	02.000		API-6D	BODY-ASTM A 216 GR. WCB PLUG-A 216 GR. WCB+0.003" ENP	BW, 600, B-16.5, RF/ 125 AARH
<b>Bolt Group</b>						
BOLT.STUD	00.500	30.000		B18.2	BOLT: 193 GR.B7,NUT: A194 GR. 2H	
<b>Gasket Group</b>						
GASKET	00.500	24.000		B16.20- ANSI B16.5	SP,WND, SS316+CAF	SPIRAL, 600
GASKET	26.000	30.000		B16.20- ANSI B16.47A	SP,WND, SS316+CAF	SPIRAL, 600



## CONTENTS

SL NO.	DESCRIPTION
1.0	SCOPE OF WORK
2.0	TECHNICAL REQUIREMENTS FOR PURCHASE OF PIPES
3.0	INFORMATION TO BE SUBMITTED WITH THE OFFER
4.0	INFORMATION TO BE SUBMITTED BY SUCCESSFUL Bidder
5.0	INSPECTION & TESTING
6.0	MARKING AND DESPATCH
7.0	GUARANTEE
8.0	HYDROSTATIC TEST

**1.0 SCOPE OF WORK**

- 1.1. This specification forms a part of the tender documents and shall be read in conjunction with the said document.
- 1.2. The scope of work of the Bidder / vendor includes manufacture, inspection & testing, marking, packaging & supply of pipes in accordance with the tentative quantities outlined in the Schedule of Rates.
- 1.3. Bidder / vendor shall quote in strict accordance with the Schedule of Rates their technical requirements and all other enclosures to the tender specifications.
- 1.4. All codes and standards for manufacture, testing, inspection etc. shall be of latest editions.
- 1.5. Bidder / vendor shall quote the unit rate for all the pipes as per the Schedule of Rates. Purchaser reserves the right to increase or decrease the Quantities to be ordered to the successful Bidder / vendor.
- 1.6. Purchaser also reserves the right to order additional quantities during execution of the order based on unit rates and other terms & conditions in the original order.

**2.0 TECHNICAL REQUIREMENTS FOR PURCHASE OF PIPES**

- 2.1. All pipe and their dimensions, tolerance, chemical composition, physical properties, heat treatment, hydrotest and other testing and marking shall conform to the codes and standards specified in the requisition deviation(s), if any, shall be clearly highlighted in the offer.
- 2.2. Test reports shall be supplied for all mandatory tests as per the applicable standards/ these specifications. Test reports shall also be furnished for any supplementary tests as required.
- 2.3. Material test certificates (physical property, chemical composition & heat treatment report) shall also be furnished for the pipes supplied.
- 2.4. Steel made by acid bessemer process shall not be acceptable. Steel pipe shall be made by open hearth, electric furnace or basic oxygen process.
- 2.5. All longitudinally welded pipes other than IS:3589 should employ only automatic welding. Vendor must confirm the same. However manual welding may be accepted in case the quantity is less. Acceptance shall be decided on quantity only. Vendor shall indicate specifically the technique of welding employed.
- 2.6. Pipe shall be supplied in single or double random length of 4 to 7 and 7 to 14 meters respectively.
- 2.7. Seamless and E.R.W. Pipes shall not have any circumferential seam joint in a random length. However, in case of E.F.S.W pipe, in one random length one welded circumferential seam of same quality as longitudinal weld is permitted which shall be at least 2.5 M. from either end. The longitudinal seams of the two portions shall be staggered by 90 deg. Single random length in such cases shall be 5 to 7M
- 2.8. Pipe with screwed ends shall have NPT external taper pipe threads conforming to ANSI B1.20.1 (up to 1.5 in NB) & IS:554 (from 2 in to 6 in NB)
- 2.9. Pipe with bevelled ends shall be in accordance with ANSI B-16.25

- 2.10. Galvanized pipes shall be coated with zinc by hot dip process conforming to IS:4736 / ASTM A 153 or by electro-galvanising.
- 2.11. All austenitic stainless steel pipes shall be supplied in solution annealed condition.
- 2.12. Inter granular corrosion test for stainless steel
- 2.12.1 For all austenitic stainless steel pipes intergranular corrosion test shall have to be conducted as per following :
- ASTM A 262 practice "B" with acceptance criteria of "60 mils/year (max.)"
- OR
- ASTM A 262 practice "E" with acceptance criteria of "NO CRACKS AS OBSERVED FROM 20X MAGNIFICATION" & microscopic structure to be observed from 250X magnification".
- 2.12.2 When specifically asked for in Schedule of Quantities for high temperature application of some grades of austenitic stainless steel (e.g. SS 309, 310, 316, 316H etc.) ASTM A 262 practice "C" with acceptance criteria of "15 mils / year (max.)" shall have to be conducted.
- 2.12.3 For the IGC test as described in 2.12.1 & 2.12.2 , two sets of samples shall be drawn from each solution annealing lot, one set corresponding to highest carbon content and other set corresponding to the highest pipe thickness when testing is conducted as per practice "E" photograph of microscopic structure shall be submitted for record.
- 2.13. All welded pipes indicated as `CRYO' & `LT' in schedule of Quantities shall be impact tested as per requirement and acceptance criteria of ASME B 31.3. The impact test temp shall be -196°C, -80°C & -45°C for stainless steel, 3½" Ni steel and carbon steel respectively unless specifically mentioned otherwise in specifications / schedule of Quantities.
- 2.14. Specified heat treatment for carbon steel and alloy steel & solution annealing for stainless steel pipes shall be carried out after weld repairs, number of weld repairs at same spot shall be restricted to maximum two by approved repair procedure.
- 2.15. **IBR PIPES**
- 2.15.1 Pipes under purview of IBR shall be accompanied with IBR certificates in form IIIA, duly approved and countersigned by IBR authority / local authority empowered by Central Boiler Board of India.
- 2.15.2 For carbon steel pipes under IBR the chemical composition shall conform to the following:
- (i) Carbon(Max) : 0.25 %
- (ii) Others (S, P, Mn) : As prescribed in IBR regulation.
- The chemical composition as indicated in this clause is not applicable for pipes other than IBR services.

### 3.0 INFORMATION TO BE SUBMITTED WITH THE OFFER

- 3.1 Bidder / vendor shall submit with the offer the following:
- 3.1.1 Manufacturer's complete descriptive and illustrative catalogue / literature, covering all pipes to be supplied by the CONTRACTOR as per Schedule of Rates.

4.0 **INFORMATION TO BE SUBMITTED BY SUCCESSFUL BIDDER / VENDOR.**

- 4.1 Test reports shall be supplied for all mandatory tests as per the applicable code. Test reports shall also be furnished for any supplementary tests as specified in clauses 2.12.1, 2.12.2, 2.12.3 & 2.13.
- 4.2 Material test certificates (physical property, chemical composition & heat treatment report) of the pipes shall be furnished for the pipes supplied.
- 4.3 Statutory test certificates, if applicable, shall be submitted.

5.0 **INSPECTION & TESTING**

Inspection and testing shall be carried out at manufacturer's works as per relevant codes / these specifications, by Purchaser / Consultant.

6.0 **MARKING AND DESPATCH**

- 6.1 All pipes shall be marked in accordance with the applicable codes, standards and specifications. In addition the purchase order No. & special conditions like "IBR", "CRYO", "NACE" etc. shall also be marked.
- 6.2 Pipes under "IBR", "CRYO" & "NACE" shall be painted in red strips, light purple brown strips & canary yellow strips respectively longitudinally throughout the length for easy identification.
- 6.3 Paint or ink for marking shall not contain any harmful metal or metallic salts such as zinc, lead or copper which causes corrosive attack on heating.
- 6.4 Pipes shall be dry, clean and free from moisture, dirt and loose foreign materials of any kind.
- 6.5 Pipes shall be protected from rust, corrosion and mechanical damage during transportation, shipment and storage.
- 6.6 Rust preventive used on machined surfaces to be welded shall be easily removable with a petroleum solvent or shall not be harmful to welding.
- 6.7 Both ends of the pipe shall be protected with the following material:
  - (i) Plain end : Plastic Cap
  - (ii) Bevel end : Wood, metal or plastic cover
  - (iii) Threaded end : Metal or plastic threaded cap
- 6.8 End protectors to be used on bevelled ends shall be securely and tightly attached with belt or wire.
- 6.9 Steel end protectors to be used on galvanized pipes shall be galvanized.

7.0 **GUARANTEE**

The CONTRACTOR shall be liable to replace the pipes for any defect/deficiency in design, material manufacture, packing, transport, shipment and performance for 12 months from date of commissioning.

8.0 **HYDROSTATIC TEST**

All pipes shall be hydrostatically tested. The mill test pressure shall be as follows:

**GROUP 1 (SEAMLESS,ERW & SPIRAL WELDED)****A CARBON STEEL**

<i>S No.</i>	<i>MATERIAL STD</i>	:	<i>TEST PRESSURE</i>
(i)	ASTM A106 GR.B	:	ASTM A 530
(ii)	API 5L GR.B,SEAMLESS	:	API 5L
(iii)	API 5L,E.R.W	:	API 5L
(iv)	API 5L,SPIRAL	:	API 5L
(v)	ASTM A333 GR.3 & 6,SEAMLESS	:	ASTM A530
(vi)	ASTM A333 GR.3 & 6,E.R.W	:	ASTM A530

**B SEAMLESS ALLOY STEEL**

<i>S No.</i>	<i>MATERIAL STD</i>	:	<i>TEST PRESSURE</i>
(i)	ASTM A335 GR.P1,P12,P11,P22,P5,P9	:	ASTM A530
(ii)	ASTM A268 TP 405,TP410	:	ASTM A530

**C SEAMLESS STAINLESS STEEL**

<i>S No.</i>	<i>MATERIAL STD</i>	:	<i>TEST PRESSURE</i>
(i)	ASTM A312 GR. TP304 ,304L ,304H, 316, 316L, 316H, 321, 347	:	ASTM A530

**D SEAMLESS NICKEL ALLOY**

<i>S No.</i>	<i>MATERIAL STD</i>	:	<i>TEST PRESSURE</i>
(i)	ASTM B161 UNS NO.2200	:	ASTM B161
(ii)	ASTM B165 UNS NO.4400	:	ASTM B165
(iii)	ASTM A167 UNS NO.6600	:	ASTM B167
(iv)	ASTM A407 UNS NO.8800	:	ASTM B407

**E WELDED NICKEL ALLOY**

<i>S No.</i>	<i>MATERIAL STD</i>	:	<i>TEST PRESSURE</i>
(i)	ASTM B725 UNS NO.2200,4400	:	ASTM B725
(ii)	ASTM B517 UNS NO.6600	:	ASTM B517
(iii)	ASTM B514 UNS NO.8800	:	ASTM B514

**GROUP II (ELECTRIC FUSION WELDED)****A CARBON STEEL & ALLOY STEEL (16" & ABOVE) E.F.S.W**

<i>S No.</i>	<i>MATERIAL STD</i>	:	<i>TEST PRESSURE</i>
(i)	API 5L GR.B ASTM A671 G.R.CC65,70 (CL32) ASTM A672 GR.C60,65,70 (CL 12,22) ASTM A671 GR.CF60,65,70,66 (CL32) ASTM A691 GR.1/2Cr,1Cr,1-1/4Cr, 2-1/4Cr,5Cr,9Cr (CL 42)	:	P=2ST/D S=90% OF SMYS EXCEPT API 5L GR.B =85% OF SMYS FOR API 5L GR.B T=NOM.WALL THK. D=O.D OF PIPE



**STANDARD SPECIFICATION  
FOR  
FABRICATION AND ERECTION OF  
PIPING**

 <b>GAIL (INDIA) LTD</b>	<b>STANDARD SPECIFICATION FOR FABRICATION AND ERECTION OF PIPING</b>	<b>SPECIFICATION</b>	<b>REV-0</b>
		<b>FABRICATION &amp; ERECTION OF PIPING – SPECS - 01</b>	Page 1 of 15

**Abbreviations:**

PMI	:	Positive Material Identification
NDT	:	Non Destructive Testing
P&ID	:	Process and Instrumentation Diagram
A.S.	:	Alloy Steel
C.S.	:	Carbon Steel
C.I.	:	Cast Iron
S.S.	:	Stainless Steel
LTCS	:	Low Temperature Carbon Steel
NACE	:	National Association of Corrosion Engineers

 GAIL (INDIA) LTD	STANDARD SPECIFICATION FOR FABRICATION AND ERECTION OF PIPING	SPECIFICATION	REV-0
		FABRICATION & ERECTION OF PIPING – SPECS - 01	Page 2 of 15

## CONTENTS

<u>Sl. No.</u>	<u>Description</u>	<u>Page No.</u>
1.	SCOPE	4
2.	SCOPE OF WORK OF CONTRACTOR	4
3.	BASIS OF WORK	6
4.	FABRICATION	7
5.	ERECTION	11

## 1.0 SCOPE

This specification covers general requirements of fabrication and erection of above ground and trench piping systems at site. The specification covers the scope of work of contractor, basis of work to be carried out by contractor and standards, specifications and normal practice to be followed during fabrication and erection by the contractor.

## 2.0 SCOPE OF WORK OF CONTRACTOR

Generally the scope of work of contractor shall include the following:

**2.1** Transportation of required piping materials (as described in Cl.2.1.1), pipe support (material as described in Cl. 2.3) and all other necessary piping materials from Owner's storage point or contractor's storage point (in case of contractor's scope of supply) to work site/ shop including raising store requisitions for issue of materials in the prescribed format & maintaining an account of the materials received from Owner's stores.

**2.1.1** Piping materials include the following but not limited to the same.

- a. Pipes (All sizes and schedule)
- b. Flanges (All sizes, types & Pressure ratings).
- c. Fittings (All sizes, types and schedule)
- d. Valves (All sizes, types and Ratings)
- e. Gaskets (All sizes, types & Ratings)
- f. Bolts, Nuts or M/C Bolts (All types)
- g. Expansion Joint/Bellows (All types)
- h. Speciality items like online filters, ejectors, sample coolers, steam traps, strainers, air traps etc.
- i. Online instruments like control valve, orifice flange, rotameter, safety valves etc.

**2.2** Shop & field fabrication and erection of piping in accordance with documents listed under Cl.3.0 i.e. 'BASIS OF WORK' including erection of all piping materials enumerated above.

**2.3** Fabrication and erection of pipe supports like shoe, saddle, guide, stops, anchors, clips, cradles, hangers, turn buckles, supporting fixtures, bracket cantilevers, struts, teeposts including erection of spring supports and sway braces.

## 2.4

 GAIL (INDIA) LTD	STANDARD SPECIFICATION FOR FABRICATION AND ERECTION OF PIPING	SPECIFICATION	REV-0
		FABRICATION & ERECTION OF PIPING – SPECS - 01	Page 4 of 15

- 2.4.1 Fabrication of piping specials like special radius bends, reducers, mitres etc.
- 2.4.2 Fabrication of plain and threaded nipples from pipes as required during erection.
- 2.4.3 Fabrication of swage nipples as and when required.
- 2.4.4 Fabrication of odd angle elbow like 60°, 30° or any other angle from 90/45° elbows as and when required.
- 2.4.5 Fabrication of flange, reducing flange, blind flange, spectacle blinds as and when required.
- 2.4.6 Fabrication of stub-in connection with or without reinforcement.
- 2.4.7 Grinding of edges of pipes, fittings, flanges etc. to match mating edges of uneven/ different thickness wherever required.
- 2.5 Modifications like providing additional cleats, extension of stem of valve, locking arrangement of valves etc. as and when required.
- 2.6 Preparation of Isometrics, bill of materials, supporting details of all NON-IBR lines upto 2- ½” within the unit battery limit and get subsequent approval from Engineer-in-Charge as and when called for.
- 2.7 Obtaining approval for drawings prepared by contractor from statutory authority, if required.
- 2.8 Spun concrete lining of the inside of pipes 3” NB & above including fittings and flanges as required in accordance with specification.
- 2.9 Rubber lining inside pipes, fittings, flanges as and when required, in accordance with specification.
- 2.10 Radiography, stress relieving, dye penetration, magnetic particle test etc. as required in specification.
- 2.11 Performing PMI using alloy analysers as per ‘Standard Specification for Positive Material Identification at Construction Sites.
- 2.12 Casting of concrete pedestals and fabrication & erection of small structures for pipe supports including supply of necessary materials.
- 2.13 Providing insert plates from concrete structures and repair of platform gratings around pipe openings.
- 2.14 Making material reconciliation statement and return of Owner’s supply left over materials to Owner’s storage.

 <b>GAIL (INDIA) LTD</b>	<b>STANDARD SPECIFICATION FOR FABRICATION AND ERECTION OF PIPING</b>	SPECIFICATION	REV-0
		<b>FABRICATION &amp; ERECTION OF PIPING – SPECS - 01</b>	Page 5 of 15

- 2.15 Flushing and testing of all piping systems as per standard specification for inspection, flushing and testing of piping systems.
- 2.16 Pickling (as and when applicable) as per standard specification for chemical cleaning of C.S. suction piping of compressors.
- 2.17 Submission of job execution procedure as per standard specification for review and approval of Engineer-in-charge covering all above activities.

**3.0 BASIS FOR WORK**

3.1 The complete piping work shall be carried out in accordance with the following

3.1.1 “Approved for Construction” drawings and sketches issued by GAIL to the Contractor - Plans and/ or Isometrics.

3.1.2 “Approved for Construction” drawings and sketches issued by Turn-key bidders to the Contractor - Plans and/or Isometrics.

3.1.3 Approved Process licensors standards and specifications.

3.1.4 Drawings, sketches and documents prepared by contractor duly approved by Engineer-in-Charge (such as isometrics of small bore piping and offsite piping etc.)

3.1.5 Approved construction job procedures prepared by Contractor as stipulated in 2.16

3.1.6 GAIL specifications/ documents as below:

- a. Process and Instrument Diagram.
- b. Piping Materials Specification
- c. Piping support standards.
- d. Line list
- e. Piping support indices (only in offsite), if supports are not shown in plan.
- f. Standard specification of Non-destructive Requirement of Piping
- g. Welding specification charts for piping classes
- h. Standard Specification for Pressure Testing of Erected Piping System
- i. Welding specification for fabrication of piping

 <b>GAIL (INDIA) LTD</b>	<b>STANDARD SPECIFICATION FOR FABRICATION AND ERECTION OF PIPING</b>	SPECIFICATION	REV-0
		FABRICATION & ERECTION OF PIPING – SPECS - 01	Page 6 of 15

- j. Any other GAIL or OTHER specifications attached with Piping Material Specification or special condition of contract (such as standard for cement lining of pipe, standard of jacketed piping, standard for steam tracing, Dimensional Tolerances etc.)
- k. Procedure for storage, preservation and positive identification of materials at Contractors works / stores.

**3.1.7** Following codes, standards and regulations

- a. ASME B 31.3 : Process Piping
- b. ASME Sec. VIII : Code for unfired pressure vessel.
- c. IBR Regulations
- d. IS: 823 : Code for procedure for Manual Metal Arc welding of Mild Steel (for structural steel).
- e. NACE Std. : Code for Sour Services material requirements

MR-0 1-75

Note: All codes referred shall be latest edition, at the time of award of contract.

**3.2 Deviations**

Where a deviation from the “Basis of Work and approved job procedure described above is required or where the basis of work does not cover a particular situation, the matter shall be brought to the notice of Engineer - in - Charge and the work carried out only after obtaining

**4.0 FABRICATION**

**4.1 Piping Material**

Pipe, pipe fittings, flanges, valves, gaskets, studs bolts etc. used in a given piping system shall be strictly as per the “Piping Material Specification” for the “Pipe Class” specified for that system. To ensure the above requirement, all piping material supplied by the Owner / Contractor shall have proper identification marks as per relevant standards / GAIL specifications/ Licensors specification. Contractor shall provide identification marks on left over pipe lengths wherever marked up pipe lengths have been fabricated I erected. Material traceability is to be maintained for AS., SS., NACE, LTCS, material for Hydrogen service and other exotic materials by way of transferring heat number, etc. (hard punching) as per approved procedure. This shall be in addition to colour coding for all piping materials to avoid mix-up.

For the purpose of common understanding the construction job procedure, to be submitted by the contractor, shall include proposal for

 GAIL (INDIA) LTD	STANDARD SPECIFICATION FOR FABRICATION AND ERECTION OF PIPING	SPECIFICATION	REV-0
		FABRICN & ERECTION OF PIPING – SPECS - 01	Page 7 of 15

- Maximizing prefabrication, inspection and testing at fabrication shop with minimum field joints.
- Positive material identification, handling, storage & preservation.

#### 4.2 Dimensional Tolerances

Dimensional tolerances for piping fabrication shall be as per EIL Standard. The Contractor shall be responsible for working to the dimensions shown on the drawings. However, the Contractor shall bear in mind that there may be variations between the dimensions shown in the drawing and those actually existing at site due to minor variations in the location of equipments, inserts, structures etc. To take care of these variations “Field Welds” shall be provided during piping fabrication. An extra pipe length of 100 mm over and above the dimensions indicated in the drawing may be left on one side of the pipe at each of the field welds. During erection, the pipe end with extra length at each field weld shall be cut to obtain the actual dimension occurring at site. Isometrics, if supplied may have the field welds marked on them. However, it is the responsibility of the Contractor to provide adequate number of field welds. In any case no extra claims will be entertained from the Contractor on this account. Wherever errors or omissions occur in drawings and Bills of Materials it shall be the Contractor’s responsibility to notify the Engineer-in-Charge prior to fabrication or erection.

#### 4.3 IBR Piping

**4.3.1** Contractor shall be supplied generally with all drawings for steam piping falling under the purview of Indian Boiler Regulations duly approved by Boiler Inspectorate. The Contractor shall carry out the fabrications, erection and testing of this piping as per requirements of Indian Boiler Regulations and to the entire satisfaction of the local Boiler Inspector. The Contractor shall also get the approval of IBR inspector for all fabrication and testing done by him at his own cost. All certificates of approval shall be in proper JBR forms.

**4.3.2** Approval of boiler inspector on the drawings prepared by the contractor shall be obtained by the contractor at his own cost.

#### 4.4 Pipe Joints

The piping class of each line specifies the type of pipe joints to be adopted. In general, joining of lines 2” and above in process and utility piping shall be accomplished by butt-welds. Joining of lines 1-1/2” and below shall be by socket welding/butt welding/threaded joints as specified in “Piping Material Specifications”. However, in piping 1-1/2” and below where socket welding/ threaded joints are specified butt - welds may be used with the approval of Engineer-in-Charge for pipe to pipe joining in long runs of piping. This is only applicable for non-galvanised piping without lining.

Flange joints shall be used at connections to Vessels, Equipment’s, Valves and where required for ease of erection and maintenance as indicated in drawings.

#### 4.5 Butt Welded and Socket Welded Piping

End preparation, alignment and fit-up of pipe pieces to be welded, welding, pre-heating, post-heating and heat treatment shall be as described in the welding specification and NDT specification.

 <b>GAIL (INDIA) LTD</b>	<b>STANDARD SPECIFICATION FOR FABRICATION AND ERECTION OF PIPING</b>	SPECIFICATION	REV-0
		<b>FABRICN &amp; ERECTION OF PIPING – SPECS - 01</b>	Page 8 of 15

#### 4.6 Screwed Piping

In general, Galvanized piping shall have threads as per IS:554 or ANSI B2.1 NPT as required to match threads on fittings, valves etc. All other piping shall have threads as per ANSI B2.1, tapered unless specified otherwise.

Threads shall be clean cut, without any burrs or stripping and the ends shall be reamed. Threading of pipes shall be done preferably after bending, forging or heat treating operations. If this is not possible, threads shall be gauge checked and chased after welding heat treatment etc.

During assembly of threaded joints, all threads of pipes and fittings shall be thoroughly cleaned of cuttings, dirt, oil or any other foreign matter. The male threads shall be coated with thread sealant and the joint tightened sufficiently for the threads to seize and give a leakproof joint.

Threaded joints to be seal-welded shall be cleaned of all foreign matter, including sealant and made up to full thread engagement before seal welding.

#### 4.7 Flange Connections

All flange facings shall be true and perpendicular to the axis of pipe to which they are attached. Flanged bolt holes shall straddle the normal centerlines unless different orientation is shown in the drawing.

Wherever a spectacle blind is to be provided, drilling and tapping for the jack screws in the flange, shall be done before welding it to the pipe.

#### 4.8 Branch Connections

Branch connections shall be as indicated in the piping material specifications. For end preparation, alignment, spacing, fit-up and welding of branch connections refer welding specifications. Templates shall be used wherever required to ensure accurate cutting and proper fit-up.

For all branch connections accomplished either by pipe to pipe connections or by using forged tees the rates quoted for piping shall be inclusive of this work.

Reinforcement pads shall be provided wherever indicated in drawings/ specifications etc.

#### 4.9 Bending

Bending shall be as per ASME B31.3 except that corrugated or creased bends shall not be used.

Cold bends for lines 1-1/2" and below, with a bend radius of 5 times the nominal diameter shall be used as required in place of elbows wherever allowed by piping specifications. Bending of pipes 2" and above may be required in some cases like that for headers around heaters, reactors etc.

 GAIL (INDIA) LTD	STANDARD SPECIFICATION FOR FABRICATION AND ERECTION OF PIPING	SPECIFICATION	REV-0
		FABRICATION & ERECTION OF PIPING – SPECS - 01	Page 9 of 15

The completed bend shall have a smooth surface, free from cracks, buckles, wrinkles, bulges, flat spots and other serious defects. They shall be true to dimensions. The flattening of a bend, as measured by the difference between the maximum and minimum diameters at any cross-section, shall not exceed 8% and 3% of the nominal outside diameter, for internal and external pressure respectively.

#### 4.10 Forging and forming

Forging and forming of small bore fittings, like reducing nipples for piping 1-1/2” and below, shall be as per ASME B 31.3.

#### 4.11 Mitre Bends and Fabricated Reducers

The specific application of welded mitre bends and fabricated reducers shall be governed by the Piping Material Specifications. Generally all 90 deg. mitres shall be 4-piece 3-weld type and 45 deg. mitres shall be 3-piece 2-weld type as per GAIL Standard unless otherwise specified. Reducers shall be fabricated as per directions of Engineer-in-Charge. The radiographic requirements shall be as per Material Specifications for process and utility systems and NDT Specification for steam piping under IBR, radiographic requirements of IBR shall be complied with.

#### 4.12 Cutting and Trimming of Standard Fittings & Pipes

Components like pipes, elbows, couplings, half-couplings etc. shall be cut / trimmed / edge prepared wherever required to meet fabrication and erection requirements, as per drawings and instructions of Engineer-in-Charge. Nipples as required shall be prepared from straight length piping.

#### 4.13 Galvanised Piping

Galvanised carbon steel piping shall be completely cold worked, so as not to damage galvanised surfaces. This piping involves only threaded joints and additional external threading on pipes may be required to be done as per requirement.

#### 4.14 Jacketed Piping

The Jacketing shall be done in accordance with GAIL Specification or Licensors specification as suggested in material specification or special condition of contract.

Pre-assembly of jacketed elements to the maximum extent possible shall be accomplished at shop by Contractor. Position of jump over and nozzles on the jacket pipes, fittings etc. shall be marked according to pipe disposition and those shall be prefabricated to avoid damaging of inner pipe and obstruction of jacket space. However, valves, flow glasses, in line instruments or even fittings shall be supplied as jacketed.

 <b>GAIL (INDIA) LTD</b>	<b>STANDARD SPECIFICATION FOR FABRICATION AND ERECTION OF PIPING</b>	SPECIFICATION	REV-0
		<b>FABRICN &amp; ERECTION OF PIPING – SPECS - 01</b>	Page 10 of 15

#### 4.15 Shop Fabrication / Prefabrication

The purpose of shop fabrication or pre-fabrication is to minimise work during erection to the extent possible. Piping spool, after fabrication, shall be stacked with proper identification marks, so as facilitate their withdrawal at any time during erection. During this period all flange (gasket contact faces) and threads shall be adequately fabricated by coating with a removable rust preventive. Care shall also be taken to avoid any physical damage to flange faces and threads.

#### 4.16 Miscellaneous

**4.16.1** Contractor shall fabricate miscellaneous elements like flash pot, seal pot, sample cooler, supporting elements like turn buckles, extension of spindles and interlocking arrangement of valves, operating platforms as required by Engineer-in-Charge.

#### 4.16.2 Spun Concrete Lining

The work of inside spun concrete lining of pipes and specials of diameter 3 and above shall be done as per material specifications and special condition contract.

#### 4.16.3 Fabrication of pipes from plate

Pipes shall be fabricated at site as and when required as per the specifications attached and the actual Piping Material Specification.

### 5.0 ERECTION

#### 5.1 Cleaning of Piping before Erection

Before erection all pre-fabricated spool pieces, pipes, fittings etc. shall be cleaned inside and outside by suitable means. The cleaning process shall include removal of all foreign matter such as scale, sand, weld spatter chips etc. by wire brushes, cleaning tools etc. and blowing with compressed air/or flushing out with water. Special cleaning requirements for some services, if any shall be as specified in the piping material specification or isometric or line list. SS jacketed piping requiring pickling shall be pickled to remove oxidation and discolouring due to welding.

#### 5.2 Piping Routing

No deviations from the piping route indicated in drawings shall be permitted without the consent of Engineer-in-Charge.

Pipe to pipe, pipe to structure / equipments distances / clearances as shown in the drawings shall be strictly followed as these clearances may be required for the free expansion of piping / equipment. No deviations from these clearances shall be permissible without the approval of Engineer-in-Charge.

 GAIL (INDIA) LTD	STANDARD SPECIFICATION FOR FABRICATION AND ERECTION OF PIPING	SPECIFICATION	REV-0
		FABRICATION & ERECTION OF PIPING – SPECS - 01	Page 11 of 15

In case of fouling of a line with other piping, structure, equipment etc. the matter shall be brought to the notice of Engineer-in-Charge and corrective action shall be taken as per his instructions.

### 5.3 Cold Pull

Wherever cold pull is specified, the Contractor shall maintain the necessary gap, as indicated in the drawing. Confirmation in writing shall be obtained by the Contractor from the Engineer-in-Charge, certifying that the gap between the pipes is as indicated in the drawing, before drawing the cold pull. Stress relieving shall be performed before removing the gadgets for cold pulling.

### 5.4 Slopes

Slopes specified for various lines in the drawings / P&ID shall be maintained by the Contractor. Corrective action shall be taken by the Contractor in consultation with Engineer-in-Charge wherever the Contractor is not able to maintain the specified slope.

### 5.5 Expansion Joints/ Bellows

Installation of Expansion Joints/Bellows shall be as follows:

**5.5.1** All Expansion joints / Bellows shall be installed in accordance with the specification and Installation drawings, supplied to the Contractor.

- 5.5.2**
- a. Upon receipt, the Contractor shall remove the Expansion Joints/ Bellows from the Case (s) and check for any damage occurred during transit.
  - b. The Contractor shall bring to the notice of the Engineer-in-Charge any damage done to the bellows / corrugations, hinges, tie-rods, flanges / weld ends etc.
  - c. Each Expansion Joint / Bellow shall be blown free of dust! foreign matter with compressed air or cleaned with a piece of cloth.

- 5.5.3**
- a. For handling and installation of Expansion Joints, great care shall be taken while aligning. An Expansion Joints shall never be slinged from bellows corrugations / external shrouds, tie / rods, angles.
  - b. An Expansion Joints / Bellow shall preferably be slinged from the end pipes/ flanges or on the middle pipe.

- 5.5.4**
- a. All Expansion Joints shall be delivered to the Contractor at “Installation length”, maintained by means of shipping rods, angles welded to the flanges or weld ends or by wooden or metallic stops.

 <b>GAIL (INDIA) LTD</b>	<b>STANDARD SPECIFICATION FOR FABRICATION AND ERECTION OF PIPING</b>	SPECIFICATION	REV-0
		<b>FABRICATION &amp; ERECTION OF PIPING – SPECS - 01</b>	Page 12 of 15

b. Expansion Joints stop blocks shall be carefully removed after hydrostatic testing. Angles welded to the flanges or weld ends shall be trimmed by saw as per manufacturer's instructions and the flanges or weld ends shall be ground smooth.

**5.5.5** a. The pipe ends in which the Expansion Joint is to be installed shall be perfectly aligned or shall have specified lateral deflection as noted on the relevant drawings.

b. The pipe ends! flanges shall be spaced at a distance specified in the drawings.

**5.5.6** The Expansion Joint shall be placed between the mating pipe ends / flanges and shall be tack welded/bolted The mating pipes shall again be checked for correct alignment.

**5.5.7** Butt-welding shall be carried out at each end of the expansion joint. For flanged Expansion Joint, the mating flanges shall be bolted.

**5.5.8** After the Expansion Joint is installed the Contractor shall ensure that the mating pipes and Expansion Joints are in correct alignment and that the pipes are well supported and guided.

**5.5.9** The Expansion Joint shall not have any lateral deflection. The Contractor shall maintain parallelism of restraining rings or bellows convolutions.

**5.5.10 Precautions**

a. For carrying out welding, earthing lead shall not be attached with the Expansion Joint.

b. The Expansion bellow shall be protected from arc weld spot and welding spatter.

c. Hydrostatic Testing of the system having Expansion Joint shall be performed with shipping lugs in position. These lugs shall be removed after testing and certification is over.

**5.6 Flange Connections**

While fitting up mating flanges, care shall be exercised to properly align the pipes and to check the flanges for trueness, so that faces of the flanges can be pulled together, without inducing any stresses in the pipes and the equipment nozzles. Extra care shall be taken for flange connections to pumps, turbines, compressors, cold boxes, air coolers etc. The flange connections to these equipments shall be checked for misalignment, excessive gap etc. after the final alignment of the equipment is over. The joint shall be made up after obtaining approval of Engineer-in-Charge.

Temporary protective covers shall be retained on all flange connections of pumps, turbines, compressors and other similar equipments, until the piping is finally connected, so as to avoid any foreign material from entering these equipments.

 GAIL (INDIA) LTD	STANDARD SPECIFICATION FOR FABRICATION AND ERECTION OF PIPING	SPECIFICATION	REV-0
		FABRICN & ERECTION OF PIPING – SPECS - 01	Page 13 of 15

The assembly of a flange joint shall be done in such a way that the gasket between these flange faces is uniformly compressed. To achieve this, the bolts shall be tightened in a proper sequence. All bolts shall extend completely through their nuts but not more than 1/4”.

Steel to C.I. flange joints shall be made up with extreme care, tightening the bolts uniformly after bringing flange flush with gaskets with accurate pattern and lateral alignment.

**5.7 Vents and Drains**

High point vents and low point drains shall be provided as per the instructions of Engineer-in-Charge, even if these are not shown in the drawings. The details of vents and drains shall be as per piping material specifications / job standards.

**5.8 Valves**

Valves shall be installed with spindle / actuator orientation / position as shown in the layout drawings. In case of any difficulty in doing this or if the spindle orientation / position is not shown in the drawings, the Engineer-in-Charge shall be consulted and work done as per his instructions. Care shall be exercised to ensure that globe valves, check valves, and other uni-directional valves are installed with the “Flow direction arrow “on the valve body pointing in the correct direction. If the direction of the arrow is not marked on such valves, this shall be done in the presence of Engineer-in-Charge before installation.

Fabrication of stem extensions, locking arrangements and interlocking arrangements of valves (if called for), shall be carried out as per drawings/ instructions of Engineer-in- Charge.

**5.9 Instruments**

Installation of in-line instruments such as restriction orifices, control valves, safety valves, relief valves, rotameters, orifice flange assembly, venturimeters, flowmeters etc. shall form a part of piping erection work.

Fabrication and erection of piping upto first block valve / nozzle / flange for installation of offline Instruments for measurement of level, pressure, temperature, flow etc. shall also form part of piping construction work. The limits of piping and instrumentation work will be shown in drawings / standards / specifications. Orientations / locations of take-offs for temperature, pressure, flow, level connections etc. shown in drawings shall be maintained.

Flushing and testing of piping systems which include instruments mentioned above and the precautions to be taken are covered in flushing, testing and inspection of piping (GAIL Stds). Care shall be exercised and adequate precautions taken to avoid damage and entry foreign matter into instruments during transportation, installation, testing etc.

**5.10 Line Mounted Equipments / Items**

 <b>GAIL (INDIA) LTD</b>	<b>STANDARD SPECIFICATION FOR FABRICATION AND ERECTION OF PIPING</b>	<b>SPECIFICATION</b>	<b>REV-0</b>
		<b>FABRICN &amp; ERECTION OF PIPING – SPECS - 01</b>	Page 14 of 15

Installation of line mounted items like filters, strainers,, steam traps, air traps, desuperheaters, ejectors, samples coolers, mixers, flame arrestors, sight glasses etc. including their supporting arrangements shall form part of piping erection work.

**5.11 Bolts and Nuts**

The Contractor shall apply molycoat grease mixed with graphite powder (unless otherwise specified in piping classes) all bolts and nuts during storage, after erection and wherever flange connections are broken and made-up for any purpose whatsoever. The grease and graphite powder shall be supplied by the Contractor within the rates for piping work.

**5.12 Pipe Supports**

Pipe supports are designed and located to effectively sustain the weight and thermal effects of the piping system and to prevent its vibrations. Location and design of pipe supports will be shown in drawings for lines 3” NB & above for line below 3” NB Contractor shall locate and design pipe supports in line with GAIL Stds. and obtain approval of Engineer - in - Charge on drawings prepared by Contractor, before erection. However, any extra supports desired by Engineer-in-Charge shall also be installed.

No pipe shoe I cradle shall be offset unless specifically shown in the drawings.

Hanger rods shall be installed inclined in a direction opposite to the direction in which the pipe moves during expansion.

Preset pins of all spring supports shall be removed only after hydrostatic testing and insulation is over. Springs shall be checked for the range of movement and adjusted if necessary to obtain the correct positioning in cold condition. These shall be subsequently adjusted to hot setting in operating condition. The following points shall be checked after installation, with the Engineer-in-Charge and necessary confirmation in writing obtained certifying that:

- All restraints have been installed correctly.
- Clearances have been maintained as per support drawings.
- Insulation does not restrict thermal expansion.
- All temporary tack welds provided during erection have been fully removed.
- All welded supports have been fully welded.

 GAIL (INDIA) LTD	STANDARD SPECIFICATION FOR FABRICATION AND ERECTION OF PIPING	SPECIFICATION	REV-0
		FABRICATION & ERECTION OF PIPING – SPECS - 01	Page 15 of 15

**STANDARD SPECIFICATION  
FOR  
SEAMLESS FITTINGS & FLANGES  
(SIZE UP TO DN 400 mm (16"))**

 GAIL (INDIA) LTD	STANDARD SPECIFICATION FOR SEAMLESS FITTINGS & FLANGES (UPTO 400 mm/ 16")	SPECIFICATION	REV-0
		SPECS - FLANGES & FITTINGS – 01	Page 1 of 6

# CONTENTS

- 1.0 SCOPE
- 2.0 REFERENCE DOCUMENTS
- 3.0 MANUFACTURER'S QUALIFICATION
- 4.0 MATERIALS
- 5.0 DESIGN AND MANUFACTURE
- 6.0 INSPECTION AND TESTS
- 7.0 TEST CERTIFICATES
- 8.0 PAINTING, MARKING AND SHIPMENT
- 9.0 DOCUMENTATION

 GAIL (INDIA) LTD	STANDARD SPECIFICATION FOR SEAMLESS FITTINGS & FLANGES (UPTO 400 mm/ 16")	SPECIFICATION	REV-0
		SPECS - FLANGES & FITTINGS – 01	Page 2 of 6

## 1.0 SCOPE

This specification covers the minimum requirements for the design, manufacture and supply of following carbon steel flanges and fittings of size upto DN 400 mm (16") to be installed in pipeline systems handling hydrocarbons in liquid or gaseous phase including Liquefied Petroleum Gas (LPG):

- Flanges such as welding neck flanges, blind flanges, spectacle blinds, spacers and blinds etc.
- Seamless fittings such as tees, elbows, reducers, caps, outlets etc.

This specification does not cover the above-mentioned items, which are to be installed in pipeline systems handling sour hydrocarbons (liquid/gas) service as defined in NACE Standard MR-01-75

## 2.0 REFERENCE DOCUMENTS

2.1 Reference has been made in this specification to the latest edition of the following Codes:

ASME B31.4 - Pipeline Transportation System for Liquid Hydrocarbons and Other Liquids

ASME B31.8 - Gas Transmission and Distribution Piping Systems

ASME B16.5 - Pipe Flanges and Flanged Fittings

ASME B16.9 - Factory Made Wrought Steel Butt Welding Fittings

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

ASME B16.48 - Steel Line Blanks

ASME Sec VIII/IX - Boiler and Pressure Vessel Code

ASTM A370 - Standard Test Methods and Definitions for Mechanical Testing of Steel Products

MSS-SP-25 - Standard Marking System for Valves, Fittings, Flanges and Unions

MSS-SP-44 - Steel Pipeline Flanges.

MSS-SP-75 - Specification for High Test Wrought Welded Fittings.

MSS-SP-97 - Forged Carbon Steel Branch Outlet Fittings-Socket Welding, Threaded and Butt welding Ends.

2.2 In case of conflict between the requirements of this specification and the requirements of above referred Codes and Standards, the requirements of this specification shall govern.

 GAIL (INDIA) LTD	STANDARD SPECIFICATION FOR SEAMLESS FITTINGS & FLANGES (UPTO 400 mm/ 16")	SPECIFICATION	REV-0
		SPECS - FLANGES & FITTINGS – 01	Page 3 of 6

### 3.0 MANUFACTURER'S QUALIFICATION

Manufacturer who intends bidding for fittings must possess the records of a successful proof test, in accordance with the provisions of ASME B 16.9.

### 4.0 MATERIAL

4.1 The Carbon Steel used in the manufacture of flanges and fittings shall be fully killed. Material for flanges and fittings shall comply the material standard indicated in the Purchase Requisition. In addition, the material shall also meet the requirements specified hereinafter.

4.2 Each heat of steel used for the manufacture of flanges and fittings shall have Carbon Equivalent (CE) not greater than 0.45 calculated from check analysis in accordance with the following formula:

$$CE = C + \frac{Mn}{6} + \frac{Cr + Mo + V}{5} + \frac{Ni + Cu}{15}$$

4.3 For flanges and fittings specified to be used for Gas service or High Vapour Pressure (HVP) liquid service, Charpy V-notch test shall be conducted on each heat of steel. Unless specified otherwise, the Charpy V-notch test shall be conducted at 00 C in accordance with the impact test provisions of ASTM A- 370 for flanges and fittings.

The minimum average absorbed impact energy values of three full-sized specimens shall be 27 joules. The minimum impact energy value of any one specimen of the three specimens analyzed as above shall not be less than 80% of the above mentioned average value.

For flanges and fittings specified to be used for other hydrocarbon service, the Charpy V-notch test requirements as stated above are not applicable, unless required by the specified material standard as a mandatory requirement.

When Low Temperature Carbon Steel (LTCS) materials are specified in Purchase Requisition for flanges and fittings, the Charpy V-notch test requirements of applicable material standard shall be complied with.

4.4 For flanges and fittings, specified to be used for Gas service or High Vapour Pressure (HVP) liquid service, hardness test shall be carried out in accordance with ASTM A 370. Hardness testing shall cover at least 10% per item, per size, per heat, per manufacturing method. A full thickness cross section shall be taken for this purpose and the maximum hardness shall not exceed 248 HV10. For flanges and fittings, specified to be used for other hydrocarbon services, the hardness requirements stated above are not applicable.

4.5 In case of RTJ flanges, the groove hardness shall be minimum 140 BHN.

### 5.0 DESIGN AND MANUFACTURE

 GAIL (INDIA) LTD	STANDARD SPECIFICATION FOR SEAMLESS FITTINGS & FLANGES (UPTO 400 mm/ 16")	SPECIFICATION	REV-0
		SPECS - FLANGES & FITTINGS – 01	Page 4 of 6

- 5.1 Flanges such as weld neck flanges and blind flanges shall conform to the requirements of ASME B16.5.
- 5.2 Spectacle blind and spacer & blind shall conform to the requirements of ASME B16.48.
- 5.3 Fittings such as tees, elbows, reducers, etc. shall be seamless type and shall conform to ASME B 16.9 for sizes DN 50 mm (2”) and above and ASME B16.11 for sizes below DN 50 mm (2”).
- 5.4 Fittings such as weldolets, sockolets, nippolets, etc. shall be manufactured in accordance with MSS-SP-97.
- 5.5 Type, face and face finish of flanges shall be as specified in Purchase Requisition.
- 5.6 Flanges and fittings manufactured from bar stock are not acceptable.
- 5.7 All butt weld ends shall be bevelled as per ASME B16.5/ ASME B16.9/MSS-SP-97 as applicable.
- 5.8 Repair by welding on flanges and fittings is not permitted.

**6.0 INSPECTION AND TESTS**

- 6.1 The Manufacturer shall perform all inspections and tests as per the requirement of this specification and the relevant codes, prior to shipment at his works. Such inspections and tests shall be, not but limited to the following:
  - 6.1.1 All flanges and fittings shall be visually inspected. The internal and external surfaces of the fittings shall be free from any strikes, gauges and other detrimental defects.
  - 6.1.2 Dimensional checks shall be carried out on finished products as per ASME B16.5 for flanges, ASME B16.48 for spacers and blinds and ASME B16.9/ MSS-SP-97 as applicable for fittings and as per this specification.
  - 6.1.3 Chemical composition and mechanical properties shall be checked as per relevant material standards and this specification, for each heat of steel used.
  - 6.1.4 All finished wrought weld ends subject to welding in field, shall be 100% tested for lamination type defects by ultrasonic test. Any lamination larger then 6.35 mm shall not be acceptable.
- 6.2 Purchaser’s Inspector reserves the right to perform stage wise inspection and witness tests, as indicated in clause 6.1 of this specification at Manufacturer’s Works prior to shipment. Manufacturer shall give reasonable notice of time and shall provide, without charge, reasonable access and facilities required for inspection, to the Purchaser’s Inspector.

Inspection and tests performed/ witnessed by Purchaser s Inspector shall in no way relieve the Manufacturer’s obligation to perform the required inspection and tests.

 GAIL (INDIA) LTD	STANDARD SPECIFICATION FOR SEAMLESS FITTINGS & FLANGES (UPTO 400 mm/ 16”)	SPECIFICATION	REV-0
		SPECS - FLANGES & FITTINGS – 01	Page 5 of 6

## 7.0 TEST CERTIFICATES

Manufacturer shall furnish the following certificates:

- a) Test certificates relevant to the chemical analysis and mechanical properties of the materials used for manufacture of flanges and fittings as per relevant standards and this specification.
- b) Test Reports on non destructive testing.
- c) Certificates for each fitting stating that it is capable of withstanding without leakage a test pressure, which results in a hoop stress equivalent to 100 % of the specified minimum yield strength for the pipe with which the fitting is to be attached without impairment of serviceability.

## 8.0 PAINTING, MARKING AND SHIPMENT

**8.1** After all inspection and tests required have been carried out; all external surfaces shall be thoroughly cleaned to remove grease, dust and rust and shall be applied with standard mill coating for protection against corrosion during transit and storage. The coating shall be easily removable in the field.

**8.2** Ends of all fittings and weld neck flanges shall be suitably protected to avoid any damage during transit. Metallic or high impact plastic bevel protectors shall be provided for fittings and flanges. Flange face shall be suitably protected to avoid any damage during transit.

**8.3** All flanges and fittings shall be marked as per applicable dimension/manufacturing standard.

## 9.0 DOCUMENTATION

**9.1** Prior to shipment, the Manufacturer shall submit six copies of the test certificates as listed in clause 7.0 of this specification.

**9.2** All documents shall be in English Language only.

 GAIL (INDIA) LTD	STANDARD SPECIFICATION FOR SEAMLESS FITTINGS & FLANGES (UPTO 400 mm/ 16")	SPECIFICATION	REV-0
		SPECS - FLANGES & FITTINGS – 01	Page 6 of 6

**TECHNICAL NOTES FOR  
BUTT WELDED, SOCKET WELDED  
AND SCREWED FITTINGS**

 GAIL (INDIA) LTD	TECHNICAL NOTES FOR BUTT WELDED, SOCKET WELDED AND SCREWED FITTINGS	SPECIFICATION	REV-0
		TECHNOTES - SW/ BW/ SCRWD FITTINGS - 01	Page 1 of 7

## TECHNICAL NOTES FOR BUTT WELDED, SOCKET WELDED AND SCREWED FITTINGS

### 1.0 GENERAL

- 1.1** Chemical composition, physical properties, tests, dimensions and tolerances, heat treatment and marking shall conform to the applicable latest codes / standards / specifications as specified in the material requisition (MR). Any deviation shall be highlighted on a separate sheet by the vendor in the quotation itself.
- 1.2** Test reports shall be supplied for all mandatory tests as per the material specifications. Test reports shall also be furnished for any supplementary tests as specified in the MR, Clauses 1.7.8, 1.9, 1.10 & 1.11. Material test certificates (physical properties, chemical composition & heat treatment report) shall also be furnished for fittings supplied.
- 1.3** All fittings shall be seamless in construction unless otherwise specified. If fittings are specified as welded, the same shall conform to Clause 1.7. Seamless fittings can be supplied in place of welded fitting but with maximum negative tolerance of 0.3mm (max.) on wall thickness. Welded fittings shall not be acceptable in place of seamless fittings.
- 1.4** Outside diameters and wall thickness (unless otherwise mentioned) of butt welded fittings shall be in accordance with ASME B36.10 and ASME B36.19 as applicable.
- 1.5** For reducing butt weld fittings having different wall thicknesses at each end, the greater wall thickness of the fitting shall be employed and inside bore at each end shall be matched with the specified inside diameter.
- 1.6** Bevelled ends for all fittings shall conform to ASME B16.25. Contour of bevel shall be as follows:

Material	Wall Thickness	Wall Contour
Carbon Steel (Except Low Temp. Carbon Steel)	Upto 22 mm	Figure 2 Type A
	> 22 mm	Figure 3 Type A
Alloy Steel, Stainless Steel & Low Temp. Carbon Steel	Upto 10 mm	Figure 4
	> 10 mm & Upto 25 mm	Figure 5 Type A
	>25 mm	Figure 6 Type A

### 1.7 Welded Fittings:

- 1.7.1** All welded fittings shall be double welded. Inside weld projection shall not exceed 1.6 mm. Welds shall be ground smooth at least 25 mm from the ends.

 GAIL (INDIA) LTD	TECHNICAL NOTES FOR BUTT WELDED, SOCKET WELDED AND SCREWED FITTINGS	SPECIFICATION	REV-0
		TECHNICAL NOTES - SW/ BW/ SCRWD FITTINGS - 01	Page 2 of 7

- 1.7.2 For fittings made out of welded pipe, the welded pipe shall be double welded type & shall be manufactured with the addition of filler metal.
- 1.7.3 Welded tees shall not be of fabricated (stub-in) type.
- 1.7.4 All welded fittings shall be normalised & 100% radiographed by X-ray on all welds made by fitting manufacturers & also on the parent materials.
- 1.7.5 Welded pipes employed for manufacture of fittings shall be made by automatic welding only.
- 1.7.6 All welded carbon steel, alloy steel & stainless steel fittings shall have maximum negative tolerance of 0.3 mm.
- 1.7.7 Specified heat treatment for carbon steel & alloy steel fittings shall be carried out again after weld repairs.
- 1.7.8 Irrespective of the material code requirement, all welded fittings indicated in the MR as “Cryo”& “LT” shall meet impact test requirements of ASME B31.3. The impact test temperature shall be -196 °C & -45 °C for stainless steel & carbon steel respectively unless specifically mentioned otherwise in the MR.

**1.8 Stainless Steel Fittings:**

- 1.8.1 All stainless steel fittings shall be supplied in solution heat treated condition.
- 1.8.2 Solution annealing for stainless steel fittings shall be carried out again after weld repairs.
- 1.8.3 For all stainless steel fittings Inter Granular Corrosion (IGC) test shall have to be conducted as per the following:

ASTM A 262 Practice “B” with acceptance criteria of “60 mils/year (max.)”.

Or

ASTM A 262 Practice “E” with acceptance criteria of “no cracks as observed from 20X magnification” & “microscopic structure to be observed from 250X - magnification

- 1.8.4 When specifically asked for in MR for high temperature application of some grades of austenitic stainless steel (e.g. SS309, 310,316,316H etc.) ASTM A 262 Practice “C” with acceptance criteria of “15 mils/year” shall have to be conducted.
- 1.8.5 For the IGC test as described in Clauses 1.8.3 & 1.8.4, two sets of samples shall be drawn from each solution treatment lot, one set corresponding to the highest carbon content and other set to the highest fitting thickness. When testing is conducted as per ASTM A 262 Practice “E”, photograph of microscopic structure shall be submitted for record.

 GAIL (INDIA) LTD	TECHNICAL NOTES FOR BUTT WELDED, SOCKET WELDED AND SCREWED FITTINGS	SPECIFICATION	REV-0
		TECHNICAL NOTES - SW/ BW/ SCRWD FITTINGS - 01	Page 3 of 7

- 1.9** Fittings under “NACE” category shall meet the requirements of MR-01-75.
- 1.10** Thickness *I* schedule lower or higher than specified shall not be accepted.
- 1.11** The gasket contact surfaces of stub ends shall be flat with face finish specified in the requisition. Interpretation on the specified face finish is as follows:
- Serrated Finish : Serrations with 250 to 500  $\mu$  in AARH
- Smooth Finish/125 AARH : Serrations with 125 to 250  $\mu$  in AARH
- 1.12** Seamless stub ends shall not have any welds on the body.
- 1.13** Galvanised fittings shall be coated with zinc by hot dip process conforming to IS 4736 / ASTM A153.
- 1.14** Threaded ends shall have NPT taper threads in accordance with ASME/ANSI B1.20.1 upto 1.5” NB & IS 554 from 2” to 6” NB.
- 1.15** Unless and otherwise specified in the MR, all socket welded and screwed fittings shall be in accordance with ASME B16.11 to the extent covered in the specification except for unions which shall be in accordance with MSS-SP-83.
- 1.16** Special fittings like weld-o-let, sock-o-let, sweep-o-let etc. which are not covered in ASME, MSS-SP & EIL Standards shall be as per manufacturer’s std. Contours of these fittings shall meet the requirements of ASME B31.3. Manufacturer shall submit drawings / catalogues of these items along with the offer.
- 1.17** Length of all long half couplings shall be 100 mm unless otherwise specified in the MR.
- 1.18** All seamless pipes employed for manufacturing of fittings shall be required to have undergone hydrotest to ASTM A 530. Welded pipes employed for manufacture of fittings shall be tested as given below:

Welded Pipe Employed For Manufacture Of Welded Fittings.	Test Criteria
ASTM A671 Gr. C65,70 (Cl.32) ASTM A672 Gr. C60,65,70 (Cl. 12, 22) ASTM A671 Gr. CF6O,65,70,66 (Cl.32) ASTM A691 Gr. ½Cr, 1Cr, 1’%Cr, 2’ACr, 5Cr, 9Cr (Cl.42)	P = 2ST/ D S = 90% of SMYS. T Nom. Wall Thickness D = O.D. of Pipe.
API5L ASTM A358 TP 304, 304L, 304H, 318, 318L, 318H, 321, 347 (Cl. 1, 3, 4)	P= 2ST/D S = 85% of SMYS. T = Nom. Wall Thickness D = O.D. of Pipe.

	GAIL (INDIA) LTD	TECHNICAL NOTES FOR BUTT WELDED, SOCKET WELDED AND SCREWED FITTINGS	SPECIFICATION	REV-0
			TECHNOTES - SW/ BW/ SCRWD FITTINGS - 01	Page 4 of 7

ASTM B725	ASTM B725
ASTM B517	ASTM B517
ASTM B514	ASTM B514

**1.19** The bevel ends of all butt weld fittings shall undergo 100% MP/ DP test.

**1.20** Swage nipples (concentric/eccentric) if specified as pipe materials are acceptable in forging materials (upto 1½”) and wrought fitting materials (above 1½”) also in the corresponding material grades.

**1.21** Abbreviations for ends of swages and nipples shall be as follows:

PBE : Plain Both Ends  
TBE : Threaded Both Ends  
TOE : Threaded One End  
TSE : Threaded Small End  
TLE : Threaded Large End

## 2.0 IBR REQUIREMENTS

### 2.1 IBR Documentation Required:

**2.1.1** Fittings under the purview of “IBR” (Indian Boiler Regulations) shall be accompanied with original IBR certificate in Form III-C duly approved and countersigned by IBR authority / local authority empowered by Central Boiler Board of India. Photocopy of the original certificate duly attested by the local boiler inspector where the supplier is located is the minimum requirement for acceptance.

**2.1.2** For materials 1¼Cr - ½Mo (ASTM A234 Gr.WP11 & ASTM A234 Gr.WP11W) & 2¼Cr - 1Mo (ASTM A234 Gr.WP22 & ASTM A234 Gr.WP22W), where fittings are manufactured from pipe, Form III-C approved by IBR shall include the tabulation of E<sub>t</sub>, S<sub>c</sub>, & S<sub>r</sub> values for the entire temperature range given below. E<sub>t</sub>, S<sub>c</sub>, & S<sub>r</sub> values shall be such that throughout the temperature range

$$\begin{array}{l} E_t / 1.5 \geq \\ S_r / 1.5 \geq \\ S_c \geq \end{array} \left| \begin{array}{l} \\ \\ \end{array} \right. S_A$$

S<sub>A</sub>: Allowable stress at the working metal temperature.

E<sub>t</sub>: Yield point (0.2% proof stress at the working metal temperature)

	GAIL (INDIA) LTD	TECHNICAL NOTES FOR BUTT WELDED, SOCKET WELDED AND SCREWED FITTINGS	SPECIFICATION	REV-0
			TECHNOTES - SW/ BW/ SCRWD FITTINGS - 01	Page 5 of 7

$S_c$ : The average stress to produce elongation of 1 % (creep) in 100000 hrs at the working metal temperature.

$S_r$ : The average stress to produce rupture in 100000 hrs at the working metal temperature and in no case more than 1.33 times the lowest stress to produce rupture at this temperature.

$S_A$ (psi)												
Temp(°F)	500	600	650	700	750	800	850	900	950	1000	1050	1100
Material												
A 234 Gr.WP11 / A234 Gr.WP11W	21700	20900	20500	20100	19700	19200	18700	13700	9300	6300	4200	2800
A 234 Gr.WP22 / A234 Gr.WP22W	17900	17900	17900	17900	17900	17800	14500	12800	10800	7800	5100	3200

Note:  $S_A$  values given above are from ASME B31.3-1996. Values shall be as per the latest edition prevailing.

**2.2** For carbon steel fittings described “IBR” chemical composition shall conform to the following:

Carbon (max) : 0.25 %

Others (S, P, Mn) : As prescribed in IBR regulations

The above composition is not valid for non-IBR fittings.

### 3.0 MARKING AND DESPATCH

**3.1** Each fitting shall be legibly and conspicuously stamped in accordance with the requirements of applicable standards along with special condition like “IBR”, “Cryo”, “NACE” etc.

**3.2** Steel die marking with round bottom punch may be permitted on body of butt weld CS & lower alloy steel fittings, but for SS & higher alloy steel fittings, the same should be marked by electro-etching only.

**3.3** Paint or ink for marking shall not contain any harmful metals or metal salts such as Zinc, Lead or Copper which causes corrosive attack on heating.

**3.4** Fittings shall be dry, clean and free of moisture, dirt and loose foreign materials of any kind.

**3.5** Fittings shall be protected from rust, corrosion and mechanical damage during transportation, shipment and storage.

**3.6** Rust preventive used on machined surfaces to be welded shall be easily removable with a petroleum solvent and the same shall not be harmful to welding.

 GAIL (INDIA) LTD	TECHNICAL NOTES FOR BUTT WELDED, SOCKET WELDED AND SCREWED FITTINGS	SPECIFICATION	REV-0
		TECHNOTES - SW/ BW/ SCRWD FITTINGS - 01	Page 6 of 7

- 3.7 Fittings under “IBR”, “Cryo”, “NACE” shall be painted in red, light purple and canary yellow stripes respectively for easy identification. Width of the stripe shall be 25 mm.
- 3.8 Each end of fitting shall be protected with a wood, metal or plastic cover.
- 3.9 Each size of fitting shall be supplied in separate packagings marked with the purchase order number, item code number, material specification, size and schedule / thickness/ rating.

 GAIL (INDIA) LTD	TECHNICAL NOTES FOR BUTT WELDED, SOCKET WELDED AND SCREWED FITTINGS	SPECIFICATION	REV-0
		TECHNOTES - SW/ BW/ SCRWD FITTINGS - 01	Page 7 of 7

## CONTENTS

SL NO.	DESCRIPTION
1.0	SCOPE
2.0	REFERENCE DOCUMENTS
3.0	MANUFACTURER'S QUALIFICATION
4.0	MATERIAL
5.0	DESIGN AND MANUFACTURE
6.0	INSPECTION AND TESTS
7.0	TEST CERTIFICATES
8.0	PAINTING, MARKING AND SHIPMENT
9.0	WARRANTY
10.0	DOCUMENTATION

## 1.0 SCOPE

1.1 This specification covers the minimum requirements for the design, manufacture and supply of the following fittings in size NB 400mm and smaller to be installed in natural gas or liquid hydrocarbon pipelines and piping system.

1.1.1 Fittings such as tees, elbows, caps etc. shall conform to the requirement of MSS-SP-75, latest edition. Dimension standard for screwed/ SW fittings shall be as per ANSI B16.11.

1.2 All requirements contained in the above standards shall be fully valid unless cancelled, replaced or amended by more requirements as stated in this specification.

This specification does not cover the above-mentioned items, which are to be installed in pipeline handling sour hydrocarbon (liquid/ gas) service as defined in NACE standard MR-0175-98.

## 2.0 REFERENCE DOCUMENTS

2.1 Reference has also been made in this specification to the latest edition of the following codes, standards and specifications :

(i)	ASME B 31.8	:	Gas Transmission and Distribution Piping System
(ii)	ASME B 31.4	:	Liquid transportation system for hydrocarbon liquid petroleum gas, anhydrous ammonia and alcohols
(iii)	ANSI B 16.25	:	Butt - Welding Ends
(iv)	ASME B 16.9	:	Factory made wrought steel butt welding fittings
(v)	ASME B 16.11	:	Forged Steel Fittings, Socket Welding and Threaded.
(vi)	ASTM A 370	:	Mechanical Testing of Steel Products
(vii)	ASTM Part-1	:	Steel Piping, Tubing, Fittings
(viii)	MSS-SP-25	:	Standard Marking System for Valves, Fittings, Flanges and Unions
(ix)	MSS-SP-75	:	Specification for High Test Wrought Welding Fittings
(x)	MSS-SP-97	:	Forged carbon steel branch outlet fittings - socket welding, threaded and butt welding ends.

2.2 In case of conflict between the requirement of MSS-SP-75, above reference documents and this specification, the requirements of this specification shall govern.

## 3.0 MANUFACTURER'S QUALIFICATION

Manufacturer who intends bidding for fittings must possess the records of a successful proof test in accordance with the provisions of MSS-SP-75 and/ or ANSI B16.9/ ANSI B16.11 as applicable. These records shall be submitted at the time of bidding.

## 4.0 MATERIAL

4.1 The basic material for fittings shall be as indicated in the Purchase Requisition Additionally, the material shall also meet the requirements specified hereinafter.

4.2 Steel used shall be fully killed.

- 4.3 Each heat of steel used for the manufacture of fittings shall have carbon equivalent (CE) not greater than 0.45 calculated from check analysis in accordance with the following formula :

$$CE = C + \frac{Mn}{6} + \frac{Cr + Mo + V}{5} + \frac{Ni + Cu}{15}$$

Carbon contents on check analysis shall not exceed 0.22%.

- 4.4 Unless specified otherwise, Charpy V-notch test shall be conducted for each heat of steel, in accordance with the impact test provisions of ASTM A370 at temperature of 0°C. The average absorbed impact energy values of three full-sized specimens shall be 27 joules.

The minimum impact energy value of any one specimen of the three specimens analysed as above, shall not be less than 80% of the above mentioned average value.

- 4.5 Hardness testing shall be carried out by Manufacturer in accordance with applicable ASTM.

**5.0 DESIGN AND MANUFACTURE**

- 5.1 Fittings such as tees, elbows and reducers shall be seamless type and shall conform to ASME B16.9 for sizes 50mm (2") NB and above and ASME B16.11 for sizes below 50mm (2") NB.

- 5.2 Fittings such as weldolet, sockolet, etc shall be manufactured in accordance with MSS-SP-97.

- 5.3 Stub-in or pipe to pipe connection shall not be used in the manufacture of tees. Tees shall be manufactured by forging or extrusion methods. The longitudinal weld seam shall be kept at 90° from the extrusion. Fittings shall not have any circumferential joints.

- 5.4 All butt weld ends shall be bevelled as per ASME B16.25.

- 5.5 Repair by welding on parent metal of the fittings is not allowed.

**6.0 INSPECTION AND TESTS**

- 6.1 The manufacturer shall perform all inspections and tests as per the requirement of this specification and the relevant codes, prior to shipment at his works. Such inspections and tests shall be, not but limited to the following :

- 6.1.1 Visual inspection.

- 6.1.2 Dimensional checks as per MSS-SP-75 for fittings/ applicable standards.

- 6.1.3 Chemical composition, mechanical properties and hardness examination.

- 6.1.4 All finished wrought weld ends shall be 100% ultrasonically tested for lamination type defects. Any lamination larger than 6.35mm shall not be acceptable.

- 6.1.5 All other tests not specifically listed but are required as per applicable standard/ specification.

- 6.2 Purchaser's Inspector may also perform stage-wise inspection and witness tests as indicated in clause 6.1 at Manufacturer's work prior to shipment. Manufacturer shall give reasonable notice of time and shall provide without charge reasonable access and facilities required for inspection to the Purchaser's Inspector.

Inspection and tests performed/ witnessed by the Purchaser's Inspector shall in no way relieve the Manufacturer's obligation to perform the required inspection and tests.

**7.0 TEST CERTIFICATES**

Manufacturer shall produce the certificates (in original) for all, including, but not limited to, the following tests.

- (a) Certificates of chemical analysis and mechanical properties of the material used for construction as per this specification and relevant standards.
- (b) Certificates of required non-destructive tests inspections.
- (c) Certificates of all other tests as required in this specification.
- (d) In case any of the said certificates is not available during the final test, the supply shall be considered incomplete.

**8.0 PAINTING, MARKING AND SHIPMENT**

8.1 All fittings shall be marked as per MSS-SP-25.

8.2 All loose material and foreign material i.e. rust, grease, etc. shall be removed from the inside and outside of the fittings.

8.3 Ends of all fittings shall be suitably protected to avoid any damage during transit. Metallic bevel protectors shall be used for fittings of size 18" and larger. Each item shall be marked with indelible paint with the following data:-

- (a) Manufacturer marking
- (b) Material Specification
- (c) Size & Sch.
- (d) Heat No

8.4 Package shall be marked legibly with suitable marking ink to indicate the following :

- (a) Order Number
- (b) Package Number
- (c) Manufacturer's Name
- (d) Type of Fitting
- (e) Size (inches) and Wall Thickness (mm)

**9.0 WARRANTY**

Purchaser will be reimbursed by Manufacturer for any fitting furnished on this order that fails under field hydrostatic test if such failure is caused by a defect in the fitting which is outside the acceptance limits of this specification. The reimbursement cost shall include fitting, labour and equipment rental for finding, excavation, cutting out and installation of replaced fitting in position. The field hydrostatic test pressure will not exceed that value which will cause a calculated hoop stress equivalent to 100% of specified minimum yield strength for the pipe with which the fitting is to be attached without impairing its serviceability.

10.0 **DOCUMENTATION**

10.1 All documents shall be in English Language.

10.2 At the time of bidding bidder shall submit the following documents :-

- (a) Reference list of previous supplies of similar fittings of similar specification.
- (b) Clause wise list of deviation from this specification, if any.
- (c) Brief description of the manufacturing and quality control facilities of the Manufacturer's work.
- (d) Manufacturer's qualification requirement as per section 3.0 of this specification.
- (e) Quality Assurance Plan (QAP).

10.3 Within three weeks of placement of order, the manufacturer shall submit four copies of method of manufacture and quality control procedure for raw material and finished product.

Once the approval has been given by Purchaser, any change in material, method of manufacture and quality control procedure shall be notified to Purchaser whose approval in writing of all changes shall be obtained before the fittings are manufactured.

10.4 Within four weeks from the approval date, Manufacturer shall submit six copies of the approved documents as stated in Para 10.3 of this specification.

10.5 Prior to shipment, Manufacturer shall submit six copies of test certificates as listed in Para 7.0 of this specification.

## CONTENTS

SL NO.	DESCRIPTION
1.0	SCOPE
2.0	REFERENCE DOCUMENTS
3.0	MANUFACTURER'S QUALIFICATION
4.0	MATERIAL
5.0	DESIGN AND MANUFACTURE
6.0	INSPECTION AND TESTS
7.0	TEST CERTIFICATES
8.0	PAINTING, MARKING AND SHIPMENT
9.0	DOCUMENTATION
10.0	GUARANTEE

## 1.0 SCOPE

This specification covers the requirements for the design, manufacture and supply of carbon steel flanges, to be installed in pipeline system handling natural gas and hydrocarbon liquid. This specification does not cover flanges which are to be installed in pipeline system handling sour hydrocarbon (liquid/gas) service as defined in NACE standard MR-0175-98.

## 2.0 REFERENCE DOCUMENTS

Reference has been made in this specification to the latest edition of the following codes, standards and specification :

(i)	ASME B 31.8	:	Gas Transmission and Distribution Piping System
(ii)	ASME B 31.4	:	Liquid transportation system for hydrocarbon liquid petroleum gas, anhydrous ammonia and alcohols
(iii)	ANSI B 16.5	:	Specification for Flanges
(iv)	MSS-SP-44	:	Steel Pipeline Flanges
(v)	ASTM A370	:	Mechanical Testing of Steel Products
(vi)	ASTM A105	:	Specification for Forgings Carbon Steel
(vii)	API 590	:	Steel line blanks
(viii)	MSS-SP-25	:	Standard marking system for valves, fittings, flanges and unions.

In case of conflict between the requirement of this specification and that of above referred documents, the requirements of this specification shall govern.

## 3.0 MANUFACTURER'S QUALIFICATION

Manufacturer who intends bidding for flanges must possess the records of a successful proof test for flanges in accordance with the provisions of relevant ANSI/ MSS Standards. These records shall be submitted at the time of bidding.

## 4.0 MATERIAL

4.1 The basic material for fittings shall be as indicated in the Purchase Requisition Additionally, the material shall also meet the requirements specified hereinafter.

4.2 Steel used shall be fully killed.

4.3 Each heat of steel used for the manufacture of flanges shall have carbon equivalent (CE) not greater than 0.45 calculated from check analysis in accordance with the following formula :

$$CE = C + \frac{Mn}{6} + \frac{Cr + Mo + V}{5} + \frac{Ni + Cu}{15}$$

Carbon contents on check analysis shall not exceed 0.22%.

4.4 Unless specified otherwise, Charpy V-notch test shall be conducted for each heat of steel, in accordance with the impact test provisions of ASTM A370 at temperature of 0°C. The average absorbed impact energy values of three full-sized specimens shall be 27 joules.

The minimum impact energy value of any one specimen of the three specimens analysed as above, shall not be less than 80% of the above mentioned average value.

4.5 Hardness testing shall be carried out by Manufacturer in accordance with applicable ASTM.

5.0 **DESIGN AND MANUFACTURE**

5.1 Flanges such as welding neck flanges and blind flanges shall conform to the requirements of ASME B16.5. Spectacle blind, spacer and blind shall conform to API 590.

5.2 Type, face and face finish of flanges shall be as specified in Purchase Requisition.

5.3 All butt weld ends shall be bevelled as per ASME B16.25.

5.4 Repair by welding on flanges is not allowed.

5.5 Flanges shall be of forged construction and designed and manufactured in accordance with relevant ANSI / MSS Standards.

6.0 **INSPECTION AND TESTS**

6.1 The Manufacturer shall perform all inspection and tests as per the requirements of this specification and the relevant codes at his works. Such inspection and tests shall be, but not limited to the following :

6.1.1 All flanges shall be visually inspected.

6.1.2 Dimensional check

6.1.3 Chemical composition and mechanical properties shall be checked as per relevant material specification.

6.1.4 All other test not specifically listed but are required as per applicable standard/ specification.

6.1.5 All flanges 12" NB, 300 Class and above should be ultrasonically tested.

6.2 Purchaser's Representative shall also perform stage-wise inspection and witness tests as indicated in para 6.1 at manufacturer's works. Manufacturer shall give reasonable notice and shall provide without charges reasonable access and facilities required for inspection, to the Purchaser's Representative.

6.3 Inspection and tests performed/ witnessed by Purchaser's Representative shall in not any way relieve the Manufacturer's obligation to supply flanges as per this specification.

7.0 **TEST CERTIFICATES**

Manufacturer shall submit following certificates to purchaser's representative :

(a) Test certificates relevant to chemical analysis and mechanical properties of the material used for construction as per this specification and relevant standards.

(b) Test report on ultrasonic inspection.

8.0 **PAINTING, MARKING AND SHIPMENT**

8.1 Flanges surface shall be thoroughly cleaned, freed from rust and grease after all the required tests have been performed and accepted by Purchaser's representative.

8.2 Flanges shall be marked with the following data :-

- (i) Manufacturer's Name
- (ii) Nominal diameter in inches
- (iii) Rating of the flanges
- (iv) Material
- (v) Tag numbers

8.3 Flanges shall be suitably protected to avoid any damage during transit and storage.

9.0 **DOCUMENTATION**

9.1 All documents shall be in English Language.

9.2 At the time of bidding bidder shall submit the following documents :-

- (a) Reference list of previous supplies of similar specification.
- (b) Clause-wise list of deviation from this specification, if any.
- (c) Manufacturer's qualification requirement as per section 3.0 of this specification.

9.3 Within two weeks of placement of order, the manufacturer shall submit four copies of, but not limited to, the following drawings, documents and specifications for approval :-

- (a) Quality Assurance Plan.
- (b) Dimensions of the flanges including tolerances.
- (c) Prior to shipment, the manufacturer shall submit six copies of the test certificates as listed in clause 7.0 of this specification.

10.0 **GUARANTEE**

10.1 Manufacturer shall guarantee that the materials, manufacturing and testing of flanges confirm to the requirement of this specification. Manufacturer shall replace or repair all flanges, which should result defective, or fail during testing or do not perform satisfactorily due to sub-standard material and poor workmanship.

**TECHNICAL NOTES**  
**FOR**  
**BOLTS, NUTS AND GASKETS**  
**(PIPING)**

 GAIL (INDIA) LTD	TECHNICAL NOTES FOR BOLTS, NUTS & GASKETS	SPECIFICATION	REV-0
		TECHNOTES - BOLTS & NUTS - 01	Page 1 of 3

## A TECHNICAL NOTES FOR BOLTS AND NUTS

1. The process of manufacture, heat treatment, chemical and mechanical requirements and marking for all stud bolts, m/c bolts, jack screws and nuts shall be in accordance with the codes/standards and specifications given in the requisition. Deviation (s), if any, shall be clearly highlighted in the quotation. The applicable identification symbol in accordance with the material specification shall be stamped on each bolt and nut.
2. a. Test reports shall be supplied for all mandatory tests as per the relevant material specifications.  
b. Material test certificate shall also be furnished. (Heat Analysis, Product Analysis and Mechanical Requirement)
3. All bolting shall be as per ANSI B 18.2.1 for studs, M/c bolts and jack screws and ANSI B 18.2.2 for nuts.
4. Threads shall be unified (UNC for 1” dia and 8UN for > 1” dia) as per ANSI B. 1.12 with class 2A fit for studs, M/c bolts and jack screws and class 2B fit for nuts.
5. Stud bolts shall be threaded full length with two heavy hexagonal nuts. Length tolerance shall be in accordance with the requirement of table F2 of Annexure-F of ANSI B 16.5.
6. The nuts shall be double chamfered, semi-finished, heavy hexagonal type and shall be made by the hot forged process and stamped as per respective material specification.
7. Heads of jack screws and m/c bolts shall be heavy hexagonal type. Jack screw end shall be rounded.
8. Each size of studs & m/c bolts with nuts and jack screws shall be supplied in separate containers marked with size and material specifications. ‘CRYO’ shall be marked additionally in case ‘CRYO’ is specified in the requisition.
9. All items shall be inspected and approved (stagewise) by GAIL inspector or any other agency authorised by GAIL.
10. The heat treatment for stud bolts & nuts shall be as per code unless mentioned otherwise.
11. All austenitic stainless steel bolts, nuts, screws shall be supplied in solution annealed condition unless specified otherwise in the material specification.
12. Any additional requirements specified in the requisition shall be fully complied with.

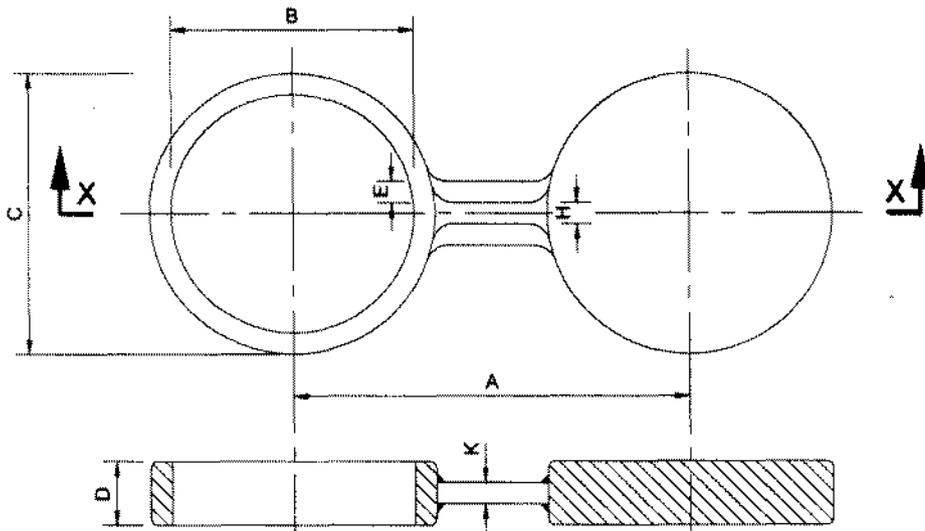
 GAIL (INDIA) LTD	TECHNICAL NOTES FOR BOLTS, NUTS & GASKETS	SPECIFICATION	REV-0
		TECHNOTES - BOLTS & NUTS - 01	Page 2 of 3

13. Stud bolts, m/c bolts, nuts & jack screws shall be impact tested wherever specified in the material specification and also where the material specification is indicated as “CRYO”. For S.S. nuts and bolts minimum impact energy absorption shall be 27 Joules and test temperature shall be -196 deg.C unless mentioned otherwise in code. For other materials impact energy and test shall be as per respective code.
14. Bolts/nuts of material of construction B7M/2HM shall be 100% Hardness tested as per supplementary requirement S3 of ASTM A193.
15. When specified as galvanised, the studs, m/c bolts and nuts shall be hot dip zinc coated in accordance with requirements of class C of ASTM A153.

**B GASKETS : TECHNICAL NOTES**

- B.1 Materials for gaskets shall conform to the codes/ standards and specifications given in the Piping Material Specification.
- B.2 Asbestos filler for spiral wound gaskets shall not have any colour or dye.
- B.3 Each size of gaskets shall be supplied in bundles labelled with size, rating and material specifications.
- B.4 All gaskets shall be inspected as follows: -
  - (a) Visual Inspection
  - (b) Dimensional Check
- B.5 Material test certificates for all mandatory tests as per the relevant material specifications and other inspection reports shall be furnished before despatch of material.
- B.6 All items shall be inspected and approved (Stage-wise) by Purchaser's Representative.

 <b>GAIL (INDIA) LTD</b>	<b>TECHNICAL NOTES FOR BOLTS, NUTS &amp; GASKETS</b>	SPECIFICATION	REV-0
		<b>TECHNOTES - BOLTS &amp; NUTS - 01</b>	Page 3 of 3



**SECTION-XX**

PIPE SIZE INCH.	150 # FF							300 # FF							600 # FF							PIPE SIZE INCH.
	A	B	C	D	E	H	K	A	B	C	D	E	H	K	A	B	C	D	E	H	K	
1"	106	29	82	5	10	16	4	117	29	70	5	10	19	4	117	29	70	5	10	19	4	1"
1 1/2"	175	43	82	5	10	16	4	144	43	92	5	10	22	4	144	43	92	7	10	22	4	1 1/2"
2"	152	55	102	7	10	19	4	162	55	106	7	10	19	4	162	55	106	10	10	19	4	2"
2 1/2"	165	64	121	7	15	19	4	180	64	127	10	15	22	6	180	64	127	15	15	22	6	2 1/2"
3"	187	80	134	7	15	19	4	203	80	148	10	15	22	6	203	80	148	15	15	22	6	3"
4"	225	106	170	8	15	19	6	227	106	170	13	15	22	6	257	106	190	18	15	28	6	4"
6"	279	157	218	11	15	22	6	312	157	248	16	15	22	6	340	157	263	24	15	28	6	6"
8"	338	207	275	15	15	22	6	373	207	305	21	15	28	8	399	207	314	30	15	32	10	8"
10"	410	260	325	18	20	26	8	440	260	350	26	20	29	10	491	260	397	37	20	35	10	10"
12"	483	312	405	19	20	26	8	508	312	410	30	20	32	10	543	312	454	43	20	35	15	12"
14"	575	342	443	22	20	29	10	571	342	480	34	20	32	15	586	342	488	48	20	38	15	14"
16"	582	393	501	26	20	29	10	630	393	536	38	20	35	15	662	393	580	54	20	42	20	16"
18"	629	443	545	28	20	32	10	691	443	592	43	20	35	20	714	443	608	62	20	45	20	18"
20"	689	496	600	30	25	32	15	751	496	650	48	25	35	20	794	496	678	67	25	45	20	20"
24"	802	597	710	37	25	35	15	861	597	772	57	25	42	20	902	597	785	81	25	54	25	24"
26"	804	648	770	38	50	22	30	876	648	830	63	50	22	30	916	648	862	86.5	50	22	50	26"
28"	964	696	830	41	50	22	30	940	696	895	67	50	22	30	963	696	910	93	50	22	50	28"
30"	914	750	882	45	60	22	30	996	750	950	72	50	22	40	1022	750	960	99.5	50	22	50	30"

**NOTES :-**

1. THICKNESS 0.15 BASED ON PLATE MATERIAL A 205 GR.C AND WITH 1.5 MM CORROSION ALLOWANCE ON EACH FACE.
2. PROVIDE CONCENTRIC SERRATED FINISH ON BOTH SIDES WITH GROOVES 0.8 MM APART AND DEPTH APPROX 0.4 MM.
3. DIMENSIONS ARE FOR FLANGES TO ANSI B 16.5 FOR SIZES UP TO 24.0, MSS.SP.44 FOR SIZES ABOVE 24 FOR FLANGES TO API 605 CALCULATE DIMENSIONS.
4. THE DIAMETER RATING AND MATERIAL SPEC SHALL BE MARKED AT THE BLIND DISC CENTER.
5. MATERIAL AS PER LINE CLASS.
6. JACK SCREW TO BE PROVIDED FOR SPCL. BLINDS 6" AND ABOVE.

REV NO	DATE	ZONE	DESCRIPTIONS	BY	APPRD			
			REVISIONS			REFERENCES	DRG. NO.	
<b>GAIL (INDIA) LIMITED</b>				<b>SPECTACLE BLIND</b>				SCALE : N.T.S.
						DRG.NO GAIL-TS-SPECTACLE BLIND		
						REV	0	

## CONTENTS

SL NO.	DESCRIPTION
1.0	SCOPE
2.0	INSPECTION
3.0	FLUSHING
4.0	TESTING
4.1	EXTENT OF TESTING
4.2	GENERAL REQUIREMENT/TEST PREPARATION FOR TESTING
4.3	TESTING MEDIA, TEST PRESSURE AND TEST PRESSURE GAUGES.
4.4	TESTING PROCEDURE
4.5	COMPLETION OF TESTING
4.6	TEST RECORDS

**1.0 SCOPE**

This specification covers the general requirements for Inspection, flushing and testing of piping systems. However testing of steam lines falling under IBR shall also be governed by Indian Boiler Regulations.

Flushing and testing of all piping system shall be witnessed by the Engineer-in- Charge.

**2.0 INSPECTION**

During various stage and after completion of fabrication and erection, the piping system shall be inspected by the Engineer- in - Charge to ensure that:

- (i) Proper piping material has been used.
- (ii) Piping has been erected as per drawings and the instruction of the engineer- in charge.
- (iii) All supports have been installed correctly.
- (iv) Test preparations mentioned in this specification have been carried out.

**3.0 FLUSHING**

Flushing of all lines shall be done before pressure testing. Flushing shall be done by fresh potable water or dry compressed air, wherever water flushing is not desirable, to clean the pipe of all dirt, debris or loose foreign materials.

Required pressure of water, flushing shall meet the fire hydrant pressure or utility water pressure. For air flushing the line, system will be pressurised by compressed air at the required pressure, which shall be 50 PSI maximum. The pressure shall then be released by quick opening of a valve, already in the line for this purpose. This procedure shall be repeated as many times as required till the inside of the pipe is fully cleaned.

In line instruments like control valves, orifice plates, rotameters, safety valves and other instruments like thermowells which may interfere with flushing shall not be included in the flushing circuit.

From all permanent strainers the screens/meshes shall be removed before flushing. Screens / meshes shall be re- installed after flushing but before testing.

In case equipment such as column, vessel, exchanger etc. forms part of a piping circuit during flushing, this shall be done with the approval of Engineer- in - Charge. However equipment thus included in the circuit, shall be completely cleaned and dried with compressed air, after flushing is completed.

During flushing discharged water / air shall be drained at the place directed the Engineer- in - Charge. If necessary, proper temporary drainage shall be provided by the contractor.

Care shall be taken during flushing so as not to damage / spoil work of other agencies. Precautions shall also be taken to prevent entry of water/foreign matter into equipment, electric motors, instruments, electrical installations etc. in the vicinity of lines being flushed.

The contractor shall carry out all the activities required before, during and after the flushing operation, arising because of flushing requirements, such as but not limited to the following.

Dropping of valves, specials, distance pieces, online instruments and any other piping part before flushing. The flanges to disengage for this purpose shall be envisaged by the contractor

and approved by the Engineer-in-Charge. These flanges shall be provided with temporary gaskets at the time of flushing.

After flushing is completed and approved, the valve, distance pieces, piping specials etc. shall be re-installed by the contractor with permanent gaskets. However, flanges of equipment nozzles and other places where isolation is required during testing, only temporary gaskets shall be provided.

Records in triplicate shall be prepared and submitted by the Contractor for each piping system for the flushing done.

#### 4.0 **TESTING**

##### 4.1 Extent of testing

With the exclusion of instrumentation, piping system fabricated or assembled in the field shall be tested irrespective of whether or not they have been pressure tested prior to site welding of fabrication.

To facilitate the testing of piping systems, vessels and other equipments may be included in the system with the prior approval of Engineer-in-charge, if the test pressure specified is equal to or less than that for the vessels and other equipments.

Pumps, compressors and other votary equipments shall not be subjected to field test pressures.

Lines which are directly open to atmosphere such as vents, drains, safety valves, discharge need not be tested, but all joints shall be visually inspected wherever necessary such lines shall be tested by continuous flow of fluid to eliminate the possibility of blockage. However, such lines if provided with block valve shall be pressure tested up to the first block valve.

Seats of all vales shall not be subjected to a pressure in excess of the maximum cold welding pressure of the valve. Test pressure applied to vales shall not be greater than the manufacturer's recommendation nor less than that required by the applicable code. Where desirable set pressure is less than test pressure, test shall be made through an open valve.

Instruments in the system to be tested, shall be excluded from the test by isolation or removal, unless approved otherwise by the Engineer-in-charge. Restrictions, which interfere with filling, venting and drawing such as orifice plates etc., shall not be installed unless testing is complete.

Control valves shall not be included in the test system. Where by-passes are provided test shall be performed through the by-pass end / or necessary spool shall be used in place of the control valve.

Pressure gauges, which are part of the finished system, but cannot withstand test pressure, shall not be installed until the system has been tested. Where piping systems to be tested are directly connected at the battery limits to piping for which the responsibility tests with other agencies, the piping to be tested shall be isolated from such piping by physical disconnection such as valves or blinds.

##### 4.2 General Requirement / Test preparation for Testing

Test shall be carried out with permanent gaskets installed unless specified otherwise or instructed by the Engineer-in- charge.

No pressure test shall be carried out against close valve unless approved by the Engineer-in-charge.

The Engineer-in-charge shall be notified in advance by the contractor, of the testing sequence and programme, to enable him to be present for witnessing the test. The contractor shall be fully responsible for making arrangements with the local boiler inspector to witness the tests for steam lines falling under IBR. IBR certificates for these tests shall be obtained in the relevant IBR forms and furnished to the Engineer-in-charge. Before testing, all piping shall be cleaned by flushing to make it free from dust loose scale, debris and other loose foreign materials.

All piping systems to be hydrostatically tested shall be vented at the high points and the systems purged of air before the test pressure is applied.

Wherever in the line any void exists due to any reasons, for absence of control valve, safety valve, check valves etc. it shall be filled with temporary spools.

All joints welded, screwed or flanged shall be left exposed for examination during the test. Before pressuring the lines, each weld joint shall be cleaned by wire brush to free it from rust and any other foreign matter.

Where a system is to be isolated of a pair of companion flanges, a blank shall be inserted between the companion flanges. Minimum thickness of the blank shall be designed in accordance with applicable design code.

Open ends of piping system where blanks cannot be used, such as pumps, compressors, turbines or wherever equipment or pipe spool have been received or disconnected prior to hydrostatic testing, shall be blinded – off by using standard blind flanges of same rating as the piping system being tested.

Pressure gauges used in testing shall be installed as close as possible to the lowest point in the piping system to be tested, to avoid overstressing of any of the lower portion of the system. For longer lines and vertical lines, two or more pressure gauges shall be installed at locations selected by the Engineer-in-charge. For lines containing check valves any of the following alternatives shall be adopted for pressure testing. Wherever possible pressurise up-stream side of valve.

Replace the valve by a temporary spool and re-install the valve after testing.

Provide blind on valve flanges and test the upstream and downstream of the line separately and remove the blind after testing. All these flanges, temporary gaskets shall be provided during testing and shall be replaced by permanent gaskets subsequently. For check valves in lines 1½" and below, flapper or seat shall be removed during testing (if possible). After completion of testing the flapper/ seat shall be refitted.

Gas lines when hydrostatically tested shall be provided with additional temporary supports during testing as directed by Engineer-in-charge.

Piping which is spring or counter – weight supported shall be temporarily supported, where the weight of the fluid would overload the support. Retaining pins for spring supports shall be removed only after testing is completed and test fluid is completely drained.

When testing any piping system, air or steam of approximately 2 kg/cm<sup>2</sup> (g) may be used as preliminary test to detect missing gaskets etc. as this avoids the necessity of purging the gas to make repairs. However, this method may not be used for this purpose, if the steam temperature is more than the design temp. of the line.

For jacketed pipes, testing of core pipes shall be done on individual pieces where the pipe is continuously packed, before it is jacketed. The outer jacket shall be tested separately as a system for piping with discontinuous jacketing; the core pipe and the jacket shall be tested as separate system.

4.3 Testing Modes, Test pressure and Test Pressure Gauges

4.4.1 Testing Modes

In general all pressure test shall be hydrostatic using iron free water, which is clean and free of silt. Maximum chlorine content in water for hydrostatic testing for M.S. piping shall be 15-20 ppm. Air shall be used for testing only if water would cause corrosion of the system or overloading of supports etc. in special cases as directed by Engineer-in-charge.

Where air / water tests are undesirable substitute fluid such as gas, oil, methanol etc. shall be used as the testing medium, with due consideration to the hazards involved. These test fluids shall be specified in the line list given to the contractor.

4.4.2 Test Pressure

The hydrostatic/pneumatic test pressure shall be as indicated in the line list or as per the instruction of Engineer-in-charge.

The selection of the piping system for one individual test shall be based on the following :-

Test pressure required as per line list.

Maximum allowable pressure for the material of construction of piping depending upon the above requirements and based on construction progress, maximum length of piping shall be included in each test.

4.4.3 Test Pressure Gauge

All gauge used for field testing shall have suitable range so that the test pressure of the various system falls in 40% to 60% of gauge scale range. Gauge shall be of a good quality and in first class working condition.

Prior to the start of any test or periodically during the field test programmes, all test gauges shall be calibrated using a standard dead weight gauge tester or other suitable approved testing apparatus. Any gauge having an incorrect zero reading or error of more than  $\pm 2\%$  of full scale range shall be discarded. The Engineer-in-charge shall check the accuracy of master pressure gauge used for calibration.

4.4 Testing Pressure

4.4.1 Hydrostatic Test

All vents and other connections used as vents shall be kept open while filling the line with test fluid for complete removal of air. For pressurising and depressurising the system, temporary isolating valves shall be provided if valves, vents, drains do not exist in the system.

Pressure shall be applied only after the system/line is ready and approved by the Engineer-in-charge.

Pressure shall be applied by means of a suitable test pump or other pressure source which shall be isolated from the system as the desired test pressure is reached and stabilised in the system.

A pressure gauge shall be provided at the pump discharge for guiding the system to the required pressure.

The pump shall be attended constantly during the test by an authorised person. The pump shall be isolated from the system wherever the pump is to be left unattended.

Test pressure shall be maintained for a sufficient length of time to permit through inspection of all joints for leakage or signs of failure. Any joint found leaking during a pressure test, shall be re-tested to the specified pressure after repair. Test period shall be maintained for a minimum of three hours.

The pump and the piping system to be tested are to be provided with separate pressure indicating test gauges. These gauges are to be checked by the standard test gauge before each pressure test.

Care shall be taken to avoid increase in the pressure due to atmospheric variation during the test.

#### 4.4.2 Air Test

When testing with air, pressure shall be supplied by means of a compressor. The compressor shall be portable type with a receiver after cooler & oil separator.

Piping to be tested by air shall have joints covered with a soap and water solution so that the joints can be examined for leaks.

All other activities shall be same as per hydro-testing procedure (specified above).

#### 4.5 Completion of Testing

After the hydrostatic test has been completed, pressure shall be released in a manner and at a rate so as not to endanger personnel or damage equipments.

All vents and drains shall be opened before the system is to be drained and shall remain open till all draining is complete, so as to prevent formation of vacuum in the system. After draining lines / systems shall be dried by air.

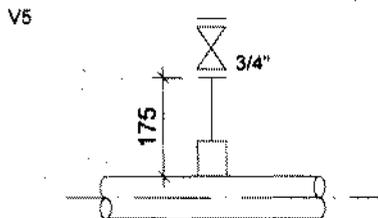
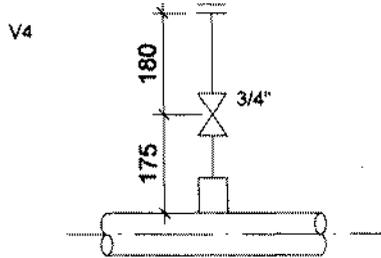
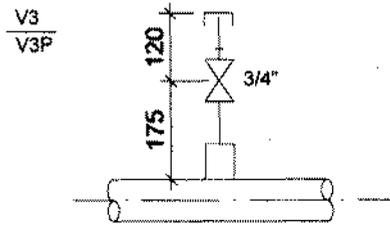
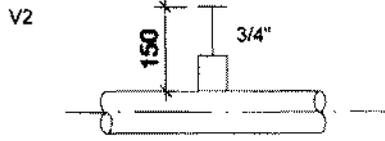
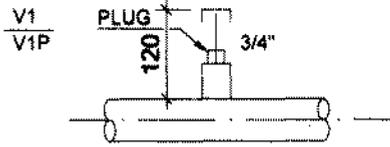
After testing is completed the test blinds shall be removed and equipment/piping isolated during testing shall be connected using the specified gaskets, bolts and nuts. These connections shall be checked for tightness in subsequent pneumatic tests to be carried out by the contractor for complete loop/circuit including equipments (except rotary equipments).

Pressure tests shall be considered complete only after approved by the Engineer-in-charge. Defects, if any, noticed during testing shall be rectified immediately and retesting of the system / line shall be done by the contractor at his cost.

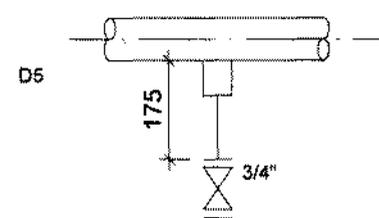
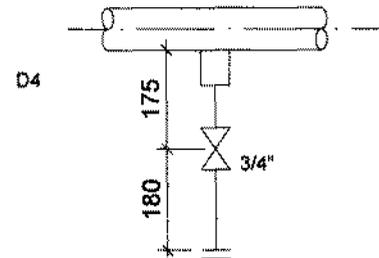
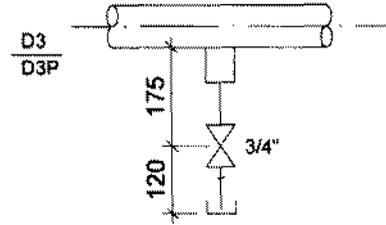
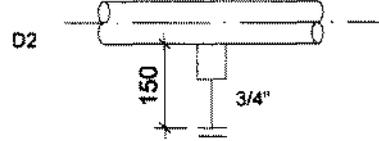
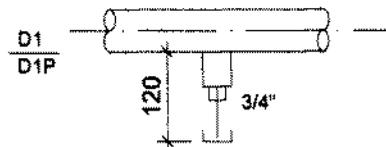
#### Test Records

Records in triplicate shall be prepared and submitted by the contractor for each piping system, for the pressure test done in the approved proforma.

**TYPE VENT**

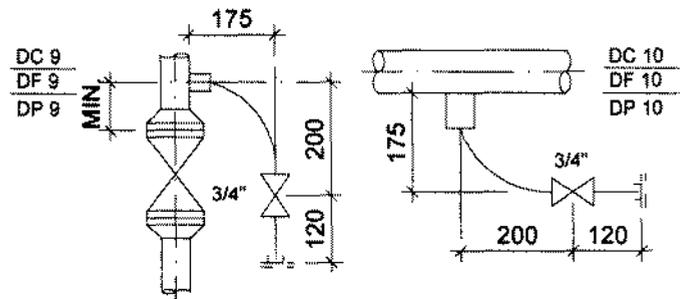


**DRAIN**



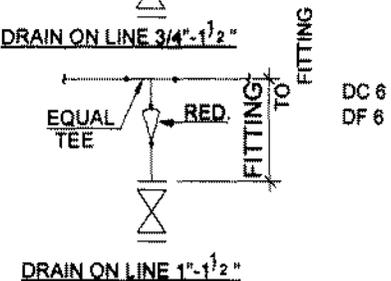
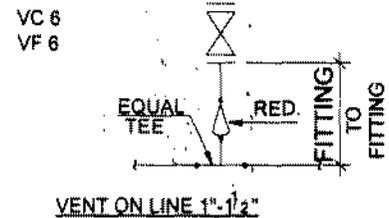
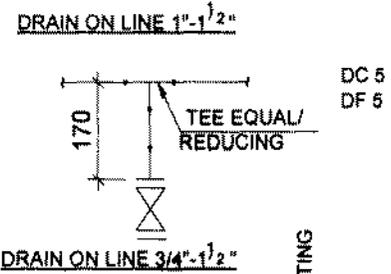
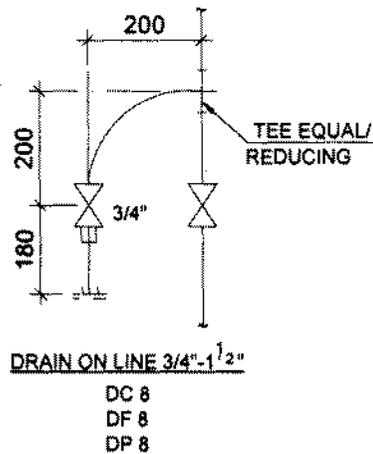
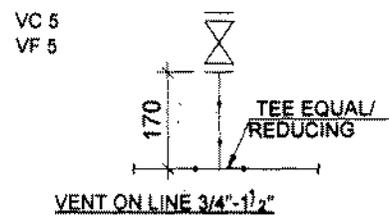
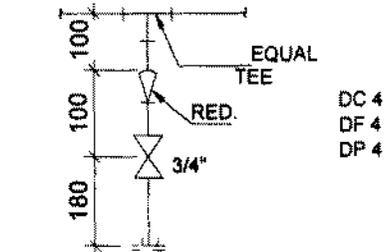
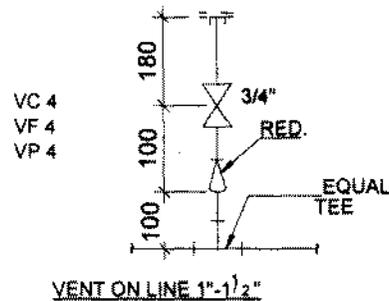
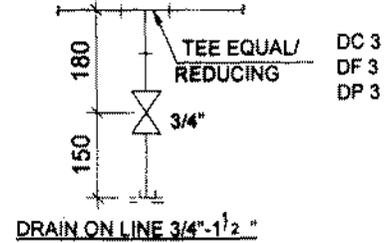
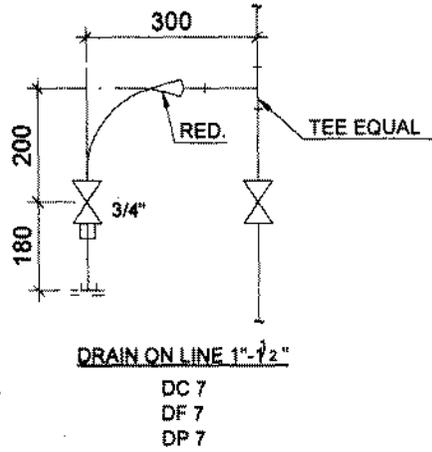
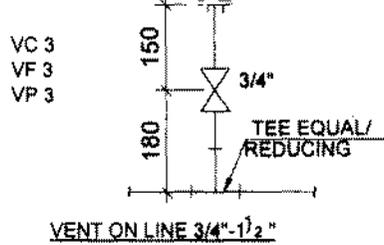
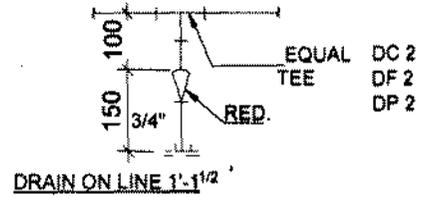
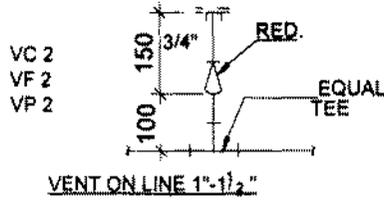
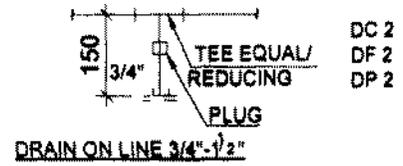
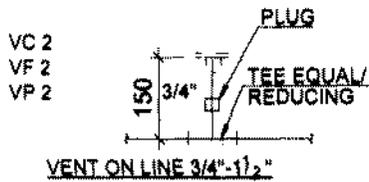
**NOTES:-**

1. DIMENSIONS ARE VALID FOR 75mm (MAX.) THICKNESS INSULATION FOR HIGHER INSULATION THICKNESS INCREASE DIMENSIONS AS REQUIRED.
2. VENTS & DRAINS SHALL BE PROVIDED WITH GATE, GLOBE OR PLUG VALVE WITH HALF COUPLING OR STUB IN WITH CAP OR FLANGE, BLIND FLANGE, AS PER PIPING SPECIFICATIONS.
3. VENTS/DRAINS CAN BE PROVIDED ON FLAT SIDE OF ECCENTRIC REDUCERS ON SIZES 4" & ABOVE.
4. LEGEND V=VENT, D=DRAIN, C=CAP, F=FLANGE, P=PLUG
5. PLUGGED END OF VALVE OR FITTING SHALL BE THREADED.



REV NO	DATE	ZONE	DESCRIPTIONS	BY	APPRD	REFERENCES	DRG. NO
			REVISIONS				

 <b>GAIL (INDIA) LIMITED</b>	<b>VENT &amp; DRAIN</b> <b>FOR LINES 2" &amp; ABOVE</b>	SCALE : N.T.S.	REV
		DRG.NO GAIL - TS - VENT & DRAINS ( 2" & ABOVE)	0



**NOTES:-**

- DIMENSIONS ARE VALID FOR 50mm (MAX.) THICKNESS INSULATION. FOR HIGHER INSULATION THICKNESS INCREASE DIMENSIONS AS REQUIRED.
- VENTS & DRAINS SHALL BE PROVIDED WITH GATE, GLOBE OR PLUG VALVE
- LEGEND V=VENT, D=DRAIN, C=CAP, F=FLANGE, R=REDUCER, COUPLING OR SWAGE, P=PLUG
- PLUGGED END OF VALVE OR FITTING SHALL BE THREADED.

REV NO	DATE	ZONE	DESCRIPTIONS	BY	APPRD	REFERENCES	DRG. NO.
			REVISIONS				
							SCALE: N.T.S. DRG.NO GAIL - TS - VENT & DRAINS (1 1/2" & BELOW)
<b>VENT &amp; DRAIN ON LINES 1-1/2" &amp; BELOW</b>							REV 0



**SPECIFICATION FOR  
STRUCTURAL STEEL FABRICATION**

DOCUMENT NO :

REV. : 0

PAGE 1 OF 23

**GAIL (India) Limited**

**GAS PIPELINE PROJECT**

REV	DESCRIPTION	DATE	PREPARED BY	CHECKED BY	APPROVED BY
0	ISSUED FOR tender	15-10-2007			



## SPECIFICATION FOR STRUCTURAL STEEL FABRICATION

DOCUMENT NO :

REV. : 0

PAGE 2 OF 23

### TABLE OF CONTENTS

1.0	SCOPE	3
2.0	DEFINITIONS	3
3.0	ABBREVIATIONS	3
4.0	CODES AND STANDARDS	4
5.0	REFERENCE DOCUMENTS	9
6.0	document precedence	9
7.0	SPECIFICATION DEVIATION/ CONCESSION CONTROL	9
8.0	QUALITY ASSURANCE/QUALITY CONTROL	9
9.0	SITE CONDITIONS	10
10.0	DOCUMENTATION	10
11.0	SUBVENDOR / CONTRACTORS/ VENDORS	11
12.0	HANDLING	11
13.0	design and detailing	12
14.0	MATERIALS	15
15.0	FABRICATION	17
16.0	MARKING AND EXPORT PACKING	20



## SPECIFICATION FOR STRUCTURAL STEEL FABRICATION

DOCUMENT NO :

REV. : 0

PAGE 3 OF 23

### 1.0 SCOPE

This specification describes the minimum technical requirements for the fabrication and delivery of structural steel in accordance with the design drawings and this specification. This specification is for the fabrication and delivery of structural steel.

### 2.0 DEFINITIONS

For the purpose of this specification, the following definitions apply:

- **OWNER** means **GAIL (India) Limited** and its legal successor in life.
- **ENGINEER** means **GAIL (INDIA) LTD**
- The **VENDOR/MANUFACTURER/SUPPLIER** is the Party which manufactures or supplies equipment and services to perform the duties specified.
- **VENDOR / CONTRACTOR** means the firm or organization hired to perform the installation, pre-commissioning and commissioning activities of the project and its legal successor in life.
- The word “shall” indicates a requirement.
- The word “should” indicates a recommendation.
- **CONCESSION REQUEST** - A deviation requested by the **VENDOR / CONTRACTOR**, or **SUBVENDOR / CONTRACTOR**, usually after receiving the contract package or purchase order. Often, it refers to an authorization to use, repair, recondition, reclaim or release materials, components or equipment already in progress or completely manufactured, but which does not comply with **GAIL / GAIL** requirements. A **CONCESSION REQUEST** is subject to **GAIL / GAIL** approval.

### 3.0 ABBREVIATIONS

AAMA	American Architectural Manufacturers Association
ANSI	American National Standards Institute
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
AWS	American Welding Society
BOD	Basis of Design
BS	British Standard
CEN	European Committee for Standardization
CIBSE	Chartered Institution of Building Services Engineers
EPC	Engineering, Procurement and Construction
FBE	Fusion Bonded Epoxy
HDPE	High Density Poly Ethylene
HF-ERW	High Frequency Electric Resistance Welding



## SPECIFICATION FOR STRUCTURAL STEEL FABRICATION

DOCUMENT NO :

REV. : 0

PAGE 4 OF 23

HSE	Health Safety and Environment
IS	Indian Standards
ISO	International Organization for Standardization
LSBD	Limit State Based Design
MSL	Mean Sea Level
MSS	Manufacturers Standardization Society
NB	Nominal Bore
NDT	Non Destructive Testing
NFPA	National Fire Prevention Association
OD	Outside Diameter
PQR	Procedure Qualification Record
QC	Quality Control
QRA	Quantitative Risk Assessment
ROW	Right of Way
SI	International System of Units
SR	Supplementary requirements
UBC	Uniform Building Code
UT	Ultrasonic Testing (inspection)
WP	Work Practice
WPS	Welding Procedure Specification
WT	Wall Thickness

#### 4.0 CODES AND STANDARDS

The following codes, specifications and standards, to the extent specified herein, form a part of this specification. When an edition date is not indicated for a code, specification or standard, the latest edition in force at the time of GAIL's contract award shall apply.

Alternate standards, specifications and codes meeting the requirements of the referenced standards, specifications and codes may be used with the approval of GAIL / GAIL.

##### **American Institute of Steel Construction Publications (AISC)**

The AISC	Specification for Structural Steel Buildings
The AISC	Code of Standard Practice for Steel Buildings and Bridges
The AISC	Specification for Structural Joints Using ASTM A325M or A490M Bolts
The AISC	Manual of Steel Construction, ASD, (9th Edition)
The AISC	M020 LRFD Manuals

**American Society for Testing And Materials (ASTM)**



## SPECIFICATION FOR STRUCTURAL STEEL FABRICATION

DOCUMENT NO :

REV. : 0

PAGE 5 OF 23

ASTM A 6M	Specification for General Requirements for Rolled Structural Steel Bars, Plates, Shapes and Sheet Piling.
ASTM A 36M	Specification for Carbon Structural Steel
ASTM A 53	Specification for Pipe, Steel, Black and Hot-Dipped Zinc-Coated Welded and Seamless
ASTM A 307	Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength.
ASTM A 325M	Specification for High-Strength Bolts for Structural Steel Joints. [Metric]
ASTM A 123	Standard Specification for Zinc (Hot –Dip Galvanized) Coating on Iron and Steel Products.
ASTM A 153	Standard Specification for Zinc Coating (Hot Dip) on Iron and Steel Hardware.
ASTM A500	Specification for Cold-Formed and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.
ASTM A 563M	Specification for Carbon and Alloy Steel Nuts (Metric).
ASTM A 569 M	Specification for Steel Carbon (0.15 Maximum Percent), Hot Rolled Sheet and Strip Commercial Quality.
ASTM B 695	Specification for Coating Zinc Mechanically Deposited on Iron and Steel.
ASTM A 490M	Specification for High-Strength Steel Bolts, Classes 10.9 and 10.9.3, for Structural Steel Joints
ASTM A 786M	Specification for Rolled Steel Floor Plates
ASTM F 436M	Specification for Hardened Steel Washers [Metric]
ASTM F 959M	Specification for Compressible - Washer - Type Direct Tension Indicators for use with Structural Fasteners. [Metric]

### **American Society For Non Destructive Testing (ASNT)**

ASNT-TC-1A Recommended Practice

### **American Welding Society Publications (AWS)**

AWS D1.1 Structural Welding Code - Steel

### **British Standards**

BS 5950 Structural use of steelwork in buildings.



## SPECIFICATION FOR STRUCTURAL STEEL FABRICATION

DOCUMENT NO :

REV. : 0

PAGE 6 OF 23

BS 1002 Hot rolled products of non alloy structural steels and their technical delivery conditions.

BS EN 1040 Hot finished structural hollow sections of non-alloy and fine grain structural Steels.

BS 4190 Specification for ISO metric black bolts, screws and nuts.

BS 3692 Specification for ISO metric precession hexagon bolts, screws and nuts.

### Indian Standards

IS : 277 Indian Standard Specification for galvanized steel sheet (plain and corrugated).

IS : 412 Indian Standard Specification for expanded metal sheets for general purposes.

IS : 800 Indian Standard Code of Practice for general construction in steel.

IS : 801 Indian Standard Code of Practice for use of cold formed light gauge steel structural members in general building construction.

IS : 806 Indian Standard Code of Practice for use of steel tubes in general building construction.

IS : 807 Indian Standard Code of Practice for design, manufacture, erection and testing (structural portion) of cranes and hoists.

IS : 808 Indian Standard Specification on for dimensions for hot rolled steel beam, column, channel and angle sections.

IS : 811 Indian Standard Specification for cold formed light gauge structural steel sections.

IS : 813 Indian Standard Specification for scheme of symbols for welding.

IS : 818 Indian Standard Code of Practice for safety and health requirements in electric and gas welding and cutting operations.

IS : 961 Indian Standard Specification for structural steel (high tensile).

IS : 1148 Indian Standard Specification on for hot-rolled rivet bars (upto 40 mm dia.) for structural purposes.

IS : 1161 Indian Standard Specification for steel tubes for structural purposes.

IS : 1239 Indian Standard Specification on for mild steel tubes, tubulars and wrought steel fittings ; Part 1 – mild steel tubes.



## SPECIFICATION FOR STRUCTURAL STEEL FABRICATION

DOCUMENT NO :

REV. : 0

PAGE 7 OF 23

IS : 1363	Indian Standard Specification for hexagonal head bolts, screws and nuts of product Grade C ; Part 1 to Part 3.
IS : 1364	Indian Standard Specification for hexagonal head bolts, screws and nuts of product Grades A and B ; Part 1 to Part 5.
IS : 1608	Indian Standard Specification for method for tensile testing of steel products.
IS : 1730	Indian Standard Specification for dimensions for steel plates, sheets strips and flats for general engineering purposes.
IS : 1732	Indian Standard Specification for dimensions for round and square steel bars for structural and general engineering purposes.
IS : 1757	Indian Standard Specification for method for charpy impact test.
IS : 1821	Indian Standard Specification for dimensions for clearance holes for bolts and screws.
IS : 1852	Indian Standard Specification for rolling and cutting tolerances for hot rolled steel products.
IS : 1862	Indian Standard Specification for studs.
IS : 1977	Indian Standard Specification for structural steel (ordinary quality).
IS : 2016	Indian Standard Specification for plain washers.
IS : 2062	Indian Standard Specification for weldable structural steel.
IS : 2266	Indian Standard Specification for steel wire ropes for general engineering purposes.
IS : 2315	Indian Standard Specification for thimbles for wire ropes.
IS : 2485	Indian Standard Specification for drop forged sockets for wire ropes for general engineering purposes.
IS : 3063	Indian Standard Specification for single coil rectangular section spring washers for bolts, nuts and screws.
IS : 3443	Indian Standard Specification for crane rail sections.
IS : 3502	Indian Standard Specification for steel chequered plates.
IS : 3640	Indian Standard Specification for hexagon fit bolts.
IS : 3696	Indian Standard safety code of scaffolds and ladders ; part 1 and part 2.



## SPECIFICATION FOR STRUCTURAL STEEL FABRICATION

DOCUMENT NO :

REV. : 0

PAGE 8 OF 23

IS : 3757	Indian Standard Specification for high strength structural bolts.
IS : 3964	Indian Standard Specification for light rails.
IS : 4082	Indian Standard Specification recommendation on stacking and storage of construction materials at site.
IS : 4923	Indian Standard Specification for hollow steel sections for structural use.
IS : 5369	Indian Standard Specification for general requirements for plain washers and lock washers.
IS : 5370	Indian Standard Specification for plain washers with outside diameter 3 x inside diameter.
IS : 5372	Indian Standard Specification for tapered washers for channels (ISMC).
IS : 5374	Indian Standard Specification for tapered washers for I-beams (ISMB).
IS : 5624	Indian Standard Specification for foundation bolts.
IS : 6610	Indian Standard Specification for heavy washers for steel structures.
IS : 6623	Indian Standard Specification for high strength structural nuts.
IS : 6639	Indian Standard Specification for hexagonal bolts for steel structures.
IS : 6649	Indian Standard Specification for hardened and tempered washers for high strength structural bolts and nuts.
IS : 6735	Indian Standard Specification for spring washers for screws with cylindrical head.
IS : 6755	Indian Standard Specification for double coil helical spring washers.
IS : 7205	Indian Standard safety code for erection of structural steel work.
IS : 7215	Indian Standard Specification for tolerances for fabrication of steel structures.
IS : 8500	Indian Standard Specification for weldable structural steel (medium and high strength qualities).
IS : 9595	Indian Standard recommendation for metal arc welding of carbon and carbon manganese steels.

All work under this specification, unless otherwise specified, shall conform to the requirements of the latest editions and supplements or any other relevant Indian Standard specifications and codes of practice and in specific cases where the work is



## SPECIFICATION FOR STRUCTURAL STEEL FABRICATION

DOCUMENT NO :

REV. : 0

PAGE 9 OF 23

not covered by an Indian Standard, any other practice as may be specified by the Engineer shall be followed.

### 5.0 REFERENCE DOCUMENTS

The following reference documents, to the extent specified herein, form a part of this specification. When an edition date is not indicated for a document, the latest edition in force at the time of GAIL'S contract award shall apply.

#### **Project specifications:**

Specification for Painting

Any standard required later, shall be provided along with construction drawings.

### 6.0 DOCUMENT PRECEDENCE

It shall be the VENDOR / CONTRACTOR'S responsibility to be, or to become, knowledgeable of the requirements of the referenced Codes, Specifications and Standards.

The VENDOR / CONTRACTOR shall notify GAIL of any apparent conflict between this specification, design drawings, the Codes and Standards and any other specifications noted herein. This specification shall govern when there is any conflict with referenced specifications. Resolution and/or interpretation of precedence shall be obtained from GAIL in writing before proceeding with the design.

In case of conflict, the order of precedence shall be:

- Purchase Order or Contract
- Design Drawings
- Project Specifications and Standards
- Industry Codes and Standards

### 7.0 SPECIFICATION DEVIATION/ CONCESSION CONTROL

Any technical deviations to the Purchase Order and its attachments including, but not limited to, the Data Sheets and Specifications shall be sought by the fabricator only through CONCESSION REQUEST format. CONCESSION REQUESTS require GAIL's review/approval, prior to the proposed technical changes being implemented. Alternative equivalent standards to the list mentioned in 'Codes and Standards' in this specification are acceptable subject to approval from GAIL. Technical changes implemented prior to GAIL's approval are subject to rejection.

### 8.0 QUALITY ASSURANCE/QUALITY CONTROL

The VENDOR / CONTRACTOR shall have in effect at all times a QA/QC program, which clearly establishes the authority and responsibility of those in charge of the quality system. Persons performing quality functions shall have sufficient and well defined authority to enforce quality requirements that initiate, identify, recommend and provide solutions to quality problems and verify the effectiveness of the corrective action.

A copy of the CONTRACTOR'S QA/QC program shall be submitted to GAIL with its quotation for GAIL'S review and concurrence prior to award. If VENDOR /



## SPECIFICATION FOR STRUCTURAL STEEL FABRICATION

DOCUMENT NO :

REV. : 0

PAGE 10 OF 23

CONTRACTOR'S QA/QC program and facility, where the work is to be performed, is ISO 9000 certified, then only a copy of the VENDOR / CONTRACTOR'S ISO 9000 certificate is required. In addition, if VENDOR / CONTRACTOR'S facility is ISO certified, GAIL QA audit requirements will be waived in favour of ISO 9000 registrar audits, unless the VENDOR / CONTRACTOR's trend analysis program indicates areas of concern.

The VENDOR / CONTRACTOR shall identify in purchase documents to its VENDORS all applicable QA/QC requirements imposed by GAIL and shall ensure compliance thereto. On request, VENDOR / CONTRACTOR shall provide objective evidence of its QA/QC surveillance of its VENDOR's activities.

The VENDOR / CONTRACTOR shall submit certified reports of production tests as soon as the tests are completed satisfactorily.

GAIL reserves the right to inspect materials and workmanship at all stages of manufacture and to witness any or all tests. The VENDOR / CONTRACTOR, shall provide GAIL with a copy of its Manufacturing and Inspection Plan for review and inclusion of any mandatory GAIL witness points 30 days after award but prior to the pre-inspection meeting.

### 9.0 SITE CONDITIONS

The following climatic conditions shall govern the design of the equipment:

Temperature:	a) Air	
	Maximum in the sun	: 65°C
	Minimum ambient	: 0°C
	b) Soil at 1m depth (dry and wet sand)	20-25 °C
Relative Humidity:	Maximum	: 94 percent
	Average	: 62 percent
	Design	: 100 Percent

Rainfall is infrequent but may occur with winds up to 40m/sec.

### 10.0 DOCUMENTATION

The VENDOR / CONTRACTOR shall submit the type and quantity of drawings and documentation for GAIL authorisation or information as listed in the individual Material Requisitions and Purchase Orders.

Mutual agreement on scheduled submittal of drawings and engineering data shall be an integral part of any formal Purchase Order.

Comments made by GAIL on drawing submittal shall not relieve the VENDOR / CONTRACTOR of any responsibility in meeting the requirements of the Project Specifications. Such comments shall not be construed as permission to deviate from requirements of the Purchase Order unless specific and mutual agreement is reached and confirmed in writing.

Each drawing shall be provided with a title block in the bottom right-hand corner incorporating the following information:



## SPECIFICATION FOR STRUCTURAL STEEL FABRICATION

DOCUMENT NO :

REV. : 0

PAGE 11 OF 23

- Official trade name of GAIL.
- VENDOR / CONTRACTOR'S drawing number.
- Drawing title giving the description of contents whereby the drawing can be identified.
- A symbol or letter indicating the latest issue or revision.

Revisions to drawings shall be identified with symbols adjacent to the alterations, a brief description in tabular form of each revision shall be given and if applicable, the authority and date of the revision shall be listed. The term "Latest Revision" shall not be used.

The VENDOR / CONTRACTOR shall submit an "Affidavit of Compliance" before beginning fabrication. The affidavit shall confirm that all material meets the requirements of this Specification.

### **11.0 SUBVENDOR / CONTRACTORS/ VENDORS**

The VENDOR / CONTRACTOR shall assume unit responsibility and overall guarantee for the fabrication of structural steel.

It is the VENDOR / CONTRACTOR'S responsibility to enforce all Purchase Order and Project Specification requirements on its SUBVENDOR / CONTRACTORS/VENDORS.

The VENDOR / CONTRACTOR shall submit all relevant SUBVENDOR / CONTRACTOR/VENDOR drawings and engineering data to GAIL.

The VENDOR / CONTRACTOR shall obtain and transmit all SUBVENDOR / CONTRACTOR/VENDOR warranties to GAIL, in addition to the system warranty.

### **12.0 HANDLING**

#### **12.1 Packaging and Shipping**

Preparation for shipment shall be in accordance with GAIL'S instructions and as noted herein. The VENDOR / CONTRACTOR shall be solely responsible for the adequacy of the preparation for shipment provisions with respect to materials and application and to provide material at the destination in ex-works condition when handled by commercial carriers.

Adequate protection shall be provided to prevent damage and atmospheric corrosion in transit and at the job site.

Preparation for shipment and packing will be subject to inspection and rejection by GAIL representative. All costs occasioned by such rejection shall be to the account of the VENDOR / CONTRACTOR.

After inspection, material shall be prepared for shipment.



## SPECIFICATION FOR STRUCTURAL STEEL FABRICATION

DOCUMENT NO :

REV. : 0

PAGE 12 OF 23

Material shall be packed, securely anchored and skid mounted when required. Bracing, supports and rigging connections shall be provided to prevent damage during transit, lifting or unloading. All temporary bracing/supports shall be marked "REMOVE BEFORE EQUIPMENT COMMISSIONING AND STARTUP".

Open ends of tubes and pipes shall be capped for protection. Separate loose spare parts, small items and all bolts, washers shall be completely boxed or bagged. A bill of material shall be enclosed in each package or container of parts.

Exposed finished and machined surfaces, including bolting, shall be given a coating of rust inhibiting compound. Internal metal surfaces shall be sprayed or coated with a suitable rust preventative prior to shipment. Items shall be suitably tagged to indicate the rust preventative applied.

Any galvanizing or painting which becomes damaged shall be repaired in accordance with the Specification for Painting, 2007-58-SP-506 and the Specification for Galvanizing, 2007-58-SP-205.

### **12.2 Preservation and Storage**

Materials shall be protected to withstand ocean transit and extended period of storage at the job site for a minimum period of 18 months. Material shall be protected to safeguard against all adverse environments, such as: humidity, moisture, rain, dust, dirt, sand, mud, salt air, salt spray and seawater.

### **13.0 DESIGN AND DETAILING**

#### **13.1 General**

- 13.1.1 Unless otherwise specified, the design drawings will be provided by the VENDOR / CONTRACTOR, in accordance with the provisions of the AISC Manual of Steel Construction or BS 5950 or IS 800.
- 13.1.3 No deviation from design drawings shall be made without GAIL'S approval in writing. The steel shapes to be galvanized clearly marked on the shop drawings.
- 13.1.4 VENDOR / CONTRACTOR shall be solely responsible for detailing and fabrication so that erection will be convenient and free from all interferences, drilling or cutting on site.
- 13.1.5 VENDOR / CONTRACTOR shall be responsible for dimensions and strength of details not shown in design drawings.
- 13.1.6 All calculations and drawings shall be in S.I. units.



## SPECIFICATION FOR STRUCTURAL STEEL FABRICATION

DOCUMENT NO :

REV. : 0

PAGE 13 OF 23

- 13.1.7 The VENDOR / CONTRACTOR shall provide erection and fabrication drawings. The VENDOR may use design drawings as erection drawings; however, the title block shall be changed to VENDOR / CONTRACTOR'S title block.
- 13.1.8 Shop drawings shall take into account agreed practical transportation measures concerning the size of shop assembled or individual pieces of steelwork.
- 13.1.9 All VENDOR / CONTRACTOR'S documents shall refer to the relevant GAIL design drawing numbers and revisions. This information shall be clearly shown near the title drawing block.
- 13.1.10 Proper clearance shall be provided for field erection.
- 13.1.11 When fabrication and delivery can be expedited by the substitution of shapes for members shown on the design drawings, such substitutions shall be made only with full knowledge and written consent of GAIL prior to fabrication.
- 13.1.12 Minimum design loads for VENDOR / CONTRACTOR designed connections will be indicated on the design drawings provided by GAIL or as per the structural calculation note.
- 13.1.13 Gussets and stiffener plates shall have a minimum thickness of 10mm.
- 13.1.14 The edge distance for bolts in bracing members, in the direction of the force, shall comply with AISC Specification for Structural Steel Buildings, ASD, 9<sup>th</sup> Edition section J 3.9 or IS.1821.
- 13.1.15 Bracing shall be connected with a minimum 2-M20 bolts.
- 13.1.16 Double angle bracing elements shall not be used, except as otherwise noted on GAIL'S drawings.
- 13.1.17 Column splices shall be detailed and designed by VENDOR / CONTRACTOR to develop full strength to the column (considered as short column).
- 13.1.18.1 Beams/Segments of beams shall be spliced only at locations specified by the VENDOR / CONTRACTOR/GAIL. Splices shall be full penetration welds in accordance with AWS D1.1 or IS 9595. Main connection design and details for splices will be provided by the VENDOR / CONTRACTOR / VENDOR/GAIL.
- 13.1.19 All shop drawings; erection drawings and calculations for connections shall be submitted to GAIL for review and approval. Only checked, signed and approved drawings will be accepted. GAIL'S review will be for general methods, arrangements and design verification only and shall not imply verification of dimensions or quantities.
- 13.1.20 Unless otherwise specified, prior to steel shipment, furnish the field with four complete full size sets of approved erection and shop drawings for each shipment, erection segment or shop order.



## SPECIFICATION FOR STRUCTURAL STEEL FABRICATION

DOCUMENT NO :

REV. : 0

PAGE 14 OF 23

### **13.2 Welded Connections**

- 13.2.1 All welded connections shall be designed in accordance with AISC Specification or BS 5950 or IS 800. Welded shop connections are preferred.
- 13.2.2 Connections requiring field welding shall not be used unless so noted on GAIL'S drawings.
- 13.2.3 The minimum size fillet welds shall comply with section J2.2b of the AISC Specification for Structural Steel Buildings, but not less than 5mm.
- 13.2.4 Butt welds, unless shown on the design drawings, are not allowed without prior written GAIL'S authorization.
- 13.2.5 All welded connections shall be continuously welded against corrosion.
- 13.2.6 VENDOR / CONTRACTOR/VENDOR shall design web thickening plates, if notching of beam flanges will reduce the remaining effective web cross section below the area required for the beam connection design shear force.
- 13.2.7 All column base plates shall be continuous fillet welded to the columns; the minimum weld size around the flange shall be 0.35 x the flange thickness and along the web 0.35 x the web thickness, unless noted otherwise on GAIL'S drawings.
- 13.2.8 Welded structural load bearing connections where the through thickness of material is subjected to tensile stress, shall be prohibited unless shown on the GAIL'S drawings.
- 13.2.9 Procedures that must be qualified as required by AWS D1.1 Section 5 shall be submitted to GAIL for authorization. Welding shall not start until these documents are returned from GAIL approved. A certificate of qualification shall be submitted for each welder, welding operator and tacker employed on the work and all weld procedures.

### **13.3 Bolted Connections**

- 13.3.1 Bolted connections shall be designed as bearing type per AISC or BS 5950 or IS 800.
- Bolts and nuts other than high strength shall be ASTM A 307 or grade 4.6 black bolts to BS 4190. Supplied in the equivalent metric sizes.
- 13.3.2 All bolt holes shall be drilled to their final diameter. Diameter of holes shall be as indicated in Table J 3.1 of the AISC Specification for Structural Steel Buildings or IS 800.
- 13.3.3 "Pinned" beam connections shall preferably have end plates with a minimum of 4-M20 bolts, except for stability bracing or floor supporting heavy equipment. The minimum end plate thickness shall be 10mm.



## SPECIFICATION FOR STRUCTURAL STEEL FABRICATION

DOCUMENT NO :

REV. : 0

PAGE 15 OF 23

13.3.4 Clip angle (cleated) connections shall be shop bolted and field tightened. Shop bolts shall be manually tightened to allow for field adjustment prior to pretensioning.

13.3.5 Minimum thickness of gusset plates and base plates shall be 10mm.

13.3.6 Bolted connections for handrail and toelate, checkered plate, ladders and cages and stair treads shall be made using ASTM A 307 bolts or grade 4.6 black bolts and ASTM A 563 Grade A nuts. Diameter of bolt shall be as required by the approved fabrication drawings.

### 14.0 MATERIALS

#### 14.1 Certification

14.1.1 VENDOR / CONTRACTOR is responsible to supply materials conforming to the following specifications, including all material certificate/ testing. Mill covering chemical and physical properties for each type of steel shall be included.

#### 14.2 Structural Steel

14.2.1 Structural steel shapes shall be in accordance with ASTM A 36M or S275 or IS 808. Steel pipe shall be in accordance with ASTM A 53, Type E or S, Grade B or IS 1161

#### 14.3 Bolts, Nuts And Washers

14.3.1 VENDOR / CONTRACTOR is responsible to supply bolts, nuts and washers and all material certificates/ testing.

14.3.2 Bolts and nuts other than high-strength shall be per ASTM A 307 Grade B bolt with ASTM A 563 Grade A heavy hex nut or grade 4.6 in accordance with BS 4190.

14.3.3 Load indicator washer shall be in accordance with ASTM F 959M.

14.3.4 All fastener products shall be furnished with mill test certificates showing full conformance with applicable ASTM standard.

14.3.5 In addition to the proper mill and test certificates furnished, a sample bolt from each mill heat and each manufacturing lot for each different VENDOR / CONTRACTOR'S fasteners shall be taken from job site for testing by an independent test lab in accordance with ASTM A 325M test procedures. At least three load indicator washers shall also be taken for each size and shall be tested in accordance with ASTM F 959M. Lot traceability to material and to manufacturing Certified Material Test Reports is required for all high strength bolts and nuts.

14.3.6 Quantities of both common and high strength bolt assemblies shall include 5 percent extra per size and length to cover requirements for fit-up and erection.

14.3.7 All bolts required for erection shall be included with the steel shipments in clearly marked containers.



## SPECIFICATION FOR STRUCTURAL STEEL FABRICATION

DOCUMENT NO :

REV. : 0

PAGE 16 OF 23

14.3.8 Bolts, nuts and washers shall be either hot-dipped or mechanically galvanized in accordance with the Specification for Galvanizing, 2007-58-SP-205.

14.3.9 Hot-dipped galvanizing shall comply with ASTM A 153, Class C. Mechanical galvanizing shall be in accordance with ASTM B 695. Nuts shall be tapped oversize, according to ASTM A 563M, prior to galvanizing and then retapped again after galvanizing; mechanically galvanized nuts need not be retapped. Surface preparation shall be in accordance with the Specification for Galvanizing, 2007-58-SP-205.

14.3.10 Load indicator washers shall be mechanically galvanized in accordance with ASTM B 695, Class 50.

### **14.4 Open Grid Flooring**

14.4.1 Open grid flooring shall be serrated rectangular grid type with bearing bars 30mmx6mm thick at 30mm cross centre with 6 x6 twisted cross bars at 100mm cross centre, hot dipped galvanized after fabrication and manufactured to ASTM A 569M. Galvanizing shall be in accordance with the Project Galvanizing Specification.

14.4.2 Open grid flooring shall be attached to the supporting steel work with clips. The fasteners will be supplied to 15% extra cover losses. The installation of clips shall be done by the erector. Holes or cut out in panels shall be made by flooring manufacturer and have perimeter stiffening strips welded in. This work to be completed before galvanising. Joints in grating shall occur at points of support unless other appropriate details shall be provided by the ENGINEER/VENDOR / CONTRACTOR.

### **14.5 Stair Treads**

14.5.1 Stair treads shall be serrated rectangular pattern open grid type, with 30mm x 5mm bearing bars at 41mm cross center, with 6 x 6mm twisted bars at 100mm cross center and non skid abrasive nosings, hot dipped galvanized after fabrication and shall be manufactured to ASTM A 569M. Galvanizing shall be done in accordance with the Specification for Galvanizing 2007-58-SP-205.

14.5.2 Stair treads shall be bolted to the stair stringer.

### **14.6 Floor Plates**

14.6.1 Floor plate shall be raised, four- way standard per ASTM A 786M or approved equal and shall be minimum 6mm thickness. Tear shaped pattern 8 x 30 x2mm. They shall be attached to the supporting steelwork with 12mm diameter counter sunk bolts, unless otherwise noted on the drawing.

14.6.2 A 13mm diameter drainage hole shall be provided per square meter of floor plate. Plates shall be hot dipped galvanized. Galvanizing shall be done in accordance with the Specification for Galvanizing 2007-58-SP-205.

### **14.7 Welding Electrodes**



## SPECIFICATION FOR STRUCTURAL STEEL FABRICATION

DOCUMENT NO :

REV. : 0

PAGE 17 OF 23

14.7.1 All welding electrodes shall comply with IS 816 and shall meet filler metal requirements given in AWS D1.1.

### **14.8 Ladders, Cages And Handrails**

14.8.1 Ladders, cages and handrails shall be in accordance with Section 12.2. Materials shall be hot dipped galvanized in accordance with the Specification for Galvanizing, 2007-58-SP-205 and applicable standards.

## **15.0 FABRICATION**

### **15.1 General**

15.1.1 Fabrication and assembly shall comply with the requirements of the AISC specification or BS 5950 or IS 800 except as amended by this specification.

15.1.2 Dimensional tolerances shall follow AISC requirements of Section 6.4 and 10 of the Code of Standard Practice and Section 1.23.8.1 of the applicable AISC Specification or IS 7215.

15.1.3 Platforms, stairways and handrails shall be shop-assembled in the largest unit suitable for handling, shipping and erection. Platforms on columns shall be systematically shop-assembled to avoid unnecessary adjustments on site.

15.1.4 Shop-assembly by welding shall be the maximum compatible with type of transport from workshop to site.

15.1.5 Members shall not be spliced without prior written approval of GAIL.

15.1.6 All cuts shall be neat, clean and free of warping, cracking and burrs. Edges and holes shall be deburred and rounded off.

15.1.7 Bolt holes shall be drilled to their final diameter.

15.1.8 Top rails of handrails, ladder rungs, rails and cages shall be smooth and free of burrs, sharp edges and weld spatter.

15.1.9 Panels for open grid flooring and floor plates shall be fabricated with span ends occurring over structural framing.

15.1.10 Panels for open grid flooring and floor plates which have shop-made cutouts shall be split on the centerline of the openings. All openings 200mm in diameter or 250mm in diagonal and larger shall be banded with a toe plate.



## SPECIFICATION FOR STRUCTURAL STEEL FABRICATION

DOCUMENT NO :

REV. : 0

PAGE 18 OF 23

15.1.11 Handrails, ladders and cages shall be shop assembled to the greatest extent possible within shipping limitations. Handrail shall be shop attached to platforms whenever practical. Handrail that cannot be shop attached to platforms shall be shop assembled in sections for field bolting to platforms. Ladder cages shall be shop assembled on ladders. Safety gates shall be tagged, shipped loose and securely wired to corresponding handrail with # 9 wire.

15.1.12 Fabrication of handrails and fencing shall be performed to such a degree that when erected top rail will be straight and level to the eye.

15.1.13 GAIL reserves the right to reject any unsatisfactory materials and misfit members resulting from errors in shop detailing, fabrication, painting or galvanizing. Any such errors which prevent the proper assembly of the structure and which require correction or adjustment shall be reported to the VENDOR / CONTRACTOR, who is responsible to correct the error. The cost of all such corrections shall be borne by the VENDOR / CONTRACTOR. The VENDOR / CONTRACTOR shall submit the proposed correction technique and method statement for GAIL remedial action. No detrimental effect on quality, cost or schedule shall result.

### **15.2 Bolting**

15.2.1 The length of the smooth cylindrical part of the bolt shall not be less than 0.85 the sum of the thickness of the members to be bolted.

15.2.2 The thread length of the bolts shall be adequate to ensure that the nuts are entirely engaged.

15.2.3 The required locking devices, if noted on the drawings, shall be provided.

### **15.3 Welding**

15.3.1 Welding, including details and drawings, procedures, qualification of personnel, consumables, workmanship, quality testing and inspection, shall comply in every respect with the requirements of AWS D1.1 Code.

15.3.2 All shop welding shall be performed in an area protected from adverse weather conditions (rain, wind) and air-borne dust and sand.

15.3.3 Parts to be welded shall be carefully prepared and be firmly held before welding to avoid, as far as possible, warping, buckling and residual stresses.

15.3.4 All welded seams shall be continuous.

15.3.5 Stitch welds shall be made in at least two passes such that filler metal is deposited over the whole thickness of the joint.

15.3.6 Weld profiles shall be controlled by gauges in accordance with the relevant standards.

15.3.7 Stitch welds not incorporated in the final weld shall be removed by grinding after completion of the work in order to produce a smooth regular finish.



## SPECIFICATION FOR STRUCTURAL STEEL FABRICATION

DOCUMENT NO :

REV. : 0

PAGE 19 OF 23

15.3.8 Prior to the beginning of the work, the VENDOR / CONTRACTOR shall submit to GAIL a welding procedure to include the following :

1. Method of preparing the parts to be welded (clearances, tolerances,...).
2. Location, type, size of welds and effective length of welds.
3. Details of non-standard welds.
4. Where seal welds are required with details.
5. Type and extent of inspection including any special inspection requirements.
6. Welding supervisor and welders shall be qualified in accordance with the relevant AWS codes / IS codes and they will have qualification certificates available for review.
7. Specification and grade of parent metal.
8. Classification of consumables.
9. Welding consumables certificates.
10. Electrodes certificates.
11. Quality of welds and inspection.

All additional information to be shown on weld maps using AWS / IS symbols and terminology.

15.3.9 The quality of welds and inspection shall be in accordance with the requirements of AWS D1.1 Code.

15.3.10 Visual examination for all categories of weld shall reveal no cracks. Uncontinuous weld shall not be permitted. Welds shall be free of all weld-slag before any visual examination or Non-Destructive Examination (NDE)

15.3.11 Butt welds noted on the drawings shall be subjected to radiographic examination in the shop.

15.3.12 Butt weld performed by automatic or semi-automatic welding shall be subjected to the above-mentioned examination and to an ultrasonic examination.

15.3.13 The quantity and the type of control shall follow the requirements of AWS code, indicated on design drawing or specified by the GAIL'S representative in workshop.

15.3.14 The following Non-Destructive Examinations (NDE) are required for structural welding

15.3.14.1 Five percent of the total number of full penetration welds shall be radiographed or ultrasonically examined 100 percent of the entire length of the weld(s) selected.

15.3.14.2 Five percent of the total number of fillet or partial penetration welds shall be magnetic particle examined 100 percent of the entire length of the weld(s) selected. If anywhere one weld line meets another weld line, that location shall be one of the selected.



**SPECIFICATION FOR  
STRUCTURAL STEEL FABRICATION**

DOCUMENT NO :

REV. : 0

PAGE 20 OF 23

15.3.14.3 When a selected weld is rejected, two additional welds shall be subject to NDE. This procedure of examining two welds for every weld rejected shall continue until all welds examined are accepted. The replaced welds shall also be examined.

15.3.14.4 Weld selected to satisfy this five percent requirements shall be selected by GAIL'S representative and shall represent a sample of each welder's work for each type of weld.

15.3.15 VENDOR / CONTRACTOR shall visually inspect all completed welds. Procedures and acceptance criteria shall be in accordance with AWS D1.1. Undercutting beyond the limits of AWS D1.1.

**15.4 Finishing**

15.4.1 Upon completion of fabrication, all surfaces of structural steel not noted otherwise are to be blasted and primed by VENDOR / CONTRACTOR according to the Specification for Painting 2007-58-SP-506

15.4.2 Galvanized items are indicated in other Sections of the Specification.

15.4.3 Prior to galvanizing or shop priming, all sharp corners, burrs (including bolt hole burrs), weld spatter, slag, weld flux, loose mill scale and other foreign matter shall be removed.

15.4.4 Provisions shall be made for inaccessible surfaces after assembly - such surfaces shall be painted before assembly.

**16.0 MARKING AND EXPORT PACKING**

**16.1 Marking**

16.1.1 All steelwork pieces shall be marked in accordance with the following marking procedures or another approved procedure to be confirmed or adapted by GAIL:

**16.1.1.1 The piece mark for structures shall consist of four parts:**

- Part 1 - Structure tag number containing the plant unit number and the sequential number of the structure within the unit.
- Part 2- Fabricator's shop detail sheet number which shall not be repeated for the same Purchase Order.
- Part 3- Piece designation by letter(s) indicating B for beams, C for columns, G for girders, BR for braces, PL for plates, etc., plus a sequential number assigned by the VENDOR / CONTRACTOR.
- Part 4- Framing level number assigned by the fabricator (for multilevel structures only)

<b>Example: Part 1</b>	<b>Part 2</b>	<b>Part 3</b>	<b>Part 4</b>
9003	14	B2	5



## SPECIFICATION FOR STRUCTURAL STEEL FABRICATION

DOCUMENT NO :

REV. : 0

PAGE 21 OF 23

The above example indicates the second beam detailed on shop drawing 14, located on the fifth framing level in the third structure in Unit 90.

The entire piece mark must be shown on all structural steel delivered to the jobsite. The shop erection drawing need show only Parts 2 and 3 and the shop detail drawing need show only Parts 3 and 4.

### 16.1.1.2 The piece mark for pipe supports shall consist of three parts:

- Part 1- Pipe support tag number containing the plant unit number and the sequential number of the pipe support within the unit.
- Parts 2 and 3 - Shall be the same as for structures.

**Example:**

<u>Part 1</u>	<u>Part 2</u>	<u>Part 3</u>
PA 9104	14	B2

The above example indicates the second beam detailed on shop drawing 14, located in the fourth pipe support in Unit 91.

The entire piece mark must be shown on all pipe supports delivered to the jobsite. The shop erection drawing need only show Parts 2 and 3 and the shop detail drawing need only show Part 3.

16.1.1.3 The location of the mark shall be on the left hand end of the piece, as detailed. On the erection diagram the mark shall be in the corresponding "in place" position.

16.1.1.4 Members shall be piece-marked using one of the following methods for each piece:

- Metal tags stamped with the mark number and seal welded to the members.
- Mark numbers steel-stencilled on the member.
- Handrails and other minor steel assemblies - metal tags stamped with the mark number and wire-tagged to the assembly.
- Mark number shall be at least 16mm high and shall be stamped or stencilled deep enough so that they will be legible after painting or galvanizing.

## 16.2 Export Packing

16.2.1 General Provisions

16.2.1.1 Packing operations (bundling, casing, etc.) may only begin after fabrication acceptance.

16.2.1.2 Maximum sizes for fabricated pieces shall be limited to the size, which can be transported by truck.

16.2.1.3 Packing shall be separate for each unit and structure. Grouping of structures provided for several units is not allowed.



## SPECIFICATION FOR STRUCTURAL STEEL FABRICATION

DOCUMENT NO :

REV. : 0

PAGE 22 OF 23

- 16.2.1.4 Steel shall be shipped in erectable lots, i.e. beams, columns, bracings, etc... for the same structure, at the same time.
- 16.2.1.5 A lot shall be deemed packed when all the material required for field erection has been packed. In particular, bolts and other fastening items shall be packed at the same time as the main material of the corresponding lot.
- 16.2.1.6 Necessary bolts shall be always sent with the structural steel components.
- 16.2.1.7 The specific identification of each package, including Purchase Order or Contract Number, shall be marked on the top and two opposite sides.
- 16.2.1.8 For each package, the following shall be marked: dimensions, net weight, gross weight to be confirmed by GAIL.
- 16.2.1.9 The weight of a package shall not exceed 5 t (except for some pieces which can be arranged in pairs) to be confirmed by VENDOR / CONTRACTOR.
- 16.2.1.10 All members shall be carefully handled and cribbed to prevent damage to members and protective coatings.
- 16.2.2 Types of packages
- 16.2.2.1 Category 1 - Bundles
- Bundles shall be used for packing of standard straight shapes and built up welded shapes.
- This type of packing will be used for parts not likely to be subject to permanent distortion during handling operations.
- Packages shall be homogeneous and all parts shall be properly wedged against one another.
- Placing of accessories between steel shape flanges is prohibited.
- Material hooping shall be with steel shapes with cross section equal to or exceeding 100mm and 24mm diameter studs provided with lock nuts.
- 16.2.2.2 Category 2 - Crates
- Crates shall be used for steel structures or plates, walkways, railing components, cage components, etc., as a rule for all components likely to be subject to distortion during handling.
- The material shall be fixed inside by means of wooden shims suiting the material shape.
- 16.2.2.3 Category 3 - Cases
- Cases without internal liner:
- They shall be used for packing of assembling components, not shop assembled in their final position on main parts, such as short angles, gussets, wedges, etc...



## SPECIFICATION FOR STRUCTURAL STEEL FABRICATION

DOCUMENT NO :

REV. : 0

PAGE 23 OF 23

These components shall previously be grouped in series per identical structure number and coated with the shop protection provided on main parts.

Cases with internal liner (waterproof):

They shall be used for bolting materials (bolts, nuts, washers) and welding electrodes.

Bolt assemblies shall be properly oiled and placed in sacks prior to packing. Sacks shall be oiled prior to packing.

Bagging shall be made per quality, length and diameter of bolts, including bolts, nuts and washers. A metal tag shall be affixed on each bag and another inside with the indication of the number, quality, diameter and length of bolts.

- 16.2.2.4 Packing lists reflecting what is actually shipped shall be furnished with each load in a waterproof package.



## SPECIFICATION FOR PAINTING

DOCUMENT NO :

REV. 0

PAGE 1 OF 35

# GAIL (India) Limited

## GAS PIPELINE PROJECT

REV	DESCRIPTION	DATE	PREPARED BY	CHECKED BY	APPROVED BY
A	ISSUED FOR TENDER	15-10-2007			



## SPECIFICATION FOR PAINTING

DOCUMENT NO :

REV. 0

PAGE 2 OF 35

### TABLE OF CONTENTS

1.0	SCOPE .....	4
1.1	Introduction .....	4
1.2	Purpose.....	4
1.3	Definitions .....	4
2.0	CODES AND STANDARDS.....	4
3.0	REFERENCE DOCUMENTS.....	6
4.0	DOCUMENT PRECEDENCE .....	6
5.0	SPECIFICATION DEVIATION / CONCESSION CONTROL .....	6
6.0	QUALITY ASSURANCE / QUALITY CONTROL.....	6
7.0	SITE CONDITIONS .....	7
8.0	SUBVENDORS.....	7
9.0	HANDLING OF COATED ITEMS.....	7
10.0	EXECUTION.....	8
10.1	Shop Versus Field Painting Policy.....	8
10.2	Responsibilities of the Vendor .....	8
11.0	MATERIALS .....	9
11.1	Abrasives .....	9
11.2	Compressed Air .....	9
11.3	Paint Materials .....	9
12.0	general requirements .....	10
12.1	Surfaces not to be Painted .....	10
12.2	Protection of Stainless Steel and Nickel Alloy Surfaces.....	10
12.3	Surfaces Requiring Insulation.....	11
12.4	Safety Requirements .....	11
13.0	SURFACE PREPARATION .....	11
13.1	Items to be Protected.....	11
13.2	Basic Cleaning .....	11
13.3	Preblast Cleaning.....	12
13.4	Cleaning of Carbon Steel Surfaces .....	12
13.5	Cleaning of Galvanized and Inorganic Zinc Surfaces .....	13
13.6	Cleaning of Stainless Steel and Nickel Alloy Surfaces.....	13
14.0	PAINTING APPLICATION .....	13
14.1	Scheduling .....	13
14.2	Preparation for Painting .....	14
14.3	Masking.....	14
14.4	Painting Application .....	14
15.0	REPAIRS .....	16
15.1	General requirements .....	16
15.2	Coating Damage Not Exposing Substrate Surface .....	16



## SPECIFICATION FOR PAINTING

DOCUMENT NO :

REV. 0

PAGE 3 OF 35

15.3	Coating Damage Exposing Substrate Surface .....	17
15.4	Repair of Zinc Silicate Primer .....	17
15.5	Repair of Fully Cured Epoxy Coating .....	17
16.0	INSPECTION AND TESTING .....	17
16.1	GENERAL .....	17
16.2	Inspection Instruments.....	17
16.3	Before Surface preparation.....	18
16.4	Before and during paint application .....	18
16.5	After Painting .....	18
17.0	inspection records and reports.....	19
APPENDIX 1	.....	20
APPENDIX 2	.....	25
APPENDIX 3	.....	33
APPENDIX 4	.....	34



## SPECIFICATION FOR PAINTING

DOCUMENT NO :

REV. 0

PAGE 4 OF 35

### 1.0 SCOPE

#### 1.1 Introduction

This Specification covers the painting requirements for exterior surfaces of aboveground Pipeline, Piping, Equipment, Storage Tanks, Valves, Tees, Fitting, Flanges and Structural Steel made out of carbon steel and low alloys, stainless steels.

#### 1.2 Purpose

The materials and procedures specified herein are provided to protect plant equipment from corrosion and to provide an aesthetically pleasing environment for personnel to work in.

#### 1.3 Definitions

For the purpose of this specification, the following definitions apply:

**OWNER** means the GAIL (India) Limited, and its legal successor in title.

The **VENDOR** is the party which manufactures or supplies equipment and services to perform the duties specified by the CONSULTANT.

**CONSULTANT** means GAIL INDIA LTD.

The word **shall** indicates a requirement.

The word **should** indicates a recommendation

### 2.0 CODES AND STANDARDS

It shall be the VENDOR'S responsibility to be, or to become, knowledgeable of the requirements of the referenced codes and standards.

The following codes and standards, to the extent specified herein, form a part of this Specification. Where an edition date is not indicated for a code or standard, the latest edition in force at the time VENDOR'S proposal is submitted shall apply. VENDOR may use alternate standards that meet or exceed those listed, if approved by the GAIL.

#### American Society For Testing And Materials (ASTM)

B117	Salt Spray (Fog) Testing
D4060	Abrasion Resistance of Organic Coatings by the Taber Abraser
D4541	Pull-Off Strength of Coatings Using Portable Adhesion Testers
D5162	Discontinuity (Holiday) Testing of Non-Conductive Coating on Metallic Substrates.

#### German Colour Standard

RAL 840 HR	Standard Colours
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## SPECIFICATION FOR PAINTING

DOCUMENT NO :

REV. 0

PAGE 5 OF 35

### International Organization For Standardization (ISO)

ISO 2409	Paints and Varnishes - Cross-cut test for adhesion
ISO 2504-2	Radiography of Welds and Viewing Conditions for films - Utilisation of recommended patterns of image quality indicators
ISO 2808	Paints and Varnishes - Determination of film thickness
ISO 4624	Paints and Varnishes - Pull-off test for adhesion
ISO 4628-2	Paints and Varnishes - Evaluation of degradation of paint coatings - Designation of intensity, quantity and size of common types of defect - Part 2: Designation of degree of blistering
ISO 4628-3	Paints and Varnishes - Evaluation of degradation of paint coatings - Designation of intensity, quantity and size of common types of defect - Part 3: Designation of degree of rusting
ISO 4628-4	Paints and Varnishes - Evaluation of degradation of paint coatings - Designation of intensity, quantity and size of common types of defect - Part 4: Designation of degree of cracking
ISO 4628-5	Paints and Varnishes - Evaluation of degradation of paint coatings - Designation of intensity, quantity and size of common types of defect - Part 5: Designation of degree of flaking
ISO 4628-6	Paints and Varnishes - Evaluation of degradation of paint coatings - Designation of intensity, quantity and size of common types of defect - Part 6: Rating of degree of chalking by tape method
ISO 8501-1	Preparation of steel substrates before application of paints and related products — Visual assessment of surface cleanliness. Part 1: Rust grades and preparation grades of uncoated steel substrates and steel substrates after overall removal of previous coatings
ISO 8502-1	Preparation of steel substrates before application of paints and related products-Tests for the assessment of surface cleanliness-Part 1: Field test for soluble iron corrosion products
ISO 8502-2	Preparation of steel substrates before application of paints and related products — Tests for the assessment of surface cleanliness — Part 2, Laboratory determination of chloride on cleaned surfaces
ISO 8502-3	Preparation of steel substrates before application of paints and related products — Tests for the assessment of surface cleanliness — Part 3, Assessment of dust on steel surfaces prepared for painting (pressure-sensitive tape method)
ISO 8502-4	Preparation of steel substrates before application of paints and related products — Tests for the assessment of surface cleanliness — Part 4, Guidance on the estimation of the probability of condensation prior to paint application
ISO 8503-2	Preparation of steel substrates before application of paints and related products — Surface roughness characteristics of blast cleaned steel blast-cleaned steel. — Part 2, Comparator procedure
ISO 8504-2	Preparation of steel substrates before application of paints and related products — Surface preparation methods — Part 2, Abrasive blast-cleaning
ISO 8504-3	Preparation of steel substrates before application of paints and related products — Surface preparation methods — Part 3, Hand and power tool cleaning



## SPECIFICATION FOR PAINTING

DOCUMENT NO :

REV. 0

PAGE 6 OF 35

ISO 9001	Quality Systems - Model for Quality Assurance in Design, Development, Production, Installation and Servicing
ISO 9003	Quality Systems - Model for Quality Assurance in Final Inspection and Test
ISO 9004	Quality Management and Quality System Elements - Guidelines

### **Steel Structures Painting Council (SSPC)**

SSPC PA-2	Measurement of Dry Coating Thickness with Magnetic Gauges
SSPC VIS-1	Pictorial Surface Preparation Standards for Painting Steel Surfaces

### **3.0 REFERENCE DOCUMENTS**

The following reference documents, to the extent specified herein, form a part of this Specification. When an edition date is not indicated for a document, the latest edition in force at the time of VENDOR'S proposal is submitted shall apply.

#### **Manufacturer's data**

MANUFACTURER's technical data sheets, recommendations and instructions.

### **4.0 DOCUMENT PRECEDENCE**

The VENDOR shall notify the apparent conflict between this Specification, the APPLICATION DATA, the codes and standards and any other Specification noted herein. Resolution and/or interpretation precedence shall be obtained from the GAIL in writing before proceeding with surface preparation or application of coatings.

In case of conflict, the order of precedence shall be:

- Project Specification.
- Product application Data Sheets.
- Industry codes and standards.

### **5.0 SPECIFICATION DEVIATION / CONCESSION CONTROL**

Any technical deviations to the Specifications and its attachments including, but not limited to, the Data Sheets and Narrative Specifications shall be obtained by the VENDOR only through CONCESSION REQUEST format. CONCESSION REQUESTS require GAIL's review/approval prior to implementation of the proposed changes. Technical changes implemented prior to GAIL approval are subject to rejection.

### **6.0 QUALITY ASSURANCE / QUALITY CONTROL**

The VENDOR shall have in effect at all times a QA/QC program, which clearly establishes the authority and responsibility of those incharge of the quality system. Persons performing quality functions shall have sufficient and well defined authority to enforce quality requirements that initiate, identify, recommend and provide solutions to quality problems and verify the effectiveness of the corrective action.

A copy of the VENDOR's QA/QC program shall be submitted to GAIL with its quotation for GAIL'S review and concurrence prior to award. If VENDOR's QA/QC program and facility, where the work is



## SPECIFICATION FOR PAINTING

DOCUMENT NO :

REV. 0

PAGE 7 OF 35

to be performed, is ISO 9000 certified, then only a copy of the VENDOR's ISO 9000 certificate is required. In addition, if VENDOR's facility is ISO certified, GAIL's QA audit requirements will be waived in favour of ISO 9000 registrar audits, unless the GAIL's trend analysis program indicates areas of concern.

The VENDOR shall identify in purchase documents to its SUBVENDORS all applicable QA/QC requirements imposed by GAIL and shall ensure compliance thereto. On request, VENDOR shall provide objective evidence of its QA/QC surveillance of its SUBVENDOR's activities.

The VENDOR shall submit certified reports of production tests as soon as the tests are completed satisfactorily.

The GAIL reserves the right to inspect materials and workmanship at all stages of manufacture and to witness any or all tests. The VENDOR, shall provide GAIL with a copy of its Manufacturing and Inspection Plan for review and inclusion of any mandatory GAIL witness points 30 days after award but prior to the pre-inspection meeting.

### 7.0 SITE CONDITIONS

The following climatic conditions shall govern the design of the equipment:

<b>Temperature:</b>	a)	Air		
		Maximum in the sun	-	65 <sup>0</sup> C
		Minimum ambient	-	0 <sup>0</sup> C
	b)	Soil at 1m depth	-	20-25 <sup>0</sup> C
		(dry & wet sand)		
<b>Relative Humidity</b>				
		Maximum	-	94 percent
		Average	-	62 percent
		Design	-	100 percent.

### 8.0 SUBVENDORS

The VENDOR shall transmit all relevant purchase order documents including specifications to his SUB-VENDORS.

It is the VENDOR'S responsibility to enforce all Purchase Order and Specification requirements on his SUB-VENDOR.

The APPLICATOR shall obtain and transmit all relevant SUB-VENDOR drawings and engineering data to the VENDOR.

The VENDOR shall obtain and transmit all SUB-VENDOR warranties to GAIL, in addition to the system warranty.

### 9.0 HANDLING OF COATED ITEMS

Preparation for shipment and packing will be subject to inspection and acceptance by the GAIL'S inspectors. All costs related to any rejection by GAIL shall be to the account of the VENDOR.

Facilities and methods of yard storage and protection of the pipe during transportation shall be subject to approval by the VENDOR



## SPECIFICATION FOR PAINTING

DOCUMENT NO :

REV. 0

PAGE 8 OF 35

Preparation of coated items for shipment shall be in accordance with the VENDOR'S standards and as noted herein. VENDOR shall be solely responsible for the adequacy of the preparation for shipment provisions with respect to coated items and to provide equipment at the destination in ex-works condition when handled by commercial carriers.

Adequate protection shall be provided to prevent mechanical damage to the applied coating system and subsequent atmospheric corrosion in transit and at the jobsite.

Finished painted pipe and pipe spools shall be handled and/or stored in a manner to protect the coating from damage. They shall not be dropped, rolled or impacted with or against solid objects with a force capable of causing coating damage.

Finished painted pipe and pipe spools shall be shipped using sufficient padding to adequately protect the pipe coating.

Finished painted pipe and pipe spools shall be lifted, lowered, or suspended by the use of rubber or canvas belt with removable pin and clevis on one end to permit removal of belt without damage to the coating. The belt shall be of sufficient width to prevent any damage being sustained by the coating. Use of ropes of any kind, hooks, bands, chains or cables shall not be permitted.

Coated items shall be protected from damage during storage and handling at the job site prior to use. Coated items shall be stored off the ground on sufficiently padded skids, properly leveled and spaced, to support the coated item. Each coated item shall be separated from each adjacent item.

Un-applied coatings and related materials shall be protected to withstand ocean transit and an extended period of storage at the jobsite, but not in excess of the MANUFACTURER'S stated shelf life, for each coating material. All materials shall be protected to safeguard against all adverse environments, such as: heat, humidity, moisture, rain, dust, dirt, sand, mud, salt air, salt spray and sea water.

Gasket contact surfaces and machined surfaces shall be protected with Shell Ensis fluid or other VENDOR approved material to prevent rusting during transportation and storage.

### 10.0 EXECUTION

#### 10.1 Shop Versus Field Painting Policy

Shop and field painting shall be based on the following policy. Shop application of the complete coating system is preferred. Where the complete paint system before transport to the site is not possible, primer application in the shop followed by intermediate coat and top coat at site after erection or primer and intermediate coat at shop followed by touch-up and top coat application at site after erection. In these cases the time limit in between coats recommended by manufacturer shall be strictly followed.

VENDOR shall submit a Work Plan/Method Statement delineating painting work execution between shop and field painting and obtain GAIL'S approval.

#### 10.2 Responsibilities of the Vendor

The VENDOR at their facility shall perform surface preparation, priming and application of at least one coat on top of the primer to the following items.

- Boilers
- Heaters
- Stacks
- Exchangers
- Piping
- Structural steel



## SPECIFICATION FOR PAINTING

DOCUMENT NO :

REV. 0

PAGE 9 OF 35

- Tanks (shop fabricated)
- Other miscellaneous items
- Vessels

Non itemized (bulk) carbon steel valves shall receive at shop, after surface preparation to Sa 2 ½ and profile roughness 50 to 100µm , one coat to 75 µm of in organic Ethyl Zinc Silicate.

Non itemized (bulk) stainless steel valves shall receive at shop the complete Painting System No. 9 (see Table 2, Appendix 1).

The VENDOR shall perform surface preparation, priming and finish painting of the following items including all attachments thereto in accordance with the painting systems of this Specification or their standard paint specification provided the total paint system has a minimum corrosion resistance of 2000 hours when tested in accordance with ASTM B117.

- Compressors
- Electrical equipment
- Motors
- Shelf items
- Turbines
- Control equipment
- Fans
- Pumps
- Specialty equipment
- Itemized valves

Any painting procedures submitted by the VENDOR and approved by GAIL shall be considered additional to the requirements of this Specification but shall not be considered in lieu of or substitution for the procedures and requirements stated in this Specification.

### 11.0 MATERIALS

The GAIL reserves the right to instruct the VENDOR to use approved materials from paint manufacturers. Prequalification of manufacturer's products is subject to compliance with GAIL'S procedures and requirements.

Unless otherwise approved by the VENDOR, products specified in this section and Table 3 (Appendix 1) shall be used.

#### 11.1 Abrasives

For surface preparation, expandable abrasives or GAIL approved abrasives shall be used.

#### 11.2 Compressed Air

Compressed air shall be clean, dry, oil free and supplied at a temperature of less than 50°C. Moisture and oil traps shall be used in compressed air lines for blast cleaning, conventional, or airless spray equipment. Compressed air pressure shall not be less than 5.5 barg (80 psi). It shall be tested for oil and moisture by a blotting paper test regularly. Oil traps and moisture traps shall be cleaned when required.

#### 11.3 Paint Materials

Coatings containing cadmium or lead or any toxic material to environment/personnel shall not be used without the prior approval from GAIL. Paints for use over stainless steels or nickel alloys shall not contain free chlorides or other halides and zinc. Chlorides or other halides tied up within the cured resin's molecule may be acceptable, unless they are subject to release through aging within the temperature range specified.

All coatings and related materials shall be as identified in Table 3 (Appendix 1).



## SPECIFICATION FOR PAINTING

DOCUMENT NO :

REV. 0

PAGE 10 OF 35

Primers, intercoats and finishes shall be factory tinted, sealed and labeled. Thinners and solvents shall be as identified in the coating manufacturer's data sheets.

All paint materials shall be used in strict rotation on a first-in, first-out basis.

Polyurethane finishes used to this specification shall have excellent colour retention and high gloss.

Primer colours shall be MANUFACTURER'S standard colours. Finish colours, except for silicone aluminum, shall be as noted in the colour schedule of Table 4 (Appendix 2). For services above 100°C, if heat stable colours matching specified colours are not commercially available from the MANUFACTURER'S standard stock, heat stable colours shall be selected regardless of colour match subject to GAIL'S choice of standard stock colour.

The VOC (Volatile Organic Compound) level of the coating materials shall not exceed 420 g/l or the limit set by local agencies whichever is lower.

VENDOR shall be completely responsible for determining the compatibility of coating materials being applied to the same item that are the products of different MANUFACTURERS.

### 12.0 GENERAL REQUIREMENTS

#### 12.1 Surfaces not to be Painted

The following items do not require any shop or field surface preparation and coating unless otherwise specified:

- Aluminum fins air coolers.
- Insulation jacketing.
- Interior surfaces of equipment (except where indicated otherwise).
- Nonmetallic surfaces.
- Nonferrous surfaces, i.e., aluminum or monel.
- Operating parts of machinery and equipment, e.g. valve stems and shafts.
- Polished and machined surfaces, e.g. flange facings.
- Other miscellaneous items such as gauge glass, name plates, push buttons, code stampings, sacrificial anodes.
- For low temperature service, the VENDOR shall paint all surfaces which are exposed to atmosphere where condensation is likely to occur in service. These may be polished or machined surfaces without any tagging and include fasteners which are prone to rust.

#### 12.2 Protection of Stainless Steel and Nickel Alloy Surfaces

Normally it is not required to paint the Stainless steel and nickel alloy steel surfaces. If it is a requirement of contract, then it shall be coated prior to coating of carbon steel or galvanized surfaces. All stainless steel and nickel alloy surfaces shall be coated prior to coating of carbon steel or galvanized surfaces. However, stainless steel tubing made from AISI 904 L and instrumentation stainless steel parts which are subject to dismantling or opening during operation and maintenance do not need to be painted.

When zinc rich primers are used, care shall be taken to avoid overspraying onto duplex or austenitic stainless steel, nickel alloys or 9% nickel steel components. Inconel 625 does not need to be painted. However, Incoloy 825 shall be painted if the chloride content in atmosphere is high.



## SPECIFICATION FOR PAINTING

DOCUMENT NO :

REV. 0

PAGE 11 OF 35

Zinc rich primers shall not be used on any surface that may develop Liquid Metal Embrittlement (LME) problems in service.

Zinc rich primers shall not be applied to any piping and equipment which is above any surface which may develop Liquid Metal Embrittlement in the event of a fire.

### 12.3 Surfaces Requiring Insulation

All surfaces under any insulation system shall be coated completely before the application of any insulation material.

### 12.4 Safety Requirements

All necessary precautions shall be taken to ensure the safety of personnel and property. The VENDOR shall comply with applicable National, State or local codes and regulations and safety orders and practices of the GAIL covering working conditions, scaffolding, clothing, fire and explosion hazards, safety equipment, solvents, lighting, venting and grounding of vessels.

Rags and other waste material soiled with paints, thinners or solvents shall be kept in tightly closed metal containers while on the job or not in use.

Extreme precautions shall be used when working with paint materials, cleaning fluids, etc. especially in close proximity to oxygen piping or oxygen equipment. Heavy concentrations of volatile or toxic fumes shall be avoided. When working in confined areas, blowers or exhaust fans shall be used.

## 13.0 SURFACE PREPARATION

### 13.1 Items to be Protected

Before abrasive blast cleaning, all equipment, which could be damaged by blast, dust or particulate matter shall be suitably protected by wrapping, taping, or other means to prevent damage. This equipment shall include, but not necessarily be limited to, the following:

- Bearings
- Control valves
- Couplings
- Fire system sprinkler heads
- Instrument dials
- Machined surfaces
- Screws
- Spring hanger graduations
- Valve stems and position indicators
- Push buttons
- Control panels
- Conduit
- Expansion joint bellows
- Flange facings (pipe)
- Level gauge glasses
- Nameplates/Code stampings
- Shafts
- Tags
- Exposed moving parts
- Valve and equipment grease nipples

### 13.2 Basic Cleaning



## SPECIFICATION FOR PAINTING

DOCUMENT NO :

REV. 0

PAGE 12 OF 35

The following cleaning procedure is mandatory for all surfaces before blast cleaning. This cleaning procedure is also mandatory before applying field coatings over shop coated items and any surface which requires coating.

Dust, dirt and debris shall be removed from the substrate surfaces by compressed air or high pressure fresh water washing. Where necessary, stubborn deposits shall be removed by scrubbing with stiff plastic brushes.

Surface contaminants such as oil, grease, hydrocarbons, etc., shall be cleaned with a degreasing agent, recommended by the paint manufacturer.

For heavily contaminated surfaces, hydro blasting may be applied. This should employ the use of clean fresh potable water having a maximum chloride level of 30ppm. With the prior approval of GAIL the water may be mixed with an approved detergent provided that the washed surfaces are finally washed with fresh potable water to remove all traces of the detergent wash.

The degreased surfaces shall be further washed with fresh water to remove all traces of the cleaner chemicals.

The surfaces shall be allowed to thoroughly dry before proceeding with any further coating work. All bolt holes shall be solvent-cleaned prior to blast cleaning.

### 13.3 Preblast Cleaning

Sharp edges, fillets, corners and weld seams shall be radiused or smoothed to a minimum of 3mm.

The VENDOR shall give special attention to all weld areas for removal of burrs, weld spatter, weld flux, slivers indentations, protrusions and other foreign matter to be removed by grinding prior to abrasive blast cleaning. If grinding is to be carried out after blast cleaning, the ground surface shall be reblast cleaned to restore the specified profile.

Supports for items to be blast cleaned shall have a configuration such that the contact points are as small as possible to limit surface area covered.

### 13.4 Cleaning of Carbon Steel Surfaces

Carbon steel surfaces shall be prepared by blast cleaning as specified for the paint system. With the prior approval from GAIL Power tool/Hand tool cleaning shall be used for the field welds and the areas, which are not possible to blast cleaning due to limited access, risks of damage to equipment, light gauge steel, the proximity of electrical components or instrumentation. Blast cleaning shall only be performed when appropriate conditions exist. See paragraph 14.1.

Specific surface preparation method shall be in accordance with ISO 8501-1 and as specified for each individual coating. Abrasives for blast cleaning shall be clean, dry, free of any constituent part that could be detrimental to long term coating performance and shall be selected to provide the proper surface profile for the coating to be applied. Silica sand shall not be used. All blast media used shall be submitted to VENDOR for approval prior to initiation of any surface preparation work.

Surface profile (also called anchor pattern) shall be 30 microns or 50% of the prime coat dry film thickness which ever is higher but shall not exceed 150 microns.

Blast cleaned surfaces shall be primed as shortly as possible, but in no case may exceed intervals given below :

- Immediately if condensation is likely to take place due to weather change or if weather conditions are likely to worsen.
- 2 hours if shift is changing



## SPECIFICATION FOR PAINTING

DOCUMENT NO :

REV. 0

PAGE 13 OF 35

- 4 hours if weather is stable.
- Before any visible change in surface appearance occurs

Blast cleaned surfaces shall meet the requirements of the surface preparation standard specified for the particular situation. After blast cleaning, any metal protrusions or other metal imperfections found shall be ground out and reblast cleaned.

Surfaces shall be clean, free of dust and abrasive particles before priming. Care shall be taken to keep cleaned surfaces free of contamination from dirt, dust, grease, weld slag and any other foreign material.

Surface preparation shall be subject to inspection before the prime coat is applied to ensure all traces of dust and foreign matter have been removed by brushing, blowing with clean compressed air, or vacuum cleaning.

The surface profile of a blast cleaned surface shall also be subject to inspection prior to application of the prime coat. The methods and equipment as noted in Section 16, Inspection and Testing, shall be used to determine and maintain the appropriate surface profile.

Abrasive blast-cleaning equipment shall be of an intrinsically safe construction and equipped with a remote shutoff valve triggered by the release of a dead man's handle at the blasting nozzle.

Where air-operated equipment is used, the operator's hood or headgear shall be ventilated by clean, cool air served through a regulator filter, to prevent blast cleaning residues from being inhaled.

### 13.5 Cleaning of Galvanized and Inorganic Zinc Surfaces

Hot-dip galvanized steel surfaces shall be prepared before application of any coating in accordance with the application data.

Galvanized or zinc primed surfaces shall be free of all zinc salts, oil and grease before application of any surface treatment or coating. Zinc salts, oil and grease shall be removed by fresh water washing and/or suitable solvent. Then, surfaces shall be lightly blast cleaned with appropriate abrasive to ensure proper adhesion of subsequently applied coating. Any other surface treatment shall require GAIL'S approval.

### 13.6 Cleaning of Stainless Steel and Nickel Alloy Surfaces

Surface preparation of stainless steel, or Incoloy shall be in accordance with ISO 8504-2, Sa 1 light blast cleaning to achieve a 25-40µm profile. Abrasive media shall be as per para 11.1 and shall contain no free metals or be contaminated with any free metals. At the jobsite, when blast cleaning is not practical, high pressure steam cleaning with an appropriate thorough solvent cleaning (chloride free) or alkaline detergent if the surface have foul deposit, may be used provided such a method is acceptable to the paint MANUFACTURER and upon prior approval from the VENDOR. The use of steam or solvent cleaning only, at a shop VENDOR'S facility, is not acceptable. Surface profile shall be checked by VENDOR.

## 14.0 PAINTING APPLICATION

### 14.1 Scheduling

Unless otherwise recommended by the manufacturer, coatings shall not be applied when:

- The ambient temperature is less than 4°C.
- The relative humidity is more than 85 percent, except for Inorganic Ethyl Zinc Silicate up to 95%.



## SPECIFICATION FOR PAINTING

DOCUMENT NO :

REV. 0

PAGE 14 OF 35

- The surface temperature is less than 3°C above the dew point.
- The metal surface temperature is higher than that recommended by the MANUFACTURER for application.
- Surface preparation has not been completed or oil, grease and dust are present on the substrate to be painted.
- Poor weather conditions for painting exist or are expected within two hours of application such as blowing sand, fog or rain.
- Where there is a deposition of water in the form of rain, condensation, frost, etc. on the surface.
- Where the available light is less than 500 lux.
- When there has been any visible deterioration in the surface condition between preparation and the time of application

### 14.2 Preparation for Painting

Storing, thinning, mixing and handling of paint materials shall be in accordance with the application data. All containers shall remain closed in factory sealed containers until required for use. Each container must have full identification information including manufacturer's name, product identification, batch number, date of manufacture, shelf life, basic instructions and contact telephone number for technical service. All aspects of safety relating to the use of coatings and associated thinners shall be in complete accordance with the manufacturer's stated requirements.

The MANUFACTURER'S pot-life and (where applicable) induction time (necessary time between mixing and application of some of 2 pack paint materials) requirements shall be followed. Mixing of different brands or generic types of coating materials is not allowed. On-site mixing of approximate proportions is not permitted. All mixing shall be done using factory proportioned containers only.

The pneumatic testing sections of the piping shall not be painted before the testing.

### 14.3 Masking

Ends of pipe and related components, tank plate, structural steel and like areas of other items that will require subsequent welding at site, shall be masked off after blast cleaning and left uncoated for a distance of 50mm from all areas requiring welding. The masking material shall be removed as soon as possible after priming or painting. It shall be the VENDOR'S responsibility to see that all masking material is thoroughly removed from the equipment and any damage to the primed/painted surface is repaired prior to shipment.

### 14.4 Painting Application

Surfaces shall be painted with paint systems specified in Appendix 1 as painting schedules for external surfaces (table 1) and paint systems (table 2) using paint materials (table 3) in accordance with application data.

Paint shall be applied to dry, clean, prepared surfaces under favorable conditions and in accordance with the application data.

Pigmented and catalyzed materials shall be thoroughly mixed using power mixers before being applied. Sticks shall not be used.

Continuous agitation type spray pots shall be used when applying metal pigmented coatings such as zinc or aluminum loaded coatings.



## SPECIFICATION FOR PAINTING

DOCUMENT NO :

REV. 0

PAGE 15 OF 35

A mist coat shall be applied over inorganic zinc primer on Paint System No. 2 (Table 2, Appendix 1) to avoid surface defects. The VENDOR shall exercise necessary care to ensure a smooth and uniform coating is applied over inorganic zinc primer.

Extra coats of paint shall be applied on areas where shape and/or plane of application results in thinly applied coating, e.g. at edges, welds, corners, etc. To compensate for these effects, a stripe coat of paint shall be brush applied before applying the finish coat.

All coatings shall be uniformly applied without runs, sags, solvent blisters, dry spray or other blemishes. All blemishes and other irregularities shall be repaired or completely removed and recoated. Special attention shall be paid to crevices, corners, edges, weld lines, bolt heads, nuts and small brackets, to apply the specified minimum dry film thickness by brush application if spray will not completely cover all surfaces.

Surfaces that will be inaccessible after assembly, including the surfaces of lap joint flanges, nozzle necks, lap joint stub ends, lap rings, bolt holes and some welded joints, shall receive the complete painting system before being assembled. Contact surfaces of bolted connections are to be primed only.

On structural steel areas which are assembled by high tension bolts, contact surfaces shall be only primed with Inorganic Ethyl Zinc Silicate. Intermediate and final coat shall not be applied.

All field welds shall be left bare until final acceptance. In such cases, an area of about 50mm on both sides of the weld shall be left bare. After acceptance, these areas shall be painted with the full required paint system for that area.

Intercoat contamination shall be minimized by maintaining proper cleanliness and by applying intermediate and finish coats within the time period recommended by the MANUFACTURER. If contaminants are present, they shall be removed before applying succeeding coats.

Adhesion qualification test plates shall be prepared at the same time and under the same conditions as the production coating work.

### 14.4.1 Spray Application

Hose and containers shall be thoroughly cleaned before addition of new materials. The spray gun shall be held no closer than 200mm or more than 600mm from the surface to be coated. During application the spray gun shall always be held at a right angle to the substrate. Each pass shall overlap the previous one by 50 percent. In order to achieve a uniform application, when large surface areas are being coated, spray application shall be made in two directions so that the passes are at right angles to each other. Pressures and spray fan shall be adjusted so that the optimum spray pattern is utilized for the surface being coated.

### 14.4.2 Brush Application

Application with brush is acceptable when the materials to be applied are suitable for brush application and under the following conditions:

- When areas cannot be properly coated by spray for any reason.
- When spray application is difficult due to location of work and wind conditions.
- For touch-up or repair of localized damaged paint or to areas of incorrectly applied paint.
- For painting of stripe coat
- When applying the initial coat of paint to corners, edges, crevices, holes, welds or other irregular surfaces prior to spray application.



## SPECIFICATION FOR PAINTING

DOCUMENT NO :

REV. 0

PAGE 16 OF 35

- The number of coats shall be adjusted to the dry film thickness to match

Paint brushes used shall be of a style and quality that will permit appropriate application of the material being applied.

Material applied by brush shall be smooth, uniform in thickness, without any apparent surface defects such as brush marks, runs, sags, or curtains.

### 14.4.3 Roller Application

Roller application shall only be used with written approval from GAIL. Sufficient coats shall be applied to build up the dry thickness of each coat(s) to the specified value for spray application.

Roller application may be used only when:

- Spraying is not an option.
- Primer coat is applied by brush.
- Paint application by roller method is acceptable to paint MANUFACTURER and is in accordance with the application data.

## 15.0 REPAIRS

### 15.1 General requirements

VENDOR shall submit a repair procedure for each coating system.

Before application of any further coat of material, all damage to previous coats shall be repaired.

Adhesion qualification tests shall be mandatory and shall be performed to determine the compatibility for each repair method.

Surface preparation shall wherever possible be carried out by dry blast cleaning. If dry blast cleaning is not specified or not feasible (e.g. due to limited access, risks of damage to equipment, light gauge steel, the proximity of electrical components or instrumentation), then manual cleaning shall be performed.

Manual cleaning shall be performed using hand wire brushes, or mechanically operated tools (grinders, chippers or wire brush) in accordance with ISO 8504-3. The surface shall be left roughly abraded, but a burnished surface is not acceptable.

If the surface being prepared lies adjacent to a sound coated surface which is not to be repaired, the surface preparation shall overlap the coated surface by at least 25mm. The remainder of existing coated surface shall be properly protected with shields or screens to prevent any possible damage to the coating.

Inorganic zinc primer shall not overlap adjacent intermediate and finish coats.

Areas with inadequate coating thickness shall be thoroughly cleaned and, if necessary, abraded and additional compatible coats applied until they meet this Specification. These additional coats shall blend in with the final coating on adjoining areas. Colour match shall be achieved.

### 15.2 Coating Damage Not Exposing Substrate Surface

Surfaces to be overcoated, which become contaminated or damaged, shall be cleaned by solvent cleaning and/or lightly brush blasted, ensuring that the surface is free of all contaminations, prior to applying the following coats. After cleaning, any residual contaminants shall be removed by dry



# SPECIFICATION FOR PAINTING

DOCUMENT NO :

REV. 0

PAGE 17 OF 35

compressed air and wiped by hand with clean, dry rags. The coating around the damaged area shall be chamfered, using an approved method, to ensure continuity of the patch coating. The full coating system shall then be reapplied strictly in accordance with the Specification.

### 15.3 Coating Damage Exposing Substrate Surface

The damaged area shall be recleaned as originally specified for that item and the full coating system reapplied in accordance with the APPLICATION DATA. The recleaning shall carry over onto tightly adhering surrounding coating for not less than 25mm all around and the edges shall be chamfered by a method approved by GAIL.

### 15.4 Repair of Zinc Silicate Primer

Damaged surfaces of zinc silicate primer shall be cleaned to remove all loose materials and blast cleaned with a portable vacuum blast cleaning unit. The surface shall be coated with one coat of the primer which is generically same as the damaged primer.

If blast cleaning is not practical, power tool cleaning may be used subject to GAIL and VENDOR approval. In such cases, subject to operating temperature limitations, one pack recoatable zinc primer may be used in lieu of zinc silicate primer subject to GAIL and VENDOR approval.

### 15.5 Repair of Fully Cured Epoxy Coating

In case of repairing damage to fully cured epoxy coatings and/or painting of a fully cured and aged epoxy coating, the coating work shall only be carried out after the surface of the fully cured epoxy to be coated has been suitably abraded to provide adequate adhesion for the coating to be applied.

## 16.0 INSPECTION AND TESTING

### 16.1 GENERAL

GAIL and VENDOR shall have the right to inspect the paint work at all stages of preparation and to reject any tools, materials, equipment or work which do not conform to this Specification.

Before painting activities commence, the VENDOR shall submit an inspection procedure for approval by GAIL. VENDOR shall employ a qualified Painting Inspector whose resume shall be approved by GAIL.

All items coated by the APPLICATOR shall be inspected on arrival and damaged areas shall be repaired by VENDOR. In case there is damage of more than 5% of the surface areas or finish coat appearance is not acceptable, GAIL shall in their sole discretion, instruct the VENDOR to apply an additional finish coat to improve appearance at no cost to GAIL.

### 16.2 Inspection Instruments

The following instruments shall be calibrated and maintained by the VENDOR and available for use by GAIL and VENDOR.

#### INSPECTION ITEM

#### INSPECTION INSTRUMENT

Surface Profile  
Film\*

Keane-Tator Surface Profile Comparator or Testex Press-O-Film\*

Surface Cleanliness

SSPC-Vis-1 or ISO 8501-1

Wet Film Thickness

Nordson Wet Film Thickness Gauge

Dry Film Thickness  
gauge)

Mikrotest Dry Film Thickness Gauge\* (with SSPC-PA-2 as a guide)



## SPECIFICATION FOR PAINTING

DOCUMENT NO :

REV. 0

PAGE 18 OF 35

Temperature and Humidity	Gardner Certified Hygrometer and Temperature Indicator*
Surface Temperature	PTC E0092.00 (-20°C to 120°C)
Adhesion	Elcometer 106*
Salt Contamination	Salt Meter SCM 400

Equivalent inspection instrument can be used upon approval of GAIL and VENDOR.

\* Test instruments shall be calibrated on a routine basis (depending on frequency of use) and maintained in good working condition at all times.

All coatings applied on the process side of equipment and piping and on buried structures, piping and equipment shall be holiday tested using a high voltage spark tester. The test voltage shall be 5 volts per micron of film thickness or as recommended by the paint manufacture should this be different. The equipment shall consist of a wire brush or for long lengths of round piping a rolling electrode may be used. All indications shall be abraded down to bare metal and the appropriate repair system applied to the satisfaction of the GAIL.

Holiday testing shall be applied in accordance with the requirements of ASTM D 5162.

### 16.3 Before Surface preparation

Prior to initiation of blast cleaning, the VENDOR shall confirm that all environmental and safety requirements relating to blast cleaning have been met.

### 16.4 Before and during paint application

Prior to painting, all surfaces shall be visually inspected to assure that the proper surface conditions necessary for painting exist. VENDOR shall:

- Verify and document that surface preparation cleanliness and surface profile are as specified. Surface profile testing shall be carried out by utilization of a VENDOR approved instrument and in accordance with ISO 8503-2.
- Verify that blast cleaned surfaces have been kept free of contamination. Tests to indicate the presence of chlorides and dust shall be carried out in accordance with ISO 8502-1, ISO 8502-2 and ISO 8502-3, respectively.
- Just prior to painting, inspect surface cleanliness and profile again to assure that no surface imperfections, moisture, or other contaminants are present.
- Verify that elapsed time from blasting has not exceeded specified time between blasting and painting.
- Verify that surfaces not to be coated are masked off or otherwise protected.
- Document the air temperature, humidity and substrate surface temperature.
- Verify that storage, mixing, thinning and application of primer, intermediate and finish coats are in accordance with the APPLICATION DATA.
- Verify by spot checking the wet film thickness (WFT) during the course of the paint application to ensure that the film thickness is being maintained. These checks shall be performed according to the procedure described in ISO 2808, Method No. 7B.
- Verify by spot checking the curing of all zinc silicate based coatings has been successfully accomplished prior to overcoating using a technique submitted to and approved by VENDOR.

### 16.5 After Painting



## SPECIFICATION FOR PAINTING

DOCUMENT NO :

REV. 0

PAGE 19 OF 35

After application of coatings, the APPLICATOR shall verify and document dry film thickness of the primer, intermediate and finish coats. ISO 2808, Method No. 6 describes the test techniques suitable for measurement of the dry film thickness.

Each coat of a system and the complete system shall be visually inspected for adhesion and surface imperfections. If upon visual inspection, loss of adhesion is suspected or found, an adhesion test shall be made. In all cases, complete system involving silicone based paint shall be tested for adhesion by pull-off test method. The adhesion of the primer to the steel substrate and the intercoat adhesion of the subsequent coat(s) after curing shall be determined by the application of either a cross-cut test in accordance with ISO 2409 to maximum grade C2 or a pull-off test described in ISO 4624. Coatings, applied to blast cleaned carbon steel, exhibiting an adhesion of less than 15 kg/cm<sup>2</sup> shall be rejected and repaired.

Each painting system and repair method shall be tested on a test plate for an adhesion qualification test. The test plate shall be coated at the same time and under same conditions as the production work.

Repairs made in the field shall be documented and re-inspected as outlined above.

### 17.0 INSPECTION RECORDS AND REPORTS

Prior to final acceptance of the paint work, an inspection shall be made. The VENDOR and GAIL shall both be represented and they shall sign an inspection report agreed upon by all parties. The report shall consist, as a minimum, of the following:

- Names of the VENDOR and the responsible personnel.
- Dates when work was carried out.
- Equipment and techniques used.
- Materials receipt condition.
- Type and calibration of instruments used.
- Weather and ambient conditions.
- Painting periods.
- Condition of surface before preparation.
- Tools and methods used to prepare surface.
- Condition after preparation.
- Information on systems being applied.
- Mixing and testing prior to application.
- Paint application techniques.



## SPECIFICATION FOR PAINTING

DOCUMENT NO :

REV. 0

PAGE 20 OF 35

**APPENDIX 1  
TABLE 1 - PAINTING SCHEDULES FOR EXTERNAL SURFACES**

Items to be coated	Operating temp, °C		Paint System Number for	
	From	To	Uninsulated surfaces	Surfaces to be Insulated
<b>Carbon Steels and Low Alloys (<math>\leq 9\%</math> Cr) steels</b>				
Equipment, piping, storage tanks and structural steel with exception of items specifically listed below (note 6)	-45	Below ambient	32	9
	Ambient	100	2	1
	101	200	3	1
	201	400	4	1
	401	538	8	8
Structural steel to be fireproofed	Ambient	100	6 (Note 8)	-
External fasteners of piping and equipment	Ambient	200	Appendix 3	-
	201	538	8	-
Buried tanks and piping	Ambient	100	25	-
Storage tank plates				
Exterior surfaces of plates (non-process sides) requiring temporary protection	Ambient	100	Note 9	-
Process side of the tank plates (note 7)	-	-	-	-
Floor plate surfaces which will be in contact with soil (Note 2)	Ambient	100	10	-
Top of stack (Red bands)	Ambient	200	3	-
<b>Galvanised Surfaces (Note 1)</b>				
Items such as ladders, ladder cages, handrails, cable trays (not fireproofed) etc. to be painted	Ambient	100	13	-
<b>Stainless Steels (Note 5)</b>				
All items exposed to cryogenic conditions	-196	Below ambient	24	24 (Note 6)
All items exposed to atmosphere	Ambient	100	23	24
	101	100	26	26
<b>Copper and its Alloys</b>				
All items exposed to plant outside environment	Ambient	100	23	-
<b>Glass or Fibre Reinforced Plastic</b>				
Piping (See Note 4) Equipment	Ambient	100	31	-



## SPECIFICATION FOR PAINTING

DOCUMENT NO :

REV. 0

PAGE 21 OF 35

### Notes:

1. Open galvanised gratings unless otherwise specified shall not be painted.
2. Tank floor plate shall be masked off 100mm from the edge to prevent coating application. Surfaces coated on the soil side shall be holiday tested and repaired, if necessary, before installation.
3. Normally, Inconel and Incoloy surfaces shall not be painted. However, if there is a requirement as specified on the PROJECT drawings, these surfaces shall be painted in accordance with this TABLE.
4. For items supplied with galvanising, all galvanised surfaces exposed to atmosphere must be top coated with Paint System No. 13 (see Table 2, Appendix 1). For galvanising requirements, see Project Specification No. 2007-58-SP-205.
5. Vendor shall be required to certify coating acceptability for operating temperature below ambient and for surfaces to be cold insulated.
6. After tank erection, the entire tank shall be blast cleaned and paint shall be applied.
7. System subject to approval by fire protection manufacturer.
8. VENDOR shall take appropriate action to avoid corrosion of plates during storage erection.



## SPECIFICATION FOR PAINTING

DOCUMENT NO : 2007-58-SP-506

REV. 0

PAGE 22 of 35

### APPENDIX 1

**TABLE 2 - PAINT SYSTEMS**

CS - Carbon steel and low alloys ( $\leq 9\%$  chrome), Cu - Copper and its alloys, SS - Stainless steel and high Nickel alloys, Galv - Galvanised carbon steel,  $\mu$  - Dry film thickness in microns.

Paint System	Applicable to Substrate Materials	Surface Preparation	PAINT SYSTEM			Total Dry Film Thickness Microns	Maximum Temperature Resistance °C
			PRIMER COAT	INTERIM. COAT	FINISH COAT		
1	CS	Sa2½	Alkyl zinc silicate primer (75 $\mu$ )	–	–	75	400
2	CS	Sa2½	Zinc rich epoxy primer (75 $\mu$ )	Polyamide epoxy (125 $\mu$ )	Polyurethane (75 $\mu$ )	275	100
3	CS	Sa2½	Alkyl zinc silicate primer (75 $\mu$ )	Silicone acrylic (30 $\mu$ )	Silicone acrylic (30 $\mu$ )	135	200
4	CS	Sa2½	Alkyl zinc silicate primer (75 $\mu$ )	Silicone aluminium (25 $\mu$ )	Silicone aluminium (25 $\mu$ )	125	400
6	CS	Sa2½	Zinc rich epoxy primer (50 $\mu$ )	Polyamide MIO epoxy (125 $\mu$ )		200	100
7	CS	Sa2½	Alkyl zinc silicate primer (25 $\mu$ ) (Preconstruction primer)	–	–	25	400
8	CS	Sa2½	Silicone aluminium (25 $\mu$ )	–	Silicone aluminium (25 $\mu$ )	50	538
9	CS, SS	Sa2½ for CS. See Section 13.6 for SS	Polyamide epoxy primer (50 $\mu$ )	Polyamide MIO epoxy (100 $\mu$ )	Polyamide MIO epoxy (100 $\mu$ )	250	100
10	CS	Sa2½	Pure epoxy (200 $\mu$ )	–	Pure epoxy (200 $\mu$ )	400	100



## SPECIFICATION FOR PAINTING

DOCUMENT NO : 2007-58-SP-506

REV. 0

PAGE 23 of 35

11	CS	Sa2½	Flakeglass polyester (750 µ)		Flakeglass polyester (750 µ)	1500	100
12	CS	Sa2½	Flakeglass polyester (1000 µ)	-		1000	100
13	GALV (HOLD)	See Section 13.5	Polyvinyl butyral wash (10 µ)	Polyamide MIO epoxy (40 µ)	Polyurethane (75 µ)	125	100
23	SS, Cu	See Section 13.6	Polyamide epoxy primer (50 µ) (Must be zinc free)	Polyamide epoxy (125 µ)	Polyurethane (75µ)	250	100
24	SS	See Section 13.6	Polyurethane primer (50 µ) (Must be zinc free)	Polyamide epoxy (125 µ)	Polyamide epoxy (125 µ)	300	100
25	CS	Sa2½	Polyurethane - tar (750 µ)	-	Polyurethane -tar (750 µ)	1500	100
26	SS	Sa2½	Flakeglass vinyl ester (600 µ)	-	-	600	200
32	CS, SS	Sa 2½ for CS see Section 13.6 for SS	Polyamide epoxy primer (50 µ)	Polyamide M10 epoxy (100 µ)	Polyurethane (75 µ)	225	100

Notes:



## SPECIFICATION FOR PAINTING

DOCUMENT NO :

REV. 0

PAGE 24 OF 35

1. Thickness of inorganic zinc primer shall be within the range 65-100 microns. In case, the DFT of the inorganic zinc is outside the range 65-100 microns, GAIL/VENDOR at their sole discretion may instruct re-blasting/ re-application of primer. Alkyl zinc silicate shall be two-pack type. The requirements of the surface preparation shall be subject to approval by GAIL/VENDOR.
2. Precautions shall be taken against over thickness application of silicone resin based coats. Adhesion tests are mandatory. High temperature finish coating must be capable of "cold curing" to handle ambient temperature.
3. Paint System No. 7 is for temporary protection only. If further painting is required, this coating shall be removed by blast cleaning and surfaces shall be tested according to ISO 8502-1 to 4.
4. Polyamide epoxy can be replaced by polyamide MIO epoxy to provide longer coating interval.
5. Inorganic zinc primer from Paint System No. 2 & No. 6 shall be sealed before applying the intermediate coat with an appropriate sealer paint material as recommended by the paint manufacturer.
6. Where polyamide MIO epoxy is used as an intermediate coat, this is to be applied within 48 hours of the application of the primer.



## SPECIFICATION FOR PAINTING

DOCUMENT NO :

REV. 0

PAGE 25 OF 35

### APPENDIX 1

**TABLE 3 - PAINT MATERIALS**

Coating Material	Continuous Operating Temp. Resistance °C	Dry Film Thickness, Microns	Minimum Salt Fog Resistance, Hours	Adhesion (kPa) or Abrasion Loss (mg)	Colour	Gloss
<b>PRIMERS</b>						
Inorganic zinc (alkyl based silicate)		75	2000	NAR	Stock	None
Inorganic zinc (alkyl based silicate) (Preconstruction primer)	400	25	500	NAR	Stock	None
Polyamide epoxy	100	75	1000	4100 kPa	Stock	None
Poly vinyl butyral wash	100	10		NAR	Stock	None
Polyurethane primer	100	75	NAR	NAR	Stock	None
Polyurethane Tar	100	750	NAR	NAR	Stock	None
<b>SECONDARY COATS</b>						
Polyamide epoxy	100	125	1000	120 mg	Custom	None
Polyamide epoxy with MIO	100	75	1000	120 mg	Custom	None
Polyurethane (Aliphatic, modified with acrylic resin)	100	75	1000	100 mg	Custom	High
Silicone acrylic	200	30	500	NAR	Heat stable stock colours only	Semigloss
Silicone aluminium	538	25	500	NAR	Aluminium	None
Siloxane epoxy	100	125	1000	120 mg	Custom	High
Coal tar epoxy (polyamine cured)	100	200	2000	NAR	Black	None
Flakeglass polyester	100	500	2000	4100 kPa	Stock	Semigloss
Flakeglass vinylester	200	600	2000	4100 kPa	Stock	Semigloss

**Notes:**

1. NAR - Not a Specification requirement
2. Salt fog resistance in hours shall be tested per ASTM B117.
3. Adhesion shall be tested per ASTM D4541 on blast cleaned carbon steels.
4. Abrasion loss, mg loss per 1000 cycles using C-17 wheel, shall be tested per ASTM D4060.
5. Inorganic zinc primer shall have metallic zinc of at least 85% (by weight) in the dried film.

**APPENDIX 2**



## SPECIFICATION FOR PAINTING

DOCUMENT NO :

REV. 0

PAGE 26 OF 35

### SAFETY COLOUR CODING AND IDENTIFICATION

#### A2.1 GENERAL

Safety colour coding and identification of equipment and piping, for this Project, shall be in accordance with this Specification. Finish colours shall match the following standard colours for the designated items. MANUFACTURERS shall use the German colour standard numbers, RAL 840, for selecting the appropriate finish colours.

The following chart lists basic piping systems, equipment and the required finish colour for that particular piping system and major equipment type. Any item that is not listed below, but is part of this project, shall be brought to the attention of the VENDOR for selection of the finish colour and exact colour coding and marking requirements.

Before execution of painting work for colour coding, specified colour codes including letter sizes, safety slogans and logos, the GAIL'S approval shall be obtained before applying colour codes.

There shall be no cost impact to the GAIL due to discrepancies or changes in the colour scheme, lettering, or logo, as specified being different from actual site requirements as this work shall be considered part of detailed engineering.



## SPECIFICATION FOR PAINTING

DOCUMENT NO :

REV. 0

PAGE 27 OF 35

### A2.2 REQUIRED SAFETY AND IDENTIFICATION COLOUR CODING

**TABLE 4**

	Colour	Colour Number
<b>PIPING</b>		
Process and utility piping (other than services listed below)	Grey	RAL 7035
Instrument & plant air (plant air shall have a white band 150 long at 30m intervals)	Light blue	RAL 5012
Potable water (potable water shall have a blue band 150mm long at 30m intervals)	Light green	RAL 6017
Fire water	Red	RAL 2002
Seawater	Dark green	RAL 6028
Acids and alkalis	Violet	RAL 4001
Control valves (actuator only)	Green	RAL
Gas transmission piping	Yellow	RAL
Liquid transmission piping	Aluminium	RAL 9006
<b>EQUIPMENT-FURNACES</b>		
Furnace casing & attached steel work	Grey	RAL 7035
Steel work not connected to casing	Grey	RAL 7010
Stacks & flue duct (Note 3)	Aluminium	RAL 9006
Top of Stack (Note 3)	Red	RAL 2002
Ladders & walkways	Grey	RAL 7010
Handrail assemblies	Yellow	RAL 1004
<b>EQUIPMENT-AIR COOLERS</b>		
Surfaces operating from ambient to 100°C	Grey	RAL 7010
Surfaces operating from 101° to 538°C	Aluminium	RAL 9006
<b>EQUIPMENT-MISCELLANEOUS</b>		
Columns, vessels, exchangers, boilers & N <sub>2</sub> storage vessels (GAIL owned)	Grey	RAL 7035
Spheres	White	RAL 9003
H <sub>2</sub> storage vessels (GAIL owned)	Yellow Ochre	RAL 1024
Ejectors & Filters	Orange	RAL 2004
Relief valves	RED	RAL 2002
Actuators of control valves	Yellow	RAL 1004
Gas storage (GAIL owned)	Grey	RAL 7035
Nitrogen (temp. above 80°C)	White & Yellow band	RAL 9003 & RAL 1004
Filling station, chain blocks, overhead crane assembly & body, guide beam, mobile cranes and fork lifts, push buttons	Yellow	RAL 1004
Fire trucks	Red	RAL 2002
Truck loading arms	Grey	RAL 7035
Air conditioning system	Green	RAL 6021
Workshop equipment	Green	RAL 6002
Extinguishers (based on contents)		
Water	Red	RAL 2002
Dry chemical powder	Blue	RAL 5010
Carbon dioxide (CO <sub>2</sub> )	Black	RAL 9005
Halon	Green	RAL 6021
Foam	Cream	RAL 9007



## SPECIFICATION FOR PAINTING

DOCUMENT NO :

REV. 0

PAGE 28 OF 35

TABLE 4

	Colour	Colour Number
<b>STRUCTURAL STEEL</b>		
External steel work	Grey	RAL 7010
Ladders, walkways & supports	Grey	RAL 7010
Handrail assemblies	Yellow	RAL 1004
Protective shelters	Blue	RAL 5014
Flare	Grey	RAL 7035
Fire Point Shelter	Red	RAL 2002
Steel work not connected to casing	Grey	RAL 7010
<b>MACHINERY</b>		
Pumps (operating to 100°C & uninsulated), compressors, motors, blowers	Green	RAL 6011
Pumps (insulated and uninsulated operating above 100°C)	Aluminium	RAL 9006
Turbines & associated power generators	Aluminium	RAL 9010
Filters of turbines	Yellow	RAL 1004
Cranes and Lifting Tackle	Yellow	RAL 1012
Workshop machinery	Green	RAL 6002
Coupling guards	Orange	RAL 2000
A/C equipment except ducts	Grey	RAL 7023
<b>TANKS</b>		
Shell-fixed and floating roof See Note 1	White	RAL 9003
Roof- fixed roof tanks	White	RAL 9003
Roof- floating roof tanks	White	RAL 9003
Mechanical Mixers	Green	RAL 6011
<b>ELECTRICAL EQUIPMENT</b>		
Switch boards	Green	RAL 6021
Junction boxes, conduit lamp standards, push buttons	Yellow	RAL 1004
Transformers and motors	Green	RAL 6011
Street light posts & lighting poles (on structures) cable trays.	Grey	RAL 7035
<b>INSTRUMENTATION</b>		
Boards	Green	RAL 6021
Instruments	Green	RAL 6011
Cable trays, instrument boxes sunshade	White	RAL 9010

Note 1: Special stripes shall be applied at the top in a format as specified by the GAIL. GAIL logos / Safety slogans shall be painted and subject to approval by the GAIL.

**GAS CYLINDERS:**



## SPECIFICATION FOR PAINTING

DOCUMENT NO :

REV. 0

PAGE 29 OF 35

GAS	CYLINDER BODY	CYLINDER NECK	CYLINDER HEAD
Acetylene	CHOCOLATE 3009	CHOCOLATE 3009	CHOCOLATE 3009
Air	OLIVE 6013	OL/WH DIA SECTORS	OL/WH DIA SECTORS
Ammonia	BLACK 9005	YELLOW	RED
Argon	BLUE 5021	BLUE	BLUE
Chlorine	YELLOW	YELLOW	YELLOW
Carbon Dioxide	BLACK 9005	OLIVE	OLIVE
Hydrogen	RED	RED	RED
Nitrogen	OLIVE	BLACK	BLACK
Oxygen	BLACK	BLACK	BLACK
Inergen Low CFC	RED 2002	BLACK 9005	GREY 7035

• Notes:

1. Cylinder contents can also be easily identified by stenciling the chemical symbol or name of the gas.
2. If desired either or both methods together can be used to identify gases.
3. Red indicates flammable gases. Yellow denotes toxic gases.
4. Repainting is necessary when external colour has faded visually.



## SPECIFICATION FOR PAINTING

DOCUMENT NO :

REV. 0

PAGE 30 OF 35

### A2.3 PIPING COLOUR CODING

Select process and utility piping will require additional colour identification to be placed directly on the coated piping or on insulation jacketing. Following is a list of such piping and the additional colour requirements:

**TABLE 5**

CONTENTS	IDENTIFICATION COLOUR	CONTENTS CODE
Process Water	Dark Blue Band	PW
Treated Water	Light Blue Band	TW
LP Steam	One Red Band	LPST
MP Steam	Two Red Bands	MPST
HP Steam	Three Red Bands	HPST
Steam Condensate	Dark Blue & White Band	SC
Fuel Oil	Black Band	FO
Fuel Gas	Yellow & Black Band	FG
Process Gas H/C	Yellow Band	PG
Gas Condensate	Dark Brown Band	PL
Hydrogen	Yellow & Red Band	H
Amine/Glycol	Light Brown Band	AM/GY
Acid Gas	Yellow Ochre Band	AG
Sulphur	Mustard Band	SU
HP Flare	Dark Violet Band	HFL
Blow Down to Liquid Flare	Light Violet Band	BD
Acid Gas Flare	Yellow Ochre Band	AF
Lube Oil System	Orange Band	LO
Seal Oil System	Orange Band	SO
Transfer Oil	Orange Band	TO
NGL	Dark Brown Band	NGL
Nitrogen	White Band	N
Liquid Petroleum Gas	Red and Green Bands	LPG
Kerosene Aviation Fuel	Light Blue and Yellow Bands	KER
Motor Gasoline	Brown and Violet Bands	BNZ
Gas Oil	Orange and Blue Bands	GOL
HVGO	Dark Blue and Black Bands	HVG
LVGO	Dark Blue and Black Bands	LVG
Residue	Black and Green Bands	RES
Diesel	Orange and Blue Bands	DSL

The width of the identification colour band shall be:

- Thru 4" NPS - 100mm
- Above 4" NPS - Pipe Diameter x 2

### A2.4 FLOW DIRECTION



## SPECIFICATION FOR PAINTING

DOCUMENT NO :

REV. 0

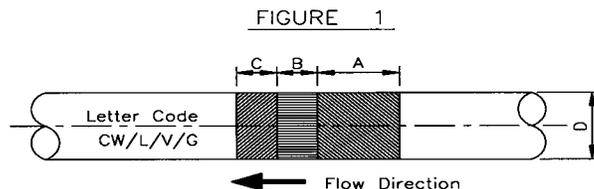
PAGE 31 OF 35

Flow direction shall be indicated by bands as described in A2.4.1. Arrows can also be used to indicate the flow direction as described in A2.4.2.

A2.4.1

### DIRECTION BY BANDS

The coding shall be arranged as indicated in the example shown in Figure 1 below.



**Figure 1**  
**Letter Code:**

First two letters of this example indicate contents (see Table 5)

Last letter indicates phase

L = Liquid phase

G = Gas phase

V = Vapor phase

For Dia > 4", A = Dia x 2, B = Dia x 1/2 and C = Dia x 1/2 up to maximum widths equivalent to 18". For piping above 18 inches diameter width, shall be 18".

For Dia < 4", A = 100mm, B = 50mm and C = 25mm.

Colour Band C is located on downstream side of Colour Band and indicates direction of flow. In case of bi-directional flow, flow Band C will be located on each side of Band A.

Where two colours are used for quick identification (such as for steam, fuel gas, hydrogen, etc.) the following procedure will be adopted:

- Up to 4" Dia Piping, Band A shall be in alternating circumferential bands and Band C shall be the predominant colour.
- Above 4" Dia Piping, Band A and Band C shall be in alternating bands.



## SPECIFICATION FOR PAINTING

DOCUMENT NO :

REV. 0

PAGE 32 OF 35

### A2.4.2 DIRECTIONS BY ARROWS

Arrows shall be used to indicate the flow direction of commodities contained in piping. The arrows shall be white or black in colour to contrast with the basic colour of the pipe. The following sizes are recommended:

- Pipe 2"-6" NPS, arrow to fit in a 25mm x 100mm rectangle.
- Pipe 8" NPS and larger, arrow to fit in a 50mm x 150mm rectangle.

Where flow of the commodity is possible in either direction, two arrows shall be indicated pointing in opposite directions.

Arrows and band markings shall be made at the unit battery limits and at the GAIL designated locations.

### A2.5 COLOUR

The code indications shall be painted either in white or in black in order to contrast clearly with the colour of paint on the pipe or equipment. For insulated lines, the code indications shall be painted over the insulation jacket.

### A2.6 LABELLING REQUIREMENTS

For piping and equipment, full name or abbreviations of chemical and symbol of fluid flowing inside a pipeline shall be indicated. The line number shall also be painted on the pipelines. For equipment, the name, tag number and service are required to be painted.

For support columns, Code indication in the form of serial numbers shall be adopted for supporting columns of concrete or structural steel. Numbers shall be provided by the VENDOR.

### A2.7 SIZE

The size of lettering used for code indications on insulated and uninsulated piping is as follows. The following are suggested sizes only and may be varied by the GAIL.

<u>ITEM</u>	<u>SIZE</u>	<u>LETTER SIZE</u>
Pipe	2" NPS and below	25m letters
Pipe	3" to 6" NPS	50mm letters
Pipe	8" NPS and above	80mm letters
Process Equipment	All sizes	100 to 300mm letters
Tanks and Spheres	All sizes	500 to 1000mm letters



## SPECIFICATION FOR PAINTING

DOCUMENT NO :

REV. 0

PAGE 33 OF 35

### APPENDIX 3

#### A3.1 EXTERNAL FASTENER COATING

External fasteners (bolts, studs and nuts) shall be coated with TAKECOAT-1000 as supplied by Takenaka Seisakusho Company of Osaka, Japan, or equivalent to be approved by GAIL. Bolting shall be accomplished using the special tools and the instructions as supplied by the approved Vendor. Alternate coating will only be acceptable upon thorough investigation of such coating as to the type, application procedures and the results of necessary testings that prove to be equivalent or superior to TAKECOAT-1000, as viewed by GAIL. It is the VENDOR's responsibility to perform the necessary investigation and to advise the outcome to GAIL. General clarification as to the extent to which the requirement is applicable is as follows:-

#### Included

1. All external flanged connections (shop and field assembled) including insulated flange bolting where the service temperature is less than 200°C.
2. Equipment bolting that requires removal for scheduled maintenance and inspection.

#### Excluded.

1. All structural bolting.
2. Fasteners/bolts used in assembly of various components within a MANUFACTURER's standard equipment, miscellaneous standard valve assemblies and the instrumentation. VENDOR shall review MANUFACTURER'S standard coating for its suitability and the specified jobsite conditions on case by case basis.
3. Insulated flange bolting above 200°C.
4. Body bonnet and gland bolting.



## SPECIFICATION FOR PAINTING

DOCUMENT NO :

REV. 0

PAGE 34 OF 35

### APPENDIX 4

#### LIST OF ABBREVIATIONS

AADL	Average Annual Daily Load
AAMA	American Architectural Manufacturers Association
AC	Alternating Current
AFC	Approved for Construction
ANSI	American National Standards Institute
ASTM	American Society for Testing and Materials
API	American Petroleum Institute
API RP	American Petroleum Institute Recommended Practices
ASME	American Society of Mechanical Engineers
AWS	American Welding Society
AWWA	American Water Works Association
BOD	Basis of Design
BOF	Basic Oxygen Furnace
BS	British Standard
BVS	Block Valve Station
CEN	European Committee for Standardization
CIBSE	Chartered Institution of Building Services Engineers
CP	Cathodic Protection
CPP	Central Process Plant
CSWIP	Certification Scheme for Welding Inspection Personnel
D	Nominal Outside Diameter
DC	Direct Current
DCS	Document Control Section
DNV	Det Norske Veritas
DWTT	Drop Weight Tear Tests
EIA	Environmental Impact Assessment
EMR	Extra Moisture Resistant
EPC	Engineering, Procurement and Construction
ERS	Engineering Research Station (British Gas)
ESD	Emergency Shutdown
FBE	Fusion Bonded Epoxy
FCAW	Flux Cored Arc Welding
FED	Front End Design
FM	Factory Mutual Engineering Corporation
FMRC	Factory Mutual Research Corporation
GMAW	Gas metal Arc Welding
GTAW	Gas Tungsten Arc Welding
HAZ	Heat Affected Zone
HDPE	High Density Poly Ethylene
HF-ERW	High Frequency Electric Resistance Welding
HMP	Hazard Management Process
HSE	Health Safety and Environment
HV	Vickers Hardness
IP	Intelligent Pig
ISO	International Organization for Standardization
LDS	Leak Detection system



## SPECIFICATION FOR PAINTING

DOCUMENT NO :

REV. 0

PAGE 35 OF 35

LNG	Liquefied Natural Gas
LPG	Liquefied Petroleum Gas
LSBD	Limit State Based Design
MADL	Maximum Annual Daily Load
MAOP	Maximum Allowable Operating Pressure
MOL	Main Oil Line
MPI	Magnetic Particle Inspection
MSL	Mean Sea Level
MSS	Manufacturers Standardization Society
MW	Molecular Weight
NACE	National Association of Corrosion Engineers
NB	Nominal Bore
NDT	Non Destructive Testing
NFPA	National Fire Prevention Association
OD	Outside Diameter
OGC	Oman Gas GAIL
PAMS	Portable Arc Monitoring System
PCS	Pipeline Construction Specification
PCN	Personnel Certification in NDT
PE	Polyethylene
PFS	Process Flow Scheme
PQR	Procedure Qualification Record
PRT	Pressure Reduction Terminal
PSL	Product Specification Level
PWHT	Post Weld Heat Treatment
QC	Quality Control
QRA	Quantitative Risk Assessment
ROW	Right of Way
RTU	Remote Terminal Unit
SAW	Submerged Arc Welding
SCADA	Supervisory Control and Data Acquisition
SDH	Synchronous Digital Hierarchy
SI	International System of Units
SMAW	Shielded Metal Arc Welding
SR	Supplementary requirements
STM	Synchronous Transfer Module
NT	Nominal Thickness
TRU	Transformer Rectifier Unit
TWI	The Welding Institute
UBC	Uniform Building Code
UPS	Uninterrupted Power Supply
UT	Ultrasonic Testing (inspection)
WP	Work Practice
WPS	Welding Procedure Specification
WT	Wall Thickness

**STANDARD SPECIFICATION  
FOR  
POSITIVE MATERIAL IDENTIFICATION  
(PMI)  
AT VENDOR'S WORKS**



GAIL (INDIA) LTD  
NEW DELHI

STANDARD SPECIFICATION FOR  
POSITIVE MATERIAL IDENTIFICATION  
(PMI) AT VENDOR'S WORKS

SPECIFICATION

GAIL/PMI/SP-01

REV-0

Page 1 of 6

## CONTENTS

- 1.0 SCOPE
- 2.0 REFERENCE DOCUMENTS
- 3.0 DEFINITIONS
- 4.0 PMI EXAMINATION
- 5.0 ACCEPTABLE METHODS FOR PMI
- 6.0 EXTENT OF PMI EXAMINATION
- 7.0 RECORDING AND DOCUMENTATION
- 8.0 MARKING



## 1.0 SCOPE

This specification applies to the requirements for Positive Material Identification (PMI) to be performed at the vendors' works on Metallic Alloys Materials procured either directly by the GAIL/Owner/Contractor or indirectly through the sub-vendors.

1.2 Any post order deviation from this specification must be approved by Owner/ GAIL in the Deviation/ Waiver Permit Format enclosed with Material Requisition.

1.3 This specification covers the procedures and methodology to be adopted to assure that the chemical composition of the alloy material is consistent with the material specifications as specified in purchase documents using "Alloy Analyzer" at the time of final inspection before dispatch.

1.4 The scope of this specification shall include but shall not be limited to Positive Material Identification (PMI) to be performed on Alloy Materials listed below:

- Alloy Steel Pipes including Pipes
- Alloy Steel Flanges & Forgings
- Alloy Steel Fittings including Clad Fittings
- Alloy Steel fasteners
- Alloy Cast & Forged steel valves
- Alloy Steel Instrumentation Items (Control Valves, Safety Valves etc.)
- Longitudinal Pipe & Fittings Welds.
- Gaskets (for Ring Type Joints)

Following Items shall be excluded from scope of PMI examination:

- Gasket other than for Ring Type Joints
- Internal Components of Valves

1.5 All grades of material supplies including Stainless Steels shall be liable for PMI test at site. In case of any defective materials being found at site, the vendor shall be responsible to effect replacement of such defective materials at project site without any delays to the satisfaction of GAIL.

## 2.0 REFERENCE DOCUMENTS

2.1 API Recommended Practice 578 (First Edition, May 1999) – Material Verification Programme for new and Existing Alloy Piping System.

## 3.0 DEFINITIONS

3.1 **Vendor:** Any Supplier or Manufacturer on whom an order is placed for the supply of referred items. This definition shall also include any sub-vendor or manufacturer on whom a sub- order is placed by the vendor.



GAIL (INDIA) LTD  
NEW DELHI

STANDARD SPECIFICATION FOR  
POSITIVE MATERIAL IDENTIFICATION  
(PMI) AT VENDOR'S WORKS

SPECIFICATION

GAIL/PMI/SP-01

REV-0

Page 3 of 6

- 3.2 Inspection Lot:** A group of items offered for inspection covered under same size, Heat and Heat treatment lot.
- 3.3 Alloy Material:** Any metallic material (including welding filler material) that contains alloying elements such as chromium, nickel, molybdenum or vanadium, which are intentionally added to enhance mechanical or physical properties and/ or corrosion resistance.

**4.0 PMI EXAMINATION**

- 4.1** The vendor shall submit a procedure of PMI to comply with the requirements of this Specification Approval of PMI Procedure shall be obtained from Owner/ GAIL/ TPI prior to commencing manufacture/ inspection of product.
- 4.2** PMI examination of alloy materials is independent of any certification, markings or colour coding that may exist and is aimed at verifying that the alloy used are as per specified grades.
- 4.3** The Vendor shall identify all incoming alloy materials and maintain full traceability of all alloy materials, including all off-cuts. Transfer of identification marks shall be undertaken prior to cutting to ensure maintenance of identification on off-cuts.
- 4.4** The Vendor shall ensure that all alloy materials are segregated and stored in separately identified locations to prevent the mix up of materials of different alloy specifications or alloy material with carbon steel. Non ferro-magnetic materials shall be segregated at all times from ferro-magnetic materials.
- 4.5** PMI examination is subject to surveillance inspection by Owner/ GAIL/ TPI.

**5.0 ACCEPTABLE METHODS FOR PMI**

- 5.1** The method used for PMI examination shall provide a quantitative determination of the alloying elements like Cr, Mo, Ni, V in Alloy Steel items.
- 5.2** Instrument or methods used for PMI examination shall be able to provide quantitative, recordable, elemental composition results for positive identification of alloying elements present.
- 5.3** The acceptable instruments for alloy analyzer shall be either “Portable X-Ray Fluorescence” or Optical Emission” type each capable of verifying the percentage of alloy elements within specified range.
- 5.4** Chemical spot testing, magnets, alloy sorters and other methods using eddy current or triboelectric testing methods are not acceptable for PMI examination.
- 5.5** The PMI instruments shall have the sensitivity to detect the alloying elements in the specified range.
- 5.6** All PMI instruments shall have been serviced within a 6 month period of the time of use to verify the suitability of batteries, sources etc, the data of the last service shall be stated on the PMI Report Form (Sample enclosed).
- 5.7** Each analyzer must be calibrated according to the manufacturer’s specification at the beginning and end of each shift. Instrument must be checked against known standard for each alloy type to be inspected during the shift.
- 5.8** Certified samples, with full traceability, of a known alloy materials shall be available for use as a random spot check on the instrument calibration.
- 5.9** The surfaces to be examined shall be prepared by light grinding or abrasive paper and solvent cleaner. Evidence of Arc burn resulting from examination shall be removed by light grinding or abrasive paper.

 <p>GAIL (INDIA) LTD NEW DELHI</p>	<p>STANDARD SPECIFICATION FOR POSITIVE MATERIAL IDENTIFICATION (PMI) AT VENDOR’S WORKS</p>	<p>SPECIFICATION</p>	<p>REV-0</p>
		<p>GAIL/PMI/SP-01</p>	<p>Page 4 of 6</p>

- 5.10** Alloy Steel ring type joint gaskets shall be inspected by using portable X-Ray Fluorescence instrument.
- 5.11** Testing shall be done as per the procedures outlined by the manufacturers of alloy analyzer being used. Modification of these procedures if any, must be approved by Owner/ GAIL.
- 5.12** The persons performing PMI shall demonstrate their capabilities to the satisfaction of Owner/ GAIL visiting engineer. If the vendor has qualified operator on their rolls, he may perform the examination. Otherwise PMI examination shall be sub-contracted to an independent testing agency approved by GAIL.
- 5.13** whenever material is identified as not meeting requirements by the visiting engineer a rejection note shall be issued.

**6.0 EXTENT OF PMI EXAMINATION**

**6.1** Following sampling plan shall be applicable for PMI examination of various alloy items:

- |  |   |  |
|--|---|--|
| <b>A.</b> Flanges, Fittings, Valves, RTJ Gaskets | – | 100%   |
| <b>B.</b> Pipes                                  | – | 100% (for pipes procured from traders)<br><br>2 random samples drawn from each size/ Heat/ Lot<br>(for pipes procured directly from Mills) |
| <b>C.</b> Fasteners                              | – |  |

<u>Lot Size</u>	<u>Sample Size</u>
Upto 100	2% (Min2)
101 to 500	1% (Min 3)
501 and above	0.5% (Min5)

**Note:**

- a.** For Welded Pipes and Fittings, PMI shall be performed on base metal as well as weldments.
- b.** Whenever any sample drawn to PMI test on the basis of percentage selection in B & C above, fails to meet specification requirements, 100% of items of lot shall be tested for PMI

**7.0 RECORDING AND DOCUMENTATION**

The results of PMI examination shall be recorded in aReport Format as enclosed with this specification.

**8.0 MARKING**

**8.1** All alloy materials tested by PMI shall be identified using either of the following methods by indicating “PMI OK”

- 8.2 a)** Bar Code/ Hologram Sticker
- b)** A low stress stamp marking

POSITIVE MATERIAL IDENTIFICATION REPORT					Page	of
BULK MATERIAL						
Project:		Client			Job No	
PMI Report No.		Vendor/ sub- Vendor				
Purchase Order No:		Testing Agency				
Purchase Requisition No:		PMI Location				
Bulk Item Type (as per requisition)						
Material Specification/ Grade						
Number of Items in Lot						
Requisition Item No./ Description		Alloy content, Weight (%)			Remarks	
					Accept/ Reject	
Element		Cr	Mo	Ni	V	t
Specified range						
Actual Observations						
1.						
2.						
3.						
4						
5						
6						
7						
8						
Instrument Type/ ID						
Last Service date		Inspection Agency			Witnessed by	



## **LIST OF VENDORS FOR BOUGHT-OUT ITEMS**

### **1) PRESSURE REGULATOR AND SLAM SHUT VALVE**

- 1) M/s Pietro Fiorentini S.p.A. (Italy)
- 2) M/s Emerson Process Management (USA)
- 3) M/s RMG-Regel Messtechnik (Germany)
- 4) M/s Mokveld Valves BV (Netherlands)
- 5) M/s Schlumberger (USA)
- 6) M/s Gorter Controls B V (Netherlands)
- 7) M/s Instromet International NV
- 8) M/s Emerson Process Mgmt asia Pacific Pte Ltd.
- 9) M/s Nirmal Industrial Controls Pvt Ltd. (up to 6" size only)
- 10) M/s ESME Valves Ltd
- 11) M/s Kaye & Macdonald Inc.
- 12) M/s Nuovo Pignone SPA (Italy) (GE Oil Co.)
- 13) M/s Richards Industries (Formerly Treloar)
- 14) M/s Samson AG Mess-und Regeltechnik
- 15) M/s Tormene Gas Technology
- 16) M/s Dresser Inc, USA (upto 8" size, 300# class only)

### **2) FLOW COMPUTERS**

- 1) M/s Daniel Measurement and Control Inc. (USA)
- 2) M/s Instromet International (Belgium)
- 3) M/s FMC Measurement Solutions (UK)
- 4) M/s Emerson Process Management (Singapore)
- 5) M/s Bistol Babcock
- 6) M/s RMG (Germany)
- 7) M/s OMNI Flow Computers Inc.
- 8) M/s Thermo Fisher, USA

### **3) TURBINE METERS**

- 1) M/s Daniel (USA)
- 2) M/s RMG (Germany)
- 3) M/s INSTROMET (Belgium)
- 4) M/s Sensus Metering System Inc
- 5) M/s Rockwin Flowmeter (India)
- 6) M/s Vemmtec Messtechnik GmbH, (Germany)
- 7) M/s ITRON GmbH (Germany)

### **4) POSITIVE DISPLACEMENT FLOW METERS**

- 1) M/s Actaris
- 2) M/s RMG (Germany)
- 3) M/s Instromet
- 4) M/s Romet
- 5) M/s Dresser
- 6) M/s ITRON GmbH (Germany)

**9) BALL VALVES, Pipe Line (API 6D)**

- 1) M/s Hopkinsons Limited (UK)
- 2) M/s O.M.S. Saleri (Italy)
- 3) M/s Pibi Viessa SPA (Italy)
- 4) M/s Nuovo Pignone (Italy)
- 5) M/s Perar SPA (Italy)
- 6) M/s Larsen & Toubro Ltd. (New Delhi)
- 8) M/s Pietro Fiorentini (Italy)
- 9) M/s Raimondi Valve S.p.A. (Italy)
- 10) M/s VIZA Valves (China)
- 11) M/s Cooper Cameron Valv Italy SRL-FRM, Itly
- 12) M/s Fraz Schuck GMBH, Germany (Formerly Borsig)
- 13) M/s ITAG, Germany
- 14) M/s Kitamura Valve manufacturing Co. Ltd
- 15) M/s MSA A.S.
- 16) M/s PCC Ball Valves SRL
- 17) M/s Petrol Valves SRL
- 18) M/s Tormene Gas Technology SPA (VALVITALIA)
- 19) M/s Virgo Engineers Ltd. India
- 20) M/s Weir Valves & Controls UK Ltd.
- 21) M/s Microfinish Valves Ltd, India
- 22) M/s Flowchem, India
- 23) M/s Flow Control Technologies (France)
- 24) M/s Friedrich Krombach GMBH &CO.Kg
- 25) M/s Grove Valve And Regulators Co (USA)
- 26) M/s JCFabrica DE Valvulas S.A. (Sharjah)
- 27) M/s Guichon Valves (France)
- 28) M/s Hindle Cockburns Limited
- 29) M/s Cameron Italy SRL

**10) PLUG VALVES**

- 1) M/s Grove Dresser Italia S.p.A. (Italy)
- 2) M/s Nordstrom Valves Inc. (USA)
- 3) M/s Serck Audo Valves (England)
- 4) M/s Breda Energia Sesto industria SPA (Italy)
- 5) M/s Fisher Xomox Sanmar Ltd. (Chennai)
- 6) M/s L&T (Audco India) Ltd. (New Delhi)

**11) GLOBE VALVES**

- 1) M/s BDK Engineering Industries Limited,Hubli, (Karnataka)
- 2) M/s Datre Corporation Limited Kolkata
- 3) M/s KSB Pumps Ltd, NOIDA
- 4) M/s Larsen & Toubro Ltd.
- 5) M/s KF Industries Alberta, Canada
- 6) M/s Ornate Valves Pvt. Ltd., Mumbai
- 7) M/s Panchvati Valves & Flanges Pvt. Ltd., Mumbai
- 8) M/s Shayburg Valves Pvt. Limited, Navi Mumbai
- 9) M/s A.V. Valves Ltd. Agra
- 10) M/s Shalimar Valves Pvt. Ltd.,Navi Mumbai
- 11) M/s JC Fabrica de Valvulas, S.A Barcelona Spain

**12) CHECK VALVES**

- 1) M/s Malbranque (France)
- 2) M/s Mannesmann Demag (Germany)
- 3) M/s Petrol Valve (Italy)
- 4) M/s True Flow Rona (Belgium)
- 5) M/s L&T (Audco) India Ltd. (Chennai)
- 6) M/s BHEL, OFE & OE Group (New Delhi)
- 7) M/s Advance valves Pvt Ltd.
- 8) M/s A V Valves Ltd.
- 9) M/s BDK Engineering Industries Ltd. India
- 10) M/s Foress Engg (I) Ltd. (Aurangabad)
- 11) M/s Valvitalia Italy
- 12) M/s KSB Pumps Ltd. Loimbattore), India
- 13) M/s Nandina Iron & Steels
- 14) M/s Nitcon valve Industries Pvt. Ltd. India
- 15) M/s Oswal Industries Ltd. India
- 16) M/s Panchvati Valves & Flanges Pvt. Ltd. India
- 17) M/s Petrochemical Engineering Enterprises, India
- 18) M/s Sakhi Engineers Pvt. Ltd.
- 19) M/s Shalimar Valves Pvt. Ltd.
- 20) M/s Steel Strong valves India Pvt. Ltd., India

**13) PRESSURE SAFETY VALVES**

- 1) M/s Keystone Valves (India) Pvt. Ltd.
- 2) M/s Larson & Toubro Ltd.
- 3) M/s Mekaster Engg Ltd..
- 4) M/s Tyco Sanmar Ltd. (New Delhi)
- 5) M/s Anderson Greenwood Crosby
- 6) M/s BHEL (Trichy)
- 7) M/s Curtiss Wright Flow Control Corporation
- 8) M/s Dresser Inc.
- 9) M/s Fukui Seisakusho Co. Ltd
- 10) M/s Lesser GmbH & Co KG
- 11) M/s Nakakita Seisakusho Co Ltd
- 12) M/s Nuovo Pignone SPA (Italy) (GE Oil co)
- 13) M/s Parcol SPA
- 14) M/s Safety Systems UK Ltd
- 15) M/s Tai Milano SPA
- 16) M/s Weir Valves & Controls France
- 17) M/s Bliss Anand Pvt Ltd.

**14) FLOW CONTROL VALVES**

- 1) M/s Fouress Engg. (New Delhi)
- 2) M/s Fisher Xomox (New Delhi)
- 3) M/s MIL Control Ltd. (Noida)
- 4) M/s KOSO India Pvt Ltd
- 5) M/s Samson Control (Thane)
- 6) M/s Dresser Valves India Pvt Ltd.
- 7) M/s Fisher Controls
- 8) M/s Valvitalia Italy
- 9) M/s CCI Valve technology
- 10) M/s Flowserve Pvt Ltd.
- 11) M/s Metso Singapore Pvt Ltd.

- 12) M/s Instrumentation Ltd Palghat
- 13) M/s Dresser Inc. USA

**15) CONTROL PANEL & ACCESSORIES**

- 1) M/s Keltron Controls Ltd., Kerala
- 2) M/s ELECHMEC Corporation Ltd., Mumbai
- 3) M/s Industrial Controls & Appliances Pvt. Ltd.,
- 4) M/s Alstom System Ltd., Noida
- 5) M/s ABB Instruments Ltd., New Delhi
- 6) M/s Emerson Process Management (I) Pvt. Ltd.
- 7) M/s Larsen & Toubro Ltd.
- 8) M/s Control & Automation, New Delhi
- 9) M/s GE Fanuc Systems Pvt. Ltd., New Delhi
- 10) M/s Rockwell Automation (I) Ltd., Ghaziabad
- 11) M/s Honeywell Automation Ltd.
- 13) M/s RITTAL
- 14) M/s Pyrotech Elcronics Pvt Ltd.
- 15) M/s Positronics Pvt Ltd.
- 16) M/s Electronics Corporation of India Ltd.

**16) LEVEL GAUGES/ LEVEL INSTRUMENTS**

- 1) M/s Bliss Anand
- 2) M/s Chemtrols
- 3) M/s V-Automat
- 4) M/s Levcon
- 5) M/s NIVO Controls
- 6) M/s Sbeletro Mechanicals
- 7) M/s TRAC

**17) SS FITTINGS / TUBING.**

**(No other makes shall be acceptable)**

- 1) M/s SWAGELOCK (USA)
- 2) M/s PARKER (USA)
- 3) M/s HOKE (USA)
- 4) M/s Sandvik

**18) JUNCTION BOXES AND CABLES GLANDS**

- 1) M/s EX-PROTECTA
- 2) M/s FLAMEPROOF CONTROL GEARS
- 3) M/s BALIGA
- 4) M/s FLEXPLO ELECTRICALS

**19) CONTROL AND SIGNAL CABLES**

- 1) M/s ASSOCIATED CABLES
- 2) M/s ASSOCIATED FLEXIBLES & WIRES (PVT) LTD
- 3) M/s UNIVERSAL Cables Ltd, India
- 4) M/s DELTON Cables Ltd, India
- 5) M/s BROOK
- 6) M/s KEI Industries Ltd INDIA
- 7) M/s CMI Limited
- 8) M/s - Cords Cable Industries Ltd, India

- 9) M/s Elkay Telelinks (P) Ltd., India
- 10) M/s Udey Pyrocables Pvt Ltd, India
- 11) M/s Goyolene Fibres (I) Pvt Ltd, India
- 12) M/s Netco Cable Industries Pvt Ltd, India
- 13) M/s NICCO Corporation Ltd, India
- 14) M/s Paramount Communications Ltd, India
- 15) M/s Polycab Wires Pvt Ltd, India
- 16) M/s Radiant Cables Pvt Ltd, India
- 17) M/s Reliance Engineers Ltd., India
- 18) M/s Suyog Electricals Ltd, India
- 19) M/s Thermo Cables Ltd
- 20) m/s Udey Pyrocables Pvt. Ltd.

**20) INDICATORS & CONTROLLERS**

- 1) M/s Yokogawa
- 2) M/s EUROTHERM CHESSEL
- 3) M/s HONEYWELL
- 4) M/s Emerson

**21) BARRIERS**

- 1) M/s MTL
- 2) M/s STHAL
- 3) M/s P&F
- 4) M/s Phoenix

**22) FASTENERS**

- 1) AEP Company, India
- 2) Boltmaster India Pvt. Ltd. India
- 3) Deepak Fasteners Limited India
- 4) Fasteners & Allied Products Pvt. Ltd.
- 5) Hardwin Fasteners Pvt. Ltd. India
- 6) J.J. Industries India
- 7) Multi fasteners Pvt. Ltd. India
- 8) Nexo Industries, India
- 9) Pioneer Nuts and Bolts Pvt. Ltd.
- 10) Precision Auto Engineering Works, India
- 11) Sandeep Engineering, India
- 12) Syndicate Engineering Industries, India.

**23) Fitting Block Forged-Carbon Steel**

- 1) Eby Fasteners, India
- 2) Leader valves Ltd. India
- 3) M.S. Fitting Mfg. Co. Pvt. Ltd. India
- 4) R. N. Gupta & Co. Ltd. India

**24) Fittings from Seamless Pipe-Carbon Steel**

- 1) CD Engineering Co., India
- 2) CD Industries (Ghaziabad), India
- 3) Chaudhry Hammer Works Ltd, India
- 4) Echjay Industries Pvt Ltd, (Rajkot), India
- 5) Golden Iron & Steel Works, India
- 6) J.K. Forgings, India

- 7) JAV Forgings (P) Ltd, India
- 8) Metal Forgings Pvt Ltd, India
- 9) Pradeep Metal Limited, India
- 10) Punjab Steel Works, India
- 12) R.N. Gupta & Co. Ltd, India
- 13) Uma Shankar Khandelwal & Co., India

**25) Gaskets Spiral Wound**

- 1) IGP Engineers Pvt. Ltd., India
- 2) Madras Industrial Products, India
- 3) Starflex Sealing India Pvt Ltd, India

**26) Pipe – Carbon Steel (Seamless) to ASTM STDS.**

- 1) BHEL (Trichy), India
- 2) Heavy Metals & Tubes Ltd (Mehsana), India
- 3) Indian Seamless Metal Tubes Ltd, Ahmednagar, India
- 4) Indian Seamless Metal Tubes Ltd, Baramati, India
- 5) Jindal Saw Ltd (Nashik Works), India
- 6) Mahalaxmi Seamless Ltd, India
- 7) Maharashtra Seamless Ltd, India
- 8) Sainest Tubes Pvt Ltd, India
- 9) Wuxi Erquan Special Steel Tube Co. Ltd.

**27) Pipe - Carbon Steel to Indian Standards**

- 1) Advance Steel Tube Ltd., India
- 2) Asian Mills Pvt Ltd, India
- 3) BMW Industries Ltd(Bansal Mech Works) , India
- 4) Goodluck Steel Tubes Ltd, India
- 5) Indus Tube Limited, India
- 6) Jindal Pipes Ltd, India
- 7) Jindal Saw Ltd (Kosi Works) , India
- 8) Lalit Profiles & Steel Ind Ltd. , India
- 9) Lloyd Metals & Engineers Ltd. , India
- 10) Maharashtra Seamless Ltd, India
- 11) Man Industries Ltd, India
- 12) Mukat Tanks & Vessels Ltd., India
- 13) North Eastern Tubes Ltd.
- 14) Pratibha Pipes & Strl Pvt Ltd
- 15) PSL Limited (Nani Chirai)
- 16) PSL Limited (Chennai)
- 17) Ratnamani Metals & Tubes Ltd
- 18) Sri Sarbati Steel Tubes Ltd
- 19) Steel Authority of India Ltd
- 20) Surindra Engineering Co Ltd (Rajpura), India
- 21) Surindra Engineering Co Ltd (Mumbai), India
- 22) Surya Roshni Ltd, India
- 23) Swastik Pipes Ltd,, India
- 24) The Tata Iron & Steel Co Ltd, India
- 25) Welspun Gujarat Stahl Rohren Ltd, India

**28) Pipe & Tubulars to API Standards**

- 1) BHEL (Trichy), India
- 2) Indian Seamless Metal Tubes Ltd, Ahmednagar, India
- 3) Indian Seamless Metal Tubes Ltd, Baramati, India
- 4) Jindal Pipes Ltd, India
- 5) Jindal SAW Ltd (Kosi Works)
- 6) Jindal SAW Ltd (Nashik Works)
- 7) Lalit Profiles & Steel Industries Ltd
- 8) Lloyds Metals & Engineers Ltd

- 9) Maharashtra Seamless Ltd, India
- 10) Man Industries (I) Ltd
- 11) Mukat Tanks & Vessels Ltd
- 12) Ratnamani Metals & Tubes Ltd
- 13) Steel Authority of India Ltd
- 14) Surindra Engineering Co Ltd (Mumbai), India
- 15) Surya Roshni Ltd, India
- 16) Welspun Gujarat Stahl Rohren Ltd, India

**29) Pipe - Carbon Steel (Welded) to ASTM Standards**

- 1) Jindal Saw Ltd (Kosi Works) , India
- 2) Lalit Profiles & Steel Ind Ltd. , India
- 3) Man Industries Ltd, India
- 4) Mukat Tanks & Vessels Ltd., India
- 5) Ratnamani Metals & Tubes Ltd
- 6) Surindra Engineering Co Ltd (Mumbai), India

**30) Field Instruments (P, DP, F, L, T)**

- 1) ABB Ltd (Faridabad), India
- 2) ABB Automation Ltd, India
- 3) Emerson Process Mgmt Asia Pacific PTE Ltd,
- 4) Emerson Process Mgmt India Pvt Ltd,
- 5) Fuji Electric Instruments Co Ltd
- 6) Honeywell Automation India Ltd,
- 7) Honeywell Inc.
- 8) Yokogawa Electric Corp.
- 9) Yokogawa India Ltd
- 10) Invensys India Pvt.Ltd

**31) Gas Chromatograph**

- 1) ABB Ltd (Faridabad), India
- 2) Daniel Measurement & Control
- 3) Instromet International, NV
- 4) RMG Regal+Messtechnik GmbH
- 5) Yokogawa

**32) I/P Converters**

- 1) ABB Ltd (Faridabad), India
- 2) ABB Automation Ltd, India
- 3) Emerson Process Management Asia Pacific PTE Ltd
- 4) Emerson Process Management India Pvt Ltd, India
- 5) IMI Watson Smith Ltd.
- 6) Moore Controls Ltd
- 7) MTL India
- 8) Shreyas Instruments Pvt Ltd, India
- 9) Thermo Brandt Instruments

**33) Instrument Valves & Manifolds**

- 1) Anderson Greenwood Crosby
- 2) Astec Valves & Fittings Pvt Ltd, India
- 3) Aura Inc.
- 4) Autoclave Engineers Fluid Components
- 5) Chemtrols Engineering Ltd, India
- 6) Circor Instrumentation Ltd
- 7) Excel Hydro Pneumatics Pvt Ltd, India
- 8) Excelsior Engg Works, India
- 9) Ham-Let (Israel-Canada) Ltd
- 10) Hyd-Air Engg. Works Lonavala, India
- 11) Micro Precision Products Pvt Ltd, India

- 12) Parker Hannifin Corporation
- 13) Precision Engineering Industries, India
- 14) Prime Engineers
- 15) Swagelok Co.
- 16) Swastic Engineering Works, India
- 17) Technomatic (India) Pvt Ltd, India
- 18) Waree Instruments Ltd
- 19) M/s Comfit & Valves Pvt.Ltd
- 20) M/s Arya Crafts & Engg.Pvt. Ltd

#### **34) Junction Boxes (Flame Proof)**

- 1) Baliga Lighting Equipments (P) Ltd, India
- 2) FCG Flameproof Control Gears P. Ltd., India
- 3) FCG Power Industries Pvt Ltd, India
- 4) Flameproof Equipments Pvt Ltd, India
- 5) Flexpro Electricals Pvt Ltd, India
- 6) Govan Industries (India) P Ltd, India
- 7) Prompt Engineering Works, India
- 8) Sudhir Switchgears Pvt Ltd, India

#### **35) L E L Detection System**

- 1) Crowcon Detection Instruments Ltd
- 2) Detection Instruments (I) Pvt Ltd
- 3) Detector Electronics Corporation
- 4) Drager Safety AG & Co. KGAA
- 5) General Monitors Ireland Ltd
- 6) Mine Safety Appliances Company
- 7) MSA – Mines safety appliances(India) ltd
- 8) Industrial Scientific Oldham France S.A.
- 9) Riken Keiki Co Ltd
- 10) Simrad Optronics Icare
- 11) Honeywell Analytics
- 12) Net Safety Monitoring Inc.
- 13) Simtronics SAS

#### **36) Pressure Gauges**

- 1) AN Instruments Pvt Ltd
- 2) Badotherm Process Instruments B.V.
- 3) Baumer Bourdon Haenni S.A.S
- 4) British Rototherm Co Ltd
- 5) Budenberg Gauge Co Ltd
- 6) Dresser Inc
- 7) Forbes Marshall (Hyd) Pvt Ltd
- 8) General Instrument Consortium
- 9) H. Guru Instruments (South India) Pvt Ltd
- 10) Manometer (India) Pvt Ltd
- 11) Nagano Keiki Seisakusho Ltd
- 12) Hirlekar Precision, India
- 13) Waaree Instruments Ltd
- 14) Walchandnagar Industries Ltd (Tiwac Divn)
- 15) Wika Alexander Wiegand & Co GmbH
- 16) Wika Instruments India Pvt Ltd
- 17) Ashcroft India Pvt Ltd.

#### **37) Temperature Gauges**

- 1) AN Instruments Pvt Ltd.
- 2) Badotherm Process Instruments B.V.
- 3) Bourdon Haenni S.A.

- 4) Dresser Inc.
- 5) General Instruments Consortium
- 6) H. Guru Instruments (South India) Pvt Ltd
- 7) Nagano Keiki Seisakusho Ltd
- 8) Solartron ISA
- 9) Walchandnagar Industries Ltd (Tiwac Divn)
- 10) Wika Alexander Wiegand & Co GmbH
- 11) Wika Instruments India Pvt Ltd
- 12) M/s Pyro Electric, Goa
- 13) Ashcroft India Pvt Ltd.

**38) Temperature Elements, Thermo-wells**

- 1) ABB Automation Ltd
- 2) Altop Industries Ltd
- 3) Bourdon Haenni S.A.
- 4) Detriv Instrumentation & Electronics Ltd
- 5) General Instruments Consortium
- 6) Invensys Software Systems (S) PTE Ltd.
- 7) Japan Thermowell Co Ltd
- 8) Nagman Sensors Pvt Ltd
- 9) Tecnomatic SPA
- 10) Tempesen Instrument India Ltd
- 11) Thermo Electric Co. Inc.
- 12) Thermo-Couple Products Co
- 13) Thermo-Electra B.V.
- 14) Wika Alexander Wiegand & Co GmbH
- 15) Altop Industries Ltd., Baroda
- 16) M/s Nagman Sensors (Pvt.) Ltd.
- 17) M/s Pyro Electric, Goa

**39) ULTRASONIC FLOW METERS**

- 1) M/s Daniel (USA)
- 2) M/s RMG (Germany)
- 3) M/s INSTROMET (Belgium)
- 4) M/s Sick Maihak, Germany
- 5) M/s FMC, Germany

**40) HYDRAULIC ACTUATOR**

- 1) BIFFI, ITALY
- 2) LEDEEN, ITALY
- 3) SCHUCK, GERMANY
- 4) ROTORK, ITALY
- 5) BETTIS (EMERSON PROCESS MGMT)

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**Notes:**

1. Bidder can select and offer equipment of two different makes, selected from the VENDOR LIST provided above and mention the same in the checklist for technical evaluation as per Annexure X(A) attached with the tender. The offered bid must include filled datasheet indicating make, model, size, rating of offered instrument/ equipment duly supported by sizing calculation of offered equipment (wherever applicable).

2. Equipment(s)/ Instrument(s) of any make which is offered by one bidder and acceptable to GAIL (I) Ltd shall be accepted for other bidder also. After placement of order, on request of the successful bidder list of other qualified makes for a particular item (for which successful bidder wants to change the vendor) shall be provided.
3. Bidder shall take prior approval of the make / model no of the offered item and it shall be from the list given above. However additional vendors will be considered in exceptional cases, provided they have supplied for similar application to reputed gas transmission/distribution companies, in quantities at least half the numbers being supplied for this tender, and working satisfactorily for minimum 6 months. Documentary evidence substantiating above shall be submitted for taking approval.

	Contractor		<b>QUALITY ASSURANCE PLAN FOR INSTRUMENTATION EQUIPMENTS</b>	Client	GAIL INDIA LTD ,New Delhi
	Order No. & Date			Project	
	Sub-Contractor	-		Package No,	-
	Order No. & date	-		Package Name	Type -

<b>INSTRUCTIONS FOR FILLING UP:</b> 1. QAP shall be submitted for each equipment separately with break up of assembly / sub-assembly & part/component or for group of equipment having same specification. 2. Use numerical codes as indicated for extent of inspection & tests and submission of test certificates & documents. Additional codes & description for extent of inspection & test may be added as applicable for the plant and equipments. 3. Separate identification number with quantity for equipment shall be indicated wherever equipment having same specifications belonging to different facilities are grouped together. 4. Weight in kilogram must be indicated under column 5 for each item. Estimated weights may be indicated wherever actual weights are not available.	<b>CODES FOR EXTENT OF INSPECTION, TESTS, TEST CERTIFICATES &amp; DOCUMENTS :</b> <table border="0" style="width: 100%;"> <tr> <td style="width: 25%;">Code Description</td> <td style="width: 25%;">Code Description</td> <td style="width: 25%;">Code Description</td> <td style="width: 25%;">Code Description</td> </tr> <tr> <td>1. Visual</td> <td>12. Routine test as per relevant IS other standard</td> <td>23. Short time rating</td> <td>D1. Approved GA drawing.</td> </tr> <tr> <td>2. Dimensional</td> <td>13. Type test as per relevant IS/ other standard</td> <td>24. Operational &amp; functional test</td> <td>D2. Approved single line/ schematic diagram</td> </tr> <tr> <td>3. fitment &amp; alignment</td> <td>14. Impulse Test</td> <td>25. Over speed test</td> <td>D3. Test certificates</td> </tr> <tr> <td>4. Physical Test ( Sample)</td> <td>15. Partial Discharge Test</td> <td>26. Flame proof Test</td> <td>D4. Approved Bill of materials</td> </tr> <tr> <td>5. Chemical test( Sample)</td> <td>16. Heat run risc test/temper</td> <td>27. Clearance and creepage distance</td> <td>D5. Un-priced P.O. copy</td> </tr> <tr> <td>6. Ultrasonic test</td> <td>17. Enclosure protection test</td> <td>28. Acceptance test</td> <td>D6. Calibration certificates of all measuring instrument and gauges.</td> </tr> <tr> <td>7. Megnetic particle test(MPT)</td> <td>18. Calibration</td> <td><b>29 Honing Test</b></td> <td></td> </tr> <tr> <td>8. Radigraphy test</td> <td>19. Noise &amp; Vibration</td> <td><b>30 Hydrotest/ Shell leak test</b></td> <td></td> </tr> <tr> <td>9. Dye Penetrant test</td> <td>20. Test certificate of bought out components</td> <td><b>31 Pneumatic Seat leak test</b></td> <td></td> </tr> <tr> <td>10. Measurement of IR value a) Before HV test b) After HV test</td> <td>21. Tank pressure test</td> <td><b>32 Impact test</b></td> <td></td> </tr> <tr> <td>11. High voltage test/Dielectric test</td> <td>22. Paint shed vibration</td> <td></td> <td></td> </tr> </table>				Code Description	Code Description	Code Description	Code Description	1. Visual	12. Routine test as per relevant IS other standard	23. Short time rating	D1. Approved GA drawing.	2. Dimensional	13. Type test as per relevant IS/ other standard	24. Operational & functional test	D2. Approved single line/ schematic diagram	3. fitment & alignment	14. Impulse Test	25. Over speed test	D3. Test certificates	4. Physical Test ( Sample)	15. Partial Discharge Test	26. Flame proof Test	D4. Approved Bill of materials	5. Chemical test( Sample)	16. Heat run risc test/temper	27. Clearance and creepage distance	D5. Un-priced P.O. copy	6. Ultrasonic test	17. Enclosure protection test	28. Acceptance test	D6. Calibration certificates of all measuring instrument and gauges.	7. Megnetic particle test(MPT)	18. Calibration	<b>29 Honing Test</b>		8. Radigraphy test	19. Noise & Vibration	<b>30 Hydrotest/ Shell leak test</b>		9. Dye Penetrant test	20. Test certificate of bought out components	<b>31 Pneumatic Seat leak test</b>		10. Measurement of IR value a) Before HV test b) After HV test	21. Tank pressure test	<b>32 Impact test</b>		11. High voltage test/Dielectric test	22. Paint shed vibration		
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Equipment Details							Inspection & test											Test certificate & Document to be submitted to GAIL	Acceptance Criteria standards/ IS/BS/ASM E/ Norms and documents	Remark/ Sampling plan	
Sl. No	Item	Identification No.	Quantity No./ M	Weight Kg	Manufact urer's Name and Address	Exp date of Insp	Raw material and in-process stage inspection						Final inspection & test								
							MFR		CONTR & TPI		GAIL		MFR		CONTR & TPI		GAIL				
1	2	3	4	5	6	7	8	P/W /R	9	P/W /R	10		11	P/W /R	12	P/W /R	13	P/W /R	14	15	16
1.0	PCV/ SDV	As per P & ID			GAIL approved Vendor		1,2,3,4, 5,8,30, 32	P P P	30, 32	W R	-		1,2,3,5, 8,20, 18 24, 31	P P P	1,2,3,5 8,20 18,24,31 30,32	R R W R	1,2,3, 5,8,20 30,31 32	R R W R	1,2,3,5,8, 18,20, 24, 30, 31,32 D1, D3, D4,D6	D3,D6, Tech. spec.	100%
2.0	Pressure Gauge / Temper. Gauge	As per P & ID			GAIL approved Vendor		1,2,3, 4, 5,	P P	-		-		1,2,3, 18,20	P P	1,2,3,4, 5,18,20, 24	R R W	1,2,3, 4 5,18,20 24	R R R	1,2,3,4,5, 18,20,24, D3, D6	D3,D6, Tech. spec.	100%

	Contractor		<b>QUALITY ASSURANCE PLAN FOR INSTRUMENTATION EQUIPMENTS</b>	Client	GAIL INDIA LTD ,New Delhi
	Order No. & Date			Project	
	Sub-Contractor	-		Package No,	-
	Order No. & date	-		Package Name	Type -

Equipment Details						Inspection & test												Test certificate & Document to be submitted to GAIL	Acceptance Criteria standards/ IS/BS/ASME/ Norms and documents	Remark/ Sampling plan	
Sl. No	Description	Identification No.	Quantity No./ M	Unit Weight Kg	Manufacturer's Name and Address	Exp. Date of Insp	Raw material and in-process stage inspection					Final inspection & test									
							MFR		CONTR & TPI		GAIL	MFR		CONTR & TPI		GAIL					
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16						
4.0	Differential Pressure Gauge	As per P & ID			GAIL approved Vendor		1,2,3,4,5	P	-				1,2,3,4,5,18,20,24	P	1,2,3,4,5,18,20,24	R	1,2,3,4,5,18,20,24	R	1,2,3,4,5,18,20,24, D3, D6	D3,D6, Tech. spec.	100%
5.0	Resistance Temperature Gauge	As per P & ID			GAIL approved Vendor		1,2,3,4,5	P	-				1,2,3,4,5,18,20,24	P	1,2,3,4,5,18,20,24	R	1,2,3,4,5,18,20,24	R	1,2,3,4,5,18,20,24, D3, D6	D3,D6, Tech. spec.	100%
6.0	Flow Control Valves	As per P & ID			GAIL approved Vendor		1,2,3,4,5,8,30,32	P	30,32	W	R		1,2,3,5,8,20,18,24,31	P	1,2,3,5,8,20,18,24,31	R	1,2,3,5,8,20,18,24,30,31,32	R	1,2,3,5,8,18,20,24,30,31,32, D1, D3, D4, D6	D3,D6, Tech. spec.	100%
7.0	Turbine / PD Flow Meter / Ultrasonic meter	As per P & ID			GAIL approved Vendor		1,2,3,4,5,8,29,30,32	P	-				1,2,3,18,20,24	P	1,2,3,4,8,18,20,24,29,30,32,5	R	1,2,3,4,5,8,18,20,24,29,30,32	R	1,2,3,4,5,8,18,20,24, D1, D3, D6	D3,D6, Tech. spec.	100%
8.0	Flow Computer	As per P & ID			GAIL approved Vendor		1,2,3,12,18	P	-				1,2,3,18,24	P	1,2,3,18,24	R	1,2,3,18,24	R	1,2,3,18,24, D1, D2, D3, D4, D6	D3, Tech. spec.	100%
<b>Remark ( If any )</b> : Legend : P : Perform, W : Witness , R : review : EN 10204, Type 3.2 certificates shall be provided for bought out items. Those shall be inspected by TPI appointed by Vendor.													QAP No.								
													Rev.		0						
For Contractor / Sub-contractor (Stamp & Signature )						For GAIL (Stamp & Signature )						Date									

	Contractor		<b>QUALITY ASSURANCE PLAN FOR MECHANICAL ITEMS</b>	Client	GAIL INDIA LTD ,New Delhi
	Order No. & Date			Project	
	Sub-Contractor	-		Package No,	-
	Order No. & date	-		Package Name	Type – B 2

<b>INSTRUCTIONS FOR FILLING UP:</b> 1. QAP shall be submitted for each equipment separately with break up of assembly / sub-assembly & part/component or for group of equipment having same specification. 2. Use numerical codes as indicated for extent of inspection & tests and submission of test certificates & documents. Additional codes & description for extent of inspection & test may be added as applicable for the plant and equipments. 3. Separate identification number with quantity for equipment shall be indicated wherever equipment having same specifications belonging to different facilities are grouped together. 4. Weight in kilogram must be indicated under column 5 for each item. Estimated weights may be indicated wherever actual weights are not available.	<b>CODES FOR EXTENT OF INSPECTION, TESTS, TEST CERTIFICATES &amp; DOCUMENTS :</b>			
<b>ABBREVIATION USED :</b> CONTR : CONTRACTOR MFR : MANUFACTURER P : PERFORM R : REVIEW W : WITNESS  * : CONTR / MFR as applicable ** : Test to be performed if applicable O : Functional Test includes : (1) Cold bench set pressure test ,(2) Seat leakage Test ,(3) Valve Lift test	Code Description 1. Visual 2. Dimensional 3. fitment & alignment 4. Physical Test ( Sample) 5. Chemical test( Sample) 6. Ultrasonic test 7. Megnetic particle test(MPT) 8. Radigraphy test 9. Dye Penetrant test 10. Metallographic Test 11. Welder Qualification and weld procedure test 12. Approval of Test and repair procedure test 13. Heat treatment 14. Pressure test 15. Leakage test 16. Balancing 17. Vibration Test	Code Description 18. Amplitude test 19. Sponge test 20. Dust/ water ingress test 21. Friction factor 22. Adhesion test 23. Performance test / characteristic curve 24. No load and free running test 25. Load and over load test 26. Measurement of speed 27. Acoustical test 28. Geometrical accuracy 29. Repeatability and position accuracy 30. Proving Test 31. Surface preparation 32. Manufacturer's test certificate 33. IBR / other statutory agencies certificate	Code Description 34. Internal Inspection report by contractor 35. Hardness test 36. Spark test of lining 37. Calibration 38. Safety devise test 39. Ease of maintenance 40. Fire Test ( Type test) 41. Charpy V-notch test 42. Operational torque Test 43. ENP 44. Painting 45. Anti-static test 46. Hydrostatic double block & bleed test 47. Functional test – O 48. Pneumatic double block & bleed test 49. Verification of Heat No.	Code Description D1. Approved GA drawing. D2. Information and other reference drg/ stamped drgs released for mfg. D3. Reference catalogue D4. Bill of materials/ Item No./ Identification D5. Matchmarks detail D6. Line and Layout diagram D7. Approved erection procedure D8. Un-priced sub P.O. with specification and amendment D9. Calibration certificates of all measuring instrument and gauges. D10. X –ray reports.

Equipment Details							Inspection & test											
Sl. No	Item	Identification No.	Quantity No./ M	Weight Kg	Manufacturer's Name and Address	Expected schedule of Final inspection	Raw material and in-process stage inspection			Final inspection & test						Test certificate & Document to be submitted to GAIL	Acceptance Criteria standards/ IS/BS/ASME/ Norms and documents	Remark/ Sampling plan
							MFR	CONTR/ TPI	GAIL	MFR	CONTR/ TPI	GAIL	MFR	CONTR/ TPI	GAIL			
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16			
1.0	Pressure Safety Valves	As per P & ID			GAIL Approved Vendor		1,2 3,4 5,8	P P P	3,4 5,8 R R	-	1,2, 3,14, 15,31 44,47	P P P P	1,2,3, 14,15, 47 W W	1,2,3, 14,15 47 R R	1,2,3,4,5,8,1 4,15, 31,32,33,34, 44,47	D1, D2, ASME Sec- VIII, ASME Sec. IX, GAIL TS, Appd. Data sheet	100%	

	Contractor		<b>QUALITY ASSURANCE PLAN FOR MECHANICAL ITEMS</b>	Client	GAIL INDIA LTD ,New Delhi
	Order No. & Date			Project	
	Sub-Contractor	-		Package No,	-
	Order No. & date	-		Package Name	Type – B 2

Equipment Details							Inspection & test													
Sl. No	Item	Identification No.	Quantity No./ M	Weight Kg	Manufact urer's Name and Address	Expected schedule of Final inspection	Raw material and in-process stage inspection			Final inspection & test			Test certificate & Document to be submitted to GAIL	Acceptance Criteria standards/ IS/BS/ASME/ Norms and documents	Remark/ Sampling plan					
							MFR	CONTR/ TPI	GAIL	MFR	CONTR/ TPI	GAIL								
1	2	3	4	5	6	7	8		9	10	11		12		13	14	15	16		
2.0	Ball Valves	As per P & ID			GAIL approved vendor		1,2,3, 4,5,6** 7**,8** 9**,13, 35,41, 43	P P P P P	4,5, 6 8,9, 13,35 41, 43	W R R W R	-	1,2,3 14,15 40,42 44,45 46,47 48	P P P P P P	1,2,3, 14,15, 42, 45,46, 47,48	W W W W W	1,2,3 4,5,6 14,15 41,42 43,44 45,46 47,48	R R R R R R	D1, D2,D3,D9,D 10, 1,2,3, 4,5,6**,7 **, 8**,9**, 13,14,15,40, 41,42,43,44, 45,46,48	D1, GAIL TS, Appd. Data sheet, API6D, ASME 16.34, API 607, BS6755, BS5351	100%
3.0	Plug Valves	As per P & ID			GAIL approved vendor		1,2,3, 4,5,6** 7**,8** 9**,35, 41,43	P P P P	4,5,6 7,8,9 35,41 43	W R W R	-	1,2,3 14,15 42,44 47	P P P P	1,2,3, 14,15, 42,47	W W W	1,2,3 4,5,6 14,15 42,47	R R R R	D1, D2,D3, D9,D10, 1,2,3,4,5,6**, 7 **, 8**,9**, 13,14,35,15, 40,41,42,43, 44,45,47,48	D1, GAIL TS, Appd. Data sheet, API6D,	100%
4.0	Check Valves	As per P & ID			GAIL approved vendor		1,2,3,4 5,6** 7**,8** 9**,41,	P P P P	4,5,6 7,8,9 41	W R R	-	1,2,3 14,15 44	P P P	1,2,3, 14,15	W W	1,2,3, 4,5 14,15	R R R	D1, D2,D3, D9, D10,1, 2, 3,4,5,6**,7 **, 8**,9**, 13,14,15,41, 44	D1, GAIL TS, Appd. Data sheet, API6D,	100%

Contractor		<b>QUALITY ASSURANCE PLAN FOR MECHANICAL ITEMS</b>	Client	GAIL INDIA LTD ,New Delhi
Order No. & Date			Project	
Sub-Contractor			Package No,	-
Order No. & date			Package Name	Type – B 2

Equipment Details							Inspection & test													
Sl. No	Item	Identification No.	Quantity No./ M	Unit Weight Kg	Manufacturer's Name and Address	Expected schedule of Final inspection	Raw material and in-process stage inspection					Final inspection & test					Test certificate & Document to be submitted to GAIL	Acceptance Criteria standards/ IS/BS/ASME/ Norms and documents	Remark/ Sampling plan	
							MFR		CONTR/ TPI		GAIL	MFR		CONTR/ TPI		GAIL				
1	2	3	4	5	6	7	8		9		10	11		12		13		14	15	16
5.0	Filter	As per P & ID			GAIL approved vendor		1,2,4,5,8,9,11,12,35	P P P P	4,5,11,12,35	W R	-	1,2,3,4,5,8,9,14,31,32,41,44	P P P P	1,2,3,8,9,14,15,32,41	W R W R	1,2,3,4,5,8,9,14,15,32	R R R R	1,2,3,4,5,8,9,11,12,14,31,32,34,35,44,D9	D1, D2, ASME Sec-VIII, ASME Sec. IX, GAIL TS, Appd. Data sheet	100% All butt weld joints to be Radiographed tested.
6.0	Pipes,	-			GAIL Approved vendor		1,2,4,5,41	P P	4,5,41	W W	-	1,2,3,4,5,14	P P	1,2,4,9	W	1,2,4,5,14,41,49	R R R	1,2,3,4,5,14,	ASTM A 106 GrB, API 5L	One sample per heat
7.0	Pipefitting, Flanges	-			GAIL Approved vendor		1,2,3,4,5,41	P P	4,5,41	W W	-	1,2,3,4,5	P P	1,2,3,4,5	W R	1,2,3,4,5	R R	1,2,3,4,5,41,	ANSI B16.5 ( flange) ANSI B 16.9 & 16.11 (fittings)	One sample per heat
8.0	Fasteners	-			GAIL Approved vendor		1,2,4,5	P P	-		-	1,2,3,4,5	P P	1,2,3,4,5	R W	1,2,3,4,5	R R	1,2,3,4,5,	ASTM A 193 Gr.B7 & ASTM A194 Gr2H	One sample per heat

Remark ( If any ) : EN 10204, Type 3.2 certificates shall be provided for bought out items. These shall be inspected by TPI Appointed by Vendor. LEGEND : P : Perform, W : Witness, R : Review													QAP No.		
													Rev.		0
For Contractor / Sub-contractor (Stamp & Signature )						For GAIL (Stamp & Signature )						Date			