



GAIL (India) Limited
(A Govt. of India Undertaking)

PIPELINE FROM HANUMAN JUNCTION TO VCL

**BID DOCUMENT
FOR
PIPELINE LAYING & TERMINAL WORKS**

**VOLUME – II OF II
(PIPELINE LAYING)**

(BID DOCUMENT NO: 110330G/WGI/GAIL/01-R0)

OPEN DOMESTIC COMPETITIVE BIDDING



DELIVERS. EVOLVES.


WHOLE LIFE SOLUTIONS FOR PIPELINE AND SUBSEA SYSTEMS

ISSUED BY



TABLE OF CONTENTS

S.NO.	Document Description	Document No.	Revision	No. of Pages
1	Design Basis for Pipelines	11-0330G01-01-07-04-001	Rev 0	3
2	Procedure for Hot Tapping	11-0330G01-01-07-02-001	Rev 0	17
3	Specification for Field Joint Coating	11-0330G01-01-07-02-007	Rev 0	28
4	Specification for pipeline concrete weight Coating	11-0330G01-01-07-02-008	Rev 0	38
5	Specification for Long Radius Induction Bends	11-0330G01-01-07-02-009	Rev 0	49
6	Specification for casing insulator and casing end seals	11-0330G01-01-07-02-010	Rev 0	58
7	Specification for Caliper Pigging	11-0330G01-01-07-02-012	Rev 0	64
8	Specification for Transportation, handling and storage of Coated Line Pipe	11-0330G01-01-07-02-013	Rev 0	71
9	Specification for Welding of On shore Pipeline for Gas Transportation	11-0330G01-01-07-02-014	Rev 0	82
10	Specification for Documentation of Pipeline Construction.	11-0330G01-01-07-02-015	Rev 0	102
11	Specification for Onshore Pipeline construction	11-0330G01-01-07-02-016	Rev 0	109
12	Specification for pipeline Crossing roads, rail and Minor Waterways	11-0330G01-01-07-02-017	Rev 0	123
13	Specification for Water crossing by Trenching	11-0330G01-01-07-02-018	Rev 0	130
14	Specification for Major Water Crossing by HDD	11-0330G01-01-07-02-019	Rev 0	140
15	Specifications for Pipe Line Hydrotesting	11-0330G01-01-07-02-020	Rev 0	149
16	Specifications for Cleaning and Drying	11-0330G01-01-07-02-021	Rev 0	166
17	Specifications for Precommissioning & Commissioning of Pipeline System	11-0330G01-01-07-02-022	Rev 0	171
18	Specification for Inspection and Testing of Production Weld	11-0330G01-01-07-02-023	Rev 0	180
19	Specification for Pipeline Marker	11-0330G01-01-07-02-024	Rev 0	186
20	Specification for Controlled Rock Blasting	11-0330G01-01-07-02-025	Rev 0	191
21	Pipeline Schematic Diagram	11-0330G01-00-07-01-001	Rev 1	191
22	Pipeline Alignment Sheets (25 No)	11-0330G-00-07-01-101 to 125	Rev B	192

	VOLUME III OF III (PIPELINE) TABLE OF CONTENTS	DOCUMENT NO.	REV
		11 /0330G01/ WGI / GAIL / 01	0
		SHEET 1 OF 1	



GAIL (India) Limited
PIPELINE FROM HANUMAN JUNCTION TO VCL



DESIGN BASIS FOR PIPELINE				CLIENT JOB NO.		-
				TOTAL SHEETS		14
DOCUMENT NO	11	0330G01	01	07	04	001

--	--	--	--	--	--	--

REV.	DATE	DESCRIPTION	PREP	CHKD	APPD
0	04-07-11	ISSUED FOR TENDER	MH	EUR	AD
A	07-06-11	ISSUED FOR IDC	MH	EUR	AD

CONTENTS

1.0	INTRODUCTION.....	3
2.0	SCOPE.....	<u>3</u>
3.0	CODES/ STANDARDS AND DOCUMENTS.....	<u>3</u>
4.0	DESIGN DATA.....	<u>4</u>
5.0	PIPELINE DESIGN	6
5.1	PIPELINE DESIGN & STRESS ANALYSIS	6
5.2	EXPANSION ANALYSIS (UNRESTRAINED SECTIONS)	10
5.3	STABILITY ANALYSIS.....	10
6.0	CROSSING DESIGN.....	11
6.1	UNCASED CROSSING.....	11
6.2	CASED CROSSINGS	11
6.3	HORIZONTAL DIRECTIONAL DRILLING CROSSING.....	12
7.0	STATION LOCATIONS.....	12
8.0	ADDITIONAL REQUIREMENTS.....	12
8.1	COLD FIELD AND HOT INDUCTION BENDS	12
8.2	UPHEAVAL BUCKLING	12
8.3	PRE OPERATIONAL STRESSES	12
8.4	WALL THICKNESS SELECTION	13
ANNEXURE – 1: CHEMICAL COMPOSITIONS OF GAS FROM DIFFERENT SOURCES		14
ATTACHMENT-1: CONCRETE COATING THICKNESS CALCULATION		
ATTACHMENT-2: PIPELINE WALL THICKNESS CALCULATIONS		



DESIGN BASIS FOR PIPELINE

DOCUMENT NO.

11-0330G01-01-07-04-001

SHEET 2 OF 14

REV

0

1.0 INTRODUCTION:

M/s Gail India Limited intends to lay a pipeline from Hanuman Junction (Chainage 154KM) on Tatipaka-Lanco pipeline to VCL where check metering station is proposed to be located.

Laying of 8"X45 Km (approx) long pipeline from Hanuman Junction (at Ch: 154 Km) on existing 18"X 204 Km Tatipaka-Lanco pipeline to Check Metering Station(CMS) without affecting the piggability of the existing 18" Tatipaka-Lanco pipeline. Hot tapping is proposed for connecting the main grid with Lingala-Kaikaluru network. This line will cater the shortfall of gas to existing customers and mitigating gas demands of new customers of 292000 SCMD at 29-30 Kg/cm².

Provision of Pig launcher facility at Hanuman Junction and Pig Receiver facility,2-stage pressure reduction, condensate recovery system and metering skid at VCL.

2 numbers of sectionalizing valve station and station works as defined later.

2.0 SCOPE:

The design principles/methodology, design data, codes and standards, which shall be considered for design of pipeline are provided in this document. The general design procedure for the following item as a minimum has been covered. However, contractor shall adopt appropriate design techniques based on established principles, recognized codes & standards for other pipeline related design activities not covered in this document.

Design methodology for the detailed design of 8" diameter pipeline.

- Design requirements for all TOP connections.
- Design of pipeline for major river crossings.
- General crossing design such as asphalt, metalled roads, national and state highways, railway tracks, canals / watercourses, rivers, streams, drains etc.
- Pipeline stress analysis as per design & site requirements.

3.0 CODES/STANDARDS AND DOCUMENTS:

The pipeline design shall be based on the following codes and standards (Latest Edition).

- ASME B 31.8 - Gas transmission and distribution piping system
- API 5L - Specification for Line pipe, 2007 – 44th edition (Latest)
- API 1102 - Steel Pipelines crossing railroads and crossings
- DIN 30670 - Standards for external coatings
- API 1104 - Standard for welding of pipelines and related facilities
- NACE RP 0169 - Recommended practice, control of external corrosion on underground or submerged metallic piping system
- OISD 141 - Design and construction requirements for cross-country Hydrocarbon pipelines



DESIGN BASIS FOR PIPELINE

DOCUMENT NO.

REV

11-0330G01-01-07-04-001

0

SHEET 3 OF 14

- API 1117 - Movement of in service pipeline
- OISD-226 – Natural Gas Transmission Pipelines & City Gas Distribution Networks
- PNGRB Specifications

NOTE- Wherever there is a conflict between codes, standards and specifications, the requirements of this criterion shall govern.

4.0 DESIGN DATA:

4.1 PIPELINE DESIGN PARAMETERS:

The pipeline design pressure, temperature & material parameters etc. are specified in the following table.

Table 4.1: PIPELINE DESIGN PARAMETERS

Service	:	Natural Gas
Pipeline Length & Dia	:	8" X 45.0 KM
		<i>The above mentioned lengths are tentative and may vary at the time of laying depending on route survey and site conditions.</i>
Pipeline Throughput	:	0.281 MMSCMD
Material for Pipeline	:	Carbon Steel – API 5L X56
Pipeline roughness	:	45 microns without coating
Subsoil temperature	:	20 to 25°C (1.0 m below ground level)
Design temperature	:	-29 to 60°C (for Buried section) -29 to 65°C (for Above ground section)
Operating temperature	:	10 to 45°C
Design pressure	:	u/s of PRMS at CMS : 72kg/sq.cm(g) d/s of PRMS at CMS : 19kg/sq.cm(g)
Operating pressure	:	u/s of PRMS at CMS : 14-19kg/sq.cm(g) d/s of PRMS at CMS : 2-4kg/sq.cm(g)
Hydrostatic Test Pressure	:	Note 1
Pipeline class	:	u/s of PRMS-600#, d/s of PRMS-150#
Design Gas Velocity	:	20 m/s
No. of SV' s	:	Two
No. of Tmnl.s	:	Two
No. of TOP' s	:	Note2
Design Life(years)	:	40

Note 1: For class -1 Minimum test pressure shall be 1.4 times the design pressure & other class-2, 3, & 4 Minimum test pressures shall be 1.5 times the design pressure. However, the maximum test pressure at

	DESIGN BASIS FOR PIPELINE	DOCUMENT NO.	REV
		11-0330G01-01-07-04-001	0
		SHEET 4 OF 14	

the lowest point of the test section or at the section with the least wall thickness shall be limited to hoop stress resulting in 95% of SMYS.

Note 2: Refer PFD / P & ID for the location and number of TOP's.

Chemical composition of Gas is given in Annexure – 1.

Table 4.2: PIPE LINE MATERIAL PROPERTIES

Material Grade for Pipe Line	API 5L Gr. X 56 - PSL2
SMYS, MPa for Main Line	387
Line Pipe fabrication method for Main Line	ERW / SMLS
Negative mill tolerance for thickness of line pipe	NIL
*Corrosion allowance (Internal / External)	0.5 MM
Steel density, kg/m ³	7850
Elastic Modulus, N/mm ²	207000
Poisson's ratio	0.3
Thermal expansion coefficient, mm/m per °C	11.7x10 ⁻⁶

Table 4.3: COATING DETAILS

Application		Type	Thickness	Density kg/m ³
External anti corrosion coating	Main line	3 layer polyethylene coating	Min 2.6 mm @ weld seam Min 2.6 mm @ Pipe body	900
	HDD	3 layer polyethylene coating with epoxy thickness of 180-250 µm	Min 2.6 mm @ weld seam Min 2.6 mm @ Pipe body	
Anti buoyancy measures		Concrete Coating	Min. 50 mm thick & as required as per calculations	2500

Note:- Minimum coating thickness is 2.6 mm.



DESIGN BASIS FOR PIPELINE

DOCUMENT NO.

11-0330G01-01-07-04-001

SHEET 5 OF 14

REV

0

4.2 LOADING PARAMETERS:

The following loads on the highway crossings as specified in Section 4 of the API RP- 1102 shall be adopted for the loading evaluation. The details are given as below:

- Earth load: The earth load is the weight of overlying soil that is conveyed to the top of pipe. The contractor shall determine the density of the soil.
- Live load Highways 574kPa / 479kPa Single axle loading / Tandem axle loading

The depth of the cover for pipeline system measured from cover surface to top of the pipeline shall be as given below (Refer Note – 1):

- a) Normal Excavation: 1.2 m
- b) Drains, Ditches lined & unlined Canals, Nala, Streams and other: 1.5m (Ref. Note 3)
- c) Uncased/Cased Road Crossings: 1.5m (Ref. Note 2)
- d) Railroad crossing: 1.8m (Ref. Note 2)
- e) River Crossing: 2.5 m (Ref Note 3)

NOTES:

1. Minimum depth of cover shall be measured from the top of the pipe coatings to the top of undisturbed surface of the soil, or top of graded working strip whichever is lower.
2. Cover shall be measured from the top of rail road cross section to the top of casing pipe or carrier pipe as per type of crossing & Minimum depth below ditch level with in ROW except under track shall be 1.2 m min. The cover specified shall also meet the Requirement of the permission obtained from statutory authorities.
3. In case of rivers/water bodies, which are prone to scour and erosion, minimum cover maintained shall be 2.5 m below the scour level for the lifetime of pipeline.
4. Wherever cased-crossing is not envisaged, higher cover depths or higher wall thickness of the pipeline shall be considered as per design requirements.

5.0 PIPELINE DESIGN

5.1 PIPELINE DESIGN & STRESS ANALYSIS

5.1.1 WALL THICKNESS DESIGN

For a Gr.X - 56 Pipe, the pipeline wall thickness is selected on the following considerations:

- Pressure confinement Criteria
- Longitudinal stress criteria
- Overburden loads and live loads for highways
- Tensile load criteria for HDD sections

	DESIGN BASIS FOR PIPELINE	DOCUMENT NO.	REV
		11-0330G01-01-07-04-001	0
		SHEET 6 OF 14	

5.1.2 PRESSURE CONTAINMENT CRITERIA

The nominal wall thickness 't' for a given design pressure shall be determined as per ASME B31.8.

$$t = PD/2S FET +CA$$

Where D = Nominal outside diameter of pipe

E = Longitudinal joint factor from Table 841.115A of ASME B31.8 (Latest Edition)

F = Design factor from Tables 841.114A & 841.114B of ASME B31.8 (Latest Edition)

P = Design Pressure

S = Specified minimum yield strength of line pipe material

T= Temperature derating factor from Table 841.116A of ASME B31.8 (Latest Edition)

CA = Corrosion allowance (Nil)

Selected wall thickness for the pipeline will be nearest higher nominal wall thickness as per API 5L.

The wall thickness of the carrier pipe at all road crossings shall be calculated considering the following whichever is stringent.

- Design factor for the pipeline section at road crossings shall be as per table 841.114B of ASME B31.8, Latest Edition.
- Next higher area classification zone shall be considered for road crossings than the adjoining normal class of main line.

5.1.3 PIPELINE STRESS CRITERIA

The pipeline longitudinal and equivalent stresses shall be evaluated for operational, installation and hydro test design conditions. (As per ASME B31.8)

Longitudinal Stresses

The total longitudinal stress S_L , in the pipe shall be calculated by the following formula.

$$S_L = S_E + S_B + S_S$$

Total longitudinal stress, S_L calculated by the above formula shall not exceed SMYS.

Where,

S_E = Existing longitudinal stress in the pipe.

S_B = Longitudinal stress in the pipe due to net downward weight of pipeline including coating and contents.

S_S = Longitudinal stress in the pipe due to its elongation caused by the vertical deflection of pipe.

Generally, buried pipelines are continuously supported in the trench. However, as a conservative approach, free spanning of the pipeline (soil erosion/ soil liquefaction could cause free spanning of the pipelines) shall also been considered in the stress analysis.



DESIGN BASIS FOR PIPELINE

DOCUMENT NO.

REV

11-0330G01-01-07-04-001

0

SHEET 7 OF 14

Total existing longitudinal stress shall be computed considering pressure, temperature and bending effects.

$$S_E = S_P + S_N + S_{BC} \text{ (For restrained lines)}$$

$$S_E = S_P + S_{BC} \text{ (For unrestrained lines), where}$$

- a) S_P is the longitudinal stress due to internal pressure.

The longitudinal stress, (S_P) in the pipe due to internal pressure shall be calculated by the following equation:

$$S_P = PD\mu / 2t \text{ - For restrained section}$$

$$S_P = 0.5 PD / 2t \text{ - For unrestrained section}$$

P = Pressure

D = Outside diameter of the pipe

μ = Poisson's ratio for steel = 0.3

t = Nominal wall thickness of the pipe

Wherever thick cylinder effects provide a more conservative estimate of the stresses, the same shall be considered. For operation and hydrotest condition the design pressure and test pressure respectively shall be considered for analysis.

- b) S_N is the longitudinal stress due to temperature change.

The longitudinal stresses in the pipe due to a change in the temperature shall be calculated with following equation.

$$S_N = E \alpha (T_2 - T_1) \text{ - For restrained section}$$

E = Modulus of elasticity of steel.

α = Linear co-efficient of thermal expansion of steel

T_1 = Temperature of the pipe at the time of installation

T_2 = Maximum/Minimum pipeline metal temperature

- c) S_{BC} is the longitudinal stress due to pipeline elastic curvature and /or stresses induced due to local bending moments

$$S_{BC} = ED / 2R$$

R = Radius of curvature of pipeline, in mm.

- d) Longitudinal stress in the pipeline due to local bending moments.

The longitudinal stress in the pipeline due to bending moments in the expansion zone or bending moments resulting from other sustained, occasional loads in the pipeline section shall be computed by the following equation.

$$S_B = i M/Z$$

M = Resultant Bending moment on the pipeline (in plane and out of plane)

Z = Elastic section modulus of the pipe

i = Stress intensification factor as per ASME 31.8.



DESIGN BASIS FOR PIPELINE

DOCUMENT NO.

11-0330G01-01-07-04-001

SHEET 8 OF 14

REV

0

- e) Shear stresses due to torsion and shear forces applied to the pipeline shall also be considered in the stress calculations.
- f) Longitudinal stress due to any other imposed axial loading shall also be considered as applicable.

5.1.4 COMBINED AND EQUIVALENT STRESS CHECKS

According to OISD 141 – The total of the following shall not exceed the SMYS of the pipe material.

- a) The combined stress due to expansion (bending and shear stresses)
- b) The longitudinal pressure stress
- c) The longitudinal bending stress due to weight and external loads.

In addition to the above, a) shall be less than 0.72 of SMYS and the sum of (b) and (c) shall not exceed 75% of SMYS.

Further the equivalent stress computed considering the hoop and longitudinal stress shall not exceed 90% of SMYS. The equivalent stress calculations shall be based on maximum shear stress theory. The maximum combined and equivalent stresses shall be evaluated considering the signs of bending stresses.

5.1.5 PIPELINE STRESS ANALYSIS AT CROSSINGS

Refer Section 6.0 of this document.

5.1.6 ADDITIONAL REQUIREMENTS for pipeline wall thickness design at HDD sections.

The pipeline wall thickness at HDD section shall be checked considering the overburden loads. In addition the combined stress criteria shall also be satisfied for all the design conditions.

5.1.7 TENSILE LOAD CRITERIA

The pipeline wall thickness shall be designed for a maximum installation pull load. Specialist sub-contractor shall provide separate design calculations for HDD.

Combined longitudinal stress = Tensile stress + Bending stress < 90% of SMYS

The equivalent stress calculations shall include torsional stress induced in the pipeline due to twisting during installation.

The equivalent stress based on maximum shear stress theory shall be less than SMYS

	<p align="center">DESIGN BASIS FOR PIPELINE</p>	<p align="center">DOCUMENT NO.</p>	<p align="center">REV</p>
		<p align="center">11-0330G01-01-07-04-001</p>	<p align="center">0</p>
		<p align="center">SHEET 9 OF 14</p>	

In addition, as per OISD 141 – The total of the following shall not exceed 75% of SMYS of the pipe material at the HDD section during pipeline operation.

- d) The longitudinal stress due to pressure and thermal loads
- e) The longitudinal bending stress due to external loads

Further, considering the hoop stress and d) and (e) above the equivalent stress shall not exceed 90% of the SMYS.

Considering pipeline in-place operational analysis, the minimum allowable curvature of each HDD section shall be obtained so as to ensure that combined stress criteria are satisfied. The allowable bending radius shall be the maximum of the calculated allowable curvature for the operational stresses and the permissible minimum allowable bending radius of $R = 1000 \times OD$ (meters) during installation so as to ensure that the geometry of the HDD section is acceptable.

5.1.8 EXPANSION ANALYSIS (Unrestrained Sections)

The pipeline expansion α , due to the effects of design pressure and temperature difference in the pipe wall, shall be computed for pipeline, taking into account resisting frictional forces developed between the pipeline and seabed soils, and expansion stress shall be computed.

5.1 STABILITY ANALYSIS

In order to prevent floatation of pipeline in marshy areas, low laying areas, river crossing etc. concrete weight coating shall be provided as per design requirement. The thickness of the concrete coating and spacing of saddle weight shall be determined based on the following criteria.

Weight of the pipe Concrete coating thickness and spacing of saddle weight shall be calculated based on the following criteria. $W_p = W_1 + W_2 + W_3$

W_p = Net downward pipe weight including coatings/unit run

W_1 = Steel pipe weight/unit run

W_2 = PE coating weight/unit run

W_3 = Concrete coating weight/unit run

$W_B = (\pi D^2 / 4) \times \text{density of water}$

D = Total outside diameter of the pipe including concrete coating

Factors of Safety = $W_p / W_B > 1.3$

Flotation check shall be carried out for buried pipelines under empty condition. A vertical settlement analysis shall also be carried out based on the soil data and should confirm no undue settlement of the pipeline.

The following minimum concrete coating thickness shall be provided for the pipelines

Table 5 Minimum Concrete Coating Thickness Requirements

	<p>DESIGN BASIS FOR PIPELINE</p>	<p>DOCUMENT NO.</p>	<p>REV</p>
		<p>11-0330G01-01-07-04-001</p>	<p>0</p>
		<p>SHEET 10 OF 14</p>	

Sl. No.	Line	Pipe Size x Wall Thickness (mm)	Minimum Concrete Coating Thickness (mm)
1	8"	8" x 6.4 –Gr. X-56	50*

*** Note:-**

The above values are indicative and shall be evaluated during detail engineering.

In the areas wherein soil is prone to liquefaction due to seismic loads or due to flooding, the effective liquefied slurry density shall be considered for the concrete coating calculations. Currently there are no seismic fault areas along the pipeline.

6 CROSSING DESIGN

6.1 UNCASSED CROSSING

All roads, water course, stream and river crossings shall be uncased, other than those which are mandatory requirement of concerned authority, crossings identified in the alignment drawings and for the crossings as stated in section 6.2. However local requirements will be dealt as per guidelines of local authority. The design of uncased crossing shall be as per Section 5 of the API-RP-1102. Typical crossing analysis to be carried out for a highway & railway crossings.

6.2 CASSED CROSSINGS

All state and national highways, railways major canals and lined canals/distributors shall be executed by thrust boring with casing pipe. The design factors used for the carrier pipe design at cased crossings shall be the same as that considered for uncased crossings. All local requirements shall be dealt as per guidelines of local authority. The design of cased crossing as per Sec 5 of API RP 1102. Next higher wall thickness (except for class 4) shall be considered for the pipeline sections at all road crossings, major rivers and canals than the adjoining wall thickness of the main pipeline.

Table 6.2 Casing Pipe Details

Type of Casing	Nominal size, mm	Material	Type	Min. wall thickness, mm
For main pipeline of 8" size	12"	API 5L Gr. B (PSL 1) or IS 3589	EW/SMLS	6.4
For OFC	6"	API 5L Gr. B (PSL 1) or IS 1239	EW	6.4

Note: For all cased crossings, HDD Crossings (as identified by OWNER) & open cut river crossings 6" steel casing pipe with two HDPE conduits shall be provided.

Separate HDD to be done for steel casing pipe for OFC in addition to the Mainline HDD.

	DESIGN BASIS FOR PIPELINE	DOCUMENT NO.	REV
		11-0330G01-01-07-04-001	0
		SHEET 11 OF 14	

All major crossing should have two HDPE conduits in one steel pipe to take care of future OFC blowing.

6.3 HORIZONTAL DIRECTIONAL DRILLING CROSSING

HDD (horizontal direction drilling) shall be carried out for the river crossings and other crossings, which are specified elsewhere in the bid. The detail design will be carried out by HDD specialist contractor. However, design criteria shall be as per the recommendations given in Section 5.1.6.

7 STATION LOCATIONS

The sectionalizing valve stations shall be located as specified in PFD / P&ID. The minimum wall thickness of the pipeline at the launcher, receiver and sectionalizing valve stations within and up till plot boundary limits shall be as per Table8.4.

8 ADDITIONAL REQUIREMENTS

8.1 COLD FIELD AND HOT INDUCTION BENDS

After providing the allowance for wall thinning due to bending, the wall thickness at the cold field bends and hot induction bends shall not be lower than the minimum required as per section 5.1. No mitre bends are permitted. Hot induction bends shall not be cut and re-welded except at the bevel ends. Thickness of pipe to be taken for hot induction bend shall be as per a location class-IV.

Table 8.1: BENDING DETAILS

Long radius bends (Induction)	Minimum radius 6D
Cold Field Bends	Minimum radius 18D (Min)

8.2 UPHEAVAL BUCKLING

For pipeline section having minimum cover and at other locations wherein the pipeline vertical curvatures are extremely sharp (like at HDD inlet and exit points etc.) the breakout of the pipeline from the trench due to upheaval buckling shall be checked and preventive measures shall be considered. Contractor shall also provide detail calculations during detail engineering to substantiate the methodology to be adopted.

8.3 PRE OPERATIONAL STRESSES

Stresses in the pre operational phase like transportation, stacking, stringing, fixed bending and back filling etc. shall be controlled and shall not cause any injury to the pipe.

	<p>DESIGN BASIS FOR PIPELINE</p>	<p>DOCUMENT NO.</p>	<p>REV</p>
		<p>11-0330G01-01-07-04-001</p>	<p>0</p>
		<p>SHEET 12 OF 14</p>	

8.4 WALL THICKNESS SELECTION

The minimum wall thicknesses to be provided for pipeline are given in the Table 8.4. This wall thickness shall be confirmed during detail engineering for adequacy.

Table 8.4-Selected Pipeline Wall Thickness (8”)

Type of Line	Pipe Line Size	Area Class / location	Type of line pipe	Line Pipe Material	Carrier Line	At SV & Terminal Piping	Cased crossings and other Major Crossings
					Selected Nominal W.T. (mm)	Selected Nominal W.T. (mm)	Selected Nominal W. T. (mm)
Main Line	8”	Class 1&2	ERW / SMLS	API 5LGr.X-56	6.4	6.4	6.4



DESIGN BASIS FOR PIPELINE

DOCUMENT NO.

11-0330G01-01-07-04-001

SHEET 13 OF 14

REV

0

ANNEXURE – 1: CHEMICAL COMPOSITIONS OF GAS FROM DIFFERENT SOURCES

S.NO.	PARAMETER	TYPICAL (MOLE%)
1)	Methane (C1)	91.89
2)	Ethane (C2)	2.48
3)	Propane (C3)	2.15
4)	i-Butane (i-C4)	0.43
5)	n-Butane (n-C4)	0.59
6)	i-Pentane (i-C5)	0.16
7)	n-Pentane(n-C5)	0.14
8)	Hexane(C6+)	0.31
9)	Carbon Di-Oxide	0.74
10)	Nitrogen(N2)	0.1

**DESIGN BASIS FOR PIPELINE****DOCUMENT NO.****REV****11-0330G01-01-07-04-001****0****SHEET 14 OF 14**



GAIL (India) Limited
PIPELINE FROM HANUMAN JUNCTION TO VCL




PROCEDURE FOR HOT TAPPING				CLIENT JOB NO.		-
				TOTAL SHEETS		9
DOCUMENT NO	11	0330G01	01	07	02	001

--	--	--	--	--	--	--

REV.	DATE	DESCRIPTION	PREP	CHKD	APPD
0	04-07-11	ISSUED FOR TENDER	MH	EUR	AD
A	07-06-11	ISSUED FOR IDC	MH	EUR	AD

CONTENTS

1	SCOPE.....	3
2	DEFINITIONS.....	3
3	WORK PROCEDURE.....	04
4	PIPELINE CONDITIONS.....	04
5	SAFETY PROCEDURE AND CHECK LIST	06
6	NON DESTRUCTIVE TESTING.....	07
7	CHECK LIST IN ADDITION TO PRE-EXECUTION & EXECUTION CHECK LIST.....	07
8	RESPONSIBILITY MATRIX.....	08
9	WELDING RECOMMENDATIONS FOR FULL ENCIRCLEMENT FITTINGS.....	08

	PROCEDURE FOR HOT TAPPING	DOCUMENT NO.	REV
		11-0330G01-01-07-02-001	0
		SHEET 2 OF 9	

1 SCOPE

1.1 It should be borne in mind that Hot Tapping will be done on in-service pipeline which contains considerable quantity of hydrocarbons and hence any deviation from the established procedure or committing any inadvertent mistake will result in serious consequences of product leak, fire or explosion, which could be disastrous. It is absolutely essential that all those concerned with the operation shall rigidly follow established procedure, be alert & vigilant all the time & ensure safety of personnel, property & environment around.

Following things are to be taken care for design of hot tapping:-

Safety

Condition of the pipe under consideration

Configuration of the connection

Code / statutory requirements

Operating conditions

Technical capabilities of the tapping equipment under operating condition

Welding

Environment/pollution aspect

1.2 The safety plan shall include:-

Access to site for personnel & equipment

Roles of dedicated personnel and their responsibilities on site

Monitoring of operating conditions

Foreseeable hazards and contingency actions

Communication on site

Warning system

Means of escape

Fire fighting equipment and personnel

Safety equipment and personnel

Safety equipment and services

First aid facilities

Emergency procedures shall also be specifically addressed, either in the safety plan or in a separate document.

2 DEFINITIONS

For this specification the following definitions shall apply:

OWNER	-	GAIL (India) Limited
CONSULTANT	-	Wood Group Kenny India Pvt. Ltd.
CONTRACTOR	-	The Company named as such in the deed
SHALL/MUST/ISTO BE	-	A mandatory requirement
SHOULD	-	A non-mandatory requirement, advisory or recently Amended

	PROCEDURE FOR HOT TAPPING	DOCUMENT NO.	REV
		11-0330G01-01-07-02-001	0
		SHEET 3 OF 9	

3 WORK PROCEDURE

3.1 Procedure shall be prepared for all aspects of the physical work:-

Site preparation

Pipe preparation

Welding

NDT

Hot Tapping

3.2 Pipe preparation:-

Coating removal

Surface cleaning & visual inspection

Ovality check with callipers/check reports

Area to be welded

Internal consideration

3.3 Welding & inspection of in-service pipeline:-

Approved welding procedure specification (WPS) shall be used and qualification in accordance with API 1104.

Approved procedure qualification record (PQR) shall be used to weld the joints.

3.4 Consumable:-

Electrode shall conform to AWS A 5.1/5.5/AWS Class E6010/E8010 electrodes shall be used for the welding as specified in WPS/PQR.

3.5 Welding inspection

a) During welding:-

Visual inspection for discontinuities such as cracking, porosity, proper slag removal

DPT of the root run

b) After welding:-

MPT of the welds

NDT personnel shall be qualified to ASNT recommended practice for non-destructive testing. Only level II or level III personnel shall be used for interpretation of the test results.

4 PIPELINE CONDITIONS:

4.1

Pipeline operating parameters	
Pipeline size	8"
Pipeline operating pressure	31-42.5 Kg/cm ²
Pipeline operating temperature	10-45 °C
Pipeline product	Gas



PROCEDURE FOR HOT TAPPING

DOCUMENT NO.

11-0330G01-01-07-02-001

REV

0

SHEET 4 OF 9

Pipeline material of construction (operating pipeline)	API 5L Gr.X-56
Design factor	0.72/0.6
Wall thickness	6.4 MM
Pipeline flow / velocity	0.303 MMSCMD(31 Kg/Cm2)
Orientation of hot tapping	Horizontal
Presence of H2S	Refer Annexure-1 of Design Basis for Pipeline(Doc.No.11-0330G01-01-07-04-001)
Presence of CO2(% Volume)	Refer Annexure-1 of Design Basis for Pipeline(Doc.No.11-0330G01-01-07-04-001)
Rating of Valve	600#

4.2 Initial inspection of the pipeline before welding

Job Description	Responsibility
Verify the atmosphere in the immediate area of the work is free of any and all flammable, explosive and toxic vapors. Flammable gases to be detected through calibrated hand held gas detectors.	Contractor/WGI
The area shall be continually monitored for vapours	Contractor/ WGI
If required, demagnetization shall be carried out and arrangements will be made in advance	Contractor/ WGI
Communication facility needs to be available at site	Contractor/ WGI
Personnel at site should not wear 100% nylon, polyester clothing. It is preferable to use cotton clothes	Contractor/ WGI
Appropriate personnel protective equipment-safety hats, safety shoes,gloves,goggles,welding hood etc. should be used	Contractor/ WGI
Identify the desired location of the tapping fitting. Clean the pipe in the area to be inspected to bare metal by mechanical and/or chemical means contaminates (using GQ-4 grinding machine with stringer brush) to remove all coating, dirt, and contaminates. necessary precautions needs to taken not to remove the parent metal during cleaning	Contractor/ WGI
Mark the area to be inspected. This area shall extend beyond the projected ends of the tapping fitting by at least 4" in both directions	Contractor/ WGI
Ultrasonically examine this area to determine the actual wall thickness and the soundness of the pipe. Ultrasonic examination to be witnessed by TPIA & owner	Contractor/ WGI
Confirm the operating flow which is meeting the requirement or not	Contractor/ WGI

5 Safety Procedure and Check list

	PROCEDURE FOR HOT TAPPING	DOCUMENT NO.	REV
		11-0330G01-01-07-02-001	0
		SHEET 5 OF 9	

It should be borne in mind that Hot Tapping will be done on in-service pipeline which contains considerable quantity of hydrocarbons & hence any deviation from the established procedure or committing any inadvertent mistake will result in serious consequences of product leak, fire or explosion, which could be disastrous. It is absolutely essential that all those concerned with the operation shall rigidly follow established procedure, be alert & vigilant all the time & ensure safety of personnel, property and environment around.

- Verify the atmosphere in the immediate area of the work is free of any and all flammable, explosive and toxic vapors. This is to be done by customer representative. The area shall be continuously monitored for vapors. The customer representative shall be present during any and all operation.
- Personnel at site should not wear 100% nylon; polyester clothing. It is preferable to use cotton clothes.
- No one should wear oil soaked clothes.
- Appropriate personnel protective equipment-safety hats, safety shoes, gloves, goggles, welding hood, safety belts etc. should be used depending on the nature of job carried out.
- Proper means of exit should be readily available for Hot Tapping personnel at site.
- For working at height, metal scaffolds should be built sturdily & stable.
- The welder should be properly protected against welding fumes.
- Customer to assist in providing a fire watch squad using personnel trained in the use of the appropriate fire fighting equipment and procedure.
- Customer representative shall verify / certify the flow & pressure of the product. Velocity required for welding and hot tapping shall be checked before start of welding.
- No work should be carried out unless authorised by the company supervisor.
- Make sure that all the points in the check list furnished below are strictly met.

5.1 Fit-up and welding of the Tapping fitting

Hot permit shall be obtained before start-up of the activity	Contractor/WGI
Provide fire fighting equipment and personnel.	Contractor/WGI
Adequate lifting equipment to be used for fit up of the Tapping Fitting on the pipeline (If required)	Contractor/WGI
All lifting equipments like crane, chains, ropes and lifting tackles shall be maintained in good operating condition and certified	Contractor/WGI
Necessary secure provision shall be made so far as is reasonably practical by fencing or otherwise using safety nets (if required)	Contractor/WGI
Emergency escape route be install for speedy evacuation of the site personnel	Contractor/WGI
Welding to be carried out as per the WPS and by using qualified welders. Crack to be detected conducting Dye Penetrant Test for root and for final weld. Preheating shall be done as per WPS after DP test	Contractor/WGI

6. Non Destructive Testing

	PROCEDURE FOR HOT TAPPING	DOCUMENT NO.	REV
		11-0330G01-01-07-02-001	0
		SHEET 6 OF 9	

a) During welding:

Visual inspection for discontinuities such as cracking, porosity, proper slag removal.

Dye penetrate test

b) After welding:

NDT personnel shall be qualified to ASNT recommended practice for non destructive testing. Only level II or level III personnel shall be used for interpretation of the test result.

7. Check list in addition to pre-execution & execution check list

a) Before starting the Hot Tap

Has the working permit been obtained?	Yes / No
Does the tapping machine have suitable pressure & temperature rating & adequate travel for the job	Yes / No
Has the exact location of the hot tap on the line been identified & marked	Yes / No
Has the weld area been inspected for thickness & freedom from lamination or other metallurgical imperfection	Yes / No
Has the metallurgy of the pipe wall is been established and is it compatible with the Hot Tap Fitting	Yes / No
Do the flanges, bolts, gaskets & valve to be installed meet the piping code for the line to be Hot Tapped?	Yes / No
Is there sufficient clearance to accommodate the operation of the Hot Tapping machine?	Yes / No
Is there sufficient clearance to retract the cutter through the valve?	Yes / No
Have combustible & toxic gas tests have been conducted in the area of Hot tapping?	Yes / No
Has fire fighting devices / equipment been provided	Yes / No
Has suitable protective equipment been provided to all the personnel in the Hot Tap area	Yes / No
Is there adequate hoisting & support equipment for the tapping machine	Yes / No

b) Before welding & after welding:

Is preheating of the weld area done as per approved WPS / PQR?	Yes / No
Is the Hot Tap fitting properly positioned so misalignment of the hot tap machine will not occur	Yes / No
Has the pressure & temperature of the pipeline been checked	Yes / No
Is there liquid or flowing gas in contact with the area to be hot tapped	Yes / No
Has the weld been tested	Yes / No

c) Before Tapping (Cutting):

	PROCEDURE FOR HOT TAPPING	DOCUMENT NO.	REV
		11-0330G01-01-07-02-001	0
		SHEET 7 OF 9	

Have the hot tap valve,packing,gasket,bolts been checked for possible leakage	Yes / No
Has the packing or seals of the tapping machine been checked	Yes / No
Has the bleeder valve been checked to be sure that it will hold, is operable, is not obstructed	Yes / No
Are all the bolts on the cutter are tight	Yes / No
Is the retainer rod(u-rods) are free	Yes / No
Is the valve centred on the flange	Yes / No
Has the tapping distance is been calculated	Yes / No
Has the boring bar run through the valve to ensure free passage	Yes / No
Have the manufacturers instructions been followed to be sure that the boring bar is completely retracted before closing the hot tap valve	Yes / No
Has the hot tap valve been closed	Yes / No
Has the bleeder valve been opened	Yes / No
Has the pressure been bleeder off from the machine before removing	Yes / No

8. Responsibility matrix

S.No.	Activity	Responsibility
1	Location marking for Hot Tapping	WGI/ Contractor
2	Preparation of Pit for Hot Tapping	WGI / Contractor
3	Pipe preparation (Coating removal,UT Testing)	WGI / Contractor
4	Fit-up & welding	WGI / Contractor
5	Non destructive testing	WGI / Contractor
6	Hot tapping	WGI / Contractor
7	Final coating	WGI / Contractor
8	Back filling	WGI / Contractor
9	House keeping	WGI / Contractor

9. Welding recommendations for full encirclement fittings

9.1 Recommended installation of full encirclement fittings

1. Weld procedures and welders should be qualified to the relevant code, applicable to the client where as in this case as per API 1104.
2. The installation location should be checked for roundness after it has been cleaned thoroughly. The external condition of the pipe should be examined for corrosion.
3. Throughout the area of the installation location an ultrasonic examination should be performed to establish.
 - a) Actual wall thickness
 - b) Actual condition of the pipe wall



PROCEDURE FOR HOT TAPPING

DOCUMENT NO.


11-0330G01-01-07-02-001

SHEET 8 OF 9

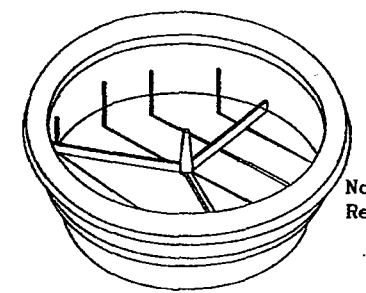
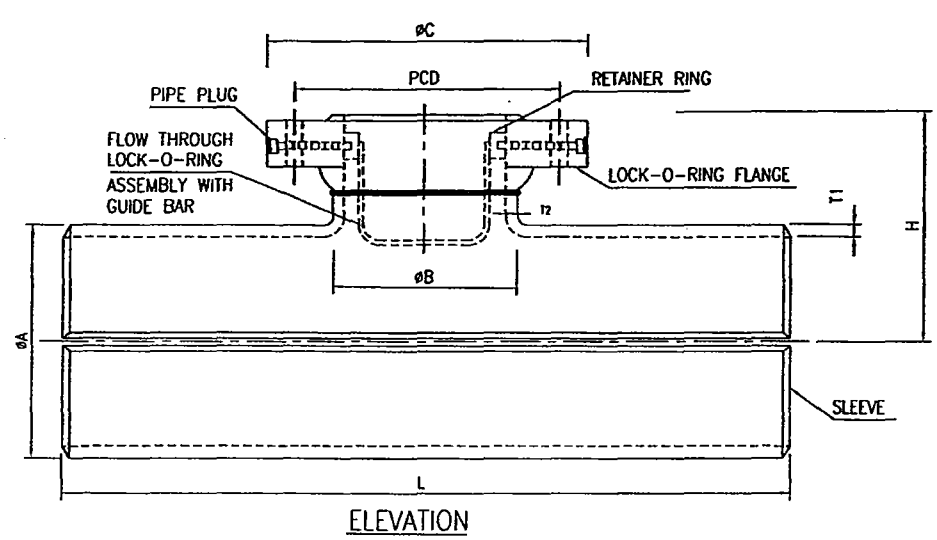
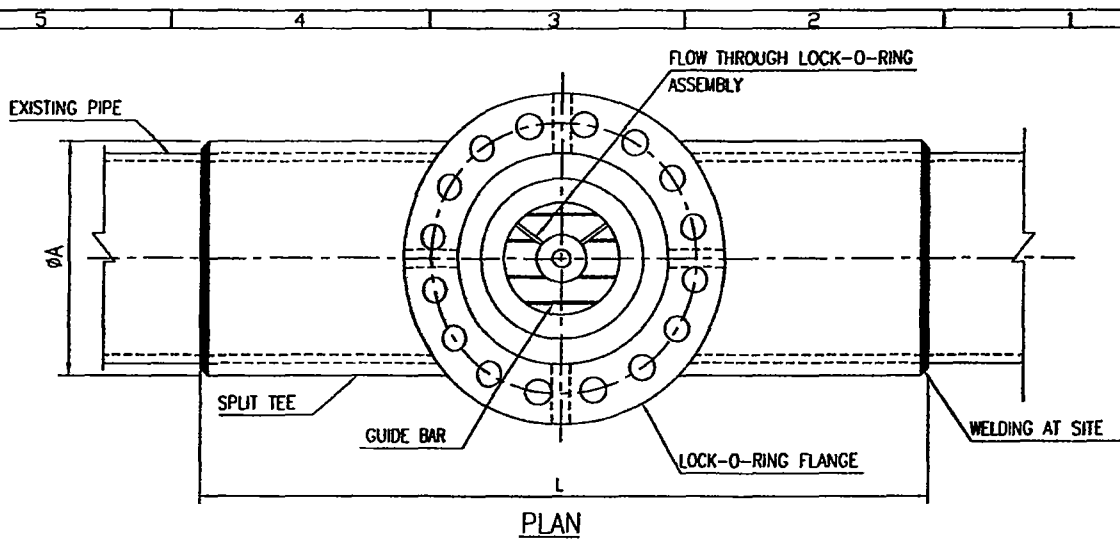
REV

0

4. Thoroughly clean both the pipe and the weld areas of the fitting, removing ail wrapping, paint, corrosion and scale.
5. In high moisture areas (If moisture content is more than 80%) the line should be preheated to a predetermined amount to reduce the moisture on the line before the installation is commenced.
6. Rest the Top (branch) of the fitting on the pipe, with the backing strips (if required) inserted in place. Ensure that the fitting, in total, is a snug fit around the pipe. The circumferential (fillet weld) gap is recommended to be between 1/16" 1/8" (1.5 – 3mm).On occasions field modification of the fitting may be required due to variations in pipe O.D. tolerance .In addition it is recommended that spiral or seam welds on the pipe O.D. are ground flush to facilitate a correct fit.
7. Centre and level the fitting. Flange centreline should intersect the centreline of the pipe. Flange gasket face should be parallel to the pipe.
8. Welding electrodes recommended for this operation are 4.00 mm diameter of E8010 is normally used for all passes to complete entire welding as per approved WPS / PQR.
9. With consideration to ambient and line temperature, and flow, hence cooling rate of the pipeline product, consideration should be given to establishing the welding cycle available. This may be done by preheating the fitting / line to the upper welding limit (250 degree C) and then timing the temperature decay to the lower welding limit (100 deg C) this would define the welding cycle.
10. After preheating, if required, tacks weld the four comers of the longitudinal seams, each tack being no longer than 12.5 mm (½").On no account should the tack, or any portion of the longitudinal weld come into contact with the pipe.
11. After positioning of the fitting by tack welding, prepare both ends of the tack welds by grinding .Pre heat the fitting, if required, to the requisite figure, then commence welding for branch joint and as well as for reinforcing pad as described above, i.e. 4 mm (5/32") electrodes for all passes until completion, ensure that welding is carried out diagonally in opposition.
12. On completion of one circumferential weld again giving consideration to pre heat and using 4 mm electrodes to complete the fillet welds. The normal sequence to be followed is that a number of buttering layers are welded to the pipe wall, but not in contact with the fitting, and the following run is then applied to the 'throat' of the tee, between the tee and the innermost buttering run. The remaining weld sequence is then to fill the rest of the fillet. The normal fillet size (leg length) deposited is between 1 and 2 times the wall thickness.


	PROCEDURE FOR HOT TAPPING	DOCUMENT NO.	REV
		11-0330G01-01-07-02-001	0
		SHEET 9 OF 9	

CLIENT:		GAIL India Limited		PIPELINE FROM HANUMAN JUNCTION TO VCL	
QUANTITY: 1 No					
1	Type of Fitting	18" x 8" Reduced Branch Split Tee with Lock-O-ring flange & Guide bar			
2	ANSI Rating	600#			
3	Quantity	01 No.			
4	Design Code	ASME B31.8			
5	Design Pressure	72 kg/cm2			
6	Design Temperature (°C)	0 to 65			
7	Corrosion Allowance (mm)	0.5			
8	Design Factor (F)	0.6			
9	Flange Facing	RF			
10	Flange Finish	125 AARH			
11	Branch End	BW (MSS-SP-75)			
12	PWHT	Yes (in accordance with code) @			
13	Field Test Pressure	108 kg/cm2			
14	a) Existing Pipeline Details (on which hot tapping is to be conducted)	Outside Diameter : 18"NB Pipe Cover: 1.5m - 2.5m Thickness : 8.7mm Material : API 5L Gr. X-60			
	b) Connecting Branch Pipeline Details	Outside Diameter : 8"NB Thickness : 6.4 mm Material : API 5L Gr. X 56			
15	Type of Valve to be used on the branch	Full Bore Ball Valve, RF at one end & BW at other end			
16	Product Handled	Natural Gas			
17	Sleeve, OD - dia. A(mm)	@			
18	Sleeve, Thickness - T1(mm)	@			
19	Sleeve, Length - L(mm)	@			
20	Branch, OD - dia. B(mm)	@			
21	Branch, Thickness - T2(mm)	@			
22	Fitting Height (center line of run pipe to flange top) - H(mm)	@			
23	Flange, OD - dia. C (mm) @	@			
24	Split Tee, Weight (kg) @	@			
25	MATERIAL REQUIREMENT				
	Part Description	Specified Material		Offered Material by Bidder	
a	Full Encirclement Sleeve - Top Portion	MSS-SP-75, Gr.X-60 / A-537Cl.1 / ASTM A 707 L3 CL3 or equivalent.		@	
b	Full Encirclement Sleeve - Bottom Portion	MSS-SP-75, Gr.X-60 / A-537Cl.1 / ASTM A 707 L3 CL3 or equivalent.		@	
c	Branch	MSS-SP-75, Gr. WPHY-56 / A-537Cl.1 / ASTM A 707 L3 CL3 or equivalent		@	
d	Lock-O-Ring Flange	Manufacturer Standard		@	
e	Lock-O-Ring Assembly with Guide Bars	Carbon Steel		@	
f	Lock-O-Ring/ Retaining Device	Manufacturer Standard		@	
NOTES:-		* To be confirmed later @ Bidder to indicate			
1	Split Tee shall be manufactured, tested and supplied in accordance with Spec				
2	For Typical arrangement of Reduced Branch Split Tee with Lock-O-Ring Flange & Guide Bar Assembly Refer Drawing				
3	Fittings thickness shall be calculated based on pressure corresponding to ANSI 600# and considering design code, design factor and corrosion allowance indicated above. Calculation in this respect shall be submitted by vendor for review/ approval of Purchaser/ Consultant.				
4	The fitting shall be capable of withstanding field hydrostatic test pressure indicated above or 90% of SMYS of fitting material which ever is more.				
5	Requirement of impact test & hardness as per tender specification shall be applicable for the Fittings & Flange material.				
6	Flow through Lock-O-ring assembly with guide bars shall allow full flow into branch line and shall allow pigs to cross the opening smooth & unobstructed in the main pipeline.				
7	Lock-O-ring flange assembly with guide bars shall be of TDW make or equivalent. Vendor shall indicate the name of manufacturer for the same.				
8	Vendor shall submit Inspection & Test Plan for approval within two weeks from date of order.				
		PROCESS DESIGN BASIS		DOCUMENT NO.	
				11-0330G01-11-02-001	
				Rev.	
				0	
SHEET 1 of 1					



Note:
Refer This drg. together with DS

FLOW THROUGH LOCK-O-RING
ASSEMBLY WITH GUIDE BAR

REV NO	DATE	ZONE	DESCRIPTIONS	BY	APPRD	REFERENCES	DRG. NO.
			REVISIONS				
			SPLIT TEE WITH LOCK-O-RING FLANGE & GUIDE BAR ASSEMBLY (TYP.)		DRAWING NO 11-0330G01-01-07-02-002		Rev. 0
SHEET 1 of 1							



GAIL (India) Limited
PIPELINE FROM HANUMAN JUNCTION TO VCL



SPECIFICATION FOR FIELD JOINT COATING				CLIENT JOB NO.		-
				TOTAL SHEETS		10
DOCUMENT NO	11	0330G01	01	07	02	007

--	--	--	--	--	--	--

REV.	DATE	DESCRIPTION	PREP	CHKD	APPD
0	04-07-11	ISSUED FOR TENDER	MH	EUR	AD
A	07-06-11	ISSUED FOR IDC	MH	EUR	AD

CONTENTS

1	SCOPE.....	3
2	DEFINITIONS.....	3
3	REFERENCE DOCUMENTS	3
4	MATERIALS AND EQUIPMENT.....	4
5	APPLICATION PROCEDURE	6
6	INSPECTION AND TESTING	8
7	REPAIRS	10
8	DOCUMENTATION	10

	SPECIFICATION FOR FIELD JOINT COATING	DOCUMENT NO.	REV
		11-0330G01-01-07-02-007	0
		SHEET 2 OF 10	

1 SCOPE

- 1.1 This specification establishes the minimum requirements of materials, equipment and installation of field joint anti-corrosion coating of buried onshore pipelines factory coated with three layer polyethylene by heat shrink wraparound sleeves conforming to DIN EN 12068 class C– “Cathodic Protection – External Organic Coatings for the Corrosion Protection of Buried Steel Pipelines.

This specification shall be read in conjunction with the conditions of all specifications and documents included in the Contract between Owner/Consultant and Contractor. Unless specified otherwise, all sections of this specification shall apply to all specifications referred in this specification.

2 DEFINITIONS

For this specification the following definitions shall apply:

OWNER	- GAIL (India) Limited
CONSULTANT	- Wood Group Kenny Pvt Ltd.
CONTRACTOR	- The Company named as such in the deed
SHALL/MUST/ISTO BE	- A mandatory requirement
SHOULD	- A non-mandatory requirement, advisory or recently Amended

3 REFERENCE DOCUMENTS

Reference has also been made to the latest edition (edition enforce at the time of floating the enquiry) of the following standards, codes and specifications:

- a) ASTM D-149: Standard Test Methods of Dielectric Breakdown voltage and Dielectric strength of solid electrical insulating materials at commercial frequencies.
- b) ASTM D-257: Standard Test Methods for D-C Resistance or conductance of insulating materials.
- c) ASTM D-570: Standard Method of Test for Water Absorption of Plastics.
- d) ISO 8502 – 3: Preparation of Steel Substrates before Application of Paints and Related Products – Part 3 - Assessment of Dust on Steel Surfaces Prepared for Painting (Pressure Sensitive Tape Method)
- e) ISO 8503 – 1: Part 1: Specification and definitions for ISO surface profile comparator for the assessment of abrasive blast cleaned surfaces.
- f) ISO 8503 – 4: Part 4: Methods for calibration of ISO surface profile comparator and for the determination of surface profile – Stylus instrument procedure.
- g) SIS-055900 : Pictorial Surface Preparation Standard for Painting Steel Surfaces.

	SPECIFICATION FOR FIELD JOINT COATING	DOCUMENT NO.	REV
		11-0330G01-01-07-02-007	0
		SHEET 3 OF 10	

h) SSPC-SP1 : Steel Structure Painting Council.

l) DIN EN12068 Class C : Cathodic Protection – External Organic Coatings for the Corrosion Protection of Buried Steel Pipelines

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

The CONTRACTOR shall be familiar with the requirements of these documents and shall make them readily available at the site to all personnel concerned with carrying out the works specified in this specification.

4 MATERIALS AND EQUIPMENT

4.1 Field joint anti-corrosion coating material shall be either heat shrinkable wraparound sleeve or cold applied tape suitable for a maximum operating temperature of (+) 60°C (T_{max}) and shall conform to designation EN 12068 - C HT 60 UV. In addition, the field joint anti-corrosion coating shall comply the requirements specified in Para 4.2 of this specification.

4.1.1 Heat shrinkable wraparound sleeves

Heat shrinkable wraparound sleeve shall consist of radiation cross-linked, thermally stabilized, ultraviolet resistant semi-rigid polyolefin backing with a uniform thickness of high shear strength thermoplastic/co-polymer hot melt adhesive. The joint coating system shall consist of a solvent free epoxy primer applied to the pipe surface prior to sleeve application. The backing shall be provided with suitable means (thermo- chrome paint, dimple, or other means) to indicate the desired heat during shrinking in field is attained. The sleeve shall be supplied in pre-cut sizes to suit the pipe diameter and the requirements of overlap.

The total thickness of heat shrinkable wraparound sleeve in the as applied condition shall be as follows:

Pipe Size (Specified Outside Diameter)	Thickness (mm)		
	On Pipe Body		On Weld Bead
	Average	Min.	Min.
8" (219.1 mm)	2.5	2.2	2.0

The heat shrink wraparound sleeve shall have the required adhesive properties when applied on various commercial pipe-coating materials. The pre-heat and application temperatures required for the application of the shrink sleeve shall not cause loss of functional properties of the pipe coating.

The Contractor shall propose the specific grade of field joint coating system meeting the requirements of this specification from these manufacturers. In case the Contractor proposes to supply heat shrinkable wraparound sleeve then the Contractor shall propose only those coating systems that have been previously used in pipelines of same or higher than the size indicated in tender for a length of 50 km and above in a single project for similar operating conditions.



SPECIFICATION FOR FIELD JOINT COATING

DOCUMENT NO.

11-0330G01-01-07-02-007

SHEET 4 OF 10

REV

0

4.2 Functional Requirements of Field Joint Coating

4.2.1 Properties of the PE backing shall be as follows:

Sl. No.	Properties	Unit	Requirement	Test Method
a.	Tensile Strength @ +25°C	N/mm ²	> 12	DIN EN 12068
b.	Ultimate Elongation @ +25°C	%	> 250	DIN EN 12068
c.	Dielectric withstand with 1000 Volts/sec	KV	> 30	ASTM D 149
d.	Water absorption, @ +25°C for 24 hours	%	<0.05	ASTM D 570
e.	Volume Resistivity @ +25°C	Ohm-cm	> 10 ¹⁵	ASTM D 257

4.2.1 Functional Properties of Joint Coating System (As applied) As applied field joint coating system shall comply the requirements of DIN EN 12068, Table 1 and 2 corresponding to designation DIN EN 12068 – C HT 60 UV, except as modified below :

- a) Cathodic Disbandment Resistance at T_{max} i.e. (+) 60°C shall be 20 mm when tested as per Annexure K of DIN EN 12068. Test shall be carried out at (+) 60°C
- b) Peel Strength shall be as follows:

Peel Strength		Unit	Requirement for Mech Resistance Class C (minimum)	Test Method as per DIN EN 12068
Inner to Inner + Outer to Inner	@ 23°C	N/mm	1.5	Annexure B
	@T max	N/mm	0.3	
Outer to Outer	@ 23°C	N/mm	1.5	
	@T max	N/mm	0.3	
To Pipe Surface	@23°C	N/mm	3.5	Annexure C
	@T max	N/mm	0.5	
To Factory Coating	@23°C	N/mm	3.5	
	@T max	N/mm	0.5	

Contractor shall obtain prior approval from Owner/Consultant regarding the Manufacturer of the joint coating material and the specific grade of the joint coating system. Complete technical details along with test certificates complying with the requirements of clause 4.2.1 and 4.2.2 shall be submitted to Owner/ Consultant for this purpose. The Contractor shall furnish test certificates from an independent DIN recognized/approved laboratory for all the properties required for the specified EN designation of field joint coating and the requirements of this specification.

4.3 The materials shall not be older than their period of validity at the time of application by Contractor. Deteriorated/decomposed material shall be disposed off and replaced by Contractor at his own expense.

	SPECIFICATION FOR FIELD JOINT COATING	DOCUMENT NO.	REV
		11-0330G01-01-07-02-007	0
		SHEET 5 OF 10	

Contractor shall ensure that the coating materials supplied by him are properly packed and clearly marked with the following:

- Manufacturer's name
- Material qualification
- Batch number
- Date of manufacturing and date of expiry

4.4 Contractor shall ensure that the Manufacturer has carried out all quality control tests on each batch and manufacturer shall provide test certificates to certify that the supplied materials meet the manufacturer's specifications as indicated in the purchase order and as approved by OWNER/CONSULTANT. Certificates and data sheets certifying the qualities of the coating materials shall be submitted by Contractor to Owner/Consultant prior to application. Owner/Consultant reserves the right to have the materials tested by an independent laboratory.

4.5 Materials shall be stored in sheltered storage in the manufacturer's original packing and away from direct sunlight and in accordance with manufacturer's instructions.

4.6 Contractor shall provide and maintain mobile facilities which contain all necessary equipment and its spares for cleaning, coating, repairs, inspection and tests.

4.7 Contractor shall furnish sufficient number of the following equipment and the required spares as a minimum for inspection and test purposes for each crew:

- a) Fully automatic full circle adjustable holiday detector with a visible and audible signal system for inspection of coatings.
- b) Thickness gauge for measuring thickness.
- c) Contact type temperature recording thermometer.
- d) Roughness profile measuring (Stylus) instrument

5 APPLICATION PROCEDURE

5.1 General

5.1.1 The application procedure shall be in accordance with manufacturer's instructions and the minimum requirements specified below, whichever are the most stringent and shall be demonstrated to and approved by the Owner/Consultant. Manufacturer's expert shall supervise the application and shall be available at site upon request during qualification of application procedure and during construction at Contractor's cost.

5.1.2 Operators for coating application shall be given necessary instructions and training before start of work, by the Contractor. To verify and qualify the application procedures, all coating applied during the qualification test shall be removed for destructive testing as detailed subsequently in this specification. Contractor shall only utilize those operators who have been approved/pre-qualified by the field joint coating manufacturer.

5.1.3 Oil, grease and salt shall be removed from steel surface by wiping with rags soaked with suitable solvents such as naphtha or benzene. Kerosene shall not be used for this purpose. Solvent cleaning procedure according to SSPC-SP1 shall be followed.

5.1.4 Each field joint shall be blast cleaned using a closed cycle blasting unit. Steel or chilled shot and iron grit shall be used and Garnet material with the second one. During blast cleaning the pipe surface temperature shall be simultaneously more than 5°C or more than 3°C above ambient Dew Point, while the ambient Relative Humidity shall not be greater than 85%. Prior to surface cleaning the surfaces shall be completely dry. The surface shall be cleaned to a grade Sa 2½ in accordance with Swedish Standard SIS-055900 with a roughness profile of 50 – 70 microns. Surface roughness profile shall be measured using an approved profile comparator in accordance with ISO 8503-1 and shall be calibrated prior to the start of the work in accordance with ISO 8503-3 or ISO 8503-4. The blast cleanliness

	SPECIFICATION FOR FIELD JOINT COATING	DOCUMENT NO.	REV
		11-0330G01-01-07-02-007	0
		SHEET 6 OF 10	

shall be checked on every joint and the roughness profile shall be checked for 1 out of every 10 joints.

Dust, dirt or foreign matter shall be removed from the cleaned surface by a suitable industrial cleaner. The dust contamination allowed shall be of a rating max 2 as per ISO 8502 -3. The frequency of checking for dust contamination shall be 1 out of every 10 joints.

Blast cleaned field joint shall be coated within 2 – 4 hours according to the conditions below :

- | | | | |
|---|----------------------------------|---|---------|
| - | Relative Humidity (RH) > 80 % | - | 2 hours |
| - | Relative Humidity (RH) 70 - 80 % | - | 3 hours |
| - | Relative Humidity (RH) < 70 % | - | 4 hours |

Pipes delayed beyond this point or pipes showing any visible rust stain, shall be blast cleaned again.

- 5.1.5 The field joint surface shall be inspected immediately after blast cleaning and any feature of the steel surface such as weld spatter, scabs, laminations or other imperfections considered injurious to the coating integrity made visible during blast cleaning shall be reported to the Owner/Consultant and on permission from Owner/Consultant, such defects shall be removed by filing or grinding. Pipes affected in this manner shall be then re-blasted cleaned if the defective area is larger than 50 mm in diameter.
- 5.1.6 The ends of existing pipe protective coating shall be inspected and chamfered. Unbounded portions of the coating shall be removed and then suitably trimmed. Portions where parent coating is removed shall be thoroughly cleaned as specified. The adjacent chamfered areas of the line pipe coating shall be cleaned and abraded, to expose a clean uniform fresh surface of uncontaminated factory applied coating.
- 5.1.7 All steel joint surfaces shall be thoroughly examined before the application of the coating in order to ensure the surfaces are free of oil, grease, rust, mud, earth or any other foreign matter. All these substances shall be removed before coating, to the procedures herein described.
- 5.1.8 Protection coating shall be applied on the joints immediately after the completion of cleaning operation.

5.2 Application Procedure for Heat Shrink Wraparound/Sleeves

In addition to the requirements stated above, following shall be complied with:

- 5.2.1 The wrap around sleeve shall be of a size such that a minimum overlap of 50 mm is ensured (after shrinking) on both sides of the yard applied corrosion coating of pipes.
- In the cases where carrier pipe is installed by direct boring/jacking, the overlap on the mill coating for the leading edges of the joints shall be minimum 200 mm. When this extra overlap is achieved by providing an additional patch of heat shrink tape/wraparound, it shall be applied in such a manner that the square edge of the patch on the joint coating is in the direction opposite to the direction of boring / jacking.
- 5.2.2 Before centring the wraparound sleeve, the bare steel surface shall be preheated either with a torch moved back and forth over the surface or by induction heating. The minimum pre-heat temperature shall be as recommended by manufacturer and shall be checked by means of contact type temperature-recording thermometer. Temperature indicating crayons shall not be used. Pre-heat temperature shall be checked on every joint. Care shall be taken to ensure that the entire circumference of the pipe is heated evenly. Temperature measuring instruments shall be calibrated immediately before the start of the works and thereafter at intervals recommended by the manufacturer of the instrument.
- 5.2.3 Upon pre-heating, the pipe surface shall be applied with two pack epoxy primer of wet film thickness 100 microns or as per manufacturer's recommendation whichever is higher, to cover the exposed bare metal of the welded field joint and 10 mm min. onto the adjacent pipe coating if recommended by the manufacturer. The wet film thickness of the primer shall be checked on every joint with a wet film thickness gauge prior to installation of sleeve. Thickness gauge shall be calibrated once per shift.



SPECIFICATION FOR FIELD JOINT COATING

DOCUMENT NO.

REV

11-0330G01-01-07-02-007

0

SHEET 7 OF 10

5.2.4 Immediately after application of epoxy primer, the wraparound sleeve shall be entirely wrapped around the pipe within the stipulated time recommended by the manufacturer. Sleeve shall be positioned such that the closure patch is located to one side of the pipe in 10 or 2 O'clock position, with the edge of the undergoing layer facing upward and an overlap of min. 50 mm. Gently heat by appropriate torch the backing and the adhesive of the closure and press it firmly into place.

5.2.5 A heat shrinking procedure shall be applied to shrink the sleeve in such a manner to start shrinkage of the sleeve beginning from the center of the sleeve and heat circumferentially around the pipe. Continue heating from the center towards one end of the sleeve until recovery is completed. In a similar manner, heat and shrink the remaining side. Shrinking has been completed when the adhesive begins to ooze at the sleeve edges all around the circumference.

Visual appearance and void after installation on the body, area adjoining the weld and area adjoining the factory applied coating. (To establish voids adjoining the weld and factory coating, a strip of 50 mm wide and 200 mm long shall be stripped and examined.)

Owner/Consultant shall witness the tests and inspection. Regular application of field joint coating shall commence only upon successful completion of the pre-qualification testing.

After successful completion of the pre-qualification testing as above, the entire field joint coating shall be removed, the pipe surface re-blasted and field joint coating re-applied as per the requirements of this specification.

5.3 Pre-Qualification of Field Joint Coating System

The field joint coating system materials and the procedures proposed by the Contractor shall be pre-qualified during the sleeve installation start-up phase. Five joints (5) shall be coated with the requirements of this specification and then inspected and tested in accordance with the requirements of this specification with respect to the following:

- i) Surface preparation, cleanliness, roughness profile and dust contamination
- ii) Pre-heat temperature (as applicable)
- iii) Primer thickness
- iv) As applied coating thickness
- v) Holiday detection
- vi) Peel test at (+) 23°C & (+) 60°C on pipe surface & factory applied coating and at overlaps (as applicable). If required to achieve the temperature of (+) 60°C, suitable thermal blanket may be used.
- vii) Visual appearance and void after installation on the body, area adjoining the weld and area adjoining the factory applied coating. (To establish voids adjoining the weld and factory coating, a strip of 50 mm wide and 200 mm long shall be stripped and examined.)

Owner shall witness the tests and inspection. Regular application of field joint coating shall commence only upon successful completion of the prequalification testing.

After successful completion of the pre-qualification testing as above, the entire field joint coating shall be removed, the pipe surface re-blasted and field joint coating reapplied as per the requirements of this specification.

6 INSPECTION AND TESTING

6.1 Visual Inspection

Visual inspection of the as applied coating shall be carried out on every joint, for the following:

- Mastic extrusion on either ends of the sleeve shall be examined

	SPECIFICATION FOR FIELD JOINT COATING	DOCUMENT NO.	REV
		11-0330G01-01-07-02-007	0
		SHEET 8 OF 10	

- There shall be no sign of punctures or pinholes or bend failure. The external appearance of the sleeve shall be smooth, free of dimples, air entrapment or void formation. All sleeves shall be tested for the presence of voids by knocking on the sleeves. A hollow sound compared to the remainder of the sleeve may indicate the presence of voids under the sleeve. Such sleeve shall be tested for adhesion at the discretion of the Owner/Consultant.
- Weld bead profile shall be visible through the sleeve
- Visual indicator provided on the backing and the closure patch showing desired heat is achieved.

6.2 Holiday Inspection

The entire surface of each joint shall be inspected by means of a full circle holiday detector approved by Owner/Consultant set to a DC voltage applicable as per the requirements of factory applied mainline coating specification of Owner/Consultant. Inspection of the sleeves shall be conducted only after the joint has cooled below 50°C. The holiday detector used shall be checked and calibrated daily with an accurate DC voltmeter. The detector electrode shall be in direct contact with the surface of coating to be inspected.

No field joint shall be covered or lowered in the trench until it has been approved by the Owner/Consultant.

6.3 As-applied Coating Thickness

Coating thickness shall be checked by non-destructive methods for each field joint. Average thickness of the as-applied coating on pipe body shall be established based on measurements at min. eight locations i.e. four measurements on either side of the girth weld at 3, 6, 9 & 12 O'clock positions. To establish the minimum thickness on the girth weld, four measurements shall be taken on apex on the weld at 3, 6, 9 & 12 O'clock positions. All such measurements shall be recorded. Owner/Consultant reserves the right to ask for additional measurements at any location on the field joint coating, whenever doubt arises.

6.4 Peel Strength Testing

6.4.1 One out of every 50 joint coatings or one joint coating out of every day's production, whichever is stringent, shall be tested to establish the peel strength on steel and factory applied coating. Contractor shall carry out such testing in the presence of Owner/Consultant.

6.4.2 From each test sleeve selected as above, one or more strips of size 25mm x 200 mm shall be cut perpendicular to the pipe axis and slowly peeled off.

The required peel strength shall meet the requirements of this specification as applicable for (+) 23°C or (+) 60°C whichever is feasible. This test shall be conducted between wrapping & metal and mill coating & between layers at overlap with joint coating (wherever applicable). After removal of strip, the bulk of adhesive shall remain adhered to the pipe showing no bare metal, otherwise, test shall be considered failed. The adhesive layer that remains on the pipe surface shall generally be free of voids resulting from air or gas inclusion. In case the peel strength test at a different temperature than that specified is warranted due to the ambient site conditions, then the peel strength shall comply the recommendation of the manufacturer. Manufacturer shall be asked to furnish peel strength values corresponding to various expected temperatures, prior to start of the works.

6.4.3 If the sleeve does not meet the requirements of above clause 6.4.2, the adjacent two sleeves shall also be tested. If the adjacent two sleeves are acceptable the test rate shall be increased to one sleeve every twenty five until Owner/Consultant's is satisfied. The test rate can then be reduced as per clause 6.4.1. If either or both of the adjacent two sleeves do not meet the requirements of clause the field coating shall be stopped.

6.4.4 Owner/Consultant reserves the right of 100% removal of sleeves if he is not convinced that the requirements of clause 6.4.2 are achieved.

	<p align="center">SPECIFICATION FOR FIELD JOINT COATING</p>	DOCUMENT NO.	REV
		11-0330G01-01-07-02-007	0
		SHEET 9 OF 10	

7 REPAIRS

- 7.1 If a field joint is detected to be unacceptable after testing as per section 6.0 of this specification the Contractor shall, at his own cost:
- determine the cause of the faulty results of the field coating.
 - mobilise the expert of manufacturer, if required.
 - Test to the complete satisfaction of the Owner/Consultant, already completed field coatings
 - stop field coating until remedial measures are taken against the causes of such faults, to the entire satisfaction of the Owner/Consultant.
- 7.2 Contractor shall replace all joint coating found or expected to be unacceptable as per section 6.0 of this specification.
- 7.3 Contractor shall, at his own cost repair all areas where the coating has been removed for testing by the Owner/Consultant.
- 7.4 After the coating work on welded joints and repairs to the coating have been completed the coating as a whole shall be tested with a spark-tester before lowering or jacking the pipeline.
- 7.5 Owner/Consultant shall be entitled to check the coating on buried pipelines or parts of pipelines with equipment such as the "Pearson Meter" and the resistance meter. If coating defects are established, the Contractor shall be responsible for excavation at such points, repairing the coating, spark testing and backfilling the excavations without extra charge.

8 DOCUMENTATION

- 8.1 Prior to procurement of coating materials, Contractor shall furnish the following information for qualification of the Manufacturer and material:
- a. Complete information as per clause 4.1, DIN EN 12068 along with descriptive technical catalogues.
 - b. Test certificates and results of previously conducted tests, for all properties listed in clause 4.2 of this specification.
 - c. Reference list of previous supplies, in last 5 years, of the similar material indicating the project details such as diameter, quantity, operating temperature, year of supply, project name, contact person and feed back on performance.
- Once the Owner/Consultant's approval has been given, any change in material or Manufacturer shall be notified to Owner/Consultant, whose approval in writing of all changes shall be obtained before the materials are manufactured.
- 8.2 Prior to shipment of materials from the Manufacturer's Works, Contractor shall furnish the following documents:
- a. Test certificates/results as per Manufacturer's Quality Control Procedure for each batch of materials.
 - b. Specific application instructions with pictorial illustrations.
 - c. Specific storage and handling instructions.
- 8.3 All documents shall be in English language only.

	SPECIFICATION FOR FIELD JOINT COATING	DOCUMENT NO.	REV
		11-0330G01-01-07-02-007	0
		SHEET 10 OF 10	



GAIL (India) Limited
PIPELINE FROM HANUMAN JUNCTION TO VCL



SPECIFICATION FOR PIPELINE CONCRETE WEIGHT
COATING

CLIENT JOB NO.

TOTAL SHEETS

11

DOCUMENT NO

11

0330G01

01

07

02

008

REV.	DATE	DESCRIPTION	PREP	CHKD	APPD
0	04-07-11	ISSUED FOR TENDER	MH	EUR	AD
A	07-06-11	ISSUED FOR IDC	MH	EUR	AD

CONTENTS

1	SCOPE.....	3
2	DEFINITIONS.....	3
3	REFERENCE DOCUMENTS	3
4	MATERIALS	4
5	COATING REQUIREMENTS	5
6	APPLICATION METHOD.....	6
7	EQUIPMENT	6
8	MEASUREMENTS & LOGGING.....	6
9	PROCEDURE QUALIFICATION.....	7
10	APPLICATION OF REINFORCEMENT AND CONCRETE COATING	7
11	TOLERANCES.....	9
12	WEIGHING.....	9
13	INSPECTION AND TEST.....	10
14	COATING OF FIELD JOINTS.....	10
15	REPAIRS	10
16	MARKING	11
17	UNLOADING, TRANSPORTATION, STORING AND HAULING.....	11

	<p style="text-align: center;">SPECIFICATION FOR PIPELINE CONCRETE WEIGHT COATING</p>	DOCUMENT NO.	REV
		11-0330G01-01-07-02-008	0
		SHEET 2 OF 11	

1 SCOPE

- 1.1 This specification defines the minimum technical requirements for the materials, application, inspection, handling and other activities for external concrete weight coating of pipeline.
- 1.2 Contractor shall, with care and diligence, execute the work in compliance with all laws, by-laws, ordinances, regulation, etc. and provide all services and labour, inclusive of supervision thereof, all materials indicated as company supplied materials in the contract, equipment, appliances or other things of whatsoever nature required in or about the execution of the work, whether of temporary or permanent nature.

2 DEFINITIONS

For this specification the following definitions shall apply:

OWNER	:	GAIL (India) Limited
CONSULTANT	:	Wood Group Kenny Pvt. Ltd.
CONTRACTOR	:	The Company names as such in the deed.
SHALL/MUST/IS TO BE	:	A mandatory requirement
SHOULD	:	A non-mandatory requirement, advisory or Recommendation

3 REFERENCE DOCUMENTS

- 3.1 Reference has been made in this specification to the following latest publication codes and standards:
- i) ASTM A-82 : Specification for steel wire, plain, for concrete Reinforcement
 - ii) ASTM A-185 : Welded steel wire fabric for concrete Reinforcement
 - iii) ASTM C-39 : Compressive strength of cylindrical concrete Specimens
 - iv) ASTM C-138 : Unit weight, yield and air content of concrete.
 - v) ASTM C-309 : Liquid membrane forming components for curing Concrete
 - vi) ASTM C-642 : Specific gravity, absorption and voids in hardened Concrete
 - vii) IS – 8112 : Indian Standard Specification for Ordinary Portland cement-43 grade
 - viii) IS – 383 : Indian Standard Specification for Coarse and Fine Aggregates from Natural Sources for Concrete

	SPECIFICATION FOR PIPELINE CONCRETE WEIGHT COATING	DOCUMENT NO.	REV
		11-0330G01-01-07-02-008	0
		SHEET 3 OF 11	

- ix) IS – 456 : Plain and Reinforced Concrete – Code of Practice (3rd Revision – 2000)
- x) IS– 2386 (Parts I thru' VIII) : Indian Standard Methods of test for aggregates concrete.
- xi) IS – 6909 : Indian Standard Specification for Sulphate Resistant Cement (1990; Reaffirmed 1997)

4 MATERIALS

The CONTRACTOR shall supply all the materials necessary for the performance of the work.

All materials supplied by the CONTRACTOR, which in the opinion of OWNER, do not comply with the appropriate specifications shall be rejected and immediately removed from site by CONTRACTOR at his own expense.

All materials for concrete coating shall comply with following requirements.

4.1 CEMENT

- 4.1.1 Ordinary Portland cement -43 grade (conforming to IS-8112) shall be used.
- 4.1.2 Sulphate Resistant Cement shall be Cement (conforming to IS 6909) shall be used wherever the soil is corrosive.
- 4.1.3 Cement which has hardened or partially set or which has become lumpy shall not be used.
- 4.1.4 Test Certificates from the cement Manufacturer shall be supplied to the OWNER for all batches of cement delivered to site.
- 4.1.5 Cement which is more than six months old shall not be acceptable.
- 4.1.6 In case concrete weight coating is to be provided at location affected by sea water tidal flats etc. Portland cement in accordance with ASTM C-150 Type –III shall be used.

4.2 AGGREGATES

- 4.2.1 Aggregate shall comply with the requirements of IS: 383 and shall be tested in accordance with IS: 2386.

4.2.2 Fine Aggregates


'Fine Aggregates' shall mean any of the following, as defined in IS: 383:

- i) Natural sand;
- ii) Crushed stone sand;
- iii) Crushed gravel sand;

Sand shall be well-graded from fine to coarse in accordance with Table 4 of IS: 383.

4.2.3 Coarse Aggregates

Use of coarse aggregates shall be subject to OWNER approval.

	SPECIFICATION FOR PIPELINE CONCRETE WEIGHT COATING	DOCUMENT NO.	REV
		11-0330G01-01-07-02-008	0
		SHEET 4 OF 11	

4.2.4 Aggregates shall be clean and free from injurious amounts of salt, alkali, deleterious substances or organic impurities.

4.3 WATER

The water shall be limpid, fresh and clean and shall be free from injurious amounts of oils, acids, alkalis, salts, sugar, organic materials or other substances that may be deleterious to concrete or steel. It shall not contain chlorides, sulphates, and magnesium salts.

Water from each source shall be tested by the CONTRACTOR before use and the test reports shall be submitted to the Owner's representative for approval. Sea water or contaminated water shall not be used. Water shall be tested in accordance with IS:3025.

4.4 REINFORCEMENT

Concrete coating shall be reinforced by a single layer or multiple layers of steel reinforcement according to the provisions hereinafter described.

4.4.1 Reinforcement shall consist of welded steel wire fabric manufactured in rolls (ribbon mesh) and shall conform ASTM A-185. Steel wires in the ribbon mesh shall conform to ASTM A-82.

4.4.2 Steel wires shall be galvanised at finished size. The diameter of the wire and wire spacing (mesh) dimensions shall be selected according to the following criteria.

- Wire fabric manufactured in rolls (ribbon mesh) shall be 1 x 2.5 inches of 14 gauge U.S. steel wires (2mm wire). The above dimensions will be applied unless otherwise specified by OWNER. As a rule wire fabric (sheets) shall be used when concrete coating is applied by casting method, while ribbon mesh (rolls) shall be used when concrete coating is applied by impingement method.

4.5 Concrete grade M-25 shall be used

5 COATING REQUIREMENTS

Pipes shall be concrete coated to a 75 mm thickness or as specified in the relevant drawings and as per the design documents.

Concrete Coating shall be applied in marshy & water logged areas. Necessary anti-buoyancy calculations shall be carried out by the contractor during detailed Engineering and approved by the Client's / consultant Specifying requirement of Concrete coating.

Concrete shall conform to the following:

Property	Minimum Acceptable Value
Concrete Density :	
Cement Concrete Reinforced	2500 Kg/m ³
Compressive Strength (After 7 Days)	165 Kg/cm ²
Compressive Strength (After 28 Days)	250 Kg/cm ²

CONTRACTOR shall be permitted to select any proportioning of materials to achieve the specified requirements of concrete density and weight.



**SPECIFICATION FOR PIPELINE
CONCRETE WEIGHT COATING**

DOCUMENT NO.

11-0330G01-01-07-02-008

REV

0

SHEET 5 OF 11

6 APPLICATION METHOD

Concrete coating shall be applied by impingement method. Any alteration or modifications to the method described in the specification shall be submitted to the OWNER for approval. The application method shall ensure the basic characteristics of concrete coating in compliance with the minimum requirements of this specification.

CONTRACTOR shall submit to the OWNER, prior to commencement of work, the procedure of concrete application for approval.

Wherever practical, the specified total thickness of concrete coating shall be applied in a single pass.

7 EQUIPMENT

The equipment used for performing the concrete coating shall be capable of doing so with a reasonable degree of uniformity with respect to thickness, density and strength. The proportioning equipment and procedure shall be of the type to ensure consistently proportioned materials by weight. Concrete shall be mixed in a mechanical mixer, which shall ensure thorough mixing of all materials. Any equipment that tends to separate the ingredients shall not be used.

8 MEASUREMENTS & LOGGING

8.1 CONTRACTOR shall submit detailed methodology in their procedure for measurement and logging. All measurements as mentioned below shall be taken during the work stages and clearly logged in a proper logbook. A special logbook shall be used for recording tests and trial results. A logbook shall refer to pipe lengths having the same nominal diameter, and wall thickness.

8.2 The logging methodology shall include minimum the following details:

a) Line pipe

- 1) Field identification number
- 2) Mill serial Number
- 3) Length (m)
- 4) Weight (kg)
- 5) Average outside diameter (mm)


b) Corrosion Coating

- 6) Type of coating
- 7) Thickness of coating (mm)
- 8) Weight of coated pipe (kg)
- 9) Date of corrosion coating application

c) Concrete Weight Coating

- 10) Batch identification number
- 11) Date of placing of concrete coating.
- 12) Average concrete coating thickness.
- 13) Wet weight of coated pipe (weight and dated of weighing)
- 14) "Dry weight" of concrete coated pipe
(Weight and date of weighing or related weight 28 days after placing of concrete and so identifiable)
- 15) "Unit dry weight" of concrete coated pipe.
- 16) "Negative buoyancy" (unit) of concrete coated pipe

8.3 No concrete placing shall be done before items 1 to 9 listed above have been logged. In addition, each batch / shift shall be identified and logged against cube samples taken for compressive strength and dry density.

	SPECIFICATION FOR PIPELINE CONCRETE WEIGHT COATING	DOCUMENT NO.	REV
		11-0330G01-01-07-02-008	0
		SHEET 6 OF 11	

9 PROCEDURE QUALIFICATION

Before commencement of the work, CONTRACTOR shall perform all tests, either in the laboratory or in field to properly select type of mix, which meets the requirements of this specification.

9.1 The type of mix, i.e., the correct combination of the cement, aggregates and water which results in the desired properties of concrete shall be first determined. For each mix the following shall be accurately checked and recorded:

- i) Proportions and weights of the respective materials used
- ii) The water/cement ratio
- iii) The grading of the aggregates.

9.2 Samples shall be prepared and tested in accordance with ASTM C-642 to determine the dry specific gravity (28 days after placing). Test for concrete specific gravity at intermediate time (7 days after coating) shall be performed.

9.3 When the results of the above tests do not meet the requirements, the mix shall be modified and concrete samples tested until a proper mix has been determined.

9.4 The mix so determined shall then be used for sampling of concrete to be submitted to compressive strength tests as per ASTM C39 / IS 516.

9.5 Frequency of sampling for tests for density and compressive strength of concrete (Refer :specification for structural concrete 11-0230-01-05-02-005, clause no. 4.2.2)

9.6 Two test cubes each per day shall be obtained from batches and tested at the end of 7 days after coating, for compressive strength and specific gravity.

9.7 The moisture content of the aggregates used shall be such as to maintain a satisfactory control on the water / cement ratio of the concrete mix.

To maintain the water / cement ratio constant at its correct value, determination of moisture contents in both fine aggregates and coarse aggregates (if used) shall be made as frequently as possible. Frequency for a given job shall be determined by the OWNER according to weather conditions.

10 APPLICATION OF REINFORCEMENT AND CONCRETE COATING

10.1 REINFORCEMENT APPLICATION


10.1.1 Prior to placing of reinforcement, the protective coating of each pipe length shall be carefully inspected visually and by holiday detectors. If damages are found, they shall be repaired before start of the work. Foreign matters, if any, shall be removed from the surface of the protective coating.

10.1.2 Reinforcement shall be placed around the pipe in such a way as to cover whole pipe length or sections to be concrete coated. The reinforcement shall protrude a minimum 50 mm from the finished concrete coating at the pipe ends.

10.1.3 Splices and attachments shall be done by binding with steel wire having 1.5mm diameter. Circular and longitudinal joints of wire fabric in sheets shall be lapped at least for one mesh. The spiral lap shall be one mesh while the spliced lap shall be three meshes.

10.1.4 Reinforcement shall rest on synthetic resin spacers forming a "Crown" whose number shall be such as to avoid contact of the steel reinforcement with the pipe's protective coating. Spacing between the two consecutive 'crown' centres shall be 500 to 1000mm.

10.1.5 One layer of reinforcement steel shall be provided for concrete thickness up to 50 mm. The reinforcement steel shall be embedded approximately midway in the concrete coating thickness. For

	SPECIFICATION FOR PIPELINE CONCRETE WEIGHT COATING	DOCUMENT NO.	REV
		11-0330G01-01-07-02-008	0
		SHEET 7 OF 11	

concrete thickness above 50mm two layers of reinforcing steel shall be provided. If application method requires more than one pass of concrete, one reinforcement layer for each pass is to be applied irrespective of the concrete coating thickness.

10.2 CONCRETE PLACING

10.2.1 Concrete shall be placed within a maximum of 30 minutes from the time of mixing (adding water to mix) and shall be handled in such a way so as to prevent aggregate segregation and excessive moisture loss. Concrete containers shall continuously be kept clean and free from hardened or partially hardened concrete.

10.2.2 If Impingement method is used, Placement of concrete shall be up to the specified thickness in one continuous course, allowance being made for splices of reinforcement and providing reinforcement in the right location. Concrete shall be projected at high velocity against the external surface of pipe, to produce a hard, tight-adhering coating of the specified thickness.

10.2.3 No passes shall be stopped for more than 30 minutes. Before placing fresh concrete against the joint, the contact surfaces shall be carefully cleaned and wetted to obtain a good bond between the fresh material and the previously placed material.

10.2.4 All pipes shall be kept clean and free from cement, concrete and grout either inside or outside of the uncoated sections.

10.2.5 The coatings at each end of the pipe shall be bevelled to a slope of approximately two-to-one (2:1).

10.2.6 Bevel protectors shall be kept in place throughout the coating application and after.

10.2.7 Suitable means shall be provided to ensure that the temperature of the concrete, when placed, does not exceed 32°C.

10.3 WINTER CONCRETE COATING

10.3.1 In ambient temperatures below 4 °C concrete must be protected from the effects of frost by warming the aggregates and / or warming of the mixing water and additionally ensuring an air temperature of 6 °C in the vicinity of the concrete.

10.3.2 Storing and curing of coated pipe shall not take place at temperatures below 1.5 Degree C, until the concrete has aged sufficiently to have achieved a crushing strength of at least 10 N/mm2.

10.4 RECLAIMED CONCRETE

10.4.1 10.6.1 Use of reclaimed rebound shall be done only with the written permission of the Owner and to the satisfaction of the Owner's representative.

10.4.2 10.6.2 When use of reclaimed rebound is permitted by the Owner, this material shall be added to and thoroughly intermixed with freshly batched concrete in a secondary mixture of a type, acceptable to the Owner's representative.

10.4.3 10.6.3 The amount of reclaimed material used shall not exceed 5% of the total mix by weight and shall only be added in an even flow during a continuous coating operation.

10.5 CUT BACK ON CONCRETE COATING

Both ends of each joint for the distance of 250mm or as specified in the Contract document shall be completely free of concrete to facilitate field joints.

10.6 HANDLING AFTER APPLICATION

	SPECIFICATION FOR PIPELINE CONCRETE WEIGHT COATING	DOCUMENT NO.	REV
		11-0330G01-01-07-02-008	0
		SHEET 8 OF 11	

Contractor shall take precautions to prevent detrimental movement of pipe after coating and to minimise handling stresses whilst concrete is hardening and curing.

Identity of each pipe shall be preserved during and after the coating process by transfer of pipe information to and outside of concrete coating at each end of the all pipes.

10.7 CURING

10.7.1 Immediately after concreting, the exposed surfaces of the concrete shall be protected during hardening from the effects of sunshine, drying winds, rain, etc., and then after the initial set has taken place, the concrete coating shall be properly cured. The coated pipe section shall be handled gently by suitable means to prevent undue distortion.

10.7.2 Curing shall be performed by application of an approved curing membrane using sealing compounds and shall meet the requirements of ASTM C-309. The curing compound material shall be stored, prepared and applied in strict conformity with the instructions of the Manufacturer. The ingredients of any such compound shall be non-toxic and non-inflammable and shall not react with any ingredient of the concrete, the reinforcement, the anti-corrosion coating or steel pipe. The application of the curing compound shall be done immediately after the coating is completed and preferably before the pipe is removed from the concrete coating apparatus. The surface of the concrete shall be lightly sprayed with water before applying the curing compound. The membrane curing period shall not be less than 4 days, during which period the freshly coated pipes shall not be disturbed. The pipe surface shall be kept wet during daylight hours for seven days after application of the concrete coating. The concrete coating shall not be allowed to dehydrate.

10.7.3 Before handling and hauling of the concrete coated pipes, a check shall be made to make sure that the concrete coating is properly cured. Stacking and shipment of the coated pipes shall be initiated only after seven days provided that the concrete coating suffers no damage.

11 TOLERANCES

11.1 CONTRACTOR shall maintain a surface tolerance of ± 6 mm on outside diameter of the coated pipes measured by diameter tape. The diameter of each coated pipe shall be obtained at five (5) points, spaced at equal intervals between end points.

11.2 The acceptance weight tolerance for any single pipe shall be limited to (-)2% to (+)5% of the calculated theoretical weight. The theoretical weight shall be calculated using total weight of the pipe with concrete and corrosion coating.

11.3 Acceptable weight tolerance from the approved mix, during production shall be as follows:

- i) $\pm 3\%$ for each type of aggregate
- ii) $\pm 2\%$ for aggregate as a whole
- iii) $\pm 3\%$ for the total quantity of water
- iv) $\pm 3\%$ for cement

12 WEIGHING

12.1 The test specimen shall be selected at equal intervals during the course of production.

12.2 CONTRACTOR shall weigh each pipe when dry prior to shipment and 28 days after placing of concrete and mark the weight with paint on the inside of the pipe.

	<p align="center">SPECIFICATION FOR PIPELINE CONCRETE WEIGHT COATING</p>	DOCUMENT NO.	REV
		11-0330G01-01-07-02-008	0
		SHEET 9 OF 11	

13 INSPECTION AND TEST

- 13.1 Before concrete coating the pipe shall be pre -tested at a pressure equivalent to 95% SMYS of pipe material. The test pressure shall be held for a period of 6 hours & reading logged at equal intervals. During the Test CONTRACTOR check all welds for leakage. Failure if any during the test shall be rectified by the CONTRACTOR.
- 13.2 After curing, every length of concrete coated pipe shall be non-destructively tested by suitable means such as "ringing" to determine if any suspected defects are present. In case this indicates faulty coating, cores shall be removed from coating and inspected. When defective coating appears from cores, the concrete coating shall be removed from the pipe lengths.
- 13.3 Every length of concrete coated pipe shall be checked to verify insulation between steel reinforcement and pipe by means of a megger or equivalent device. For this purpose provisions should be made during placing of concrete such as to leave atleast a point of exposed steel reinforcement whenever the latter shall terminate inside of concrete coating.
- 13.4 During the tests above and before transporting of concrete coated pipes, every pipe length shall be visually inspected to detect whether any damages and/or defects are present. Possible damages and/or defects with their allowable limits are described at following section. Repairable concrete coating shall be clearly marked while the non-repairable ones shall be removed from the pipe lengths.


14 COATING OF FIELD JOINTS

- 14.1 The CONTRACTOR shall coat the uncoated pipe surface at field welds in accordance with methods approved by OWNER. CONTRACTOR shall submit a detailed procedure for joint coating for Owner's approval.
- 14.2 The reinforcement for the field welds shall be same as that for line pipe coating with the same number of layers and the same space between layers as for the existing coating. The edges of this netting must be carefully secured with galvanised wire to the reinforcement extending from the existing coating.
- The reinforcement shall not make direct /electrical contract with the pipe.
- Synthetic resin spacer blocks shall be used to keep the reinforcement away from the corrosion coated pipe surface.
- 14.3 The composition of the concrete shall be the same as that of the concrete coating of the pipe.
- 14.4 When moulds are used if approved by the OWNER, the CONTRACTOR shall prevent air being trapped by applying mechanical vibrators or by striking the outside of the moulds with suitable sticks.

15 REPAIRS

The following are repairs that will be permitted to coating due to unavoidable damage in handling and in storage (This applies only to concrete that has hardened).

- 15.1 Spalling due to compression or shearing caused by impact against other objects. Spalling is defined as damage, which causes a loss in concrete of more than 25 percent of the total thickness of the coating at the point of damage.
- 15.2 Damage due to spalling of an area of less than 0.1 m² (1 square foot) where the remaining concrete is sound will be accepted without repairs.
- 15.3 Damage due to spalling of an area of more than 0.1 m² and less than 0.3 m² shall have the concrete remaining in place over that area removed as necessary to expose the reinforcing steel throughout the damaged area. Edges of the spalled area shall be under-cut so as to provide a key lock for the repair

	SPECIFICATION FOR PIPELINE CONCRETE WEIGHT COATING	DOCUMENT NO.	REV
		11-0330G01-01-07-02-008	0
		SHEET 10 OF 11	

material. A stiff mixture of cement, water and aggregate shall be trowelled into and through the reinforcement and built up until the surface is level with the coating around the repair. The pipe shall then be carefully laid with the repaired area at the top. The repaired area shall be moist cured for a minimum of thirty six (36) hours before further handling.

- 15.4 Should the damaged area be more than 0.3 m², coating shall be removed around the entire damaged area. A repair shall be made by satisfactorily restoring the reinforcement, forming the area with a metal form and pouring a complete replacement of materials similar to that from which the coating was made. The mixture shall be one (1) part of cement to three (3) parts of aggregate and the necessary water to produce a slump not to exceed 100 mm (four inches). The resulting coating shall be equal in weight, density, uniformity, thickness, strength and characteristics to the originally applied coating. The pipe shall then be carefully laid in a position where it shall be allowed to remain for a minimum of 36 hours before further handling.

16 MARKING

- 16.1 Every concrete coated pipe length shall be clearly marked by a suitable type of paint (i.e., red and/or white lead paint). Markings out of concrete coating shall be made inside of pipe close to bevel end, in such a way that the area involved by welding operations is not affected by paint.
- 16.2 For each concrete coated pipe length, at one of the two ends, the field identification number and the date of concrete placing shall be marked, while the dry as well as the wet weight along with number of days after coating shall be marked at the other end. In addition, Contractor shall develop a colour coding (band) system to be marked on the outside surface for easy identification of the coated pipe for each concrete coating thickness, concrete density, pipe diameter, pipe thickness and pipe material variation.

17 UNLOADING, TRANSPORTATION, STORING AND HAULING

- 17.1 During loading, transport, unloading and hauling of inert aggregates, any contact and mixing with mud, earth, grease and any other foreign material shall be carefully avoided. Precautions shall be taken to prevent contamination, to maintain the cleanliness and against effects of hot or cold weather or other adverse climatological condition.
- 17.2 During the operations of loading, unloading and stock-piling, the pipe sections shall be handled in such a way so as to avoid damages to pipe ends, protective and/or concrete coating.
- 17.3 Stacks shall consist of a limited number of layers such that the pressure exercised by the pipes' own weight does not cause damages to coating. Stacking with more number of layers shall be agreed upon with the OWNER provided that each pipe section is separated by means of spacers suitably spaced so as to avoid stresses and compressed points of contact on the coated surfaces.

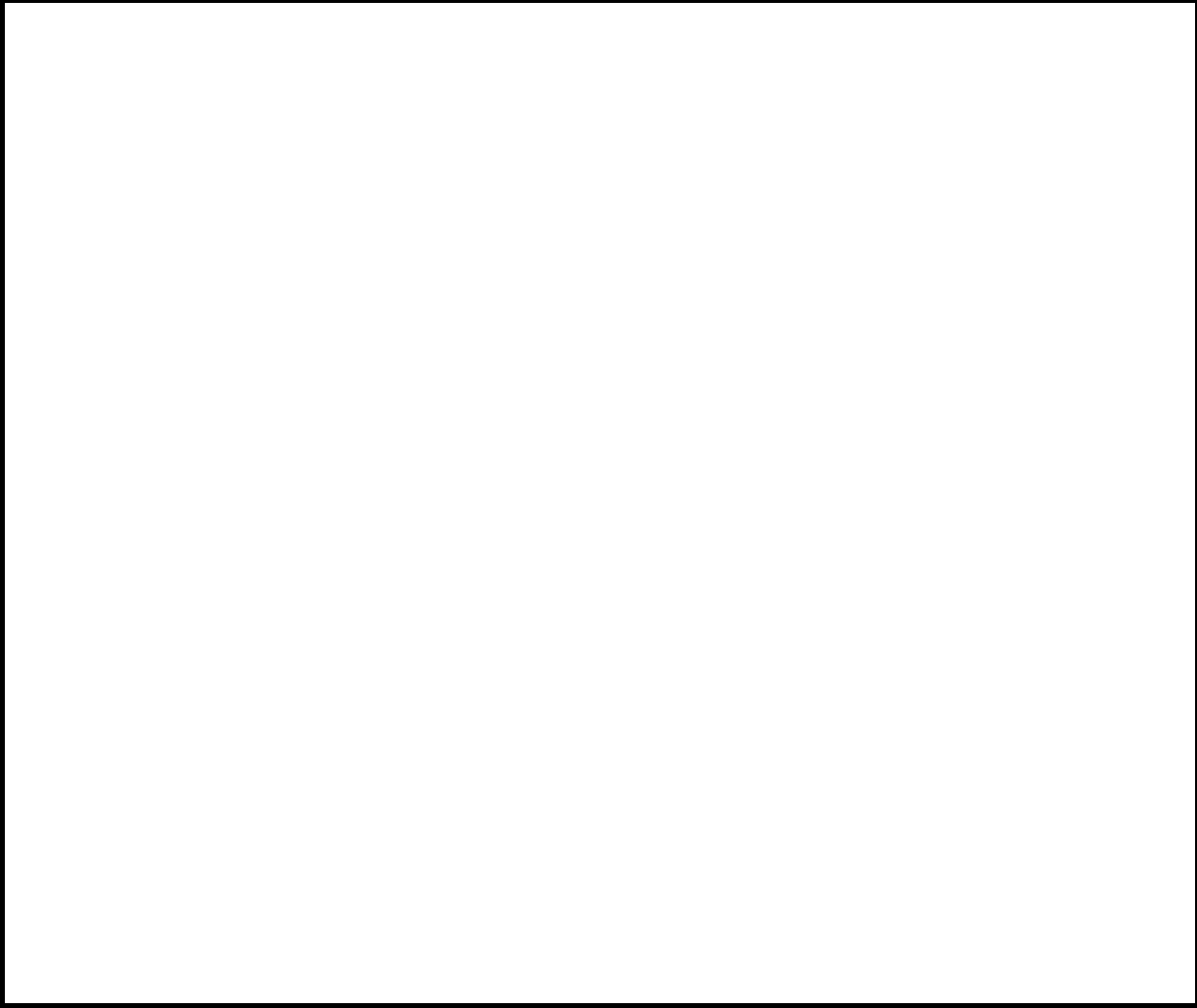
	<p align="center">SPECIFICATION FOR PIPELINE CONCRETE WEIGHT COATING</p>	DOCUMENT NO.	REV
		11-0330G01-01-07-02-008	0
		SHEET 11 OF 11	



GAIL (India) Limited
PIPELINE FROM HANUMAN JUNCTION TO VCL




SPECIFICATION FOR LONG RADIUS INDUCTION BENDS				CLIENT JOB NO.		-
				TOTAL SHEETS		9
DOCUMENT NO	11	0330G01	01	07	02	009



0	04-07-11	ISSUED FOR TENDER	MH	EUR	AD
A	07-06-11	ISSUED FOR IDC	MH	EUR	AD
REV.	DATE	DESCRIPTION	PREP	CHKD	APPD

CONTENTS

1	SCOPE.....	3
2	CODES, STANDARDS AND REFERENCE DOCUMENTS.....	3
3	MATERIAL.....	3
4	MANUFACTURE	4
5	INSPECTION & TESTS	5
6	TEST CERTIFICATES	6
7	MARKING, PACKING AND SHIPMENT.....	6
8	DOCUMENTATION	7
9	BEND MANUFACTURING PROCEDURE QUALIFICATION	7

	SPECIFICATION FOR LONG RADIUS INDUCTION BENDS	DOCUMENT NO.	REV
		11-0330G01-01-07-02-009	0
		SHEET 2 OF 9	

1 SCOPE

This Specification defines the minimum requirements for the manufacturing, marking, inspection, testing and shipment of long radius bends made from carbon steel line pipes for use in onshore gas pipeline systems. Manufacture & Supply shall be in Contractor's Scope. Contractor can engage sub-Manufacturer with prior approval of OWNER / CONSULTANT.

1.1 DEFINITIONS

For this specification the following definitions shall apply:

OWNER	:	GAIL (India) Limited
CONSULTANT	:	Wood Group Kenny India Pvt. Ltd
CONTRACTOR	:	The Company named as such in the deed.
SHALL/MUST/IS TO BE	:	A mandatory requirement
SHOULD	:	A non-mandatory requirement, advisory or recently Amended

2 CODES, STANDARDS AND REFERENCE DOCUMENTS

The manufacturer shall perform work in accordance with the latest edition of the following codes, standards and specifications:

2.1 CODES & STANDARDS

ASME B 31.8	Gas Transmissions and Distribution Piping System
MSS-SP-75	Specification for High Test Wrought Weld Fitting
API-5L	Specification for Line Pipe
API-5L 1	Recommended Practice for Rail Road Transportation of Line Pipes
ASNT-TC-1A	Personnel Qualification and Certification in Non-Destructive Testing

The MANUFACTURER shall be in possession of all the above referred Codes, Standards and Specifications. All such documents shall be made readily available to all personnel involved in executing the work, including OWNER / CONSULTANT personnel.

Alternative codes and standards, at least equivalent to those listed above, may be substituted, after obtaining prior approval from OWNER / CONSULTANT.

3 MATERIAL

- 3.1 Bends shall be fabricated from steel line pipe manufactured in accordance with the latest revision of the Owner's Specifications. The type of pipe to be used for fabrication of bends shall be as indicated in the Purchase Order. Pipes with positive wall thickness tolerances shall be used for fabrication of bends.

	SPECIFICATION FOR LONG RADIUS INDUCTION BENDS	DOCUMENT NO.	REV
		11-0330G01-01-07-02-009	0
		SHEET 3 OF 9	

- 3.2 Unless specified otherwise in the Purchase Order, the line pipes for fabrication of bends shall be procured by the Manufacturer.
- 3.3 Heat treatment shall be carried out for all finished bends in case it is established during bending procedure qualification that heat treatment is required to meet the specification requirements. Heat treatment procedure shall be such that the mechanical properties and steel microstructure of the finished bends comply with the minimum requirements specified in the applicable line pipe specification.
- 3.4 Mechanical testing of test bends performed during the bend manufacturing procedure qualification as per Section 9.0 of this specification, shall ensure that all bends made according to the Owner approved bend manufacturing procedure have the required mechanical properties and destructive testing of production bend is required.

4 MANUFACTURING

- 4.1 Material grade, bend size, bend radius and bend angle shall be as indicated in the Purchase Order. Unless specified otherwise, the bending radius for bends shall be minimum six times the nominal outside diameter.
- 4.2 Bends shall be manufactured by high frequency induction heating and forming method. Once the bending operation has commenced no stoppage shall be permitted until the entire bend has been completed. If bending temperature, bending rate, cooling medium volume or heat treatment temperature depart from the Owner approved bend manufacturing procedure, then the pipe shall be discarded and another bend shall be made in its place.
- 4.3 All bends shall be provided with a tangent length at both ends. Tangent length shall be 500mm or pipe outside diameter whichever is more.
- 4.4 Unless otherwise specified differently in the Purchase Order, the bevels at the ends shall be as per the relevant pipe specification.
- 4.5 Bends shall not have any circumferential joint.
- 4.6 No repair by welding is allowed on any part of the bends.
- 4.7 Bulges, dents and flat areas shall not appear within 100 mm front end of the bend. For the remaining part of the bend these deviations from the original contour of the pipe are permitted provided these deviations do not exceed 6.0 mm. The same shall not extend (in any direction) over a distance of more than 25 % of nominal diameter of the bend.
- 4.8 The excess weld material at the inside of the bend in case of bends made from SAW pipes shall be removed over a distance of 100 mm at both ends.

4.9 Tolerances


The dimensions of bends shall be controlled to make sure that they are manufactured according to the tolerances indicated below in addition to the requirements of MSS-SP-75. However, the ends of finished pipe bend shall meet the dimensional tolerances of the relevant pipe specification.

- 4.9.1 Following tolerances shall be applicable for Bend Angle and Bend Radius:

Bend Angle : ± 0.5 degree of specified angle

Bend Radius : + 1 % of bending nominal radius

- 4.9.2 The manufacturer shall check the wall thickness of the pipe ultrasonically before bending along both the

	SPECIFICATION FOR LONG RADIUS INDUCTION BENDS	DOCUMENT NO.	REV
		11-0330G01-01-07-02-009	0
		SHEET 4 OF 9	

inside and outside radii, at approximately 15 degree intervals or 300mm whichever is less. The wall thickness shall be measured ultrasonically after bending at the same locations measured before bending. These measurements shall be taken at four equally spaced locations around the pipe circumference at both welding ends of the bend. The measured wall thickness shall be at least equal to the pipeline nominal wall thickness specified in the purchase requisition.

4.9.3 Ovality in any plane along the finished bend shall not exceed 5mm (max) Ovality shall be calculated using the following formula:

$$\text{Ovality} = \frac{2(\text{OD max} - \text{OD min})}{\text{OD nom}}$$

Where

OD max - Maximum outside Diameter
 OD min - Minimum outside Diameter
 OD nom - Nominal outside Diameter

The measurements shall be made over the circumference of the bend either at distances approximately equal to pipe diameter or 300mm whichever is less. Minimum three measurements shall be taken for each bend.

4.9.4 Off-Plane

Off-Plane of bends shall not exceed $(\Theta/90) \times 10$ mm, where Θ is the bend angle in degree or the tolerance limit specified in MSS-SP-75 whichever is less. The measurement shall be in accordance with MSS-SP-75.

5 INSPECTION & TESTS

5.1 The manufacturer shall perform all inspection and tests as per the requirements of this specification and MSS-SP-75 prior to shipment, at his Works. Such inspection and tests shall be as a minimum, but not limited to, the following:

- a) Verify that the unfinished product arriving at Manufacturer's shop is in full compliance with the pipe specification.
- b) Visual inspection.
- c) Dimensional and tolerances check as per MSS-SP-75 and requirements of Section 4.0 of this specification.
- d) Check heat treatment, if carried out, as required and maintain its records.
- e) Temperature against time recorder charts for each induction heating.
- f) The non-destructive inspection on the finished bend shall be carried out as given below:
 - All seam welds of bends fabricated from SAW and electric welded pipe shall be fully radiographed and acceptance limits shall be as per pipe specification.
 - The full circumference of both ends of each bend after beveling shall be ultrasonically tested for laminations over a length of 25 mm and acceptance limits shall be as per pipe specification.
 - The finished bends shall be magnetic particle inspected on the outside and inside radii to include the area encompassed 30 degrees either side of the line passing through the plane of the bend. Acceptance criteria shall be as per ASME Sec. VIII Appendix 6.

	SPECIFICATION FOR LONG RADIUS INDUCTION BENDS	DOCUMENT NO.	REV
		11-0330G01-01-07-02-009	0
		SHEET 5 OF 9	

- g) A check shall be performed on each bend by passing a gauging pig consisting of two discs having a diameter equal to 95 % of the nominal internal diameter of the pipe, connected rigidly together at a distance equal to 500 mm. Details of the gauging pig, including its dimensions shall be approved by Owner.

5.2 Owner's Inspector reserves the right to perform stage wise inspection and witness tests on all bends as indicated in Clause 5.1 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 Owner's Inspector. Inspection and tests performed or witnessed by Owner's Inspector shall in no way relieve the Manufacturer's obligation to perform the required inspection and tests. Under no circumstances any action of the Owner's Inspector shall relieve the Manufacturer of his responsibility for the material and quality of the bends.

6 TEST CERTIFICATES

The Manufacturer shall submit the following Certificates:

- a) Test certificates of chemical, mechanical tests, heat treatment, dimensional inspection and hydrotest carried out on pipe used for fabrication of bend.
- b) Certificates of non-destructive test/examination carried out on bends.
- c) Records of heat treatment, if carried out for bends.
- d) Certified reports of dimensional tolerance of bends.
- e) Certificates of all other tests as required in this specification.

The Certificates shall be valid only when signed by Owner's Inspector. Only those bends which have been certified by Owner's Inspector shall be dispatched from Manufacturer's works.

7 MARKING, PACKING AND SHIPMENT

7.1 All bends shall be marked as per MSS-SP-75.

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

7.3 A coat of antirust paint shall be applied on the bends for protection during transit and storage. Type of paint shall be as agreed upon with the Owner.

7.4 Both ends of all bends shall be suitably protected to avoid any damage during transit by means of metallic or high impact plastic bevel protectors.

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

- a) Order Number
- b) Package Number
- c) Manufacturer's Name
- d) Size (Inches) and wall thickness (mm)
- e) Radius of bend (mm).

	SPECIFICATION FOR LONG RADIUS INDUCTION BENDS	DOCUMENT NO.	REV
		11-0330G01-01-07-02-009	0
		SHEET 6 OF 9	

8 DOCUMENTATION

Documentation to be submitted by Manufacturer to Owner is summarized below. Number of Copies (Hard copies / soft copies etc.) shall be as indicated in Contract document.

8.1 All documents shall be in English language.

8.2 At the time of bidding, bidder shall submit the following documents:

- a) Reference list of previous supplies of bends of similar specifications.
- b) Brief description of manufacturing including heat treatment and quality control facilities of the Manufacturer's Works.
- c) Brief description of manufacturing and quality control facilities of the Manufacturer's works.

8.3 Within three weeks of placement of order, the Manufacturer shall submit six copies of bend manufacturing procedure including manufacturing, inspection, testing procedures, quality control manual and quality plans.

The Bend Manufacturing Procedure shall detail the following, as a minimum:

- a) Sequence of operation
- b) Induction forming process including bending temperature, temperature control, bending rate, cooling rate and cooling procedure.
- c) Temperature measurement and calibration
- d) Post bend heat treatment procedure including temperature and time.
- e) Dimensional control procedure
- t) Pipe material used for bend manufacture
- g) NDT procedures
- h) Quality Control and Quality Plans

Upon successful completion of the bend manufacturing procedure qualification as per Section 9.0 of this specification, Manufacturer shall submit six copies of the qualified procedure to Owner for approval. Regular production of bends shall commence only after the bend manufacturing procedure has been qualified and approved by Owner.

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

8.4 Within four weeks from the approval date Manufacturer shall submit one reproducible and six copies of the documents as stated in Clause 8.3 above.

8.5 Prior to shipment, the Manufacturer shall submit one reproducible and six copies of test certificates as listed in Section 6.0 of this specification.

9 BEND MANUFACTURING PROCEDURE QUALIFICATION

9.1 Prior to start of production bending, Manufacturer shall demonstrate the suitability of the proposed

	SPECIFICATION FOR LONG RADIUS INDUCTION BENDS	DOCUMENT NO.	REV
		11-0330G01-01-07-02-009	0
		SHEET 7 OF 9	

manufacturing procedures for producing pipe bends including the post-bending heat cycle, if any, that meet the requirements of this specification, by mechanically testing additional bend(s) (test bends). The bending procedure shall be qualified in the presence of Owner Representative.

9.2 Test bends shall be made by using the pipe specified in Clause 3.1 of this specification. One test bend is required per 'heat lot' where a heat lot is deemed to include all bends of the same diameter, wall thickness, mill heat number and bend forming parameters such as bending temperature, bending rate, cooling medium volume & heat treatment temperature (excluding bend angle). The test bend shall be bent to an angle of 90 degree.

9.3 Inspection and Testing of Bends

9.3.1 All finished test bends shall meet the requirement of dimensional tolerances, inspection and non-destructive testing requirements specified in Section 4.0 and 5.0 of this specification.

9.3.2 In addition, all finished test bends shall be subjected to following mechanical testing to confirm that the bends manufactured meet all mechanical property requirements of linepipe specifications. Test procedure and acceptance criteria shall be in accordance with the linepipe specification. The test specimen shall be taken from the bent portion of the bend only.

a) **Tensile Test**

One tensile test shall be conducted on the base material of finished test bend, to establish yield strength, ultimate tensile strength and elongation. The specimen shall be taken longitudinal or transverse to the axis as specified in the relevant pipe specification. In case of bends of 450 mm (18') NB and larger, the specimen shall be taken at inside radius and one at outside radius of the bend.

b) **All Weld Tensile Test**

In case of bends fabricated from SAW pipes, an all weld tensile test shall be conducted to establish yield strength, ultimate tensile strength and elongation of weld material on bend.

c) **Guided Bend Test**

In case of bends fabricated from SAW/EW pipes, one face and one root guided bend weld test shall be performed.

d) **Hardness Test**

Hardness testing shall be performed "thru thickness" on a test ring removed from the middle of the bend. Four specimens shall be prepared one from each quadrant. In case of bends fabricated from SAW/EW pipes, one specimen shall have longitudinal weld seam in the middle. Hardness shall be checked for base metal, weld metal and HAZ. In addition, hardness test shall be performed at spots where dents, bulges or wrinkles have been formed on the bends.

e) **Fracture Toughness Test**

Charpy-V-notch test temperature shall be the same as specified in the relevant pipe specifications. Three base material specimens shall be taken longitudinal or transverse to the axis as specified in the relevant pipe specification. In case of bends fabricated from SAW and EW pipes, three transverse weld material specimens shall be taken with weld in the middle. In case of bends of 450 mm (18") NB and larger, the base material specimens shall be taken at

	SPECIFICATION FOR LONG RADIUS INDUCTION BENDS	DOCUMENT NO.	REV
		11-0330G01-01-07-02-009	0
		SHEET 8 OF 9	

the outside radius of the bend.

Should test bends fail to comply with the above requirements, the bend manufacturing procedure shall be disqualified. The Manufacturer shall revise the manufacturing procedure and re-qualify the same at his own cost and time.

Upon completion of the successful procedure qualification, manufacturer shall provide a written bending procedure for each test bend. The submitted procedure shall indicate in addition to the details as per Clause 8.3, tolerances on various controlling parameters.



**SPECIFICATION FOR LONG RADIUS
INDUCTION BENDS**

DOCUMENT NO.

REV

11-0330G01-01-07-02-009

0

SHEET 9 OF 9



GAIL (India) Limited
PIPELINE FROM HANUMAN JUNCTION TO VCL



SPECIFICATION FOR CASING INSULATORS AND CASING END SEALS				CLIENT JOB NO.		-
				TOTAL SHEETS		6
DOCUMENT NO	11	0330G01	01	07	02	010

--	--	--	--	--	--	--

REV.	DATE	DESCRIPTION	PREP	CHKD	APPD
0	04-07-11	ISSUED FOR TENDER	MH	EUR	AD
A	07-06-11	ISSUED FOR IDC	MH	EUR	AD

CONTENTS

1	FUNCTIONAL REQUIREMENTS	3
2	DEFINITION	3
3	DESIGN REQUIREMENTS	3
4	DOCUMENTATION	5
5	SUPPLEMENTARY REQUIREMENTS.....	5



**SPECIFICATION FOR CASING
INSULATORS AND CASING END
SEALS**

DOCUMENT NO.

REV

11-0330G01-01-07-02-010

0

SHEET 2 OF 6

1 FUNCTIONAL REQUIREMENTS

1.1 CASING INSULATORS

Pipeline insulators shall be used to support the carrier pipe inside the casing pipe and electrically isolate the carrier pipe from the casing pipe at the cased crossings.

The Casing insulators shall have the following properties:

- Resist cold flow and will not soften at design temperature.
- Resist corrosion.
- Resist mechanical damage while being pulled into the casing.
- Have high electrical insulating value and low water absorption, thus preventing leakage and maintain electrical isolation between carrier and casing pipes.
- Have high compressive strength in order to ensure a permanent support to the carrier pipe.

Manufacture shall obtain prior approval from OWNER on drawing/design of casing insulators.

1.2 CASING END-SEALS

Casing end seals are intended to be used for sealing the annular space between casing pipe and carrier pipe at casing ends so as to prevent ingress of moisture and water.

Manufacturer shall obtain approval from OWNER on design/drawing of end seals.

2 DEFINITION

For this specification the following definitions shall apply:

Owner : GAIL (INDIA) LIMITED


Consultant : Wood Group Kenny India Pvt. Ltd

Shall/Must/To be : A mandatory requirement

Should : A non-mandatory requirement, advisory or recommendation

3 DESIGN REQUIREMENTS

3.1 CASING INSULATORS

	SPECIFICATION FOR CASING INSULATORS AND CASING END SEALS	DOCUMENT NO.	REV
		11-0330G01-01-07-02-010	0
		SHEET 3 OF 6	

The arrangement of insulating shall be generally in accordance with Fig 3.0. It shall be made in segments duly held together with cadmium plated bolts and nuts, to be supplied with casing insulators.

The number of segments shall be two for pipe diameters up to 12" (generally). For larger diameters, the number of segments shall not be more than 3.

The skid height shall be obtained by the following formula & shall be ≥ 2 inch

$$\frac{\text{Casing Internal Dia} - \text{Carrier Outer Dia}}{2}$$

The spacing between insulators shall be 2.5 meters. The insulators at ends shall be located at 250 mm min from the end points of the casing. The support point of successive collars shall be regularly staggered.

MATERIAL:

Casing insulators shall be made of injection moulded high density polyethylene or other material equivalent or superior as approved by OWNER and shall meet the requirements given in Table-1.

Table 1 : Material Properties for Casing Insulators		
Property	Value	ASTM Test Method
Dielectric Strength	450-500 Volts/Mil	D-149
Compressive Strength	3200 psi	D-695
Tensile Strength	3100-5000 psi	D-638, D-651
Impact Strength	4.Oft.1b./inch of notch	D-256
Water Absorption	0.01%	D-570

3.2 CASING END SEALS

The seals shall be suitable for the casing and carrier pipe diameter as applicable for each case. The casing end-seal shall be flexible to cater for the expansion and contraction of carrier and casing pipes and shall be able to tolerate both angular and concentric misalignment of casing pipe without loss of sealing efficiency.

The design of the casing end seal shall permit easy installation of the seal to the cased pipeline crossing.

It shall provide moisture-proof seals when installed for the entire anticipated life of the buried pipeline

MATERIAL:

	SPECIFICATION FOR CASING INSULATORS AND CASING END SEALS	DOCUMENT NO.	REV
		11-0330G01-01-07-02-010	0
		SHEET 4 OF 6	

The casing end-seals shall be made of heat shrink high density radiation cross linked polyethylene with an adhesive having a melt point suitable for the pipeline service temperature and ambient temperature foreseen during construction. End-seals material shall be resistant to heat, cold, vibration, impact, abrasion, corrosive fluids, disbonding, organic and bio-deterioration.

Material for casing end seals shall meet the requirements given in Table-2.

Property	Value	Test Method
Backing (Sleeve and closure patch)		
Tensile Strength Ultimate Elongation Heat Shock	2200 psi 400% No visual cracks, flow or drips (at 225°C, 4 hours)	ASTM D-638 ASTM D-638 ASTM D-2671
Adhesive Ring and Ball softening point	90°C	ASTM E-28
Lap Shear	60°C - 25 psi 23°C - 250 psi (2 inch/min.)	ASTM D 1002
System (as applied) Peel strength (To casing and carrier pipe and closure patch)	5 pli (10 inch/min.)	ASTM D-1000


4 DOCUMENTATION

Manufacturer shall submit documentation for Casing insulators and End seals, which shall include the following as minimum.

- i) General Arrangement Drawings
- ii) Test and material certificates of all components used in the assembly of casing insulators and end seals.
- iii) Application Procedures / Manuals

5 SUPPLEMENTARY REQUIREMENTS

- 5.1 The manufacturer shall replace, at no extra cost, any material not conforming to the material and performance requirements of this specification.

	SPECIFICATION FOR CASING INSULATORS AND CASING END SEALS	DOCUMENT NO.	REV
		11-0330G01-01-07-02-010	0
		SHEET 5 OF 6	

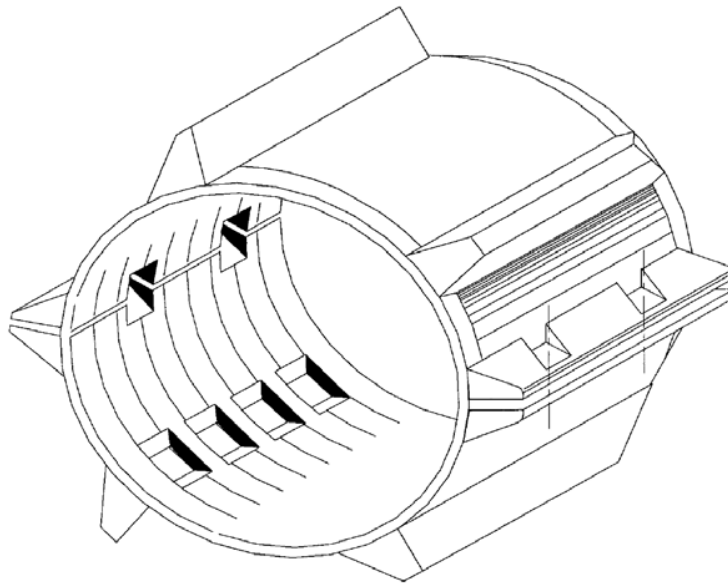
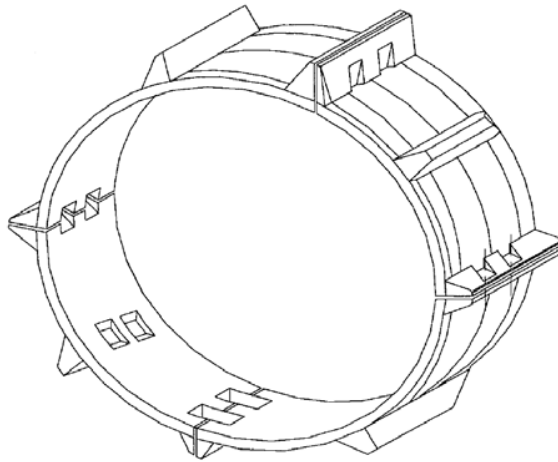


FIG.3.0

Casing Insulator



**SPECIFICATION FOR CASING
INSULATORS AND CASING END
SEALS**

DOCUMENT NO.

11-0330G01-01-07-02-010

REV

0

SHEET 6 OF 6



GAIL (India) Limited
PIPELINE FROM HANUMAN JUNCTION TO VCL




SPECIFICATION FOR CALIPER PIGGING				CLIENT JOB NO.		
				TOTAL SHEETS		7
DOCUMENT NO	11	0330G01	01	07	02	012

--	--	--	--	--	--	--

REV.	DATE	DESCRIPTION	PREP	CHKD	APPD
0	04-07-11	ISSUED FOR TENDER	MH	EUR	AD
A	07-06-11	ISSUED FOR IDC	MH	EUR	AD

CONTENTS

1	SCOPE.....	3
2	OBJECTIVE.....	3
2.1	DEFINITIONS.....	3
3	SCOPE OF WORK	3
4	VELOCITY OF DIFFERENT PIGS	4
5	FOAM PIG RUN	4
6	GAUGE PIG RUN	4
7	CLEANING PIG RUN.....	4
7.1	PIPELINES WITH INTERNAL COATING.....	4
7.2	PIPELINES WITHOUT INTERNAL COATING	5
8	CALIPER PIG RUN.....	5
9	PIG TRACKING	6
10	MARKER DEVICES	6
11	DEFECT VERIFICATION	6
12	ABNORMAL SITUATIONS	6
12.1	TOOL FAILURE.....	6
12.2	STUCK-UP TOOL.....	7
13	WORK REPORT	7
14	INFORMATION TO BE FURNISHED BY BIDDER IN HIS OFFER FOR EVALUATION.....	7

	SPECIFICATION FOR CALIPER PIGGING	DOCUMENT NO.	REV
		11-0330G01-01-07-02-012	0
		SHEET 2 OF 7	

1 SCOPE

The intent of this specification is to set forth the requirements of the caliper pigging. The specification is not intended to be all-inclusive and the use of this specification will not absolve the contractor of his responsibility of generating valid, interpretable and physically verifiable data.

2 OBJECTIVE

The objective of the present pigging programme is to access the internal geometry of the following pipelines and detect significant geometry defects if any, which may affect safe operation of the pipeline.

2.1 DEFINITIONS

For this specification the following definitions shall apply:

OWNER	:	GAIL (India) Limited
CONSULTANT	:	Wood Group Kenny India Pvt. Ltd.
CONTRACTOR	:	The Company named as such in the deed.
SHALL/MUST/IS TO BE	:	A mandatory requirement
SHOULD	:	A non-mandatory requirement, advisory or recently Amended

3 SCOPE OF WORK

To achieve the above objective, contractors SCOPE OF WORK includes running of adequate numbers of foam pigs, cleaning pigs (magnet, brush, combination of brush and magnet, scraper, pin wheel etc.), gauge pig and caliper pig.

Further the scope of work comprises supply of skilled personnel, all equipment e.g. foam pigs cleaning pigs, gauging pig, caliper pigs, pig locating and pig tracking devices, spares consumables, communication and transportation including their mobilisation and demobilisation. It is expressly understood that this do not limit the scope of work of the CONTRACTOR in any way. The quantities to be mobilized for different equipment (different types of pigs pig tracking device, marker device) accessories, spare and consumables need to be carefully evaluate by the CONTRACTOR taking in to the consideration that caliper pigging of various pipelines in the scope of work should be carried out without any constraint and turn around time.

The contractor shall submit the details of each type of pig including foam, gauge and caliper for approval of OWNER / CONSULTANT, which he proposes to use. Pigs shall be launched in the pipeline only after their design and size has been approved by OWNER / CONSULTANT. Due care shall be taken not to damage internal coating by the contractor, while proposing the pigs for internally coated pipeline.

	SPECIFICATION FOR CALIPER PIGGING	DOCUMENT NO.	REV
		11-0330G01-01-07-02-012	0
		SHEET 3 OF 7	

The detailed scope of work shall be, but not limited to under

- Supply of all equipment, personnel and consumables.
- Running of foam, Gauge, Cleaning and Caliper pigs and Tracking to generate valid data.
- Placement of marker devices along the Row over the pipeline.
- Identification of defects in the field as found
- Preparation of work reports.

4 VELOCITY OF DIFFERENT PIGS

Contractor shall be required to maintain velocities of propelling medium in such a way that the objective of each pig run shall be achieved.

5 FOAM PIG RUN

Contractor to carry out adequate number of foam pigs runs in each pipeline covered under Scope of Work prior to running of cleaning pigs to make a final assessment of the line pig- ability to the satisfaction of the Contractor and provide detailed daily site report for each run in the approved format before commencing the subsequent run. Contractor to select size of the foam pigs in such a way that the objective shall be achieved.

6 GAUGE PIG RUN

Contractor to carry out adequate number of gauging pig runs in each pipeline covered under Scope of work including pig tracking for pipeline to assess any internal restriction in the pipeline that may restrict the passage of cleaning and caliper pig. Contractor to provide detailed daily site report for each run in the approved format before commencing the subsequent run Gauge pig shall be equipped with a gauge plate made of Aluminium having its diameters 95% of minimum pipeline Internal Diameter (I.D.). The gauge pig should be able to pass over or negotiate lateral tees or bends on the pipeline.

7 CLEANING PIG RUN

7.1 Pipelines with Internal Coating

Contractor to carry out adequate number of cleaning pig runs by running suitable cleaning pigs in the pipelines including pig tracking till such time contractor is satisfied with himself about the degree of cleanliness of pipeline and provide detailed daily site report for each run in the approved format before commencing the subsequent run. Choice of the type of cleaning pig has been left to the contractor. The contractor shall assure that the pigs, which are proposed to be used, are adequately soft and they do not damage internal coating under any circumstances. The brushes and scrappers used shall be of non-metallic/ plastic material. However, the details of these pigs including their construction details of

	SPECIFICATION FOR CALIPER PIGGING	DOCUMENT NO.	REV
		11-0330G01-01-07-02-012	0
		SHEET 4 OF 7	

brushes, scrappers etc. (if applicable) shall be submitted to OWNER / CONSULTANT for approval before their usage.

7.2 Pipelines without Internal Coating

CONTRACTOR to carry out adequate numbers of cleaning pig runs by running suitable cleaning pigs in pipeline covered under SCOPE OF WORK including pig tracking till such time CONTRACTOR is satisfied with himself about the degree of cleanliness of pipeline and provide detailed daily site report for each run in the approved format before commencing the subsequent run. Choice of the type of cleaning pig has been left to the contractor. Contractor may deploy brush cleaning pig, magnetic cleaning pig, combination of brush and magnet, scrapper pig etc. the cleaning pigs should be able to pass over negotiate lateral tees or bends on the pipeline.

8 CALIPER PIG RUN

CONTRACTOR to carry out adequate number of electronic geometry (caliper) pig runs each pipeline covered under SCOPE OF WORK including pig tracking for each pipeline decided after findings of gauging pig run to generate valid and interpretable geometry data of the pipeline and analysis of data of the caliper survey to detect the nature, extent and location of geometry defect. Contractor to provide detailed daily site report for each run in the approved format before commencing the subsequent run. The caliper should be capable of inspecting entire length of the pipeline i.e. from launcher to receiver in single run. Battery life should be adequate to commensurate with the run time required to travel the pipeline length. The electronic recorder system should have requisite data storage capacity. The drive cups should have requisite resistance to wear and tear to maintain effective seal throughout the entire run time.

The measurement shall cover the entire 360° of internal pipe wall circumference using properly oriented and sufficient quantity of sensors. For internally coated pipelines adequate care shall be taken by using soft cups so that no damage takes place to the internal coating of pipe. The tool shall be capable to identify and locate the following features as minimum.

- Individual Girth weld
- Dent, ovality, buckles, or any other out of roundness, change in pipeline I.D. and difference of thickness.
- Bend with bend radius and degree of bend.
- Valves or any partially closed valves.
- Tees/ off-takes.

The caliper pig should have minimum capability to identify and detect the defects of following threshold.

Dent	:	3% of outer diameter (O. D.)
Ovality	:	5% of outer Diameter (O. D.)
Location accuracy	:	Axial ± 3.0m
Circumferential	:	± 12°

	SPECIFICATION FOR CALIPER PIGGING	DOCUMENT NO.	REV
		11-0330G01-01-07-02-012	0
		SHEET 5 OF 7	

(For dents, ovalities and pipeline feature as detailed above).

9 PIG TRACKING

The movement of any type of pig (Except, foam pig) put into the line during caliper pigging shall be required to be monitored along the pipeline length from launcher to receiver trap. The BIDDER shall detail out the complete methodology of pig tracking proposed to be deployed by him including complete technical details of the equipment and device proposed to be used for this purpose.

It is proposed that pig tracking would be done in a discrete manner at least 5 to and 10 km - interval on each pipeline at pre-selected locations. The exact KM chainage of these locations shall be decided at site in consultation with the Contractor and OWNER / CONSULTANT.

10 MARKER DEVICES

The contractor shall submit the details of marker devices, which he proposes to place for relocating the defect accurately in the field, when the same has been identified as a result of Caliper survey.

The contractor shall be responsible for placing these devices (Marker Magnets or Locator coils or any other device) at suitable interval so that the defect can be easily located in the field with minimum above ground measurement. It may be noted that placement of marker devices, their retrieval and locating the identified defect in the field shall be the responsibility of the contractor. The liquidation of defects, if any, is however, not included in the scope of work of the contract.

11 DEFECT VERIFICATION

At the discretion of the OWNER/ CONSULTANT identify at least two verification dig sites for each pipeline jointly with OWNER and CONSULTANT from the recorded data and provide OWNER / CONSULTANT with their distance from the nearest pipeline feature or reference marker to facilitate location of defect in the field.

The contractor shall depute his representative to observe the verification at verification sites for proving that filed log detected anomalies conform to sizing including linear and circumferential positions.

12 ABNORMAL SITUATIONS

The objective of this section is to write down foreseeable abnormal circumstances for taking appropriate measures, should such a condition arise during implementation of project.

The following abnormal condition has been foreseen by the OWNER. However, if the BIDDER foresees any other abnormal condition, he is free to make a mention of the same in his technical BID offer.

12.1 Tool Failure

CONTRACTOR is required to get valid interpretable and verifiable data for pipeline. In case CONTRACTOR'S equipment fails to perform electronic geometry inspection to generate valid data for

	SPECIFICATION FOR CALIPER PIGGING	DOCUMENT NO.	REV
		11-0330G01-01-07-02-012	0
		SHEET 6 OF 7	

any of the pipeline, CONTRACTOR will make extra runs of pigs to get valid and physically verifiable data.

12.2 Stuck-Up Tool

The BIDDER shall details out a contingency plan in his BID as proposed by him in case any of the pigs get stuck up. The plan shall identify procedure for exactly locating the stuck up pig, detail procedure for retrieval of pig, equipment, including support facilities required to retrieve the pig.

If pig does not move from stuck up location, by any measure, then the pipeline section shall have to be cut for retrieval of Pig. Necessary erection, fabrication and modification of pipe with new pipe piece after retrieval of pig shall be done by Contractor. The cost for this works shall be borne by Contractor on actual. After fabrication & erection, pigging contractor shall run Gauge pig to check internal restriction, if any. Locating the stuck up pig and its retrieval shall be the responsibility of the CONTRACTOR.

13 WORK REPORT

The work report shall be prepared and submitted in hard copy (4 sets) and Electronics media (2 sets) The work report shall consist of following as a minimum.

- All field activities.
- Equipment description
- List of installations
- List of significance with feature information and installation reference.
- Survey log and enlargement areas of special interest to suitable scale.

14 INFORMATION TO BE FURNISHED BY BIDDER IN HIS OFFER FOR EVALUATION.

- List of similar projects executed in the past.
- Specification of foam pigs, cleaning pigs, gauge pig and caliper pig for pipelines with and without internal coating respectively.
- Details of caliper pig in following respects:
 - Max.% of Nominal pipeline ID tool can pass (% of ID)
 - Minimum deformation level reported (as % of ID)
 - Accuracy of measurement (% of ID)
 - Bend radius tool able to negotiate
- Details of pig tracking equipment and pig tracking procedure.
- Pig contingency plan.
- Proposed methodology for execution of pipeline pigging.
- Sample reporting format.
- Minimum velocity of various pigs acceptable to bidder for generation of valid data.

	SPECIFICATION FOR CALIPER PIGGING	DOCUMENT NO.	REV
		11-0330G01-01-07-02-012	0
		SHEET 7 OF 7	



GAIL (India) Limited
PIPELINE FROM HANUMAN JUNCTION TO VCL



SPECIFICATION FOR TRANSPORTATION, HANDLING AND STORAGE OF COATED LINE PIPE				CLIENT JOB NO.		-
				TOTAL SHEETS		11
DOCUMENT NO	11	0330G01	01	07	02	013

--	--	--	--	--	--	--

REV.	DATE	DESCRIPTION	PREP	CHKD	APPD
0	04-07-11	ISSUED FOR TENDER	MH	EUR	AD
A	07-06-11	ISSUED FOR IDC	MH	EUR	AD

CONTENTS

1 SCOPE..... 3

2 CODES, REGULATIONS AND STANDARDS..... 3

3 GENERAL..... 3

4 TRUCK/ TRAILOR TRANSPORTATION..... 7

5 INSPECTION 8

6 SAFETY 8

7 STORAGE AT PIPEYARD..... 8

	SPECIFICATION FOR TRANSPORTATION, HANDLING AND STORAGE OF COATED LINE PIPE	DOCUMENT NO.	REV
		11-0330G01-01-07-02-013	0
		SHEET 2 OF 11	

1 SCOPE

This specification covers the minimum requirements for transportation and handling of bare and Polyethylene coated line pipe.

2 CODES, REGULATIONS AND STANDARDS

2.1 Contractor shall meet or exceed the requirements of the latest edition of the following codes, regulations and standards, except as superseded herein. In cases where more than one code, regulation or standard apply to the same condition, the most stringent shall be followed. In the even of a conflict between this specification and other specifications or correspondence, the OWNER / CONSULTANT shall be consulted and a ruling, in writing, shall be obtained before any work is started.

API RP 5L 1	Recommended Practice for Railroad Transportation of Steel Line Pipe
API RP 5LW Marine Vessels	Recommended Practice for Transportation of Line Pipe on Barges and Marine Vessels
DIN 30670	Polyethylene Coatings for Steel Pipes and Fittings

All Laws and Regulations of Authorities having jurisdiction over transportation of goods in all locations between the point of lading and the destination.

2.2 Some requirements in this specification may be modified by specific requirements in the Purchase Specification. In case of conflict, the specific requirements supersede this specification.

2.3 Any deviation from this specification must be approved, in writing, by OWNER / CONSULTANT. Such written approval must be obtained prior to the commencement of any work which would constitute such a deviation.

3 GENERAL

3.1 Definitions

For this specification the following definitions shall apply:

OWNER	- GAIL (India) Limited
CONSULTANT	- Wood Group Kenny India Pvt. Ltd.
CONTRACTOR	- The Company named as such in the deed.
SHALL/MUST/ISTO BE	- A mandatory requirement
SHOULD	- A non-mandatory requirement, advisory or recently Amended

3.2 Transportation and handling of line pipe to this specification shall meet the requirements of API RP 5L1 OR API RP 5LW as applicable, as well as the requirements of this specification which exceed the requirements of API RP 5L1 or API RP 5LW.



**SPECIFICATION FOR
TRANSPORTATION, HANDLING AND
STORAGE OF COATED LINE PIPE**

DOCUMENT NO.

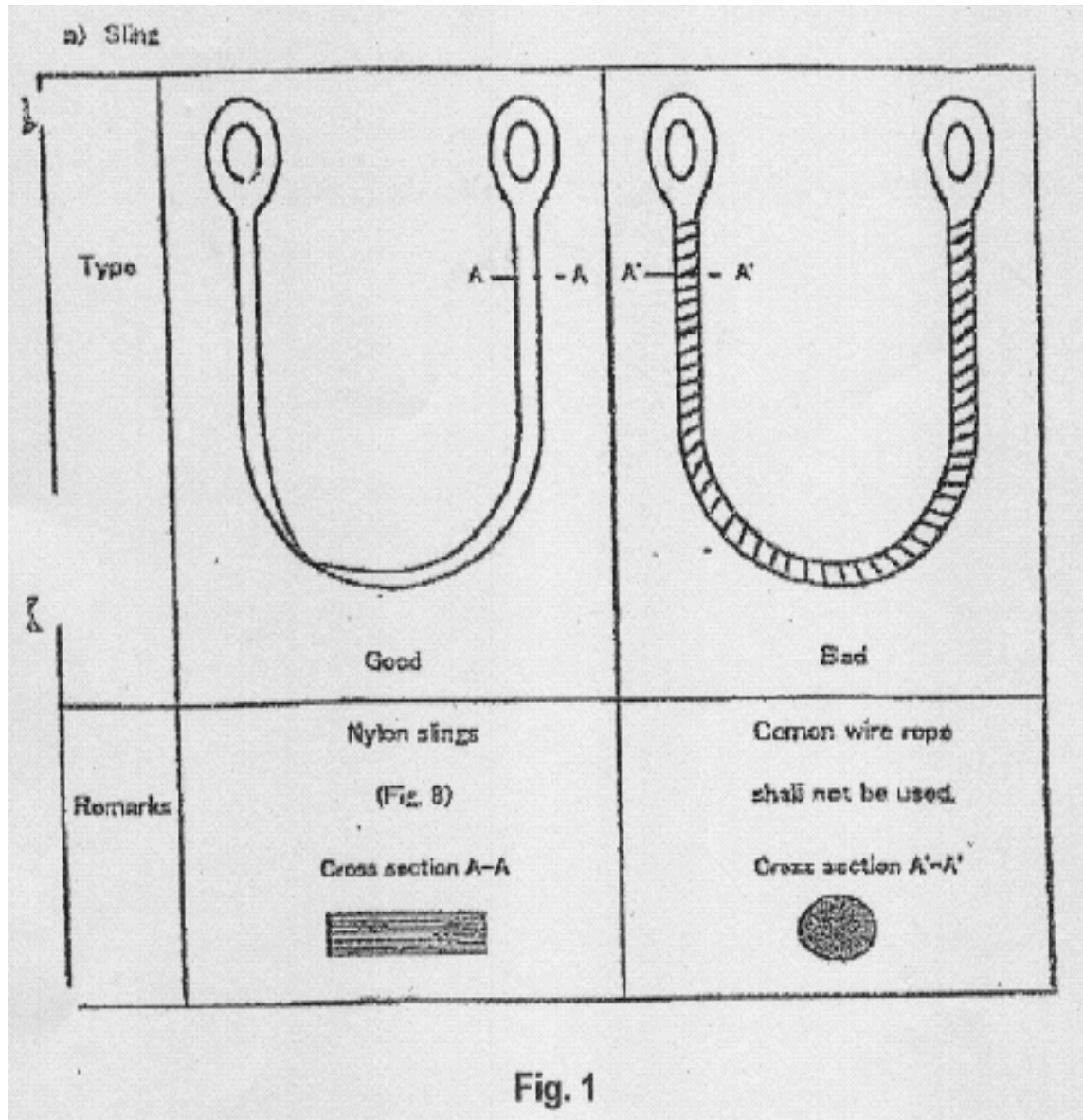
11-0330G01-01-07-02-013


REV

0

SHEET 3 OF 11

- 3.3 Pipe shall be transported, handled and stored in a manner such that corrosion and mechanical damage, to both pipe and coating are prevented until the pipe has been delivered to designated stockpile area.
- 3.4 Special attention shall be paid for loading/unloading and handling works so as to prevent damage of pipe body and polyethylene.
- 3.5 Nylon Sling or pipe handling hooks which do not damage pipe ends shall be used for loading/unloading and stacking Refer Fig. 1 & 2.



	SPECIFICATION FOR TRANSPORTATION, HANDLING AND STORAGE OF COATED LINE PIPE	DOCUMENT NO.	REV
		11-0330G01-01-07-02-013	0
		SHEET 4 OF 11	

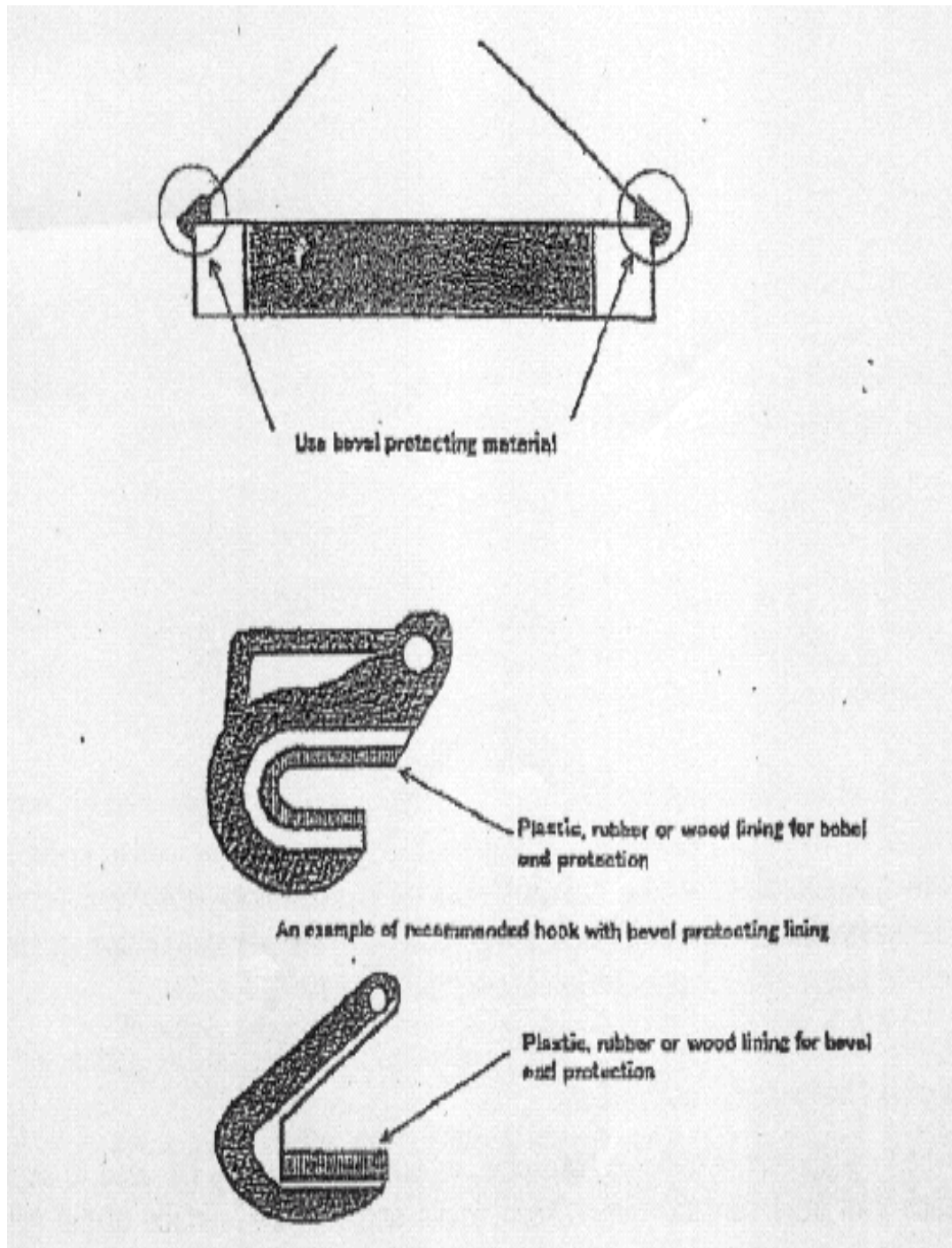


Fig.2



**SPECIFICATION FOR
TRANSPORTATION, HANDLING AND
STORAGE OF COATED LINE PIPE**

DOCUMENT NO.

REV

11-0330G01-01-07-02-013

0

SHEET 5 OF 11

- 3.6 Any shock or pressure by hard substance which may damage the surface of pipe body and polyethylene coating should be avoided Refer Fig. 3 & 4.

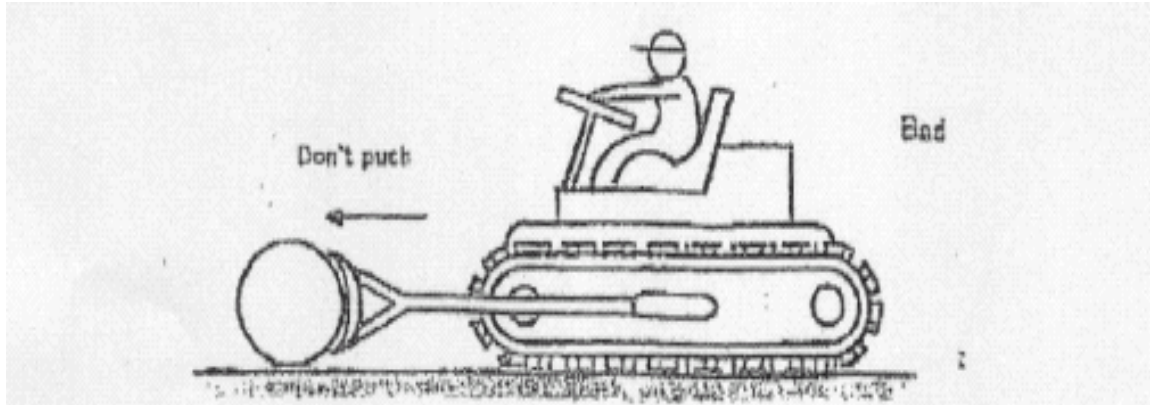


Fig. 3

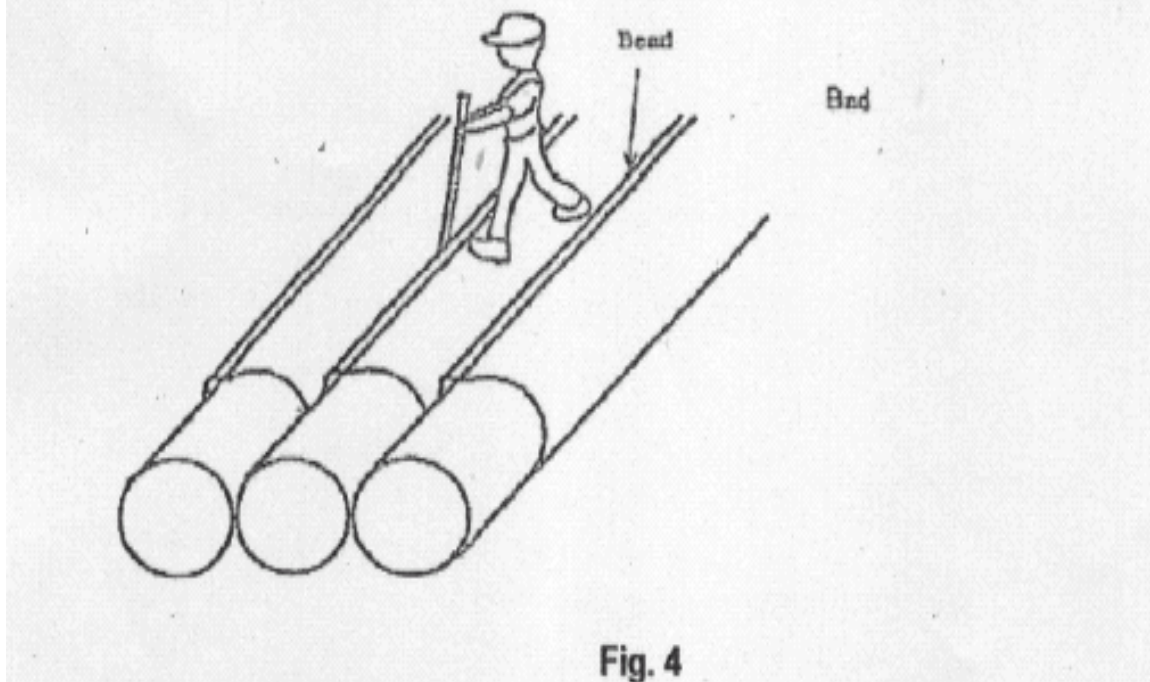


Fig. 4



**SPECIFICATION FOR
TRANSPORTATION, HANDLING AND
STORAGE OF COATED LINE PIPE**

DOCUMENT NO.

11-0330G01-01-07-02-013

REV

0

SHEET 6 OF 11

- 3.7 Pipe shall be stacked in a nested manner such that the weld seams of the pipes are kept free from contact with other pipes or blocking.
- 3.8 Loading of pipes of different outside diameter in one stack shall be avoided.
- 3.9 Any additional requirements to be applied to a particular purchase shall be included on specification sheets accompanying the Purchase inquiry. This specification sheet shall be deemed as part of the project specification.
- 3.10 If pipes of the same outside diameter but different wall thickness or steel grade are loaded in one stack, pipe with the higher steel grade shall be loaded under lower steel grade, or heavier wall thickness shall be loaded under lighter wall thickness. For loads of mixed steel grade and wall thickness, the product of steel grade and wall thickness shall be used to determine stacking order.
- 3.11 Joints shorter than the average joint length shall be loaded on top, and in any case shall not be loaded in bottom tiers.

4 TRUCK/ TRAILOR TRANSPORTATION

- 4.1 Transportation of line pipe by truck to this specification shall comply with the laws and regulations of authorities having the jurisdiction over transportation of goods in all jurisdictions between the point of loading and location of destination. Loading and handling procedures shall comply with the requirements of API RP 5L1 for loading and handling for rail transportation where applicable.
- 4.2 Wooden Dunnage shall be laid at approximately same interval. Soft material such as rubber sheet should preferably be applied between pipe and dunnage.
- 4.3 Pipe shall be stacked in a nested manner such that the weld seams of the pipes are kept free from contact with other pipes or blocking.
- 4.4 Loading of pipes of different outside diameter in one stack shall be avoided.
- 4.5 If pipes of the same outside diameter but different wall thickness or steel grade are loaded in one stack, pipe with the higher steel grade shall be loaded under lower steel grade, or heavier wall thickness shall be loaded under lighter wall thickness. For loads of mixed steel grade and wall thickness, the product of steel grade and wall thickness shall be used to determine stacking order.
- 4.6 Joints shorter than the average joint length shall be loaded on top, and in any case shall not be loaded in bottom tiers.
- 4.7 Permitted stacking height 2 layers for 10" & 4 layers for 8" on pipe outside diameter, wall thickness, steel grade, coating, blocking, bearing strips and intended route, and shall be evaluated separately with the outside diameter, wall thickness and steel grade of each individual pipe.
- 4.8 Trucks shall be provided with fenders/mud flaps to prevent stones and gravel from impacting the pipe
- 4.9 When transporting exterior coated pipe, rubber padding shall be used to separate each joint from contact with adjacent joints and with the surface of the rail car. Reasonable care shall be used in handling to ensure that the pipe reaches its destination with coating intact and undamaged.
- 4.10 Details of handling/loading procedures for each size or type of pipe shall be provided in writing to OWNER / CONSULTANT for approval, prior to commencement of loading operations. OWNER / CONSULTANT review and/or approval of Contractor's procedures do not relieve the Contractor of any responsibility for complying with all of the requirements of this specification.



**SPECIFICATION FOR
TRANSPORTATION, HANDLING AND
STORAGE OF COATED LINE PIPE**

DOCUMENT NO.

11-0330G01-01-07-02-013

REV

0

SHEET 7 OF 11

5 INSPECTION

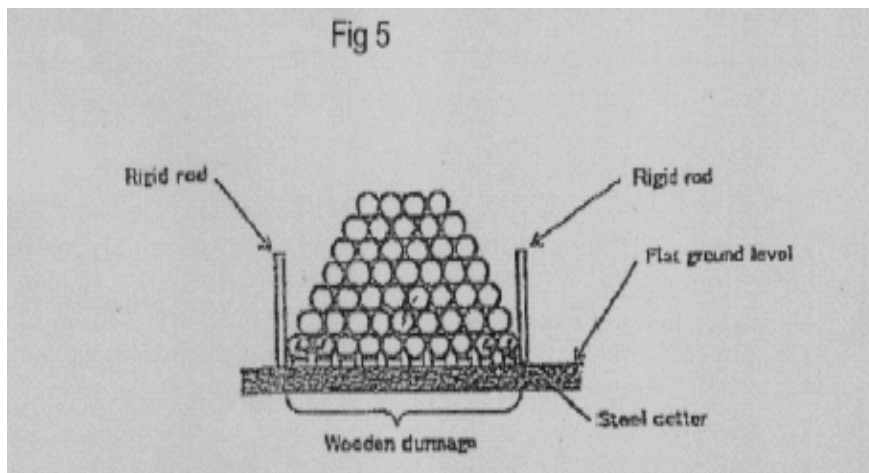
Contractor shall give OWNER / CONSULTANT a minimum of ten (10) working days written notice, prior to commencement of any loading/unloading operations. OWNER / CONSULTANT reserves the right to inspect at any time, without advance notice, at point of loading, or at any point in transit, any loading/unloading or transportation operation.

6 SAFETY

Contractor shall comply with local Occupational Health and Safety laws and regulations and with local laws and regulations governing transportation of goods by railroad, truck or water as applicable.

7 STORAGE AT PIPEYARD

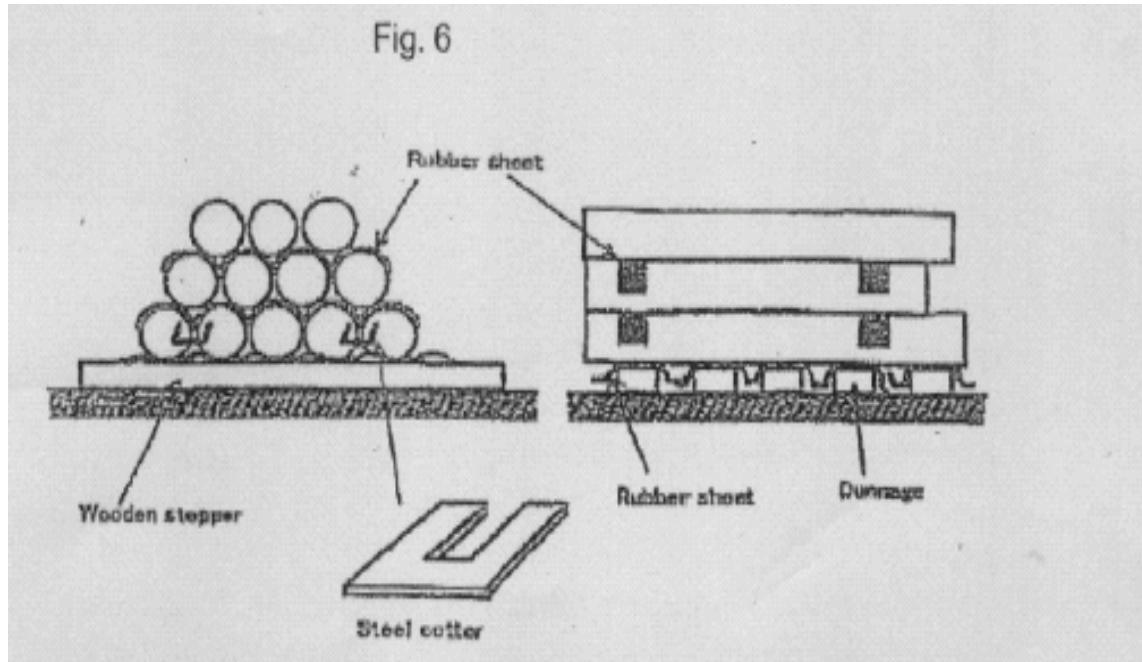
- 7.1 To avoid sinking, the pipe yard shall be compacted and levelled.
- 7.2 Proper drainage of water shall be maintained so that there is no water logging in the pipe yard.
- 7.3 The approach to pipe yard shall be motorable.
- 7.4 All the development plans for pipe yard shall be submitted for OWNER / CONSULTANT approval.
- 7.5 Special attention shall be paid for loading/unloading and handling pipes so as to prevent damage of pipe body and coating.
- 7.6 Nylon slings or pipe-handling hooks which do not damage pipe ends shall be used for loading/unloading and stacking.
- 7.7 Any shocks or pressure by hard substance which may damage the surface of the pipe body and coating should be avoided.
- 7.8 Pipes can be stored horizontally and parallel. Refer Fig. 5.



- 7.9 Wooden Dunnage shall be laid on the ground approximately the same interval.

	SPECIFICATION FOR TRANSPORTATION, HANDLING AND STORAGE OF COATED LINE PIPE	DOCUMENT NO.	REV
		11-0330G01-01-07-02-013	0
		SHEET 8 OF 11	

- 7.10 For both ends of bottom tier suitable wooden stoppage shall be applied and fixed with nails or spikes. Refer Fig. 6.



- 7.11 Applicable international standard to be followed for storage of the coated and bare pipes at pipe yard. Contractor to furnish copies of relevant standard followed. Pipes shall be placed so as not to contact.
- 7.12 The parts of equipments/items which come in direct contact with pipes for handling the coated pipes shall be of rubber coated or such material which can avoid damage to the pipes.
- 7.13 Pipes should be stored using pallets, rubber sheets or any other soft material.
- 7.14 Rubber sheet or any other soft material to be used in between pipes to avoid pipe to pipe contact so as to avoid damage to pipes.



**SPECIFICATION FOR
TRANSPORTATION, HANDLING AND
STORAGE OF COATED LINE PIPE**

DOCUMENT NO.

11-0330G01-01-07-02-013

REV

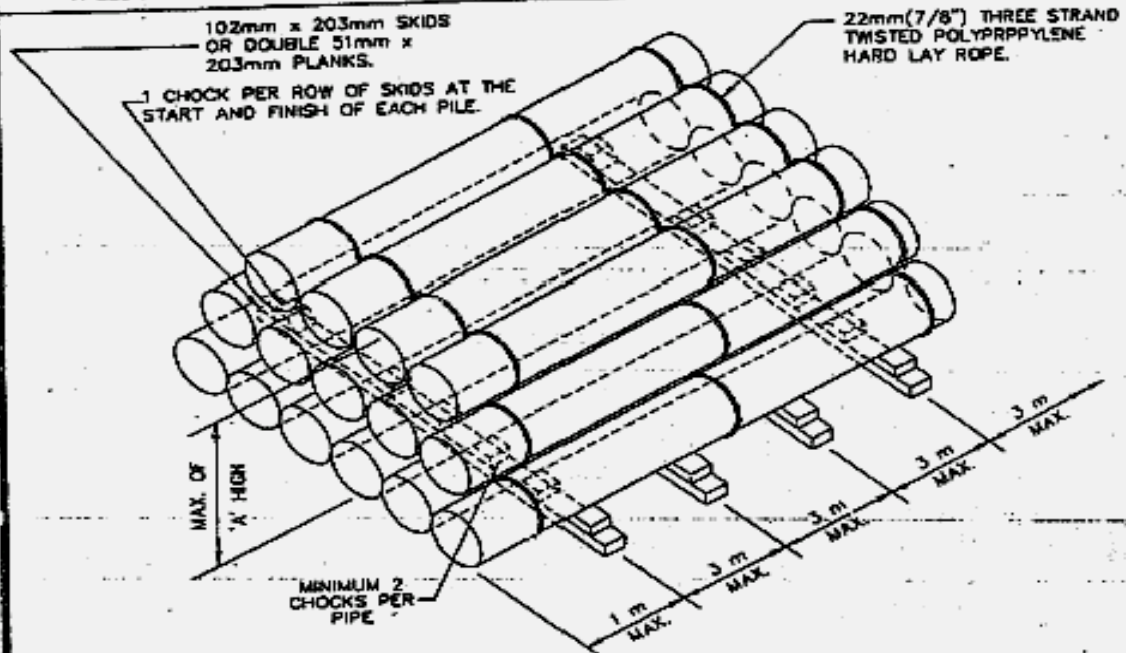
0

SHEET 9 OF 11

SIZE (in)	'A' (NO OF ROWS)	CIRCUMFERENCE OF FINISHED LOOPS(mm)	SIZE (in)	'A' (NO OF ROWS)	CIRCUMFERENCE OF FINISHED LOOPS(mm)	SIZE (in)	'A' (NO OF ROWS)	CIRCUMFERENCE OF FINISHED LOOPS(mm)
8"	6	750	20"	4	1680	30"	3	2500
10"	6	910				34"	3	2860
12"	5	1070				36"	3	3030
16"	5	1360	24"	4	2020	42"	3	3510

ROPE INSTALLATION

ROPE SPACING SHOULD BE A MAXIMUM OF 2m FROM THE PIPE ENDS AND A MAXIMUM OF 2m FROM GIRTH WELDS. THE INTERVALS BETWEEN RINGS SHOULD BE BETWEEN 3m AND 8m WITH A MINIMUM OF FOUR LOOPS SPACED OVER A STANDARD DOUBLE JOINT LENGTH (24m). THE INTERVALS MUST BE ADJUSTED TO INSURE THERE IS NO PIPE TO PIPE CONTACT. ROPE ENDS SHALL BE FUSED WITH A BLOW TORCH PRIOR TO SLIPPING THE LOOP OVER THE PIPE.



NOTE

1. THE USE OF ALTERNATE METHODS FOR STOCKPILING PIPE AND/OR THE USE OF ALTERNATE MATERIALS FOR PREVENTING PIPE TO PIPE CONTACT SHALL REQUIRE THE APPROVAL OF THE COMPANY.



SPECIFICATION FOR
TRANSPORTATION, HANDLING AND
STORAGE OF COATED LINE PIPE

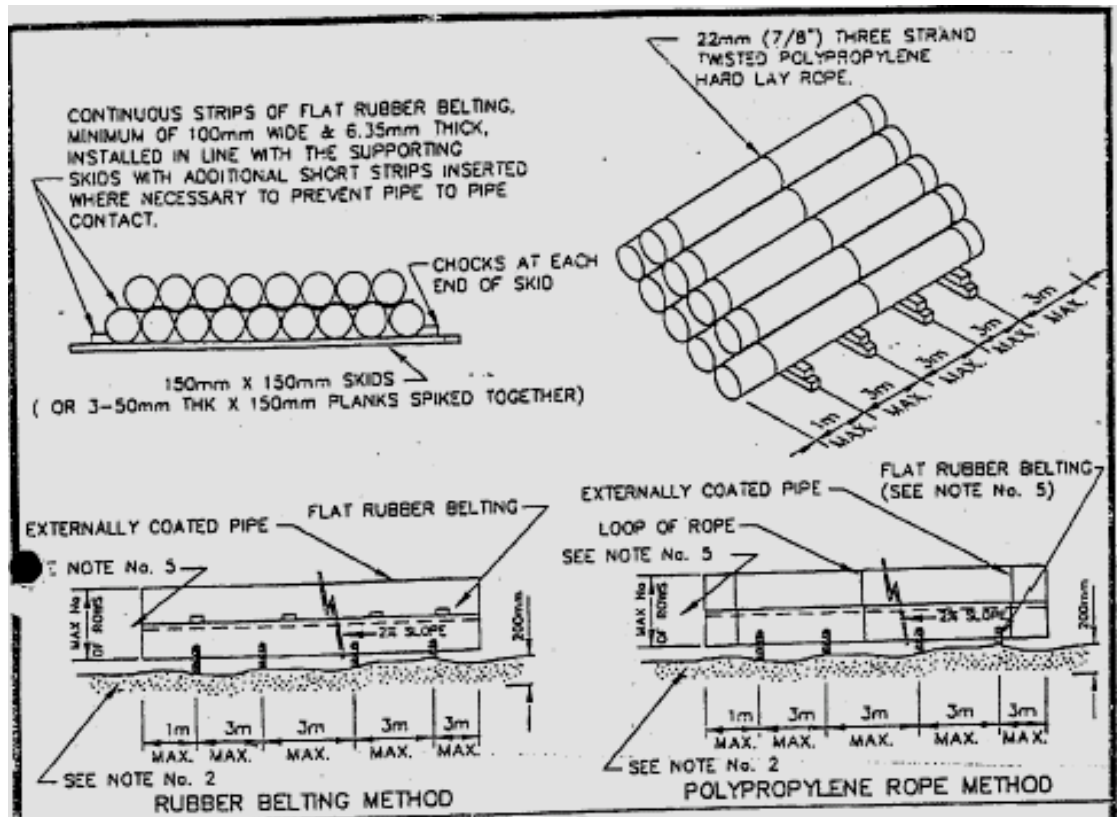
DOCUMENT NO.

11-0330G01-01-07-02-013

REV

0

SHEET 10 OF 11



NOTES:

1. THE USE OF THE RUBBER BELTED METHOD OR THE POLYPROPYLENE ROPE METHOD TO PREVENT PIPE TO PIPE CONTACT IN THE STOCKPILE SHALL BE DIRECTED BY THE COMPANY.
2. SITE TO BE GRADED TO 2% SLOP AND PADDED WITH 200mm OF PIT RUN GRAVEL.
3. SKIDS TO BE CAREFULLY LEVELLED TO MAINTAIN 2% SLOPE, PIPES TO MAINTAIN CLOSE CONTACT THROUGHOUT ENTIRE LENGTH TO PREVENT SPLITTING AND ROLLING OF THE STOCKPILE.
4. LONGITUDINAL WELDS TO BE ARRANGED AT TOP OF PIPE TO ALIGN WITH SPACES BETWEEN NESTED PIPES.
5. PIPE 10 3/4" & 16" TO BE STOCKPILED A MAXIMUM OF 3 ROWS HIGH. PIPE LARGER THAN 20" TO BE STOCKPILED A MAXIMUM OF 2 ROWS HIGH.
6. THE BOTTOM ROW OF PIPE SHALL REST ON SKIDS PROTECTED BY A CONTINUOUS STRIP OF FLAT RUBBER BELTING.

ROPE INSTALLATION

ROPE SPACING SHOULD BE A MAXIMUM OF 2m FROM THE PIPE ENDS AND A MAXIMUM OF 2m FROM GIRTH WELDS. THE INTERVAL BETWEEN RINGS SHOULD BE BETWEEN 3m AND 8m WITH A MINIMUM OF FOUR LOOPS SPACED OVER A STANDARD DOUBLE JOINT LENGTH (24m). THE INTERVALS MUST BE ADJUSTED TO INSURE THERE IS NO PIPE TO PIPE CONTACT. ROPE ENDS SHALL BE FUSED WITH A BLOW TORCH PRIOR TO SLIPPING THE LOOP OVER THE PIPE.

CIRCUMFERENCE OF LOOPS

THE CIRCUMFERENCE OF LOOPS (MINIMUM) SHOULD BE IN ACCORDANCE WITH THE FOLLOWING TABLE

PIPE O.D. (IN)	42"	36"	34"	30"	24"	20"	16"	12"	10 3/4"	8"
CIRCUMFERENCE OF FINISHED LOOPS (mm)	3510	3030	2960	2500	2020	1680	1360	1070	910	750



**SPECIFICATION FOR
TRANSPORTATION, HANDLING AND
STORAGE OF COATED LINE PIPE**

DOCUMENT NO.

11-0330G01-01-07-02-013

REV

0

SHEET 11 OF 11



GAIL (India) Limited
PIPELINE FROM HANUMAN JUNCTION TO VCL



SPECIFICATION FOR WELDING OF ON SHORE PIPELINE FOR GAS TRANSPORTATION				CLIENT JOB NO.		-
				TOTAL SHEETS		20
DOCUMENT NO	11	0330G01	01	07	02	014

--	--	--	--	--	--	--

REV.	DATE	DESCRIPTION	PREP	CHKD	APPD
0	04-07-11	ISSUED FOR TENDER	MH	EUR	AD
A	07-06-11	ISSUED FOR IDC	MH	EUR	AD

CONTENTS

1	SCOPE.....	3
2	DEFINITION'S.....	3
3	REFERENCE CODE AND STANDARDS	3
4	WELDING PROCESS AND CONSUMABLES.....	3
5	WELDING PROCEDURE SPECIFICATION	4
6	QUALIFICATION OF WELDERS.....	5
7	ALIGNMENT	5
8	JOINT PREPARATION.....	6
9	PRODUCTION WELDING	7
10	HEAT TREATMENT	8
11	INSPECTION & TESTING.....	9
12	WELD NUMBERING AND WELD DATA RECORDS.....	11
13	REPAIRS OF WELDS	11
ANNEXURE - 1		13
1	DESTRUCTIVE TESTING OF BUTT WELDED JOINTS	13
1.1	PREPARATION.....	13
1.2	TENSILE STRENGTH	13
1.3	NICK-BREAK TEST	13
1.4	MACROSCOPIC EXAMINATION	13
1.5	HARDNESS TEST.....	13
1.6	CHARPY-V-NOTCH IMPACT TEST	14
1.7	BEND TEST REQUIREMENTS.....	14
ANNEXURE-2		15
1	ULTRASONIC INSPECTION	15
1.1	EQUIPMENT AND OPERATORS	15
1.2	SPECIFICATION FOR ULTRASONIC TESTING PROCEDURE: QUALIFICATION	15
1.3	TEST PROCEDURE	15
1.4	REFERENCE BLOCKS.....	16
1.5	AMPLIFICATION DURING PRODUCTION TESTING.....	16
1.6	QUALIFICATION OF ULTRASONIC TESTING OPERATORS	16
1.7	EVALUATION OF INDICATIONS GIVEN BY ULTRASONIC TESTS	16
1.8	OTHER EQUIPMENT	16
2	RADIOGRAPHIC TESTING	16
3	MAGNETIC PARTICLE & DYE PENETRANT EXAMINATION	19

	SPECIFICATION FOR WELDING OF ON SHORE PIPELINE FOR GAS TRANSPORTATION	DOCUMENT NO.	REV
		11-0330G01-01-07-02-014	0
		SHEET 2 OF 20	

1 SCOPE

This specification defines the minimum requirements for welding of carbon steel pipeline systems and related facilities.

2 DEFINITION'S

For this specification the following definitions shall apply:

OWNER	-	GAIL (India) Limited
CONSULTANT	-	Wood Group Kenny India Pvt. Ltd.
CONTRACTOR	-	The Company named as such in the deed
SHALL/MUST/ISTO BE	-	A mandatory requirement
SHOULD	-	A non-mandatory requirement, advisory or recently amended.

3 REFERENCE CODE AND STANDARDS

The following latest codes and standards shall be applicable for this specification:

a.	ASME B3 1.8	:	Gas Transmission and Distribution Piping Systems,
b.	API 1104	:	Standard for welding of Pipelines and Related Facilities
c.	ASME Sec. II C	:	Specification for welding Electrodes and Filler Materials
d.	ASME Sec. V	:	Non Destructive examination
e.	ASME Sec. VIII Div. I	:	Boiler and Pressure Vessel Code: Pressure Vessels
f.	ASME Sec. IX	:	Boiler and Pressure Vessel Code: Welding and Brazing Qualification
g.	ASTM E23	:	Notched Bar Impact Testing of Metallic Testing
h.	ASTM E92	:	Test Method for Vickers Hardness of Metallic Materials
i.	ASTM E709	:	Practice for magnetic Particle Examination
j.	ASTM A370	:	Standard Test Methods and Definitions for Mechanical Testing of Steel Production
k.	OISD –141	:	Oil industry safety Directorate Standard for Design and Construction Requirements for Cross country Hydrocarbon Pipeline
.	ASNT-SNT-TC-1A	:	American Society for Non-destructive Testing

4 WELDING PROCESS AND CONSUMABLES

4.1 INTRODUCTION

4.1.1 The mainline welding shall be carried out by semi-automatic/manual welding process. The requirements for welding will be according to section 12 API 1104 and this specification.



**SPECIFICATION FOR WELDING OF ON
SHORE PIPELINE FOR GAS
TRANSPORTATION**

DOCUMENT NO.

11-0330G01-01-07-02-014

SHEET 3 OF 20

REV

0

4.2 WELDING PROCESS

4.2.1 Welding of various materials under this specification shall be carried out using Shielded Metal Arc Welding process (SMAW) with the approval of the OWNER/CONSULTANT. Any other process of welding shall require prior approval from the OWNER/CONSULTANT.

4.2.2 The welding electrode shall be of Licoln /Bohler make.

4.3 WELDING CONSUMABLES

4.3.1 The welding electrodes/filler wires supplied by the CONTRACTOR shall conform to the class specified in the approved welding procedure specification.

4.3.2 The CONTRACTOR shall submit batch test certificates from the electrode manufacturers giving details of physical and chemical tests carried out by them for each batch of electrodes to be used. The certificates shall have as minimum information such as batch number, date of manufacturer, consumable cast number, consumable, chemistry, weld metal chemical analysis, weld metal mechanical properties including charpy impact energy.

Electrode Qualification test records shall be submitted as per relevant code requirements by the CONTRACTOR for obtaining the approval of the OWNER/CONSULTANT. The following details shall be provided in qualification test records. All weld tensile test, base material used, pre-heat and post weld heat treatment details, visual examination results, radiographic examination results, tensile test results (incl. UTS, and elongation), impact test values, chemical analysis report, fillet weld test results, other tests like transverse tensile tests and guide bend test results.

4.3.3 The electrode shall be suitable for the production welding process recommended and the base metal used. Physical properties of the welds produced by the electrode & brand recommended for the welding of particular base metal shall not be lower than the minimum values specified for the base metal unless otherwise specified in approved Welding Procedure Specification. (WPS) The choice of electrode shall be made after conducting the required tests on the electrodes as per relevant standards, and acceptance shall be the sole prerogative of the OWNER/CONSULTANT.


4.3.4 All electrodes shall be purchased in sealed, containers and stored properly to prevent deterioration. Electrodes shall be kept in oven, if required, at all conditions as per manufacturer recommended temperature. Different grades of electrodes shall be stored separately. The electrodes used shall be free from rust, oil, grease, earth and other foreign matter, which affect the quality of welding.

4.3.5 The composition and purity of shielding gas when required by the welding processes other than shielded metal arc welding, when permitted by the OWNER/CONSULTANT shall be submitted to the OWNER/CONSULTANT for approval.

4.3.6 CONTRACTOR shall supply all necessary welding and cutting equipment current and voltage meters, temperature measuring instruments, fluxes, gases, tiller metals and testing equipment for satisfactory completion of all the work and to meet the targeted schedule.
CONTRACTOR shall supply all necessary equipment for performing the heat treatment, including transformers, thermocouples, pyrometers, automatic temperature recorders with suitable calibration arrangements, etc.

5 WELDING PROCEDURE SPECIFICATION

5.1 Contractor shall submit the welding procedure specification indicating the proposed welding process to OWNER/CONSULTANT for approval. Any deviation desired by the CONTRACTOR shall be obtained through the express consent of the OWNER/CONSULTANT.

	SPECIFICATION FOR WELDING OF ON SHORE PIPELINE FOR GAS TRANSPORTATION	DOCUMENT NO.	REV
		11-0330G01-01-07-02-014	0
		SHEET 4 OF 20	

- 5.2 A combination of different welding processes or a combination of electrodes of different classes/makes could be employed for a particular joint only after duly qualifying the welding procedures to be adopted and obtaining the approval of the OWNER/CONSULTANT.

Welding procedure qualification shall be carried out in accordance with the relevant requirements of API 1104 and other applicable codes and other job requirements by the CONTRACTOR. The CONTRACTOR shall submit the welding procedure specifications as per the formats given in API- 1104 with in one month after the receipt of the order indicating details of welding consumables, welding process, welding position, welders, destructive test sample positions, pre-heating requirements, voltage, current, heat input etc. All size & thickness shall be used for welding procedure qualification. Inter pass temperature shall be considered as an essential variable in the procedure qualification.

- 5.3 OWNER/CONSULTANT representative will approve the welding procedure submitted and shall release the procedure for qualification tests. The CONTRACTOR shall carry out under field conditions at their own expense the procedure qualification test. A complete set of test results shall be submitted to the OWNER/CONSULTANT Representative Inspector for approval immediately after completing the procedure qualification test and atleast 2 weeks before the commencement of actual work. All tests shall be carried out as per provisions of these specifications.
- 5.4 Radiography of the entire weld shall be carried out using the same source of radiation, radiographic , and technique and exposure time as that to be used for production weld.


6 QUALIFICATION OF WELDERS

Only qualified welders, according to the requirements of section VI of API 1104 will be used for manual welding.

- 6.1 Welder qualification test shall be sole responsibility of the contractor.
- 6.2 The qualification tests will be made using a coupon of a line-pipe. Every welder will be execute a test weld using qualified procedure.
- 6.3 A welder where successfully completed the qualification tests shall be qualified.
- 6.4 Every welder shall execute for his qualification test a weld at least on half the circumference of pipeline starting from the top of the pipeline until the bottom.
- In case W.P.S. specifies a prosedure for single welder the welder will execute the weld test on the entire circumference of the pipe.
- 6.5 A wlder can only participate once in the qualification test. If not qualified requalification test for the same job shall at sole discretion of client / Consultant.
- 6.6 Before Test of Production weld, the Contractor shall submit following documents to Client / Contracor and / or third party inspection agency.
- a) List of qualified welders
 - b) The procedure for which they are qualified
 - c) The records of the welding performance test
 - d) The validity dates of qualification.

7 ALIGNMENT

Immediately prior to line-up, CONTRACTOR shall inspect the pipe ends inside and outside for damage, dents, laminations etc. Pipe for welding shall be set up, correctly spaced, allowing for the temperature changes during welding. In correct alignment shall in no circumstances be sprung into position. Temporary attachments of any kind shall not be welded to the pipe. Welds joining the sections

	SPECIFICATION FOR WELDING OF ON SHORE PIPELINE FOR GAS TRANSPORTATION	DOCUMENT NO.	REV
		11-0330G01-01-07-02-014	0
		SHEET 5 OF 20	

of the pipeline, valve installation or similar welds classified as tie-in welds shall be made in the trench. Otherwise the alignment and welding shall be made alongside the ditch with the pipe supported on skids, and pack pads or other suitable means placed at least 500 mm above the ground unless approved otherwise by the OWNER/CONSULTANT in specific cases.

For welded pipes, circumferential weld seams and, longitudinal weld seams of adjoining pipes shall be staggered such that a minimum distance of 250 mm is maintained along the circumference and both longitudinal welds or at top 90° quadrant of the pipeline whichever is lesser (Except for bends). A longitudinal joint shall pass an appurtenance of a structural element at a minimum distance of 50 mm.

For pipe of same nominal wall thickness the off-set shall not exceed 1.6 mm. The off set may be checked from outside using dial gauges. And branch connection sleeve, etc. shall be minimum 150 mm from any other weld. The welds for fittings shall be so located that the toe of the weld shall not come within 50mm of any other weld. Cold dressing is permissible only in cases of slight misalignment and may only be carried out with a bronze headed hammer. Hot dressing shall not be permitted.

When welding pipes of different wall thickness, end connection shall be as per ASME B31.8. If required transition piece shall be used. This shall have a minimum of 1:4 taper. The welds shall be subject to both ultrasonic and radiographic inspection.

The root gap shall be accurately checked and shall conform to the qualified welding procedure. The use of internal Line-up Clamps is mandatory for pipe diameters 8" and above. However, in some case (tie-in welds, flanges, fittings, small section etc.) where it is impossible to use internal Clamps, an external line-up clamp may be used.

The internal line-up clamp shall not be released before the entire root pass has been completed.

When an external line-up clamp is used, all spaces between bars or minimum 60% of the root pass length shall be welded before the clamp is released. The remaining pipe shall be adequately supported on each side of the joint.


Segments thus welded shall be equally spaced around the circumference of the pipe. Slag, etc. shall be cleaned off and the ends of the segments shall be prepared by grinding, so as to ensure continuity of the weld head.

8 JOINT PREPARATION

Before welding, all rust and foreign matter shall be removed from the bevelled ends by power operated tools at inside and outside edges for a minimum distance of 25mm from the edge of the weld bevel. Joints shall be swabbed with canvas belt or leather if required as per OWNER/CONSULTANT's discretion. If any or the ends of the pipe joints are damaged to the extent that, in the opinion of OWNER/CONSULTANT, satisfactory weld spacing cannot be obtained, and local repair by grinding cannot be successfully done, then the damaged ends shall be cut and bevelled to the satisfaction of the OWNER/CONSULTANT, with an approved bevelling machine.

Manual cutting end weld repairs of bevels are not allowed. Should laminations, split ends or inherent manufacturing defects in the pipe be discovered, the lengths of pipe containing such defects shall be removed from the line to the satisfaction of OWNER/CONSULTANT. On pipes, which have been cut back, a zone extending 25 mm back from the new field bevel, shall be ultrasonically tested to the requirement of the line pipe specification to ensure freedom from laminations. The new bevel shall be 100% visual and 100% dye penetrate / MPI tested A report shall be written for all testing. The rebevelled pipe heat number identification shall be maintained by transferring information to the new pipe end. Where the pipe is to be field cut and welded, the shop applied coating shall be neatly peeled and ground for a distance of 100 mm from the weld.

The parts joints being welded and the welding personnel shall be adequately protected from rain and strong winds. In the absence of such a protection no welding shall be carried out. All completed welding work shall be protected from bad weather conditions.

	SPECIFICATION FOR WELDING OF ON SHORE PIPELINE FOR GAS TRANSPORTATION	DOCUMENT NO.	REV
		11-0330G01-01-07-02-014	0
		SHEET 6 OF 20	

9 PRODUCTION WELDING

Production welding shall be performed as per qualified welding procedure. If any change is essential variables are made then a new welding procedure is to be established and qualified for production welding.

9.1 WELDING PASSES


- a) Root pass is a critical welding activity, which shall be carefully carried out by the Contractor as per approved WPS. Root pass shall be made with branded electrodes/filler wires recommended in the qualified WPS. The size of the electrodes used shall be as per the approved welding procedure. It is recommended that immediately after the root pass the first hot pass is completed. However, OWNER/CONSULTANT'S engineers at site can make this requirement mandatory as per site conditions.
- b) Position or roll welding may be permitted. Separate procedures shall be submitted and qualified for up hill, down hill, vertical down and roll welding. Down hill welding shall be used when internal clamp is used. The vertical up method of welding shall be used for the root pass of the tie-ins. special crossings, fittings and special parts, fillet welds, repairs and when an external line up clamp is used. The down hill welding may be used for root run welding of tie-ins and special crossings when (a) the edges are machined or have equivalent preparation (b) line up clamps are used and the fit up is geometrically and mechanically similar to one of the ordinary line welding without misalignment or unevenness.
- c) Weld projection inside the pipe shall not exceed 1.6 mm.
- d) Any deviations desired from the recommended welding technique and electrodes indicated in the WPS shall be adopted only after obtaining express approval of the OWNER/CONSULTANT.
- e) Welding shall be continuous and uninterrupted during root pass. On completion of each run, craters, welding irregularities, slag, etc. shall be removed by stringing wire brush and chiseling. While the welding is in progress care shall be taken to avoid any kind of movement of the components, shocks, vibration and stresses to prevent occurrence of weld cracks.
- f) The weld reinforcement shall not be excess of 1/16" but the weld crown shall not be below the outside surface metal of the pipe.
- g) Two beads shall not be started at the same location.

9.2 JOINT COMPLETION

In case of manual welding, the first pass shall be carried out by a minimum of two welders, working simultaneously and so placed as to cause minimum distortion of the pipe. The number of welders and the allowable welding sequences shall be as those laid down in the qualified welding procedure specification. Once the deposit of the first pass has been started, it must be completed as rapidly as possible, reducing interruptions to the minimum. The welding and wire speed shall be approximately same as that established in the qualified welding procedure specification.

The interruption between completion of the first pass and starting the second pass shall be as stated in the procedure specification, normally not exceeding four minutes.

The time lapse between second and third pass shall be as stated in the procedure specification, normally not exceeding five minutes. Welding can be suspended, so as to allow the joint to cool down, provided that the thickness of the weld metal deposited is atleast 50% of the pipe thickness. Upon restarting, preheating to at least of 100°C shall be carried out. Subsequent passes tip to weld

	SPECIFICATION FOR WELDING OF ON SHORE PIPELINE FOR GAS TRANSPORTATION	DOCUMENT NO.	REV
		11-0330G01-01-07-02-014	0
		SHEET 7 OF 20	

completion shall be protected to avoid rapid cooling, if meteorological conditions so dictate. Cleaning between passes shall be done carefully so as to reduce the possibility of inclusions.

Electrode starting and finishing points shall be staggered from pass to pass. Arc-strikes outside the bevel on the pipe surface are not permitted, Arc-strike or arc-burn on the pipe surface outside the weld, which are caused accidentally by electrical arcs between the electrode, electrode holder, welding cable or welding cable round and the pipe shall be removed by grinding in accordance with a procedure approved by OWNER/CONSULTANT and the repair checked by ultrasonic, radiographic, magnetic particle or dye penetrate tests which the OWNER/CONSULTANT feels necessary. The pipe wall thickness after grinding shall not be less than the minimum thickness limit permitted for the pipe. Repair of arc strikes by welding is prohibited.

Tie-in weld shall be completed without delays and shall not be left incomplete overnight.

All Fillet weld and branch connections shall be as per ANSI B31.8. Where pipes of an equal diameter and/or wall thickness are to be joined. They shall be done with transition pieces as per ANSI B31.8 Appendix-1. The completed weld shall be carefully brushed and cleaned and shall appear free from spatters, scales, etc.

During welding operation the coating shall be protected from weld spatter burning either by using a 600mm wide asbestos blanket or by OWNER/CONSULTANT approved procedures. The protection device shall be placed 50mm from the weld center.


10 HEAT TREATMENT

10.1 PREHEATING

- a) Preheating requirement for this project shall be minimum 100°C or as per qualified welding procedure requirements if higher.
- b) Preheating shall be performed using resistance or induction/heating methods. Preheating by gas burners is strictly prohibited.
- c) Preheating shall extend uniformly to at least three times the thickness of the joint, but not less than 50mm, on both sides of the weld. Preheating temperature shall be maintained over the whole length of the joint during welding temperature indicating crayons or other temperature indicating devices shall be provided by the CONTRACTOR to check the temperature.
- d) Maximum interpass temperature shall be 250°C.
- e) Pre-heating is also required prior to attachment of any branch connections or fittings on the line.
- f) Asbestos blankets may be placed with the welds to slow the cooling rate as per procedure.

10.2 POSTWELD HEAT TREATMENT

- a) The Heat treatment of welded joints shall be carried out as per the requirements laid down in ASME B.31.8 and other special requirements mentioned in approved W PS.
- b) Post weld heat treatment shall be done by using an electric resistance or induction heating equipment, as decided by the OWNER/CONSULTANT.
- c) While carrying out local post weld heat treatment, technique of application of heat must ensure uniform temperature attainment at all points of the portion being heat treated. Care shall be taken to ensure that width of heated band over which specified post weld heat treatment temperature is attained is at least as that specified in the relevant applicable standards/codes.

	SPECIFICATION FOR WELDING OF ON SHORE PIPELINE FOR GAS TRANSPORTATION	DOCUMENT NO.	REV
		11-0330G01-01-07-02-014	0
		SHEET 8 OF 20	

- d) Throughout the cycle of heat treatment, the portion outside the heat band shall be suitably wrapped under insulation so as to avoid any harmful temperature gradient at the exposed surface of pipe. For this purpose temperature at the exposed surface of the pipe shall not be allowed to exceed 400°C.
- e) Contractor shall submit detailed procedure for post-weld heat treatment specifying the temperature measurement, minimum no. of thermocouple to be used, details of the equipment to be used, method of execution etc. for approval.
- f) Automatic temperature recorders which have been suitably calibrated shall be employed. The calibration chart of each recorder shall be submitted to the OWNER/CONSULTANT prior to starting the heat treatment operation and its approval shall be obtained.
- g) Immediately on completion of the heat treatment, the post weld heat treatment charts/records along with the hardness test results on the weld joints (whenever required as per the welding specification chart) shall be submitted to OWNER/CONSULTANT for approval.
- h) Proper identification of weld joint shall be maintained and same shall appear on the corresponding post weld head treatment charts and in corresponding radiography films.
- i) Hardness of the heat affected zone as well as of the weld metal, after heat treatment shall be measured using a suitable hardness tester by Vickers or Brinell and shall not exceed the maximum hardness specified in the specification. The weld joint shall be subjected to reheat treatment, when hardness measured exceeds the specified Limit by the CONTRACTOR at his own expense.

11 INSPECTION & TESTING

11.1 WELDING PROCEDURE QUALIFICATION (WPQ)

The welding procedure qualifications must be performed according to the requirement of section 5 of API 1104.

A welding procedure qualification must be performed for

- Each welding procedure used.
- Each diameter & thickness.
- Each type of steel from a different origin (Steel mill and/or Pipe mill).

The Tenderer shall attach in his bid every preliminary WPS he intends to use during the execution work.

After award of the job , the contractor shall submit a list of required final WPS he plan to qualify for use.

Contractor can start with qualification welding after approval by Owner/ Consultant.

11.2 VISUAL INSPECTION OF THE WELD JOINT

Inspection of all welds shall be carried out by OWNER/CONSULTANT as per the latest editions of the applicable codes and specifications. All finished welds shall he visually inspected for alignment, excessive reinforcement, concavity of welds, shrinkage, cracks, under-cuts, dimensions of the weld, surface porosity and other surface detects. Under-cutting adjacent to the completed weld shall not exceed the limits specified in the applicable standard/code.

11.3 NON DESTRUCTIVE EXAMINATDN

The non-destructive examination shall mainly consist of Radiographic examination and Ultrasonic Testing of the weld as detailed in Annexure-2.

	SPECIFICATION FOR WELDING OF ON SHORE PIPELINE FOR GAS TRANSPORTATION	DOCUMENT NO.	REV
		11-0330G01-01-07-02-014	0
		SHEET 9 OF 20	

Radiographic examination of all girth welds with 100% coverage of the weld shall be done as per requirement. All welds shall meet the of criteria as set forth in API 1104.

Any weld which as a result of radiographic and/or ultrasonic examination in the opinion of OWNER/CONSULTANT exhibits imperfections greater than the limits stated in API-1104 latest edition shall be considered defective and shall so be marked with an identification paint marker.

The CONTRACTOR shall make all the arrangements for the radiographic examination of work covered by the specification at his expense.

The OWNER/CONSULTANT will review all the radiographs of welds and inform the CONTRACTOR regarding unacceptable welds. The decision of the OWNER/CONSULTANT shall be final and binding in this regard.

Ultrasonic inspection is required in the following cases as per Annexure-2 of this Specification.

- a) When in the opinion of OWNER/CONSULTANT, ultrasonic inspection is required to confirm or clarify defects indicated by radiography.
- b) When 20 mm or more are cut from the pipe end as supplied, the ends shall be ultrasonically inspected for an additional length of 20mm to assure no lamination exist.
- c) On the first Curve welded joints corresponding to each automatic (GTAW/GMAW) welding procedure used.
- d) When welds are repaired.

In addition, ultrasonic inspection may be required for certain critical welding of the pipeline (i.e. tie-ins, welding of valves, flanges) randomly selected at OWNER/CONSULTANT,s discretion. All fillet and groove welds other than those, which are not radio graphically or ultrasonically examined, shall be examined by Dye Penetration or Magnetic Particle inspection techniques.

In gas cutting pipe end Ultrasonic inspection shall be done for lamination/checking before welding of Tie-in joints.

The OWNER/CONSULTANT must approve all non-destructive test systems used for inspecting welds.


Suitable records shall be maintained by the CONTRACTOR as desired by the OWNER/CONSULTANT on the day-to-day work done on welding radiography and ultrasonic testing. The CONTRACTOR shall present the records to the OWNER/CONSULTANT on a day-to-day basis and whenever demanded for approval.

11.4 DESTRUCTIVE TESTING

One weld out of total number of welds completed in abstract of 15 km shall be subjected to destructive testing or as advised by OWNER/CONSULTANT as per Annexure – 1. The weld considered for destructive testing shall be considered as production welds and shall be as per specification 11-0230-01-07-02-023.

In addition, welds already cut out for defects for any reason may also be subjected to destructive testing. If the results are unsatisfactory, welding operations shall be suspended and may not he restarted until the causes have been identified and the Contractor has adopted measures which guarantee acceptable results, If it is necessary in the OWNER/Consultant’s opinion the procedure shall be re-qualified.

If one production weld fails to conform to the specified requirements, the Contractors shall cut two additional weld joints from either side of the failed one and shall carry destructive testing as per the specification requirement. If one or both the retested joints fail to conform to the specified requirements,

	SPECIFICATION FOR WELDING OF ON SHORE PIPELINE FOR GAS TRANSPORTATION	DOCUMENT NO.	REV
		11-0330G01-01-07-02-014	0
		SHEET 10 OF 20	

the OWNER/CONSULTANT shall select joints randomly in pipeline for production testing. If one or more out of ten joints fail, then welding work shall be terminated and further investigation shall be carried out.

12 WELD NUMBERING AND WELD DATA RECORDS

12.1 Numbering

Contractor shall indicate the kilometer point along the working strip.

The welds between KP 0 & KP 1 are numbered 000 / 0001, 000/0002, 000/0003 etc.

The welds between KP 1 & KP 2 are numbered 001/001, 000/102, 000/003 etc.

All tie in weld between KP 0 & KP 1 are numbered 000/101, 000/102, 000/103 etc.

These numbers are shown on the radiographic images preceded by the digit code number of the pipeline.

12.2 Applying the weld numbers:

The contractor will submit for approval to the OWNER / OWNER's Representative the may he will indicated the weld number on the pipes

13 REPAIRS OF WELDS

13.1 With the prior permission of OWNER/CONSULTANT welds which do not comply with the standards of acceptability, shall be repaired or the joint cut out and re-welded.


A separate welding procedure specification sheet shall be formulated and qualified by CONTRACTOR for repair welds simulating the proposed repair to be carried out. Separate procedures are required to be qualified for (a) through thickness repair (b) partial thickness repair. Welders shall be qualified in advance the repairs. Welders shall perform repair test weld between the 3 and 6 'O' clock positions for welding peef earned in the 5G position. The root pass, for repairs opening the root, shall be replaced by the vertical uphill technique. The procedure shall be proven by satisfactory procedure tests to API-1104 including the special requirements of the specification, and shall also be subjected to metallographic examination, hardness surveys and Charpy tests to determine the effects of repair welding on the associated structure.

Root sealing or single pass repair deposit shall not he allowed. Internal root defects shall be ground thoroughly and welded with a minimum of two passes. However, while grinding for repairs, care shall be taken to ensure that no grinding marks are made on the pipe surface anywhere.

The repair weld shall be subjected, as a minimum requirement to the same testing and inspection requirements as the original weld, the entire joint shall be re-radiographed. A 100% ultrasonic inspection shall be done at the repaired area externally. Any repaired area that is wide, irregular or rough shall be rejected and a full cut out shall be done. The repair welding shall have a minimum preheat of 100°C and shall be preheated for atleast 150 mm on either side of repair. Only low hydrogen electrodes shall be used for repair of welds

Welds not meeting the specification after one repair shall be cut out depending upon the extent of repair. A report of all repairs shall be maintained by CONTRACTOR. All repairs shall be carried out the day after initial radiography or earlier. A full report of all repairs made shall be submitted every day to the OWNER/CONSULTANT.

13.2 ELIMINATION OF REPAIRS

	SPECIFICATION FOR WELDING OF ON SHORE PIPELINE FOR GAS TRANSPORTATION	DOCUMENT NO.	REV
		11-0330G01-01-07-02-014	0
		SHEET 11 OF 20	

Only one attempt at repair of any region is permitted. Repairs are limited to a maximum 30% of the weld length. For internal repairs or external repairs which open the weld root, only 20% of the weld length may be repaired. Repairs opening the root must only be carried out in the presence of OWNER/CONSULTANT. The minimum length of a repaired area shall be 100mm as measured over the-recapped length. Welds containing cracks shall be cut out and rebevelled to make joint. OWNER/CONSULTANT shall authorize all repairs.

13.3 WEATHER CONDITION

Welding SHALL not be done in open areas during blowing sands, dust storms, high winds, rains or where relative humidity is higher than 75%. Welding at ambient temperature below 5°C shall be done only with specially qualified procedure with controlled heating and cooling practices.

13.4 MARKING

The Contractor according to the numbers assigned to the welders shall mark all welds on the top quarter of the pipe adjacent to the weld. Metallic dies shall not be used to mark on the pipe. Contractor shall furnish to OWNER/CONSULTANT with all records of welder numbers and Joint numbers.

	SPECIFICATION FOR WELDING OF ON SHORE PIPELINE FOR GAS TRANSPORTATION	DOCUMENT NO.	REV
		11-0330G01-01-07-02-014	0
		SHEET 12 OF 20	

ANNEXURE - 1

1 DESTRUCTIVE TESTING OF BUTT WELDED JOINTS

1.1 PREPARATION

After the visual and the non-destructive inspection, the test weld shall be subjected to mechanical test.

After satisfactory completion of all visual and non-destructive testing the procedure test weld shall be set aside for a period not less than 24 hour No further work on the test weld and no cutting of test specimens from the weld shall be performed until a period or at least 24 hours has expired.

Weld specimens shall be taken from the positions as per approved WPS. In addition to API 1104 tests the following tests of minimum numbers to be carried out as specified in the subsequently clauses in this specification

Macro and hardness shall be carried out, generally at the top and bottom of the joint suitably as per approved WPS.

The test shall be carried out at laboratories approved by the OWNER/CONSULTANT. The specimens shall be prepared in accordance with the relevant standards code requirements.

1.2 TENSILE STRENGTH

Specimens shall be taken from the position as per approved WPS. The test shall be carried out in accordance with API 1104. Acceptance Criteria shall be as per API 1104.

1.3 NICK-BREAK TEST

Specimens for nick-break test with notches thus worked can break in the base metal, instead of in the fusion zone ; therefore an alternative test piece may be used after authorisation by the OWNER/CONSULTANT with a notch cut in the reinforcement of outside weld head to a maximum depth of 1.5Mm, measured from the surface of the weld head.

Acceptance Criteria shall be as per API 1104.

1.4 MACROSCOPIC EXAMINATION

Specimens shall be taken from the positions as indicated in the approved WPS and shall be prepared in accordance with ASTM E2 and E3. One of the specimens shall be taken at the T-intersection at the line pipe seam weld.

The width of the macro-section has to be at least three times the width of the weld. The section is to be prepared by grinding and polishing and etched to clearly reveal the weld metal and heat effected zone.

Specimens shall be carefully examined under the microscope, with a magnification of at least 25 (25:1).

OWNER/CONSULTANT reserves the right to ask for a micrograph with 5 times (5:1) magnification, for DOCUMENTATION purposes.

Under macroscopic examination, the welded joints shall show good penetration and fusion, without any defect exceeding the limits stated in the evaluation criteria of the nick break test.

1.5 HARDNESS TEST

The prepared macro-section is to be used for hardness testing using the Vickers method (HV10). Test shall be made on elected specimen of weld joint. These series of reading shall extend from unaffected base metal or one side across the weld to unaffected base metal on the other side. Three transeverse



**SPECIFICATION FOR WELDING OF ON
SHORE PIPELINE FOR GAS
TRANSPORTATION**

DOCUMENT NO.

11-0330G01-01-07-02-014

REV

0

SHEET 13 OF 20

shall be made, on 2 mm from the outer edge, the second across the center and third 2 mm from the inner edge. The specimen between the hardness impression shall be 0.75 mm. The hardness impression nearest the fusion line shall be within 0.5 mm.

Hardness value shall not exceed 325HV10.

All the hardness values contained from the heat affected zone shall not exceed 40 HV with respect to the average hardness of the values obtained for the base metal. If these additional tests give hardness within the specification limit the slightly higher value may be accepted.

1.6 CHARPY-V-NOTCH IMPACT TEST

Specimens shall be taken from the position as per approved WPS. The test shall be carried out in accordance with ASTM-370 & ISO R148 for types of samples are to be taken out:

- a) At Fusion line
- b) 2.00 mm from fusion line
- c) 5.00 mm from fusion line

Five test specimens shall be taken from each sample and they shall be cut and worked so that their length is transversal and perpendicular to the weld bead with the notch position. The notch shall be perpendicular to the rolled surface. The test specimen width shall depend upon the pipe wall nominal thickness as following:

Nominal wall thickness in mm	Test specimen width in mm
Over 12	10

The test shall be carried out as in accordance with ASTM-370 & ISO R148.

Test pieces shall be immersed in a thermostatic bath and maintained at the test temperature for at least 15 minutes. They shall then be placed in the testing machine and broken immediately on their removed from the batch.

The test temperature shall be 0°C.

The acceptable values of the impact energy shall be as follows:

Test specimen size mm)	Average of three specimens (Note 1) Joules (Minimum)	Any single value Joules (Minimum)
10.0	27	22

Note:

- 1. Two samples of the highest and lowest values shall be discarded.

1.7 BEND TEST REQUIREMENTS

The Bend test Specimens shall be made and tested as per the requirements of API 1104.

The acceptance criteria shall be as per API 1104.



SPECIFICATION FOR WELDING OF ON SHORE PIPELINE FOR GAS TRANSPORTATION

DOCUMENT NO.

11-0330G01-01-07-02-014

REV

0

SHEET 14 OF 20

ANNEXURE-2

1 ULTRASONIC INSPECTION

Ultrasonic inspection is required to be performed on the pipeline field welds as per conditions listed in this specification. This section concerns manual ultrasonic inspection. However ultrasonic inspection by automatic equipment shall be used only with OWNER/CONSULTANT approval.

1.1 EQUIPMENT AND OPERATORS

The operators shall be qualified by a Third Party Inspection Authority. All operators shall be qualified as per AST-SNT-TC-1A minimum level II.

The OWNER/CONSULTANT has the option of checking the ability of personnel employed for ultrasonic testing by means of qualification tests.

1.2 SPECIFICATION FOR ULTRASONIC TESTING PROCEDURE: QUALIFICATION

Before work begins, the CONTRACTOR shall present a specification describing the proposed procedure qualification and calibration methodology.

This specification shall state, as an indication only but not limited to the following information:

- Type of LT. Equipment used
- Details for calibration
- Type and dimensions of transducers
- Frequency range
- Coupling medium
- Inspection technique
- Record details
- Reference to the welding procedure where it is intended to adopt the specified location.
- Temperature range of the joints to be inspected.

The ultrasonic inspection procedure shall be approved by the OWNER/CONSULTANT. This specification test consists in testing (under normal operating conditions) some CONTRACTOR welds made according to the same production procedure, where there are typical defects the test intends to detect.

This test shall be conducted in the presence of the OWNER/CONSULTANT.

1.3 TEST PROCEDURE

Circumferential welds shall be inspected from both sides using angled probes.

The surface with which the probe comes into contact shall be free of metal spatter, dirt, iron oxide, and scales of any type, therefore it shall be necessary to clean a strip at least 50 mm wide on both sides of the weld with steel wire brushes & anyhow the cleaned strip must be at least wide enough to allow full skip examination.

If, during the test, echoes of doubtful origin appear, it shall be necessary to inspect a convenient area on the pipe surface, close to the weld, with a straight beam transducer in order to check whether any manufacturing defects are present which could have interfered with the ultrasonic beam.

The equipment shall include but not be limited to the following

- Ultrasonic equipment and coupling medium
- Sample sections for calibration of instruments

	SPECIFICATION FOR WELDING OF ON SHORE PIPELINE FOR GAS TRANSPORTATION	DOCUMENT NO.	REV
		11-0330G01-01-07-02-014	0
		SHEET 15 OF 20	

- Equipment for cleaning of surface to be examined
- Rules calibrated in centimeters for exact location of the position of defects.

1.4 REFERENCE BLOCKS

The efficiency of the equipment used, the effective refraction angle of the probe, and the beam output point, shall be checked using a V₁ and V₂ sample block, IIW type or the calibration block ASTM E-428.

1.5 AMPLIFICATION DURING PRODUCTION TESTING

The amplification during production testing shall be obtained by adding 2-6 dB (according to the surface condition of the pipe and its cleanness) to the reference amplification.

1.6 QUALIFICATION OF ULTRASONIC TESTING OPERATORS

Before the inspection begins or during the same inspection, the OWNER/CONSULTANT may require a qualification test for the ultrasonic equipment operators. Minimum qualification of the operator shall be ASNT-Level –II.

1.7 EVALUATION OF INDICATIONS GIVEN BY ULTRASONIC TESTS

Each time that echoes from the weld head appear during production testing, the instrument amplification shall be altered to coincide with the reference amplifications and the probe shall be moved until maximum response is obtained, paying attention all the time to the probe-tube coupling.

If under these conditions, the height of the defect echo is equal to or greater than that of the reference echo, the defect shall be evaluated according to section 11.3 of this specification. If the defect has also been detected by the radiographic and/or visual examination, the dimensions shall be judged according to the type of examination which detects the greater defect. Returns which are less than 50% of the reference echo, will not be considered. If returns are above 50% but lower than 100% of the reference echo, and if the operator has good reasons to suspect that the returns are caused by unfavorably oriented cracks, he shall inform the OWNER/CONSULTANT. Moreover, when there is a defect to be repaired, such defect shall be removed for a length corresponding to the one where no more return echo is given.

1.8 OTHER EQUIPMENT

The use of rules calibrated in centimeters, attached if possible to the probe, for the precise location of the position of welding defects, is recommended. Defect location is effected by measuring the projection distance between the probe output and the reflecting surface.

The operators carrying out the tests shall have, besides the probing instrument, tools for cleaning the pipe surface (tiles, brushes, etc.) as well as the coupling liquid or paste appropriate For the temperature of the section to be examined.

2 RADIOGRAPHIC TESTING

- 2.1 Proposed Radiographic examination procedure shall be submitted by the CONTRACTOR for approval.
- 2.2 The procedure of radiographic examination shall be qualified to the entire satisfaction of OWNER/CONSULTANT prior to use. It shall include but not be limited to the following requirements
 - i) Only Lead foil intensifying screens, at the rear of the film shall be used for all exposures.
 - ii) Type 2 and 3 films as per: ASTM E-94 shall be used.
 - iii) A densitometer shall be used to determine film density. The transmitted film density shall be between 2.0 and 3.5 throughout the weld. The unexposed base density of the film shall not

	SPECIFICATION FOR WELDING OF ON SHORE PIPELINE FOR GAS TRANSPORTATION	DOCUMENT NO.	REV
		11-0330G01-01-07-02-014	0
		SHEET 16 OF 20	

exceed 0.30.

- iv) Radiographic identification system and documentation for radiographic interpretation reports and their recording system.
- v) Film type and brand, film processing methods, exposure conditions (kV, mAmin, Cimin).
- vi) Type of penantrimeters, Radiographic technique and number of exposures.
- vii) Type of radiation source (power, local spot size etc).
- viii) Diameter and thickness of pipe to be inspected and weld/welder numbering system.
- ix) Type of crawlers (internal / external) used during the process.

2.3 The CONTRACTOR shall qualify each procedure in the presence of the OWNER/CONSULTANT prior to use.

2.4 All the girth welds of mainline shall be subjected to 100% radiographic examination. Each weld shall be clearly and permanently numbered adjacent to weld or down stream side.

2.5 When the radiation source and the film are both on the outside of the weld and located diametrically opposite each other, the maximum acceptable length of film for each exposure shall not exceed the values given in API 1104. The minimum film overlap, in such cases, shall be 40mm. The ellipse exposure technique may be used on nominal pipe sizes of 2 inch and smaller provided that the source of film distance used is a minimum of 12 inch. When such a procedure is used exposure 90° to each other shall be obtained.

Penentrameters shall be placed on both source and the film side. The sensitivity level achieved shall be satisfied by penentrameter on the source side.

2.7 Films shall have no fogs, spots or makes and shall not be exposed to back scatter radiation. All weld spatter, debris, foreign matter and other detects which interferes with the interpretation of the radiograph shall be removed from the weld area.

2.8 Three copies of each acceptable radiographic procedure and three copies of radiographic qualification records, shall be supplied to OWNER/CONSULTANT. One set of the qualifying radiographs on the job shall be kept by the CONTRACTOR's authorised representative to be used as a standard for the quality of production radiographs during the job. The other two sets shall be retained by OWNER/CONSULTANT for its permanent record.

2.9 Three copies of the exposure charts relating to material thickness, kilo voltage, source of film distance and exposure time shall also be made available to OWNER/CONSULTANT by the CONTRACTOR.

2.10 The CONTRACTOR shall provide all the necessary facilities at site, such as a dark room with controlled temperature, film viewer etc. to enable the OWNER/CONSULTANT to examine the radiographs.

2.11 The CONTRACTOR, if found necessary, may modify the procedure of radiographic examination suiting to the local conditions prevailing. This shall, however, be subject to the approval of the OWNER/CONSULTANT. The OWNER/CONSULTANT shall have live access to all the CONTRACTOR's work facilities in the field.

2.12 Any approval granted by the OWNER/CONSULTANT shall not relieve the CONTRACTOR of his responsibilities and guarantees.

2.13 RADIATION SOURCE

Radiographic examination shall be carried out only using X-radiation's. Radiographic examination by Gamma rays may be allowed, at the discretion of the OWNER, in ease of inaccessible joints. X-ray

	SPECIFICATION FOR WELDING OF ON SHORE PIPELINE FOR GAS TRANSPORTATION	DOCUMENT NO.	REV
		11-0330G01-01-07-02-014	0
		SHEET 17 OF 20	

equipment shall have sufficient power (voltage and current) for the diameter and thickness of the pipeline to be inspected.

2.14 LEVEL OF QUALITY

The quality level of Radiographic sensitivity required for radiographic inspection shall be 2% of thickness.

2.15 PENENTRAME'1'ERS

The image quality indicator (abbreviation: IQI) shall be used for the qualification of the welding procedure and during normal line production. Radiographic sensitivity shall be measured with the wire image quality indicator (Penetrameter). The penetrameter shall be selected according to DIN54109 or ISO1027. The placement of the penentrameter shall be as per approved procedures.

The sensitivity limit may be considered to have been reached when the outline of the IQI, its identification number and the wire of the required diameter show up clearly on the radiograph.

The OWNER/CONSULTANT may authorise use of types of IQI other than those planned, provided that they conform to recognised standards and only if the CONTRACTOR is able to demonstrate that the minimum sensitivity level required is obtained. For this demonstration, a test shall be carried out comparing the IQI specified and the CONTRACTOR's to show up the identification number and other details of the proposed IQI, which must be visible in the test radiograph.

2.16 FILM IDENTIFICAITON MARKERS

All films shall be clearly identified by lead numbers, letters, and/or markers. The image of the markers shall appear on the films, without interfering with the interpretation. These markers positions shall also be marked on the part to be radiographed and shall be maintained during radiography.

2.17 PROTECTION AND CARE OF FILM

All unexposed films shall be protected and stored properly as per the requirements of API 1 104 standards and ASTM E.94.

The exposed and unexposed film shall be protected from heat, light, and dust and-moisture. Sufficient shielding shall be supplied to prevent exposure of film to damaging radiation prior to and following the use of the film for radiographic exposure.

Film processing (development, fixing, washing etc.) shall comply with suppliers requirements and as per ASTM Section V SE-94

2.18 RE- RADIOGRAPHY


The weld joints shall be radiographed in ease of unsatisfactory quality of the radiographs, at the expense of the CONTRACTOR.

All the repaired weld joints shall be re-radiographed at no extra cost to the OWNER/CONSULTANT in the same manner is that followed for the original welds. In addition, the repaired weld areas shall be identified with the original identification number plus the letter R to indicate the repair.

When evaluating repair film, radiographers shall compare each section (exposure) of the weld wall the original film to assure repair was correctly marked and original defect removed.

The OWNER/CONSULTANT will review prior to any repair of welds, all the radiographs of welds which contain, according to the CONTRACTOR's interpretation unacceptable defects. The final disposition of all unacceptable welds shall be decided by the OWNER/CONSULTANT.

2.19 QUALIFICATION OF RADIOGRAPHERS

	SPECIFICATION FOR WELDING OF ON SHORE PIPELINE FOR GAS TRANSPORTATION	DOCUMENT NO.	REV
		11-0330G01-01-07-02-014	0
		SHEET 18 OF 20	

Pipeline radiographers shall be qualified in accordance with the requirement of API 1104 and to the full satisfaction of OWNER/CONSULTANT and as per ASNI-TC-1A Level 2.

Certification of all the radiographers, qualified shall be furnished by the CONTRACTOR to the OWNER/CONSULTANT before a radiographer will be permitted to perform production radiography.

The radiographers shall be required to qualify with each radiographic procedure they use, prior to performing the work assigned to him in accordance with the specification.

2.20 PRESERVATION OF RADIOGRAPHS

The radiographs shall be processed to allow storage of films without any discoloration for at least three years. All the radiographs shall be presented in suitable folders for preservation along with necessary documentation.

All radiographs shall become property of the OWNER/CONSULTANT.

2.21 EQUIPMENT AND ACCESSORIES

CONTRACTOR shall make necessary arrangements at his own expense, for providing the radiographic equipment, radiographic films and all the accessories for carrying out the radiographic examination for satisfactory and timely completion of the job. The Contractor shall be responsible for obtaining necessary permits regarding, holding use and transport of sources.

2.22 RADIATION PROTECTION

CONTRACTOR shall be responsible for the protection and personnel monitoring of every man with or near radiation sources.

The protection and monitoring shall comply with local regulations. Contractor shall be responsible for complying with all rules and regulation set forth by Atomic Energy Commission or any other Government of India agencies in this regard and OWNER/CONSULTANT shall not be responsible. OWNER/CONSULTANT shall be kept indemnified at all times by the Contractor.

2.23 SAFETY INSTRUCTIONS

The safety provisions shall be brought to the notice of all concerned by display on a notice board at prominent place at the work spot. The person responsible for the "safety" shall be named by the CONTRACTOR.

3 MAGNETIC PARTICLE & DYE PENETRANT EXAMINATION

3.1 For welded joints and for detection of surface defects that cannot be radiographed or ultrasonic tested either dye penetrant or magnetic particle inspection shall be carried out after approval of the OWNER/CONSULTANT.

3.2 The procedure for magnetic particle examination shall contain as a minimum the following information for approval by the OWNER/CONSULTANT.

- Type and size of material to be examined.
- Type of magnetization and equipment
- Type of ferromagnetic particles used
- Method of surface preparation
- Magnetisation current
- Type of ferromagnetic particle used.

3.3 The area being examined shall be magnetised in at least two directions perpendicular to each other.

	SPECIFICATION FOR WELDING OF ON SHORE PIPELINE FOR GAS TRANSPORTATION	DOCUMENT NO.	REV
		11-0330G01-01-07-02-014	0
		SHEET 19 OF 20	

The non-fluorescent particles (wet order) shall have sufficient contact with respect to the surface to be examined.

- 3.4 The surface to be examined shall be made free of grease, dirt, oil, scale, oxides, etc.
- 3.5 MPE shall not be performed on parts whose temperature exceeds 300°C.
- 3.6 Magnetic particle operators and dye penetrant shall be qualified to ANSI-IV-1A Level II or equivalent as approved by OWNER/CONSULTANT.
- 3.7 Dye penetrant examination procedure shall also be submitted to OWNER/CONSULTANT for approval.

	SPECIFICATION FOR WELDING OF ON SHORE PIPELINE FOR GAS TRANSPORTATION	DOCUMENT NO.	REV
		11-0330G01-01-07-02-014	0
		SHEET 20 OF 20	



GAIL (India) Limited
PIPELINE FROM HANUMAN JUNCTION TO VCL



SPECIFICATION FOR DOCUMENTATION OF PIPELINE
CONSTRUCTION

CLIENT JOB NO.

-

TOTAL SHEETS

7

DOCUMENT NO

11

0330G01

01

07

02

015

--	--	--	--	--	--	--

REV.	DATE	DESCRIPTION	PREP	CHKD	APPD
0	04-07-11	ISSUED FOR TENDER	MH	EUR	AD
A	07-06-11	ISSUED FOR IDC	MH	EUR	AD

CONTENTS

1	SCOPE.....	3
2	DEFINITIONS.....	3
3	RECORDS	3
4	AS-BUILT DRAWINGS AND PIPE BOOK	5



**SPECIFICATION FOR
DOCUMENTATION OF PIPELINE
CONSTRUCTION**

DOCUMENT NO.

REV

11-0330G01-01-07-02-015

0

SHEET 2 OF 7

1 SCOPE

- 1.1 This specification covers the minimum requirements of the various records, reports and drawings for all aspects of pipeline construction to be prepared by CONTRACTOR and submitted to the OWNER at intervals as described in this specification and as directed by OWNER.
- 1.2 All documents required to be prepared and submitted by CONTRACTOR as per this specification shall be in addition to the various reports, records, methodology statements, calculations, drawings etc. to be submitted by the CONTRACTOR for OWNER's record, review or approval as per the requirements of all other specifications included in the CONTRACT between the OWNER and the CONTRACTOR.
- 1.3 This specification shall be read in conjunction with the condition of all specifications and documents included in the CONTRACT between OWNER and CONTRACTOR.

2 DEFINITIONS

For this specification the following definitions shall apply:

OWNER	- GAIL (India) Limited
CONSULTANT	- Wood Group Kenny India Pvt. Ltd.
CONTRACTOR	- The Company named as such in the deed.
SHALL/MUST/ISTO BE	- A mandatory requirement
SHOULD	- A non-mandatory requirement, advisory or recently Amended

3 RECORDS

CONTRACTOR shall submit daily, weekly, monthly and after completion to the OWNER various records and reports, for OWNER's documentation purposes during and immediately after the construction. This shall as a minimum include, but not limited to the following:

3.1 DAILY

- Planning Sheet
- Separate progress reports of all crews
- Daily welding results and repairs
- Actual weather conditions
- Application for variations, if any
- Accidents
- Damages
- Activities required from OWNER at short notice.
- Materials Receipts
- Urgently required materials etc

	SPECIFICATION FOR DOCUMENTATION OF PIPELINE CONSTRUCTION	DOCUMENT NO.	REV
		11-0330G01-01-07-02-015	0
		SHEET 3 OF 7	

3.2 WEEKLY


- Up-to-date list of confirmed site instructions issued by OWNER
- Materials procured
- Material defects and repairs
- Outstanding activities of OWNER
- List of installed markers, chainage
- Required approvals from OWNER
- Progress planned
- Report of manning of all crews, equipment and plant
- Report of equipment and plant
- Report of accidents
- Report of damages
- Report of acquired releases, permits
- Priced variations
- Required materials for next month etc.

3.3 MONTHLY

- Progress report for payment, safety report, report of accidents, security report, health and environment report, material balance, approved variations.

3.4 Further CONTRACTOR shall supply (for approval if required OWNER with documents such as but not limited to:

- Organogram for the construction of the work.
- Bio-data of key personnel (including foremen).
- List of addresses of personnel in particular of medical staff, safety and security officers.
- List of approved coaters.
- List of approved sub-contractors.
- Time schedule.
- Acquired permits and/or approvals from authorities, endowments, if any.
- Minutes of meeting with OWNER with comments, if any.
- Material certificates, material receipts, etc.
- Guarantees from Vendors and Sub-contractors

	SPECIFICATION FOR DOCUMENTATION OF PIPELINE CONSTRUCTION	DOCUMENT NO.	REV
		11-0330G01-01-07-02-015	0
		SHEET 4 OF 7	

- Calculations, temporary works, buoyancy, blasting, etc.
- Drawing issued by CONTRACTOR
- Vendor drawings
- As-built drawings of route maps, profile drawings, detail drawings and isometric drawings.
- Procedures such as surveying, staking, fencing etc.
- Welder procedure qualification record, radiographic procedure qualification, Welder qualification.
- Coating procedure.
- Installation of crossings.
- Hydrostatic testing procedure,
- Blasting procedure.
- Radiographic report along with original radiographs.
- Pipe and welding book
- Material records and accounting book
- Reports:
 - Materials tests (coating, welding, painting, etc.)
 - Computerised Potential Logging Test
 - Water samples
 - Cleaning, pigging report before hydrostatic test
 - Hydrostatic test
 - Calibration test
 - Rock
 - Blasting trials
 - Equipment certificates (dead weight tester, instruments, vessels, equipment, etc.)
 - Manuals
 - Major water crossings
 - Releases.

3.5 CONTRACTOR shall submit to OWNER colour photographs of various construction activities/ operations at regular intervals. Size, number and frequency of the photographs shall be mutually agreed upon at a later stage. Also CONTRACTOR shall make video recordings of all operations right from the start of construction till the completion of works, covering to the extent as instructed by OWNER and submit to the OWNER.


4 AS-BUILT DRAWINGS AND PIPE BOOK

4.1 GENERAL

CONTRACTOR shall prepare “as-built” drawings of all by or on behalf of OWNER issued drawings and of all CONTRACTOR work drawings including Vendor drawings, such as but not limited to:

For pipeline section:

- Route maps

	SPECIFICATION FOR DOCUMENTATION OF PIPELINE CONSTRUCTION	DOCUMENT NO.	REV
		11-0330G01-01-07-02-015	0
		SHEET 5 OF 7	

- Profile maps
- Detail drawings (road, railway, minor water crossings, major water crossings, etc.)
- Isometric drawings of installations
- Special installations, etc.

Further CONTRACTOR shall prepare a pipe and weld book.

4.2 AS-BUILT DRAWINGS

CONTRACTOR shall prepare a complete set of “as-built” drawings. From the start of construction CONTRACTOR shall daily process any changes into two sets of drawings. Deleted parts shall be indicated in red, new parts in blue, remarks in green and unchanged parts in yellow. Said drawings shall be kept in site and be available to OWNER at all times. CONTRACTOR shall prepare “as-built” drawings based on these data and as laid down hereafter. One set of these drawings with data shall be sent to OWNER before taking over of the work, while the other set shall be handed to OWNER at the same time. On completion of the work, one revised film transparency of all drawings made “as-built” by CONTRACTOR containing the “as-built” information shall be handed to OWNER as well as one complete set of microfilms of same as will be specified by OWNER. CONTRACTOR shall prepare and submit a specimen of the layout of the drawings for OWNER approval.

The required measurements for “as-built” drawings shall be executed by CONTRACTOR by experienced, qualified surveyors.

The surveyors shall daily take care of all measurements required such as but not limited to:

- Horizontal location of the pipeline with regard to deviations and permanent grid pillars.
- Vertical levels with regard to Mean Sea Level of pipeline and grade.
- Location and type of bends, fittings etc. and grades, points of intersections, etc.
- Changes of wall thickness, materials.
- Location and details of valves, insulating flanges, fencing etc.
- Location and details of buried services.
- Location and details of road, railway, water crossing etc.
- Location and details of casing pipes, vents etc.
- Location and type of coating
- Location and type of weighting, anchoring
- Location and type of markers.
- Location of further appurtenances (pig – signallers, etc.)
- Location of ROW and of pipeline with respect to ROW.
- Type of soil
- Type of rock.
- Type of blasting or ripping
- Sand padding.
- Type of road pavement
- Details of bank protection, number of insulators, seals etc.
- Etc.


CONTRACTOR shall also prepare isometric drawings of all installations (facilities) etc. for which the data as mentioned in or required for the pipe and welding book can be identified as such and which drawings can also be used for material accounting.

4.3 NAMEPLATES OF EQUIPMENT

All permanent equipment supplied and installed by CONTRACTOR shall be provided with nameplates by CONTRACTOR. All texts size of the plate shall be submitted to OWNER for approval before plates may be manufactured.

4.4 PIPE BOOK

Every page of the pipe and welding book shall mention.

	SPECIFICATION FOR DOCUMENTATION OF PIPELINE CONSTRUCTION	DOCUMENT NO.	REV
		11-0330G01-01-07-02-015	0
		SHEET 6 OF 7	

- Data relevant to the project and section thereof.
- Sequential number
- Length brought forward (for pipes and other materials)
- Length to bring forward (for pipes and other materials).

Alignment sheet number and at least the location thereon of two welds on every page of the pipe book.

Further,

- Diameter of pipeline
- Length of each pipe
- Wall thickness
- Pipe number
- Heat number, certificate number
- Cut and re-numbered pipe ends
- Coating
- Date of stringing
- Date of welding
- Direction of working
- Weld number
- Welder number
- Type of welding, electrode, diameter
- Weld treatment
- Used equipment for radiography
- Limits of valve stations, water crossings, etc
- Test pressure, data and test (hydrostatic)
- Length of section per page in line separated in the pipes including field bends and factory bends and/or other inline fittings.
- Length to bring forward (pipes and other materials)
- Length brought forward (pipes and other materials)

In order to achieve this CONTRACTOR shall identify all pipe elements. Sample format of pipe book shall be submitted for OWNER approval.

	SPECIFICATION FOR DOCUMENTATION OF PIPELINE CONSTRUCTION	DOCUMENT NO.	REV
		11-0330G01-01-07-02-015	0
		SHEET 7 OF 7	



GAIL (India) Limited
PIPELINE FROM HANUMAN JUNCTION TO VCL



SPECIFICATION FOR ONSHORE PIPELINE CONSTRUCTION	CLIENT JOB NO.		-			
	TOTAL SHEETS		14			
DOCUMENT NO	11	0330G01	01	07	02	016

--	--	--	--	--	--	--

REV.	DATE	DESCRIPTION	PREP	CHKD	APPD
0	04-07-11	ISSUED FOR TENDER	MH	EUR	AD
A	07-06-11	ISSUED FOR IDC	MH	EUR	AD

CONTENTS

1	SCOPE.....	3
2	DEFINITIONS.....	3
3	REFERENCE CODES, STANDARDS AND SPECIFICATIONS	3
4	MOBILISATION OF EQUIPMENT / PERSONNEL	4
5	RIGHT-OF-WAY (ROW)	4
6	HANDLING, HAULING, STRINGING AND STORING OF MATERIALS	6
7	TRENCHING.....	7
8	BENDING.....	9
9	LINING UP	11
10	LAYING.....	11
11	BACK-FILLING.....	13
12	PIPELINE TIE-IN.....	13
13	CROSSINGS.....	14
14	INSTALLATION OF INSULATING JOINTS.....	14
15	CLEAN-UP & RESTORATION OF RIGHT-OF-WAY	14
16	PIPELINE MARKERS	14



**SPECIFICATION FOR ONSHORE
PIPELINE CONSTRUCTION**

DOCUMENT NO.

11-0330G01-01-07-02-016

REV

0

SHEET 2 OF 14

1 SCOPE

- 1.1 This specification defines the minimum requirements for the various activities to be carried out by Contractor for the construction of onshore pipelines.
- 1.2 The various activities covered in this specification include all works during the following stages of pipeline construction :
- Clearing, grubbing and grading of right-of-way ;
 - Staking of the pipeline route ;
 - Handling, hauling, stringing and stacking/storing of all materials ;
 - Trenching ;
 - Field – bending of line pipe ;
 - Lining-up and Welding
 - Pipeline laying ;
 - Backfilling ;
 - Tieing-in ;
 - Hydrostatic testing, dewatering and drying
 - Installation of auxiliary facilities and appurtenances forming a part of pipeline installation ;
 - Clean-up and restoration of right-of-way ;
- 1.3 CONTRACTOR shall submit detailed work procedures including drawings, calculations as required equipment and manpower deployment details for the all pipeline activities, to OWNER for approval. Entire work shall be carried out as per approved procedures and to the satisfaction of OWNER.

2 DEFINITIONS

For this specification the following definitions shall apply:

OWNER	:	GAIL (India) Limited
CONSULTANT	:	Wood Group Kenny India Pvt. Ltd.
CONTRACTOR	:	The Company named as such in the deed.
SHAL/MUST/IS TO BE	:	A mandatory requirement
SHOULD	:	A non-mandatory requirement, advisory or Recommendation

3 REFERENCE CODES, STANDARDS AND SPECIFICATIONS

- 3.1 Reference has been made in this specification to the latest codes, standards and specifications:

i.)	ASME B31.8	-	Gas Transmission and Distribution Piping systems
ii)	ASME B31.4	-	Pipeline transportation systems for liquid hydrocarbons and other liquids.
iii)	API 1104	-	Standard for Welding Pipelines and related facilities
iv)	API 1105	-	Bulletin on construction practices for oil and products pipelines
v)	Part 192 Title 49	-	Transportation of natural and other gas by pipeline (U.S Department of Transportation – Pipeline safety standards)

	SPECIFICATION FOR ONSHORE PIPELINE CONSTRUCTION	DOCUMENT NO.	REV
		11-0330G01-01-07-02-016	0
		SHEET 3 OF 14	

vi)	Part 195	-	Transportation of liquids by pipeline (U.S department of Transportation – Pipeline safety standards)
vii)	OISD 141	-	Design construction requirements for cross country hydrocarbon pipelines.

4 MOBILISATION OF EQUIPMENT / PERSONNEL

In order to adhere to complete the schedule of work in time, the contractor must mobilize the machinery / equipment given below:

- All materials, equipment, trailers for transportation, loading, unloading, stringing etc.
- All welding machines, lifting equipment, instruments, transporting vehicles and consumables for welding such as oxygen, acetylene, inert gases and all types of electrodes, filter wire, solder wire, brazing rods, flux etc. for welding / cutting and soldering purpose.
- All materials, equipment and instruments required for all types of tests such as radiography, ultrasonic testing, magnetic particle and dye penetrate examination and any other tests as per the requirement of Owner/Owner's representative.
- All materials, equipment, instruments and consumables including primer calibrated pump required for external corrosion coating and concrete coating (where required) of field weld joints.
- All equipment and material for excavation.
- All materials, equipment for lowering and back filling and tie-in of pipeline sections.
- All materials, equipment and consumables required for repair of damaged coating of line pipe.
- All materials, consumables and equipment related to blasting of rock for excavating trench or grading the Right-Of-way.
- All materials, equipment required for repair/restoration of pavements, roads, bunds, other structure affected/ damaged by Contractor's construction activities. Materials shall be equivalent / superior to those used for original construction of the facility.

5 RIGHT-OF-WAY (ROW)

5.1 GENERAL

The Right-of-Way will be handed over to Contractor by OWNER as the work progresses. The Contractor is required to perform his construction activities within the width of Right-of-Way set aside for construction of pipeline, unless he has made his own arrangements with the land owner and/or tenant for using extra land. Variation in the width of ROW caused by local conditions or installation of associated pipeline facilities or existing pipelines will be identified in the field or instructed to the Contractor by OWNER.

The Right-of-Way boundary lines shall be staked by the Contractor, so as to prepare the strip for laying the pipeline. Contractor shall also establish all required lines and grades necessary to complete the work and shall be responsible for the accuracy of such lines and grades.

A minimum clearance of 300mm shall be ensured when pipelines are to be laid parallel along near underground power and/or communication cables, conductors or conduit. When such clearance cannot be maintained due to unavoidable reasons extra precautions shall be taken as approved by OWNER.

	SPECIFICATION FOR ONSHORE PIPELINE CONSTRUCTION	DOCUMENT NO.	REV
		11-0330G01-01-07-02-016	0
		SHEET 4 OF 14	

During ROW cleaning, the vegetation shall be cut off at ground level leaving the roots intact. Only stumps & root directly over the trench shall be removed for pipeline installation.

Generally ROW of 20 metre is provided to the Contractor unless noted otherwise. During construction, ROW may be restricted due to any other reasons. In this regard, Contractor has to make own arrangements cost & time affect to Owner.

The Contractor shall not be compensated for any reduction in the width of working strip or reversal in the working of working strip.

5.2 STAKING

Prior to clearing operations Contractor shall carry out the following.

- Install bench marks, intersection points and other required survey monuments.
- Stake markers in the centreline of the pipeline at distances of maximum 100 metres for straight line sections and maximum 10 metres for horizontal bends. Stake two ROW markers at boundaries at least at every 100 metres.
- Install distinct markers locating and indicating special points, such as but not limited to: Contract limits, obstacle crossings, change of wall thickness, including corresponding chainage etc.

All markers shall be of suitable materials so as to last till replacement with permanent markers and shall be coloured distinctly for easy identification. Type, material and colouring of stake markers shall be subject to approval of OWNER. Any deviation from the approved alignment shall be executed by Contractor after seeking OWNER approval in writing prior to clearing operations.

Contractor shall be responsible for the maintenance and replacement of the reference line markers until the permanent pipeline markers are placed.

5.3 FENCING

If OWNER demands, contractor shall install temporary fencing on either side of ROW wherever it is required to ensure safety and non-interference with others. For convenience of construction, Contractor's shall install temporary gates to the fencing as per Owner's guidelines. However the Contractor shall be fully responsible for any damage, accident etc. arising during construction works along the route and any construction thereof and suitably indemnify Owner / Engineer for any such damage & accident.

5.4 CLEARING AND GRADING

5.4.1 Clearing of Obstacles

Any obstacle, which may hinder the construction and laying of the pipeline along the approved pipeline route and for a strip of land of the size provided shall be removed.

5.4.2 Clearing of Vegetation

All grubbed stumps, timber bush, undergrowth and roots shall be cut and removed from the ROW and shall be disposed of in a method satisfactory to OWNER and authorities having jurisdictions. ROW cross fall shall not exceed 10%.

5.4.3 Uprooting of Trees

All trees which may hinder the construction of the pipeline along the approved pipeline route that belong to the protected green belt, reserved forest and other areas demarcated by the government authorities

	SPECIFICATION FOR ONSHORE PIPELINE CONSTRUCTION	DOCUMENT NO.	REV
		11-0330G01-01-07-02-016	0
		SHEET 5 OF 14	

and any other tree in the opinion of the OWNER requiring relocation / re-plantation shall be relocated and replanted by the CONTRACTOR at an alternate location as recommended by the jurisdiction authorities / OWNER. All such uprooting and re-plantation of trees shall be carried out by the CONTRACTOR in a manner that is satisfactory to the jurisdiction authorities / OWNER.

CONTRACTOR shall submit a procedure for uprooting and replanting of trees to the OWNER for approval.

Trees that are required to be uprooted and not specified / recommended for re-plantation by the jurisdiction authorities / OWNER shall be disposed of as debris and cleared from the ROW / Project site by the CONTRACTOR.

5.4.4 Grading of ROW

Contractor shall grade the pipeline Right-of-way as required for proper installation of the pipeline, for providing access to the pipeline during construction, and for ensuring that the pipeline is constructed in accordance with the most up-to-date engineering and construction practices. During entire period of pipeline construction and testing, CONTRACTOR shall maintain the ROW in motorable condition. Final cleared & graded ROW shall be subject to approval of OWNER.

5.5 APPROACH ROADS

Grading operations should normally be carried out along the Right-of-way with mechanical excavators or manually. In certain areas, grading may have to be resorted to exclusively by blasting.

In plain, rough or steep terrain, Contractor may have to grade access roads and temporary bypass roads for its own use. Where such access roads do not fall on the Right-of-way, Contractor shall obtain necessary written permission from land owners and tenants and be responsible for all damages caused by the construction and use of such roads, and at no extra cost to OWNER. Where rocky terrain is encountered, grading shall be carried out in all types of solid rocks which cannot be removed until loosened by blasting, drilling or by other recognised methods of quarrying solid rocks.

5.6 PROVISION OF DETOURS

Contractor shall be responsible for moving his equipment and men across or around watercourses and road crossings. This may require the construction of temporary bridges or culverts. Contractor shall ensure that such temporary works shall not interfere with normal water flow, avoid overflows, traffic, keep the existing morphology unchanged and shall not unduly damage the banks of water courses. No public ditches or drains shall be filled or bridged for passage of equipment until Contractor has secured written approval of the authorities having jurisdiction over the same. Contractor shall furnish OWNER a copy of all such approval.

5.7 OFF RIGHT-OF-WAY DAMAGES

Any damage to property outside ROW shall be restored or settled to the Contractor's account.

6 HANDLING, HAULING, STRINGING AND STORING OF MATERIALS

6.1 GENERAL

Contractor shall be fully responsible for all materials and their identification until such time that the pipes and other materials are installed in permanent installation. Contractor shall be fully responsible for arranging and paying for stacking/storage areas for the pipeline materials, however, method of stacking/storage shall be approved by OWNER.

6.2 LINE PIPES

	<p align="center">SPECIFICATION FOR ONSHORE PIPELINE CONSTRUCTION</p>	DOCUMENT NO.	REV
		11-0330G01-01-07-02-016	0
		SHEET 6 OF 14	

The Contractor shall load, unload, transport and stockpile the bare/coated pipes using approved suitable means and in a manner to avoid damage to the pipe and coating. Contractor shall submit to OWNER a complete procedure indicating the manner and arrangement used for handling, transportation and stacking of bare/coated pipes for OWNER approval prior to commencement of handling operations.

Stacks shall consist of limited number of layers so that the pressure exercised by the pipes own weight does not cause damage to the coating. CONTRACTOR shall submit the staking height calculations as per API RP 5L1 to OWNER for approval. Stacks of difference diameter, wall thickness and damaged, rejected pipe shall be separately segregated and identified properly. The pipes shall be stacked at a slope so that driving rain does not collect inside the pipe.

The ends of pipes during handling and stacking shall be protected with bevel protectors. Supports shall be provided for atleast 10% of the pipeline length. These supports shall be lined with rubber protection. The second layer and subsequent layers shall be separated from each other by material such as straw in plastic covers or mineral wool strips or equivalent.

Materials excluding line pipes shall be stored in sheltered storages

6.3 STRINGING OF PIPE

Pipes shall be unloaded from the stringing trucks/trailors and lowered to the ground by means of boom tractor or swinging crane or other suitable equipment using lifting devices. Dragging or sliding of pipe shall not be permitted. Special precaution shall be taken during stringing of corrosion coated pipe as per the special requirements of previous para. Stringing of pipe shall only be carried out in daylight and after clearing and grading operations have been completed. Pipe shall not be strung on the Right-of-way in rocky areas where blasting may be required, until all blasting is complete and the area cleared of all debris. Contractor shall submit to OWNER for approval a complete procedure for stringing of line pipes.

6.4 REPAIR OF DAMAGED PIPES

After the pipe has been strung on the Right-of-way it shall be inspected by the Contractor and the OWNER and all defective pipes and pipe ends shall be repaired. Defective pipe shall be repaired or rejected as the OWNER may direct as per the requirements of specification.

6.5 IDENTIFICATION

For all pipes, numbers and lengths shall be identified and recorded properly. Before a pipe end is cut, the painted pipe number and cold die stamped pipe number shall be transferred by Contractor in presence of OWNER to either side of the joint which is to be made by cutting.

7 TRENCHING


7.1 Contractor shall excavate and maintain the pipeline trench on the staked center line of the pipeline taking into account the curves of the pipeline.

7.2 EXCAVATION

7.2.1 Contractor shall, by any method approved by OWNER, dig the pipeline trench on the cleared and graded Right-of-way.

7.2.2 In cultivated land the arable soil shall be properly prescribed and same to be replaced at original place during backfilling as advised by OWNER.

Care shall be exercised to see that fresh soil recovered from trenching operation, intended to be used for backfilling over the laid pipe in the trench, is not mixed with loose debris or foreign material. The excavated material shall never be deposited over or against the strung pipe.

	SPECIFICATION FOR ONSHORE PIPELINE CONSTRUCTION	DOCUMENT NO.	REV
		11-0330G01-01-07-02-016	0
		SHEET 7 OF 14	

7.2.3 In steep slope areas or on the hillside, before commencing the works, proper barriers or other protection shall be provided to prevent the removed materials from rolling downhill.

7.2.4 In certain slopy sections, before the trench cuts through the water table, proper drainage shall be ensured both near the ditch and the right-of-way in order to guarantee soil stability.

7.3 BLASTING

7.3.1 CONTRACTOR shall execute the blasting as per approved procedures, which will also detail out safety precautions to safe guard the existing pipelines.

7.3.2 No blasting is allowed within 15m of any existing pipeline or structures (either above or below ground) (Only Rock Breaker shall be used)

7.3.3 Where blasting is to be carried out between 50m and 15m away from any existing pipelines or structures (either below or above ground) the CONTRACTOR shall submit a procedure for controlled blasting e.g. break-holes, slit trench etc. CONTRACTOR shall perform a trial blast for Owner's approval.

7.4 NORMAL COVER AND TRENCH DIMENSIONS

The trench shall be excavated to a minimum width maintaining clearance on both sides of the installed pipeline and to a depth to maintain the cover of the pipeline as indicated in the other contract documents or approved procedure.

Pipeline shall be laid with atleast 500mm free distance from the obstacles or as specified in the drawings or wherever it is required by concerned authorities.


The depth of the cover for pipeline system measured from cover surface to top of the pipeline shall be as given below (Refer Note – 1):

- a) Normal Excavation: 1.0 m
- b) Drains, Ditches lined & unlined Canals, Nala, Streams and other: 1.5m (Ref. Note 3)
- c) Uncased/Cased Road Crossings: 1.5m (Ref. Note 2)
- d) Railroad crossing: 1.8m (Ref. Note 2)
- e) River Crossing: 2.5 m (Ref Note 3)

Note:

1. Minimum depth of cover shall be measured from the top of the pipe coatings to the top of undisturbed surface of the soil, or top of graded working strip whichever is lower.
2. Cover shall be measured from the top of rail road cross section to the top of casing pipe or carrier pipe as per type of crossing & Minimum depth below ditch level with in ROW except under track shall be 1.0 m min. The cover specified shall also meet the Requirement of the permission obtained from statutory authorities.
3. In case of rivers/water bodies, which are prone to scour and erosion, minimum cover maintained shall be 2.5 m below the scour level for the lifetime of pipeline
4. Wherever cased-crossing is not envisaged, higher cover depths or higher wall thickness of the pipeline shall be considered as per design requirements.

At points where the contour of the earth may require extra depth to fit the minimum radius of the bend as specified or to eliminate unnecessary bending of pipe or where deeper trench is required at the approaches to crossings of roadways, streams etc. contractor shall excavate such additional depths as may be necessary at no extra cost to OWNER.

	<p align="center">SPECIFICATION FOR ONSHORE PIPELINE CONSTRUCTION</p>	DOCUMENT NO.	REV
		11-0330G01-01-07-02-016	0
		SHEET 8 OF 14	

7.5 NEGATIVE BUOYANCY TO THE PIPE

Contractor shall dewater if necessary, using well point system or other suitable systems, install the pipe in the trench and backfill the trench. All underground utilities shall be located and protected as per the guidelines of jurisdiction authority/OWNER.

Contractor shall check if up-floating danger for the pipeline is present in open trench. If such danger of up-floating is present, CONTRACTOR shall take appropriate measures to prevent up-floating such as applying soil dams and dewatering of trench or temporary filling of water into the line (in exceptional cases) as approved by OWNER. CONTRACTOR shall furnish details of all negative buoyancy calculations to the OWNER for approval. CONTRACTOR shall carry out any anti buoyancy measures only after obtaining Owner's approval for such calculations.

In case of presence of water on the ditch bottom when the pipeline is being laid, the ditch shall be drained to the extent and for the time required to make a visual inspection of the ditch bottom. After such inspection, the presence of water will be allowed provided its level does not cause sliding of the ditch sides and pipe floating before backfilling.

Wherever up-floating of the pipeline after backfilling is indicated, anti-buoyancy measures shall be provided by Contractor for areas indicated in the drawings or as may be encountered during construction using the following method:

- Applying a continuous concrete coating around the pipe

Any other anti-buoyancy method adopted by the CONTRACTOR shall require prior written approval from the OWNER

The above provisions shall be in accordance with the relevant specifications and/or approved procedures / drawings and to the satisfaction of OWNER.

7.6 PADDING

In all cases where rock or gravel or hard soil is encountered in the bottom of the trench, extra padding shall be provided by Contractor as per Owner's instructions. The thickness of the compacted padding shall not be less than 200 mm. In those areas that are to be padded, the trench shall be atleast 200 mm deeper than otherwise required, and evenly and sufficiently padded to keep the pipe when in place, at least 200 mm above bottom of excavated trench. Reference drawing of trench, please refer Standard Dwg. No. 1 -07-005.

The thickness of compacted padding on top of pipe shall be at least 200 mm. Exact extent of trench padding shall be as per OWNER instructions. Padding materials that are approved by OWNER shall be graded soil / sand and/or other materials containing no gravel, rock, or lumps of hard soil.

Contractor shall keep the trench in good condition until the pipe is laid.

8 BENDING

Contractor shall preferably provide for changes of vertical and horizontal alignment by making elastic bends. Contractor may provide cold field bends, at its option for change of direction and change of slope. OWNER at its option may authorise fabricated bends for installation at points where in Owner's judgement the use of such bends is unavoidable.

Over bends shall be made in such a manner that the centre of the bend clears the high points of the trench bottom. Sag bends shall fit the bottom of the trench and side bends shall conform and leave specified clearance to the outside wall of the trench.

	SPECIFICATION FOR ONSHORE PIPELINE CONSTRUCTION	DOCUMENT NO.	REV
		11-0330G01-01-07-02-016	0
		SHEET 9 OF 14	

8.1 COLD FIELD BENDS

8.1.1 The minimum radius of cold field bends shall be as follows:

Nominal Pipe Size (NPS)	Minimum Radius of Cold Bend
Less than 12"	21D
14 " - 18 "	30D
Greater than 20 "	40D

Spiral SAW line pipes shall not be used for fabrication of cold field bends.

Contractor shall use a bending machine and mandrel and employ recognised and accepted methods of bending of coated pipe in accordance with good pipeline construction practice. However, bending machines shall be capable of making bends without wrinkles, buckles, stretching and with minimum damage to the coating.

8.1.2 Contractor shall, before the start of the work, submit and demonstrate to OWNER a bending procedure, which shall conform with the recommendations of the bending machine manufacturer. The procedure shall include amongst other steps – lengths, maximum degree per pull and method and accuracy of measurement during pulling of the bend. This procedure and the equipment used shall be subject to Owner’s approval.

8.1.3 For welded pipes, longitudinal seam shall be suitably placed as per approved procedure so that the weld seam shall not be overstressed.

8.1.4 The ends of each bent length shall be straight and not involved anyway in the bending. The length of the straight section shall permit easy joining. In no event shall the end of the bend be closer than 1.0m from the end of a pipe.

8.1.5 The ovality used on each pipe by bending shall be less than 5 mm of the nominal diameter at any point. Ovality is defined as the reduction or increase in the internal diameter of the pipe compared with the nominal internal diameter. A check shall be performed on all bends in the presence of OWNER by passing a gauging pig / buckle detector consisting of two discs with a diameter equal to 95% of the nominal internal diameter of the pipe connected rigidly together at a distance equal to 300mm.

8.1.6 Cold bent pipes on site shall have the corrosion coating carefully checked with the aid of a holiday detector for cracks in the coating down to the pipe wall. It must also be checked whether the coating has disbanded from the pipe wall during bending by beating with a wooden mallet along the outer radius. Any defects or disbanding of the coating caused during bending shall be repaired at the Contractor’s expense in accordance with OWNER approved procedures.

8.2 MITRE AND UNSATISFACTORY BENDS

All bends showing buckling, wrinkles, cracks or other visible defects or which are in any way in disagreement, in whole or in part, with this specification shall be rejected.

No mitre bends shall be permitted in the construction of the pipeline. Cutting of factory made bends and cold field bends for any purpose are not permitted.

	SPECIFICATION FOR ONSHORE PIPELINE CONSTRUCTION	DOCUMENT NO.	REV
		11-0330G01-01-07-02-016	0
		SHEET 10 OF 14	

9 LINING UP

Each length of pipe shall be thoroughly examined internally and externally to make sure that it is free from visual defects, damage, severe corrosion (sea water pitting), dirt, animals or any other foreign objects. Each length of the pipe shall be adequately swabbed, either by use of canvas belt disc of proper diameter or by other methods approved by the OWNER. Damaged/ corroded pipes shall be kept separate. Each length of pipe shall be pulled through just before being welded. Contractor shall submit a detail procedure for Lining of line pipe to OWNER for approval.

9.1 PIPE DEFECTS AND REPAIRS

9.1.1 Repair on line pipe shall be executed as specified in OWNER material specification or Code ASME B31.8 whichever is more stringent.

Repair of damaged pipe ends by hammering and/or heating is not allowed. Contractor shall submit detailed procedure for pipe defects and repairs to OWNER for approval.

9.2 SKID SPACING

9.2.1 A strip of soft material shall be placed in between skid and pipe to protect the external coating of pipe from any damage.

9.2.2 The pipes shall be maintained or skids at the minimum distance of 500mm above ground.

9.3 NIGHT CAPS/TEMPORARY CAPS

After each day's work or when work is interrupted, the open ends of the welded strings of pipes shall be capped with a securely closed metal cap as approved by OWNER.

10 LAYING

10.1 LOWERING IN TRENCH

10.1.1 Lowering shall follow as soon as possible, after the completion of the field joint coating of the pipeline. In the case of parallel pipelines, laying shall be carried out by means of successive operations, if possible without interruption. Contractor shall submit a detail procedure for lowering of pipeline to OWNER for approval.

10.1.2 Before lowering in, a complete check by a full circle holiday detector for pipe coating and for field joint coating shall be carried out and all damages repaired as agreed by OWNER at Contractor's cost. All the points on the pipeline where the coating has been in contact with either skids or with lifting equipment shall be properly checked. Where water is present in the trench, no laying shall be permitted until the ditch has been drained.

10.1.3 The pipeline shall be lifted and laid using, for all movements, necessary, suitable equipment of non-abrasive material having adequate width for the fragility of the coating. Care shall be exercised while removing the slings from around the coated pipe after it has been lowered into the trench. Any damage caused to the coating shall be promptly repaired. Lowering in utilising standard pipe cradles shall be permitted if Contractor demonstrates that pipe coating is not damaged. No sling shall be put around field joint coating.

10.1.4 The portion of the pipeline between trench and bank shall be supported by as many side-booms as required and approved by OWNER for holding the line in gentle S-curve maintaining minimum elastic bend radius as specified in approved procedure. Lowering in and back filling shall preferably be carried out at the highest ambient temperature.

The maximum length of pipe to be lowered at a time more than 1.5 km shall be avoided.

	SPECIFICATION FOR ONSHORE PIPELINE CONSTRUCTION	DOCUMENT NO.	REV
		11-0330G01-01-07-02-016	0
		SHEET 11 OF 14	

In laying parallel pipelines in the same trench, the minimum distances between the pipelines indicated in the approved drawings shall be maintained.

10.1.5 Over-head sections

a) The following works shall be completed before proceeding with the assembly and laying of overhead pipelines:

- Construction of the pipe support structures or of mounts on supports.
- Paints and/or coating of the pipework, as indicated in the engineering specification.

b) The erection of the supports shall be carried out taking care that the elevation and alignment is in accordance with the drawings.

In the case of metal work supports, pre-fabrication and/or assembly shall take into account the maximum allowed free span and the supports shall not interfere with the pipeline welds.

c) In case roller supports are used, the rollers shall be lubricated, then checked for smooth rotation and, in case of seizure, the defect shall be repaired or roller shall be replaced. In the case of overhead section where the pipeline is slanting, the alignment of the end supports shall be made after placing the pipeline in position. Before installation of the pipe section, all the rollers shall be perfectly centred acting on the seat of the support plates.

The above alignment operations shall be carried out before connecting the overhead section with the ends of the buried section.

d) Lifting, moving and laying of the pipeline shall be carried out in accordance with the provisions of this specification.

An insulation sheet shall be installed to isolate the pipe from the support or support from the earth.

The sheet shall be hard polyethylene at least 5mm thick.

It shall extend at least to 25 mm outside the saddles or clamps.

e) Moving supports, if any shall be centered on their support and allow for a movement of at least 300mm in both directions.

f) A comprehensive report / method statement on the laying operation to be used shall be submitted to the OWNER well in advance for approval. The report as a minimum shall include, but not limited to the following:

- Method of installation by lifting (as a preferred method).
- Pulling method and related calculations, whenever lifting method cannot be used.
- Pulling device and its characteristics.
- Method of anchoring the pulling device
- Characteristics of the pulling rope
- Braking device, if any.
- Pipeline assembly system.

g) TELETRANSMISSION:
Contractor shall supply HDPE Conduit and all other accessories for OFC laying.

For all crossing to HDPE ducts (supplied by Contractor) shall be put in 6" steel conduit. One HDPE duct will accommodate OFC cable and other HDPE duct shall be laid empty for future expansion.

	<p align="center">SPECIFICATION FOR ONSHORE PIPELINE CONSTRUCTION</p>	DOCUMENT NO.	REV
		11-0330G01-01-07-02-016	0
		SHEET 12 OF 14	

11 BACK-FILLING

11.1 Backfilling shall be carried out immediately after the pipeline has been laid in the trench, inspected and approved by the OWNER, so as to provide a natural anchorage for the pipeline, thus avoiding long exposure of coating to high temperature, damaging actions of adverse weather conditions, sliding down of trench sides and pipe movement in the trench. If immediate back filling is not possible, a covering of at least 200mm of earth shall be placed over and around the pipe coatings. Contractor shall submit to OWNER the detailed procedure for backfilling for approval.

For this purpose top soil (arable) shall not be used. Surplus materials shall be neatly crowned directly over the trench as per instruction of Owner's representative.

Crown shall be high enough to prevent the formation of a depression in the soil when back fill has settled into its permanent position.

The areas where the pipeline is crossing the cultivated land 200mm of top soil shall be stored along the ROW & replace the same during restoration activity.

11.2 As directed by OWNER/ CONSULTANT, wherever hard rocks/soil are encountered, padding and rock shield shall be provided across the pipe to cover all exposed pipe area to avoid any possible damages during back filling of hard materials like rock, gravel, lumps of hard soil etc.

11.3 When trench has been dug through roads, all back fills shall be executed by sand or suitable material as approved by OWNER and shall be thoroughly compacted. In certain cases, special compaction methods, such as moistening or ramming of the backfill in layer may be required as advised by OWNER.

11.4 In areas prone to soil erosion, back filling shall be carried out as per approved procedures, carefully and to the satisfaction of the OWNER/authorities having jurisdiction.

11.5 Contractor shall furnish materials and install breakers in the trench in step areas (slop generally 10% and more) for the purpose of preventing erosion of the backfill. The type of breakers installed shall be as per the approved drawings. Breakers shall be constructed of grout bags filled with a mixture of 4: 1 Sand: Portland cement at Owner's direction.

11.6 Warning Tape:

A Printed warning tape is made of PVC pipeline sheet of red colour with width of 900 mm and 0.1 mm thickness shall be laid over the HDPE conduit. HDPE conduit shall be backfilled with soft soil or sand like pipeline as per clause no. 7.4 & 7.6 of this specification.

12 PIPELINE TIE-IN

12.1 The unconnected sections of the pipeline at various locations have to be tied in after the sections are coated, lowered and backfilled. The sections to be connected shall have at the ends, sections of overlapping, uncovered pipe of sufficient length to absorb, without including excessive stresses in the steel, small displacements necessary for perfect alignment and connection of the ends.

11.5 If a pup end cannot be avoided for tie-in, the minimum length that shall be added is 1.0 metres and two or more such pups shall not be welded together. All cut-off lengths greater than 1.0 meters shall be moved ahead in order to be welded into the pipeline at a suitable location. Tie-in with two or more pups may be used provided that they each have minimum length of 1.0 metre and are separated by an entire length of pipe. In no case more than three (3) welds shall be permitted on a 10-metre length of pipeline.

11.6 Maximum post hydrostatic tie-ins (Golden tie-ins) shall be limited to 2 per station, 2 in the mainline & 2 for HDDs. Contractor shall strictly adhere to the no. of Golden tie-in specified above.

	SPECIFICATION FOR ONSHORE PIPELINE CONSTRUCTION	DOCUMENT NO.	REV
		11-0330G01-01-07-02-016	0
		SHEET 13 OF 14	

13 CROSSINGS

Pipe line sections at all major crossings like State and National Highways, Railways, major canals and lined canal / distributaries shall be laid by boring with casing pipe complying to all other statutory requirements. All other crossings shall be executed by open cut method unless otherwise specified in the CONTRACT or specified by statutory authorities.

14 INSTALLATION OF INSULATING JOINTS

- 14.1 Insulating joints shall be installed at the locations shown in the drawings. Contractor shall obtain approval from the OWNER before installation of the insulating joints.
- 14.2 Handling and installation of the insulating joints shall be carried out with all precautions required to avoid damage and excessive stresses and that the original pup length is not reduced.
- 14.3 The insulating joints and the welded joints shall be protected by external coating as per the relevant specifications issued for the purpose.

15 CLEAN-UP & RESTORATION OF RIGHT-OF-WAY

- 15.1 After all required tests have been concluded satisfactorily Contractor shall clean up the site as laid down in the specifications issued for the purpose. The site finish shall be graded in accordance with the approved drawings.
- 15.2 Contractor shall restore the Row and all sites used for the construction of pipelines, water crossings and other structures in accordance with Owner's instructions, and deliver them to the satisfaction of OWNER.

16 PIPELINE MARKERS

- 16.1 Contractor shall submit detailed drawings for pipeline markers to the OWNER for approval. After approval, all markers shall be installed along the pipeline route as advised by OWNER. As a minimum the markings shall be provided at intervals / spacing as follows:

Marker Type	Minimum Spacing Requirement
Kilo Meter Post	One marker every one kilometre
Aerial Marker	One marker at every five kilometres
Navigable Water ways	One each on either bank of the navigable water way
Boundary Markers	One each on either side of the boundary of the ROW at intervals of 250 m.
Direction Markers	One at the centre of curvature of the turning point. One each at a distance of 200m on either side of the alignment.
Warning Signs: National Highway/State Highway/ railroad crossings. Water course, nallah, canal, Asphalted, Metalled, & Other Road Crossing	One no. on either side of the road / railroad a) One no. for width less than 15m b) Two nos. on either side of the crossing for width greater than 15 m and all cased crossings

	SPECIFICATION FOR ONSHORE PIPELINE CONSTRUCTION	DOCUMENT NO.	REV
		11-0330G01-01-07-02-016	0
		SHEET 14 OF 14	



GAIL (India) Limited
PIPELINE FROM HANUMAN JUNCTION TO VCL



SPECIFICATION FOR PIPELINE CROSSING ROADS, RAIL AND MINOR WATERWAYS				CLIENT JOB NO.		-
				TOTAL SHEETS		7
DOCUMENT NO	11	0330G01	01	07	02	017

--	--	--	--	--	--	--

0	04-07-11	ISSUED FOR TENDER	MH	EUR	AD	
A	07-06-11	ISSUED FOR IDC	MH	EUR	AD	
REV.	DATE	DESCRIPTION	PREP	CHKD	APPD	

CONTENTS

1 SCOPE.....3

2 DEFINITIONS.....3

3 REFERENCES.....3

4 PROJECT GENERAL REQUIREMENTS3

5 ROAD AND RAIL ROAD CROSSINGS4

6 CROSSING OF BURIED SERVICES.....4

7 MINOR WATER WAYS.....5

8 CASSED CROSSING.....6

9 PRE AND POST TESTING7

	SPECIFICATION FOR PIPELINE CROSSING ROADS, RAIL AND MINOR WATERWAYS	DOCUMENT NO.	REV
		11-0330G01-01-07-02-017	0
		SHEET 2 OF 7	

1 SCOPE

- 1.1 This Specification defines the minimum technical requirements for the various activities to be carried out by CONTRACTOR for the installation of pipelines at roads, railroads, minor watercourses and other service crossings.

2 DEFINITIONS

For this specification the following definitions shall apply:

OWNER	- GAIL (India) Limited
CONSULTANT	- Wood Group Kenny India Pvt. Ltd.
CONTRACTOR	- The Company named as such in the deed.
SHALL/MUST/ISTO BE	- A mandatory requirement
SHOULD	- A non-mandatory requirement, advisory or recently Amended

3 REFERENCES

3.1 CODES AND STANDARDS

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

a)	ANSI B 31.8	Gas Transmissions and Distribution Piping System
b)	ANSI B 31.4	Liquid Petroleum Transportation Piping System
c)	API RP 1102	Steel Pipeline Crossing Railroads and Highways
d)	Part 192 Title 49	Transportation of Natural and other Gas by Pipeline (US Department of Transportation – Pipeline Safety Standards)
e)	Part 195	Transportation of Liquids by Pipeline (US Department of Transportation – Pipeline Safety Standards).
f)	OISD 141	Design Construction Requirements for Cross Country Hydrocarbon Pipelines

4 PROJECT GENERAL REQUIREMENTS

- 4.1 Laying of pipeline at crossing of roads, railroads, buried services, canals and minor watercourses is allowed only after obtaining approval from the authorities having jurisdiction. CONTRACTOR shall make suitable arrangements for safeguarding the roads, etc., and the verges and/or banks thereof and the buried services with appropriate provisions.

Highways, Main Roads and Railroads and their verges and banks of water crossings are not allowed to be used for loading, unloading or stacking of materials and/or equipment. For secondary roads, such loading/unloading is permitted only after prior approval from the concerned authorities. Contractor is not allowed to close or divert roads or watercourses without prior approval from the OWNER and the

	SPECIFICATION FOR PIPELINE CROSSING ROADS, RAIL AND MINOR WATERWAYS	DOCUMENT NO.	REV
		11-0330G01-01-07-02-017	0
		SHEET 3 OF 7	

concerned authorities. Contractor shall never unnecessarily hamper the users of the roads, railroads, buried services and/or watercourses. The water flow shall not be obstructed in any way.

4.2 The CONTRACTOR shall submit a detailed report including the following for individual crossing for approval by the OWNER / CONSULTANT

- Approval letter from concerned authorities
- Time Schedule
- Execution methodology with details of equipment
- Test procedure
- Manpower deployment

Such Works shall be executed without any extra cost to company.

4.3 Pipeline sections for crossings of roads, railroads, & canals etc., shall be hydrostatically pre-tested ex-site, prior to joint coating and post tested after installation.

4.4 Pipeline sections at all major crossings like State/National Highways, railways, major canals and lined canals/distributaries shall be laid by boring with casing pipe complying with all other statutory requirements.

4.5 CONTRACTOR shall take suitable measures for the protection of pipeline from overhead high tension power lines by providing plastic gratings/concrete slabs as per approved drawings/job standards.

4.6 Post installation of Carrier pipe the casing section shall be filled with bentonite mud.

5 ROAD AND RAIL ROAD CROSSINGS

5.1 The work under crossing shall include necessary clearing, grading and trenching to required depths and widths, welding of casing (when required) and carrier pipes, coating, lowering-in, backfilling, clean-up, restoration to the original condition and further strengthening and protective works, testing, installation of assemblies, insulators and seals and temporary works such as sheet piling, bridges, etc.

Before the installation work of crossing commences the CONTRACTOR shall provide suitable barricade, temporary bridge/bypass work (especially where roads are open-cut) with railing, if required by OWNER / CONSULTANT for safety of traffic. Adequate traffic warning signals and/or traffic lights and suitable diversions shall be provided as directed by OWNER / CONSULTANT Authority having jurisdiction over these areas. Such diversions shall not cross the pipeline where it has already been installed, unless proper safeguarding at OWNER / CONSULTANT's opinion is ensured.

The work shall be carried out in accordance with the approved drawings/job standards, as directed by OWNER / CONSULTANT and to the satisfaction of OWNER / CONSULTANT and the authorities having jurisdiction over the facility crossed. The work carried out for road and railroad crossings shall meet the minimum requirements of API RP 1102, latest edition.

6 CROSSING OF BURIED SERVICES

6.1 The pipeline under construction may pass above or below the existing buried facilities such as pipelines, cables, etc. Type of crossing shall be such that a minimum depth of cover as required in the drawings and specifications are guaranteed. The minimum clearance required between pipeline and the existing facility shall be 500mm and / or as the crossing permission given by the concerned authority.

	SPECIFICATION FOR PIPELINE CROSSING ROADS, RAIL AND MINOR WATERWAYS	DOCUMENT NO.	REV
		11-0330G01-01-07-02-017	0
		SHEET 4 OF 7	

- 6.2 Whenever buried services in the ROW are to be crossed by CONTRACTOR, shall safeguard the buried facilities and the required protecting precaution shall be executed as approved by OWNER / CONSULTANT of the buried service.
- 6.3 For buried services to be crossed by boring, the provisions of relevant OPERATOR specification shall apply.

7 MINOR WATER WAYS

- 7.1 Minor water crossing are crossings of (future) ditches, distributaries, canals, water courses, streams, etc., whether the bed(s) contain(s) water or not, and not being specified as 'Major Water Crossing' in the CONTRACT.
- 7.2 Whenever minor water crossing in the ROW is to be crossed, CONTRACTOR shall install suitable temporary bridges as advised by OWNER / CONSULTANT / Authority jurisdiction bridges and further comply with the provision as laid down in this specification.
- 7.3 Before executing the work CONTRACTOR shall carry out detailed/survey to determine the nature of flow rate of the watercourse with the object of determining what precautions are necessary to be taken care during period of execution.
- 7.4 In the case of crossings of watercourses for which no special methods of laying are required, crossing spool piece shall be assembled and subsequently laid. Bends shall be of cold field type.
- The depth of the existing bottom of a minor watercourse crossing shall be determined in relation to the adjacent ground level by taking the average of four measurements.
- CONTRACTOR shall take special care to check with the concerned authorities for special conditions applying to working on, over, under or through minor water crossing and CONTRACTOR shall comply with all such conditions. Written arrangements with authorities shall be drawn up in co-operation with OWNER / CONSULTANT.
- 7.5 The minimum cover over the pipe shall be as specified in the relevant approved drawings and specifications.
- 7.6 For crossing of ditches, canals, banked channels, etc., by boring, the pipe section shall be prepared, laid and tested in accordance with the applicable provisions of Section 8.0 of this specification.
- 7.7 The CONTRACTOR shall arrange temporary installation on diversion as may be necessary; to ensure the effective functioning of watercourses to be crossed, to the entire satisfaction of the concerned local authorities as well as the OWNER.
- 7.8 Banks and trenches of minor water crossings shall be backfilled with soil which is to be approved by OWNER / CONSULTANT and shall be thoroughly compacted to prevent soil and bank erosion as per the drawings and standards to the satisfaction of authorities having jurisdiction thereof and OWNER / CONSULTANT.

Whenever boulders, rock, gravel and other hard objects are encountered, they shall not be placed directly on the pipe. Sufficient earth, sand or other selected and approved backfill material shall be placed initially around and over the pipe to provide a protective padding or cushion extending to a minimum thickness of 30 centimetres around the pipe before backfilling of the trench with excavated or other material as per approved drawings and standards.

After the trench has been backfilled and during the clean-up works, the minor water crossing shall be cleaned at least across the whole width of the ROW.

	<p align="center">SPECIFICATION FOR PIPELINE CROSSING ROADS, RAIL AND MINOR WATERWAYS</p>	DOCUMENT NO.	REV
		11-0330G01-01-07-02-017	0
		SHEET 5 OF 7	

When specified in the CONTRACT, CONTRACTOR shall repair the ditch/river/stream bank with materials to be supplied by him as follows:

The excavation shall be backfilled with well compacted soil followed by a minimum 0.25m thick layer of properly shaped boulders (75mm to 150mm) encased in a net of galvanised iron wire of 3mm diameter spaced at a maximum distance of 50mm to be laid over the backfilled, compacted and graded banks.

7.9 The crossing of any embankments shall be carried out strictly in accordance with approved drawings.

No drilling work on embankments shall be permitted without prior written approval from the relevant Authorities.

8 CASED CROSSING

8.1 Jacking of line pipe for crossing is not allowed at any circumstances. Whenever boring is to be carried out, casing pipe shall be used.

During the execution of the boring the ground water table over the length of the boring shall be lowered up to at least 0.50m below bottom of the pipeline. This water table is to be regularly inspected and maintained by CONTRACTOR and reported to OWNER / CONSULTANT.

To safeguard the stability of the bore pit, CONTRACTOR shall, if necessary in OWNER / Consultant's opinion, use a closed sheet piling, which shall extend at least over 50% of the length in undisturbed soil. The length of casing pipe shall extend of the crossing (road, railroad, etc.), minimum 0.6m extra on either side of the crossing (Road, railroad, etc.).

In approaches to the crossing, CONTRACTOR shall eliminate unnecessary bending of pipe by conforming to the contour of the ground by gradually deepening the ditch at such approaches.

8.2 The size of casing pipe selected shall be at least 2 diameters more than the size of carrier pipe. In case of statutory requirements CONTRACTOR shall follow the mandatory statutory requirements specified by the authorities. The casing pipe material selected may be either of IS 3589 / API 5L / Gr. B / IS: 2062 Gr. B.

8.3 The bottom of the trench and/or the pit for at least twelve (12) meters at the approach to each end of a casing shall be graded and if necessary backfilled with clean sand and compacted up to at least 95% Proctor density to an elevation that will provide sufficient and continuous support to the pipeline so that the pipeline remains correctly aligned at the casing ends during and after backfilling.

8.4 The diameter of the hole for a bored section shall have a hole diameter as close as practicable to the outside diameter of the carrier or casing pipe. Equipment proper operation shall be demonstrated before the work is commenced to the satisfaction of OWNER / CONSULTANT.

Removal of soil from the pipeline during boring shall be done mechanically by means of a standard, locked augur, which has to be safeguarded against jacking ahead of the pipe. If, in the opinion of the OWNER / CONSULTANT, fluid sand may arise, an inner pipe with funnel shall be used.

During boring the progress of the pipe to be bored and the cutting capacity of the auger shall be mutually adjusted, by regulating the speed of the auger, to prevent the road from bulging (rpm too low) or cave-ins (rpm too high). In any case no more soil shall be removed than the volume of the pipe. The auger drive shall be provided with a clutch.

	<p align="center">SPECIFICATION FOR PIPELINE CROSSING ROADS, RAIL AND MINOR WATERWAYS</p>	DOCUMENT NO.	REV
		11-0330G01-01-07-02-017	0
		SHEET 6 OF 7	

During the progress of the work, the readings of the gauge pipes, the bored pressure observed, etc. shall be recorded in a logbook, to be presented to OWNER / CONSULTANT upon request. All information shall be supplied to OWNER / CONSULTANT on completion of the work.

OWNER / CONSULTANT reserve the right to inspect certain lengths of pipes to assess damages, if any, to the corrosion coating of the carrier pipe used for boring. CONTRACTOR shall weld additional lengths of pipe and pull the required extra lengths for Owner's inspection. If during inspection any defects are noticed, CONTRACTOR, in consultation with OWNER / CONSULTANT, shall carry out the remedial measures required.

- 8.5 All the execution of the work, loading/unloading of material shall be carried out within the proximity of the crossing as allotted by OWNER/Authorities. Casing must be laid with a single gradient in order to allow for an easy insertion and, if necessary at a future date, to allow for the removal or replacement of the pipeline, leaving the casing undisturbed.
- 8.6 Welding of casing and vent/drain pipes need not be radiographed, however, only normal visual inspection shall be carried out. Before welding, the single length of pipe shall be inspected in order to check that there is no out of roundness and dents. If these defects cannot be repaired, the defective section shall be cut out.
- 8.7 The assembly of vent pipe units as approved by OWNER / CONSULTANT shall be carried out by direct insertion and welding to the ends of the casing pipe before introducing the carrier pipe. The operation of assembling and extending the vent pipe shall be carried out in such a way that there is no contact with the carrier pipe. The painting/coating on the vent pipes shall be applied before backfilling as per relevant specifications/approved procedures.
- 8.8 The casing pipe shall be considered ready for installation of the carrier pipe, after careful inspection and internal cleaning with the removal of soil, mud, stones and all other foreign materials.
- 8.9 Insulators, as approved by OWNER / CONSULTANT, shall be securely fastened to the carrier pipe with all bolts and fixtures firmly tightened. The number of insulators and spacing shall be as shown in the project drawings or at 2.5 meters centre whichever is more stringent. At the end of both sides of the casing, a double set of insulators shall be installed. Casing insulators and end materials are to be conformed as per Section 9.0 of this specification.
- 8.10 Care must be taken in pushing or pulling carrier pipe into the casing so that the pipe is aligned correctly in the casing and that the pushing or pulling force is evenly and constantly applied to avoid damages to the insulators. A nose piece having a diameter equal to that of the pipe shall be welded on the front and back end of the carrier pipe to facilitate installation of the carrier pipe properly in the casing and to keep it dry and clean.
- 8.11 Petroleum Jelly / Bentonite mud filling shall be carried out between casing & carrier pipe. Contractor shall ensure that the space between carrier and casing pipe is duly filled up with Petroleum Jelly / Bentonite mud.
- 8.12 After installation of the carrier pipe section, but prior to making tie-in welds and backfilling, an electrical test shall be conducted by the CONTRACTOR in the presence of the OWNER / CONSULTANT, to determine the resistance between the casing and the carrier pipe or the carrier and the soil. These tests shall show at least a resistance of 100000-ohm m² after backfilling and compaction, additional tests shall be conducted to determine, if the casing is electrically shorted to the pipe. If the installation is found to be shorted, CONTRACTOR shall make the necessary corrections and repairs, until a test to the satisfaction of the OWNER is obtained.

9 PRE AND POST TESTING

Refer Technical Specification No. 11-0230-01-07-02-020.

	SPECIFICATION FOR PIPELINE CROSSING ROADS, RAIL AND MINOR WATERWAYS	DOCUMENT NO.	REV
		11-0330G01-01-07-02-017	0
		SHEET 7 OF 7	



GAIL (India) Limited
PIPELINE FROM HANUMAN JUNCTION TO VCL



SPECIFICATION FOR WATER CROSSING BY TRENCHING				CLIENT JOB NO.		-
				TOTAL SHEETS		10
DOCUMENT NO	11	0330G01	01	07	02	018

--	--	--	--	--	--	--

REV.	DATE	DESCRIPTION	PREP	CHKD	APPD
0	04-07-11	ISSUED FOR TENDER	MH	EUR	AD
A	07-06-11	ISSUED FOR IDC	MH	EUR	AD

CONTENTS

1	SCOPE.....	3
2	DEFINITIONS.....	3
3	REFERENCES.....	3
4	PROJECT GENERAL REQUIREMENTS	4
5	METHODOLOGY	5
6	TRENCHING	6
6.1	EXCAVATION	6
6.2	METHOD OF DISCHARGE	6
6.3	DIKES, DAMS AND WEIRS	7
7	CONTINUOUS CONCRETE COATING	7
8	HYDROSTATIC TESTING	7
9	INSTALLATION	7
10	BACK-FILLING AND BANK PROTECTION.....	8
10.1	BACK FILLING	8
10.2	BANK PROTECTION	9
10.3	GAUGING.....	9
11	FINAL HYDROSTATIC TEST	9
12	POST-CONSTRUCTION SURVEY	10
13	FINAL CLEAN-UP	10
14	DOCUMENTATION	10

	SPECIFICATION FOR WATER CROSSING BY TRENCHING	DOCUMENT NO.	REV
		11-0330G01-01-07-02-018	0
		SHEET 2 OF 10	

1 SCOPE

This specification defines the minimum technical requirements for the various activities to be performed by CONTRACTOR for the construction of pipeline at major water crossings by conventional trenching method. Provisions of this specification are applicable only for "major water crossings" specifically named as such in the CONTRACT.

CONTRACTOR shall be deemed to have inspected and examined the work area and its surroundings and to have satisfied himself so far as practicable as to the form and nature thereof, including sub-surface conditions, hydrological and climatic conditions, the extent and nature of the work and materials necessary for the completion of the work, and the means of access to the work area.

CONTRACTOR shall be deemed to have obtained the necessary information mentioned above to risks, contingencies and till other circumstances, which may influence the work.

2 DEFINITIONS

For this specification the following definitions shall apply:

OWNER	- GAIL (India) Limited
CONSULTANT	- Wood Group Kenny Pvt. Ltd.
CONTRACTOR	- The Company named as such in the deed.
SHALL/MUST/ISTO BE	- A mandatory requirement
SHOULD	- A non-mandatory requirement, advisory or recently Amended

3 REFERENCES

3.1 CODES AND STANDARDS

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

a)	ANSI B 31.8	Gas Transmissions and Distribution Piping System
b)	ANSI B 31.4	Liquid Petroleum Transportation Piping System
c)	API RP 1102	Steel Pipeline Crossing Railroads and Highways
d)	Part 192 Title 49	Transportation of Natural and other Gas by Pipeline (US Department of Transportation – Pipeline Safety Standards)
e)	Part 195	Transportation of Liquids by Pipeline (US Department of Transportation – Pipeline Safety Standards).
f)	OISD 141	Design Construction Requirements for Cross Country Hydrocarbon Pipelines

3.2 PROJECT DOCUMENTS

	SPECIFICATION FOR WATER CROSSING BY TRENCHING	DOCUMENT NO.	REV
		11-0330G01-01-07-02-018	0
		SHEET 3 OF 10	

- i) 11-0230-01-07-02-016 : Specification for onshore pipeline construction.
- ii) 11-0230-01-07-02-014 : Specification for welding of onshore pipeline for Gas Transportation

4 PROJECT GENERAL REQUIREMENTS

4.1 Before start of the construction, CONTRACTOR shall submit in triplicate to OWNER/CONSULTANT for approval for each major water crossing a complete report containing the following as minimum:

- i) Installation methodology.
- ii) Proposed time schedule, indicating start and finish dates and detailed break-up of duration for all critical activities associated with the work.
- iii) Required work area along with layout and location and other drawings / sketches
- iv) Equipment (including number and capacity of each equipment) and proposed manpower deployment during construction.
- v) Proposed sub-contractors and/or vendors along with their scope of work.

All works of the pipeline major water crossing shall be performed in accordance with the approved construction drawings, procedures, other applicable documents as per the CONTRACT, good pipeline construction practices and as directed by OWNER/CONSULTANT.

The description of the installation method as a minimum shall include the followings as applicable:

- a) Study of water currents in relation to the method of launching (on bottom and on surface).
- b) Calculations for stability of pipeline during launching and final test.
- c) Buoyancy Studies.
- d) Preparation of fabrication yard and launching areas.
- e) Pipeline construction details (including hauling, stringing, welding, NDT, concrete coating, etc.).
- f) Pre-test procedure.
- g) Procedure for anti-corrosion coating of field joint.
- h) Dredging / trenching methodology.
- i) Pulling method and related calculations/analysis.
- j) Pulling arrangement including launching and anchoring device.
- k) Trench correction before launching.
- l) Method of positioning and sinking/lowering of pipeline.
- m) Method of rectification of damages to the pipeline/coating, during launching.
- n) Method of backfilling, bank protection and survey.
- o) Final test procedure after backfilling.
- p) Safety system adopted during construction.
- q) Communication system adopted during construction / testing / survey.
- r) Abandonment and recovery procedures.

	SPECIFICATION FOR WATER CROSSING BY TRENCHING	DOCUMENT NO.	REV
		11-0330G01-01-07-02-018	0
		SHEET 4 OF 10	

Approval by OWNER / CONSULTANT of the methods used by CONTRACTOR shall in no way relieve CONTRACTOR from the sole responsibility for safe and satisfactory installation of the pipe in crossing.

4.2 OWNER's Responsibility to obtain necessary permits from the Authorities having jurisdiction, for performing the work. CONTRACTOR shall comply with all the conditions and requirements issued by authorities having jurisdiction in the area where the work is to be performed.

CONTRACTOR shall make own arrangement for temporary roads, bypasses and diversions.

4.3 Prior to start of any work, CONTRACTOR shall carry out a survey of the major water crossings and acquaint himself with site conditions and collect any data regarding the water velocity and the tidal variations, and flow pattern and shall verify the suitability of his equipment and the method of construction.

5 METHODOLOGY

This brief methodology is intended to describe the best management practices (BMPs) for mitigating environmental damage on account of natural gas pipelines crossing rivers and streams by open cut method;

Options are:

- (1) Open Cut Dry ("Isolated") Crossing
- (2) Open Cut Wet ("In-stream") Crossing
 - 1) Open Cut Dry ("Isolated") Crossing:

This method is best suited for narrow streams and crossings (widths not greater than 10.0m, and flows greater than 4cu.m/sec);

Under this method, the stream is isolated and then diverted around the pipeline crossing while a trench is excavated and the pipeline installed;

This may be done in two stages, each being approximately half of the river crossing at a time;

After isolation of the first half of the crossing, a flexible casing pipe with inside diameter larger than outside diameter of the carrier pipe is installed at the required depth of cover;

The cofferdam is then dismantled, and reinstalled on the opposite side of crossing such that it encompasses the end of the just installed carrier pipe;

The second half of crossing is excavated, and the pipeline or carrier pipe is pulled through the casing pipe to the other side of crossing;

The stream is then stabilized, and allowed to return to its bed;

- 2) Open Cut Wet Crossing:

Under this method, the stream is not diverted during construction;

The pipe is installed and backfilled while the stream continues flowing through the site;

To minimize environmental damage, it is necessary to complete construction in the shortest possible time;

	SPECIFICATION FOR WATER CROSSING BY TRENCHING	DOCUMENT NO.	REV
		11-0330G01-01-07-02-018	0
		SHEET 5 OF 10	

6 TRENCHING

6.1 Excavation

6.1.1 Contractor shall excavate the trench for the crossing in conformity with the approved drawings. The trench shall be excavated to such depth as required to provide the minimum cover and the pipeline configuration as specified. The pipeline profile of the crossing shall be followed as accurately as possible. Before laying, the trench shall be cleaned and levelled. The trench shall be subject to verification by OWNER/CONSULTANT prior to installation of the pipeline.

6.1.2 CONTRACTOR is fully responsible for the execution of the blasting, whenever permitted, the dredging and excavation work, hopping of the spoil, transportation, dumping on land or in water, all to be executed in agreement with authorities, land owners and OWNER/CONSULTANT.

6.1.3 Navigation traffic through the waterway shall not be obstructed, unless permission has been given thereto. CONTRACTOR shall issue all necessary publications according to the local regulations. Instructions given by Authorities shall be followed accurately and immediately, so that no hindrance occurs to the traffic through the waterway.

CONTRACTOR cannot request a compensation if his work is hampered or delayed due to weather conditions, any obstacles/or by any traffic on the spot, where work is executed.

6.1.4 During the execution of trenching work, the CONTRACTOR shall take bearing measurements and levels on behalf of OWNER/CONSULTANT. CONTRACTOR shall render assistance for this purpose and make available for OWNER/CONSULTANT appropriate equipment's, survey boats, and manpower before the excavation work of the water-crossing trench can be started. CONTRACTOR, if so desired by OWNER/CONSULTANT, shall make cross-profiles at intervals of not more than 10.0m of the bottom of the watercourse along the surveyed centre line of the water crossing.

Vertical measurements shall be taken with a sonic recording device and shall be taken with such accuracy that each depth is known within 0.2m. Vertical measurements shall be taken at points averaging not more than 5.0m apart and no two measurements shall be more than 7.0m apart. The cross profiles shall extend at least 10m on both sides of the top of the trench.

All measurements shall be witnessed by OWNER/CONSULTANT. The resulting profile, corrected to the elevation of the undisturbed water-course, shall be plotted on a 1:200 vertical and horizontal scale.

6.1.5 Immediately before installation of the water crossing to the excavated trench, CONTRACTOR shall prepare a profile of the trench bottom along the surveyed centre line of the water crossing for comparison with the reference profile. CONTRACTOR shall also make cross sections of the trench at intervals of not more than 25m. All profile and cross section measurements shall be taken as specified and shall be witnessed by OWNER/CONSULTANT.

The above data shall be submitted to OWNER/CONSULTANT for approval and OWNER/CONSULTANT will approve or reject the trench excavation as completed within 24 hours after receipt of the profile and cross section.

6.1.6 CONTRACTOR shall keep the trench in good condition until the pipe is pulled into position. CONTRACTOR shall do whatever is required to excavate and maintain the trench, install the pipe in it and backfill the trench in accordance with the OWNER/CONSULTANT specifications at no extra cost to OWNER/CONSULTANT.

6.2 Method of Discharge

In case CONTRACTOR uses pumping lines to discharge the spoil, he shall obtain all necessary permits for carrying out such activities.

	SPECIFICATION FOR WATER CROSSING BY TRENCHING	DOCUMENT NO.	REV
		11-0330G01-01-07-02-018	0
		SHEET 6 OF 10	

Pumping lines, discharges and siphons shall be installed by CONTRACTOR and removed before the completion of the work. All crossings with existing roads, the pumping lines shall be led through a casing pipe bored/jacked under the road or led through a porch over the road. A stress calculation must then be handed over to OWNER/CONSULTANT.

All the necessary provisions to embank the dumping area and also the spoil basins shall be made by CONTRACTOR. CONTRACTOR shall be responsible for transportation of the spoil and dumping on land and is liable for damage to works of third parties caused by leakage of pumping lines etc. CONTRACTOR shall at all time prevent overflow of pumping water, spoil or sand embankments, or roads.

CONTRACTOR shall also safeguard OWNER/CONSULTANT from claims of compensation by third parties due to encountered damage.

6.3 DIKES, DAMS AND WEIRS

CONTRACTOR shall install temporary provisions in the existing dikes, dams, etc. to prevent flooding of low areas.

As a general requirement in existing dikes, dams etc., a double substituting weir must be installed before start of excavation in the existing dike or dam. Such a double substituting weir can be a closed wall of sheet piling, supported by soil. The provisions shall be such that the underwater profile of the dredged trench, the water movement caused by ships, etc. cause no slides/cave-ins of the dike or dam.

7 CONTINUOUS CONCRETE COATING


CONTRACTOR shall provide concrete coating over the pipeline including the bends in accordance with the specification issued for the purpose and approved procedure. CONTRACTOR shall coat the weld joints in order to arrive at a continuously concrete coated pipeline. However such concrete coating on the weld joints shall be applied after the pre-hydrostatic testing.

8 HYDROSTATIC TESTING

CONTRACTOR shall carry out pre and post hydrostatic testing of the pipeline section at the crossing. Pre-Test shall be carried out at a pressure equivalent to 95% SMYS of pipe material. The pretest shall be carried out for a minimum hold period of 6 hours. After post hydro-static test the pipeline section shall be integrated with the main line for the final hydrostatic testing along mainline. The testing of the pipeline section shall be in accordance with document No. 11-0230-01-07-02-020 Specification for Hydro-testing.

9 INSTALLATION

- 9.1 CONTRACTOR shall submit a detailed methodology, which is to be adopted for installing the pipeline to OWNER/CONSULTANT for approval. CONTRACTOR shall calculate all stresses in the pipeline while laying and check whether the stresses remain within permissible limits. A set of all calculations shall be submitted to the OWNER/CONSULTANT for approval.
- 9.2 The equipment for pipe pulling shall be in good condition and the pipeline shall be laid without impact or jerking and is not subjected to stresses of any type other than those, which are allowable. Minimum allowed radius of curvature shall be followed particularly at the end of the launching way towards the water in the freely suspended section.
- 9.3 After the water-crossing section has been installed in place, CONTRACTOR shall fill this section including the pertaining land sections with water for testing.

	SPECIFICATION FOR WATER CROSSING BY TRENCHING	DOCUMENT NO.	REV
		11-0330G01-01-07-02-018	0
		SHEET 7 OF 10	

9.4 CONTRACTOR shall check if the position and cover over the pipeline at the water crossing are in accordance with the approval drawing, by means of a profile of the pipeline, before and after the water-crossing section is filled with water. CONTRACTOR shall lower each pipeline section which is not sufficiently deep either by dredging or by jetting the underlying ground.

9.5 The maximum allowed horizontal deviation from the required centre-line shall be limited by the following:

Pipe Size	Max. Deviation from center line
Diameter \leq 16"	300 mm
Diameter \geq 16"	500 mm

9.6 CONTRACTOR shall ensure that prior to backfill; the pipeline when laid in the trench shall conform to the bottom contour of the trench, so that it will be firmly, uniformly and continuously supported. CONTRACTOR shall facilitate the work of the diver and shall furnish the necessary equipment and helpers (other than actual diving equipment) necessary for the diver/inspector to perform inspection work at the bottom of the trench by OWNER/CONSULTANT

9.7 If the pipe does not properly fit inside the trench or does not rest at sufficient depth to satisfy the minimum requirements of cover as specified in approved drawings, the CONTRACTOR shall make necessary corrections either to the trench or to the pipe alignment or to both so that the pipe, when finally in position inside the trench, shall fully meet the specifications and relay the pipeline to the specification, failing which CONTRACTOR may be asked to remove the pipeline and delay the pipeline to meet the specification. This shall be done at no extra cost to the OWNER/CONSULTANT.

9.8 **INSTALLATION OF PARALLEL PIPELINES (IF APPLICABLE)**

When Parallel pipelines are required to be installed for major water crossing. CONTRACTOR shall comply with the following requirements.

9.8.1 Depending on the diameters of the parallel pipelines, the characteristics of the crossing and the limitations of CONTRACTOR'S equipment, CONTRACTOR may propose installation of the parallel pipelines either together in a combined operation or separately in a common trench.

9.8.2 If the pipelines are installed together, the minimum clear distance between the parallel pipelines (measures from the outside diameters of the concrete coated pipes) shall be 300mm. CONTRACTOR shall provide spacers at sufficient intervals along the length of the pipe section(s), securely fixed to the pipes, or shall propose other suitable alternative methods, so as to ensure that the stipulated minimum clear distance is maintained, The spacers may be removed before the trench is back-filled.

CONTRACTOR shall furnish detailed drawings for the pipe assembly showing the details of spacers/other arrangements for OWNER/CONSULTANT's approval before start of construction.

9.8.3 If the parallel pipelines are installed separately in a common trench, the minimum clear distance between the parallel pipelines in the trench shall be 3.0 m. CONTRACTOR shall ensure that this minimum spacing be maintained till the time the trench is back-filled.

10 BACK-FILLING AND BANK PROTECTION

10.1 BACK FILLING

Back-filling of the water-crossing section shall be performed as described in the following clauses:

10.1.1 The bottom of the waterway shall be reinstated to its original level by back-filling the trench in a manner and with suitable material and as prescribed and approved by the authorities and OWNER /CONSULTANT In case material other than the original spoil is required. this shall be supplied and applied by CONTRACTOR.

	SPECIFICATION FOR WATER CROSSING BY TRENCHING	DOCUMENT NO.	REV
		11-0330G01-01-07-02-018	0
		SHEET 8 OF 10	

Wherever boulders, rock, gavel and other hard objects are encountered, they shall not be placed directly on the pipe. Sufficient earth, sand or selected and approved backfill material shall be used as padding at trench bottom of 500mm thick and 500mm thick around and over the pipeline. Remaining portion of the trench will be filled with excavated or other material

Wherever required by OWNER/ CONSULTANT, CONTRACTOR shall cover the (nearly) back-filled trench with a layer of rock boulders as approved by OWNER/CONSULTANT over a width equal to the width of the excavated trench with an extra of 5m on either side at no extra cost to OWNER/CONSULTANT .

- 10.1.2 Back-filling progress of the trench shall be checked continuously, and a daily progress report shall be made and submitted to OWNER/CONSULTANT.
- 10.1.3 All embankments and/or dikes, bed and banks shall be reinstated to their original state and levels, unless otherwise prescribed in the drawings by the CONTRACTOR.
- 10.1.4 All remaining spoil deposits shall be cleaned by CONTRACTOR to the satisfaction of OWNER/CONSULTANT.

10.2 BANK PROTECTION

CONTRACTOR shall back-fill the trenches in banks of major water crossings with soil/ crushed stone approved by OWNER/CONSULTANT. The fill at the banks shall be tamped firmly and reinforced as directed by OWNER/CONSULTANT to the satisfaction of authorities having jurisdiction thereof Quality of soil and size of crushed stones shall be as approved by OWNER/CONSULTANT . After the trench has been back-filled and during the clean up works, the water crossing shall be cleaned across the whole width of ROW.

Unless stipulated otherwise by the authorities or by OWNER/CONSULTANT , CONTRACTOR shall protect the banks of the major water crossing by using gravel and boulders filled embankment mattresses of galvanized iron wire to be laid over the back-filled, compacted and graded banks. In case slope of the banks is 1 : 1 or more, bank protection shall be carried out using gabion baskets. Bank protection works shall be carried out by CONTRACTOR in accordance with the approved drawings. All materials required for such works shall be supplied by CONTRACTOR and all works carried out in accordance with approved specifications, approved drawings, instructions of OWNER/CONSULTANT and to the complete satisfaction of authorities having jurisdiction.

The width of the above protection shall be equal to the bank excavation and damage and further extending 10m on either side. The depth of the restoration on the slope shall be determined by the following levels:


- i) Base of trench
- ii) 5m shore of top of bank.

10.3 GAUGING

Before final hydrostatic testing, CONTRACTOR shall gauge the diameter of the pipeline by passing a gauging (caliper) pig through the pipeline. The gauging plate shall have a diameter equal to 95% of the internal diameter of the pipe.

11 FINAL HYDROSTATIC TEST

The complete water crossing must be tested immediately after the approved backfilling of the trench. The test procedure shall result in a hoop stress in pipe corresponding to 95% SMYS of the pipe material. After temperature stabilisation, pressure shall be retained in the pipeline for a minimum 24 hours and recorded by manothermograph. The hydrostatic testing shall be carried out in accordance

	SPECIFICATION FOR WATER CROSSING BY TRENCHING	DOCUMENT NO.	REV
		11-0330G01-01-07-02-018	0
		SHEET 9 OF 10	

with approved procedures as per specification for pipeline hydrotesting Document No. 11-0230 -01-07-02-020.

12 POST-CONSTRUCTION SURVEY

After laying of the pipeline, CONTRACTOR shall carry out a post-construction survey jointly with OWNER/CONSULTANT. CONTRACTOR shall promptly correct any defects brought to the notice of CONTRACTOR at his own expense to the complete satisfaction Of OWNER/CONSULTANT .

13 FINAL CLEAN-UP

After completion of construction, CONTRACTOR shall clear the site of all balance construction material, construction equipment, debris and all other items to the satisfaction of the OWNER/CONSULTANT.

14 DOCUMENTATION

14.1 In addition to the documents specified elsewhere in this specification, CONTRACTOR shall submit to the OWNER/CONSULTANT six copies each of the following documents/records:

- i) Records of Non Destructive Testing of Welds, Joint Coating, Lowering, Back filling, Hydro-testing and all other testing.
- ii) Clearance certificates from the landowners and authorities having jurisdiction regarding satisfactory clean up and restoration of pipeline ROU and work areas.

14.2 After completion of construction, CONTRACTOR shall prepare and furnish six sets of copies and two sets of reproducible of As-Built drawings for the crossings. As-built drawings shall be as a minimum, include the following information:

- i) True profile of the bed and banks of the water crossing along the pipeline after back--filling.
- ii) True profile of the pipeline as installed and *the* depth of cover to top of pipe at regular intervals.
- iii) Location and angle of sag bends and over bends.
- iv) Cross sections along the pipeline indicating nature and extent of backfill materials, thickness of concrete coating to pipe etc.,
- v) Method and extent of bank protection.

	SPECIFICATION FOR WATER CROSSING BY TRENCHING	DOCUMENT NO.	REV
		11-0330G01-01-07-02-018	0
		SHEET 10 OF 10	

CONTENTS

1.0 SCOPE.....3

2.0 DEFINITIONS.....3

3.0 REFERENCES3

4.0 DESIGN & ENGINEERING3

5.0 CONSTRUCTION.....5

6.0 DOCUMENTATION.....8



**SPECIFICATION FOR MAJOR WATER
CROSSING BY HORIZONTAL
DIRECTIONAL DRILLING (HDD)**

DOCUMENT NO.

REV

11-0330G01-01-07-02-019

0

SHEET 2 OF 9

1.0 SCOPE

This specification defines the minimum technical requirements for the various activities to be performed by the Contractor for the engineering and construction of pipeline at major river crossings using directional drilling technique.

2.0 DEFINITIONS

For this specification the following definitions shall apply:

OWNER/CONSULTANT	:	GAIL (India) LIMITED
CONSULTANT	:	Wood Group Kenny Pvt. Ltd.
CONTRACTOR	:	The Company named as such in the Contract.
SHALL/MUST/IS TO BE	:	A mandatory requirement.
SHOULD	:	A non-mandatory requirement, advisory or recommendation.

3.0 REFERENCES

3.1 Codes and Standards

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

- a) ANSI B 31.8 - Gas Transmission and Distribution Piping System.
- b) ANSI B 31.4 - Liquid Petroleum Transportation Piping Systems
- c) API RP 1102 - Steel pipeline crossing railroads and highways.
- d) Part 192 Title 49 - Transportation of Natural and other Gas by Pipeline (US Department Of Transportation Pipeline Safety Standards).
- e) OISD 141 - Design construction requirements for cross country hydrocarbon pipelines

3.2 Project Documents

The following project documents/specification shall be applicable for this specification.

- i) 11-0330G01-01-07-02-016 - Specification for Onshore Pipeline Construction.
- ii) 11-0330G01-01-07-02-014 - Specification for welding of Onshore pipeline for Gas Transmission

4.0 DESIGN & ENGINEERING

4.1 The minimum requirements of limits of each river crossing shall be as defined in the preliminary drawings furnished by Owner/Consultant. Contractor may change the limits slightly to suit his requirement and installation technique, with prior written approval from Owner/Consultant and authorities having jurisdiction.

4.2 Within the entire limits of crosser, as defined in the drawings, the cover to top of corrosion coated pipe shall be at least 2.5 Meters below the "specified" minimum scour level profile for the river with normal soil below river bed, and at least 1.5 meters below the "specified" minimum scour level per stile for the



**SPECIFICATION FOR MAJOR WATER
CROSSING BY HORIZONTAL
DIRECTIONAL DRILLING (HDD)**

DOCUMENT NO.

11-0330G01-01-07-02-019

REV

0

SHEET 3 OF 9

river with rock sub-strata. Contractor shall establish the scour depths in consultation with authorities having jurisdiction and the same shall be approved by the Owner/Consultant.

- 4.3 The entry and exit points of the pipeline at ground level shall not come within the limits of crossing as defined for individual crossings.
- 4.4 Contractor shall carry out calculations for determining the maximum permissible overburden on pipe, to check that the empty pipeline is safe from collapse at any point along the drilled crossing section.
- 4.5 Contractor shall submit the detailed calculations for stress analysis, overburden calculations, coating stresses etc. to Owner/Consultant for approval.

4.6 Stress Analysis

Contractor shall determine the minimum allowable elastic bend radius for pipe from the following considerations.

4.6.1 Pipeline Maximum Longitudinal Stress During Installation.

Total maximum equivalent stress in the pipeline due to tension, bending and overburden pressure down hole at any location shall not exceed 90% of the SMYS of the pipe material

Contractor shall, in order to check this requirement, evaluate the maximum tension forces to which the pipeline is subjected at any phase of its installation during the pulling operation.

4.6.2 Pipeline Maximum Equivalent Stress during service shall be governed by the requirements of ANSI B 31.8/OISD 141 as applicable.

After installation, the pipeline shall be hydrostatically tested to a pressure of 1.5 times design pressure in accordance with Specification for Hydrostatic Testing – 11-0330G01-07-02-020.

According to OISD 141 - the total of the following shall not exceed the SMYS of the pipe material.

- a) The combined stress due to expansion
- b) The longitudinal pressure stress
- c) The longitudinal bending stress due to external loads.

In addition to the above, the sum of (b) and (c) shall not exceed 75% of SMYS.

4.7 The minimum allowable radius of curvature for the pipeline shall be 1000 times the outside diameter of the pipeline.


4.8 Pipeline configuration along the support string before entry point

For each crossing, Contractor shall determine the required pipeline configuration in order to allow smooth pull in the crossing entry point and admissible stress in the supported pipeline string. Pipeline combined stress shall not exceed 90% of the specified minimum yield strength for line pipe material.

Contractor shall furnish all calculations and specify the number of required supports, description of the supports their coordinates and capacity in metric ton. Contractor shall also furnish a drawing of the launching ramp indicating the pipeline configuration.

The distance between each roller shall also be specified.

4.9 Contractor shall, based on results of design and engineering carried out by him, prepare construction drawings for each river crossing and shall submit the same for Owner/Consultant's approval,

	SPECIFICATION FOR MAJOR WATER CROSSING BY HORIZONTAL DIRECTIONAL DRILLING (HDD)	DOCUMENT NO.	REV
		11-0330G01-01-07-02-019	0
		SHEET 4 OF 9	

Construction drawings shall indicate the pipeline profile with levels furnished at sufficient intervals. Details such as, entry, exit points and angles, radius of curvature, etc. shall also be indicated. Contractor shall also calculate the total length of pipeline required as well as the maximum tension required on the pull head of the rig.

All construction works shall be carried out in accordance with the construction drawings, approved by Owner/consultant.

Before commencement of any installation works, Contractor shall furnish for Owner/consultant's approval all design calculations as specified above.

5.0 CONSTRUCTION

The method of Construction shall comply with all the conditions and requirement issued by Authorities having jurisdiction in the area where the work is to be performed.

If no public road exists, Contractor shall arrange for access to his work area at no extra cost to Owner/consultant.

Contractor shall carry out geo-technical and hydrographical survey and the same shall be submitted to Owner/consultant for review and approval.

CONTRACTOR shall use three layer Polyethylene coated pipes for execution of HDD. Spiral SAW line pipes shall not be used for HDD crossings.

5.1 Installation Procedure


Contractor shall, before commencing any work at site, submit for Owner/consultant's approval a detailed installation procedure for each river crossing.

The installation procedure as a minimum shall include the following:

- a. Project Manpower deployment at site and co-ordination office.
- b. Time schedule for construction.
- c. Details of equipment: Contractor shall furnish the complete list of all equipment to be deployed for preparation of pipe string and installation of crossing including technical characteristics and capacity of each equipment including instrumentation, monitoring and control equipment.
- d. Preparation of fabrication yard and launching areas.
- e. Pipeline string preparation (hauling, stringing, welding, etc.).
- f. Pre & Post hydrostatic test procedure.
- g. Method of installation covering all stages of construction, viz. Rig up, Pilot Hole, Back-reaming, Pulling Rig Down, Back filling, etc.
- h. Calculations for maximum pulling force on the rig.

The time schedule shall be in accordance with overall time schedule for the project.

Approval by Owner/Consultant of the methods used by Contractor shall in no way relieve Contractor from the sole responsibility for safe and satisfactory installation of the crossing.

	SPECIFICATION FOR MAJOR WATER CROSSING BY HORIZONTAL DIRECTIONAL DRILLING (HDD)	DOCUMENT NO.	REV
		11-0330G01-01-07-02-019	0
		SHEET 5 OF 9	

5.2 R.O.W. Preparation

Contractor shall arrange additional land required for pipeline string preparation, rig set-up and launching operations. Contractor shall clear and grade the length of ROW required for installation of the land portion and drilled river-crossing portion. Contractor shall do such grading on ROW as is necessary and properly to perform the pipeline construction operations, to provide access to the pipeline construction and to ensure safe construction of pipeline.

Contractor shall ensure that his construction activities shall not cause inconvenience to public nor shall there be any undue interference with the normal use of the land and watercourses.

5.3 Handling, Hauling, Storing And Stringing Of Pipes And Other Materials

Contractor shall be fully responsible for arranging and paying for storage areas. Contractor shall load, unload, transport and stock-pile the coated pipes using approved suitable means and in a manner to avoid damage to the pipe and coating. Transportation and handling of coated pipes shall also comply with requirements of API RP 5L-1.

5.4 Pipe String

Complete pipe string shall be prepared as a single string for pulling:

5.5 Lining-Up, Welding & Field Joint Completion

The lining-up, welding and field joint coating completion shall be in accordance with Specification No. 11-0330G01-01-07-02-014 and 11-0330G01-01-07-02-007

5.6 Installation

5.6.1 Installation shall be taken in accordance with approved installation procedures.

5.6.2 The lateral offset of the actual exit point of the pilot hole from the calculated and theoretical exit point shall not exceed +/- 0.5% of the length of the crossing, however the actual exit point shall not come outside the ROU limits of the pipeline.

The length tolerance shall not exceed +/- 0.5% of the crossing length, subject to the condition that the actual exit point shall be within the limits of crossing as defined in the approved drawings.

5.6.3 Back reaming shall be done separately from the pipeline pulling operation. The size of the back-reamed hole shall be adequate (approximately 1.5 times the pipeline diameter) to allow enough clearance for smooth pull-back of the pipeline.

5.6.4 Contractor shall be responsible for maintaining the drilled hole till such time the pipeline is pulled in.


5.6.5 During pulling operation, the buoyancy of the pipeline shall be controlled by suitable approved methods so as to maintain the buoyancy as close as possible to zero during pull-back in order to reduce friction forces of the pipeline in the hole.

Bentonite slurry of specified viscosity shall be pumped into the hole, preventing the wall from collapsing and protecting the pipeline coating.

5.6.6 Contractor shall provide suitable facilities to Owner/consultant's personnel to witness all stages of construction.

5.6.7 Contractor shall be responsible for the integrity of the corrosion coating and shall apply necessary approved protective coatings.

Coating inspection of the pipeline after completion of pulling operation shall be made by:

	SPECIFICATION FOR MAJOR WATER CROSSING BY HORIZONTAL DIRECTIONAL DRILLING (HDD)	DOCUMENT NO.	REV
		11-0330G01-01-07-02-019	0
		SHEET 6 OF 9	

- a) Pulling the pipe to the extent possible with normal rig set tip at the exit point;
- b) Excavating the adjacent portion tip to and including the first held joint.

The pipeline and joint coating shall be examined visually and with holiday detectors for defect. The length to be inspected shall, as a minimum, be one pipe length and one joint coating. In case damages/holidays are detected in the first pipe length/ joint, the subsequent pipe length / joint shall be exposed and coating integrity checks shall be made. If found acceptable by Owner/consultant, the first pipe length/ joint shall be repaired and/or replaced as directed by Owner/consultant. If the coating of second pipe length/ joint is also found damaged, Contractor shall propose further course of action and Owner/consultant's instructions shall be followed. All such works shall be done at no extra cost to Owner/consultant.

5.6.8 Before final hydrostatic testing, Contractor shall prove the diameter of the pipeline by passing a gauging (calliper) pig through the pipeline. The gauging pig shall have a diameter equal to 95% of the nominal internal diameter of the pipe. Contractor shall supply and install all temporary scraper launchers/ receivers and other equipment, piping and materials and consumables for the purpose.

5.6.9 Contractor shall obtain plans and full details of all existing and planned underground services from the relevant Local Authorities and shall be responsible for location and protection of the same. Contractor shall execute the work at the crossings as per guidelines of the authorities having jurisdiction and to the satisfaction of the Owner/consultant.

5.6.10 After pulling the pipeline across the drilled crossing, Contractor shall cut the extended portion of the pipeline at the entry and exit points. Thereafter, the drilled portion of the pipeline shall be cut at suitable location/depth and extended on either bank by installing a cold field bend with minimum bend radius as specified in the relevant specification and a straight pipe length of 12m, such that at the ends the top of the pipeline is minimum 1.0m below the natural ground level.

5.7 Hydrostatic Testing

5.7.1 Pre- testing

Contractor shall hydrostatically pre-test the complete pipe string of each river crossing before installation as per approved procedure.


The section of the pipeline corresponding to the river crossing shall, before installation, be subjected to hydrostatic pre-testing to a combined equivalent stress of 95% SMYS of line pipe as specified in this specification. After the temperature has been stabilized, the pressure shall be maintained in the pipeline for at least 6(six) hours and recorded by manothermograph. During the test, Contractor shall check all welds for leakage. Failure, if any, during the test shall be rectified by the Contractor to the satisfaction of Owner/consultant at no extra cost. The method adopted for pre-hydrotesting shall be in accordance with Specification.

5.7.2 Post Installation Hydrostatic Test

Post installation hydrostatic test shall be in accordance with Specification No. 11-0330G01-01-07-02-020

5.7.3 De watering-Cleaning –Drying

Once the tests have been declared satisfactory, the pipeline shall be de watered and properly cleaned and dried as per Specification No. 11-0330G01-01-07-02-021.

	SPECIFICATION FOR MAJOR WATER CROSSING BY HORIZONTAL DIRECTIONAL DRILLING (HDD)	DOCUMENT NO.	REV
		11-0330G01-01-07-02-019	0
		SHEET 7 OF 9	

5.8 Fencing

Contractor shall supply all materials and install G.I. Wire Chain link security fencing at HDD site.

5.9 Idle Time Preservation Of Pipeline

If directed by Owner/consultant, Contractor shall supply all materials and consumables including water, corrosion inhibitor and shall install all piping connections, valves, instrumentation, etc., perform all works for preservation of pipeline by pressurization with inhibitor added water. Contractor shall use approved inhibitors and shall determine the required dosages of inhibitors and pressure for idle time preservation of the pipeline for a period of maximum six months from the date of completion of construction.

Corrosion inhibitors and dosages shall be subjected to Owner/consultant's approval prior to use.

5.10 Final Clean Up

After completion of construction, Contractor shall clear the sites of all balance material and debris to the satisfaction of owner/consultant and authorities having jurisdiction.

The ground occupied during the work shall be reinstated to its original condition as quickly as possible after the completion of work.

Contractor shall take due care in disposing off inhibitor added water so that it doesn't cause any adverse affect on the surrounding environment.

5.11 Markings

The location of the pipe shall be clearly marked by suitable means: conventional yellow markers, overhead markers, sign etc.

6.0 DOCUMENTATION

6.1 In addition to the documents specified elsewhere in this specification, Contractor shall submit to the Owner/consultant six copies each of the following documents/records.


6.2 During the course of execution of the crossing contractor shall generate/compile the following data. It shall be obligatory on part of the Contractor to furnish this data to Owner/consultant for the event it is required for.

Detailed drilling log and down hole data, including but not limited to, the following:

- a) Torque and pulling/pushing force
- b) Data on drilling fluid consisting of the following:
 - i) Density.
 - ii) Type of mud and additive employed.
 - iii) Mixing, pumping & cleaning.

Wash and drill pipe data, viz.

- a) Dimension and material properties,
- b) Data on APT classification,
- c) Type of inspection previously carried out on these pipes.


	SPECIFICATION FOR MAJOR WATER CROSSING BY HORIZONTAL DIRECTIONAL DRILLING (HDD)	DOCUMENT NO.	REV
		11-0330G01-01-07-02-019	0
		SHEET 8 OF 9	

- d) Topics of the permits obtained from authorities having jurisdiction for the various works.
- e) Detail profile of the drilled hole along with the water level variations.
- f) Records of hydrostatic pre-testing and final testing
- g) Record of Non Destructive Testing of welds.
- h) Clearance certificates from the land Owner/consultant, authorities having jurisdiction regarding satisfactory clean-up and restoration of pipeline ROU and work areas.

6.3 After completion of construction, contractor shall prepare and furnish six sets of copies and two sets of reproducible of As-Built drawings for the crossings. As built drawings shall, as a minimum include the following information:

- True profile of the river bed and banks along the pipeline;
- True profile of the pipeline as installed;
- Depth of cover to top of-pipe at regular intervals;
- Location of entry and exit points and angles of entry and exit, along with lateral offset of exit point from the original pipeline alignment;
- Location and angle of field bends;
- Location of pipeline markers.

6.4 All documents shall be in English language.

	SPECIFICATION FOR MAJOR WATER CROSSING BY HORIZONTAL DIRECTIONAL DRILLING (HDD)	DOCUMENT NO.	REV
		11-0330G01-01-07-02-019	0
		SHEET 9 OF 9	



GAIL (India) Limited
PIPELINE FROM HANUMAN JUNCTION TO VCL



SPECIFICATIONS FOR PIPE LINE HYDROTESTING				CLIENT JOB NO.		-
				TOTAL SHEETS		17
DOCUMENT NO	11	0330G01	01	07	02	020

--	--	--	--	--	--	--

REV.	DATE	DESCRIPTION	PREP	CHKD	APPD
0	04-07-11	ISSUED FOR TENDER	MH	EUR	AD
A	07-06-11	ISSUED FOR IDC	MH	EUR	AD

CONTENTS

1	SCOPE.....	3
2	DEFINITIONS.....	3
3	REFERENCE DOCUMENTS AND SPECIFICATIONS.....	3
4	FUNCTIONAL REQUIREMENTS	3
5	TEST DURATION AND PRESSURE	7
6	PROCEDURES	8
7	ACCEPTANCE	10
8	TERMINATION	10
9	CALCULATIONS	11
10	TEST REPORT / DOCUMENTATION	12
11	PRECAUTIONS DURING THE TEST.....	13
TABLE 1: DIFFERENCE BETWEEN THE WATER THERMAL EXPANSION FACTOR AND THE STEEL THERMAL EXPANSION FACTOR ($^{\circ}\text{C}^{-1}$).....		14-17

	SPECIFICATIONS FOR PIPE LINE HYDROTESTING	DOCUMENT NO.	REV
		11-0330G01-01-07-02-020	0
		SHEET 2 OF 17	

1 SCOPE

- 1.1 This specification defines the minimum technical requirements for supply, works and operations to be performed by CONTRACTOR for hydrostatic testing of cross country pipelines transporting hydrocarbons in liquid or gaseous phase.

2 DEFINITIONS

For this specification the following definitions shall apply:

OWNER	- GAIL (India) Limited
CONSULTANT	- Wood Group Kenny India Pvt. Ltd
CONTRACTOR	- The Company named as such in the deed.
SHALL/MUST/ISTO BE	- A mandatory requirement
SHOULD	- A non-mandatory requirement, advisory or recently Amended

3 REFERENCE DOCUMENTS AND SPECIFICATIONS

- 3.1 Reference has been made in this specification to the latest following codes and standards:

3.2 PROJECT SPECIFICATIONS


i)	11-0330G01-01-07-02-016.	Specification for Onshore Pipeline Construction.
ii)	11-0330G01-01-07-02-017	Specification for pipeline Crossing Roads, Rail and Minor Water Ways.
iii)	11-0330G01-01-07-02-018	Specification for Water Crossing by Trenching
iv)	11-0330G01-01-07-02-019	Specification for Crossing by HDD

4 FUNCTIONAL REQUIREMENTS

- 4.1 Hydrostatic test shall be performed on the entire length of the pipeline. Hydrostatic test shall be performed in accordance with approved test diagrams for each test section. The maximum length of each test section shall not exceed 25 kilometres. The hydrostatic testing shall exclude all the facilities that are installed as a part of the scrapper station. For hydrostatic testing, temporary test headers shall be provided and the pipeline section between the headers shall be tested as per approved procedure. The test shall not commence until the pipeline has been cleaned, gauged and flooded as per this specification.

Wherever pipeline is installed through casing or by HDD, the pipe strings/sections, shall be pre-tested and post-tested. The pre/post testing requirements, test pressures and holding period shall be as per relevant specification specified in section 3.2 above. Hydrostatic test shall include all those sections, which have been previously tested i.e. rail, road and water crossing.

- 4.2 In addition to the above, for pipeline sections, which in OWNER/CONSULTANT opinion, once installed would require an inordinate amount of effort for repair in case of a leak, a provisional pre-test shall be

	SPECIFICATIONS FOR PIPE LINE HYDROTESTING	DOCUMENT NO.	REV
		11-0330G01-01-07-02-020	0
		SHEET 3 OF 17	

conducted in consultation with the OWNER/CONSULTANT. However, after installation, all such pre-tested sections shall be tested again along with the entire pipeline.

4.3 Hydrostatic testing of the mainline shall be done only after completion of all mechanical and civil works i.e., all welds have been accepted and the pipeline has been laid and backfilled according to the specifications. Further, the test shall commence only after the pipeline has been cleaned, pigged, gauged and flooded as per this specification. Contractor shall perform all works required for testing after obtaining written approval from the OWNER/CONSULTANT. All pipe work in test sections shall be adequately supported to holds loads imposed by weight of water.

4.4 Corrosion Inhibitor

If considered necessary by OWNER/CONSULTANT the CONTRACTOR shall provide corrosion inhibitor to the water to be used for hydro-testing.

Contractor (not the inhibitor manufacturer) shall get the inhibitor tested for corrosion inhibition and microbiological control efficiency from competent Govt. /PSU Laboratory. The test report shall be submitted to company for approval prior to undertaking hydro-testing works.

The dosage as recommended by Company shall only be adopted.

4.5 Contractor is to ensure that the numbers of golden welds that remain untested are a minimum. The hydrotest for the total pipeline system indicating the estimated number of subsections, which will hydro-tested, shall be part of the procedure. The consecutive test sections shall be constructed with adequate overlap and planning so that tie-in can be carried out with a single weld. If tie-in cannot be carried out with a single weld, then that length of pipe shall be pre-tested at the specified test pressure for a duration not less than three hours. All tie-in welds not subjected to pressure testing shall be welded and subjected to radio-graphical and ultrasonic inspection.

4.6 The maximum variation in altitude within the test sections shall be restricted as far as possible within 60 meters.

4.7 Contractor shall prepare a detailed test procedure and submit for OWNER/CONSULTANT's approval at least one month before the scheduled commencement of tests. The procedure shall strictly comply with the requirements of this specification. The procedure shall include all temporary materials and equipment, but not limited to the following items:

- a) A test diagram indicating all fittings, test ends, vents, valves test headers, temporary connections, instruments, thermocouples, relevant elevations and ratings. The diagram shall also indicate injection location and intake and discharge lines. The P&ID and pipeline drawings shall be marked up showing the battery limit of the test section.
- b) The hydrostatic test diagram shall also indicate pipeline wall thickness, length of test sections, specified minimum test pressure, points of maximum and minimum elevations and their relationship to the pressure at the test point.
- c) Estimated amount of test water, water sources, results of test sample, including required concentration of corrosion inhibitors and additives, procedure for inhibitor injection and control of concentration.

The test water shall be supplied by the Contractor. It must be clean not silty with a pH between 6 & 8 and non corrosive. A compulsory analysis of water shall be carried out of contractor's expense (with the exception of potable tap water).

- d) Cleaning, gauging, filling and flushing procedures, including a complete description of all proposed equipment and instruments (including spares), their location and set-up.

	SPECIFICATIONS FOR PIPE LINE HYDROTESTING	DOCUMENT NO.	REV
		11-0330G01-01-07-02-020	0
		SHEET 4 OF 17	

- e) The type and sequence of pigs and the pig tracking system for cleaning and removal of air pockets. Drawings of pigs, pig inspection procedures, including procedure to be followed in case the caliper pig to indicate damage
- f) Pressure testing procedure including a complete description of all proposed equipment and instruments (including spares), their location and set-up, and proposed system for observation and recording of data during the pressure test.
- g) Procedure for filling, pressurization and residual air volume determination.
- h) Procedure for thermal stabilization and pressure and temperature monitoring during stabilization and hold period.
- i) Theoretical pressure volume and pressure temperature curves including calculating steps.
- j) Procedure for detection and location of leaks.
- k) Procedure for depressurisation, dewatering the pipeline section after testing, including a complete description of all proposed equipment and instruments (including spares), their location and set-up, the type and sequence of pigs and the pig tracking system along with the pig specification.
- l) Formats for recording the test data, calculation sheets, pig tracking system, etc.
- m) HSE requirements during filling, hydro-testing, water disposal, use of chemicals, etc.
- n) An emergency procedure in the event of a test failure through rupture.
- o) Contingency procedure for removal of stuck pig/blocked pigs in pipeline.

4.8 EQUIPMENT AND INSTRUMENTATION

The Contractor shall furnish all necessary equipment for performing the work as stated in cleaning, flushing, filling, levelling, stabilizing and testing and dewatering procedures.

This shall include, but not be limited to the following equipment and instruments.

- 1) Sufficient number of Pigs for filling, cleaning and gauging of the following type:
 - a) Cleaning pigs with nylon/polyurethane brushes.
 - b) Four cup batching pigs
 - c) Caliper pigs with gauge plate diameter equal to 95% of the nominal inner diameter of the most heavy wall thickness pipe in the pipeline sections.
 - d) Magnetic pigging shall be carried out for total pipeline section.
- 2) Air compressors for cleaning, gauging & dewatering of minimum 3000 Nm³/h capacity 0-100 bar.
- 3) Calibration of all measuring instruments in OWNER/ CONSULTANT approved laboratory.
- 4) Fill pumps: The Contractor shall determine the type and number of fill pumps in order to guarantee the following:
 - a) Differential head 20% greater than the maximum required.

	SPECIFICATIONS FOR PIPE LINE HYDROTESTING	DOCUMENT NO.	REV
		11-0330G01-01-07-02-020	0
		SHEET 5 OF 17	

b) Flow rate : Minimum 200 m³/h
Maximum 1000 m³/h

If a single pump is used, a standby unit must be available. The stuffing boxes of the pumps must be sealed to prevent air from entering the internals of the pump.

- 5) Breakwater tanks with filters for water filling and chemical dosing.
- 6) Variable speed positive displacement pumps equipped with a stroke counter to pressurize the line with a known volume per stroke and capable of exceeding the maximum test pressure by at least 20 bar.
- 7) Two positive displacement meters and/or turbine flow meters with flow straightners to measure the volume of water used for filling the line. These meters shall be provided with a calibration certificate not older than six months. However all instruments used for measurement of volume of water added for pressurization shall have calibration certificates not older than one month.
- 8) Large diameter (6" Minimum) Bourdon Pressure gauges of suitable pressure range (1.5 x test pressure to be measured) and accuracy of $\pm 0.1\%$ of the full-scale value. These shall be calibrated at site with dead weight tester. Its calibration shall be checked at the beginning, end and during the hydrotest period. The pressure gauges shall be installed at both ends of the test section.
- 9) Pressure recording instruments with pressure sensors and 24-hour charts. These shall be calibrated against dead weight tester.
- 10) Dead weight testers with an accuracy of 0.01 bar measuring in increments and sensitivity of 0.05 bar shall be provided with a calibration certificate no older than one month. The pressure range of the dead weight tester shall be 1.5 times the hydrotest pressure.
- 11) Two temperature recorders for fill water with an accuracy of $\pm 1\%$ of full-scale range. The scale range shall be 0° to 60°C and the sensitivity shall be 0.1°C. The temperature shall be recorded throughout filling stage.
- 12) Thermocouples for measuring the pipe wall temperature with an accuracy of $\pm 0.2^\circ\text{C}$.
- 13) Ambient/Environmental temperature shall be recorded throughout hydrotest duration from the beginning of pressurization. The recorder shall have a range of 0°C to 60°C and shall have an accuracy of $\pm 1\%$ of full-scale range. Two recorders one at each end shall be used.
- 14) A barograph with an accuracy of ± 0.8 millibar and measuring increments of 1mbar.
- 15) Two laboratory thermometers (thermocouples based) of 0°C to 60°C range, with an accuracy of $\pm 0.1^\circ\text{C}$ to be used in thermo-wells. The temperature measuring instruments shall be provided with NPL calibration certificate not older than one month. These shall be used for calibration of the temperature recorders.
- 16) Portable tanks of sufficient size to provide a continuous supply of water to the pump during pressurizing.
- 17) Means to measure the volume of water necessary to drop the line pressure by 0.5 bar (container on scales or graduated cylinder). Resolution shall be 0.0005% of fill volume of the pipeline.
- 18) Injection facilities to inject additives for anti-corrosion, oxygen scavenger and bactericides into the test medium in the required proportions.
- 19) The temporary test headers shall be installed according to the testing sections fixed in the test procedure manual. Proper piping and valve arrangements shall be available to allow launching



**SPECIFICATIONS FOR PIPE LINE
HYDROTESTING**

DOCUMENT NO.

11-0330G01-01-07-02-020

SHEET 6 OF 17

REV

0

and receiving of each pig independently. The test heads, manifolds etc., shall be pre-tested for four hours at a pressure equal to 110% of maximum test pressure. The manifolds, test heads, end closures and other temporary testing equipment shall be designed as per recognized codes and shall be either flange/bolted or welded to the pipeline section.

- 20) A good and well laid out test cabin shall be located at a safe distance and shall have sufficient space to house all instruments and for recording of data.
- 21) Communication equipment suitable for a continuous connection between the beginning and the end of the test section and with the inspection team along the line, in accordance with the requirements of Local Authorities.
- 22) Thermocouples for measuring the temperature of the pipe wall shall be installed on the pipeline to be tested :
 - 1 thermocouple at about 500m distance from the pumping head.
 - 1 thermocouple every 2500m of the pipe.
 - 1 thermocouple at about 500m distance from the terminal head.

These instruments shall be installed at least 2 days before the commencement of test so that the ground temperature trend is well established.

- 23) All instruments used for measurement shall be certified for accuracy repeatability and sensitivity.
- 24) The temperature along the pipeline section shall be measured prior to start of water filling, during filling, during thermal stabilization, and during hydrotest. The recording frequency shall be in terms of every four hours or lesser based on site condition or as directed by the OWNER.
- 25) The contractor shall deploy pig-tracking system as and when required and as advised by OWNER/CONSULTANT.

In addition to above, OWNER/CONSULTANT reserves the right to demand to install more thermocouples as per site conditions.

Thermocouples shall be attached on the external surface of the pipe after removal of external coating and shall be adequately protected and OWNER/CONSULTANT coating instruction shall be followed.

- 4.9 Contractor shall carry out caliper pigging on the pipeline length (launcher to receive). Caliper pigging vendor shall be pre-qualified by OWNER/CONSULTANT. Vendor shall submit detailed procedure for intelligent pigging to OWNER/CONSULTANT for approval.

5 TEST DURATION AND PRESSURE

- 5.1 The duration of hydrostatic test shall be minimum 48 hours (24 hours for strength test & 24 hours for leak test) after stabilization and the test pressure shall be as indicated in approved hydrostatic test diagram. In addition 6 hours mechanical resistance test shall be carried out.
- 5.2 Unless otherwise specified in the Contract, Minimum test pressure shall be 1.5 times the design pressure, at the highest point of the test section. However, the maximum test pressure at the lowest point of the test section or at the section with the least wall thickness shall be limited to hoop stress resulting in 95% of SMYS.
- 5.3 Pre-testing:

	SPECIFICATIONS FOR PIPE LINE HYDROTESTING	DOCUMENT NO.	REV
		11-0330G01-01-07-02-020	0
		SHEET 7 OF 17	

Pre-testing of pipe shall be carried out of carrier pipes in case of cased crossings, pipe strings in case of HDD, pipe before concrete coating and as specified elsewhere in the tender document at a test pressure limited to hoop stress resulting in 95 % of SMYS.
The test duration shall be 6 hours shall be properly recorded.

6 PROCEDURES

The test medium shall be soft non-aggressive water. The water to be used shall be filtered, potable and free from sand or silt. The water shall be free of dissolved substances, harmful chemicals, bacteria etc., which could be harmful to the pipe or which could form internal deposits in the pipeline. The water quality shall correspond to filtration through a 50 micron filter and the average content of suspended matter shall not exceed 20g/m³. Contractor shall submit laboratory test reports of water used for testing.

CONTRACTOR shall provide OWNER/CONSULTANT approved corrosion inhibitors, oxygen scavengers and bactericides to be added to the test water as required. The Contractor shall furnish and install all temporary piping which may be necessary to connect from source of water to its pumps and manifolds/ tankages. All temporary piping shall be adequately supported during the pressure test. Pressure hoses used shall be properly armoured and shall have a safe working pressure at least equal to twice the hydrostatic test pressure. The hoses shall be anchored to prevent pipe whip and shall not be used inside the test cabin. All hoses shall be pre-tested at least for one hour at their rated working pressure.

6.1 CLEANING AND CALIPER PIGGING

Before filling operation the Contractor shall clean the pipeline by air driven pigs to remove all mill scale, rust/sand, weld debris and other metallic particles from the internal of pipe sections. The finishing touch shall be executed with pigs provided with air jet holes or nozzles to keep the internal dust in turbulence ahead of the pigs. Contractor to ensure that the cleaning pigs does not damage pipeline components and facilities. The number of pig runs shall depend upon the cleaning results and shall be determined by the OWNER/CONSULTANT Representative at site. In case of stuck/blocked pigs contractor to submit detail action plan at site for Owner's approval before proceeding with any remedial measures. Pig train speed shall be maintained between 0.5 m/sec to 1 m/sec. Progress of pig train shall be monitored. CONTRACTOR to furnish detailed procedure including placement of pig locators on the line.

During filling the pigs used shall be capable of providing positive air/water interface and minimise air entertainment. All spaces in which air could be entrapped such as valve bodies, bypass pipe work should be vented and sealed. The cleaning fluids shall remove chemical particles and organisms. The cleaning and gauging train design, number of pigs, train velocity etc., shall be based on pipeline size and gradient along pipeline route. Care should be taken in downhill pipe sections where air pressure shall be maintained to ensure that pigs do not move ahead of line fill resulting in air pocket beings trapped at the uphill. The pressure produced by downhill point of water column on the pig shall be balanced by sufficient back pressure. The fill pump discharge pressure & values shall consider this effect.

A Calliper pig shall be launched using inhibited water in order to check possible out of roundness along the pipeline. The calliper pig shall also locate right weld, faults, dents, wrinkle and feat spots. The results of the calliper pig run shall be analysed to evaluate the internal status of the pipeline.

After gauging, pipeline will be flushed with minimum 1 km of pipeline volume and water shall be filled with corrosion inhibitor by propelling minimum 2 pigs with water column of 100 meters.

6.2 THERMAL STABILISATION

After a check has been made to confirm if the pressure has attained at least 1 bar (g) on the highest section, the thermal stabilization can be started.

Thermal equilibrium between the pipeline and environment shall be checked through the thermocouples installed on the pipeline.

	SPECIFICATIONS FOR PIPE LINE HYDROTESTING	DOCUMENT NO.	REV
		11-0330G01-01-07-02-020	0
		SHEET 8 OF 17	

Temperature readings shall be taken at 4 hour intervals. Thermal stabilization shall be done for 24 hours and shall be considered to have been achieved when a difference not higher than 1°C is attained between the average values of the last two readings. OWNER/CONSULTANT shall approve thermal stabilization completion before pressurization.

6.3 PRESSURISATION

The pressurization rate shall not be more than 2 bar/min. Pressure shall be recorded by using a dead weight tester and confirmation shall be done with pressure gauge on the same header. Water volume shall also be recorded with respect to pressure.

- Each 5 bar increments up to 80% of test pressure as recorded by the dead weight tester.
- Each 2 bar increment between 80% of test pressure as recorded by the dead weight tester.
- Each 0.2 bar increments between 90% of the test pressure up to full test pressure as recorded by dead weight tester.

Pressure cycling and Air volume ratio calculations requirements:

- i) Pressurise to 50% of test pressure, hold pressure for 1 hour, and collect water for air volume calculations.
- ii) Drop pressure to static head of test section at test head.
- iii) Re-Pressurise to 75% of test pressure, hold pressure for 1 hour, and collect water for air volume calculations.
- iv) Drop pressure to static head of test section at the test head.
- v) Re-pressurise to test pressure and hold for stabilization.

6.4 AIR VOLUME CALCULATION

In order to check the presence of air in the pipeline, two separate consecutive pressures lowering of 0.5 bar shall be carried out.

For calculation of air in the pipeline the second pressure lowering shall be used, and the relevant drained water shall be accurately measured (V_1). This amount measured shall be compared to the theoretical amount (V_2) corresponding to the pressure lowering that has been carried out, by using the procedure outlined in the specification.

If no air is present in the length under test:

$$\frac{V_1}{V_2} = 1$$

The above ratio is acceptable, provided it shall not differ from 1 by more than 1.02.

If ratio is found to be above within limits, then pressurization can proceed. If not, water refilling shall be carried out by another run of batching pigs after depressurizing the pipeline.

Simultaneously contractor shall also construct a plot of pressure volume (Refer Figure.2) from the initial stage of pressurization until a definite linear relationship is obtained. The theoretical P/V plot shall also be plotted on the same graph. Once 50% of test pressure is reached, the linear curve shall be extrapolated backwards to cut the volume axis. The measured air volume and its percentage of pipeline test section volume shall be calculated. On completion of the air inclusion P/V plot, a separate P/V plot

	SPECIFICATIONS FOR PIPE LINE HYDROTESTING	DOCUMENT NO.	REV
		11-0330G01-01-07-02-020	0
		SHEET 9 OF 17	

should commence and continue until the test pressure is reached. The slopes of the actual P/V plot, and theoretical P/V plot shall be compared and all calculations and graphs shall be submitted to OWNER/CONSULTANT for information.

6.5 TESTING (Pressure Holding Test)

a) Strength Test & Leak Test

After the section has been pressurized and the air column test has given acceptable results the test pressure shall be held for a minimum of 48 hours (24 hours for strength test and 24 hours for leak test) after stabilization for 24 hours. After temperature and pressure are stabilized, (for the 24 hours leak test) the injection pump shall be disconnected and all connections at the test heads shall be checked for leakage. The pressure and temperature recorders shall then be started once again with the charts in a real time orientation for continuous recording throughout the test duration. No further pumping is permitted during the test period.

All data shall be recorded on appropriate formats attached to the hydrostatic test procedure manual. Care shall be taken that the maximum test pressures are not exceeded. If the water temperature increases resulting in increased test pressure above, maximum test pressure limits, then bleeding of water shall be done to bring the test pressure within limits. Bleed-off water shall be accurately measured and recorded.

7 ACCEPTANCE

The hydrostatic test shall be considered as positive if pressure has kept a constant value throughout the test duration, except for change due to temperature effects. Such changes shall be evaluated as described below.

The pressure change value as a function of temperature change shall be algebraically added to the pressure value as read on the meters. The methodology for calculation of pressure change due to temperature shall be as per section 10.0 of this specification. The pressure value thus adjusted shall be compared with the test and shall be considered as acceptable if the difference is less than or equal to 0.32% of test pressure. In case of doubt or if for any reason the test pressure has been reduced other than for bleed-off excess pressure, the test duration shall be extended by 24 hours.

If test section doesn't meet the above requirement, Contractor shall determine by search the location of leakage or failure. All leaks and failures within the pipe wall or weld seam shall be repaired by replacement of entire pipe or pipes in which leakage or failure occurs. In those cases, where leaks occur in circumferential welds the OWNER/CONSULTANT shall determine the method of repair. Contractor shall comply with instructions of the OWNER/CONSULTANT's Representative whether to replace a section of the line pipe that includes the line leak or whether to repair the circumferential weld. The repair shall be carried out as per specifications. Where failures occur in pipeline field bends, bends shall be replaced with same degree bends. After completion of repairs, the hydrostatic test shall be repeated as a complete cycle, as per this specification. All repairs and retesting shall be carried out at the expense of the Contractor. All work of reinstalling line pipes to replace failed pipes shall be carried out as per specifications. For OWNER/CONSULTANT verification, all failed pipes shall be stored, marked, and tagged indicating date and location of failure and pressure at which failure occurred. The failed areas shall be greased to prevent corrosive action.

8 TERMINATION

After the positive results of testing and all the data have been gathered, the test shall be terminated upon written approval given by OWNER/CONSULTANT.

	<p align="center">SPECIFICATIONS FOR PIPE LINE HYDROTESTING</p>	DOCUMENT NO.	REV
		11-0330G01-01-07-02-020	0
		SHEET 10 OF 17	

The pipeline shall be slowly depressurized at a moderate and constant rate as instructed by OWNER/CONSULTANT.

Contractor shall dispose of test water in a responsible manner to the satisfaction of the local authorities, client and contiguous property owners. There shall be minimum damage to environment and shall not result in any ground water contamination.

All thermocouples installed on the line shall be removed and coating repaired to satisfaction of the client. All piping and instrument connections shall be blanked, plugged or capped as per requirements.

9 CALCULATIONS

The theoretical water amount that is necessary for filling the section to be tested shall be obtained from the geometrical volume of the section considering the pipe tolerances.

The theoretical water amount that is necessary for pressurising the section shall be calculated by means of the following formula:

$$V_p = (0.884 r_1/t + A) \times 10^{-6} \times V_t \times \Delta P \times K$$

Where:

V_p = computed water amount required to raise by P the pressure in the section to be tested (m³)

V_t = geometrical volume of the section (m³)

P = Pressure rise (bar)

r_1 = nominal inner radius of the pipe (mm)

t = nominal pipe thickness (mm)

A = isothermal compressibility value for water at the pressurization temperature in the P range (bar⁻¹). Refer Figure.1.

K = a dimensionless coefficient that is equal to a value of 1.02 for longitudinally welded pipe, and 1.0 for seamless pipe.

The pressure change due to a water temperature change shall be calculated through the following formula:

$$\Delta P = \frac{B \times \Delta T}{\left\{ 0.884 \frac{r_1}{t} + A \right\}}$$

ΔP = Pressure change resulting from a temperature change (bar).

ΔT = Algebraic difference between water temperature at the beginning of the test and water temperature as measured at the end of the test (°C).

B = Value of the difference between the thermal expansion of water at the pressure and temperature as measured at the end of the test and that of Steel (°C). Refer Table-1.

A = Isothermal compressibility value of water as estimated at the pressure and temperature values obtained at the end of test (bar⁻¹). Refer Figure.1.

	SPECIFICATIONS FOR PIPE LINE HYDROTESTING	DOCUMENT NO.	REV
		11-0330G01-01-07-02-020	0
		SHEET 11 OF 17	

- r1 = nominal inner radius of the pipe (mm).
- t = nominal pipe thickness (mm).

10 TEST REPORT / DOCUMENTATION

A complete report signed by Contractor and the OWNER/ CONSULTANT Representative shall be submitted upon completion of the hydrostatic testing operations for each test section.

The report shall contain as minimum:

- Cleaning, flushing, filling and testing procedure used
- Schematic layout of cleaning, filling and testing facilities
- All Instruments calibration certificates
- A profile of the pipeline that shows the test sites, all instrument and injection connections.
- Pipe filing logs and records.
- Hydrotest chemicals specification, dosage, injection records specifications and certificates.
- Pig specifications
- Pigging records including details of pig runs.
- Pig inspection records including photographs of the damage
- Records of gauging pig survey and photographs
- Records of calliper pig survey and interpretation of results
- Pressurisation and stabilisation records and charts with all information specified.
- Pressure and temperature recording charts with appropriate information inscribed thereon.
- Dead weight tester logs and recordings
- Air volume calculations and plots
- Pressure – temperature change calculations
- Profiles of pipelines with elevations
- Environmental data, barometric data
- Depressurisation logs and records
- Disposal method of test water
- Records and photograph of all leaks/failure, location of failure and method of repair
- Schematic isometric drawing of test header with all auxiliaries.
- Daily log of events.

	SPECIFICATIONS FOR PIPE LINE HYDROTESTING	DOCUMENT NO.	REV
		11-0330G01-01-07-02-020	0
		SHEET 12 OF 17	

11 PRECAUTIONS DURING THE TEST

In addition to all that has been expressly described in the procedures for carrying out the test, the following requirements shall also be complied with.

- 11.1 During the hydrotest, no other activities shall be performed on or near pipeline being tested. Further, the test sections shall be kept under continuous surveillance by regular patrols during test and with continuous communication.
- 11.2 Signs stating "PIPE UNDER TEST – KEEP OFF" shall be placed where the test ends are located. Such areas shall be suitably guarded throughout the duration of the test. In case pressurizing is done from the shore end, the entire operational area shall suitably be fenced to prevent entry of unauthorized personnel. The warning sign shall also be in Local Language.
- 11.3 All personnel working on the hydrotest spread shall be instructed on the possible dangers connected with the high-pressure test operations. During the testing, operations, unauthorized personnel shall not be allowed near by the test head location. Test cabin shall be atleast 10 m away from the pipeline so that it is not affected by any pipeline failure.
- 11.4 All precautions pertaining to handling and disposal of chemicals shall be as per manufacturer's standards.
- 11.5 All pumps shall have overprotection devices set @ 5 barg above test pressure.
- 11.6 The pressure shall be reduced to a safe level of 1 barg before any work is permitted on the pipeline section.
- 11.7 All crossing areas and areas of public access should be patrolled during test.
- 11.8 Contractor to ensure that all safety precautions comply with statutory and other national/state and local regulations and shall give notice to the concerned authorities regarding the intention to carry out the test.
- 11.9 Contractor to ensure that a hydrotest organisation chart is made and all personnel are fully aware of their responsibilities and scope of work.

	SPECIFICATIONS FOR PIPE LINE HYDROTESTING	DOCUMENT NO.	REV
		11-0330G01-01-07-02-020	0
		SHEET 13 OF 17	

TABLE 1: DIFFERENCE BETWEEN THE WATER THERMAL EXPANSION FACTOR AND THE STEEL THERMAL EXPANSION FACTOR (°C⁻¹).

°C Bar	1	2	3	4	5	6	7	8
0.981	-98.62	-79.89	-61.81	-44.34	-27.47	-11.14	+4.66	+91.98
10	-95.55	-76.94	-58.99	-41.65	-24.89	-8.67	+7.02	+22.23
20	-92.15	-73.68	-55.86	-38.64	-22.01	-5.92	+9.65	+24.74
30	-88.74	-70.40	-52.72	-35.63	-19.14	-3.16	+12.29	+27.26
40	-85.32	-67.12	-49.58	-32.62	-16.24	-0.41	+14.93	+29.78
50	-81.90	-63.84	-46.43	-29.60	-13.36	+2.36	+17.57	+32.31
60	-78.47	-60.55	-43.27	-26.58	-10.46	+5.15	+20.23	+34.85
70	75.03	-57.25	-40.10	-23.54	-7.56	+7.92	+22.89	+37.39
80	-71.60	-53.96	-36.94	-20.51	-4.65	+10.70	+25.55	+39.94
90	-68.16	-50.66	-33.77	-17.47	-1.73	+13.50	+28.23	+42.50
100	-64.72	-47.35	-30.60	-14.43	+1.18	+16.29	+30.90	+45.05
110	-61.28	-44.05	-27.43	-11.38	+4.10	+19.08	+33.58	+47.61
120	-57.84	-40.74	-24.26	-8.34	+7.02	+21.88	+36.26	+50.18
130	-54.40	-37.44	-21.08	-5.29	+9.95	+24.68	+38.94	+52.75
140	-50.96	-34.13	-17.90	-2.25	+12.87	+27.49	+41.63	+55.32
150	-47.53	-30.83	59.00	+0.80	+15.79	+30.29	+44.31	+57.89
160	-44.10	-27.53	-11.56	+3.85	+18.72	+33.10	+47.00	+60.46
170	-40.67	-24.23	-8.40	+6.89	+21.64	+35.90	+49.69	+63.04
180	-37.24	-20.94	-5.23	+9.94	+24.56	+38.70	+52.37	+65.62
190	-33.83	-17.65	-2.06	+12.98	+27.48	+41.51	+55.06	+68.19
200	-30.42	-14.37	+1.09	+16.01	+30.40	+44.30	+57.75	+70.77
210	-27.02	-11.09	+4.25	+19.04	+33.31	+47.10	+60.43	+73.34
220	-23.63	-7.82	+7.40	+22.06	+36.22	+49.90	+63.12	+75.90
230	-20.24	-4.56	+10.54	+25.08	+39.13	+52.69	+65.80	+78.48
240	-16.87	-1.30	+13.67	+28.10	+42.03	+55.48	+68.48	+81.05
250	-13.58	+1.94	+16.79	+31.11	+44.92	+58.26	+71.15	+83.61
260	-10.14	+5.17	+19.90	+34.12	+47.81	+61.04	+73.81	+86.81
270	-6.80	+8.39	+23.00	+37.11	+50.69	+63.80	+76.48	+88.73
280	-3.48	+11.60	+26.11	+40.09	+53.56	+66.57	+79.14	+91.29
290	-0.17	+14.80	+29.19	+43.07	+56.43	+69.33	+81.78	+93.83
300	+3.13	+17.98	+32.27	+46.03	+59.29	+72.08	+84.83	+96.38



**SPECIFICATIONS FOR PIPE LINE
HYDROTESTING**

DOCUMENT NO.

11-0330G01-01-07-02-020

REV

0

SHEET 14 OF 17

TABLE 1: DIFFERENCE BETWEEN THE WATER THERMAL EXPANSION FACTOR AND THE STEEL THERMAL EXPANSION FACTOR (°C-1).

°C	9	10	11	12	13	14	15
0.981	+34.82	+49.22	+63.20	+76.78	+89.99	+102.83	+115.34
10	+36.97	+51.26	+65.15	+78.64	+91.75	+104.51	+116.93
20	+39.36	+53.55	+67.33	+80.71	+93.72	+106.39	+118.71
30	+41.76	+55.84	+69.51	+82.79	+95.70	+108.26	+120.49
40	+44.18	+58.14	+71.70	+84.87	+97.68	+110.14	+122.28
50	+46.60	+60.45	+73.90	+86.96	+99.68	+112.04	+124.07
60	+49.02	+62.76	+76.10	+89.07	+102.67	+113.93	+125.88
70	+51.44	+65.08	+78.32	+91.17	+103.68	+115.84	+127.69
80	+53.88	+67.40	+80.53	+83.29	+105.69	+117.76	+129.50
90	+56.32	+69.73	+82.75	+95.41	+107.70	+119.67	+131.32
100	+58.77	+72.07	+84.98	+97.53	+109.73	+121.59	+133.15
110	+61.21	+74.41	+87.22	+99.66	+111.75	+123.52	+134.98
120	+63.67	+76.74	+89.45	+101.79	+113.79	+125.46	+136.82
130	+66.12	+79.09	+91.69	+103.93	+115.83	+127.39	+138.67
140	+68.58	+81.45	+93.93	+106.07	+117.87	+129.34	+140.51
150	+71.05	+83.80	+96.18	+108.21	+119.90	+131.20	+142.37
160	+73.51	+86.15	+98.43	+110.36	+121.96	+133.74	+144.22
170	+75.97	+88.51	+100.68	+112.51	+124.91	+135.19	+146.08
180	+78.44	+90.87	+102.94	+114.66	+126.06	+137.15	+147.94
190	+80.91	+93.23	+105.19	+116.82	+128.12	+139.11	+149.81
200	+83.37	+95.59	+107.45	+118.97	+130.17	+141.07	+151.68
210	+85.84	+97.95	+109.71	+121.13	+132.24	+143.03	+153.55
220	+88.30	+100.31	+111.97	+123.29	+134.29	+144.99	+155.42
230	+90.67	+102.67	+114.23	+125.45	+136.36	+146.96	+157.30
240	+93.22	+105.03	+116.48	+127.60	+138.42	+148.93	+159.18
250	+95.69	+107.39	+118.74	+129.76	+140.48	+150.90	+161.05
260	+98.14	+109.74	+121.00	+131.92	+142.54	+152.87	+162.93
270	+100.60	+112.10	+123.25	+134.08	+144.61	+154.84	+164.81
280	+103.05	+114.44	+125.50	+136.24	+146.67	+156.84	+166.69
290	+105.50	+116.79	+127.75	+138.39	+148.73	+158.78	+168.57
300	+107.94	+119.13	+130.00	+140.54	+150.79	+160.75	+170.45



SPECIFICATIONS FOR PIPE LINE HYDROTESTING

DOCUMENT NO.

11-0330G01-01-07-02-020

REV

0

SHEET 15 OF 17

TABLE 1: DIFFERENCE BETWEEN THE WATER THERMAL EXPANSION FACTOR AND THE STEEL THERMAL EXPANSION FACTOR (°C-1).

°C Bar	16	17	18	19	20	21	22	23
0.981	+127.52	+137.41	+151.00	+162.31	+173.37	+184.18	+194.75	+205.08
10	+129.02	+140.83	+152.36	+163.58	+174.56	+185.30	+195.79	+206.07
20	+130.71	+142.42	+153.85	+165.00	+175.90	+186.55	+196.96	+207.16
30	+132.40	+144.02	+155.35	+166.42	+177.23	+187.80	+198.14	+208.26
40	+134.10	+145.62	+156.87	+167.85	+178.58	+189.07	+199.33	+209.37
50	+135.80	+147.24	+158.39	+169.29	+179.93	+190.34	+200.52	+210.49
60	+137.51	+148.86	+159.92	+170.73	+181.29	+191.62	+201.72	+211.61
70	+139.22	+150.49	+161.46	+172.18	+182.66	+192.91	+202.93	+212.74
80	+140.95	+152.11	+163.00	+173.64	+184.03	+194.20	+204.14	+213.88
90	+142.67	+153.75	+164.56	+175.10	+185.41	+195.50	+205.36	+215.03
100	+144.42	+155.40	+166.11	+176.58	+186.80	+196.80	+206.59	+216.17
110	+146.15	+157.04	+167.66	+178.05	+188.20	+198.12	+207.82	+217.33
120	+147.90	+158.70	+169.24	+179.54	+189.59	+199.44	+209.06	+218.49
130	+149.65	+160.36	+170.81	+181.02	+191.00	+200.75	+210.31	+219.66
140	+151.40	+162.03	+172.39	+182.51	+182.41	+202.09	+211.56	+220.84
150	+153.16	+163.70	+173.98	+184.00	+193.82	+203.42	+212.81	+222.02
160	+154.93	+165.37	+175.56	+185.51	+195.24	+204.76	+214.08	+223.20
170	+156.69	+167.05	+177.15	+187.02	+196.66	+206.10	+215.34	+224.39
180	+158.47	+168.73	+178.75	+188.53	+198.05	+207.45	+216.61	+225.58
190	+160.24	+170.42	+180.35	+190.05	+199.52	+208.80	+217.89	+226.79
200	+162.01	+172.10	+181.95	+191.57	+200.97	+210.16	+219.17	+227.99
210	+163.80	+173.80	+183.55	+193.09	+202.40	+211.53	+220.46	+229.20
220	+165.58	+175.49	+185.16	+194.62	+203.85	+212.89	+221.74	+230.41
230	+167.36	+177.19	+186.78	+196.14	+205.30	+214.26	+223.04	+231.63
240	+169.16	+178.89	+188.39	+197.68	+206.75	+215.63	+224.33	+232.85
250	+170.94	+180.59	+190.01	+199.21	+208.20	+217.00	+225.63	+234.08
260	+172.73	+182.30	+191.63	+200.75	+209.66	+218.40	+226.93	+235.31
270	+174.53	+184.00	+193.25	+202.29	+211.12	+219.77	+228.24	+236.54
280	+176.32	+185.70	+194.88	+203.83	+212.59	+221.16	+229.55	+237.77
290	+178.11	+187.42	+196.50	+205.37	+214.05	+222.54	+230.86	+239.01
300	+179.90	+189.13	+198.13	+206.92	+215.51	+223.93	+232.18	+240.26



**SPECIFICATIONS FOR PIPE LINE
HYDROTESTING**

DOCUMENT NO.

11-0330G01-01-07-02-020

REV

0

SHEET 16 OF 17

TABLE 1: DIFFERENCE BETWEEN THE WATER THERMAL EXPANSION FACTOR AND THE STEEL THERMAL EXPANSION FACTOR ($^{\circ}\text{C}^{-1}$).

$^{\circ}\text{C}$ Bar	24	25	26	27	28	29	30
210	+237.77	+246.18	+254.45	+262.50	+270.54	+278.39	+286.11
220	+238.91	+247.26	+255.45	+263.49	+271.40	+279.19	+286.85
230	+240.06	+248.33	+256.46	+264.43	+272.28	+280.00	+287.59
240	+241.21	+249.41	+257.46	+265.37	+273.16	+280.82	+288.35
250	+242.36	+250.49	+259.48	+266.31	+274.04	+281.63	+289.11
260	+243.52	+251.58	+259.49	+267.27	+274.92	+282.46	+289.86
270	+244.68	+252.66	+260.52	+268.23	+275.82	+283.29	+290.64
280	+245.84	+253.76	+261.54	+269.18	+276.71	+284.12	+291.40
290	+247.01	+254.86	+262.57	+270.15	+277.61	+284.95	+292.18
300	+248.18	+255.96	+263.60	+271.11	+278.51	+285.79	+292.95



**SPECIFICATIONS FOR PIPE LINE
HYDROTESTING**

DOCUMENT NO.

11-0330G01-01-07-02-020

REV

0

SHEET 17 OF 17



GAIL (India) Limited
PIPELINE FROM HANUMAN JUNCTION TO VCL



SPECIFICATIONS FOR CLEANING AND DRYING

CLIENT JOB NO.

-

TOTAL SHEETS

5

DOCUMENT NO

11

0330G01

01

07

02

021

--	--	--	--	--	--

REV.	DATE	DESCRIPTION	PREP	CHKD	APPD
0	04-07-11	ISSUED FOR TENDER	MH	EUR	AD
A	07-06-11	ISSUED FOR IDC	MH	EUR	AD

CONTENTS

1 SCOPE..... 3

2 DEFINITIONS..... 3

3 CLEANING AND DRYING 3

3.1 PIPE CONSTRUCTION..... 3

3.2 DEWATERING AND SWABBING OF PIPELINE 3

3.2.1 DRYING..... 4



SPECIFICATIONS FOR CLEANING AND DRYING

DOCUMENT NO.

REV

11-0330G01-01-07-02-021

0

SHEET 2 OF 5

1 SCOPE

This specification covers the minimum requirements to be followed by the contractor in carrying out cleaning and drying operation of pipeline after testing.

2 DEFINITIONS

For this specification the following definitions shall apply:

OWNER	- GAIL (India) Limited
CONSULTANT	- wood Group Kenny India Pvt. Ltd.
CONTRACTOR	- The Company named as such in the deed.
SHALL/MUST/ISTO BE	- A mandatory requirement
SHOULD	- A non-mandatory requirement, advisory or recently Amended

3 CLEANING AND DRYING

3.1 Pipe Construction

For pipeline construction once tests (resistance and leak test) results have been declared satisfactory, the cleaning and drying operations shall be carried out. The pipeline section to be cleaned and dried is to be sealed at the ends by means of welded testing pig traps. These end stations are equipped with instruments for permanent measurement of the temperature, pressure and dew point. After dewatering, conventional pigs and foam pigs shall be run through the pipelines as many times as necessary until internal surface is free of dirt, such as welding slags, rust, oil and dust particles.

The compressors used to draw the pigs shall have an absorption drying units with adequate dew point outlet. After having measured a constant dew point of -8°C during the last run, the pipeline is closed for at least 24 hours.

Except otherwise specified the dew point is fixed at -8°C during this time, the dew point is measured every 4 hours. If the dew point has not increased after 24 hours, the pipeline is considered dry. It is left at 0.2 bar overpressure dry air or under Nitrogen. Dew point measurements are carried out under the supervision of and in consultation with the Owner / Consultant at the other end from the drying installation. The Contractor shall only use oil – free and soundproofed compressors for supply to the drying units. When venting the pipeline sections, there shall always be a Contractors staff present and the public authorities concerned shall be informed by the Contractor.

3.2 Dewatering and Swabbing of Pipeline

Dewatering of a pipeline section shall be done to facilitate EGP / calliper pigging. During the dewatering operation, the major quantity of water shall be removed from the main pipeline.

The disposal of the water shall be performed such that no harm is done to the environment and the dewatering procedure, to be submitted by the pipeline contractor for Owner / Consultant approval, should indicate this safe disposal methodology.

The Swabbing operation shall consist of running several suitable foam pig trains using air as propellant through the pipeline. This is done by operation no of swabbing pigs so that the weight increase in pig

	SPECIFICATIONS FOR CLEANING AND DRYING	DOCUMENT NO.	REV
		11-0330G01-01-07-02-021	0
		SHEET 3 OF 5	

before & after the swabbing driving operating is not more than 25%. During swabbing operation, the residual free water content in the pipeline shall be reduced to an acceptable lower value for EGP.

It is the responsibility of the pipeline contractor to develop a suitable dewatering and swabbing procedure and submit the same for Owner / Consultant approval.

Operational Requirements

The pipeline contractor may use suitable dewatering for pipeline dewatering purpose. In such case, at least two dewatering pig runs is to be completed with air as propellant. The pipeline contractor shall provide suitable compressor for dewatering and swabbing.

Sealing pigs shall be used and will be suitable for traversing the whole length of the pipeline segment being dewatered, without damaging the internal pipe-wall.

If dewatering pigs are used, the minimum speed and the backpressure of the pigs to be maintained during dewatering operation shall be proposed by the pipeline contractor to do continuous operation and without pig getting stuck.

Upon arrival of the pigs at the receiving end, the pipeline contractor in the presence of Owner / Consultant shall remove the pigs without delay.

For swabbing, suitable foam pigs shall be used by pipeline contractor and will be suitable for traversing the whole length of the pipeline segment being swabbed. Before starting swabbing operation, the pipeline contractor has to weight the swabbing pigs and record. On arrival of the pigs at the receiving, the pipeline contractor to judge the weight gained by the swabbing shall again weight the pigs.

Acceptance Criteria

Before proceeding to the next stage of operation, the pipeline contractor shall ensure that bulk of the water has been removed from the pipeline system and swabbing is done to meet the requirement of EGP.

Note-1: After dewatering and swabbing of the main pipeline segment, other Contractor shall carry out Electronic Geometry Pigging (EGP) / calliper pigging of the pipeline.

Note-2: Ideally, EGP / calliper pigging shall be followed by commissioning activities of the pipeline. If subsequent to EGP activities, commissioning activities of the pipeline is taken up after long time delay then adequate measures should be taken to preserve the pipeline during this idle period so that internal corrosion does not occur. Suitable preservative fluid should be introduced in the pipeline and the pipeline should be kept bottled up with this preservative inside it.

3.2.1 Drying

Unless otherwise stipulated the piping shall be dried with compressed air. The compressors used for drying shall have an absorption drying units with adequate dew point outlet.

Valves shall be drained as much as possible in the half – open position under air pressure through the vent pipes under the supervision of and in consultation with the Owner / Consultant. Manipulation of the valves without the supervision of the Owner / Consultant is strictly forbidden. The blowing shall be continued until a constant dew point of -8^oC (or other dew point as per TS) is measured. Subsequently, the pipe shall be closed for 24 hours. If the dew point has not increased after 24 hours, the installation is considered dry.

- The piping to be dried must have the necessary measuring devices to measure constantly the temperature, pressure and dew point.

	SPECIFICATIONS FOR CLEANING AND DRYING	DOCUMENT NO.	REV
		11-0330G01-01-07-02-021	0
		SHEET 4 OF 5	

- The piping is considered dry if following several measurements in 24 hours and at several branches of the pipe the dew point measurements are constant and the desired value is not exceeded.

For faster drying, the Contractor may propose drying with heated Nitrogen. The temperature shall be limited to +50^oC.



SPECIFICATIONS FOR CLEANING AND DRYING

DOCUMENT NO.

REV

11-0330G01-01-07-02-021

0

SHEET 5 OF 5



GAIL (India) Limited
PIPELINE FROM HANUMAN JUNCTION TO VCL



**SPECIFICATIONS FOR PRECOMMISSIONING &
COMMISSIONING OF PIPELINE SYSTEM**

CLIENT JOB NO.

-

TOTAL SHEETS

9

DOCUMENT NO

11

0330G01

01

07

02

022

--	--	--	--	--	--	--

REV.	DATE	DESCRIPTION	PREP	CHKD	APPD
0	04-07-11	ISSUED FOR TENDER	MH	EUR	AD
A	07-06-11	ISSUED FOR IDC	MH	EUR	AD

CONTENTS

1 SCOPE..... 2

2 DEFINITION'S..... 3

3 GENERAL..... 3

4 RESPONSIBILITY OF CONTRACTOR 3

4.1 PRE-COMMISSIONING 3

4.2 COMMISSIONING..... 4

4.3 PRE-COMMISSIONING ACTIVITIES 5

4.4 COMMISSIONING RELATED ACTIVITIES 7

5 DOCUMENTATION 8

6 SPARES AND CONSUMABLES 9

7 SAFETY 9

8 OTHERS 9



**SPECIFICATIONS FOR
PRECOMMISSIONING &
COMMISSIONING OF PIPELINE
SYSTEM**

DOCUMENT NO.	REV
11-0330G01-01-07-02-022	0
SHEET 2 OF 9	

1 SCOPE

The specification covers the minimum technical requirements for testing and commissioning of entire pipeline facilities including Commissioning activities such as pre-commissioning checks, dewatering, swabbing, flushing/blowing, leak testing etc.

2 DEFINITION'S

For this specification the following definitions shall apply:

OWNER	- GAIL (India) Limited
CONSULTANT	- Wood Group Kenny Pvt Ltd.
CONTRACTOR	- The Company named as such in the deed.
SHALL/MUST/ISTO BE	- A mandatory requirement
SHOULD	- A non-mandatory requirement, advisory or recently Amended

3 GENERAL

The scope of work for testing & commissioning including Pre – Commissioning activities shall include but no limited to the manpower, machinery & equipments, detailed Procedures, Materials & Consumable, Communications etc. to perform the work satisfactorily .

Contractor shall prepare detailed procedures for piping, dewatering, swabbing, pigging & commissioning of the pipeline, covering all accepts of work for owner's approval.

Contractors shall design & supply all temporary line connections Valves, Instruments, as required during the various operations.

In the event of any details which are not fully addressed, it is warranted by Contractor that work shall be performed in accordance with the specification & the best recognised practices in the on shore pipeline industry.

4 RESPONSIBILITY OF CONTRACTOR

The pipeline contractor shall be responsible for all the pre-commissioning and commissioning activities that need to be carried out for the project.

4.1 Pre-commissioning

In order to execute and perform pre-commissioning activities, the pipeline contractor shall be responsible for (but not limited to) the following:

- Carrying out pre-commissioning checks of the pipeline system including Pig Launchers/Pig Receiver at Despatch Station/Tap-off Stations/Receipt Stations, Sectionalizing Valve (SV) Stations and their associated facilities under the scope of work to ascertain that the project has been mechanically completed in all respects.
- Checking of field instruments, laying out survey of pipeline, checking of communication system, checking of Electrical, Instrumentation system, controls & interlock etc.

	SPECIFICATIONS FOR PRECOMMISSIONING & COMMISSIONING OF PIPELINE SYSTEM	DOCUMENT NO.	REV
		11-0330G01-01-07-02-022	0
		SHEET 3 OF 9	

- Dewatering of Pipeline and above ground piping, flushing/air-blowing and leak testing of piping i.e. piping and equipments under their scope of work.
- Supply and supervision of manpower for pre-commissioning.
- Operation of machinery and equipment for pre-commissioning.
- Supply and use of materials/consumables as required for the pre-commissioning activities.
- Erection of all temporary facilities like pig launcher/receiver, line connections, spool pieces, pigs and requisite accessories, valves, instruments, manpower etc. as required during various operations.
- Preparation of detailed pre-commissioning procedures, activity schedules, bar charts, schemes etc.

This shall include preparation of detailed procedures for dewatering, electronic geometric pigging / calliper pigging (By other Contractor), idle time preservation (if applicable), removal of idle time preservers (if applicable, flushing/blowing, leak testing and shall address the sequence and methodology describing all operations, data on materials, equipments, instruments, consumables (e.g. Pigs and associated items), communication systems, necessary calculations, detailed time schedule and organization chart.

- All necessary work to perform the job successfully including all modifications that would be required at various stages.

The pipeline contractor shall demonstrate to the OWNER / CONSULTANT (for approval) the successful completion of all the above-mentioned activities.

In the event of any detail, which is not fully addressed, the pipeline contractor should warrant that work shall be performed in accordance with the relevant codes, OWNER / CONSULTANT's specifications and the best recognized engineering guidelines and practices being followed in the on-shore gas pipeline industry.

4.2 Commissioning

In order to execute and perform commissioning related activities, the pipeline contractor shall be responsible for providing all support/assistance required for commissioning under the overall guidance and supervision of OWNER / CONSULTANT. Contractor shall submit a detailed commissioning procedure for OWNER / CONSULTANT approval.

The pipeline contractor shall be also responsible to coordinate with the Composite Contractor(s), who is responsible for commissioning of the cathodic protection of the entire pipeline so that the commissioning process can proceed uninterruptedly in a harmonious manner for the entire project.

Commissioning assistance broadly covers the following activities:

- Commissioning checks including Safety Review prior to start of commissioning activities to achieve 'Ready for commissioning' status for pipeline
- Surveillance of pipeline and attending leaks and operation of SVs and metering station (at Despatch Station//Tap-Off Station/Receipt Stations, IDS whenever required.
- Supply and supervision of manpower for commissioning. Manning of SV and Tap-Off Station/Receipt Stations for pig tracking, pig receiving and other activities.

	SPECIFICATIONS FOR PRECOMMISSIONING & COMMISSIONING OF PIPELINE SYSTEM	DOCUMENT NO.	REV
		11-0330G01-01-07-02-022	0
		SHEET 4 OF 9	

- Supply and operation of machinery and equipment for commissioning, if required.
- Supply of Nitrogen and its associated accessories for purging required for carrying out commissioning.
- Supply and use of materials/consumables as required for the commissioning activities.
- Any other assistance of required by OWNER / CONSULTANT.
- Erection and supply all temporary line connections, spool pieces, strainers, valves, instruments, manpower etc. as required during various operations.
- Ensuring all communication facilities is in place and in proper working condition prior to start of commissioning activities of the pipeline system.
- Stabilization and total system operation for 72 hrs with all instruments controls & interlocks working satisfactorily at normal operating conditions. On completion of this stage one month operating run period will start.
- All necessary work to perform the job successfully including all modifications that would be required.

In the event of any detail, which is not fully addressed, contractor should warrant that work should be performed in accordance with the relevant codes, Owner's specifications and the best recognized engineering guidelines and practices being followed in the on-shore pipeline industry.

4.3 Pre-commissioning Activities

4.3.1 Pre-commissioning Checks

Pre-commissioning checks shall be carried out for the pipeline system to ascertain that the pipeline system has been mechanically completed in all respect. **These checks shall cover all the facilities of the main cross country pipeline, including Metering Stations, tap-Off Stations, Receipt Stations, Sectionalizing Valve Stations, as applicable.** The pre-commissioning checks shall include the following:

A) System Checks

The entire facilities shall be checked against the latest P&ID's, Engineering and Vendor Drawings/Documents and other design specifications. Any shortcoming observed shall be listed down in the form of punch lists and these should be duly attended or liquidated. The pipeline contractor should check the stations systems from the angle of pre-commissioning and commissioning and spell out any additional requirement of vents/drains, temporary arrangement/modification etc. that may be required during the pre-commissioning and commissioning activities and arrange for the same in consultation with the OWNER / CONSULTANT representative.

B) Checking of Field Instrument

All the field instruments like actuated valves, shutdown valves, transmitters, solenoid valves, shut down switches, alarms etc. shall be checked physically and also for their intended application by simulating the actual conditions. It will also include checking of different meters, gauges, action of actuated valves, control valves, shutdown valves etc.

	SPECIFICATIONS FOR PRECOMMISSIONING & COMMISSIONING OF PIPELINE SYSTEM	DOCUMENT NO.	REV
		11-0330G01-01-07-02-022	0
		SHEET 5 OF 9	

C) **Survey of the Pipelines**

This shall be performed to confirm that proper fittings/supports, Cathodic protection system, route markers, warning signs, fencing around SV stations, etc. have been installed along the pipeline.

D) **Checking of Communication System**

This is to check that there is proper communication with adequate back-up power to ensure uninterrupted communication.

E) **Checking of Electrical Distribution System**

This is to ensure safety and also to ensure an uninterrupted power supply during start-up and normal pipeline operation.

F) **Checking of Instrument, controls & Interlocks**

This is to check that instrument controls and interlocks are functional as per the normal operating conditions.

G) **Checking of Utilities**

This is to check that utilities like power system, etc. are available prior to start-up.

H) **Any other checks as may be considered necessary.**

4.3.2 Pre-commissioning works for the above ground piping (Dispatch Station, Metering Stations, Receipt Stations etc. under the scope of work)

4.3.2.1 Dewatering (Hydro Test Water)

General

Dewatering of a piping system shall be done subsequent to the hydro-test of the respective piping section. During the dewatering operation, the major quantity (to the maximum extent possible) of hydro-test water shall be removed from the main interconnecting piping work in the stations. A standard blind shall be arranged and provided at the inlet and outlet nozzles of pumps and sump tank to avoid entry of debris/dirt/mud etc., before start-up of pre-commissioning activities.

Operational Requirements

The dewatering operation of the piping work in the stations shall consist of physically draining the water content in the piping work by opening low point drains and/or end flanges. If required, air shall be used to push-off water from the pipes. The pipeline contractor shall arrange suitable compressor for such purposes.

Flushing/Blowing of Aboveground Piping in the Terminal

Flushing/blowing of the above ground piping with water/air to remove debris/dirt/mud from within the piping has to be performed by the pipeline contractor. Subsequent to water flushing, to ensure complete cleanliness of the piping work, air blowing/cardboard blasting method has to be adopted. All instruments, control valves, orifice plates etc. to be dismantled from the piping work and any gap produced should be bridged with suitable temporary spool. Proper supporting of the piping, during such flushing/blowing activities is to be ensured by the pipeline contractor.

	SPECIFICATIONS FOR PRECOMMISSIONING & COMMISSIONING OF PIPELINE SYSTEM	DOCUMENT NO.	REV
		11-0330G01-01-07-02-022	0
		SHEET 6 OF 9	

The pipeline contractor has to make arrangement of clean water/air for these flushing / blowing activities.

The pipeline contractor should submit a plan/methodology for carrying out such activities detailing out each aspect/step.

Acceptance Criteria

The pipeline contractor shall specify when flushing/air blowing is completed to the satisfaction of the Owner/Consultant, and shall obtain approval of the Owner/Consultant before proceeding to the next step.

4.3.2.2 Internal Cleaning of Equipment

General

Equipments like Scraper Launcher, filters, Corrosion Inhibitor Dosing Tanks, Sump Tanks and Scraper Receiver are to be checked for internal cleanliness and shall be ensured by the pipeline contractor.

Acceptance Criteria

The laying contractor has to demonstrate cleanliness of the internals of all equipment to the satisfaction of the Owner/Consultant and obtain approval for final box up of the equipment.

4.3.2.3 After dewatering / swabbing is over & all functional checks carried out as specified in pre-commissioning checks, drying of the pipeline is to be closed out with compressed air. The pipeline shall be dried to achieve a content dew point of -8°C as specified in specification No. 11-0230-01-07-02-021.

4.3.2.4 Trial Run of Rotating Equipments

The pipeline contractor has to arrange for trial run of the sump pump with water for short duration of time.

The pipeline contractor has to arrange all temporary arrangements required for such trial runs. The pipeline contractor has to submit procedure/method statement regarding how he plans to take such trial runs and take approval of the Owner/Consultant, before actually proceeding for the same. If pump vendor(s) is available for such trial run, the pipeline contractor has to provide all sorts of assistance to the vendor and help the vendor in completing the successful trial run.


4.4 Commissioning Related Activities

Safety Review Prior to Start of Commissioning Activities

A pre-start-up safety review of the cross-country pipeline system shall be arranged by the pipeline contractor, involving all concerned in the commissioning. The Owner/Consultant shall also participate in the pre-start-up safety review. The pipeline contractor shall generate all requisite formats to record the findings of such Safety Review.

Ready for Commissioning

After completion of pre-commissioning activities and Owner approved safety start-up review followed by liquidation of review punch list points, the pipeline contractor shall notify the Owner/Consultant that the pipeline systems in totality are ready in all respects for hydrocarbon-in. 'Ready for commissioning status' shall be jointly assessed by Owner/Consultant, composite work contractor, Pipeline contractor.

	SPECIFICATIONS FOR PRECOMMISSIONING & COMMISSIONING OF PIPELINE SYSTEM	DOCUMENT NO.	REV
		11-0330G01-01-07-02-022	0
		SHEET 7 OF 9	

After such joint assessment, if all the criteria are met, it will then be declared by the Owner that the entire pipeline system has reached a stage of 'Ready for Commissioning'.

It should be noted that if the actual commissioning of the stations is taken up after idle time of sufficient length, then before starting the rotating equipment again, revisioning of the rotating equipments has to be done in presence of pump vendor(s). The pipeline contractor has to provide all sorts of assistance during such revisioning activities.

4.4.1 Commissioning and Stabilization

The pipeline contractor shall be responsible for providing all necessary assistance to carry out commissioning activities under the overall guidance and supervision of Owner/Consultant for the entire pipeline system.

Commissioning of pipeline shall be considered completed when the line is charged with product natural gas at operating pressure and the total system operated at normal operating pressure for a minimum period of 72 hrs with all the instruments, controls & interlock satisfactorily at normal operating conditions. Contractor shall submit a detailed commissioning procedure for owner's approval.

5 DOCUMENTATION

The pipeline contractor shall submit the complete description, detailed procedures and time schedule for all of the following activities for approval of the Owner/Consultant.

- Pre-commissioning Checks
- Dewatering
- Swabbing
- Flushing / Blowing
- Low Pressure Leak Test with Air
- Drying
- Idle Time Preservation (if applicable), including Removal of Preservers

All these documents should be prepared covering all aspects of HSE, quality assurance and quality control plans.

The pipeline contractor shall ensure that his documents are related to "as-built" conditions of the pipeline, equipment and structures involved.

Documents shall also contain all safety plans, procedures to be followed while carrying out the activities.

Upon successful completion of the work, the pipeline contractor shall prepare a final report of the work which shall include necessary charts, diagrams, graphs, calculations, recordings, daily logs, measurements, details of the operation etc. Report shall also include all certificates of calibration of instruments required, together with records of calibration performed at site prior to the start of any operation and the approved pre-commissioning and commissioning formats and check sheets.

	SPECIFICATIONS FOR PRECOMMISSIONING & COMMISSIONING OF PIPELINE SYSTEM	DOCUMENT NO.	REV
		11-0330G01-01-07-02-022	0
		SHEET 8 OF 9	

6 SPARES AND CONSUMABLES

The pipeline contractor shall identify and arrange for supply of manpower, spares, tools, tackles and consumables as required for pre-commissioning and commissioning activities.

7 SAFETY

The pipeline contractor shall follow the safety practices during execution of pre-commissioning and commissioning works as detailed in the scope of work. The pipeline contractor shall also maintain and follow all safety practices equivalent or better than those being practiced by the industry during pre-commissioning and commissioning activities. A dedicated safety department from the pipeline contractor's side should be available for the job.

8 OTHERS

The pipeline contractor, along with his bid documents, is required to submit the following:

- Execution plan and method statement for pre-commissioning and commissioning activities.
- Past experience of pre-commissioning and commissioning activities carried out for a similar pipeline system / network.

	SPECIFICATIONS FOR PRECOMMISSIONING & COMMISSIONING OF PIPELINE SYSTEM	DOCUMENT NO.	REV
		11-0330G01-01-07-02-022	0
		SHEET 9 OF 9	



GAIL (India) Limited
PIPELINE FROM HANUMAN JUNCTION TO VCL



SPECIFICATION FOR INSPECTION AND TESTING OF PRODUCTION WELD				CLIENT JOB NO.		-
				TOTAL SHEETS		6
DOCUMENT NO	11	0330G01	01	07	02	023

--	--	--	--	--	--	--

0	04-07-11	ISSUED FOR TENDER		MH	EUR	AD
A	07-06-11	ISSUED FOR IDC		MH	EUR	AD
REV.	DATE	DESCRIPTION		PREP	CHKD	APPD

CONTENTS

1.0 PURPOSE3

2.0 DEFINITION3

3.0 GENERAL3

4.0 TESTING OF WELDED JOINTS AND ACCEPTANCE CRITERIA3

4.1 NON – DESTRUCTIVE TESTING3

4.2 OTHER TEST METHOD.....4

4.3 DESTRUCTIVE TEST5

5.0 IMPLEMENTATION OF THE NON-DESTRUCTIVE TESTS5

6.0 ANNOUNCEMENT OF TEST RESULTS5

6.1 WELDING OF TIE-INS AND REPAIRS.....5

7.0 INSPECTION OF FILMS BY CONTRACTOR6

8.0 LOCAL REPAIRS AND CUTOUT DEFECTIVE WELDS6

8.1 GENERAL6

	SPECIFICATION FOR INSPECTION AND TESTING OF PRODUCTION WELD	DOCUMENT NO.	REV
		11-0330G01-01-07-02-023	0
		SHEET 2 OF 6	

1.0 PURPOSE

This Specification defines the minimum technical requirements for the various activities to be carried out by CONTRACTOR for Inspection & Testing of Production Weld.

2.0 DEFINITION

For this specification the following definitions shall apply:

OWNER	:	GAIL (India) Limited.
CONSULTANT	:	Wood Group Kenny Pvt. Ltd.
CONTRACTOR	:	The Company names as such in the deed.
SHALL/MUST/TO BE	:	A mandatory requirement
SHOULD	:	A non-mandatory requirement, advisory or recommendation

3.0 GENERAL

Except otherwise stated by the Owner / Consultant for the number of field butt welds selected for non-destructive examination the ASME code B 31.8 shall govern.

The Consultant shall determine the non-destruction examination method applicable and their specific field application.

The Owner / Consultant shall supervise and inspect the welding activities in accordance with the provisions laid down in the Codes.

The Owner / Consultant is also exclusively responsible for its personal interventions and decisions as supervisor and inspector of the welding activities.

Except otherwise stated by the Owner and the Consultant. The inspection and testing of production welds will be carried out in accordance with the provisions of the provisions of the ASME B 31.8 code and the standard mentioned in this chapter.

4.0 TESTING OF WELDED JOINTS AND ACCEPTANCE CRITERIA

The welded joints shall be tested prior to painting or coating.

4.1 NON – DESTRUCTIVE TESTING

4.1.1 Visual Inspection

The visual inspection shall be interpreted in accordance with API 1104 with the following additional requirements:

- Arc ignition Points
 - ≤ 0.5 mm: acceptable if ground out
 - > 0.5 mm: unacceptable and cut out

	SPECIFICATION FOR INSPECTION AND TESTING OF PRODUCTION WELD	DOCUMENT NO.	REV
		11-0330G01-01-07-02-023	0
		SHEET 3 OF 6	

- Clamp Crates
 - ≤ 0.5 mm: acceptable if ground out
 - 0.5 mm – 1.5 mm: acceptable if ground out and welded according to repair procedure.
 - > 0.5 mm: unacceptable and cut out

4.1.2 Radiographic Testing

4.1.2.1 Test method and acceptance criteria

Radiographic testing with X rays or gamma rays shall be carried out in accordance with the provisions of API Std 1104.

4.1.3 Ultrasonic Testing

4.1.3.1 Test Method and Acceptance criteria

The ultrasonic testing shall be carried out in accordance with ASME V-Art. 5 and API 1104

The number of field joints welds selected for ultrasonic examination is specified by the Owner / CONSULTANT.

4.1.3.2 Scope of the Test

a) Minimum test planned

- For the stations and valves stations all welds will be inspected by ultrasound.
- Welded joints, which are welded using external clamps (e.g. tie-ins welds) shall be 100% tested by ultrasound.

b) Supplementary Tests

Further to a decision by the Owner / Consultant (for example in the event of cracks) all the welds carried out in the course of that day may be tested with ultrasound and if necessary this inspection may be extended to all welds. If these tests bring to light any defective welds, the Contractor shall carry out the repairs at his own expense.

4.2 OTHER TEST METHOD

As well as the non-destructive tests describe above, the Owner / Consultant, decide to carry out additional destructive or non-destructive tests, such as:

- Magnetic Particle Test
- Liquid Penetrant test
- Weld Sampling
- Any other destructive or non – destructive test methods

The acceptance criteria for the magnetic partial test and liquid penetrant test are defined on the basis of the following standards:

- Magnetic particle test

	SPECIFICATION FOR INSPECTION AND TESTING OF PRODUCTION WELD	DOCUMENT NO.	REV
		11-0330G01-01-07-02-023	0
		SHEET 4 OF 6	

- Method: ASME V-Art 7
- Acceptance criteria ASME VIII Div 1 – App 6 and API 1104.
- Liquid penetrant test
 - Method: ASME V-Art 6
 - Acceptance criteria ASMEVIII – Div 1 – APP 8 and API 1104

The acceptance criteria for the weld samples shall be the same as for the welding procedure qualification.

4.3 DESTRUCTIVE TEST

At least one production weld (to be checked by Owner / Consultant) will be cut out during the first week of welding production and sent for destructive testing. Other production welds (Cut-out) to be sent for destructive testing shall be chosen by Owner / Consultant. The frequency of other production weld shall be one joint / 15 km with a minimum of 50 cm of material on either side of the weld.

Contractor will not be entitled for any type of compensation for any destructive test deemed necessary by Owner/ Consultant.

The destructive testing shall be carried out in accordance with section 5.6 of API 1104. All tests shall be carried out in Owner /Consultant approved laboratory.

5.0 IMPLEMENTATION OF THE NON-DESTRUCTIVE TESTS

Radiographic tests will be carried out daily after the completion of the welding on the day's welding pipeline stretch.

No tests shall be carried out on strings, which are still being welded even if the usual deadlines are compromised as a result.

Ultrasonic tests shall in principle be carried out 24 hours after welding.

6.0 ANNOUNCEMENT OF TEST RESULTS

The NDT results shall be sent to contractor by Owner / Consultant / TPI during normal working hour in the following day as agrees with Owner.

6.1 WELDING OF TIE-INS AND REPAIRS

6.1.1 Radiographic Testing

Subject to the approval of the Owner / Consultant, in urgent cases, TPI shall inform the Contractor verbally of the provisional test results within the hour following the photograph by interpreting the wet film.

The results shall not be definitive until the dry film has been examined.

The deadline for verbal communication of the definitive results shall be twelve hours following the announcement of the results when they have been interpreted from the wet film.

6.1.2 Visual and ultrasonic Testing

The results of these tests shall be given verbally at the time of the test.

	SPECIFICATION FOR INSPECTION AND TESTING OF PRODUCTION WELD	DOCUMENT NO.	REV
		11-0330G01-01-07-02-023	0
		SHEET 5 OF 6	

Written communication of the results shall be carried out in the same way as described in clause 6.0.

7.0 INSPECTION OF FILMS BY CONTRACTOR

Before carrying out any repairs, the Contractor may inspect the relevant film himself. The film remains the property of the Owner.

8.0 LOCAL REPAIRS AND CUTOUT DEFECTIVE WELDS

8.1 GENERAL

The Contractor shall be obliged to repair welds or re-weld or cut out welds which are deemed defective by the TPI. This shall be carried out within normal working hours.

Each repair of defective weld, whether local or total, shall be carried out with two working days following the announcement of the results by TPI.

Section 10 of API1104 is applicable with the following requirements.

- All cracks other than carter cracks or star cracks (ref 9.3.10 of API 1104) shall not be repaired by welding. The cracks must be removed by cutting out the weld.
- All other defects except superficial defects detected by NDT can only be repaired by welding after approval by TPI on site.
- Superficial defects can be removed by grinding provided min. thickness of pipe is respected. After grinding, the ground area will be inspected by liquid penetrant test or magnetic particle test.
- The weld repairs shall be tested by X-rays, UT and / or MT as required by TPI at site.
- A second repair on weld is not acceptable and weld must be cut out if defects are detected in repair.
- In case of cut out of weld, & zone of at least 5 cm of the pipe material shall be removed on both side of the weld. The new bevel should be checked by penetrant test in the absence of defect.
- The cut out welds shall be preserved in the weld number for further investigation.

	SPECIFICATION FOR INSPECTION AND TESTING OF PRODUCTION WELD	DOCUMENT NO.	REV
		11-0330G01-01-07-02-023	0
		SHEET 6 OF 6	

CONTENTS

1.0	SCOPE	3
2.0	REFERENCE CODES	3
3.0	GENERAL	3
4.0	AERIAL MARKERS	4
5.0	KILOMETRE MARKERS.....	4
6.0	PIPELINE WARNING SIGN	4
7.0	ROW BOUNDARY MARKERS	4
8.0	DIRECTION MARKERS	4
9.0	NAVIGABLE WATERWAY PIPELINE CROSSING WARNING SIGN	5

	SPECIFICATION FOR PIPELINE MARKERS	DOCUMENT NO.	REV
		11-0330G01-01-07-02-024	0
		SHEET 2 OF 5	

REFERENCE DRAWINGS:-

Wood Group Kenny Standard Drawing

- 1-07-010 : PIPELINE WARNING SIGN
- 1-07-011 : DIRECTION MARKER
- 1-07-013 : K.M. POST
- 1-07-015 : AERIAL MARKER
- 1-07-016 : NAVIGABLE WATERWAY PIPELINE CROSSING WARNING SIGN
- 1-07-017 : TYPICAL ROW BOUNDARYMARKER

1.0 SCOPE

- 1.1 This specification covers the minimum requirements for supply, fabrication and erection of pipeline markers to be installed by CONTRACTOR at various locations along the route of a cross-country pipeline.
- 1.2 This specification shall be read in conjunction with the conditions of all specifications and documents included in the CONTRACT between COMPANY and CONTRACTOR.

2.0 REFERENCE CODES

Reference has been made in this specification to the latest revision of the following code:

API RP 1109 : Recommended practice for marking liquid petroleum pipeline facilities.

3.0 GENERAL

- 3.1 CONTRACTOR shall supply, fabricate and install the pipeline markers along the pipeline route as per Wood Group Kenny standard drawings. The locations of markers as indicated in the approved drawings shall be treated for guidance purposes only and the exact location of the markers shall be based on AS BUILT drainage and as directed by COMPANY.
- 3.2 The pipeline markers shall be fabricated and installed in accordance with the Wood group Kenny standard drawings included herein. Before start of fabrication of the markers, CONTRACTOR shall prepare and submit for COMPANY'S approval the detailed scheme for the marker plates as applicable for the project.
- 3.3 The pipeline markers shall be installed, as far as possible, at locations such that they do not cause any hindrance to the regular use of the land or to the traffic.

	SPECIFICATION FOR PIPELINE MARKERS	DOCUMENT NO.	REV
		11-0330G01-01-07-02-024	0
		SHEET 3 OF 5	

4.0 AERIAL MARKERS

Aerial markers shall in general be installed along the pipeline at every five (5) kilometres intervals and at places specified by COMPANY. Refer Wood Group Kenny Standard Drawing No. 1-07-015 for details.

5.0 KILOMETRE MARKERS

Kilometre markers shall in general be installed along the pipeline between the aerial markers at every one (1) kilometre interval. Markers shall indicate cumulative chainage in kilometres from the reference station, as directed by COMPANY. A kilometre marker is not required if the relative length between its location and any pipeline warning sign is less than 200 metres. Refer Wood Group Kenny Standard Drawing No. 1-07-013 for details.

6.0 PIPELINE WARNING SIGN

Pipeline Warning Sign shall in general be installed at

- National, State Highway & Other Road Crossings(above 15m width) : 2 Nos. Min.
- Other Road Crossings (less than 15m width) : 1 No. Min.
- Railway Crossings : 2 Nos. Min.
- Water Crossings (less than 15m width) : 1 No. Min.
- Water Crossings (above 15m width) : 2 Nos. Min.
- SV Stations & TOP Station : 1 No. Min.
- And at any other location of importance as observed by Owner /Owner's Representative during construction.


Pipeline Warning Sign shall identify the existence of the pipeline and display the name of the COMPANY, with an emergency telephone number, as shown in Wood Group Kenny Standard Drawing No. 1-07-010 for details.

7.0 ROW BOUNDARY MARKERS

Right-of-Way boundary markers shall be fabricated and installed as per the drawings at every 250 metres interval along the entire pipeline route. These shall be installed on either side of the pipeline route to define the ROW boundary limits. These shall also be installed at pipeline turning points to maintain the continuity of the ROW limits. Refer Wood Group Kenny Standard Drawing No. 1-07-017 for details.

8.0 DIRECTION MARKERS

Direction markers as shown in Wood Group Kenny Standard Drawing No. 1-07-011 shall be installed to identify the significant turning points of the pipeline during serial traverse. One direction marker shall be installed at each turning point along the pipeline alignment. Two more directional markers shall be installed along the Pipeline alignment on either side of the Turning Point at 200 m from Turning Point of the pipeline route.

	SPECIFICATION FOR PIPELINE MARKERS	DOCUMENT NO.	REV
		11-0330G01-01-07-02-024	0
		SHEET 4 OF 5	

9.0 NAVIGABLE WATERWAY PIPELINE CROSSING WARNING SIGN

The Navigable Waterway Pipeline Crossing Warning Sign shall be fabricated in accordance with Wood Group Kenny Standard Drawing No. 1-07-016 Such Warning Sign shall be installed one on each bank of navigable water courses at the pipeline crossing location, in lieu of the Pipeline Warning Sign described in clause 6.0 of this specification.

	SPECIFICATION FOR PIPELINE MARKERS	DOCUMENT NO.	REV
		11-0330G01-01-07-02-024	0
		SHEET 5 OF 5	



GAIL (India) Limited
PIPELINE FROM HANUMAN JUNCTION TO VCL



SPECIFICATION FOR CONTROLLED ROCK BLASTING

CLIENT JOB NO.

-

TOTAL SHEETS

9

DOCUMENT NO

11

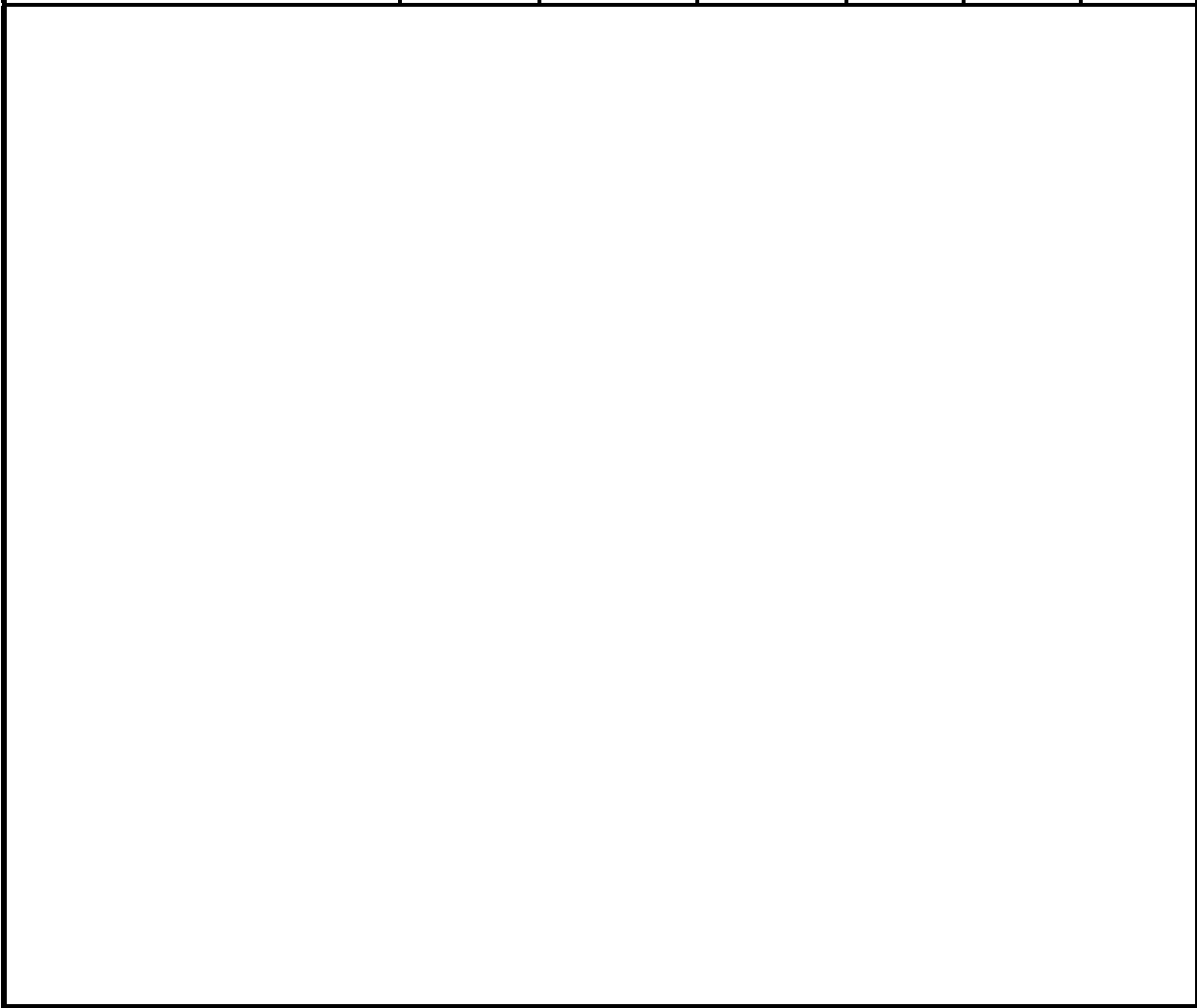
0330G01

01

07

02

025



REV.	DATE	DESCRIPTION	PREP	CHKD	APPD
0	04-07-11	ISSUED FOR TENDER	MH	EUR	AD
A	07-06-11	ISSUED FOR IDC	MH	EUR	AD

CONTENTS

1.0	SCOPE	3
2.0	REFERENCE DOCUMENTS.....	3
3.0	GENERAL	3
4.0	MATERIALS.....	4
5.0	PERSONNEL	5
6.0	STORAGE OF EXPLOSIVES.....	5
7.0	PREPARATION OF EXPLOSIVES	6
8.0	PREPARATION OF PRIMERS.....	7
9.0	CHARGING OF HOLES	7
10.0	ELECTRICAL FIRING	8
11.0	VIBRATION RECORDING	8
12.0	MISFIRES.....	8
13.0	DISPOSAL OF DETERIORATED EXPLOSIVES	9

	SPECIFICATION FOR CONTROLLED ROCK BLASTING	DOCUMENT NO.	REV
		11-0330G01-01-07-02-025	0
		SHEET 2 OF 9	

1.0 SCOPE

- 1.1 This specification covers the minimum requirements for materials, personnel, transportation, storage and use of explosives for grading of Right of Use (ROU) and excavation of trenches for the burial of pipelines in rocky terrain.
- 1.2 This specification does not cover the construction or operation of permanent magazines.

2.0 REFERENCE DOCUMENTS

- 2.1 The following National and International regulations and codes shall be used:

BS 5607 : Safe use of Explosives in the Construction Industry

NFPA-495 : Manufacture, Transportation, Storage & Usage of Explosive Materials.

IS 4081 : Safety Code for Blasting and related drilling operations

Applicable Safety Rules of CCE, Nagpur

2.2 DEFINITIONS

For this specification the following definitions shall apply:

OWNER - GAIL (India) Limited

CONSULTANT - Wood Group Kenny Pvt. Ltd.

CONTRACTOR - The Company named as such in the deed.

SHALL/MUST/ISTO BE - A mandatory requirement

SHOULD - A non-mandatory requirement, advisory or recently Amended

3.0 GENERAL

- 3.1 The CONTRACTOR shall acquaint himself and comply with all the applicable local laws and regulations concerning storing, handling and the use of explosives. All such laws, regulations and rules etc., as enforced from time to time shall be binding upon CONTRACTOR. National/Local Laws and regulation shall take precedence over this specification in the event of conflict. All conflicts shall be brought to the notice of the OWNER.
- 3.2 The requirements stated herein however in no way relieve the CONTRACTOR of his responsibility of carrying out safe blasting operations and shall be solely responsible for damages and claims thereof.
- 3.3 The use of explosives requires an approval from the Chief Controller of Explosives and/or his authorized Inspector. It shall be the responsibility of the CONTRACTOR to obtain all such permits and observe all requirements regarding the safe storage, handling and use of explosives. All expenses incurred in this regard shall be to CONTRACTOR's account.
- 3.4 Contractor shall inform the OWNER in writing at least four(4) weeks prior to planned use of explosives.

	SPECIFICATION FOR CONTROLLED ROCK BLASTING	DOCUMENT NO.	REV
		11-0330G01-01-07-02-025	0
		SHEET 3 OF 9	

- 3.5 Contractor shall notify the OWNER prior to any blasting in the proximity of overhead power lines, roads, communication lines, pipelines, utility services or other services and structures above and below ground. Before, starting blasting operations, local authorities and owners of utilities shall be consulted to check on the presence of services which could be damaged and their approval obtained to undertake blasting operations. The distances to nearest structures(houses, offices, factories) or service shall also be taken into consideration when planning blasts so that ground vibration and air-over pressure is kept within acceptable levels as given in section 11.0 of this specification.
- 3.6 CONTRACTOR shall prepare an Explosives Handling and usage Procedure for the information of the OWNER which shall incorporate the following:
- Detailed procedure and calculations
 - Nature of blasting operations, including hole diameter, depth and presence of cavities.
 - Rock characteristics.
 - Type of explosives.
 - Temperature likely to be encountered in use.
- 3.7 Unless specified otherwise, blasting shall not be allowed within 20 m of any above ground or underground structure, Pipelines or other facilities. However, in case it is necessary to carry out blasting operation within 20m from any under ground or above ground structures, Pipelines or other facilities, the blasting may be allowed, at discretion of Owner, subjected to the following:
- a) Minimum clear distance from the facility is 5 m.
 - b) Contractor Demonstrates the blasting technique proposed by him doesn't result in any damage to existing facility. (Contractor shall carry out mock demonstration as per the direction of the Owner/Consultant for this purpose).
 - c) Contractor fulfils the condition laid out by the Owner of existing facilities.
 - d) Contractor fulfils the requirement laid out by the National / Local Laws and Regulations and other statutory / regulatory Authorities.

In case of presence of overhead power lines/cables, specific approval shall be obtained by Contractor from the concerned Authorities having jurisdiction over it.

4.0 MATERIALS

All materials such as explosives, detonators, fuses, tamping materials etc. that are proposed to be used by the CONTRACTOR in blasting operations, shall be as Approved for use in the Country.

- 4.2 All electric detonators used in the blast shall be of the same electrical sensitivity and be produced/procured from the same manufacturer.
- 4.3 The detonators used shall be capable of giving effective blasting of the explosives. Damaged explosive materials shall be destroyed by a responsible person as per manufacturer's instructions or returned to the manufacturer.
- 4.4 No explosive material shall be abandoned.
- 4.5 All blasting materials and testing equipment shall be regularly tested for correct performance. The intervals between tests shall be decided after consideration of the local factors, but tests shall always

	SPECIFICATION FOR CONTROLLED ROCK BLASTING	DOCUMENT NO.	REV
		11-0330G01-01-07-02-025	0
		SHEET 4 OF 9	

be carried out if the blasting materials and/or test equipment have been subjected to abnormal conditions, or following misfires. Guidelines/recommendations of the manufacturer shall be adhered to.

4.6 All packaging and other waste materials gathered together during blasting operation shall be burnt after the blast has been fired. The burning site shall be chosen at a safe distance with due respect to prevailing wind strength and direction, at least 100 meters from explosives stores and other premises. A minimum of two fire extinguishers shall be on hand during burning activities.

5.0 PERSONNEL

5.1 Excavation by blasting will be permitted only under personal supervision of competent and licensed persons and by trained workmen.

5.2 The storage of explosives shall be in the charge of a person approved by the OWNER. OWNER may, if necessary, ask police inquiries being made as to his reliability, antecedents etc.

6.0 STORAGE OF EXPLOSIVES

6.1 The CONTRACTOR shall build a magazine for storing the explosives. The site of the magazine, its capacity and design shall be subject to approval by the OWNER and the Inspector of Explosives before the fabrication is taken up. As a rule the explosives should be stored in a clean, dry, well ventilated, bullet proof and fire proof building, at an isolated site. Adequate security shall be provided to ensure no unauthorized entry into the magazine. A notice shall be hung next to magazine entrance prohibiting entry of unauthorized persons.

6.2 CONTRACTOR shall comply with National/Local Regulations and specifications for truck mounted mobile explosives store. Mobile stores shall only carry ONE DAY's Explosives requirements and shall be parked overnight inside the compound at the authorized magazine.

6.3 All safety precautions and necessary equipment for maintenance, operation of mobile stores, as required by local authorities or regulatory bodies shall also be installed/provided on the Mobile Store.

6.4 A careful and day-to-day account of all explosives shall be kept by the CONTRACTOR in a register and in an approved manner. The register shall be produced by the CONTRACTOR, for the inspection of the OWNER / Inspector of Explosives when so required by the later. Any loss, damage or theft shall be reported immediately to the necessary local authorities and to the OWNER.

6.5 The magazine shall on no account be opened during or on the approach of a thunderstorm and no person shall remain in the vicinity of the magazine during such period.

6.6 Magazine-shoes without nails shall, at all times, be kept in the magazine, and a wood-tub or cement trough, filled with water shall be fixed near the door of the magazine.

6.7 Persons entering the magazine must put on the magazine-shoes.

- I) Not to put their feet on the clean floor unless they have magazine-shoes on.
- II) Not to allow the magazine-shoes to touch the ground outside the clean floor.
- III) Not to allow any dirt or grit to fall on the clean floor.

6.8 No matches or inflammable material shall be allowed in the magazine. Light shall be obtained from an electric storage battery lamp.

	SPECIFICATION FOR CONTROLLED ROCK BLASTING	DOCUMENT NO.	REV
		11-0330G01-01-07-02-025	0
		SHEET 5 OF 9	

- 6.9 No person having articles of steel or iron on him shall be allowed to enter the magazine. No tools or implements other than those of copper, brass, gun metal or wood shall be allowed inside the magazine.
- Oily cotton, rags, wastes and articles liable to spontaneous ignition, shall not be allowed inside the magazine.
- 6.10 Boxes of explosives shall not be thrown down or dragged along the floor and shall be stacked on wooden trestles. Open boxes of explosives shall never be exposed to the direct rays of the sun. Empty boxes or loose packing materials shall not be kept inside the magazine.
- 6.11 The magazine shall have a lightning conductor, which shall be got tested at least periodically, by an officer authorized by the OWNER, the testing fee shall be to the CONTRACTOR's account.
- 6.12 The magazine shall be inspected periodically by an officer representing the OWNER, who will see that all the rules are strictly complied with. He will notify all omissions etc. to the CONTRACTOR, who shall rectify the defects within a period of 3 days from the date of receipt of the notice, failing which the OWNER may take whatever actions it considers suitable.

7.0 PREPARATION OF EXPLOSIVES

7.1 CONTRACTOR shall submit the following procedure for INFORMATION of the OWNER as a minimum.

- Loading of explosives
- Drilling of new holes and extending existing holes
- Handling of explosives at site
- Tamping explosives into holes
- Machines, tools and cables required
- Initiation of blasting
- Safety of personnel
- Vibration control
- Blast pattern and shot size establishment
- Misfires
- Emergency procedures

7.2 Trial blasts in conjunction with vibration recording shall be carried out for each rock and trench type, in order to assess rock breakability and vibration levels. These trial blasts shall be carried out prior to actual trench blasting of the pipeline route. CONTRACTOR shall conduct trial digs as directed by OWNER in order to check suitability of the blasting pattern and to measure vibration levels to ensure vibration levels are below the allowable maximum.

7.3 "Weight per Distance Tables" shall be drawn up from these trials.

7.4 The detonators shall never be forced into the primer cartridge. It shall be inserted in a hole made by a wooden, copper, brass or aluminum pricker. The detonator shall be firmly embedded in the primer so that it is not pulled out of place during loading.

	SPECIFICATION FOR CONTROLLED ROCK BLASTING	DOCUMENT NO.	REV
		11-0330G01-01-07-02-025	0
		SHEET 6 OF 9	

- 7.5 Detonators shall be activated electrically. In proximity of electric over-head power lines, CONTRACTOR may use non-electric system with the approval of OWNER. Fly rock shall be minimized by the use of approved blast mats and by careful selection of shot size and drill hole configuration.
- 7.6 Use of explosives is prohibited in areas exposed to flammable gasses or dust.
- 7.7 Explosive and detonators shall be carried in separate boxes, tightly closed, and transported separately. For the conveyance of primers special containers shall be used.
- 7.8 Explosives shall be stored and used chronologically to ensure that the ones received earlier are being used first.
- 7.9 A make-up house shall be provided at each working place in which cartridges shall be made up by experienced men as required. The make-up house shall be separated from other buildings. Only electric storage battery lamps shall be used in this house.
- 7.10 No smoking shall be allowed in the make-up house.

8.0 PREPARATION OF PRIMERS

The primers shall not be prepared near open flames or fires. The work of preparation of primers shall always be entrusted to the qualified and approved personnel. Primers shall be used as soon as possible after they are ready.

9.0 CHARGING OF HOLES

- 9.1 The work of charging shall not commence before all the drilling work at the site is completed and the OWNER has satisfied itself to that effect by actual inspection.
- 9.2 The lead wires shall be kept away from conductors or sources of stray current. While charging, open lamps/flames shall be kept away.
- 9.3 Only wooden tamping rods without any kind of metal on them shall be used.
- 9.4 Only one cartridge shall be inserted at a time and gently inserted to the required depth with the tamping rod. The sand, clay or other tamping material used for filling the hole completely shall not be tamped too hard.
- 9.5 Blasting shall not take place after sunset or before sunrise unless specific approval is first obtained by CONTRACTOR from local authorities and the OWNER.
- 9.6 The site of blasting operations shall be prominently demarcated by red danger flags. The order of fire shall be given only by the supervisor-in-charge of the work and this order shall be given only after giving the warning signal three times, so as to enable all the labour, watchmen etc. to reach safe shelter and after having ascertained that nobody is within the danger zone.
- 9.7 A buegle with a distinctive note shall be used to give the warning signals. The buegle shall not be used for any other purpose. All the labour shall be made acquainted with the sound of the buegle and shall be strictly warned to leave their work immediately at the first warning signal and to take safe shelters, and not to leave the shelters until the all clear signals have been given.
- 9.8 All the roads and foot-paths leading to the blasting area shall be watched.

	SPECIFICATION FOR CONTROLLED ROCK BLASTING	DOCUMENT NO.	REV
		11-0330G01-01-07-02-025	0
		SHEET 7 OF 9	

10.0 ELECTRICAL FIRING

- 10.1 Only the Supervisor-in-charge shall keep the key of the firing apparatus and shall keep it always with himself.
- 10.2 Special apparatus shall be used as source of current for the firing operations. Power lines shall not be tapped for the purpose.
- 10.3 The firing cable shall have a proper insulating cover so as to avoid short circuiting due to contact with water, metallic parts or rock.
- 10.4 The use of earth as a return line shall not be permitted.
- 10.5 The firing cable shall be connected to the source of current only after ascertaining that nobody is in the area of blasting.
- 10.6 Before firing, the circuit shall be checked by a suitable apparatus.
- 10.7 After firing, whether with or without an actual blast, the contact between the firing cable and the source of current shall be cut off before any person is allowed to leave the shelter.
- 10.8 During storms, charging with electrical detonators shall be suspended. The charges already placed into the holes shall be blasted as quickly as possible after taking all the safety precautions and giving necessary warning signals. If this is not possible, the site shall be abandoned till the storm has passed.

11.0 VIBRATION RECORDING

- 11.1 CONTRACTOR shall use OWNER approved vibration recording system capable of measurement in three axes (tri-axial). The device shall have an accuracy of 0.0025 mm and a resonance of 2 Hz. The device shall measure both frequency and amplitude of vibration.
- 11.2 All the measurement devices shall be calibrated by an APPROVED certification body.
- 11.3 Particle velocity shall not exceed the following:
 - 11.3.1 Areas not with 500 m of existing facilities
 - 50 mm/sec at a surface measured distance of 15 m from trench center line.
 - 11.3.2 Areas with existing buried or above ground facilities within 500 m.
 - 20 mm/sec. At a surface measured distance from the trench center line towards the nearest existing facilities.
- 11.4 The particle velocity levels are provided for the guidance only, CONTRACTOR shall be responsible and liable for any injury to life or damage to property/facilities.
- 11.5 Air-over pressure/sound levels shall be limited to 100 db in inhabited areas.

12.0 MISFIRES

- 12.1 If it is suspected that part of the blast has failed to fire, or is delayed, sufficient time shall be allowed to lapse before entering the danger zone. When fuse and blasting caps are used, a safe time should be allowed and then the Supervisor alone shall leave the shelter to see the misfire.

	SPECIFICATION FOR CONTROLLED ROCK BLASTING	DOCUMENT NO.	REV
		11-0330G01-01-07-02-025	0
		SHEET 8 OF 9	

- 12.2 Drilling near the hole that has misfired shall not be permitted until one of the two following operations have been carried out by the Supervisor:
- I) The Supervisor should very carefully (when the tamping is of damp clay) extract the tamping with a wooden scraper or jet of water or compressed air (using a pipe of soft material) and withdraw the fuse with the primer and detonator attached. A fresh primer and detonator with fuse shall then be placed in this hole and fired.
 - II) The Supervisor shall get one foot of the tamping cleaned off and indicate the direction by placing a stick in the hole. Another hole may then be drilled at least 9" away and parallel to it, this hole should then be charged and fired. The balance of the cartridges and detonators found in the muck shall be removed.
- 12.3 The Supervisor shall at once report to the office all cases of misfire, the cause of the misfire and the steps taken in connection therewith.
- 12.4 If a misfire has been found to be due to defective detonator, or explosive, the whole quantity from the box from which the defective articles were taken must be returned to the manufacturer for inspection to ascertain whether the whole box contains defective materials.
- 12.5 Re-drilling the holes that have misfired either wholly or partly shall not be permitted.

13.0 DISPOSAL OF DETERIORATED EXPLOSIVES

All deteriorated explosive shall be disposed off in an approved manner. The Contractor shall prepare said disposal Plan, which shall be approved by Owner / Local Authorities / Controller of explosives. The quantity of deteriorated explosive to be disposed off shall be intimated to Owner prior to its disposal. All the records of such disposal shall be maintained by Contractor.

	SPECIFICATION FOR CONTROLLED ROCK BLASTING	DOCUMENT NO.	REV
		11-0330G01-01-07-02-025	0
		SHEET 9 OF 9	