



BHAGYANAGAR GAS LIMITED

(BGL)

TENDER FOR

**LAYING & CONSTRUCTION OF U/G STEEL P/L
NETWORK IN KAKINADA AND VIJAYAWADA OF**

M/s BGL

OPEN DOMESTIC COMPETITIVE BIDDING

TENDER NO. – BGL/VCS/WORKS/2025-26/02

Dated : 13.10.2025

VOLUME II OF II: TECHNICAL



ENERGISING QUALITY

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MASTER - INDEX		
SL.NO.	DESCRIPTION	PAGE NO.
1.	VOLUME – A (PIPELINE & PIPING)	03 - 1052
2.	VOLUME – B (CIVIL)	1053 – 1166
3.	VOLUME – C (TCP)	1167 – 1241

VOLUME A

(PIPELINE & PIPING)

INDEX

S.NO.	DESCRIPTION	PAGE NO.
1.	SCOPE OF WORK	05 - 54
2.	DATA SHEETS	55 - 75
3	PIPING MATERIAL SPECIFICATION	76 - 103
4.	STANDARD SPECIFICATION	104 - 864
5.	QUALITY ASSURANCE PLAN	865 - 927
6.	STANDARD DRAWINGS	928 - 990
7.	APPROVED VENDOR LIST	991 - 1051
8.	TPIA LIST	1052 - 1052



PROJECT NUMBER: C251151



SCOPE OF WORK
(FOR PIPELINE LAYING)

Total Sheets

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SOW

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BHAGYANAGAR GAS LIMITED

LAYING & CONSTRUCTION OF U/G STEEL P/L NETWORK IN KAKINADA AND VIJAYAWADA OF M/S BGL

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LAYING & CONSTRUCTION OF U/G STEEL P/L NETWORK IN KAKINADA AND VIJAYWADA OF M/S BGL

CONTENT

1.	INTRODUCTION.....	3
2.	PROJECT BRIEF	3
3.	PURPOSE	4
4.	DEFINITION	4
5.	WORK TENDERED	4
6.	DETAILED SCOPE OF WORK	6
7.	SCOPE OF SUPPLY	17
8.	SCOPE OF WORK AND SCOPE OF SUPPLY FOR OTHER DISCIPLINES	27
9.	OTHER CONDITIONS OF BID	28
10.	AS BUILT DOCUMENTS	47
11.	DOCUMENTS TO BE SUBMITTED AT TIME OF BIDDING	48
12.	DOCUMENTS, SPECIFICATION, STANDARDS AND DRAWINGS.....	48

	SCOPE OF WORK PIPELINE LAYING	Document No.	Rev
		C251151-00-PP-SOW-2001	C1
		Page 2 of 50	



LAYING & CONSTRUCTION OF U/G STEEL P/L NETWORK IN KAKINADA AND VIJAYWADA OF M/S BGL

1. INTRODUCTION

BGL was incorporated to implement City Gas Distribution (CGD) projects in the erstwhile Andhra Pradesh region, which now includes Andhra Pradesh and Telangana. The company serves the geographical areas of Hyderabad, Vijayawada, and Kakinada. Furthermore, BGL operates 137 CNG stations in these cities across Andhra Pradesh and Telangana.

BGL has a CGD network comprising 2,478 km of MDPE pipeline and 183 km of steel pipeline and has provided 3,16,046 domestic connections, 365 commercial and 88 industrial consumers in its authorized geographical region.

VCS Quality Services has been appointed as Engineering Project Management Consultant by M/s BGL to provide engineering consultancy services.

2. PROJECT BRIEF

The brief scope of work covered in this bidding document broadly consist of Laying, Testing and Commissioning of 6" and 4" NB dia. x 26.14 Km approx. long pipeline and associated facilities for transportation of Natural Gas for Kakinada and Vijayawada GA in the state of Andhra Pradesh.

The brief scope of work includes supply of bulk materials (other than free issue), pipe laying work including but not limited to Construction Management, HSE & Quality Management, Survey, clearing of ROU, grading. Stringing, bending, welding, trenching, lowering, crossings. Tie-ins, NDT and destructive testing, backfilling, site restoration, hydrotesting, dewatering, drying, MDPE laying, pre-commissioning, commissioning and Gas-in of pipeline of size 6" & 4" Dia. including construction / installation of related facilities at consumer ends & metering skids, SV Stations, tap-off station at various locations including associated Mechanical, Civil, Structural, Cathodic Protection at stations etc.

Total Scope of work as mentioned below:

Part- A (Vijayawada)			
Stretch	Dia (Inch)	Length (KM)	Remarks
Swathi Theater road to Durga Gudi upto Fly Over	6	0.95	
	4	0.12	
From Swathi Theater Junction to Gollapudi	4	2.0	
Gollapudi Junction to Ibrahimpatam (HYD Highway)	6	8.25	
	4	0.22	
Total		11.54	

 ENERGISING QUALITY	SCOPE OF WORK PIPELINE LAYING	Document No.	Rev
		C251151-00-PP-SOW-2001	C1
		Page 3 of 50	

Part- B (Kakinada)			
Stretch	Dia (Inch)	Length (KM)	Remarks
From ADB Road to Achampeta Junction	6	0.6	TOP and Sri Lakshmi Ganapthy Fuels(DBS) on ADB Road
From Achampeta Junction To Pithapuram	6	12.2	JVVR Filling Station, Nandu Fuels (Future)
	4	1.8	Connect DBS Ujjawala FS (HPCL)
Total		14.6	

3. PURPOSE

This Document is for the Detailed Scope of Work for Pipeline Laying and Shall Be Read In Conjunction With Particular Job Specifications, Technical Specifications, Schedule Of Rates (SOR) & Various Parts Of Bidding Documents Meant for The Execution Of The Proposed Natural Gas Pipeline Under Kakinada and Vijayawada GA for City Gas Distribution Project in the state Andhra Pradesh.

4. DEFINITION

Where used in this document, the following terms shall have the meanings indicated below, unless clearly indicated by the context to this order

PROJECT	CITY GAS DISTRIBUTION PROJECT IN KAKINADA AND VIJAYAWADA GA
OWNER	BHAGYANAGAR GAS LIMITED
CONSULTANT	VCS Quality Services Private Limited (VCS) the party to act for and on behalf of OWNER for the Detailed Engineering Services and Project Management.
MANUFACTURER	The party, which manufactures and supplies equipment and services to the OWNER or to Contractor.
SOW	Scope of Work

5. WORK TENDERED

Work tendered as a part of this Bid document consists of supply of materials as required, laying/ installation of Steel Pipeline, testing, pre-commissioning of pipeline, drying, preservation and commissioning. The work includes installation of Steel pipeline and related piping works at sectionalizing valve stations and all associated mechanical, civil, architectural, structural, cathodic protection, electrical, instrumentation, telecom works at

 ENERGISING QUALITY	SCOPE OF WORK PIPELINE LAYING	Document No.	Rev
		C251151-00-PP-SOW-2001	C1
		Page 4 of 50	

Stations along the route etc.

The brief scope of work includes supply of materials (other than free issue), pipeline laying work including but not limited to Construction Management, HSE & Quality Management, Survey, ROU management, clearing of ROU, grading, stringing, bending bending, welding (Manual), trenching, joint coating, lowering, crossings, crossings by HDD (wherever specified), Tie-ins, NDT and destructive testing, backfilling, TCP works, site restoration, hydro-testing, dewatering, swabbing, drying, nitrogen purging (as applicable), pre-commissioning, commissioning and Gas-in of pipeline including construction / installation of related facilities , all piping works at Sectionalizing valve stations, Tap-off station & Injection points, etc. including associated Mechanical, Cathodic protection, Civil works and Structural works at all stations.

This document shall be read in conjunction with Schedule of Rates, SCC, Technical specifications, standards, drawings, and other documents forming a part of the Tender Document.

5.1. The details of proposed work are as under:

- Pipeline laying works including installation of SV Station, all valves, fittings, flow tee etc. & associated Piping works at SV stations. Pipeline work starts after IJ at proposed Station. For details, refer P&IDS of the pipeline network attached with the Bid Document.
- Laying of approx. 26.14 Km of 6" and 4" O.D x 6.4 mm W.T. API 5L Gr. X-52 PSL-2 coated main pipeline including associated works.
- Entire works including installation of IJ, flow tee, all valves, equipment's, fittings, other facilities and all associated mechanical, civil (pavement & supports works at SVs), instrumentation, telecom, structural, and all other SV terminal works civil approach road, electrical works etc.
- Entire work of SV Stations with/ without future tap-off as specified in Drawings/ P&ID including installation of underground valves and blow down vents etc.
- Entire work of Isolation Valves as specified in Drawings/ P&ID including installation of underground valves & other associated facilities.
- Installation, testing of MDPE pipeline along with Steel Pipeline in common trench of Steel Pipeline including construction of valve chambers.
- Installation of all Sectionalizing valve stations including construction of valve chambers along with all Mechanical, civil, structural, and electrical, instrumentation, telecom, etc.
- Crossings of road, rail, utilities, forest, underground pipelines and water crossings (minor water body, canal, nala / drain, waterways etc.) by Open cut, HDD and boring including crossing drawing and calculation for HDD.
- Carrying out all topographical and geo-technical surveys required for re-routing (If required any).
- Installation of Pipeline by Horizontal Directional Drilling (HDD) method, wherever required.
- Installation of pipeline by machine moling, wherever required.
- All works related to hydro-testing, dewatering, swabbing, drying and tie-in with

 ENERGISING QUALITY	SCOPE OF WORK PIPELINE LAYING	Document No.	Rev
		C251151-00-PP-SOW-2001	C1
		Page 5 of 50	

adjoining pipeline/ terminal piping sections/parts including tie-in with the HDD sections.

- Pre-commissioning of the pipeline section and associated facilities.
- Commissioning assistance (as applicable) and Commissioning: Overall Commissioning of the pipeline including supply of Nitrogen for purging. Contractor shall also provide all assistance to owner during commissioning
- Idle time preservation by filling Nitrogen at a positive pressure of 2 bar (g) as per specification including supply of Nitrogen (if required)
- Making all necessary arrangements to prevent rolling down of removed earth while grading and ROU clearance in hill side and steep slope areas. Stabilization of side hill faces to prevent landslides.
- Making necessary arrangements to prevent rolling down of pipes in steep slopes.
- Supply and installation of slope breaker as per specifications and drawings in steep slope areas, wherever required;
- Supply and Installation of trench breakers with 1:4 ratio of cement and sand in bags for slopes, stabilization of soil, stabilization of trench, wherever required and as directed by Owner / Owner's Representative.
- Excavation of National Highway /State Highway/others Road/canals etc. during laying of Pipeline and restoration of same to original condition on completion of the work to the satisfaction of Concern Authority.

5.2. CONSTRUCTION FRONTS

Fully equipped, maintained and functional fronts are required to be mobilized by the Contractor to complete installation of facilities covered under each stretch/part as a minimum. All the construction fronts shall work simultaneously. In addition, contractor shall deploy separate crews for rail, road, water crossings and restricted areas. Contractor shall also mobilize separate teams for mechanical works SV Stations.

- 5.3. Successful Bidder is required to submit detailed methodology for working in rainy season before start of the work.
- 5.4. Contractor shall adopt suitable method of construction/ execution of work for restricted ROU/ Common ROU and deploy adequate equipment & manpower etc. as required. CONTRACTOR shall provide complete details of manpower, equipment etc. to be deployed. Contractor shall mobilize and provide all equipment, manpower (skilled and unskilled), consumables and other resources and separate crew etc. for each front as required for the execution of the complete job defined herein.
- 5.5. For execution of the pipeline work in the narrow ROU space in forest areas, the CONTRACTOR shall consider the special requirements/ measures and shall deploy adequate amount of manpower and equipment for performing the work.
- 5.6. Mechanical, civil, temporary cathodic protection, telecom works for the respective sections/parts shall be carried out as per relevant particular job specification provided elsewhere in the Bid document.

6. DETAILED SCOPE OF WORK

The Contractor's Scope of work for the pipeline shall consist of, but shall not be limited to, supply (as required), fabrication, installation, testing, swabbing, drying, EGP, pre-

 ENERGISING QUALITY	SCOPE OF WORK PIPELINE LAYING	Document No.	Rev
		C251151-00-PP-SOW-2001	C1
		Page 6 of 50	

commissioning and commissioning of the proposed pipeline system including terminal piping works and hook-up works at terminals along with all associated mechanical, civil, structural etc. All such works that are not indicated here below but are otherwise required to complete the work in all respects shall form part of Contractor's Scope of Work.

The scope indicated below shall be read in conjunction with Schedule of Rates as applicable, drawings, SCC, standards, specifications, and other documents forming part of the Contract document.

The detailed scope of work pertaining to pipeline shall be in general but not limited to the following:

6.1. Main Pipeline

- 6.1.1. "Receiving and Taking-over" of COMPANY supplied externally corrosion- coated and bare line pipes of all thicknesses at Company's designated storage yard in presence of Company's representative. Transportation including loading, unloading, handling, stacking, hauling and stringing of pipes from Company's storage yards to Contractor's worksite(s)/ workshop(s)/ pipeline Right-Of-Use (ROU), including arranging all pipe trailers, cranes, arranging all necessary intermediate storage area(s) required thereof till the complete pipeline system is permanently installed.

COMPANY shall set up storage yards for coated and bare line pipes near pipeline ROU as defined subsequently in this document. The exact location of Company's storage yards shall be intimated to the CONTRACTOR at the time of award. In addition, COMPANY shall set up stores for all items other than line pipes as defined in scope of supply.

- 6.1.2. All construction works shall be carried out as per "Approved for Construction" drawings, procedures, specifications and applicable codes and standards. Any changes at site shall also need prior approval from the Company and revision of drawings.
- 6.1.3. Carrying out inspection of COMPANY supplied line pipes and pipe corrosion coating at the time of receiving and taking-over for all defect etc. in the presence of Company's representative
- 6.1.4. Carrying out repairs (including supply of all materials required for repair) of line pipe and pipe coating not attributable to COMPANY which will include repair of all defects/damages occurring during transportation and/ or handling after receiving and taking over.
- 6.1.5. For pipes were cutting out involves more than 25mm from pipe ends, ultrasonic inspection shall be carried out at pipe ends for line pipe and including supply of all equipment's. Contractor shall take prior approval from Company for the agency engaged for carrying out ultrasonic inspection.
- 6.1.6. Loading, unloading, handling, stacking, storing and transportation to workshop/ work site of all materials (other than bare and corrosion coated line pipes) that may be used for the construction of pipeline system either supplied by COMPANY at their designated storage yard/ store and/ or by CONTRACTOR as the case may be. All Company supplied materials (other than line pipe) shall be issued to Contractor from Company's designated store.
- 6.1.7. Preparation of bevel end and coating edge of line pipes for welding.
- 6.1.8. Contractor shall incorporate the crossing details in the as-built alignment sheet after completion of work.
- 6.1.9. Carrying out all additional topographic and/ or geotechnical survey as required for local detours, detours at crossing locations and elsewhere during execution including preparing plan and profile drawings as directed by Engineer-in-Charge.

 ENERGISING QUALITY	SCOPE OF WORK PIPELINE LAYING	Document No.	Rev
		C251151-00-PP-SOW-2001	C1
		Page 7 of 50	

- 6.1.10. Geo-technical investigation and hydrological survey of all major water body crossings are being carried out by the Company and the same shall be provided to the contractors during execution of the contract. However, contractor shall verify the authenticity of the data provided during execution and if required, additional geo-technical investigation & hydrological survey shall be carried out by the contractors for HDD crossings without any cost and time implication. Geo-technical & topographical survey for all plots shall be carried out by the respective contractor during execution of the contract.
- 6.1.11. Carrying out thorough internal cleaning of all pipes to remove debris, shots, grits etc. to the satisfaction of Engineer-in-charge.
- 6.1.12. Mobilizing and providing all equipment's, manpower (skilled and unskilled), consumables, and other resources etc., as required for the execution of complete work and thereafter demobilizing the same upon completion of work.
- 6.1.13. Obtaining all necessary approvals and work permits from concerned authorities having jurisdiction, as applicable for performing the work including shifting/ relocation and restoration of telephone/ electrical poles and underground pipes and other utilities etc., as required by local authorities and as directed by COMPANY. Contractor shall also obtain all necessary approvals and work permits from concerned authorities having jurisdiction for crossing underground utilities/ pipelines wherever encountered along the pipeline route.
- 6.1.14. Cutting/ uprooting of trees within ROU, counting the number and type of trees to be cut (before cutting) during pipeline laying works in presence of DFO/ concerned authorities keeping record thereof and handing over the cut trees as directed by concerned authorities/ COMPANY.
- 6.1.15. The Pipeline corridor shall be kept as narrow as possible at all times. The pipeline shall be fully buried. Wherever possible vegetation along the center line of the pipe shall be uprooted carefully, with soil and roots intact, so that it can be used in the reinstatement. During the excavation of the pipeline, trench top soil and subsoil material shall be kept separate and backfilled in the same order where possible imported backfill material shall be avoided and a selective backfill method used. The Trench shall be opened and closed as quickly as possible. Safe exit routes/ramps from the trench shall be provided for wildlife if a trench is left open overnight. The Pipeline shall not alter the drainage characteristic of the land. Clay Stopper bungs will be used as required.
- 6.1.16. Staking, clearing, grading of Right of Use (ROU) as required, trenching to all depths in all types of soils including soft and hard rock, including blasting, controlled blasting, chiseling, or otherwise cutting etc. as per relevant standards, drawings, specifications etc., stringing, aligning, bending, welding, NDT by AUT/X-ray, field weld joint coating including supply of all materials, protective coating of long radius bends and buried fittings/ valves including supply of materials, providing sand/ soft soil padding, rock shield in the trench wherever required including supply of sand/ soft soil, laying and lowering of the pipeline including locating existing pipeline using pipe locator, wherever applicable and maintaining the specified minimum spacing from existing pipeline(s), back filling including supply of select backfill material where required, carrying out rail, road, river, canal, drain, utility and submerged minor and major water course crossings including installation of carrier pipe inside casing pipe at cased crossings wherever required, providing two component epoxy coating on inner surface of casing pipe wherever required by statutory authority, bank stabilization of water course crossings as required, arranging all additional temporary land/ area required for construction purposes. Supply and installation of anti-buoyancy measures viz. continuous concrete coating, geo-textile gravel filled bags, saddle weight, extra cover, select backfill etc. on pipeline, installation of supports wherever required, tie- in/ hook-up

with pipeline/ piping installed by others including cutting of temporary test headers, if any, re-beveling, NDT, fit-up, welding, radiography etc.; clean-up, ROU restoration, pigging, flushing, gauging, hydrostatic testing with the quantity of corrosion inhibitor as required, dewatering with the addition of approved chemicals to neutralize the effect of inhibitor added during hydro test at required dosage, swabbing, drying, pre-commissioning and commissioning of pipeline including supply of all materials such as required type and quantity of pigs, manpower, equipment, consumables and carrying out all associated works as per relevant specifications, standards and approved drawings enclosed with the Contract document.

6.1.17. All welding and NDT shall be carried out as per welding specification and as per welding specification charts enclosed in the bid document.

6.1.18. Welding Techniques & NDT

Sl. No.	Description	Welding Technique	NDT
1	6" x 6.4 mm, API 5L Gr. X-52	Manual	X-Ray
2	4" x 6.4 mm, API 5L Gr. X-52	Manual	X-Ray

Notes:

a) Pipeline welding may be carried out as mentioned above.

6.1.19. Welding of all tie-in joints including tie-in joints and bends on either side of major river/ canal/ road/ rail crossings/ other facilities as required including adjoining pipeline spreads, cutting of test header, re-beveling and tie-in with adjacent pipeline segments.

6.1.20. Carrying out welding including cutting, edge preparation (inclusive of grinding the edges of pipe, fittings, flanges, etc. to match with the matching edges of different thickness wherever required), fit-up, bending, pre heating wherever required, NDT including radiography and other non-destructive tests as specified. NDT requirements for process and other piping shall be in accordance with relevant specifications enclosed with the Bid document.

6.1.21. Transportation of bare pipes or Coated Pipe, removing of 3LPE coating, fabrication, supply, installation and coating of LR Bend as per requirement of pipeline route.

6.1.22. Corrosion coating of long radius 3D bends by heat shrink sleeve as per specification.

6.1.23. Field weld joints coating and corrosion coating of Long Radius (LR) bends and pup pieces of sectionalizing valves by Heat Shrink Sleeve. 100% solid high build epoxy (minimum 500-micron thk.) shall be applied for underground piping & valves.

6.1.24. Installation of all in-line insulating joints, valves, appurtenances, online instruments etc.

6.1.25. Providing slope breakers in steep slope areas including supply of all materials, wherever required. Contractor shall carry out slope breaker survey and slope breaker shall be installed (before backfilling) as per standard after approval of Engineer-In- charge. Supply and installation of slope breaker as per specification and drawing in slightly undulating areas (having slope 6° to < 20°); slope stabilization as per specification and drawing in highly undulating areas (having slope ≥ 20°)

6.1.26. Sand/soft soil padding of minimum 150 mm thickness around pipe wherever required in areas where trenching has been done in rock or gravel or pebble or murram or hard soil

 ENERGISING QUALITY	SCOPE OF WORK PIPELINE LAYING	Document No.	Rev
		C251151-00-PP-SOW-2001	C1
		Page 9 of 50	

including supply of sand/ soft soil. The pipeline trench shall not be filled with gravel and large stones or boulders. Supply and installation of rock-shield in addition to 150 mm of sand/soft soil padding around the pipe in rocky areas. The rock shield (polyethylene mat) shall be of minimum 6 mm thick or as approved by CLIENT/PMC and same shall be as per COMPANY specifications. Contractor shall furnish all details of proposed rock shield to be used, for COMPANY's approval. Extra digging of trench shall be carried out to comply with above requirements & to provide minimum cover (as specified) over pipeline within Quoted rates and with no additional Cost to Company.

- 6.1.27. Providing engineered select backfill consisting of loosely compacted cohesion less soil like sand (for the areas prone to seismic activity) including supply of cohesion less soil like sand for a distance of 500 m on each side, as per job standards. The pipeline shall be surrounded by at least 0.6 m of select backfill. Extra digging of trench shall be carried out to comply with above requirement.
- 6.1.28. The list of crossings indicating crossing methodology is enclosed. However, mentioned crossing methodology for respective crossing may vary depending upon site conditions during time of execution. In case of such situation, Client /PMC has reserve right to inform contractor about revised crossing methodology to be adopted. The payment will be regulated based on the actual crossing methodology executed as per relevant SOR item.
- 6.1.29. Carrying out National highway /State Highway, Expressway, railways, and major road crossings by conventional/ boring/ Jacking/ HDD method.
- 6.1.30. Supply and Installation of warning mat over entire pipeline, and covering widthwise complete Pipeline as per relevant specification & drawings. Warning mat shall be laid above the top of pipeline at a distance as specified in drawings.
- 6.1.31. Qualifying Procedure for cold field bending of pipes, Making and handling of cold field bends at site as per the specification, as required for laying of pipelines and crossings is in the scope of contractor.
- 6.1.32. Providing all necessary barricading material, safety signboards, warning lights etc. to safeguard the pipeline against accidents during construction of line in city area.
- 6.1.33. Localized purging/ inertisation including supply of nitrogen during hook up with existing Pipeline/ piping at existing terminal, if any.
- 6.1.34. Loading, unloading, handing over and transportation of all surplus COMPANY supplied free issue materials including line pipe to COMPANY designated stores and stacking of the same. Stacking of surplus pipe & other material shall be inclusive of supplying of sand bags etc.
- 6.1.35. Return of surplus material/ bends etc. to storage yard/ work site/ Company's store shall be in Contractor's scope.
- 6.1.36. Carrying out cleaning, flushing, swabbing (as applicable), dewatering, testing and pre-commissioning of pipeline and associated facilities at Dispatch Station, Sectionalizing Valve Stations & Receiving terminal up to the respective battery limits. Locating all major and minor leaks during hydro-testing, if any.
- 6.1.37. Repair of leaks/ burst, not attributable to Contractor, occurring in Company supplied material, shall be carried out by the contractor and the Contractor shall be compensated as per provisions of the contract. However, Contractor shall carry out repair of defects attributable to Contractor at no extra cost to Company. Contractor shall submit a report for failure to Company.
- 6.1.38. Commissioning of pipeline & associated facilities providing all equipment's,

 ENERGISING QUALITY	SCOPE OF WORK PIPELINE LAYING	Document No.	Rev
		C251151-00-PP-SOW-2001	C1
		Page 10 of 50	



LAYING & CONSTRUCTION OF U/G STEEL P/L NETWORK IN KAKINADA AND VIJAYWADA OF M/S BGL

manpower, machinery, consumables including required number of pigs and assistance as required during commissioning of pipeline system and associated facilities viz. Dispatch Terminal, Sectionalizing Valve Stations and Receiving Terminal up to the respective battery limits.

- 6.1.39. Final clean-up and restoration of ROU and other conveniences like temporary approach roads/ temporary works, barren land, road, rail, canals, water crossings, cultivable land etc. to original condition as per specification and drawings to the entire satisfaction of COMPANY and/ or authorities having jurisdiction over the same, including disposal of surplus construction materials to Company's designated stock yard(s) or as directed by Engineer-in-charge. CONTRACTOR shall restore stones laid to mark the boundaries of adjoining fields to original conditions. Contractor shall arrange necessary clearance from all concerned authorities/ land owners to the effect that ROU has been restored back to the original condition.
- 6.1.40. Disposal of surplus excavated soil from trench outside ROU.
- 6.1.41. Idle time preservation by filling Nitrogen at a positive pressure of 2 bar (g) as per specification, if required including supply of Nitrogen.
- 6.1.42. Preparation of as-built drawings, pipe-books, documents, photographs and project records as per specification and instructions of the COMPANY including furnishing of all Test Certificates/ Inspection Reports for all materials used for permanent installation. Taking over Crossing details from HDD agency (in case of separate agency) and completion of all as-built drawings, project records, pipe book etc. shall be in laying contractor's scope of work.
- 6.1.43. Taking over surplus bare and coated pipe from coating contractor at storage yard after completion of work, loading, unloading, transportation and handing over of all surplus Company supplied free issue material including short length of pipes to Company's designated Storage yard as directed by Engineer-in-charge.
- 6.1.44. In case any activity though not specifically covered in schedule of rates description but same is covered under scope of work/ Specification / drawings, it is understood that the contractor shall do such performance & provisions so mentioned without any time & cost implication.**
- 6.1.45. Installation of casing pipes (by open cut/jacking/ boring/ any other trenchless technique) assembly, including supply of all materials, casing insulators and end seals, vents and drains etc. complete, at cased crossings.
- 6.1.46. Providing loosely compacted cohesion less soil like sand, murrum, silty sand for specified distance in seismic prone areas.
- 6.1.47. Crossings of streams/canals/Nala by Open Cut or as specified in Crossing Methodology
- 6.1.48. Pre-construction surveys, preparation of detailed construction method statement and calculations for Company's approval.
- 6.1.49. Geo-technical investigations, if required.
- 6.1.50. Site preparation, arranging required land for setting up of string fabrication yard and obtaining necessary permissions from concerned authorities.
- 6.1.51. Preparation of pipeline Launch way, continuous concrete coating of pipes, repair of damages to corrosion and concrete coating, string preparation, field welding, NDT including radiography, pretest of completed strings, corrosion and concrete coating of field joints, trenching, laying at approved depth, backfilling including supply of select backfill material

 ENERGISING QUALITY	SCOPE OF WORK PIPELINE LAYING	Document No.	Rev
		C251151-00-PP-SOW-2001	C1
		Page 11 of 50	

(where required), stabilization of banks, post installation hydro test, capping, providing and installing of markers, etc.

- 6.1.52. HDD works shall be carried out in accordance with specification enclosed with bid package. For directionally drilled crossing, following shall be performed:
- Carrying out all surveys and collection of data, as may be required for the design and construction of the crossings.
 - Carrying out all engineering, design calculations and preparing all construction drawings for laying of pipeline as per requirements for installation of river crossings by HDD method. Contractor shall prepare crossing drawing & calculation and submit all for approval work will start only after Approval from PMC/ Client
 - All construction activities required for installation of the crossings viz. site preparation, preparation of pipe string, repair of damages to corrosion coating, field welding, NDT including radiography, pretest of completed string, corrosion coating of field joints, holiday testing of complete pipe string, drilling in all types of soil including gravel, boulders and disintegrated and hard rock, installation of pipeline, post installation hydro-testing of the crossing section, capping, providing and installing markers at crossings.
 - After the successful completion (Pulling) of HDD for final acceptance gauging to be carried out.
 - Field joint coating shall be carried out by using approved sleeves.
 - Drilled hole or separately in two independent drilled holes as Approved by EIC).
 - Tie-in with main pipeline after successful installation of pipeline at river crossing.
 - All associated pipeline work w.r.t. temporary Cathodic protection.
 - Contractor shall dispose bentonite slurry safely as per technical specification and environmental requirements as applicable.
- 6.1.53. Clean-up and restoration of ROU and other conveniences like road, rail, canals, cultivable land, water facilities, irrigation facilities, boundary wall/fence etc. to original condition as per specification and drawings to the entire satisfaction of Company and/or Authorities having jurisdiction over the same, including disposal of surplus excavated soil and other construction materials to a location identified by Contractor approved by local authority without causing any disturbance to environment and to the entire satisfaction of Company.
- 6.1.54. Contractor shall arrange necessary clearance from the concerned authorities/ land owners to the effect that ROU/ ROW has been restored back to original condition. Contractor shall carry out joint survey with representative of Competent Authority (CA) and will obtain clearance in writing from CA that ROU has been restored to original condition. Necessary clearance from statutory authority / NOC for restoring the ROU to original condition shall be in Contractor's scope. Necessary proof of restoration i.e. through photographs and video recordings will have to be submitted by the contractor where ever NOC is not available.
- 6.1.55. Supply and installation of all types of pipeline markers including their painting suitable for and Normal/Highly/Costal/marine corrosive environment and all associated civil works. Location of markers shall be as per specification/ standards and as directed by Engineer-in-Charge. If Corrosive environment is not defined then stringent requirement of above-mentioned corrosive environment shall be followed.
- 6.1.56. Installation of all inline/ online instruments/ valves/ insulation joints/ appurtenances etc. as per requirements of approved drawings

 ENERGISING QUALITY	SCOPE OF WORK PIPELINE LAYING	Document No.	Rev
		C251151-00-PP-SOW-2001	C1
		Page 12 of 50	



LAYING & CONSTRUCTION OF U/G STEEL P/L NETWORK IN KAKINADA AND VIJAYWADA OF M/S BGL

- 6.1.57. Tie-in with the pipeline at rail, road, river and other crossings including cutting of test headers as required and tie-in with terminal piping & with existing facilities as applicable.
- 6.1.58. Preparation of video films with audio commentary covering all aspects of pipeline construction annotated as required, conversion of the same to video CD/DVD ROM format and USB, submitting three (3) sets of the same.
- 6.1.59. All incidental and associated works and any other works not specifically listed herein but are required to be carried out to complete entire work related to pipelines and the associated facilities and making the entire pipeline system ready for operation.
- 6.1.60. Repair of any leaks/burst occurring during testing of main pipeline.
- 6.1.61. Installation of carrier pipe in canal/ road (NH/ Express highway)/ railway crossings by boring/ HDD/ Trench less method, as directed by Company. Whenever HDD/Trench less method is to be adopted for pipeline installation, the same shall be carried out as per specification. Contractor to note that the minimum elastic bend radius to be adopted, shall be as per pipeline engineering design basis enclosed with the tender.

6.1.62. Any other works not specifically listed herein but are required to be carried out to complete entire work related to pipelines and the associated facilities.

6.2. ASSOCIATED WORKS FOR PIPELINE CONSTRUCTION

- 6.2.1. Installation of CS casing pipes (by open cut/ jacking/ boring) assembly, including transportation & supply of all materials, viz. CS casing Pipe, casing insulators and end seals, vents and drains etc. complete, at cased crossings. In case, coated casing pipe is supplied as free issue material, then the contractor shall remove coating before installation.
- 6.2.2. Cased crossings shall be installed at locations as per instructions of Engineer in- charge. The number of crossings indicated in alignment sheets is subject to change based on engineering, construction and statutory requirements or the requirements of the authority having jurisdiction over a utility crossing.
- 6.2.3. Supply and installation of all types of pipeline markers including their painting suitable for Normal/Highly/Costal/marine corrosive environment (as specified in Design Basis) as per specification and all associated civil works. If corrosive environment is not defined then stringent requirement of above-mentioned corrosive environment shall be followed.
- 6.2.4. Tie-in/ hook-up of pipeline at Dispatch / Receipt Terminal / SV Stations/ and existing facilities, if any, is in the scope of Contractor.
- 6.2.5. Laying Contractor shall engage underground Scanning agency for finding out the location and depth of underground utilities particularly residential and other areas in consultation with Engineer In charge/ Client and Concerned Authorities.
- 6.2.6. Contractor shall also inform all local authorities in advance and obtain all necessary approvals for crossing underground utilities/ pipelines wherever encountered along the pipeline route. Contractor shall be required to carry out all the works as mentioned in the work permit.
- 6.2.7. Owner Reserve the right to award part of the work to Contractor. Or Contractor Performance is not found satisfactory owner reserve the right to award part of Contractor work to others.
- 6.2.8. Bidders shall also be responsible for Collaborate, Cooperate, co-ordination and communication for smooth execution completing the site work from respective statutory authorities i.e., PWD, NHAI, SH, Railway, Nagar Nigam, Local authorities, Forest/ central

 ENERGISING QUALITY	SCOPE OF WORK PIPELINE LAYING	Document No.	Rev
		C251151-00-PP-SOW-2001	C1
		Page 13 of 50	



LAYING & CONSTRUCTION OF U/G STEEL P/L NETWORK IN KAKINADA AND VIJAYWADA OF M/S BGL

forest etc.

- 6.2.9. Wherever advised by owner, Collaborate, Cooperate, co-ordination and communication for smooth execution completing the site work for clearance from Statutory Authorities including regular follow ups and obtaining the clearance shall be done by Contractor. Client will issue introductory letter for applying and for submission of demand note raised by statutory authorities. Contractor shall do the follow up with the concerned authorities to get the clearance to execute the job in time.
- 6.2.10. Contractor shall provide schedules, progress reporting, and organization chart at construction site, quality assurance plan and developing quality control procedures, as per requirements of the bid package.
- 6.2.11. Contractor shall be responsible for payment of claims if any arising out of damage/ obstruction to public utilities like OFC lines of DOT, water pipelines etc. where the claims will cover the restoration costs as well as loss of revenue due to down time. Owner may deduct cost of such claims from contractor's bill to settle such claims.
- 6.2.12. Providing all equipment's, manpower, machinery, consumables, apparatus, tools and tackles for fabrication, installation, inspection, testing, pre-commissioning and commissioning complete as required including facilities for inspection and interpretation of testing results by Company/Company's Representative personnel; providing all types of safety tools, tackles, devices and apparatus, equipment etc.
- 6.2.13. Co-ordination and supervising the work of Approved sub-Contractors.
- 6.2.14. Transportation of appropriate materials to worksite, intermediate storage points, maintaining and operating an adequate material control procedure at worksite.
- 6.2.15. Fabrication of all piping, structural components as per approved drawings.
- 6.2.16. All associated civil, structural works shall be performed in accordance with relevant specifications and requirements enclosed elsewhere in the bid package.
- 6.2.17. Contractor shall depute independent third-party inspector for carrying out radiographic inspection and interpretation of radiograph of welds. Third party inspector shall be approved by Company.
- 6.2.18. Provide, maintain and operate all temporary facilities required for the construction related works and remove after completion of work.
- 6.2.19. Hook up/tie-in of pipeline and piping system with terminal facilities.

6.3. Piping Works at Tap- off Points and Sectionalizing Valve Stations.

Facilities to be installed at various sectionalizing Valve (SV) Stations, as a part of overall pipeline system are shown in respective Piping & Instrumentation diagrams (P&IDs) enclosed.

a) Tap- off Points/ SV Stations/Isolation Valves

- Preliminary typical drawings and P&ID for the SV/tap-off stations are enclosed with this Bid. These drawings are indicative only and are enclosed to enable the Contractor to understand the nature of work involved. Issued for Construction (IFC) Drawings shall be progressively furnished to the Contractor, at an appropriate time at project execution stage.
- Contractor shall carry out all works strictly in accordance with the Issued for Construction (IFC) drawings and reference specifications/ standards, documents,

 ENERGISING QUALITY	SCOPE OF WORK PIPELINE LAYING	Document No.	Rev
		C251151-00-PP-SOW-2001	C1
		Page 14 of 50	

data sheets etc. enclosed with this Bid document and instructions of Company/ Engineer- in-Charge and other provisions of Bid document.

- The Contractor's Scope of Work for the work tendered shall consist of, but not be limited to, supply (as indicated in Scope of Supply), installation, testing, pre-commissioning and commissioning of terminal piping complete, with all associated mechanical, civil, architectural, structural, corrosion monitoring system, electrical, instrumentation, telecom, etc. as applicable including all such works which though specifically not indicated here but will otherwise be required to complete the work in all respects.
- The scope indicated below shall be read in conjunction with Schedule of Rates as applicable, drawings, standards, specifications and other documents forming part of the Contract document.

- 6.3.1. "Receiving and Taking over" as defined in specifications of all Company supplied materials including equipment from the Company's designated place(s) of issue defined elsewhere, transportation including loading, unloading, handling from Company's designated place(s) of issue to Contractor's own stock yard(s)/ work site(s)/ workshop(s), including arranging all necessary intermediate storage area(s) thereof till the materials are installed in permanent installation.
- 6.3.2. Procurement and supply of all materials, equipment's that are included in the scope of supply of Contractor, transportation of all materials from manufacturer's works including loading, unloading, handling, storing and transportation to work site(s)/work shop(s) including arranging all necessary intermediate storage area (s) thereof, as required.
- 6.3.3. Fabrication, erection, testing of all above-ground/ buried piping system including installation pipes, valves (manual and remote actuated), flanges, fittings, flow tees, , insulating joint etc.; carrying out all applicable works associated with buried pipeline within the SV station ,carrying out welding, NDT including radiography; weld repairs/ retesting, cleaning/ flushing hydro testing, dewatering, functional testing, cutting of mainline and beveling (if required), excavation in all types of soil for installation of piping and pipe supports, pre-commissioning, providing commissioning assistance (wherever required) and commissioning including supply of all materials and manpower that are required during pre-commissioning and commissioning and all associated works.
- 6.3.4. Installation of Sectionalizing Valve stations in all terrains/ soils including all above ground/ underground piping at all elevations and depths including all civil works, viz. filling and compaction of valve station areas, excavation of pits, gravel filling, construction of supports, foundations, construction of access road to installation from nearest metaled road, installation of all valves and valve actuators and all fittings/ piping works.
- 6.3.5. Preparation of isometrics and/or fabrication drawings required for the purpose of fabrication during execution of work.
- 6.3.6. Obtaining all necessary approvals and work permits from concerned local authorities having jurisdiction including hot work permit as applicable for performing the work in existing terminal facilities. Arranging of adequate fire-fighting equipment viz. fire brigade, fire extinguisher, shielding from existing facilities, oxygen mask etc. for carrying out the work safely to the satisfaction of COMPANY.
- 6.3.7. Carrying out welding including cutting, edge preparation (inclusive of grinding the edges of pipe, fittings, flanges, etc. to match with the matching edges of different thickness wherever

 ENERGISING QUALITY	SCOPE OF WORK PIPELINE LAYING	Document No.	Rev
		C251151-00-PP-SOW-2001	C1
		Page 15 of 50	

required), fit-up, bending, pre heating wherever required, NDT including radiography and other non-destructive tests specified. NDT requirements for process and other piping shall be in accordance with relevant specifications enclosed with the Contract document.

- 6.3.8. Installation of all types of valves (manual/ actuated), all types of inline/ online instruments such as PSVs (other than those covered separately), safety valves, tapping for thermowells, sample connections, pressure gauges, corrosion monitoring system etc. for all sizes and ratings including fixing of gaskets, bolts, studs and nuts of all sizes, ratings and materials.
- 6.3.9. Installation of all in-line and on-line instruments including Skin Temperature measurement assemblies.
- 6.3.10. All associated civil works, viz. levelling, filling and compaction of station areas as required, necessary stone pitching at the sides of earth fill (if required), excavation of pits, gravel filling, paving as required, access road to installation from nearest metaled road, etc.
- 6.3.11. All associated structural and mechanical works including supply of all materials required, unless covered separately elsewhere in the Bid document, including construction of foundations (PCC/ RCC works) for equipment's and pipe supports and sleepers, fabrication and erection of supporting structural elements for piping such as shoes, clamps, anchors, guides, insert plates, brackets, structural column, valve operating platforms, pipe crossovers etc. Contractor shall provide grating as per details currently included in the tender document or as per details furnished subsequently.
- 6.3.12. Supply of bolts, nuts, gaskets, washers, U bolts, clamps, clips, gaskets for supports for all piping works.
- 6.3.13. Supply, fabrication and erection of supporting structural elements for piping such as shoes, clamps, anchors, guides, insert plates, brackets, structural column etc.
- 6.3.14. All associated structural, instrumentation, telecom, mechanical and civil works including supply of all material required, covered separately elsewhere in the Bid document.
- 6.3.15. Hook-up of piping with equipment's and vessels and hook-up of all piping at the battery limit with the pipeline/ piping including cutting of temporary test header, re- beveling, NDT, fit-up, welding, radiography etc. including interface/ coordination as required with other Contractor(s)/Agencies.
- 6.3.16. Painting of above ground piping (including supply of materials), structural steel elements, for pipe supports, all equipment's and all related miscellaneous items as required and as directed by Engineer-in-charge. Paint shall be suitable for highly corrosive environment in accordance with specification. Wherever touch up/ repair of primer is required, high build epoxy zinc phosphate primer shall be used
- 6.3.17. Protective coating of 100% solid high build epoxy minimum 1000-micron thk. (powercrete R95) for all underground piping, valves, fittings, etc.
- 6.3.18. Corrosion protection coating of all field weld joints for buried piping of all sizes including supply of all materials.
- 6.3.19. Cleaning, Hydro testing, dewatering and drying of piping system of all sizes as per specifications enclosed.
- 6.3.20. Final clean up and restoration of site, facilities etc. as per the requirement of COMPANY/ Engineer-in-Charge including filling (wherever required) and grading of areas around stations for avoiding any local flooding of area.
- 6.3.21. Transportation and stacking of all surplus COMPANY supplied free issue material to

 ENERGISING QUALITY	SCOPE OF WORK PIPELINE LAYING	Document No.	Rev
		C251151-00-PP-SOW-2001	C1
		Page 16 of 50	

Company's designated store after completion of works or as directed by Engineer-in-Charge.

- 6.3.22. Preparation of as-built drawings, documents and project records as per instructions of Engineer-in-Charge.
- 6.3.23. Preparation of detailed procedures for fabrication, installation, testing, pre-commissioning and commissioning. Such procedures shall be submitted to COMPANY/ Engineer-in-Charge for review and approval.
- 6.3.24. Obtaining all statutory clearances, approvals, permissions and hot work permit for the works as required.
- 6.3.25. Fabrication and erection of piping supports and change of existing support/additional supports installed by others as directed by Engineer-in charge.
- 6.3.26. Idle time preservation of mainline and terminal piping by nitrogen gas with positive pressure 2 bar (g) for specified period.
- 6.3.27. Any other works not specifically listed herein but required for completion of the works in all respects.
- 6.3.28. All construction works shall be carried out as per "Issued for Construction" drawings, procedures, specifications and applicable codes and standards. Any changes at site shall also need prior approval from the COMPANY and revision of drawings.

6.4. Temporary Cathodic Protection Works

Temporary Cathodic Protection works shall be carried out as per the scope detailed in particular job specification enclosed elsewhere with the tender.

6.5. Civil Works

Civil, Architecture & Structural works shall be carried out as per the scope detailed in particular job specification enclosed elsewhere with the tender.

7. SCOPE OF SUPPLY

7.1. Materials to be supplied by COMPANY as Free Issue

Company shall supply the following Pipeline/ Terminal piping materials required for permanent installation to the Contractor at an appropriate time during the execution stage as free issue materials:

a) 3LPE externally Coated, API 5L Gr. X-52 PSL2 Steel Line Pipe.

- Entire required quantity of coated line pipes of all thickness shall be supplied by Company. Line pipes (coated) shall be made available to the Contractor at designated storage yards. Transportation of the line pipe from designated storage yards in to work site shall be in the scope of the CONTRACTOR. Further the CONTRACTOR has to ensure safe storage.
- Bare Line Pipes API 5L Gr. X-52 shall be used for above ground piping section by the respective part Contractor. Contractor can use the Coated Pipe after removal of coating & painting the same with approved painting Scheme.
- The quantities of coated and bare line pipes indicated in the bid document are approximate and may vary. The exact quantity shall be intimated to the Contractor after award of work.

 ENERGISING QUALITY	SCOPE OF WORK PIPELINE LAYING	Document No.	Rev
		C251151-00-PP-SOW-2001	C1
		Page 17 of 50	

- Contractor to note that it is the responsibility of installation contractor to return surplus pipes to the COMPANY designated storage yard as per instructions of Engineer In-Charge after completion of installation works.
- Receiving and taking over of coated line pipes at Storage yard including its inspection. All trucks / trailers for transportation of line pipes from storage yards to site/ ROU/ Contractor's storage Yard shall be supplied by contractor.
- Contractor shall note the exact location of Pipe Storage Yards shall be intimated to the Contractor at the time of award. Contractor shall be responsible for performing all works as per scope of work at the finally selected storage yard location by the COMPANY at no extra time / cost to the COMPANY.
- Contractor shall note that Chainage indicated for SVs are approximate and may vary based on the availability of land and NH/ SH/ Rail approach. The exact location of SV stations shall be intimated to the Contractor at the time of award or during execution of work. Contractor shall be responsible for performing all works as per scope of work at the finally selected SV locations by the COMPANY at no extra time/ cost to the COMPANY.
- Transportation of pipes and other free issue material from place of issue is in Contractor's scope. Contractor shall note that the prices indicated in the Schedule of Rates shall be inclusive of taking the delivery and transportation of line pipes and other material from the above storage yard/ stockyard to work place(s).
- Bevel Protectors of the line pipes shall be the property of the pipeline installation Contractor. He has to collect and dispose off the bevel protectors. Contractor shall quote accordingly.

b) Metallic Valves (ball, plug, globe etc.) of size 4" and above

- Wherever required, actuators shall be supplied along with valves

The Company shall make above free issue materials available at the Client store.

Contractor shall arrange all trucks/ trailers, cranes etc. for transportation of above materials including loading at Company store, unloading at contractor's storage yard/ work site, arrangement of cranes, handling etc.

Contractor shall return all surplus material to company designated storage yard as decided by Engineer- In- charge.

7.1.1. Conditions for COMPANY Supplied Material

1. The Contractor shall be responsible for taking over of the material and subsequent handling, hauling, transportation to the actual work site(s)/fabrication yard(s) and storage & safe keeping of the materials. Contractor shall arrange all equipment/ cranes etc. for loading of these materials on their truck/trailers for transportation except line pipe.
2. The Contractor shall inspect all COMPANY supplied free issue materials at the time of

 ENERGISING QUALITY	SCOPE OF WORK PIPELINE LAYING	Document No.	Rev
		C251151-00-PP-SOW-2001	C1
		Page 18 of 50	

taking over from the COMPANY and defects noticed, if any, shall be brought to the notice of COMPANY/ COMPANY representative and jointly recorded. Once the material has been taken over by the Contractor, all the responsibility for safe keeping of the materials shall rest with the Contractor.

3. Every month the Contractor shall submit to the COMPANY an account for the material issued to the Contractor in the Performa prescribed by Engineer-in- Charge.
4. On completion of the works, Contractor shall submit a "Material Appropriation Statement" for all materials supplied by the COMPANY as free issue materials.
5. The scrap allowances shall be permissible as per the provision of Bid document. The percentage allowance shall be accounted on the basis of actual consumption as incorporated in the work.
6. All unused and scraps material shall be the property of the COMPANY and shall be returned by Contractor to COMPANY at COMPANY's designated storage point(s) including transportation of the same from Contractor's stock yard(s)/worksite(s)/work shop(s) to the COMPANY's designated storage point(s). Contractor shall be responsible for the proper measurements of the unused/ scrap materials to be returned to the COMPANY.
7. Rebuffing of dents in bevels less than 1 mm in depth shall be carried out by Contractor ahead of welding in the field at no extra cost to Company.
8. For the purpose of accounting of pipes all cut pieces in length of 2 m and above when returned to the Company's storage point shall be considered as serviceable material. All pipes measuring less than 2 m shall be treated as scrap/wastage.
9. All unused pipes and serviceable/ scrap material shall be the property of the Company and shall be returned by Contractor to Company at Company's designated storage point(s).

7.2. Materials to be supplied by CONTRACTOR

The procurement and supply, in sequence and at appropriate time and place, including inspection and expediting, of all materials and consumables required for completion of the work as defined in this bid document except the materials specifically listed under para 7.1 above as COMPANY free issue material, shall be entirely the CONTRACTOR's responsibility and the item rates quoted for the execution of the WORK shall be inclusive of supply of all these materials. All materials supplied by the CONTRACTOR shall be strictly in accordance with the requirements of relevant COMPANY material specifications enclosed with the Contract document. All equipment's, materials, components etc. shall be new and specifically purchased for this job from Company approved vendors, duly inspected by third party inspection agency (shall be 3.2 certified-) along with manufacturing certificate for relevant pressure containing equipment/ materials/ parts/ components etc. For other contractor supplied equipment/ materials/ parts/ components, contractor has to submit test certificate as per technical specification/ applicable codes/ approved

 ENERGISING QUALITY	SCOPE OF WORK PIPELINE LAYING	Document No.	Rev
		C251151-00-PP-SOW-2001	C1
		Page 19 of 50	

QAP (as applicable) before supply. As a minimum, the materials to be supplied by CONTRACTOR may include but shall not be limited to the following

1. Insulating Joints
2. 3D Bends (90°, 45°, 22.5° & 12.5°) of sizes as per tender requirement.
3. All materials like Assorted pipes, all type of Valves (below 4"), all type of Flanges (WNRF, BLRF etc) elbows, tees, reducers, weldolets, sockets, nipples, spectacle blinds, end caps, Gasket and stud & bolt etc. as per tender requirement; spacer & blinds required for permanent installation in the system. Each item shall be inclusive of commissioning spares. List of such spares shall be made part of the offer and the quoted unit/total price shall be inclusive of the spares.
4. All equipment's & consumables such as welding electrodes, oxygen, acetylene, inert gases, all types of welding electrodes, filler wires, solder wires, brazing rods, flux etc. for welding/ cutting and soldering purposes.
5. All equipment's, materials, components etc. shall be new and specifically purchased for this job. All material to be supplied by the Contractor shall be purchased from the approved vendors of the Company, duly inspected by Third party inspection agencies as per vendor list attached in tender documents. The list of approved vendors is enclosed along with bid document.
6. The procurement and supply, in sequence and at appropriate time, of all materials and consumables required for completion of the Work as defined in this bid document except the Company free issue material, shall be entirely the Contractor's responsibility and price quoted for the execution of the Work shall be inclusive of supply of all these materials.
7. All materials for all types of pipeline markers including cement, sand, reinforcements, structural steel etc. and paint conforming to normal corrosive environment as per specification enclosed with the bid documents.
8. Casing insulators and end seals and materials for casing vents and drains as per drawings.
9. All materials required for continuous concrete coating/ gravel filled geo- textile bags/ saddle weight for providing negative buoyancy to the pipeline wherever required. Contractor shall take prior approval of COMPANY and furnish all details including design calculations in case of use of purpose built geo-textile bags. For river crossings, only continuous concrete coating shall be provided for negative buoyancy.
10. Supply of warning mats as per the technical specification/ EN: 12613 standard (latest edition).
 - The material of warning mat shall be of virgin quality polyethylene (PE) / polypropylene (PP) as per EN: 12613 (latest edition).

 ENERGISING QUALITY	SCOPE OF WORK PIPELINE LAYING	Document No.	Rev
		C251151-00-PP-SOW-2001	C1
		Page 20 of 50	

- It shall have UV-resistant, non- biodegradable, non-hazardous and non-toxic properties. If warning mat is made from PE material, then, the same shall have anti-rodent properties in addition to above properties.
- Warning mat shall have golden yellow color and printed text shall be in red color and of non-deletable type with high abrasion resistance.
- All test shall be conducted and accepted as per requirement of EN: 12613 (latest edition) unless otherwise mentioned in approved QAP.
- Handling including loading and unloading, packaging, transportation, laying shall be carried out as per manufacturers / supplier's guidelines so that material at all stages up to laying shall be in safe and sound condition.
- Printer matter and their layout shall be approved by PMC/owner before supply.
- Print matter shall be printed in English and Local language alternatively at every 1 m distance. Manufacturer's name, year of manufacturing and batch/lot number shall appear at every running meter of warning mat strip
- In case warning mat is supplied in more than 500 mm width, a sample of width 500 mm from the same lot/batch of material shall be tested as per requirement of EN: 12613. The sample drawn should have same production parameters (except width) as of higher width section.
- Contractor has to submit the QAP of warning mat for approval before commencement of production. Inspection of material will be done at vendor's works by owner/PMC representatives. Any test failed during inspection for the referred lot/batch, the total lot/batch will be rejected. Along with the dispatch clearance photo of the production sample should be submitted for verification.
- Print matter text/ font size will be of letter height 15 mm and thickness of letter line 2 mm. However, vendor to ensure that print matter text size shall be legible when viewed from the range of minimum 5 m distance without magnification.
- If center width of the mat is not sufficient to accommodate the requirement mentioned above, in that case the vendor may put separate PE Centre band/strip to accommodate the below mentioned requirements.
- PE center band/strip shall be golden yellow color and made from virgin quality, high density polyethylene, center band/strip thickness shall be of minimum 0.1 mm thick and shall have UV-resistant, non-biodegradable, non-hazardous, non-toxic and anti-rodent properties.
- PE center band /strip width shall be 100 mm for warning mat width upto 550mm and 150 mm width of PE center bend shall be kept for warning mat width more than 550mm

 ENERGISING QUALITY	SCOPE OF WORK PIPELINE LAYING	Document No.	Rev
		C251151-00-PP-SOW-2001	C1
		Page 21 of 50	

- PE center band/strip shall be pasted on center of the warning mat in such a manner, so that after paste inherent material properties of warning mat shall not be compromised. Further peel strength of the used adhesive material shall be sufficient enough so that PE center band/strip shall not peel off during handling, transportation, storage, laying in trench and in wet environment/condition either at above ground or underground condition. Manufacturer/Supplier shall give declaration/ compliance statement regarding the used adhesive for paste purpose of PE centers band/strip.
 - The warning mat shall be supplied in single part of 600 mm width for 12" Pipeline.
- 11.** Supply of all materials for installation of windsock and safety signboard at different stations.
 - 12.** All materials and consumables required for external corrosion coating and concrete coating (where required) of field weld joints.
 - 13.** All materials required for field joint coating, corrosion coating of LR bends, pup pieces of sectionalizing valves and repair of damaged corrosion coating of line pipe. Contractor shall confirm that proposed field joint coating material is suitable for type of terrain encountered along pipeline route. Contractor shall take prior approval from COMPANY for field joint coating material to be used. The cut back length shall be 150 mm + 20 (-0) mm.
 - 14.** All material, equipment & consumables for HDD works including approved sleeve.
 - 15.** All materials required for sand/ soft soil padding around pipeline and optical Fiber cable, select backfill of approved quality, slope breakers, bank stabilization of water crossings etc.
 - 16.** For rocky areas, rock shield shall be provided in addition to sand/ soft soil padding. Rock shield shall be of high density extruded polyethylene mat with following properties:

Thickness	ASTM D-1777	6 mm (minimum)
Compressive Strength	ASTM D-1621	250 PSI
Impact Resistance	ASTM G-14	100 in-lb

Contractor shall obtain prior approval from Engineer-in-charge for rock shield material & its application procedure.

- 17.** All materials including consumables, nitrogen etc. required for hook-up with existing facilities and equipment's.
- 18.** Mobilizing and providing all necessary barricading material, safety signboards, warning lights etc. to safeguard the pipeline against accidents during

 ENERGISING QUALITY	SCOPE OF WORK PIPELINE LAYING	Document No.	Rev
		C251151-00-PP-SOW-2001	C1
		Page 22 of 50	

construction of line in city area.

19. All safety tools, tackles, devices, apparatus, equipment etc. including ladders and scaffolding complete as required.
20. All stud bolts, nuts, jack screws, all type of gaskets (metallic spiral wound gaskets) in required quantities to be used for permanent installation into the system for all sizes and ratings of flanges and flanged valves, equipment etc., including nuts, bolts, gaskets, washers, U bolts, clamps, clips etc. for pipe/ equipment supports. All materials for supports shall be in contractor's account.
21. All types of coating and painting materials including primer and paints suitable for specified corrosive environment for painting above ground piping and 100% solid high build epoxy R95/R150 (minimum 1000-micron Thk.) for underground piping/ valves, fittings, flanges etc.
22. All pipes, fittings, flanges, blind flanges, gaskets, nuts, bolts, clamps, strainers, equipment/ consumable, metallic blinds, temporary gaskets as required for filling, pressurizing, hydrostatic testing and dewatering, swabbing etc. including test headers for pigging and hydro-testing.
23. All materials such as cohesion less soil/ sand required for installation of pipeline in seismic active zones.
24. All materials required for civil, structural and general civil works including structural steel, cement, reinforcement, concreting, grouting etc. in facilities like dispatch terminal, IP Station, SV stations, injection points and receiving terminal including all types of equipment and material required for excavation/ construction of pits for equipment and instrument installations and steel/ structural steel materials of all types.
25. All materials required for repair/ restoration of pavements, roads, bunds, walls, other structures affected/ damaged by Contractor's construction activities. Materials shall be equivalent/ superior to those used for original construction of the facility.
26. All equipment and consumables required for hydrostatic testing like pumps, pressure and temperature gauges, test water and corrosion inhibitors for test water for hydrostatic testing.
27. Supply of insulators, end seals etc. in case of cased crossings.
28. All materials, consumables and equipment required for welding and for all types of tests and NDT such as radiography, ultrasonic testing, magnetic particle, dye penetrate examination etc. including radiography film, X-ray machines, developing equipment and consumables, Ultrasonic equipment's etc.
29. All safety tools, tackles, devices, apparatus, equipment etc. including ladders and scaffolding complete as required.

 ENERGISING QUALITY	SCOPE OF WORK PIPELINE LAYING	Document No.	Rev
		C251151-00-PP-SOW-2001	C1
		Page 23 of 50	

- 30.** Steel materials such as structural steels, reinforcement steels and steel for all types of supports, foundations, ladders, platforms, etc.
- 31.** All steel materials such as structural steel, reinforcement steel, shims, wedges, packing plates (machined wherever required), pipes, nuts & bolts, washers, U-bolts, anchor bolts, clamps, clips, pipe saddles/ shoes etc. as required for the fabrication of structural supports and supports basements/ foundations, platforms etc. Pipes supplied by COMPANY shall not be used for fabrication of supports and support saddles etc.
- 32.** All materials for corrosion protection of buried piping, pipe fittings, valves, casing pipes, etc.
- 33.** All materials and equipment's related to blasting of rock/ controlled blasting for excavating trench, grading of ROU, pipeline & pipe laying/ installation and other works.
- 34.** All materials for surface type temperature element.
- 35.** Mobilizing Pipe/ cable locator for locating existing pipelines/ cables.
- 36.** All types of corrosion measuring instruments e.g. Corrosion coupons, corrosion probes etc. wherever required as per specification.
- 37.** Sand ridges (sand, polyethylene sheets etc.) and other materials for stacking of surplus pipes at Company's designated storage yard.
- 38.** Corrosion inhibitor shall contain the properties of oxygen scavengers and bactericides. The water test results will determine the recommended dosage in PPM.
- 39.** Required quantities of nitrogen for idle time preservation and pre-commissioning of Pipeline and associated facilities, if required.
- 40.** All pigs for cleaning, gauging, filling, dewatering, swabbing, drying, pre-commissioning and commissioning of the pipeline.
- 41.** All materials i.e. fittings, flanges, valves, blind flange etc. required for isolation and nitrogen purging for pipe section, manpower, equipment, pigs, consumables, nitrogen required for carrying out commissioning of pipeline along with necessary piping and instrumentation connection for monitoring flow rate, pressure, temperature etc. providing temporary facilities for venting/ flaring along with necessary piping, valves and instrumentation etc. shall be in contractor's scope.
- 42.** All materials, manpower, spares, tools & tackles and consumables for carrying out pre-commissioning activities and during commissioning (including bi-directional and foam pigs, compressor, nitrogen required for achieving the specified criteria for pipeline intertization/ purging prior to declaring pipeline fit

 ENERGISING QUALITY	SCOPE OF WORK PIPELINE LAYING	Document No.	Rev
		C251151-00-PP-SOW-2001	C1
		Page 24 of 50	

for commissioning) necessary piping and instrumentation connection for measuring flow rate, pressure, temperature etc., temporary facilities for blowdown/ venting/ flaring along with necessary piping, valves & instrumentation as well as consumables and manpower required during pre-commissioning and commissioning.

- 43.** All materials and consumables required for external corrosion coating and concrete coating (where required) of field weld joints shall be included in the cost of laying of pipeline network and shall be in scope of contractor.
- 44.** Dirax or equivalent field joint coating material for HDD works.
- 45.** All materials required for sand/soft soil padding around pipeline and optical fiber cable, select backfill of approved quality, slope breakers, bank stabilization of water crossings wherever required.
- 46.** All materials including consumables required for hook-up with adjoining pipeline section or wherever required.
- 47.** Supply of cohesion less soil, if required, like sand, silty sand, etc. for complete backfilling of pipeline trench for a specified distance in areas prone to Seismic activity.
- 48.** All primer and paints for painting above ground piping. All painting shall be as per specification enclosed with the bid package. Paint shall be suitable for low temperature application as per company specification enclosed with the bid document wherever specified.
- 49.** Material for the maintenance of sand ridges and other materials for pipe stacking at Contractor's warehouse/storage yards/work site/ROU.
- 50.** All materials for skin measurement instrument.
- 51.** All temporary materials and consumables required for filling and pressurizing in connection with hydrostatic testing, dewatering, swabbing and pre-commissioning activities, etc. Including pipes, flanges, fittings, gaskets, bolts, nuts, etc. required for fabrication of temporary pig traps and /or test headers.
- 52.** All materials required for repair/restoration of pavements, roads, canals, temporary water pipes, walls, other structures affected/damaged by Contractor's construction activities. Materials shall be equivalent/superior to those used for original construction of the facility. Any other area damaged outside the construction area by the contractor due to movement of machinery or any other reason will be repaired by the Contractor without any extra cost to the owner.
- 53.** All pigs for cleaning, gauging, de-watering, swabbing, filling, pre-commissioning and commissioning of the pipeline.
- 54.** Pumps and water to be used for hydrostatic testing/ flushing shall be supplied by

 ENERGISING QUALITY	SCOPE OF WORK PIPELINE LAYING	Document No.	Rev
		C251151-00-PP-SOW-2001	C1
		Page 25 of 50	

the contractor. All materials & consumables required for hydrotesting shall be supplied by the contractor.

- 55.** All casing pipes, casing insulators and end seals including materials for vent and drain and strapping CS conduit with pipe and carbon steel pipes in required quantities.
- 56.** All consumables and equipment's required for all types of tests and NDT such as radiography, ultrasonic testing, magnetic particle, dye penetrant examination etc. including radiography film etc.
- 57.** All safety tools and tackles, devices, apparatus, equipment, personal safety gazettes to be used as personal protective equipment (such as helmets, safety belts, safety shoes, etc.) including ladders and scaffolding etc. complete as recommended by Engineer-in-Charge as per relevant safety standards
- 58.** All structural steel material for all types of supports.
- 59.** All materials and equipment for excavating trench or grading the Right-Of-Use pipeline and pipe laying/installation and other works.
- 60.** All steel materials such as structural steels, reinforcement steels and steel for all types of supports, foundations, ladders, platforms etc. including Bolts, nuts, washers, U bolts, clamps, clips, gaskets, Shims, wedges and packing plates (Machined wherever required) and materials required for fabrication of low friction sliding bearing supports.
- 61.** All fencing, gate and steel materials such as structural steels, reinforcement steels and steel for all types of supports, foundations, ladders, platforms, etc
- 62.** All other materials not specified above but required for successful completion of the entire work whether temporary or permanent in nature.
- 63.** All materials supplied by the Contractor shall be strictly in accordance with the requirements of relevant Company material specifications enclosed with the tender document.
- 64.** All spares for pre-commissioning and commissioning as required for all items supplied by Contractor for the entire pipeline system.
- 65.** All materials, equipment and personnel required for videography and all associated works.

The item rates quoted for the execution of the work shall be inclusive of supply of all materials mentioned above unless specifically covered otherwise under schedule of rates. The quantities indicated in schedule of rates under Contractor's scope of supply are approximate. Contractor shall carryout MTO of all materials required based on IFC general arrangement drawings, P&IDs and firm up the actual requirement of materials. All escalation/ extra materials procured by Contractor for

 ENERGISING QUALITY	SCOPE OF WORK PIPELINE LAYING	Document No.	Rev
		C251151-00-PP-SOW-2001	C1
		Page 26 of 50	

contingencies shall be Contractor's property and no payments shall be made for such materials. Payment shall be made for actual materials installed by the Contractor as a part of permanent installation.

In case, any item is covered in scope of work but is not present in Schedule of Rates (SOR), it will be assumed that bidder has included cost implication of those items in their total price.

7.3. STORAGE OF MATERIALS

- 7.3.1. All materials shall be preserved against deterioration and corrosion due to poor or improper storage while under the custody of the Contractor.
- 7.3.2. All materials shall be duly protected by the CONTRACTOR at his own cost with the appropriate preservatives like primer, lacquer coating, grease etc. and shall be covered with suitable material to prevent them from direct exposure to sun, rain, wind and dust.
- 7.3.3. Whenever applicable, pipes shall be stacked according to the identification marks and stacks shall be arranged on sleepers/ sand pads at least 300 mm above ground.
- 7.3.4. The CONTRACTOR shall check that valves, fittings, specials etc. are not subjected to corrosion from hydrostatic test water remaining in the packing. Any such condition when detected should be brought to the notice of Engineer-in-Charge and remedial measures taken as directed.
- 7.3.5. All machined surfaces shall be properly greased and should be maintained and protected from damages.
- 7.3.6. Openings of equipment, machinery, valves etc. shall be kept blocked/ covered with blinds to prevent entry of foreign matter.
- 7.3.7. As far as possible materials shall be transported to the site of erection only just prior to the actual erection and shall not be left lying around indefinitely on ground but kept on packing/ sleepers etc. to maintain the minimum distance from the ground as specified and/ or as per directions of Engineer-in-Charge.
- 7.3.8. Client reserves right to unload line pipe directly in the store on contractor. Contractor shall maintain store yard accordingly and shall submit their price considering factor of the same. Client shall not pay any extra cost to Contractor for loading & unloading the contractor's store or elsewhere for handling of Line pipes

8. SCOPE OF WORK AND SCOPE OF SUPPLY FOR OTHER DISCIPLINES

Detailed scope of work and scope of supply covered in this document given above is pertaining to pipeline laying and associated pipeline terminal/ station piping works only. Detailed scope of work related to civil, architectural, structural, Cathodic protection, corrosion monitoring system, electrical, instrumentation, telecom, firefighting and water supply works are covered in separate documents in detail and the same are enclosed elsewhere with the Bid document. All these documents shall be read in conjunction with this document and shall form an integral part of the overall Scope of work of the Contractor(s).

 ENERGISING QUALITY	SCOPE OF WORK PIPELINE LAYING	Document No.	Rev
		C251151-00-PP-SOW-2001	C1
		Page 27 of 50	

9. OTHER CONDITIONS OF BID

9.1. Basis of Work

9.1.1. All piping/ pipeline works shall be carried out as per following:

- Piping and Instrumentation Diagram (P & IDs) and line schedule.
- Approved for construction Piping General Arrangement Drawings (GADs).
- Approved for construction Alignment sheets/ crossing drawings.
- Piping Material Specifications.
- Specifications
- Piping support standards/ drawings and support index.
- Any other drawings/ sketches prepared by Company and/ or by the Contractor and approved by the Company

9.2. Topographic Survey

- The alignment sheets including plan and ground profile details, details of various crossings shall be provided at the time of execution.
- It shall be the Contractor's responsibility to verify the pipeline routes. Wherein Contractor's opinion the survey and investigation data is not found to be sufficient in detail, it shall be the responsibility of the Contractor to collect/ arrange and provide such topographic surveys.
- Further, successful contractor(s) after award of work shall immediately carry out topographic survey and geotechnical investigation of all crossings other than those provided by the company in the pipeline route and prepare crossing drawing for each crossing. The drawing shall be submitted for Company's approval. IFC alignment sheet shall be issued based on the input of above crossing drawings.
- Contractor shall also perform any additional topographic surveys and geotechnical investigations that may be required for local detours or at crossings or at any other location during execution of the project without any extra cost to the COMPANY. Pipeline alignment shall be marked on village maps by CONTRACTOR wherever detouring is beyond existing ROU. CONTRACTOR shall be deemed to have considered such eventualities while formulating his bid.
- It shall be the responsibility of the Contractor to re-establish the route from the survey data made available by Company. Contractor shall maintain and preserve survey monuments (staked on ground) such as bench marks and intersection points, till construction is completed.

9.3. Alignment Sheets and Station Drawings

- Typical station drawings are also included in the Bid package. These drawings are marked as "Tender Purpose Only".

 ENERGISING QUALITY	SCOPE OF WORK PIPELINE LAYING	Document No.	Rev
		C251151-00-PP-SOW-2001	C1
		Page 28 of 50	

- The IFC (Issued for Construction) drawings issued during project execution stage may vary from the drawings included in the Bid Package. CONTRACTOR shall carry out all works in accordance with these IFC drawings at no extra cost to the COMPANY.

9.4. Description of pipeline Route

9.4.1 Route Description

- Bidder shall visit the entire route before bidding.

9.4.2 Most of the areas the Pipeline network shall be laid along the road/ industrial area and residential area. The ROU shall be restricted in all along the pipeline network Route.

9.5. Soil Investigation and Soil Resistivity survey

Survey report for soil investigation and soil resistivity survey shall be provided prior to execution.

It shall be Contractor's responsibility to verify the data and satisfy himself with regard to accuracy and utility of data. CONTRACTOR shall carry out any additional soil data/ investigation required for installation. CONTRACTOR shall not be entitled for any compensation in terms of time or cost in case of any variation in actual site conditions from the data furnished in the bid package. **It shall be Contractor's responsibility to familiarize himself with sub-soil conditions along the pipeline route and workout the lengths of pipeline to be laid in different subsoil conditions including the quantum of rock excavation that would be necessary. Unit rates quoted shall also be inclusive of all rock excavation. No extra compensation shall be payable to CONTRACTOR for any rock excavation whatsoever.**

9.6. Pipeline ROU

Contractor shall carry out construction work within the width of pipeline available ROU as made available to them with no time and cost implication to the Company. The Contractor shall arrange any additional ROU requirement for construction purposes. It shall be Contractor's responsibility to make arrangement for any additional land required for fabrication, construction, storage and all other work areas. In certain restricted areas such as private holdings, congested and plantation areas etc. ROU is restricted. In forest areas only 10 m ROU will be made available to the contractor. Contractor shall propose suitable execution methodology and time schedule for construction/ execution of work at areas of restricted ROU and deploy adequate equipment& manpower etc. as required. Contractor shall also arrange additional land during installation of Pipeline by HDD. Damages, if any, to existing pipeline and facilities shall be Contractor's account. Wherever the detouring is carried out beyond ROU during pipeline installation, the detoured pipeline alignment shall be marked on village maps by the pipeline installation Contractor.

9.7. Pipeline Passing Through City Area and Along NH/ SH

 ENERGISING QUALITY	SCOPE OF WORK PIPELINE LAYING	Document No.	Rev
		C251151-00-PP-SOW-2001	C1
		Page 29 of 50	

In case the pipeline passes through city areas, it will be laid generally in the carriage way. Wherever it is not possible to lay the pipe line on the carriage way for any reason whatsoever, the pipeline will be laid on service road / footpath. It will be the responsibility of the Contractor to identify all the underground utilities after surveying the area along the gas pipeline route and lay the pipeline with clear distance (as specified in Specification) from other existing utilities like cable, water pipeline etc. In case of hydrocarbon pipeline the clear distance shall be as specified in Specification.

9.8. RESTRICTION OF ROU

- In congested urban/industrial areas where the exact location of the existing services (aboveground as well underground) is not known, the contractor shall contact the concerned authorities to get the permission to cross the existing utility including approval of the final alignment of the pipeline before commencement of work. Contractor shall obtain the Digging Permit from the respective authority. In addition to this acquisition of NOC from the respective utilities' companies will be also in the scope of the contractor.
- In most of the areas, the Pipeline shall be laid along the road and residential/ Industrial/ city area. The ROU shall be restricted in the entire pipeline Route. Contractor shall consider all these eventualities while bidding. It shall be Contractor's responsibility to make arrangement for any additional land required for fabrication, construction, storage and all other work areas. Contractor shall carry out construction work within the width as available to him. Damage to any obstruction, temporary/permanent structure, boundary walls etc. shall be repaired and restored and shall be to Contractor's account.
- The Contractor must ensure that during laying of the pipeline minimum damage occurs to the land. The land has to be restored to original condition. All construction activities shall be in accordance with the local Government regulations.
- During pipeline construction, measures shall be adopted in order to minimize the impact of pipeline construction activities on the environment.
- In case contractor wishes to propose any detour from the acquired alignment due to constructability problems or otherwise, he may be permitted to do so only after explicit approval from the Company. All immediate measures for taking the land and compensations to land owner(s) shall be to Contractor's account. Company shall proceed with regular notifications etc. in due course. All statutory fees shall be paid/ reimbursed by Company. However, such activity shall not affect the construction schedule and overall completion period.
- In many areas due to pipeline being laid in ROW of NH/ SH areas and due to several underground obstacles encountered during construction, mechanical trenching may not be possible. In such cases Contractor shall perform the work by manual means without any Cost as well as time implications.
- The contractor shall finalize the alignment of pipeline by making the trial pits at regular intervals in order to ensure the location of existing underground utilities.
- In urban/ Industrial areas where there are numerous underground utilities,

 ENERGISING QUALITY	SCOPE OF WORK PIPELINE LAYING	Document No.	Rev
		C251151-00-PP-SOW-2001	C1
		Page 30 of 50	

the cover of 1.2m /1.5 m may not be sufficient; Contractor will not raise any compensation for any such necessary deepening. Due to deepening of trench, it may be required that shoring of trench may be required to avoid collapse of the same along the road. The same shall be done by the contractor without any cost implications.

- Due to restriction by statutory authorities, the Contractor may not be allowed to work during monsoon season. Thus, for such areas the contractor shall plan his work accordingly and submit his schedule to relevant authorities without any time as well as Cost implication.
- In city areas where, due to restrictions by the statutory authorities, the movement of heavy machinery is not allowed, the laying /Construction activities shall have to be carried out manually. Only tyre mounted equipment such as Hydra/ JCB etc. will be permitted with consent of the concerned authorities.
- Contractor may plan to work in the Night shift to avoid traffic and in residential/industrial/city areas to keep minimum disturbance during day time. But Contractor has to plan and take approval from Engineer In charge/ Client and Concerned Authorities before start of construction. Contractor to arrange all lighting and safety precaution for the same.
- The authorities may impose stringent conditions for laying the pipeline in certain areas like limited length of working section, night work shift only etc. Thus, the contractor must submit his working methodology to relevant authorities in order to obtain the necessary permission for laying the pipeline prior to commencement of work.
- Due to non-mobilization of the heavy machinery and due to underground utilities, the welding of long pipe string above ground and lowering may not be possible, therefore welding may need to be carried out in the trench by making bell holes for individual pipe or small sections of pipe.
- To comply with the agreed work schedule, the contractor may work in shift or extended hours.
- The Contractor shall be deemed to have taken into consideration all variations as mentioned above at the time of formulating his bid and no extra compensation either by way of time or cost shall be admissible.

9.9. PARTICULAR INSTRUCTIONS

- In Principle all statutory permissions from all concerned shall be obtained by Client. However, all activities related to liaison, co-ordination etc. with all authorities needed to achieve the work as per schedule will be under Contractor's scope including taking work permit/ Digging Permit before commencement of work. Contractor shall also inform and seek necessary permission from the local traffic police before commencement of trenching work.
- For access route to the working strip, the Contractor will be responsible to negotiate with the relevant owner, tenant or authorities. Any deemed compensation will be borne by the Contractor.

 ENERGISING QUALITY	SCOPE OF WORK PIPELINE LAYING	Document No.	Rev
		C251151-00-PP-SOW-2001	C1
		Page 31 of 50	

- The contractor shall be responsible for overall entire quality control activities for the present project.
- Contractor proponent shall have to take prior approval of concerned Government agencies while carrying out blasting wherever required.
- Contractor proponent shall have to take preserve top soil dug and shall be restored to original condition on completion of the work.
- Owner shall obtain permission from the Forest department. However, required assistance to get the permission from the respective authorities, necessary liaison, co-ordination etc., with the authorities needed to achieve the work as per schedule including taking work is in the Contractor's scope.
- While carrying out the laying activities any damage to other utilities to be repaired by the contractor to the full satisfaction of the utility agency. Any claim arises out of damage of other utilities shall be borne by the contractor.
- Contractor proponent shall construct the pipeline and other infrastructure and adopt safety measures as per the standards & specification laid down by the concerned agencies from time to time.
- Contractor proponent is required to comply with the manufacturing, Storage and import of Hazardous Chemicals Rules -1989 framed under the Environment (protection) Act 1986.
- On completion of all temporary work structures, surplus materials and wastes shall be suitably disposed of.
- Similarly, any additional conditions issued by statutory authorities will also have to be complied with by the contractor without any cost implications.

9.10. PREPARATION OF CONSTRUCTION SITE

The overall duration of the works at every point of the pipeline route, from the opening of the working area to lowering of pipeline and trench backfilling shall not exceed the permit condition of relevant authority.

9.11. WORKING STRIP

No ROU exist for the city portion line along the authority land. Working strip may be available along the road side for the construction site. Contractor should deploy suitable equipment and adopt his working methodology accordingly.

9.12. REDUCING THE WORKING STRIP

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

9.13. REVERSE OF THE WORKING STRIP

No fencing of any kind along the pipe route is essential to be provided. However, it remains the responsibility of the Contractor to barricade the area of open trenches so

 ENERGISING QUALITY	SCOPE OF WORK PIPELINE LAYING	Document No.	Rev
		C251151-00-PP-SOW-2001	C1
		Page 32 of 50	

that no untoward accident takes place.

9.14. EXCAVATIONS (UNDERGROUND OBSTACLES)

In congested area or if deemed necessary by Owner's Engineer or concerned authorities where numerous utilities may be encountered the contractor should carry out the excavation manually without entitlement of any compensation. Proposed pipeline shall be beneath the main underground utilities and minimum 500 mm gap also to be maintained in-between proposed pipeline and existing underground utility.

9.15. REINFORCED CONCRETE SLABS AS MECHANICAL PROTECTION FOR THE PIPE

Crossing of utilities will be done by invariably going below the utilities maintaining a clear gap of minimum 20 cm except hydrocarbon pipelines. From hydrocarbon pipelines, clear gap of minimum 50 cm shall be maintained. If due to site constraint it is not possible to lay the pipeline as per the above cover requirement, Contractor shall initiate the proposal for approval of Deviation and obtain written permission from EIC.

9.16. MARKERS

Pipeline Warning Markers shall be installed at each and every Kilometer. Apart from this, additional warning markers shall also be installed at each side of highways (NH/SH), major district roads (MDR), all metaled roads, railway crossings, water body crossings, any other major crossings and at entrance to stations.

For urban Agglomeration (UAs) / Towns having a population of 1 lakh or more, the warning marker shall be installed at least at every 50 meters and if required additional markers shall be installed where there is possibility of damage or interference.

Pipeline Warning Sign shall in general be installed at

- National and State Highway Crossings (2 Nos.)
- Other Road Crossings (1 No.)
- Railway Crossings (2 Nos.)
- Minor Water Crossings (less than 15m width) (1 No.)
- Minor Water Crossings (above 15m width) (2 Nos.)
- Major Water Crossings (2 Nos.)
- Valve Station (1 No.)
- And at any other location as shown in the approved drawings and as directed by the COMPANY.
- Pipeline Warning Sign shall identify the existence of the pipeline

 ENERGISING QUALITY	SCOPE OF WORK PIPELINE LAYING	Document No.	Rev
		C251151-00-PP-SOW-2001	C1
		Page 33 of 50	

Aerial markers shall in general be installed along the pipeline at every 5 kilometer's interval and at places specified by COMPANY. The aerial kilometer marker having the warning details can also be treated as warning marker.

Kilometer markers shall in general be installed at every one (1) kilometer interval along the pipeline route and in place of every fifth kilometer marker, aerial marker shall be provided. The Aerial/ Kilometer Markers having the warning details can also be treated as Warning Marker.

Right-of-Way/ boundary markers shall be installed at every 250 meters interval along the entire pipeline route. These shall be installed on either side of the pipeline alignment to define the ROW boundary limits. These shall also be installed at pipeline turning points to maintain the continuity of the ROW limits. In urban agglomerates (UAs)/ towns having a population of 1 lakh or more, pipeline route marker shall be installed at least at every 25 meters.

9.17. DIRECTIONAL MARKERS

Direction markers shall be installed to identify the significant turning points of the pipeline during aerial traverse. One direction marker shall be installed at each turning point. In addition, direction markers shall also be installed along the pipeline alignment at 150 m upstream and downstream of turning points.

9.18. EXCAVATED MATERIALS

- The excavated material shall be placed in such a way as to avoid any inconvenience to property owners, or interference to the circulation of pedestrians or vehicles as well as to the operation of near-by installations. The excavated material shall be piled up in such a way that they enable the watering of the trees. No excavated material shall be piled up in the road crossings. It may be insisted upon by the authority to remove all the excavated materials immediately after trenching.
- To prevent the excavated stone and earth from falling into the trench, a strip
- 20cm shall be left clear between the edge of the trench and the bottom of the pile of excavated earth. This width may be increased, according to the nature of the ground and the atmospheric conditions.
- Wherever necessary, the contractor is required to remove the excavated material from the site and to be kept at a dump yard until the trench is to be back filled and to be brought back to the site for backfilling.
- When the excavated material is judged by the Engineer to be unsuitable for re-use, the Contractor shall remove it from the site as the digging of the trench proceeds and shall supply in its place suitable material approved by the Engineer-In-Charge.
- Contractor is required to arrange the steel plates (preferably 1.5 meters wide x 20mm Thk.) to place on the excavated trench for smooth movement of traffic.

 ENERGISING QUALITY	SCOPE OF WORK PIPELINE LAYING	Document No.	Rev
		C251151-00-PP-SOW-2001	C1
		Page 34 of 50	

9.19. Signalling, Fencing & Lighting

- Each site shall be provided with an identification board mentioning the reason for the work and the names of the Company, the Contractor and the Consulting Engineer, as stipulated in the special specifications.
- At both ends of the trench, the Contractor shall install 2 traffic and warning signs, and Display board one immediately close to the trench and the other ahead, as required by the Engineer-In-Charge.
- The Contractor shall install lights and warning lights around all working areas, in accordance with the special specifications. The voltage shall conform to the safety regulations in force.
- The Contractor shall install barricading and lighting of all trial-holes, trench sections and other excavations.
- The Contractor shall provide watchmen wherever deemed necessary for the safety of the public and of the workers, in particular as regards working sites, on site material stockage, temporary dumping yards, etc.

9.20. Barricading

- The contractor shall provide the barricades of size 2m wide X 1.5m high of wooden/plastic/steel with necessary supports along the open trenches to protect/caution the public about the digging work without any cost to owner. The barricades shall be painted as per the requirement of authority with the owner's/Consultants/Contractor's details, job being carried out, cautions, inconvenience captions, etc. also needs to be provided.
- Contractor shall Excavated trench & pits in residential area, area near heavy traffic and other areas for kept for movement of animals, shall not be left open without barricading. Contractor shall consider all these eventualities while bidding.

9.21. Site Visit

- Bidders are advised to make site visits for complete pipeline network route to establish the route, missing survey stones and familiarize with the working conditions familiarize themselves with all the salient features of subsoil, terrain and available infrastructure along the pipeline route so as to plan for deployment of man and machinery. Contractor shall be deemed to have considered all constraints and eventualities on account of site conditions along pipeline route while formulating his bid. Contractor shall not be eligible for any compensation in terms of cost and/ or time, on account of site conditions along pipeline route varying to any extent from whatever described in the Bid Package and the survey/drawings/data furnished along with the Package.

9.22. Line Pipes & Coatings

9.22.1. Taking Over of Pipes

COMPANY shall supply bare, externally corrosion coated with 3-layer polyethylene

 ENERGISING QUALITY	SCOPE OF WORK PIPELINE LAYING	Document No.	Rev
		C251151-00-PP-SOW-2001	C1
		Page 35 of 50	

coating and internally epoxy coated line pipes. Contractor shall receive and take over the pipes progressively as per construction requirements at designated place of issue in presence of Company's representative. At the time of taking-over, Contractor shall perform inspection of pipes and pipe coating for all defects in the presence of Company's Representative. COMPANY shall be liable for repair defects and damage to pipe coating noticed at the time of taking over. However, installation Contractor shall repair all defects to pipe and pipe coating occurring after taking over including those during transportation and handling. Rebuffing for dents (in bevels) less than 1 mm in depth shall be carried out by Contractor ahead of welding in the field at no extra cost to COMPANY. Contractor shall take-over the entire quantity of bare and coated line pipe from storage yard after completion of installation works.

Return of surplus line pipe material to Company's designated storage yard is in installation Contractor's scope including loading, transportation, unloading, handling, stacking of pipes at storage yard and getting the pipes inspected to Company's representative at storage yard.

9.22.2. Repair of Coatings

CONTRACTOR using suitable material compatible with parent coating system shall carry out any repairs to 3-layer polyethylene coating. The coating repair material and procedure for application shall be submitted to COMPANY for approval prior to start of construction.

Repair of PE coated pipes in field shall be carried out as follows in accordance with bid specification.

- i. Damages caused to coating by handling such as scratches, cuts, dents, gouges, not picked up during holiday test, having a total reduced thickness on damaged portion not less than 2.0 mm and an area not exceeding 20 cm² shall be rebuild by heat shrink patch only and without exposing to bare metal.
- ii. Defects of size exceeding above mentioned area or holidays of width less than 300 mm shall be repaired with heat shrink repair patch by exposing the bare metal surface.
- iii. Defects exceeding the above and in number not exceeding 2 per pipe and linear length not exceeding 500mm shall be repaired using heat shrinkable.

9.23. Statutory Permissions

The COMPANY shall obtain a general permission from the various authorities having jurisdiction over the area as necessary for construction of the pipeline. However, for some of the permissions, if not available, Contractor shall do the follow up with the concerned authorities to get the permissions to execute the job in time. However, all statutory payments required for such permissions shall be reimbursed by Company at actuals. CONTRACTOR shall obtain the necessary permits like work permit/ excavation permit/ trench opening permit etc. for all works from the authorities having jurisdiction before the actual execution of various phases of the works and all stipulations/ conditions/ recommendations of the said authorities shall be strictly

 ENERGISING QUALITY	SCOPE OF WORK PIPELINE LAYING	Document No.	Rev
		C251151-00-PP-SOW-2001	C1
		Page 36 of 50	

complied with at no extra cost to COMPANY. CONTRACTOR shall also obtain all necessary permissions from the concerned authorities for installation of pipeline at railways, roads, water crossings and at places where blasting is required. COMPANY may, however, assist CONTRACTOR in obtaining such permissions, wherever required, by issuing recommendation letters etc. In case of damage to other utilities/ infrastructure, Contractor shall be responsible and the required compensation as per the directions of concerned authorities/ COMPANY shall be paid by the Contractor. After completion of work, Contractor shall obtain a certificate from the concerned authorities that the job has been completed as per their requirement and the area/ land has been restored to their satisfaction.

9.24. Controlled Blasting's

In case blasting is required for making of trench for laying pipeline, it shall be responsibility of the contractor to ensure safety of pipeline while carrying out blasting operations. The controlled blasting procedure shall be subject to approval of Company.

9.25. Environmental Restrictions

- The following measures shall be adopted during pipeline construction in order to minimize the impact of pipeline construction activities on the environment.
- While working in plantation areas, Contractor shall take due care to minimize the damage of trees. The number of trees felled shall be restricted to minimum based on working requirement for pipeline installation. In the paddy field area, Contractor shall exercise maximum care not to damage the crop outside the ROU. The compensation of damage of crop outside ROU, if any, shall be to Contractor's account. Damage to any obstruction, temporary/ permanent structure, boundary walls etc. within ROU shall be repaired, restored and shall be to Contractor's account.
- During ROU clearance, the vegetation shall be cut off at ground level leaving the roots intact to the extent possible. Only stumps and roots directly over the trench shall be removed for pipeline installation.
- Intake and discharge of water required/ used for line flushing and testing should not cause unacceptable environmental disturbance. During dewatering process, proper drainage arrangement shall be made to discharge the hydro-test water to avoid flooding of the nearby area.
- As far as possible, the contractor shall ensure that river and stream crossings are done during dry season to avoid disturbance of breeding grounds and soil erosion. The riverbed, embankments and dykes shall be restored adequately after installation of crossings
- The contractor shall exercise adequate care while working, in order to avoid damage to forests and wildlife.

9.26. Pipeline through Seismic Areas

 ENERGISING QUALITY	SCOPE OF WORK PIPELINE LAYING	Document No.	Rev
		C251151-00-PP-SOW-2001	C1
		Page 37 of 50	

The requirements specific to safety of pipeline against seismic activity:

- Backfill for pipeline trench at locations where the pipeline crosses the faults should be provided with loosely compacted (unit weight $< 1.8 \text{ t/m}^3$) cohesion less soil for a distance of 1 km on both side of such crossings. The angle of friction of cohesion less soil to be used for backfilling should not be more than 25° . In case the dugout soil of the trench is clayey in nature (undrained shear strength greater than 0.5 T/m^2), the local soil shall be replaced by engineered (cohesion less) backfill as mentioned in previous paragraph. Otherwise, the same dugout soil can be used as backfill. The recommended backfill shall be at least 600 mm thick all around the pipeline. Extra digging of trench shall be carried out to provide 600 mm cohesion less soil all around the pipeline.
- If the fault crossing zone, the pipeline is in rocky terrain, the following recommendation is made. When the pipeline is to be laid on a rocky terrain, the stones/ boulder/ rock dugout from the trench should be crushed such that maximum size of stone/ boulders is limited to 20 mm. The crushed stone should be mixed with locally available soil, before using as backfill. Alternatively, 150 mm sand padding shall be provided all around the pipeline before crushed boulders/ stones are placed over the sand padding. In this case the size of boulders can be increased up to 100 mm.
- A minimum gap of 100 m shall be maintained between two successive bends of the underground pipeline where the deflection angle is more than 45° . Rerouting shall be carried out in consultation with Company incase minimum gap could not be maintained.

9.27. Pipeline Burial

The pipeline shall be buried normally at a depth of 1.0 meter except river/ rail/ road/ canal/ water crossings/ paddy fields/PWD roads where cover shall be as given in design basis, Alignment sheet or as per the requirements of statutory/ local authorities whichever is more stringent. Increased wall thickness (as indicated in alignment sheets) and cover shall be provided at critical locations and at crossings.

The pipeline, in general shall be laid underground with minimum cover as provided in design Basis.

9.28. Crossings

For all rails, road, canal, river & other water crossings, Contractor shall liaison with relevant authorities and intimate them well in advance about the schedule and methodology of crossing. It shall be obligatory on the part of the laying Contractor to ensure that Authorized Representative of the authority under whose jurisdiction the crossing falls should be made available at site by the Contractor at the time of making crossing. After completion of works and complete restoration of ROW, Contractor shall provide NOC from the relevant official pertaining to complete restoration to their satisfaction and certification in respect of no other damage caused to their property outside the earmarked ROW.

 ENERGISING QUALITY	SCOPE OF WORK PIPELINE LAYING	Document No.	Rev
		C251151-00-PP-SOW-2001	C1
		Page 38 of 50	

9.29. Railway Crossings

In case of permission by Boring: Pipeline at railway crossings shall be provided with a casing pipe. The casing pipe shall be three nominal pipe sizes larger than carrier (unless advised otherwise by concerned authorities) and shall be installed by boring/ jacking/ HDD/ ramming. Internal of Casing pipe shall be coated with two-component epoxy coating wherever required by statutory authorities. It should be noted that the extent of casing pipe generally specified by Railways is 14.0 m beyond centerline of the outermost tracks on either side or 0.6 meter beyond the ROU/ROW limits of Railways on either side, whichever is more. Carrier pipe shall be electrically insulated from the casing pipe and casing ends shall be sealed using durable, electrically non-conducting materials. The crossing drawing shall be subject to approval of concerned Railway Authorities prior to implementation. The railway crossing shall comply with the requirements of API 1102 and Indian Railways regulations. The crossing angle shall be as close to 90° as possible. Cover of casing pipe for railway crossings shall be minimum 1.7 m wherever railway track is on embankment. Care shall be taken to isolate the pipeline crossing installation from aerial electrical wires and shall be suitably insulated from underground conduits carrying electrical wires. The casing pipe shall be provided with minimum 50 mm diameter vent pipe. Casing vent pipe shall be at least 1.2 m away vertically from aerial electrical wires and shall be suitably insulated from underground conduits carrying electrical wires on railway land. Casing pipe should be so placed and oriented so as to prevent any leakage inside railway boundary except through the vent pipes. The casing pipes shall be installed with even bearing throughout the length

In case of permission by HDD: If railway authority grants permission for crossing of railway by HDD method, pipeline shall be laid at least 7 m below the ground level throughout the railway land width embankment and also at least 7m below formation level in cutting throughout land width.

Further, as per railway Guideline on Pipeline Crossing under Railway track, in case of pipelines carrying gas, Railway operations should be considered equivalent to Location Class 4 for design of carrier pipe thickness. Design factor of 0.4 shall be used for calculating wall thickness of carrier pipes within railway land and up to a distance of risk radius outside the railway boundary (ROU/ROW) on either side.

9.30. Road Crossings

- The method of crossing of roads such as open cut/ trench-less shall be firmed up by CONTRACTOR in consultation with concerned authorities and COMPANY. The CONTRACTOR shall also take due care to identify and take due precautions so as not to disturb or damage the utilities like cables, water lines and other structures.
- After laying the pipeline in a road crossing by open cut method, the CONTRACTOR shall completely restore the road to its original condition.
- While laying the pipeline in road crossings by open cut method the CONTRACTOR should ensure that the traffic is not stopped during the execution of work. This may

 ENERGISING QUALITY	SCOPE OF WORK PIPELINE LAYING	Document No.	Rev
		C251151-00-PP-SOW-2001	C1
		Page 39 of 50	

be done by cutting half of the road at a time so as to enable the traffic to pass on the remaining half of the road. Alternatively, the CONTRACTOR can provide diversion roads to maintain the flow of traffic. For NH crossings, traffic of both sides shall not be disturbed.

- The CONTRACTOR shall provide proper caution boards during daytime and danger lights during night time when the cutting operation of the road is going on.
- For National Highways/ state highways, crossing shall not be too near the existing structure on the NH maintaining a minimum distance of 15 meters or as specified by Highway Authority.
- The National Highway crust shall be built to the same strength as the existing crust on either side of the trench or to thickness and specification stipulated by Highway Authority. Care shall be taken to avoid the formation of a dip at the trench.

9.31. Canal/Drain/Minor water Crossings

- Canal and other water crossings shall be carried out by open cut/ trench-less technology method. CONTRACTOR shall firm the method of crossing in consultation with concerned authorities and COMPANY.
- HDD method shall be adopted for river/water/ canal crossings that are specifically mentioned in this document or decided at site by Engineer-in- charge. These crossings shall be installed and paid separately as per schedule of rates.
- No damage should be caused to any irrigation sources, while laying the pipeline through canal crossings.
- The flood banks of the River/ Canal should be brought to the original condition, if they are damaged by the laying of the pipeline. Stabilization of banks shall be carried out as per requirements of concerned authorities.
- The detailed construction methodology/ plan and time etc. shall have to be finalized by CONTRACTOR in consultation with concerned authorities having jurisdiction over canals/ rivers. COMPANY shall provide assistance by providing introductory letters.

9.32. Existing Pipeline Crossings

The specific requirements of Owner / operator of existing pipeline shall generally be followed. The minimum clearance between the lines shall be 500 mm below existing pipeline unless specified otherwise.

9.33. Pipeline in Forest Area

- Contractor shall restrict the pipeline laying activities within the ROU acquired. No additional land in forest area shall be used. Contractor shall clear only the minimum width required for laying of pipeline. Number of trees/ plants felled shall be kept a minimum based on construction requirements. ROU width in forest area is 10 m. or less.
- Full care shall be taken to ensure that no damage is caused to the adjoining forest

area while carrying out the work. However, in case of any damage, Contractor shall be liable to pay suitable compensation as per requirements of Forest Department.

9.34. Cathodic Protection Works

- Temporary Cathodic Protection (TCP) of respective pipeline sections/parts shall be in the scope of the CONTRACTOR. However Permanent Cathodic protection works (PCP) will be carried out by different agency under different contract while the pipeline laying works are going on. For details of Temporary Cathodic Protection works, refer the enclosed Temporary Cathodic Protection Works attached elsewhere in tender documents.

9.35. Hydrostatic Testing

9.35.1. Pipelines

Hydrostatic testing of mainline shall exclude valves at terminals, SV's, DRS and online station. Hydrostatic Temporary test headers shall be provided and the mainline shall be hydrostatically tested between the temporary test headers only. The highest point of the test section shall be subjected to the minimum test pressure as specified below. The minimum hydrostatic test pressure in the pipeline during testing shall be as follows:

9.35.2. 1.5 times Design Pressure

- The maximum hydrostatic pressure shall not however exceed the pressure required to produce hoop stress equal to 95% of SMYS of pipe material based on the minimum wall thickness in the test section. The test duration shall be 24 hrs. Hydro test shall be done with corrosion inhibitor, wherever required. Mainline valves shall be installed after successful completion of hydrostatic pressure testing. Station piping to be tested hydrostatically for minimum 6hours at pressure of 1.5 times Design Pressure.
- The pipeline string of HDD crossing shall be pre-tested for min. 6 hours and post-installation testing for min. 24 hours at 1.5 times the design pressure.
- The pipeline string of 500 m. and above shall be hydro-tested (post- installation) as per mainline hydro testing procedure.
- Control and instrumentation piping, actuators to be tested by Dry air or nitrogen at pressure of 1.1 x MOP (design pressure), test time– soaping time.
- In case any class location is upgraded due to requirements, the hydrotest pressure shall be governed by the actual class/ population density.
- Subsequent to separate hydro testing of pipeline and associated facilities, the Contractor shall carry out tie-in/ hook up. Pipes/ prefabricated assembly used for such tie-in shall be pre-tested to a test pressure specified for the pipeline. The Contractor at no extra cost shall provide all materials required for the fabrication of the test headers to Company. After successful completion of hydrostatic testing, the Contractor shall de water the pipeline as per the directions of Engineer-in-

 ENERGISING QUALITY	SCOPE OF WORK PIPELINE LAYING	Document No.	Rev
		C251151-00-PP-SOW-2001	C1
		Page 41 of 50 Digitally signed by RAMAKANT Date: 2025.10.13 18:20:32 IST	

charge.

- For HDD, Pre-hydrotest, post-hydrotest and pipeline final hydrotest, contractor has to arrange soft water in view of alkalinity/ Salinity in the river water.

9.35.3. Dewatering & Swabbing

- It is envisaged that dewatering and swabbing operations shall be carried out as a part of pre-commissioning activities. Contractor shall take up dewatering of pipeline after hydrostatic testing only when Contractor is ready for swabbing operations. Till such time Contractor is ready to start pre-commissioning activities, the pipeline/ section of pipeline after hydrostatic testing shall be left filled with inhibited water. In case, if contractor proposes to dewater any test section for any reason depending upon site conditions (e.g., using test water for adjoining section due to non-availability of water), the Contractor shall swab such sections as per applicable requirements of Contract and fill the section with nitrogen at a pressure of 2 bar (g) with residual content of oxygen less than 1% v/v at no extra cost to the company. In no case shall the pipeline be kept empty i.e., without nitrogen filling.
- Transfer of test water from one test section to another section may be considered, however dosing additional quantity of corrosion inhibitor shall be done.
- Disposal of water (hydro testing) shall be done by Contractor after seeking necessary permission from concerned authority/ land owner so that no liability on this account comes on COMPANY.

9.35.4. Corrosion Inhibitor (Wherever applicable)

- The products to be used for corrosion inhibition of the water used for hydro testing and their dosage shall be as specified in Hydro test specification.
- 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. Necessary records for dosing of inhibitor should be maintained by the laying Contractor and such records should be handed over to COMPANY.

9.35.5. Terminal Facilities

- Piping facilities between the insulating joint and hook up point/ battery limit, sectionalizing valve stations and all above ground facilities installed by Contractor shall be hydrostatically tested to a test pressure equivalent to **1.5 times design pressure** as per "Flushing and Testing of Piping System" enclosed with the Contract document. All valves in the piping network being hydro tested shall be kept in the crack open position. Holding time shall be minimum **six hours**.

9.35.6. Preservation

- The positive pressure shall be maintained at 2 bar (g)** in the pipeline during preservation. The necessary arrangements like valves, fittings, manpower etc. shall be kept for maintenance of pressure in the pipeline during idle time.

9.36. Direction of Construction

 ENERGISING QUALITY	SCOPE OF WORK PIPELINE LAYING	Document No.	Rev
		C251151-00-PP-SOW-2001	C1
		Page 42 of 50	

- The direction of construction shall be in the direction of flow, unless specified otherwise. In case the contractor proposes to carry out construction in direction opposite to direction of flow, the contractor may do so at no extra time and cost to Company and subject to Company Approval.

9.37. Leak Detection

- CONTRACTOR shall submit a detailed procedure for leak detection during hydro test. Such method of detection shall consume minimum possible time to complete the hydro test activity within contractual completion schedules. This procedure needs approval of the Engineer-in-charge.
- All works for locating and repair of major leak/ burst attributable to COMPANY (occurred during hydrostatic testing) including necessary repairing/ replacing/ cutting and removing out defective pipe length as defined in the specification and shall be payable as per relevant items of schedule of rates.
- All works for locating and repair of minor leak attributable to COMPANY (occurred during hydrostatic testing) which require sectionalizing of pipeline shall be payable as per relevant items of schedule of rates.
- Contractor shall carry out repairing/ replacing of defective pipe length including cutting and removing of defective pipes, pre testing of replacement pipe for 24 hours and welding into main line, NDT of the welds, coating of the weld joints, clean up, re-testing of pipeline including providing all equipment's, manpower & consumables.

9.38. Pre-Commissioning and Commissioning assistance of Pipeline

- Pipeline Contractor shall be responsible for pre-commissioning and commissioning assistance of the pipeline system being installed by him. The above shall include P&ID checks (with respect to requirement of design/ operation/ safety and interlocks of latest revision of P&IDs), flushing, tightness test, de-watering, as required and supply of consumables required during pre-commissioning and commissioning assistance. Contractor shall supply manpower, materials, equipment including consumables along with necessary piping and instrumentation connections for monitoring flow rate, pressure, temperature etc. temporary venting along with necessary piping, valves and instrumentation as well as consumables.

9.39. Commissioning

- Contractors shall mobilize all equipment, consumables and manpower for carrying out pigging, drying, inertization and commissioning activities.
- Whenever required, contractors shall provide commissioning assistance to other section/part contractor.
- Contractors shall engage a specialized team/ agency who have previously carried out such operations and shall develop procedures, supervise and monitor the entire operations, coordinate with other Contractor(s) as required till the time

 ENERGISING QUALITY	SCOPE OF WORK PIPELINE LAYING	Document No.	Rev
		C251151-00-PP-SOW-2001	C1
		Page 43 of 50	

commissioning operations are completed. Contractor shall mobilize all equipment, materials, consumables including pigs, nitrogen and manpower etc. for commissioning activities. All necessary piping connection as required shall be carried out.

- Commissioning activities shall be carried out as per applicable specifications enclosed with Contract.

9.40. Priorities

- COMPANY may, at its sole option, assign priority of construction to any part of the total pipeline or terminal works. Contractor shall comply with such priority of execution without any time and cost implication to the COMPANY.

9.41. Terminal Piping Works

- The construction work shall be carried out based on Issued for Construction (IFC) drawings issued to Contractor at the time of construction. The final IFC drawings issued during execution stage may vary to some extent from the drawings included in the Bid Package. CONTRACTOR shall carry out all works in accordance with the IFC drawings and reference specifications/ documents with the Contract at no extra cost to the COMPANY.
- The piping fabrication, erection, welding, flushing and hydro testing and painting works shall be carried out as per standard piping specifications enclosed with Contract. The hydro test duration shall be minimum 6 hours.

9.42. Working in Areas of Existing Facilities

- For pipeline installation work within existing terminal facilities which are under operation, Contractor shall obtain all necessary permissions for working in/ around the facility including hot work permit as applicable and shall be fully responsible for the safety of the existing facilities/ areas during all phases of work and shall fully abide by and comply with the restrictions and conditions of COMPANY/ concerned authorities imposed on Contractor from time to time. Providing all safety appliances, gas detectors required during execution of the work, arranging of adequate firefighting equipment viz. fire brigade, fire extinguisher, shielding from existing facilities, oxygen mask etc. for carrying out the work safely to the satisfaction of COMPANY shall be done by the Contractor.
- Contractor may be permitted to work for limited hours in such places. For working on Sundays/ Holidays, the required permission may be obtained well in advance. During any emergency, work shall be suspended till further permission is obtained by Contractor. Idle period in case of interruption shall not be compensated to Contractor.
- The structure/ electric poles/ telegraph poles existing in the vicinity of proposed pipeline shall be properly taken care so that the stability of structure is not affected during construction.

 ENERGISING QUALITY	SCOPE OF WORK PIPELINE LAYING	Document No.	Rev
		C251151-00-PP-SOW-2001	C1
		Page 44 of 50	

9.43. Contractor Responsibilities

- Appraisal and taking cognizance of site-conditions, pipeline route, Central Government/state Govt. rules and regulations/ bye-laws, applicable Indian Standards and Codes, authorities having jurisdiction over the work site(s), environmental and pollution rules and regulations including conditions/ stipulations laid down by the concerned authorities etc. The CONTRACTOR is deemed to have recognized any restrictive features and constraints of the site(s), pipeline route and/ or specific requirements of the work and made due allowance for it in the work to be performed by him. Furnishing and mobilizing at site(s) of all construction equipment, manpower, tools and tackles, construction fronts, fully equipped and fully manned with other required support facilities etc.
- An onsite – offsite emergency plan shall be prepared and submitted to Disaster Management Authorities under intimation to respective state authorities.
- Company shall provide the available information and survey data along pipeline route and crossings. Company gives no guarantee or warranty as to the accuracy or completeness of the information provided. It is the Contractor's sole responsibility to obtain sufficient information / data along pipeline route and crossings to allow safe and sound design and installation of the proposed pipeline.
- "Receiving and taking over" of "free issue" Line pipes, Valves, Fittings etc. from BGL Store Yard location to Contractor Store yard/working site/material required location; Carrying out inspection of Line pipes at the time of receiving and taking-over, recording of pipe & coating defects at the time of taking over in the presence of Company's representative, carrying out repair of coating defects & pipe defects attributable to Company; including supply of materials, consumables & equipment's; handling, hauling and transportation from designated place of issue to Contractor Storage Yard; unloading and stacking of the line pipes at Contractor Storage Yard; including arranging all equipment's, trailers, trucks & manpower; all works as per Scope of Work, drawings, PTS, GTS and other provisions of the Contract and instructions of Owner/ Owner's Representative; all associated works not indicated herein but required to complete the work as per Scope of Work, Provision of Contract & instructions of Owner/ Owner's Representative. If transportation of free issue Line pipes, valves **outside GA boundary (as per PNGRB)** is held as per the direction of Owner/ Owner's Representative is under contractor scope and for that cost shall bear by Client. For transportation within GA boundary (as per PNGRB) is under Contractor scope as mentioned.
- Interpretation and verification of data/information furnished by Company in respect of pipeline route surveys, crossing details, contained in the bid package. Any additional information/data/surveys etc. required by Contractor for detailed engineering and execution of the works shall be obtained by him. Company may assist him in obtaining such information/ data by issuing recommendatory letters.
- Entire design and detailed engineering including drawings and installation procedures, engineering for procurement & fabrication, engineering for installation including drawings, QA/QC procedures, etc. performed by the Contractor for complete pipeline system shall be reviewed and approved by Company. Contractor shall submit six sets of design/detailed engineering documents, drawings,

 ENERGISING QUALITY	SCOPE OF WORK PIPELINE LAYING	Document No.	Rev
		C251151-00-PP-SOW-2001	C1
		Page 45 of 50	

procedures Company's review and approval. All works shall be executed based on approved documents only.

- Provide office and office support services/facilities for Company's Personnel at Contractor's design office for design review and approval of documents as per the requirement of the bid package.
- Review and approval of Contractor's entire work(s) by Company shall in no way relieve the Contractor of his sole responsibility for safe and efficient design, engineering, installation and subsequent operation of pipeline system.
- Furnishing and mobilizing at site(s) of all construction equipment, manpower, tools and tackles, construction spreads, fully equipped and fully manned with other required support facilities etc. commensurate for spreads needed for successful execution of the works.
- Contractor shall depute independent third-party inspector for carrying out radiographic inspection/ UT and interpretation of radiograph/ UT of welds. Third party inspector shall be approved by Company.
- Pre-commissioning/ commissioning of entire pipeline/piping system.
- Preparing and furnishing calculation books, pipe books, material/ purchase requisitions, final purchase orders including specifications, Vendor's data books (including Guarantees), fabrication and construction drawings, all survey reports, inspection and testing reports, as-built records for all phases of work.
- The Contractor is cautioned to exercise extreme care and take necessary precautions to prevent damage to the existing pipeline(s), facilities, electrical and other cables during execution of the entire works. Restoration/reconstruction of all structures/ facilities affected during pipeline construction shall be carried out by Contractor.
- Wherever Contractor comes across water lines/open channels/drains in the fields used for cultivation, suitable arrangements similar to or higher specs. than the existing type shall be made by the Contractor for ensuring water supplies across the fields and maintain the same till construction is completed in that stretch. Any claims arising out of non-compliance to the above requirements, as granted by competent authorities shall be to Contractor's account.
- Contractor shall carry out all testing and inspection of materials, equipment etc. in independent testing institutions, laboratories, if so desired by Company.
- Disposal and treatment of treated hydro-testing water, excavated materials and surplus materials etc. as per local authority's requirements.
- Any other work not specifically listed but required for successful completion of entire pipeline system

9.44. Technical Requirements

The technical requirements for the pipeline laying as well as terminal works as defined

 ENERGISING QUALITY	SCOPE OF WORK PIPELINE LAYING	Document No.	Rev
		C251151-00-PP-SOW-2001	C1
		Page 46 of 50	

herein shall be read in conjunction with Schedule of Rates, specifications, standards, drawings and other applicable documents enclosed with the Bid document. All piping/pipeline works shall be carried out as per following:

- Piping and Instrumentation Diagram (P&IDs) and line schedule.
- Approved for construction Piping General Arrangement Drawing (GADs).
- Approved for construction Alignment sheets/crossing drawings.
- Piping Material Specifications.
- Specifications.
- Piping support standards/drawings and support index.

10. AS BUILT DOCUMENTS

On successful completion of hydrostatic testing, the Contractor shall prepare As Built drawings/ reports for entire pipeline/piping system as specified in scope of work. All "As Built" drawings / reports shall be submitted as below.

Main Pipeline

- As laid alignment sheets and crossing drawings/details.
- As built HDD crossing details, as applicable.
- Details/ Drawings of Sectionalizing Valve (SV) stations.
- All Inspection, Testing and NDT records. Radiographs/ UT of all weld joints packed kilometer wise in separate card board boxes in one set.
- Pipe and calculation books/records.
- All inspection & testing documents.
- All purchase specification & procurement documents
- All piping GA drawings and supports at terminals.
- Installation and testing reports.
- All Inspection, Testing and NDT records. Radiographs/ UT of all weld joints.

Above list is minimum requirement.

Contractor shall prepare all documents as per the requirements indicated in Specification for Documentation for Pipeline Construction enclosed with the Contract document. In addition to the hard copy, three copies of final documents shall also be submitted in electronic media i.e., CD ROM/ DVD ROM diskettes and USB drive. Software used for the presentation of these documents shall be as follows: Type of document Software

- Reports MS Office (Word / Excel)
- Drawings AutoCAD

For the purpose of preparation of as-built drawings, Contractor shall update the "Issued

 ENERGISING QUALITY	SCOPE OF WORK PIPELINE LAYING	Document No.	Rev
		C251151-00-PP-SOW-2001	C1
		Page 47 of 50	

for Construction" drawings provided by the Company. For drawings where electronic copies are available for IFC drawings, Contractor shall provide as built drawings in electronic form as well as in hard copies. Where only hard copies are available for IFC drawings, Contractor shall prepare and submit as built drawings in hard copies.

11. DOCUMENTS TO BE SUBMITTED AT TIME OF BIDDING

No technical documents are required to be submitted at the time of bidding. Bidder is advised to comply with all requirements of Bid document without any deviation. Company reserves the right to reject any bid with deviation without making any reference to the Bidder.

12. DOCUMENTS, SPECIFICATION, STANDARDS AND DRAWINGS

- Owner shall furnish piping and instrumentation diagrams (P&ID), preliminary plot plan along with the tender. Owner shall also supply design & engineering drawings and construction drawings including general arrangement drawings for piping, mechanical & instrumentation systems and other related/ required systems, at appropriate times and as requisitioned by contractor in his time schedule.
- Contractor shall prepare isometric drawings & bill of materials and submit the same for owner/ consultant's approval/ record. Contractor shall prepare drawing for utilities line as required as per sor and submit the same for owner/ consultant's approval/ record.
- No construction small or big shall be carried out without proper construction drawings duly approved by owner's engineers at delhi or site office or owner's representative duly authorized to do so. For mainline, route survey alignment sheets and crossing survey details shall be furnished along with bid by owner. However, detail-crossing drawings with crossing methodology shall be submitted by contractor for prior approval. Any additional survey and data required to complete above should be done by contractor without any extra cost.
- After completion of construction & commissioning of terminal, contractor shall incorporate all the correction in drawings, prepare and issue the drawings "as-built drawings" as listed below to owner as final submission of drawings. For mainline pipeline alignment sheet, all x-ing details, all cp drawings, pipe book etc. And for terminals P&Id, layout drg., piping gad, isometric, all electrical & instrumentation drg, all civil drawings. For final submission only 4 sets of documents plus the original transparencies shall be handed over by contractor. Any construction done by contractor without duly approved drawings shall be wholly at his risk and cost. Contractor shall also submit soft copy of pipe book in excel along with hard copy. Soft copy of all as-built drawings shall be also submitted in autocad. Videography/ photograph of all major activities/ milestone achieved shall also be arranged and submitted by the contractor. For details of documentation to be submitted for mainline and terminal refer enclosed specification for documentation for standard specification for pipeline construction no. VCS-SS-PP-2001 enclosed elsewhere with the tender.
- **Specifications**

 ENERGISING QUALITY	SCOPE OF WORK PIPELINE LAYING	Document No.	Rev
		C251151-00-PP-SOW-2001	C1
		Page 48 of 50	

The work shall be carried out by contractor strictly in accordance with the specifications enclosed in tender.

• **Additional Clauses**

- Contractor to note that the minimum requirements of inspection and testing of the bought-out items shall be governed by attached gap with the tender document. However, contractor shall submit their gap in line with the requirement specified in attached gap for Owner's/ PMC's approval.
- Contractor to note that all the documents/drawings submitted by them as a part of bid shall be considered only to assess bidder's technical capability and shall in no way absolve them from complying with all the requirements of the tender. All works to be performed by the bidder shall be strictly in accordance with tender conditions.
- Contractor shall submit duly signed & stamped hard copies of all required documents/ drawings/ data sheets etc. to VCS for their review & approval as per terms & condition of tender documents. The date of receipt of these documents/ drawings/ data sheets etc. at VCS shall be deemed as the date of submission. If any documents/ drawings/ data sheets etc. require re-submission due to any error/ deficiency noticed during review/ approval stage, in that event the additional time required by the contractor to get the revised document/ drawing reviewed/approved by vcs shall be solely to contractor's account and in no case, contractor shall be entitled for any time or cost benefit.
- The drawings/documents/ data sheets etc shall be reviewed, checked, approved and duly signed/stamped by successful contractor before submission. Revision number shall be changed and revisions shall be highlighted by clouds during submission of revised documents/drawings/data sheets by the successful contractor. Whenever the successful contractor require any sub-supplier drawings to be reviewed/approved by VCS, the same shall be submitted by the contractor after review/ approval and stamped by the contractor. Direct submission of the sub-supplier's drawings/documents/data sheets etc without contractor's approval shall not be entertained.
- Review/approval of the contractor's submitted drawings/ documents/ data sheets etc by VCS would be only to review the compatibility with basic design and concepts including mainline work procedure and in no way absolve the successful contractor of his responsibility/contractual obligation to comply with tender requirements, applicable codes, specifications and statutory rules/regulations. Any error/deficiency noticed during any stage of manufacturing/execution/installation shall be promptly corrected by the contractor without any extra cost or time, whether or not comments on the same were received from VCS during the drawing review stage.
- Contractor shall make & maintain their own suitable sized storage yard/ area (covered as well as open space) to store free issue materials (FIM) in proper manner. Contractor shall also maintain the free issue material (FIM) in good condition during entire storage period by using all type of servicing / overhauling such as cleaning, greasing, protecting from rusting/ pitting etc.
- Storage yard/ area shall have proper motorable approach, adequate indoor & outdoor area lighting, potable & service water, proper rack & wooden sleeper etc. For staking/ storing the material, availability of material

 ENERGISING QUALITY	SCOPE OF WORK PIPELINE LAYING	Document No.	Rev
		C251151-00-PP-SOW-2001	C1
		Page 49 of 50	

handling equipment of adequate capacity etc.

- Owner/PMC's site in-charge shall visit & inspect the contractor's storage yard/ area and upon his concurrence only, the FIM shall be stored by the contractor at the particular storage yard/ area. Delay in issuance of FIM due to non-acceptance of contractor's storage yard/ (i.e mainly because of non-compliance of the minimum condition as mentioned above for storage yard/ area) shall not be attributable to Owner/PMC.
- During construction, Owner / PMC, on their discretion, have reserve right to take samples for any bought-out item received at site and test the same in a NABL approved or equivalent laboratory even if the lot has already been inspected and cleared by PMC / Owner for use in construction. The cost for such testing shall be borne by the contractor. In case of failure of the samples, the lot shall be rejected and the same shall be replaced by the contractor without any additional cost to owner.

 ENERGISING QUALITY	SCOPE OF WORK PIPELINE LAYING	Document No.	Rev
		C251151-00-PP-SOW-2001	C1
		Page 50 of 50	



Energising Quality

PROJECT NUMBER - C251151



M/s Bhagyanagar Gas
Ltd.

DATA SHEET FOR INSULATING JOINT

Total Sheet

8

DOCUMENT NO.

C251151

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PP

DS

2001

BHAGYANAGAR GAS LIMITED

LAYING & CONSTRUCTION OF U/G STEEL P/L NETWORK IN KAKINADA AND VIJAYAWADA OF M/s BGL

C1	24.03.2025	ISSUED FOR TENDER	PS	AG	MK
REV	DATE	DESCRIPTION	PREP	CHK	APPR



LAYING & CONSTRUCTION OF U/G STEEL P/L NETWORK IN KAKINADA AND VIJAYAWADA OF M/s BGL

Data Sheet No.	01
Insulating Joint Manufacturer	-
IJ Material Requisition (MR)	-
IJ Specification No.	VCS-SS-PP-2029
<u>DESIGN DATA FOR INSULATING JOINT</u>	
Service, Design Life	NG, 25 yrs
Size (OD), mm (inch)	168.3 (6")
Design Pressure	49 kg/cm ² g
ANSI Rating/ Design Factor	300# / 0.5
Design Temperature (°C)	(-)29 to 65.0
Corrosion Allowance (mm)	1.5
Design Code (Pipeline / Insulating Joint)	ASME B31.8 / ASME Sec VIII Div. -I
End Connection/End Finish	Butt weld ends. Bevelled as per Line pipe Specification
Insulating Joint type	Monolithic
Installation	Above ground
Piggability	Piggable
Bevel end protection	Required, metallic or high impact plastic bevel protectors;
<u>TESTING</u>	
Charpy Impact Test	Required, at (-)29 °C
Hardness Test	Required, maximum hardness of base metal, weld metal & HAZ of all the pressure containing parts shall not exceed 248 HV10
Di-Electric test	5 KV AC, 50 Hz For One Minute Minimum
Insulation Resistance Test	Min. 25 Mega Ohms, when checked with 500-1000 v dc
Hydrostatic Test	At 73.5 Kg/cm ² g for Minimum Time 30 Minute
Pneumatic Test	7 Kg/cm ² g for minimum Time 15 Minutes.
Internal Vacuum Sustainability	One (1) Millibar

 Energising Quality	DATA SHEET FOR INSULATING JOINT	Document No.	Rev
		C251151-00-PP-DS-2001	C1
		Page 2 of 8	

LAYING & CONSTRUCTION OF U/G STEEL P/L NETWORK IN KAKINADA AND VIJAYAWADA OF M/s BGL

Torsional Test	Required, As per Specification
Chemical Test	Required, As per Specification
Dimensional Check	Required, As per Specification & Approved Drawings
Visual Inspection	Required, As per Specification
Other Testing	Required, As per Specification
NDE	- Wet MPI on 100% Forged Surfaces (MSS SP 53) 100% RT of Butt Weld (API 1104) 100% UT / MPI of fillet welds (As per ASME SEC. VIII) 100 % UT of Finished Bevel Ends - DP of Butt Weld - 100%

SURFACE PREPARATION, PAINTING & MARKING

Surface Preparation	Shot Blasting to SP10 in accordance with "Steel Structures Painting Council- Visual Standard SSPC-VIS-I
Painting (Internal Coating)	Two-pack (solvent free) non-conducting epoxy compound (cold or hot curing). Total DFT –200 micron. Shade Brown
Painting- External (Non-conducting epoxy :3 Layer Paint System)	Primer: Two Pack Non-Conducting Epoxy, (Total DFT – 200 -micron) Finish Coat: Polyurethane Epoxy – DFT 100-micron, Shade Orange, The coating shall end approximately 75mm from the ends of the joint.
Final Colour Shade	Canary Yellow
Marking	On stainless-steel name plate as per Specification

INSULATING JOINT MATERIAL (EQUIVALENT OR SUPERIOR)

Part	Material of Construction	
	Specified	Offered
• Body	• ASTM A694 Gr. F52 (Charpy)	
Pups	• API 5L Gr. X-52, PSL2	
Epoxy resin Filler Material	• CIBA Araldite CY-220 & Araldite HT-951 hardener.	

 Energising Quality	DATA SHEET FOR INSULATING JOINT	Document No.	Rev
		C251151-00-PP-DS-2001	C1
		Page 3 of 8	

LAYING & CONSTRUCTION OF U/G STEEL P/L NETWORK IN KAKINADA AND VIJAYAWADA OF M/s BGL

Spacing Ring (Insulating Ring)	Epoxy glass fibre reinforced laminate (comply with ASTM D 709 Type TV, Group G-11 properties) Average dielectric strength shall be minimum 15 KV. (Compressive Strength $\geq$ 450 MPa)		
Sealing Ring /Gasket	Hardness test, Viton ASTM D2000 or as per Vendor Recommendation		
Sealant Material	Cold Curing Thermosetting Resin + Hardener. (Compressive Strength $\geq$ 150 MPa)		
Double Seal Requirement	Yes		
CONNECTING PIPE DETAILS			
S. No.	Outside Diameter, OD mm (inch)	Wall Thickness, (mm)/ Schedule	Material
1.	168.3 (6")	6.4	API 5L Gr. X-52, PSL2

 Energising Quality	DATA SHEET FOR INSULATING JOINT	Document No.	Rev
		C251151-00-PP-DS-2001	C1
		Page 4 of 8	



LAYING & CONSTRUCTION OF U/G STEEL P/L NETWORK IN KAKINADA AND VIJAYAWADA OF M/s BGL

Data Sheet No.	02
Insulating Joint Manufacturer	-
IJ Material Requisition (MR)	-
IJ Specification No.	VCS-SS-PP-2029
<u>DESIGN DATA FOR INSULATING JOINT</u>	
Service, Design Life	NG, 25 yrs
Size (OD), mm (inch)	114.3 (4")
Design Pressure	49 kg/cm ² g
ANSI Rating/ Design Factor	300# / 0.5
Design Temperature (°C)	(-)29 to 65.0
Corrosion Allowance (mm)	1.5
Design Code (Pipeline / Insulating Joint)	ASME B31.8 / ASME Sec VIII Div. -I
End Connection/End Finish	Butt weld ends. Bevelled as per Line pipe Specification
Insulating Joint type	Monolithic
Installation	Above ground
Piggability	Piggable
Bevel end protection	Required, metallic or high impact plastic bevel protectors;
<u>TESTING</u>	
Charpy Impact Test	Required, at (-)29 °C
Hardness Test	Required, maximum hardness of base metal, weld metal & HAZ of all the pressure containing parts shall not exceed 248 HV10
Di-Electric test	5 KV AC, 50 Hz For One Minute Minimum
Insulation Resistance Test	Min. 25 Mega Ohms, when checked with 500-1000 v dc
Hydrostatic Test	At 73.5 Kg/cm ² g for Minimum Time 30 Minute
Pneumatic Test	7 Kg/cm ² g for minimum Time 15 Minutes.
Internal Vacuum Sustainability	One (1) Millibar
Torsional Test	Required, As per Specification

 Energising Quality	DATA SHEET FOR INSULATING JOINT	Document No.	Rev
		C251151-00-PP-DS-2001	C1
		Page 5 of 8	

LAYING & CONSTRUCTION OF U/G STEEL P/L NETWORK IN KAKINADA AND VIJAYAWADA OF M/s BGL

Chemical Test	Required, As per Specification
Dimensional Check	Required, As per Specification & Approved Drawings
Visual Inspection	Required, As per Specification
Other Testing	Required, As per Specification
NDE	- Wet MPI on 100% Forged Surfaces (MSS SP 53) 100% RT of Butt Weld (API 1104) 100% UT / MPI of fillet welds (As per ASME SEC. VIII) 100 % UT of Finished Bevel Ends - DP of Butt Weld - 100%

SURFACE PREPARATION, PAINTING & MARKING

Surface Preparation	Shot Blasting to SP10 in accordance with "Steel Structures Painting Council- Visual Standard SSPC-VIS-I
Painting (Internal Coating)	Two-pack (solvent free) non-conducting epoxy compound (cold or hot curing). Total DFT –200 micron. Shade Brown
Painting- External (Non-conducting epoxy :3 Layer Paint System)	Primer: Two Pack Non-Conducting Epoxy, (Total DFT – 200 -micron) Finish Coat: Polyurethane Epoxy – DFT 100-micron, Shade Orange, The coating shall end approximately 75mm from the ends of the joint.
Final Colour Shade	Canary Yellow
Marking	On stainless-steel name plate as per Specification

INSULATING JOINT MATERIAL (EQUIVALENT OR SUPERIOR)

Part	Material of Construction	
	Specified	Offered
• Body	• ASTM A694 Gr. F52 (Charpy)	
Pups	• API 5L Gr. X-52, PSL2	
Epoxy resin Filler Material	• CIBA Araldite CY-220 & Araldite HT-951 hardener.	
Spacing Ring (Insulating Ring)	• Epoxy glass fibre reinforced laminate (comply with ASTM D 709 Type TV, Group G-11 properties) Average dielectric strength shall be minimum 15 KV. (Compressive Strength $\geq$ 450 MPa)	

 Energising Quality	DATA SHEET FOR INSULATING JOINT	Document No.	Rev
		C251151-00-PP-DS-2001	C1
		Page 6 of 8	



LAYING & CONSTRUCTION OF U/G STEEL P/L NETWORK IN KAKINADA AND VIJAYAWADA OF M/s BGL

Sealing Ring /Gasket	Hardness test, Viton ASTM D2000 or as per Vendor Recommendation		
Sealant Material	Cold Curing Thermosetting Resin + Hardener. (Compressive Strength ≥ 150 MPa)		
Double Seal Requirement	Yes		
CONNECTING PIPE DETAILS			
S. No.	Outside Diameter, OD mm (inch)	Wall Thickness, (mm)/ Schedule	Material
1.	114.3 (4")	6.4	API 5L Gr. X-52, PSL2

 Energising Quality	DATA SHEET FOR INSULATING JOINT	Document No.	Rev
		C251151-00-PP-DS-2001	C1
		Page 7 of 8	

LAYING & CONSTRUCTION OF U/G STEEL P/L NETWORK IN KAKINADA AND VIJAYAWADA OF M/s BGL

Notes:

1. The internal diameter of Insulating Joint shall be uniform through out the entire length and shall not be less than specified internal diameter of connecting Pipeline.
2. Insulating joint shall comply the requirement of Project Specification VCS-SS-PP-2029.
3. The Charpy Impact temperature shall be (-)29o C as specified in data sheet and shall supersede the temperature requirement specified in Specification
4. For the welding end, the out of roundness and tolerance on internal diameter at pipe ends shall be same as diameter tolerance for the pipe ends indicated in line Pipe Specification & API 5L.
5. Insulating Joint shall be suitable for all type of pigging operation including intelligent pigging.
6. Insulating Joint shall be monolithic boltless.
7. Vendor to ensure that all material specified herein/ offered is suitable for specified fluid type & design & operating Condition.
8. All applicable test (Impact, hardness, Chemical, mechanical etc) shall also be carried out on pup piece.
9. Overall isolating joint's length shall be such that the heat generated by field welding is not detrimental to the insulating, filler materials, and internal/external coating.
10. Vendor shall furnish the allowable forces & moments for the axial, lateral & transverse (i.e. X, Y & Z) directions
11. Manufacturing shall not commence until materials, dimension (including the calculation sheet), drawings, manufacturing process and welding procedure qualification selected by the Manufacturer are approved by COMPANY.
12. Manufacturer shall ensure that the wall thickness (W.T.) of all parts of insulating joint shall be adequate to sustain design pressure and selected W.T. shall be suitable for welding with W.T. of connected pipeline.

 Energising Quality	DATA SHEET FOR INSULATING JOINT	Document No.	Rev
		C251151-00-PP-DS-2001	C1
		Page 8 of 8	



Energising Quality

PROJECT NUMBER: **C251151**



DATA SHEET FOR LONG RADIUS BEND

Total Sheets

09

Document No

C251151

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BHAGYANAGAR GAS LIMITED

LAYING & CONSTRUCTION OF U/G STEEL P/L NETWORK IN KAKINADA AND VIJAYAWADA OF M/s BGL

C1	24.03.2025	ISSUED FOR TENDER	PS	AG	MK
REV	DATE	DESCRIPTION	PREP	CHKD	APPR

		Data Sheet No.	01
General	1.	Project Title	LAYING & CONSTRUCTION OF U/G STEEL P/L NETWORK IN HYDERABAD OF M/s BGL
	2.	Project No.	C251151
	3.	Item / Type	Factory made Pipeline Induction Bend – Butt Welded ends
	4.	Pipeline	NG
	5.	Installation / Location	Onshore – (Buried / Above Ground)
Design Data	6.	Design Code	ASME B31.8/ ASME B16.49
	7.	Design Specifications	Project Spec: VCS-SS-PP-2009
	8.	Design Factor	0.5
	9.	Line Size (inch)/(mm) "D"	NPS 6" / 168.3
	10.	Corrosion Allowance (mm)	0.5 mm
	11.	Min. Design Life (Years)	25
	12.	Operational Requirement	Shall be suitable for smooth Pigging operation in either direction
	13.	Environmental Data	Onshore application
	14.	End Finish	Bevelled As per Spec VCS-SS-PP-2009/ API 5L & Line pipe Specification
	15.	End Protection	Metallic or high impact plastic bevel protector (As per Spec VCS-SS-PP-2009)
Process Data	16.	Transported Medium	NG
	17.	Design Pressure (kg/cm ² g)/ASME Class	49
	18.	Max. / Min. Design Temp. of Pipe (°C)	65 ° / (-)29°
Connected Pipeline Data	19.	Pipeline Material & Grade	Carbon Steel API 5L GR. X-52
	20.	Type of Pipe	ERW
	21.	Nominal Wall Thickness (mm)	6.4/7.1
Mother Pipe for Bend	22.	Mother Pipe Material & Grade	Carbon Steel API 5L GR. X-52
	23.	Type of Pipe	ERW
	24.	Nominal Wall Thickness (mm)	6.4/7.1
Section B	25.	Manufacturing method	High Frequency continuous Induction heating and forming

LAYING & CONSTRUCTION OF U/G STEEL P/L NETWORK IN KAKINADA AND VIJAYAWADA OF M/s BGL

	26.	Bend Procedure Qualification		As per Spec: VCS-SS-PP-2009
	27.	Production Bending		As per Spec: VCS-SS-PP-2009
	28.	Bend Angle (Degree)		20° to 90°
	29.	Bending Radius		3D
	30.	Tangent Length(mm) "TL"		Either side 500mm or Pipe outside diameter whichever is more.
	31.	Weld Seam Position		±5° from the Neutral Axis
	32.	Maximum Thinning (%)		8
Inspection, Testing & Marking	33.	Visual Inspection		As per Spec: VCS-SS-PP-2009
	34.	Dimension & Tolerance	General	As per Spec: VCS-SS-PP-2009
			Out of Roundness – Ends	As per Spec: VCS-SS-PP-2008
			Bend angle	± 0.5°
			Bend Radius	± 1%
	35.	CVN Impact Test		At 0°
	36.	Minimum Mill Hydrotest Pressure		Test Pressure that shall result in Hoop Stress Corresponding to of 95% SMYS of Pipe Material.
	37.	Procedure Qualification		On 90° bend, as per Spec: VCS-SS-PP-2009
	38.	Thickness Measurement of Bend		As per Spec: VCS-SS-PP-2009
	39.	Gauging Requirement		As per Spec: VCS-SS-PP-2009
	40.	Hardness		As per Spec: VCS-SS-PP-2009
	41.	Certification		BS EN 10204 Type 3.2
Coating	42.	External Coating		As per Spec: VCS-SS-PP-2009

		Data Sheet No.	02
General	43.	Project Title	LAYING & CONSTRUCTION OF U/G STEEL P/L NETWORK IN HYDERABAD OF M/s BGL
	44.	Project No.	C251151
	45.	Item / Type	Factory made Pipeline Induction Bend – Butt Welded ends
	46.	Pipeline	NG
	47.	Installation / Location	Onshore – (Buried / Above Ground)
Design Data	48.	Design Code	ASME B31.8/ ASME B16.49
	49.	Design Specifications	Project Spec: VCS-SS-PP-2009
	50.	Design Factor	0.5
	51.	Line Size (inch)/(mm) "D"	NPS 4" / 114.3
	52.	Corrosion Allowance (mm)	0.5 mm
	53.	Min. Design Life (Years)	25
	54.	Operational Requirement	Shall be suitable for smooth Pigging operation in either direction
	55.	Environmental Data	Onshore application
	56.	End Finish	Bevelled As per Spec VCS-SS-PP-2009/ API 5L & Line pipe Specification
	57.	End Protection	Metallic or high impact plastic bevel protector (As per Spec VCS-SS-PP-2009)
Process Data	58.	Transported Medium	NG
	59.	Design Pressure (kg/cm ² g)/ASME Class	49
	60.	Max. / Min. Design Temp. of Pipe (°C)	65 ° / (-)29°
Connected Pipeline Data	61.	Pipeline Material & Grade	Carbon Steel API 5L GR. X-52
	62.	Type of Pipe	ERW
	63.	Nominal Wall Thickness (mm)	6.4/7.1
Mother Pipe for Bend	64.	Mother Pipe Material & Grade	Carbon Steel API 5L GR. X-52
	65.	Type of Pipe	ERW
	66.	Nominal Wall Thickness(mm)	6.4/7.1
Production	67.	Manufacturing method	High Frequency continuous Induction heating and forming

 ENERGISING QUALITY	DATA SHEET FOR LONG RADIUS BEND	Document No.	Rev
		C251151-00-PP-DS-2002	C1
		Page 4 of 5	

	68.	Bend Procedure Qualification	As per Spec: VCS-SS-PP-2009
	69.	Production Bending	As per Spec: VCS-SS-PP-2009
	70.	Bend Angle (Degree)	20° to 90°
	71.	Bending Radius	3D
	72.	Tangent Length(mm) "TL"	Either side 500mm or Pipe outside diameter whichever is more.
	73.	Weld Seam Position	±5° from the Neutral Axis
	74.	Maximum Thinning (%)	8
Inspection, Testing & Marking	75.	Visual Inspection	As per Spec: VCS-SS-PP-2009
	76.	General	As per Spec: VCS-SS-PP-2009
		Out of Roundness – Ends	As per Spec: VCS-SS-PP-2008
		Bend angle	± 0.5°
		Bend Radius	± 1%
	77.	CVN Impact Test	At 0°
	78.	Minimum Mill Hydrotest Pressure	Test Pressure that shall result in Hoop Stress Corresponding to of 95% SMYS of Pipe Material.
	79.	Procedure Qualification	On 90° bend, as per Spec: VCS-SS-PP-2009
	80.	Thickness Measurement of Bend	As per Spec: VCS-SS-PP-2009
	81.	Gauging Requirement	As per Spec: VCS-SS-PP-2009
	82.	Hardness	As per Spec: VCS-SS-PP-2009
	83.	Certification	BS EN 10204 Type 3.2
Coating	84.	External Coating	As per Spec: VCS-SS-PP-2009

NOTES:

1. Bend shall be corrosive coated for transportation and storage.
2. Bends shall be supplied with end caps to prevent internal bevel damage during transport and to prevent internal corrosion during storage under exposed conditions.
3. Bend angle and bend quantity shall be as given in the Material Requisition for Induction.
4. Testing of chemical, mechanical properties and NDE to be done as per specification.
5. Anti-corrosive paint as per manufacturer standard to be provided.
6. Inspection shall be as per Inspection & Test plan (ITP).

  Energising Quality		CLIENT : BHAGYANAGAR GAS LIMITED		JOB NO : C251151					
		PROJECT : LAYING & CONSTRUCTION OF U/G STEEL P/L NETWORK IN KAKINADA AND VIJAYAWADA OF M/s BGL		DOC. NO.: C251151-00-PP-DS-2003A					
		DATA SHEET OF FE/BW, ABOVEGROUND, MANUAL BALL VALVE DN 50 TO DN 300 (NPS 2" to NPS 12"), RATING 300# , PIPING CLASS - 30HC, SPLIT /WELDED BODY DESIGN		No. of Pages : 02 <table border="1"> <tr> <th colspan="2">Revision</th> </tr> <tr> <td>C1</td> <td></td> </tr> <tr> <td>24.03.2025</td> <td></td> </tr> </table>		Revision		C1	
Revision									
C1									
24.03.2025									
Location		KAKINADA AND VIJAYAWADA		MR No.					
Sr. No.		-		P.O No.					
1		Valve Manufacturer							
2		Tag Numbers / Material Requisition Item No.		-					
3		Company's Specification No.		VCS-SS-PP-2004					
4		Category		Station Piping Ball Valve					
5		Pipeline Line No		Not Required					
6		Class		30HC					
7		Size		DN 50 (NPS 2") to DN 300 (NPS 12")					
8		Type of Valve		Trunnion Mounted, Double Block and Bleed, Antistatic, Vent Drain/ Flush Connection with Anti Blowout Stem, Split Body Design/ Fully Welded Body Design as specified in MTO, Tight Shut Off (As Applicable)					
9		Type of Port (Full/ Reduced)		Refer MTO					
10		Design Temperature (°C)		Maximum					
11				Minimum					
12		Corrosion Allowance (mm)		1.5					
13		Installation (Aboveground/Underground)		Aboveground					
14		Service		NATURAL GAS (NG)					
15		End Connection		Refer MTO					
16		Flange Face Finish		RF/125AARH for Flanged Ends (As applicable)					
17		Design Standards		API 6D					
18		End Connection Standard		ANSI B16.5 for Flanged Ends (As applicable)/ ANSI 16.25 for Butt Welded Ends (As applicable)					
19		ASME Class		300#					
20		Stem Extension Requirement (If required, Note - 20)		Not Required					
21		Length of Stem Extension		Not Applicable					
22		Orientation of Stem		Perpendicular to Valve axis					
23		Type of Valve Operator		DN ≤ 100 mm (4") - Wrench / Lever - Pull Force 350N max. DN ≥ 150 mm (6") - Gear Operated					
24		Valve Actuator Operating Time		Not Applicable					
25		Requirement of Locking Mechanism (LO / LC)		Refer P&ID					
26		Length of Pup Piece / Nipple (mm), (If Required) (Note-16) (Integrally welded to the BW valve on each side)		Required for Welded End Valves, as per Standard Valve Specification					
27		Pup Piece Size / Material Grade / Schdeule/ Thickness (Note-16)		As per Piping Material Specification					
28		Operator Specification No.		Not Applicable					
29		Valve Design Pressure (kg/cm ²)		49 kg/cm ²					
30		Hydrostatic Test Pressure (kg/cm ²) & Time		Body : 73.5 kg/cm ² & Test Duration - 30 Minutes					
31		Pneumatic Test Pressure (kg/cm ²) & Time		7.0 kg/cm ² & Test Duration as per API 6D					
32		Charpy Impact Test (° C)		Yes (at -29 °C)					
33		Fire Safe Design (Note-24)		API 6FA / ISO10497					
34		Anti Static Testing Requirement		As per API 6D Latest Edition					
35		Hardness Test		248 HV10 max					
36		Painting (Note-21)		As per specification (Suitable for Highly Corrosive Environment) Note-21					
37		Operator Data Sheet No.		Not Applicable					
38		Flow (Min/Nor/Max) (m ³ /hr)		Not Applicable					
39		Pressure (Min/Nor/Max) (barg)		Not Applicable					
40		Temperature (Min/Nor/Max) (° C)		Not Applicable					
41		Max Shutoff DP (barg)		Not Applicable					
42		Viscosity (cP)		Not Applicable					
43		Density (Kg/m ³)		Not Applicable					
44		Mol . Wt		Not Applicable					
45		Sp Heat Ratio (Cp/Cv)		Not Applicable					
46		Compressibility (Z)		Not Applicable					
47		Ambient Temperature		Not Applicable					
48		Outside Diameter (Inch)		DN 50 (NPS 2") to DN 300 (NPS 12")					
49		Thickness (mm) / Schedule		As per Piping Material Specification					
50		Pipe Material		As per Piping Material Specification					
51		Design Code		ASME B31.8					
52		ASME Rating		300#					
53		Piping Class		30HC					
54		Orientation of Pipe		Suitable for all orientation					

 Energising Quality  Bhagyanagar Gas Ltd.		CLIENT : BHAGYANAGAR GAS LIMITED		JOB NO : C251151			
		PROJECT : LAYING & CONSTRUCTION OF U/G STEEL P/L NETWORK IN KAKINADA AND VIJAYAWADA OF M/s BGL		DOC. NO.: C251151-00-PP-DS-2003A			
		DATA SHEET OF FE/BW, ABOVEGROUND, MANUAL BALL VALVE DN 50 TO DN 300 (NPS 2" to NPS 12"), RATING 300# , PIPING CLASS - 30HC, SPLIT /WELDED BODY DESIGN		No. of Pages : 02	Revision		
Location		KAKINADA AND VIJAYAWADA		MR No.		-	
Sr. No.		-		P.O No.		#	
55	VALVE MATERIAL	Part Description	Material Specified		Material Offered (By Bidder)		
56		Body	ASTM A216 GR. WCB/ASTM 105				
57		Ball (Single Piece, Solid Construction)	SS-304 / SS-316 (Solid) OR (ASTM A105/ ASTM A216 Gr. WCB) + 75 micron ENP				
58		Seat Rings (No Casting)	(AISI 4140 +75 micron ENP)/ AISI 410/ SS 304/ SS 316				
59		Seat Seal	Primary Devlon V/ PEEK/ Viton with Secondary Metal to Metal				
60		Stem (No Casting)	(AISI 4140 +75 micron ENP)/ AISI 410 / SS 304 / SS 316				
61		Stem Seal	GRAFOIL / R-PTFE				
62		Body Seal	GRAFOIL / R-PTFE				
63		Gland	13% Cr. Steel/ SS 316 / SS 304 / ASTM A105				
64		Stud Bolts/Nut	ASTM A 193 Gr. B7/ ASTM A 194 Gr. 2H				
65	Handle / Lever / Hand Wheel	Carbon Steel					
66	DATA TO BE PROVIDED BY VENDOR (if Applicable)	Valve Model No.		*			
67		Flow Coefficient, Kv (Cubic Meters per Hour)		*			
68		Valve Cavity Volume(CC)	Open position	*			
69			Closed position	*			
70	Operator Manufacturer / Model No.		*				
71	Break-away Torque Under Max. Diff Pressure(Nm)		*				
72	Running Torque (Open - Close/Close - Open) (Nm)		*				
73	NOTES	NOTES:					
74		1. Bidder to submit in offer, Soft Seal details and type, grade & class selected with manufacturer's recommendation like Pressure-Temperature Curve/Table for not to damage the soft seal during welding of valve ends at site.					
75		2. This Data Sheet shall be read in conjunction with Material Requisition, Piping Material Specification, valve Specification & other Tender Documents.					
76		3. Dimension / Input Data as & where marked " * " shall be supplied by Vendor.					
77		4. Manufacturer shall have valid API 6D license to use API monogram. API monogram is required.					
78		5. Valve design shall ensure repair of stem seals / packing under full line pressure.					
79		6. 100.0 % Valve castings shall undergo Radiographic Examination.					
80		7. Valves shall have support foot & lifting lugs as per valve Specification.					
81		8. Valve design shall ensure repair of stem seals / packing under full line pressure.					
82		9. Wrench operated valves shall be supplied with wrench.					
83		10. The Charpy Impact temperature shall be -29°C as specified in data sheet and it shall superceded the Specification (VCS-SS-PP-2004) requirement at 0°C					
84		11. A supplementary air seat test as per API 6D (Annex I, Para I.9 Type II) shall be carried out for all valves. A bubble tight seal is required without the use of any sealant. No leakage is allowed. Test pressure shall be held for at least 15 minutes.					
85		12. Design of weld end valves shall be such that during field welding operations, the soft seals or plastic components of the valve (where ever used) is not liable to be damaged. The manufacture shall furnish necessary field welding instructions and post-weld test procedure to demonstrate integrity and leak-tightness of valves after field welding operations.					
86		13. Gear operators, when provided, shall have a self-locking provision and shall be fully encased in water proof/ splash proof enclosure and shall be filled with suitable grease					
87		14. For the manual operator of all valves, the diameter of the hand wheel or the length of operating wrench shall be such that under the maximum differential pressure, the total force required to operate the valve does not exceed 350N.					
88		15. Manufacturer shall also indicate the number of turns of hand wheel in case of gear operators (along with their offer) required for Operating the valve from full open to full close position. The numbers of turn shall not exceed 250 for valves sizes up to 24" and 450 for valve size above 24".					
89		16. Adequacy for Length of pup piece/ Nipple shall be confirmed by manufacturer so as to avoid damage to seats during field welding or post weld heat treatment. These nipples shall be welded to the valve body by the manufacturer before fitting the packings, seats & seals.					
90		17. Name plate material shall be minimum stainless steel. Marking shall be as per MSS-SP-25					
91		18. Valve body & other pressure containing parts shall be designed as per ASME Sec-VIII Div-I. Minimum thickness shall not be less than ASME B16.34.					
92		19. For tag No./ Fluid Data/ Operating Data refer Process Document , P&IDs					
93		20. Stem extension length shall be finalized during drawing approval stage after award of order.					
94		21. For the valves to be installed underground the external surfaces of buried portion of the valve shall be painted with 100% Solid high build epoxy(Powcrete R-95) with a minimum dry film thickness of 1000 microns or 1.5 mm thick polyurethane coating					
95		22. Bidder shall clearly write all / any deviation against each part material of valve in the space provided for. Wherever bidder agrees with company's spec bidder shall indicate "agreed". Flanges of flanged end cast/ forged body shall be integrally cast/ forged with the body of valve.					
96		23. All Elastomeric material used for pressure tight sealing or drip sealing shall be of anti Explosive Decompression type and must be certified according to testing Procedures. Manufacturer shall submit test certificate confirming conformance with Anti Explosive Decompression. Manufacturer shall confirm the suitability of soft sealing and seating material for the pressure and temperature & service mentioned above in this data sheet.					
97		24. Not only during commissioning, but also during life cycle of all valves, sediments/corrosion deposits/ silica/ mill scale of less than 40 mesh percent in process fluid have to be tolerated by all valves with malfunctioning.					
98	24. Fire Safe test certificate qualifying the valves as per API 6FA/ API 607/ ISO 10497 carried out in last 10 years shall be furnished.						
99	25. Flanges of flanged end cast/ forged body shall be integrally cast/ forged with the body of valve. Vendor to guarantee the suitability of seat/ seal material for the given service condition						
100	26. Minimum all pressure containing and controlling parts of the valve shall be provided with EN 10204-3.2 certificate.						
101	27. Cyclic test is required. The valve shall be subjected to at least 200 open close cycle with maximum differential pressure corresponding to valve rating.						
102	28. Stem seal / body seal, gland packing materials shall be provided with corrosion inhibitor.						
103	29. Vendor to guarantee the suitability of seat/ seal material for the given service condition						

		PROJECT : LAYING & CONSTRUCTION OF U/G STEEL P/L NETWORK IN KAKINADA AND VIJAYAWADA OF M/s BGL					
CLIENT		BHAGYANAGAR GAS LIMITED					
PMC		VCS QUALITY SERVICES PVT. LTD.					
DATA SHEET : BALL VALVE (LESS THAN 2.0 INCH) SOCKET WELDED (PIPING CLASS - 30HC)							
GENERAL SPECIFICATION							
Process Fluid	NG	ANSI Pressure Rating		800#			
Design Temperature	(-)29°C to 65°C	Design Pressure		49 kg/cm2			
Size, Inch (DN)	Less than 2" (50)						
Valve Type	Full Bore, Floating Ball						
End Connection Type	Socket Welded	Design Standard		BS EN ISO 17292			
Face Finish	Not Applicable	Locking Arrangement		As per P&ID			
VALVE DESIGN CONDITIONS							
Corrosion Allowance	1.5 mm	Design Factor		0.5			
Installation	Above Ground	Stem Ext Length (mm)		Not Applicable			
VALVE OPERATION							
Actuation Type	Not Applicable	Type of Actuator		Not Applicable			
PUP PIECE DETAILS							
100mm extension pups in ASTM A106 Gr.B, Sch 160 (for 3/4") and Sch XS (for 1 1/2")							
VALVE MATERIAL SPECIFICATION							
PART DESCRIPTION	MATERIAL SPECIFIED			MATERIAL OFFERED (Equivalent or Higher)			
Body	ASTM A105						
Ball	13% Cr Steel						
Body Seat	RPTFE/ DELRIN						
Gland	13% Cr Steel						
Stem (No Casting)	13% Cr Steel						
Body Seal	Grafoil						
Stem Seal	Grafoil						
Body Studs/ Nuts	ASTM A193 Gr. B7/ A194 Gr. 2H						
TESTING REQUIREMENT							
Hydrostatic Test Pressure & Time	Body: 210 kg/cm ² & 30 Minutes			Seat: 155 kg/cm ² & 30 Minutes			
Pneumatic Test Pressure & Time	7 kg/cm2 & 15 Minutes						
Hardness Test	248 HV10 max.						
Charpy Impact Test @ Temperature	Yes (at -29°C)						
Anti-Static Testing Requirement	As per BS EN ISO 17292						
Fire Safe Test	API 607 / API 6FA						
DOCUMENT NO.							
C251151-00-PP-DS-2003B							
	C1	24.03.2025	PS	AG	MK	ISSUED FOR BID	
SHEET NO.	1 OF 2	REV	DATE	PRPD	CHKD	APVD	REMARKS

		PROJECT : LAYING & CONSTRUCTION OF U/G STEEL P/L NETWORK IN KAKINADA AND VIJAYAWADA OF M/s BGL					
CLIENT		BHAGYANAGAR GAS LIMITED					
PMC		VCS QUALITY SERVICES PVT. LTD.					
DATA SHEET : BALL VALVE (LESS THAN 2.0 INCH) FLANGED END (PIPING CLASS - 30HC)							
GENERAL SPECIFICATION							
Process Fluid	NG	ANSI Pressure Rating		300#			
Design Temperature	(-)29°C to 65°C	Design Pressure		49 kg/cm2			
Size, Inch (DN)	Less than 2" (50)						
Valve Type	Full Bore / Reduced Bore, Floating Ball						
End Connection Type	Flanged End	Design Standard		BS EN ISO 17292			
Face Finish	ASME B16.5, 300#,RF/125AARH	Locking Arrangement		As per P&ID			
VALVE DESIGN CONDITIONS							
Corrosion Allowance	1.5 mm	Design Factor		0.5			
Installation	Above Ground	Stem Ext Length (mm)		Not Applicable			
VALVE OPERATION							
Actuation Type	Not Applicable	Type of Actuator		Not Applicable			
PUP PIECE DETAILS							
Not Applicable							
VALVE MATERIAL SPECIFICATION							
PART DESCRIPTION	MATERIAL SPECIFIED			MATERIAL OFFERED (Equivalent or Higher)			
Body	ASTM A105						
Ball	13% Cr Steel						
Body Seat	RPTFE/ DELRIN						
Gland	13% Cr Steel						
Stem (No Casting)	13% Cr Steel						
Body Seal	Grafoil						
Stem Seal	Grafoil						
Body Studs/ Nuts	ASTM A193 Gr. B7/ A194 Gr. 2H						
TESTING REQUIREMENT							
Hydrostatic Test Pressure & Time	Body: 73.5 kg/cm ² & 30 Minutes			Seat: 73.5 kg/cm ² & 30 Minutes			
Pneumatic Test Pressure & Time	7 kg/cm2 & 15 Minutes						
Hardness Test	248 HV10 max.						
Charpy Impact Test @ Temperature	Yes (at -29°C)						
Anti-Static Testing Requirement	As per BS EN ISO 17292						
Fire Safe Test	API 607 / API 6FA						
DOCUMENT NO.							
C251151-00-PP-DS-2003C							
	C1	24.03.2025	PS	AG	MK	ISSUED FOR BID	
SHEET NO.	1 OF 2	REV	DATE	PRPD	CHKD	APVD	REMARKS



DATA SHEET : PLUG VALVE (2.0 INCH) FLANGED END (PIPING CLASS - 30HC, 300#)

PMC

VCS QUALITY SERVICES PVT. LTD.

GENERAL SPECIFICATION

Process Fluid	NG	ANSI Pressure Rating	300#
Design Temperature	(-)29 °C to 65 °C	Design Pressure	48.06 barg
Size, Inch (DN)	2" (50)		
Valve Type	Regular Pattern		
End Connection Type	Flanged End	Design Standard	API 6D/ BS 5353
Face Finish	ASME B16.5, 300#,RF/125AARH	Locking Arrangement	As per SOR/P&ID

VALVE DESIGN CONDITIONS

Corrosion Allowance	1.5 mm	Design Factor	0.5
Installation	Above Ground	Stem Ext Length (mm)	Not Applicable

VALVE OPERATION

Actuation Type	Not Applicable	Type of Actuator	Not Applicable

PUP PIECE DETAILS

Not Required

VALVE MATERIAL SPECIFICATION

PART DESCRIPTION	MATERIAL SPECIFIED	MATERIAL OFFERED (Equivalent or Higher)
Body	ASTM A105/A216GR.WCB	
Plug (Lubricated)	ASTM A105 + 75 microns ENP	
Stem (No Casting)	(AISI 4140 + 75 microns ENP Coating)/ AISI 410	
Stem Seal	GRAFOIL/ PTFE V-RINGS + GRAFOIL	
Gland	ASTM A 105	
Gland Packing	Graphite/ PTFE	
Gasket	N.A	
Body Studs/ Nuts	ASTM A193 Gr. B7/ A194 Gr. 2H	
Lubricant Screw	Manufacturer's Standard	

TESTING REQUIREMENT

Hydrostatic Test Pressure & Time	Body: 72.09 barg & 30 Minutes	Seat: 52.86 barg & 30 Minutes
Pneumatic Test Pressure & Time	7 barg & 15 Minutes	
Hardness Test	248 HV10 max.	
Charpy Impact Test @ Temperature	Yes (at -29 oC)	
Fire Safe Test	API 607 / API 6FA	

DOCUMENT NO.

C251151-00-PP-DS-2003D

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24.03.2025

PS

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MK

ISSUED FOR BID

SHEET NO.

1 OF 2

REV

DATE

PRPD

CHKD

APVD

REMARKS



DATA SHEET : PLUG VALVE (LESS THAN 2.0 INCH) FLANGED END (PIPING CLASS - 30HC)

PMC

VCS QUALITY SERVICES PVT. LTD.

Valve Painting Specification :

1	Surface Preparation by Short Blasting as per grade SA 2 1/2, Swedish Standard SIS-055 909.
2	For above ground installation - Three coats of corrosion resistant paint shall be applied with minimum thickness of 300 micron (Permissible thickness in each coat shall be within 80 to 120 micron). Colour of paint shade shall be RAL-7038, however any change in colour shall be finalized during drawing approval stage.
3	Lock open/ lock close requirement : As indicated in P&ID / Schedule of Rates (SOR).

NOTES :

1	This Data Sheet shall be read in conjunction with Tender Documents & Specifications.
2	Material test certificates and hydrostatic test reports shall be furnished prior to dispatch.
3	Gland Packing Assembly shall permit repair of gland packing under full line pressure.
4	Valve shall have an inherent feature using the line pressure to ensure that the line pressure cannot cause taper locking of the plug / plug movement into the taper i.e. valves shall be of " pressure balanced design"
5	All valves shall be provided with valve position indicator.
6	Separate wrench shall be provided with each wrench operated valve.
7	Stops shall be provided to ensure positive alignment of plug with ports and ensure proper installation of handle.
8	Valve body & other pressure containing parts shall be designed as per ASME Sec-VII Div.-1. Minimum thickness shall not be less than ASME B16.34.
9	The Charpy Impact Test temperature specified in datasheet shall supersede the specification requirements.
10	Valve design shall ensure repair of stem seals / packing under full line pressure.
11	Painting procedure of valves shall be as per Manufacturer's standard.
12	Inspection and Testing shall be done as per data sheet, specification & BS:12266 (Part-I).
13	Minimum port area for regular pattern shall be 55%.
14	Minimum all pressure containing and controlling parts of the valve shall be provided with EN 10204-3.2 certificate.

DOCUMENT NO.							
C251151-00-PP-DS-2003D							
		C1	24.03.2025	PS	AG	MK	ISSUED FOR BID
SHEET NO.	2 OF 2	REV	DATE	PRPD	CHKD	APVD	REMARKS



Energising Quality

PROJECT NUMBER: C251151



Bhagyanagar Gas Ltd.

PIPING MATERIAL SPECIFICATION

Total Sheets

39

Document No

C251151

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PP

PMS

2001

BHAGYANAGAR GAS LIMITED

**LAYING & CONSTRUCTION OF U/G STEEL P/L NETWORK
IN KAKINADA AND VIJAYAWADA OF M/S BGL**

C1	24.03.2025	ISSUED FOR TENDER	PS	AG	MK
REV	DATE	DESCRIPTION	PREP	CHKD	APPR

ABBREVIATION

ANSI	American National Standards Institute
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
AARH	Arithmetic Average Roughness Height
BS	British Standards
CS	Carbon Steel
MS	Mild Steel
IS	Indian Standard Code
NFPA	National Fire Protection Association
OISD	Oil Industry Safety Directorate
PNRGB	Petroleum & Natural Gas Board
ERW	Electric Resistance Welding
BE	Bevel End
BW	Butt Welded
FF	Flat Face
PBE	Plain Both End
PE	Plain End
RF	Raised Face
SCRF	Screwed End - Female
SCRM	Screwed End - Male
CA	Corrosion Allowance
M	To Match Pipe

 Energising Quality	PIPING MATERIAL SPECIFICATION	Document No.	Rev
		C251151-00-PP-PMS-2001	C1
		Page 2 of 28	

CONTENTS

1.0	INTRODUCTION	4
2.0	CODES AND STANDARDS	4
3.0	MATERIAL SPECIFICATIONS	4
4.0	CLASS DESIGNATION CODE	5
5.0	TECHNICAL REQUIREMENTS	5
6.0	PIPELINE	6
7.0	PIPES	6
8.0	FITTINGS	7
9.0	BENDS	7
10.0	FLANGES	7
11.0	GASKETS	9
12.0	BOLTING & THREADS	9
13.0	THREAD SEALANT	9
14.0	VALVES	9
15.0	QUICK OPENING END CLOSURE	11
16.0	HYDROTESTING VENTS AND DRAINS	11
17.0	PIPING SPECIALTY ITEMS	11
18.0	INSULATING GASKET, SLEEVE AND WASHER	11
19.0	CHARPY V-NOTCH TEST & HARDNESS TEST	13
APPENDIX – A PIPING MATERIAL SPECIFICATION – INDEX		14
APPENDIX – B PIPING CLASS		16

 Energising Quality	PIPING MATERIAL SPECIFICATION	Document No.	Rev
		C251151-00-PP-PMS-2001	C1
		Page 3 of 28	

1.0 INTRODUCTION

This specification covers minimum requirements for the material specification for pipe, fittings, flanges, line blinds, bolts, gaskets, and valves that shall be used for natural gas pipeline and associated facilities in accordance with ASME B31.8, OISD-226 and PNGRB guideline.

This specification also defines, by piping class for each listed service, and defines the pressure/temperature limitations within which they may be used.

This specification shall be read in conjunction with various codes and standards as applicable.

2.0 CODES AND STANDARDS

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

ASME 31.3	:	Process Piping
ASME 31.8	:	Gas Transmission and Distribution Piping Systems
OISD STD-226	:	Natural Gas Transmission Pipeline and City Gas Distribution Networks
PNGRB	:	Petroleum and Natural Gas Regulatory Board

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

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

In addition to this PMS, various piping and pipeline materials shall also be applicable.

3.0 MATERIAL SPECIFICATIONS

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

 Energising Quality	PIPING MATERIAL SPECIFICATION	Document No.	Rev
		C251151-00-PP-PMS-2001	C1
		Page 4 of 28	

4.0 CLASS DESIGNATION CODE

The piping class designation shall generally consist of three digits made up of a letter, number & letter e.g. 15HC, 15HLT, 30HC, 30 HLT etc. as follows:

First two numerals letter indicates ASME class rating, e.g.

15 - 150 Class

30 - 300 Class

The first alphabet indicates differences in the Fluid Services within the same class rating and material, e. g. H stands for Hydrocarbon, W stands for Water, G stands for Galvanize etc.

The last one or two letter (as applicable) indicates type of material, e.g.

C - Carbon steel

LT - Low Temperature (Carbon Steel)

5.0 TECHNICAL REQUIREMENTS

5.1 General Notes

1. All piping materials selected under this specification shall be in compliance with the project specification.
2. Material selections shall comply with the maximum pressure and temperature limitation as specified in the service summary.
3. Substitution of equivalent materials is subject to approval of the Client /PMC. All requests for substitution shall be accompanied with sufficient data, drawings and descriptive details to permit evaluation by the Client /PMC.
4. Cast iron, ductile or malleable iron, aluminum, plastic or copper-bearing alloys shall not be used in hydrocarbon service.
5. Piping design pressure is based on flange maximum-allowable working pressure, unless otherwise noted in Job Specification.
6. When required, impact testing shall comply with applicable standards and material specifications.
7. All gaskets shall be asbestos free.
8. Aluminum jumper shall be provided across the flanged joint and length of the bolt shall be taken such that at least two threads remain exposed after the nut for fixing the continuity jumper.

 Energising Quality	PIPING MATERIAL SPECIFICATION	Document No.	Rev
		C251151-00-PP-PMS-2001	C1
		Page 5 of 28	

5.2 Units

1. All units are expressed in SI system with the exception of nominal pipe sizes (NPS) and bolting diameters, which are in inches.
2. Pressures are gauge pressures (in Kg/cm²g) and temperatures are in deg. Celsius (°C).
3. Pressures and Temperatures ratings are based ASME 16.5.

6.0 PIPELINE

- Line pipe material grade and wall thickness details are indicated in PMS.

7.0 PIPES

- Carbon steel pipe shall be made by open hearth, electric furnace or basic oxygen process only. The steel used shall be fully killed and made with fine grain structure. The grade and wall thickness of various sizes of pipes shall be as per piping material specification for the applicable class.
- Pipe dimensions shall be in accordance with ASME B 36.10 for carbon steel ASTM standard pipes & API 5L for carbon steel API 5L grade pipes.
- All pipe threads shall conform to American Standard taper as per ASME B 1.20.1 NPT, unless otherwise specified.
- For butt weld end, bevel shall be in accordance with API specification 5L or ASME B16.25 as applicable.
- Where difference in thickness of matching pipe ends exist, bevels for such matching pairs shall be prepared in accordance with ASME B 31.8.
- Pipes shall be supplied with beveled end. Beveling shall be in accordance with ASME B16.25. Where plain end pipes are specified, as for small bore pipes for socket welded piping, the pipes shall be supplied with square cut ends.
- All pipe threads shall conform to American Standard taper as per ASME B 1.20.1 NPT, unless otherwise specified.
- Dimensions of socket weld ends shall confirm to ASME B 16.11. Bore shall match pipe OD and pipe ID.
- Pipe to pipe joints shall be made as follows:

For sizes upto & including DN40

Socket weld/ As per Piping Class

For size DN50 and above

Butt Welded

 Energising Quality	PIPING MATERIAL SPECIFICATION	Document No.	Rev
		C251151-00-PP-PMS-2001	C1
		Page 6 of 28	

8.0 FITTINGS

- Fully killed carbon steel shall be used in the manufacture of fittings. The fitting shall have carbon equivalent not exceeding 0.45, based on check analysis.
- Threaded joints, if used, shall conform to American Standard taper as per ASME B1.20.1 NPT.
- Dimensions of socket welded/screwed fittings shall conform to ASME B 16.11. Swage shall be as per BS 3799.
- Dimensions of steel butt welded fittings shall be as per ASME B 16.9.
- Bore of socket welded fittings shall suit outside diameter (OD) of pipe and its thickness.
- Butt welding ends shall conform to API specification 5L or ASME B 16.25 as applicable. In case of difference in thickness of matching ends, requirements of ASME B 31.4 shall apply.
- Integrally reinforced forged branch fittings such as Sockolet, Weldolet etc. shall be as per MSS-SP-97. Fittings not covered in ASME B16.9 and MSS-SP-97 shall conform to manufacturer's standard.
- Fittings thickness tolerances shall match pipe thickness tolerance.

9.0 BENDS

- Unless otherwise specified for process piping, elbow of radius $R = 1.5 D$ shall only be used.
- In order to accommodate changes in vertical and horizontal alignment in piggable section of pipeline, Elastic bends/ Cold field bends/ Hot formed long radius bends shall be used. Radius of bend shall be as per Design Basis.
 $D = \text{Specified Outside Diameter}$
- Miters shall not be used.

10.0 FLANGES

- Pressure Temperature rating of flanges shall conform to B16.5/ MSS-SP44/ B16.47 Series A, as applicable.
- Dimensions of flanges shall be in accordance with B16.5/ MSS-SP44/ B16.47 Series A, as applicable.
- Neck of weld neck (WN) flanges shall suit pipe bore and thickness.
- Bore of socket welded (SW) flanges shall suit pipe O.D. and its thickness.
- Threads for screwed flanges, if used, shall conform to American Standard taper as per ASME B 1.20.1 NPT.
- Sizes for blind flanges shall be indicated by nominal pipe size.

 Energising Quality	PIPING MATERIAL SPECIFICATION	Document No.	Rev
		C251151-00-PP-PMS-2001	C1
		Page 7 of 28	

- Unless specified otherwise in Piping Material Specification the flange face finish shall be as per ASME B16.5.
- Butt welding ends of WN flanges shall conform to ASME B 16.25.
- Spectacle blind/spacer & blinds shall be in accordance with ASME B 16.48/ manufacturer's standard.
- Flange face finish for raised face flanges shall be as per ASME B16.5/ ASME B 16.47 as applicable. For RTJ flanges groove finish shall be 32-63 micro inches AARH as per MSS-SP-6. Hardness of groove surface shall be minimum 140 BHN.
- Butt welding ends of WN flanges shall conform to ASME B 16.25.
- Spectacle blind/spacer & blinds shall be in accordance with ASME B16.48 / manufacturer's standard.
- Two jackscrews, 180° apart shall be provided for all RTJ flange assemblies and Spacer blind/ Figure 8 assemblies. Holes for jackscrews shall be drilled and tapped at site. Jackscrews shall be as per ASTM A193 Gr. B7. Heads of jackscrews shall be heavy hexagonal type and jackscrew end shall be rounded. Dimensions shall be as per ASME B18.2.1.
- Flanges shall be packed and shipped in such a way as to prevent damage of machined parts.
- All machined or threaded parts shall be protected in accordance with ASTM A700. Suitable protection shield, or cover shall be provided on the gasket contact surface.
- Carbon steel forgings shall be supplied with a maximum carbon content of 0.25% and CE of 0.45 by product analysis.
- The finish of contact faces of pipe flanges & connecting end flanges of valves & fittings shall be governed by ASME B16.5 & following:
Roughness requirements (Finish: AARH standards per ASME B46.1):
a) Raised Face (RF): Serrated finish 125 to 250 µin Ra.
b) Flat Face (FF): Serrated finish 125 to 250 µin Ra.
c) Ring Type Joint (RTJ): Extra-smooth finish 63 µin Ra max.
- Flat face flanges, unless specified on the Piping Specifications, shall not be used without specific Client/PMC approval. Full-face gaskets shall be used with flat-face flanges as per ASME B16.20.
- All flanged joints shall be installed with a single gasket between contact faces.
- Spectacle blank (figure 8 blank), blank (blind) & spacer shall confirm to the requirement of ASME B16.48 up to sizes 24". For 150#, 300# and 600# spectacle blank shall be used up to 8", blank (blind) & spacer for sizes 10" & above

 Energising Quality	PIPING MATERIAL SPECIFICATION	Document No.	Rev
		C251151-00-PP-PMS-2001	C1
		Page 8 of 28	

11.0 GASKETS

- Spiral wound metallic gasket with Graphite filled winding with SS304 inner ring and CS outer ring/ Soft iron octagonal ring type joint gasket, and shall conform to ASME B 16.20/ API 601
- Spiral wound gaskets shall be self-aligning type.

12.0 BOLTING & THREADS

- Nuts for stud bolts shall be American Standard Hexagon Heavy Series and double chamfered.
- Dimension and tolerances for stud bolts and nuts shall be as per ASME B18.2.1 and 18.2.2 with full threading to ASME B 1.1 Class 2A thread for bolts and Class 2B for nuts. Diameter and length of stud bolts shall be as per ASME B16.5/ASME B16.47 with full threading.
- Threads for nuts shall be as per ASME B 1.1 as follows:

Nuts for stud bolts Dia ¼" to 1"	:	UNC-2B
Nuts for stud bolts Dia 1½" to 3¼"	:	8UN-2B
- Threads for stud bolts shall be as per ASME B 1.1, as follows:

Stud bolts Dia ¼" to 1"	:	UNC-2A
Stud bolts Dia 1½" to 3¼"	:	8UN-2A
- Threads for threaded pipe, fitting, flanges and valve shall be in accordance with B1.20.1 taper threads, unless specified otherwise.
- Heads of jack screws shall be heavy hexagonal type. Jack screw end shall be rounded. Stud bolts shall be fully threaded with two hexagonal nuts.

13.0 THREAD SEALANT

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

14.0 VALVES

- Valve ends shall be as per valve data sheets for various piping class.
- Sectionalizing valves, Block valves and other isolation valves installed on the main pipeline shall be ball valves with butt welding ends. All inline isolation valves on the mainline (pipeline) shall be full bore valves to allow smooth passage of cleaning as well as intelligent pigs.
- All buried valves shall be provided with stem extension shall have Butt Welded ends as per relevant specification/ data sheet.
- All valves in the piggable section of pipeline and Main Process Flow Line shall be Full Opening valve as per API 6D. Other valves shall be Reduced Opening type unless specified otherwise in P&ID.

 Energising Quality	PIPING MATERIAL SPECIFICATION	Document No.	Rev
		C251151-00-PP-PMS-2001	C1
		Page 9 of 28	

- Flange dimensions and face finish of flanged end valves shall conform to clause 10.0 of this specification.
- Butt welding ends of Butt Welded valves shall conform to ASME B 16.25.
- Face to face and end to end dimensions shall conform to applicable standards.
- Valves shall conform to following standards unless specified otherwise in piping material specification for various piping class.

Flanged/Socket Welded end valves (1½" and below)
Design STD. for Process lines

Gate Valves	:	API 602
Globe Valves	:	BS EN ISO 15761
Check Valves	:	BS EN ISO 15761
Ball Valve	:	BS EN ISO 17292
Plug Valve	:	BS 5353

Flanged/Butt Welded end valves (2" and above)
Design STD. for Process Lines

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

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

• **Gate Valves**

For ANSI class 150 and 300	-	Hand wheel operated for size ≤ 12" NB. Gear operated for size ≥ 14" NB.
For ANSI class 600	-	Hand wheel operated for size ≤ 10" NB. Gear operated for size ≥ 12" NB.

• **Globe Valves**

For ANSI class 150, 300, 600 and 900 - Hand wheel operated for all Size.

• **Ball Valves & Plug Valves**

 Energising Quality	PIPING MATERIAL SPECIFICATION	Document No.	Rev
		C251151-00-PP-PMS-2001	C1
		Page 10 of 28	

For all ANSI class

- Wrench operated for size $\leq 4"$ NB.
- Gear operated for size $\geq 6"$ NB.

- **Actuated Valves**

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

15.0 QUICK OPENING END CLOSURE

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

16.0 HYDROTESTING VENTS AND DRAINS

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

17.0 PIPING SPECIALTY ITEMS

- Primary material Pipeline specialty items viz. flow tees, insulating joints, LR bends etc. shall be as per respective data sheets and specification.
- For mainline items, corrosion allowance shall be as per respective data sheet.

18.0 INSULATING GASKET, SLEEVE AND WASHER

The insulating gasket shall consist of a PTFE (Teflon) spring-energized face seal, or an elastomeric O-ring, seated in an isolating laminate, which shall be permanently bonded to a high strength metal gasket core. Due to this unique pressure activated sealing mechanism, the gasket requires far less bolt stress to seal than any other gasket. The gasket inner diameter shall be exactly matched to the flange bore to eliminate turbulent flow and flange face erosion/ corrosion. The seal elements shall be replaceable in the reusable gasket retainer. The core of gasket shall be made of annealed 316 stainless steel or other metals including duplex and Inconel etc.

Insulating gasket shall include the following applications,

- Flange isolation in conjunction with Cathodic protection.
- Isolation between dissimilar metals to prevent galvanic corrosion.
- Mating mismatched ring-joint to raised -face flanges.

 Energising Quality	PIPING MATERIAL SPECIFICATION	Document No.	Rev
		C251151-00-PP-PMS-2001	C1
		Page 11 of 28	

- Eliminate fluid trap corrosion between ring-joint (RTJ) flanges where high concentrations of Co₂, H₂S and other aggressive hydrocarbon media are present.
- Eliminate turbulence and flow induced erosion between ring-joint (RTJ) flanges.
- Protect against coating impingement on coated flange faces.
- To seal between flanges subjected to vibration/ cavitation.

18.1 Insulating Gaskets, Sleeves and Washer Materials Properties

Compressive Strength	:	65000 psi
Average Dielectric Strength	:	15 kV or more
Electrical Resistance	:	>1 MΩ (When tested with 500-1000 V DC merger)
Max. Operating Temperature	:	302°F (150°C)
Min. Operating Temperature	:	(-) 200°F (-129°C)
Water Absorption	:	5%
Flexural Strength	:	70000 psi
Tensile Strength	:	50000 psi
Bond Strength	:	2600 lb.
Shear Strength	:	22000 lb.

18.2 Seal Material

The sealing elements shall intend to provide an impervious barrier through which no contained media or other substance can penetrate. The composite retainer backing material behind the seal remains uncontaminated and thus permanently holds the seal in place in a static, fully encapsulated manner.

Viton as a seal material shall consist following properties,

- General purpose oilfield elastomer.
- Excellent resistance to aliphatic hydrocarbons, glycols and H₂S.
- Good resistance to aromatic hydrocarbons.

Isolating Sleeve

Mylar as a seal material shall consist following properties,

- Spiral wound Mylar is a general-purpose material recommended for bolting application with flange temperatures below 250°F.

 Energising Quality	PIPING MATERIAL SPECIFICATION	Document No.	Rev
		C251151-00-PP-PMS-2001	C1
		Page 12 of 28	

- Material shall be fair resistance to crushing, cracking, breaking and thread pinch.

Isolating washer: 1/8" (0.125) Thick washer

Steel Washer: ZPS standard – Zinc plated steel washers.

Butt weld (BW) ends of the insulating assembly shall be protected by metallic or high impact plastic bevel protectors.

The dimensions of insulating components (gaskets, sleeves and washers) shall be as indicated in Data Sheet. The insulating gasket and washers shall have adequate compressive strength to permit proper tightening of flange bolts for leak proof joint.

The insulating material shall be suitable for pressure and temperature indicated in Data Sheet under connecting pipeline details and shall be resistant to the fluid to be handled through the pipeline.

I.D. and O.D. of insulating washers shall be designed to fit over insulating sleeves and within spot faces on flanges.

After the hydrostatic test, insulating flange assembly shall be tested with air at 5 kg/cm² for 10 minutes. The tightness shall be checked by immersion or with a frothing agent. No leakage shall be accepted.

Insulating gasket, sleeve and washer after the field hydrostatic test shall be tested for dielectric integrity at 5000 V A.C., 50 Hz for one minute and the leakage current before and after shall be equal. Testing time, voltage and leakage shall be recorded and certified. The test shall be carried out in dry conditions.

19.0 CHARPY V-NOTCH TEST & HARDNESS TEST

All piping material like valves, fittings, flanges bolting etc. shall be Charpy impact tested. Charpy V-notch impact tests are required for the base metal weld metal and heat-affected zone (HAZ)

 Energising Quality	PIPING MATERIAL SPECIFICATION	Document No.	Rev
		C251151-00-PP-PMS-2001	C1
		Page 13 of 28	

Appendix – A

Piping Material Specification – Index

 Energising Quality	PIPING MATERIAL SPECIFICATION	Document No.	Rev
		C251151-00-PP-PMS-2001	C1
		Page 14 of 28	



LAYING & CONSTRUCTION OF U/G STEEL P/L NETWORK IN KAKINADA AND VIJAYAWADA OF M/S BGL

Sr. No.	Piping Class	Rating	C. A. (MM)	Spl. Reqt.	Basic Material	Service	Remarks
1	15HC	150	1.5	NON IBR	CARBON STEEL	NON-CORROSIVE PROCESS-FLAMMABLE /NONFLAMMABLE, NON LETHAL- HYDROCARBONS	Page 16
2	30HC	300	1.5	NON IBR	CARBON STEEL	NON-CORROSIVE PROCESS-FLAMMABLE / NONFLAMMABLE, NON LETHAL- HYDROCARBONS	Page 22

 Energising Quality	PIPING MATERIAL SPECIFICATION	Document No.	Rev
		C251151-00-PP-PMS-2001	C1
		Page 15 of 28	

Appendix – B

Piping Class

 Energising Quality	PIPING MATERIAL SPECIFICATION	Document No.	Rev
		C251151-00-PP-PMS-2001	C1
		Page 16 of 28	

PIPE CLASS	15HC
DESIGN CODE	ASME B31.8
RATING	150#
BASE MATERIAL	CARBON STEEL
CA	1.5 MM
SPECIAL REQUIREMENT	Non IBR
SERVICE	Natural Gas, Utilities (water, inst. air, plant air, nitrogen, carbon dioxide)

Temperature (Deg. C) and Pressure (Kg/cm²g) Ratings

Temperature	-29	38	93	149	204	260	316	343	371
Pressure	20.03	20.03	18.28	16.17	14.06	11.95	9.84	8.78	7.73

NOTES:

- All vents and drains shall be provided with gate valve with blind flange assembly unless otherwise indicated in P&ID.
- NDT of welds shall be as follows:
 Radiography : All butt welds 100%
 MPI : Socket welds 100%
- Piping design as per ASME B 31.8, OISD 226 & PNGRB Guidelines
- Charpy V notch test and hardness test shall be conducted for pipes, fittings and flanges at (-) 29°C.
- All branch connections including vent, drain, pressure and temperature connection shall be as per branch connection table.
- For valves, refer valve data sheets.

ITEM	SIZE	DESCRIPTION
Maintenance joints	ALL	Flanged, to be kept minimum
Pipe joints	1.5" & BELOW	SW coupling
	2.0" & ABOVE	Butt welded
Drains	ON LINES ≤ 1.5"	Refer std. Drawing
	ON LINES ≥ 2.0"	As per P&ID or 0.75". Refer std. Drawing
Vents	ON LINES ≤ 1.5"	Refer std Drawing
	ON LINES ≥ 2.0"	As per P&ID or 0.75". Refer std. Drawing

 Ennergising Quality	PIPING MATERIAL SPECIFICATION	Document No.	Rev
		C251151-00-PP-PMS-2001	C1
		Page 17 of 28	

LAYING & CONSTRUCTION OF U/G STEEL P/L NETWORK IN KAKINADA AND VIJAYAWADA OF M/S BGL

Temp. Connection	1.5"	Flanged, installation as per std. Drawing, except skin temperature measurement.
Press. Connection	0.75"	SW nipple with Plug/ Ball Valve to spec. as per Refer std. Drawing

Branch Table

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CODES

T
W
S

DESCRIPTION

Tees
Weldolet
Sockolet

 Energising Quality	PIPING MATERIAL SPECIFICATION	Document No.	Rev
		C251151-00-PP-PMS-2001	C1
		Page 18 of 28	

Item	Lower Size (Inch)	Upper Size (Inch)	Sch. / Thk.	Dmn. STD	Material (Charpy)	Description
PIPE GROUP						
PIPE	00.500	02.000	XS	B-36.10	ASTM A 106 GR.B	PE, SEAMLESS
PIPE	03.000	03.000	STD	B-36.10	ASTM A 106 GR.B	PE, SEAMLESS
PIPE	04.000	04.000	6.4 mm	B-36.10	ASTM A 106 GR.B (Charpy)	BE, SEAMLESS
PIPE	06.000	12.000	STD	B-36.10	ASTM A 106 GR.B (Charpy)	BE, SEAMLESS
NIPPLE	00.500	01.500	M	B-36.10	ASTM A 106 GR.B	PBE, SEAMLESS
FLANGE GROUP						
FLNG.SW	00.500	01.500	M	B-16.5	ASTM A 105	150, RF/125AARH
FLNG.WN	2.000	12.000	M	B-16.5	ASTM A 105 (Charpy)	150, RF/125AARH
FLNG.BLIND	00.500	01.500		B-16.5	ASTM A 105	150, RF/125AARH
FLNG.BLIND	00.500	12.000		B-16.5	ASTM A 105 (Charpy)	150, RF/125AARH
FLNG.FIG.8	00.500	08.000		ASME B16.48	ASTM A 105 (Charpy)	150, FF/125AARH
SPCR&BLND	10.000	24.000		ASME B16.48	ASTM A 105 (Charpy)	150, FF/125AARH
FITTING GROUP						
ELBOW.90	00.500	01.500		B-16.11	ASTM A 105	SW, 6000
ELBOW.90	02.000	12.000	M	B-16.9	ASTM A 234 GR.WPB (Charpy)	BW, 1.5D
ELBOW.45	00.500	01.500		B-16.11	ASTM A 105	SW, 6000
ELBOW.45	02.000	12.000	M	B-16.9	ASTM A 234 GR.WPB (Charpy)	BW, 1.5D
T.EQUAL	00.500	01.500		B-16.11	ASTM A 105	SW, 6000
T.EQUAL	02.000	12.000	M	B-16.9	ASTM A 234 GR.WPB (Charpy)	BW
T.RED	00.500	01.500		B-16.11	ASTM A 105	SW, 6000

 Energising Quality	PIPING MATERIAL SPECIFICATION	Document No.	Rev
		C251151-00-PP-PMS-2001	C1
		Page 19 of 28	

**LAYING & CONSTRUCTION OF U/G STEEL P/L NETWORK IN KAKINADA AND
VIJAYAWADA OF M/S BGL**

Item	Lower Size (Inch)	Upper Size (Inch)	Sch. / Thk.	Dmn. STD	Material (Charpy)	Description
T.RED	02.000	12.000	M, M	B-16.9	ASTM A 234 GR.WPB (Charpy)	BW
REDUC. CONC	02.000	12.000	M, M	B-16.9	ASTM A 234 GR.WPB (Charpy)	BW
REDUC. ECC	02.000	12.000	M, M	B-16.9	ASTM A 234 GR.WPB (Charpy)	BW
SWAGE. CONC	00.500	03.000	M, M	BS-3799	ASTM A 105 (Charpy)	PBE
SWAGE.ECC	00.500	03.000	M, M	BS-3799	ASTM A 105	PBE
CAP	00.500	00.750		B-16.11	ASTM A 105	SCRF, 6000
CAP	01.000	01.500		B-16.11	ASTM A 105	SCRF, 3000
CAP	02.000	12.000	M	B-16.9	ASTM A 234 GR.WPB (Charpy)	BW
PLUG	00.500	00.750		B-16.11	ASTM A 105	SCRM, 6000
O'let						
WELDOLET	02.000	06.000	M, S160	MSS-SP97	ASTM A 105 (Charpy)	BW
SOCKOLET	00.500	00.750		MSS-SP97	ASTM A 105	SCRF, 6000
SOCKOLET	01.000	01.500		MSS-SP97	ASTM A 105	SW, 3000
VALVES GROUP						
VLV.GLOBE	00.250	01.500		BS EN ISO 15761	BODY-ASTM A 105, TRIM- STELLITED, STEM- 13%CR STEEL	SW, 800, 3000, B- 16.11
VLV.GLOBE	02.000	12.000		BS-1873	BODY-ASTM A 216 GR.WCB, TRIM- 13% CR.STEEL	FLGD, 150, B- 16.5, RF/125AARH
VLV.CHECK	00.250	01.500		BS EN ISO 15761	BODY-ASTM A 105, TRIM- STELLITED	SW, 800, 3000, B- 16.11
VLV.CHECK	02.000	12.000		API-6D	BODY-ASTM A 216 GR.WCB, TRIM- 13% CR.STEEL	FLGD, 150, B-16.5, RF/125AARH
Item	Lower Size (Inch)	Upper Size (Inch)	Sch. / Thk.	Dmn. STD	Material (Charpy)	Description

 Energising Quality	PIPING MATERIAL SPECIFICATION	Document No.	Rev
		C251151-00-PP-PMS-2001	C1
		Page 20 of 28	

VLV.BALL	00.500	01.500		BS EN 1SO 17292	BODY-ASTM A 105,TRIM-13% CR.STEEL, SEAT- RPTFE	SW, 800, B-16.5, RF/125AARH
VLV.BALL	02.000	12.000		API-6D	BODY-ASTM A216 GR.WCB,TRIM/BALL SEAT-(AISI 4140 + 0.003"ENP)/AISI 410	FLGD, 150, B-16.5, RF/125AARH
VLV.BALL	02.000	12.000		API-6D	BODY-ASTM A 216 GR.WCB, TRIM- BALL, SEAT-(AISI 4140 + 0.003"ENP) /AISI 410	BW, 150, B-16.25
VLV.PLUG	00.500	01.500		BS-5353	BODY-ASTM A 105,PLUG - A105 + 0.003" ENP	SW, 800, 3000, B- 16.11,
VLV.PLUG	02.000	12.000		API-6D	BODY- A 216GR. WCB, PLUG: A216 GR.WCB + 0.003" ENP	FLGD, 150, B-16.5, RF/125AARH
VLV.PLUG	02.000	12.000	M	API-6D	BODY-ASTM A 216 GR.WCB, PLUG: A216 GR.WCB + 0.003"ENP	BW, 150, B- 16.25
BOLT GROUP						
BOLT.STUD	00.500	12.000		B-18.2	BOLT:A193 GR.B7, NUT:A194 GR.2H	
GASKET GROUP						
GASKET	00.500	12.000		B-16.20- ANSI B16.5	SP.WND METTALIC WITH GRAPHITE FILLER	SPIRAL, 150

Note: For all Valves, valve data sheets shall also be referred, stringent requirement among data sheet and above details shall be followed.

 Energising Quality	PIPING MATERIAL SPECIFICATION	Document No.	Rev
		C251151-00-PP-PMS-2001	C1
		Page 21 of 28	

PIPE CLASS	30HC
DESIGN CODE	ASME B31.8
RATING	300#
BASE MATERIAL	CARBON STEEL
CA	1.5 MM
SPECIAL REQUIREMENT	Non IBR
SERVICE	Natural Gas, Utilities (water, inst. air, plant air, nitrogen, carbon dioxide)

Temperature (Deg. C) and Pressure (Kg/cm²g) Ratings

Temperature	-29	38	93	149	204	260	316
Pressure	52.02	52.02	47.45	46.05	44.64	42.18	40.66

NOTES:

- All vents and drains shall be provided with gate valve with blind flange assembly unless otherwise indicated in P&ID.
- NDT of welds shall be as follows:
 - Radiography : All butt welds 100%
 - MPI : Socket welds 100%
- Piping design as per ASME B 31.8, OISD 226 & PNRB Guidelines
- Charpy V notch test and hardness test shall be conducted for pipes, fittings and flanges at (-) 29°C.
- Corrosion allowance of 1.5 mm has been considered for terminal piping.
- All branch connections including vent, drain, pressure and temperature connection shall be as per branch connection table.
- For valves, refer valve data sheets as enclosed.
- Design Factor 0.5
9. Ball Valve to be used in main pipeline shall have butt welded ends.

ITEM	SIZE	DESCRIPTION
Maintenance joints	ALL	Flanged, to be kept minimum
Pipe joints	1.5" & BELOW	SW coupling
	2.0" & ABOVE	Butt welded
Drains	ON LINES <= 1.5"	Refer std. drawing
	ON LINES >= 2.0"	As per P&ID or 0.75". Refer std. drawing

 Enersing Quality	PIPING MATERIAL SPECIFICATION	Document No.	Rev
		C251151-00-PP-PMS-2001	C1
		Page 22 of 28	

Vents	ON LINES $\leq 1.5"$	Refer std. drawing
	ON LINES $\geq 2.0"$	As per P&ID or 0.75". Refer std. drawing
Temp. Connection	1.5"	Flanged, installation as per std. drawing, except skin temperature measurement.
Press. Connection	0.75"	SW nipple with Plug/ Ball Valve to spec. as per Refer std drawing

 Energising Quality	PIPING MATERIAL SPECIFICATION	Document No.	Rev
		C251151-00-PP-PMS-2001	C1
		Page 23 of 28	

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CODES	DESCRIPTION
T	Tees
W	Weldolet
S	Sockolet

 VCS Energising Quality	PIPING MATERIAL SPECIFICATION	Document No.	Rev
		C251151-00-PP-PMS-2001	C1
		Page 24 of 28	

**LAYING & CONSTRUCTION OF U/G STEEL P/L NETWORK IN KAKINADA AND
VIJAYAWADA OF M/S BGL**

Item	Lower Size (Inch)	Upper Size (Inch)	Sch . / Thk	Dmn. STD	Material (Charpy)	Description
PIPE GROUP						
PIPE	00.500	02.000	XS	B-36.10	ASTM A 106 GR.B	PE, SEAMLESS
PIPE	03.000	03.000	STD	B-36.10	ASTM A 106 GR.B	PE, SEAMLESS
PIPE	04.000	04.000	6.4 mm	B-36.10	ASTM A 106 GR.B (Charpy)	BE, SEAMLESS
PIPE	06.000	12.000	STD	B-36.10	ASTM A 106 GR.B (CHARPY)	BE, SEAMLESS
NIPPLE	00.500	01.500	M	B-36.10	ASTM A 106 GR.B	PBE, SEAMLESS
FLANGE GROUP						
FLNG.SW	00.500	01.500	M	B-16.5	ASTM A 105	300, RF/125AARH
FLNG.WN	02.000	24.000	M	B-16.5	ASTM A 105 (CHARPY)	300, RF/125AARH
FLNG.BLIND	00.500	01.500		B-16.5	ASTM A 105	300, RF/125AARH
FLNG.BLIND	02.000	12.000		B-16.5	ASTM A 105 (CHARPY)	300, RF/125AARH
FLNG.FIG.8	00.500	01.500		ASME- B 16.48	ASTM A 105	300, FF/125AARH

Item	Lower Size (Inch)	Upper Size (Inch)	Sch . / Thk	Dmn. STD	Material (Charpy)	Description
FLNG.FIG.8	02.000	08.000		ASME- B 16.48	ASTM A 105 (CHARPY)	300, FF/125AARH
SPCR&BLND	10.000	12.000		ASME- B 16.48	ASTM A 105 (CHARPY)	300, FF/125AARH
FITTING GROUP						
ELBOW.90	00.500	00.750		B-16.11	ASTM A 105	SW, 6000
ELBOW.90	01.000	01.500		B-16.11	ASTM A 105	SW, 3000
ELBOW.90	02.000	12.000	M	B-16.9	ASTM A 234 GR.WPB (CHARPY)	BW, 1.5D
ELBOW.45	00.500	00.750		B-16.11	ASTM A 105	SW, 6000
ELBOW.45	01.000	01.500		B-16.11	ASTM A 105	SW, 3000
ELBOW.45	02.000	12.000	M	B-16.9	ASTM A 234 GR.WPB (CHARPY)	BW, 1.5D

 Energising Quality	PIPING MATERIAL SPECIFICATION	Document No.	Rev
		C251151-00-PP-PMS-2001	C1
		Page 25 of 28	

LAYING & CONSTRUCTION OF U/G STEEL P/L NETWORK IN KAKINADA AND VIJAYAWADA OF M/S BGL

T.EQUAL	00.500	00.750		B-16.11	ASTM A 105	SW, 6000
T.EQUAL	01.000	01.500		B-16.11	ASTM A 105	SW, 3000
T.EQUAL	02.000	12.000	M	B-16.9	ASTM A 234 GR.WPB (CHARPY)	BW
T.RED	00.500	00.750		B-16.11	ASTM A 105	SW, 6000
T.RED	01.000	01.500		B-16.11	ASTM A 105	SW, 3000
T.RED	02.000	12.000	M, M	B-16.9	ASTM A 234 GR.WPB (CHARPY)	BW
REDUC. CONC	02.000	12.000	M, M	B-16.9	ASTM A 234 GR.WPB (CHARPY)	BW
REDUC. ECC	02.000	12.000	M, M	B-16.9	ASTM A 234 GR.WPB (CHARPY)	BW
SWAGE. CONC	00.500	03.000	M, M	BS-3799	ASTM A 105 (CHARPY)	PBE
SWAGE. ECC	00.500	03.000	M, M	BS-3799	ASTM A 105 (CHARPY)	PBE
CAP	00.500	00.750		B-16.11	ASTM A 105	SCRf, 6000
CAP	01.000	01.500		B-16.11	ASTM A 105	SCRf, 3000
CAP	02.000	12.000	M	B-16.9	ASTM A 234 GR.WPB (CHARPY)	BW
PLUG	00.500	00.750		B-16.11	ASTM A 105	SCRm, 6000
PLUG	01.000	01.500		B-16.11	STM A 105	SCRm, 3000
CPLNG.FULL	00.500	00.750		B-16.11	ASTM A 105	SW, 6000
CPLNG.FULL	01.000	01.500		B-16.11	ASTM A 105	SW, 3000
CPLNG.HALF	00.500	0.750		B-16.11	ASTM A 105	SW, 6000
CPLNG.HALF	01.000	01.500		B-16.11	ASTM A 105	SW, 3000
CPLNG.LH	00.500	00.750		B-16.11	ASTM A 105	SW, 6000
CPLNG.LH	01.000	01.500		B-16.11	ASTM A 105	SW, 3000
CPLNG.RED	00.500	00.750		B-16.11	ASTM A 105	SW, 6000
CPLNG.RED	01.000	01.500		B-16.11	ASTM A 105	SW, 3000
O'let						

 Energising Quality	PIPING MATERIAL SPECIFICATION	Document No.	Rev
		C251151-00-PP-PMS-2001	C1
		Page 26 of 28	

LAYING & CONSTRUCTION OF U/G STEEL P/L NETWORK IN KAKINADA AND VIJAYAWADA OF M/S BGL

SOCKOLET	00.500	00.750		MSS-SP97	ASTM A 105	SW, 6000
SOCKOLET	01.000	01.500		MSS-SP97	ASTM A 105	SW, 3000
WELDOLET	02.000	08.000	M, XX	MSS-SP97	ASTM A 105 (CHARPY)	BW
VALVE GROUP						
VLV.GATE	00.500	01.500		API-602	BODY-ASTM A 105, TRIM- STELLITED, STEM 13%	SW, 800, 3000, B-16.11
VLV.GATE	02.000	12.000		API 600/ ISO 10434	BODY-ASTM A 105/ ASTM A 216 GR.WCB STELLITED, STEM- SS304	FLGD, 300, B-16.5, RF/125AARH
VLV.GLOBE	00.500	01.500		BS EN ISO 15761	BODY-ASTM A 105, TRIM- STELLITED, STEM- 13%	SW, 800, 3000, B-16.11
VLV.GLOBE	02.000	12.000		BS 1873	BODY-ASTM A 105 / ASTM A 216 GR.WCB , TRIM-13% CR.STEEL	FLGD, 300, B-16.5, RF/125AARH
VLV.CHECK	00.500	01.500		BS EN ISO 15761	BODY-ASTM A 105, TRIM- STELLITED	SW, 800, 3000, B-16.11
VLV.CHECK	02.000	12.000		API-6D/BS-1868	BODY-ASTM A 105 / ASTM A 216 GR.WCB	FLGD, 300, B-16.5, RF/125AARH
VLV.BALL	00.500	01.500		BS EN ISO 17292	BODY-ASTM A 105,	SW, 800, B-16.5, RF/125AARH
VLV.BALL	02.000	12.000		API-6D	BODY-ASTM A 216 GR.WCB/ ASTM 105	FLGD, 300, B-16.5, RF/125AARH
VLV.BALL	02.000	12.000	M	API-6D	BODY-ASTM A 216 GR.WCB/ASTM 105,	BW, 300, B-16.25
VLV.PLUG	00.500	01.500		BS-5353	BODY-ASTM A 105, PLUG- A105 +0.003" ENP	SW, 800#, 3000, B-16.11

 Energising Quality	PIPING MATERIAL SPECIFICATION	Document No.	Rev
		C251151-00-PP-PMS-2001	C1
		Page 27 of 28	

LAYING & CONSTRUCTION OF U/G STEEL P/L NETWORK IN KAKINADA AND VIJAYAWADA OF M/S BGL

VLV.PLUG	02.000	12.000		API-6D	BODY- A 216GR. WCB, PLUG: A216 GR.WCB + 0.003" ENP	FLGD, 300, B-16.5, RF/125AARH
VLV.PLUG	02.000	12.000	M	API-6D	BODY-ASTM A 216 GR.WCB, PLUG: A216 GR.WCB + 0.003"ENP	BW, 300, B- 16.25
BOLT GROUP						
BOLT.STUD	00.500	12.000		B-18.2	BOLT:A193 GR.B7, NUT:A194 GR.2H	
GASKET						
GASKET	00.500	12.000		B-16.20- ANSI B16.5	SP.WND METTALIC WITH GRAPHITEFILLER	SPIRAL, 300

Note: For Valve Material, valve data sheet shall also be referred, stringent requirement among data sheet and above details shall be followed.

 Energising Quality	PIPING MATERIAL SPECIFICATION	Document No.	Rev
		C251151-00-PP-PMS-2001	C1
		Page 28 of 28	

STANDARD SPECIFICATIONS



ENERGISING QUALITY

VCS QUALITY SERVICES PVT. LTD.

STANDARD SPECIFICATION FOR PIPELINE CONSTRUCTION (ONSHORE)

VCS – SS – PP - 2001

					
03	29.04.2022	RP	MC	HK	GW
02	03.01.2022	SR	MC	HK	HK
Rev. No	Date	Prepared By	Checked By	Approved By	Authorized By

UNCONTROLLED COPY : If printed

CONTROLLED COPY : If in soft and signed

REVISION RECORD						
Rev.	Revision Date	Prepared by	Checked by	Approved by	Authorized by	Revision Description
00	28.01.2020					Issued as Standard Specification
		MB	MC	AD	SK	(Document formatting, Cover Page, Doc numbering updated from SS-PL-015 to VPC-SS-PL-0015 keeping Revision Number Same)
01	28.01.2020					Document numbering updated from VPC-SS-PL-0015 to VPC-SS-PP-2001
		MB	MC	AD	SK	
02	03.01.2022					Revised as marked
		SR	MC	HK	HK	
03	29.04.2022					VCS QMS Integration
		RP	MC	HK	GW	

ABBREVIATIONS:

ASME	American Society of Mechanical Engineers
ASTM	American Society of Testing and Materials
API	American Petroleum Institute
BS	British Standards
ISO	International Organization for Standardization
MSS-SP	Manufacturers Standardization Society - Standard Practice
NACE	National Association of Corrosion Engineers
OISD	Oil Industry Safety Directorate
SSPC	Steel Structures Painting Council

CONTENTS

1.0	SCOPE.....	4
2.0	REFERENCE CODE & STANDARDS	5
3.0	GENERAL Requirement	6
4.0	ROUTE SURVEY & MARKING.....	7
5.0	RIGHT-OF-USE (ROU)	8
6.0	CLEARING, GRADING AND BACKFILLING OF ROU	10
7.0	HANDLING, HAULING, AND STRINGING OF STRINGING OF LINE PIPES AND STORAGE OF OTHER MATERIAL	12
8.0	TRENCHING	17
9.0	BLASTING.....	22
10.0	PIPE BEND/ BENDING	23
11.0	LINEING UP AND WELDING.....	25
12.0	LOWERING-IN	27
13.0	BACKFILLING	29
14.0	TIE-IN.....	32
15.0	SPECIAL INSTALLATIONS ON THE PIPELINE.....	32
16.0	THIRD PARTY FACILITIES	36
17.0	MARKER	38
18.0	FINAL CLEAN-UP OF THE CONSTRUCTION RIGHT-OF-USE (ROU).....	38
19.0	MAINTENANCE DURING DEFECTS LIABILITY PERIOD	41

1. SCOPE

- 1.1 This specification covers the minimum requirements for the various activities to be carried out by Contractor for or about the construction of cross-country onshore pipelines and associated facilities.
- 1.2 This specification shall be read in conjunction with scope of work and requirements indicated in specifications and documents included in the contract between Company and Contractor.
- 1.3 Contractor shall take full responsibility for the stability, suitability and safety of all operations and methods involved in the work.
- 1.4 The Contractor shall be deemed to have visited, inspected and examined the work area(s) and its surroundings and to have satisfied himself with the form and nature thereof, including sub-surface conditions, hydrological and climatic conditions, accessibility to the work area(s), the extent and nature of the work and materials and equipment necessary for the completion of the work.
- 1.5 The Contractor shall be deemed to have obtained all necessary information and provided for all risks, contingencies and all other circumstances, which may influence the work.
- 1.6 Contractor, as part of his Scope of work, shall investigate and establish any new development which may have taken place since the topographical survey was carried out by the Company during feasibility stage and shall submit detailed documentation to support any proposed realignment of the surveyed pipeline route resulting from the actual conditions encountered during his investigations or as required by the relevant Local Authorities. Any realignment of the surveyed pipeline route shall be subject to Company approval prior to implementation.
- 1.7 Requirements related to pipeline construction including, but not limited to, clearing and grading of Right-of-Use (ROU), staking of the pipeline route, handling, hauling, stringing of pipes along ROU, storing of all materials, trenching, cold field bending of pipes, line-up, welding, lowering, backfilling, tie-in, installation of associated facilities and pipeline appurtenances, testing, clean-up and restoration, maintenance during defect liability period, etc. are addressed in this specification.

2. REFERENCE CODE & STANDARDS

Reference code and Standards latest version has been followed for specification, in case of conflict between the requirement of this standard specification and the reference codes and regulations mentioned below, the more stringent requirement shall apply unless otherwise agreed by Company.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

- B 31.4 : Pipeline Transportation System for Liquid Hydrocarbons
and Other Liquids.
- B 31.8 : Gas Transmission and Distribution Piping Systems.
- B 16.5 : Pipe Flanges and Flanged Fittings.

- B 16.9 : Factory made Wrought Butt Welding Fittings.
- B 31.3 : Process Piping.

AMERICAN PETROLEUM INSTITUTE (API)

- 5L 1 : Recommended practice for rail road transportation of line pipe.
- 1104 : Welding of Pipeline and related Facilities.
- 1105 : Bulletin on construction Practices for oil and related facilities.
- 1109 : Marking Liquid Petroleum Pipeline facilities.
- 1110 : Recommended Practice for Pressure Testing of Petroleum Pipeline.
- 1102 : Steel Pipelines Crossing Railroads and High way.

BRITISH STANDARDS (BS)

- 8010 Part 2 : Pipeline on Land Design, Construction and Installation.

PNGRB REGULATIONS:

G.S.R 808(E) T4S: Regulations for Natural Gas Pipelines

G.S.R. Infra/ T4S/ P&PPPL : Regulations for Petroleum and Petroleum products pipelines

G.S.R. 612(E) T4S: Regulations for CGD Network

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION (ISO)

- Part 192 : Transportation of natural gas by Pipeline (US Department of Title 49 transportation–Pipeline Safety standards).
- Part 195 : Transportation of liquid by Pipeline (US Department of Transportation–Pipeline safety standards).

3. GENERAL REQUIREMENT

- 3.1.** Contractor shall, with due care and diligence, execute the work in compliance with all laws, by laws, ordinances, regulations etc. of the land and provide all services and labor, inclusive of supervision thereof, supply of all materials, excluding the materials indicated as "Company Supplied Materials" in the contract, equipment, appliances or other things of whatsoever nature required for the execution of the work, whether of a temporary or permanent in nature.
- 3.2.** In case, the Company will get the surveys and soil investigations carried out along pipeline route, the details of the surveys, soil investigations and other data collected by the Company shall be presented in the drawings and documents enclosed with the Contract for

the information of the Contractor. The Contractor shall be deemed to have reviewed and satisfied himself with regard to the details provided in the Contract. Contractor shall not be entitled for any compensation in terms of time or cost in case of any variation in actual site conditions from the data furnished in the Contract.

- 3.3.** Where in the Contractor's opinion the survey and investigation data are not found to be sufficient in detail, it shall be the responsibility of the Contractor to assess, requirement of any additional surveys and/ or soil investigations or any other data collection that may be deemed necessary for proper execution of the works. The Contractor shall be responsible for carrying out all such surveys and collect additional data/ information at no extra cost to Company.
- 3.4.** Details of the permissions/ clearances obtained by the Company from agencies/ authorities having jurisdiction in the area where the work is to be performed are indicated in the documents enclosed with the Contract for the information of the Contractor. It shall be the responsibility of the Contractor to comply with all the conditions and requirements issued by the agencies/ authorities. In case any other permit/ authorization is required to be obtained from the relevant authorities for performance of the work, the same shall be obtained by the Contractor.
- 3.5.** Compliance with the requirements of this specification or the Company's approval of any aspect of any operations covered by this specification shall in no way relieve the Contractor of his ultimate responsibility for the satisfactory completion of the work authorized under this Contract.
- 3.6.** The Contractor shall provide full access to the Company Representative for monitoring of all work areas during all phases of work.
- 3.7.** The Contractor shall provide and maintain all lights, guards, fencing, watchmen, etc., when and where necessary or required by Company or by any duly constituted authority and/ or by the authorities having jurisdiction thereof for the protection of the work and properties or for the safety and the convenience of public and/ or others.
- 3.8.** The Contractor shall take full responsibility for the suitability and safety of all operations and methods involved in the work.

For the purpose of this specification the following definitions apply:

- Words 'Shall' and 'Must' where used indicate that a provision is mandatory.
- Words 'Should' and 'Will' where used indicate that a provision is not mandatory but is recommended as good practice.
- 'May' used as a verb to indicate that a provision.

3.9. WORKING SPREAD LIMITATIONS

Contractor shall, in general, observe the following maximum distances between the working mainline spread:

Between ROU grading, clearing and backfilling	:	25 Kms
Between backfilling and final clean-up	:	10 Kms

4. ROUTE SURVEY & MARKING

- 4.1 Having been granted the accessibility of the route the contractor shall inspect and analysis the entire pipeline route within the designated corridor including Major crossing, Terminal/ Despatch Station and Terminal/ Receipt Station and if any spur lines to other pipeline/ station before commencement of construction.
- 4.2 These inspection reports shall state the condition of the item potentially affected by construction and record the mutual approval of all parties concerned
- 4.3 Contractor shall establish reference points in every 500 meters along the pipeline route. The reference points shall be positioned at 25 meters offset from pipeline centerline.
- 4.4 The contractor shall stake markers in the centerline of the pipeline in 100 m intervals. In areas where it is difficult to follow the centerline when staked at 100 m intervals, the stakes shall be set at 50 m intervals or less to ensure unobstructed visibility.

5. RIGHT-OF-USE (ROU)

Company shall make available the ROU acquired for the works covered in the Contract to the Contractor. The Contractor shall carry out the construction activities within the ROU acquired by Company. In case any additional land is required for carrying out the works, it shall be the responsibility of the Contractor to make arrangement for all such additional land at no extra cost to Company.

5.1 STAKINGS

Company has surveyed and marked the centreline of the pipeline route with stone pillars at every 250 meters and also provided pillars at all turning points. In addition, Company also has established survey bench marks along the route. However, it is possible that some of the pillars may have been removed or shifted since their installation. The Contractor shall locate and/ or re-establish benchmarks, turning points and intermediate points by field survey prior to commencement of grading and clearing.

The Contractor shall stake markers in the centreline of the pipeline at a distance of maximum 100 m for straight line sections and maximum 10 m for horizontal bends.

The width of the pipeline ROU acquired by Company and the location of the pipeline centreline within the ROU is shown on the Alignment Sheets. The Contractor shall stake ROU boundary line, so as to prepare the strip for laying the pipeline. Two ROU markers shall be staked at every 100 m, one on either side of the surveyed centerline, for this purpose by the Contractor.

In addition, the Contractor shall also install distinct markers for special points such as obstacle crossing, change of wall thickness along with chainage and contract limits.

Chainage markers shall be installed at every 250 meters.

Any deviation from the approved alignment shall be executed by Contractor after seeking Company approval in writing prior to clearing operations.

5.2 PUBLIC CONVENIENCE AND SAFETY

The Contractor shall give due consideration to the interests of property owners and tenants wherever involved, adhere to all ROU restrictions and permits, and exert all reasonable efforts

to maintain the goodwill of the tenants and Land Owners for the benefit of the Company.

The Contractor shall provide temporary approaches to and from crossings of public roads, private roads and entrances that may be opened for construction, and maintain them in a safe condition.

Warning signs shall be erected on both sides of highway/ road crossing. The signs shall state that the pipeline ROU is a private work area and that unauthorized entry is prohibited.

5.3 FENCING

- 5.3.1 Prior to clearing and grading of the Right-of-Use or stringing of pipe, Contractor shall open fences on or crossing the construction Right-of-Use and install temporary gate. Before such fences are cut and opened, Contractor shall notify the land owner or tenant, and where practicable, the opening of the fences shall be in accordance with the wishes of said owner and tenant. In all cases where Contractor removes fences to obtain work room, Contractor shall provide and install temporary fencing, and on completion of construction shall restore such fencing to its original condition.
- 5.3.2 Contractor shall install temporary fencing on either side of ROU where in Company's opinion, it is considered essential to ensure safety and non-interference, especially in areas like grazing lands, villages etc.
- 5.3.3 Fencing shall be removable type wherever necessary, to permit crossing of traffic. The type of fencing must be suitable for the situation in accordance with user. The pole distance shall not be greater than 6m. The minimum height of the fencing shall be 1.2 m above grade. Fencing can consist of one or more rows of smooth wire and/ or of barbed wire.
- 5.3.4 Fencing shall be continuously maintained and the thorough-ways inspected to be shut during the execution of the work.

5.4 CARE OF SERVICES AND PROPERTY

- 5.4.1 When ingress and egress of equipment interferes with existing services, the necessary arrangements shall be made to preserve the continuous use of the existing services during construction of the pipeline.
- 5.4.2 Temporary culverts shall be installed in all drainage ditches, creeks, and other drainage courses where blockage might result in damage to property. All temporary culverts shall be removed when no longer required. Continuity of water supplies for both domestic and agricultural purposes shall be maintained.
- 5.4.3 In the event of damage to a facility, the Owner of the facility concerned shall be immediately informed and the facility repaired as necessary (where permitted by the Owner) to allow for its proper function until such time as permanent repairs can be made.

5.5 RESTRICTED WIDTH OF ROU

In certain areas restricted width of ROU shall be available and it shall be Contractor's responsibility to arrange its equipment etc. in such a manner as not to cause any hindrance to the movement of manpower or machinery and at the same time not to cause any damage to other's property.

5.6 ACTIVITIES IN FLOODED FIELDS

Where the pipeline is constructed across agricultural land where regular flooding is necessary, such as rice paddocks. Contractor shall ensure that the water supply and access to land on either side of the ROU is maintained, and that the landowner's farming activities are not restrained in any way.

5.7 DUST CONTROL

Adequate dust control measures shall be adopted, including water sprinkling, to ensure that dust does not affect the work or the health and safety of personnel working and travelling on the ROU, adjacent landowners or tenants, animals, crops or pastures.

6. CLEARING, GRADING AND BACKFILLING OF ROU

- 6.1.1** ROU shall be cleared of all trees, bush, hedges or other obstacles lying within the width of ROU that may hinder the construction of pipeline.
- 6.1.2** Before clearing operations are started, the Contractor shall familiarize itself with all special provisions included in the ROU secured by the Company and the Contractor shall comply with these provisions.
- 6.1.3** Wherever the pipeline ROU runs across, through or alongside farm yards, built-up areas, groves, plantations, forests, horticultural spreads, gardens, plantations or grass-fields, ditches, dikes, roads, paths, railways or any other area with restrictions, the Contractor shall grade only the width of the ROU necessary for digging the pipeline trench and constructing. The Contractor shall carry out the work in such a way that damage resulting from the pipeline construction is kept to a minimum.
- 6.1.4** Permission for felling of "Scheduled Trees" as per applicable tree felling Acts shall be obtained by the Contractor prior to felling of the trees.
- 6.1.5** All stumps shall be grubbed on a continuous strip, with a width equal to trench top width plus two meters on either side centered on the pipeline centreline. In addition, all stumps shall be grubbed from areas of the construction. Outside of these areas to be graded, the stumps may either be grubbed or cut off to ground level. Any stump cut off must be left in a condition suitable for rubber-tyred pipeline equipment movement. Whenever stumps are grubbed and a hole is left in the ground, the Contractor shall back-fill the hole-and compact it to prevent water from gathering in it and making a big hole.
- 6.1.6** The ROU shall be graded to establish the working platform as required for efficient pipeline construction. The Contractor shall grade the pipeline ROU as required for installation of the pipeline and for providing access to the pipeline during construction.
- 6.1.7** The Contractor shall grade sharp points or low points to allow the pipe to be bent and laid within the limits set forth in this specifications and alignment sheets with regards to the minimum elastic curvature permitted. All grading shall be done as is necessary to minimize the necessity of sag and over bends.
- 6.1.8** Temporary or permanent deposit of any kind of material resulting from clearing and grading shall not be permitted in the approach to roads, railways, streams, ditches, drainage ditches and any other position which may hinder the passage and/ or the natural water drainage.

- 6.1.9** The ROU clearing and grading operations, however, shall in no case involve embankment/ structures of any type without prior approval of the authorities having jurisdiction over the same.
- 6.1.10** In the case of natural or artificial deposits of loose soil, sand, heaps of earth or other fill materials, these shall be removed till stable natural ground level is reached so as to ensure the construction of the pipeline ditch in stable ground.
- 6.1.11** No filling of the ground over the pipeline centreline to achieve the minimum depth of cover shall be permitted. In locations where the ground is filled for access or other reason, the natural surface profile shall be surveyed to ensure that compliance with the minimum cover requirements can be demonstrated.
- 6.1.12** Grading of the ROU shall be kept to a minimum in order to preserve as much of rootstock as possible.
- 6.1.13** Cleared materials shall be stockpiled and preserved for use during restoration and final clean up. In no case shall it be left to interfere with the grading and laying operations.
- 6.1.14** Entire clearing and grading operations shall comply with Environment Management Plan.

6.2 GRADING IN STEEP AND ROCKY AREAS

- 6.2.1** In the case of ROU clearing and grading on the hillside or in steep slope areas, barriers or other arrangements shall be provided to prevent the removed materials from rolling downhill. Slope of side hill faces shall be stabilized to prevent landslides.
- 6.2.2** Grading operations in rocky terrain should normally be carried out by drilling, wedging, mechanical excavators or manually. In certain areas where solid rock cannot be removed until loosened by blasting, in order to make an adequate working space along the pipeline, blasting may have to be resorted to. Contractor shall identify such areas and take prior approval of concerned authorities before resorting to any blasting operations.

6.3 PROVISION OF DETOURS

- 6.3.1** Contractor shall do all necessary grading and bridging at road, water and other crossings and at other locations where needed, to permit the passage of its men and equipment. It is understood that the Contractor has recognized such restrictive features of the Right-of-Use and shall provide the necessary detours and execute the works without any extra cost to Company. Public travel shall not be inconvenienced nor shall it be wholly obstructed at any point.
- 6.3.2** In 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-Use; 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 Company.
- 6.3.3** Contractor at his own cost shall furnish and maintain watchman detours, lanterns, traffic lights, barricades, signs, wherever necessary to fully protect the public.
- 6.3.4** Contractor shall be responsible for moving its equipment and men across or around watercourses. This may require the construction of temporary bridges or culverts.

Temporary bridging required for Right-of-Use crossing water courses shall be constructed in consultation with concerned Authorities. Contractor shall ensure that such temporary works shall not interfere with normal water flow, avoid overflows, 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 Company a copy of such approval.

6.4 OFF RIGHT-OF-USE DAMAGES

Contractor shall confine all its operations within limits of the Right-of-Use. Any-damage to property outside ROU shall be restored or settled to the Contractor's account.

Contractor shall promptly settle all off Right-of-Use damage claims. Should Contractor fail to do so, Company shall give written notice to Contractor that if Contractor does not settle such claims within seven days after such notice, Company shall have the authority to settle claims from the account of Contractor.

6.5 DISPOSAL OF DEBRIS

All grubbed stumps, timber, bush, undergrowth and roots cut or removed from the ROU, blasted rocks and boulders shall be disposed of in a manner and method satisfactory to Company, Land Owner and/ or tenant, and Government Authorities having jurisdiction and as soon as practical after the initial removal.

6.6 CONSERVATION OF TOP SOIL

6.6.1 In cultivable lands and other areas specifically designated by the Company representative, top 300mm of the arable soil, excavated shall, be stockpiled separately; for; replacing in original position. Removed topsoil shall be stockpiled in a location that will minimize any loss due to erosion or mixing with other material.

6.6.2 Any topsoil lost due to erosion or mixing with other material shall be replaced with imported topsoil that is compatible with the area subject to approval by Company representative.

7. HANDLING, HAULING, AND STRINGING OF LINE PIPES AND STORAGE OF OTHER MATERIAL

7.1 GENERAL

The Contractor shall exercise utmost care in handling line pipe and other materials. 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 temporary storage areas for the pipeline materials, however, method of storage shall be approved by Company.

Contractor shall reimburse the Company for the cost of replacement of all Company supplied materials damaged during the period in which such materials are in the custody of the Contractor. It shall be Contractor's responsibility to unpack any packings for the materials supplied by Company.

Pipe bevel protectors shall always be kept in position during all handling, transportation and stringing operations and shall be removed only prior to fit-up for welding. After

fabrication and welding, the Contractor shall arrange to return all such bevel protectors at Company's designated storage yard and as instructed by Company.

7.2 "TAKING-OVER" OF LINE PIPES

In case Company supplies line pipes to the Contractor as 'Free Issue Material', the Contractor shall receive and 'take over' against requisition, line pipes from the Company's designated place(s) of delivery as defined in the Contract. The Contractor shall, in the presence of Company Representative, visually inspect the entire surface of the bare pipes and coating of the coated pipes at the time of taking delivery and record all damages and exact length of pipes received.

In the case of coated pipes, the Contractor at his option may carry out holiday detection at a prescribed set voltage and record any holidays detected at the time of 'taking over', in the presence of Company Representative. However, if the Contractor proposes to perform only visual inspection, then repair of all holidays found at the time of laying the pipeline shall be carried out by the Contractor at no extra cost to Company as per relevant Specification.

The Contractor at his option may also carry out gauging of the pipes and record any dents detected at the time of 'taking over', in the presence of Company Representative. However, if the Contractor proposes to perform only visual inspection, then repair of all dents found at the time of laying the pipeline shall be carried out by the Contractor at no extra cost to Company. Repair of all damage occurring after taking over delivery of material shall be contractor's cost.

7.3 HANDLING OF LINE PIPES

7.3.1. BARE PIPES

Contractor shall unload, load, stockpile and transport the bare pipes using suitable means and, in a manner, to avoid denting, flattening, or other damages to pipes. Pipe shall not be allowed to drop or strike objects, which will damage the pipe but shall be lifted or lowered from one level to another by suitable equipment. Lifting hooks when used shall be equipped with a plate curved to fit the curvature of the pipe. In loading pipe on trucks each length shall be lowered to position without dropping and each succeeding length shall rest on special supports on the truck and shall be separated from the adjacent pipes. After loading, suitable chains and padding shall be used to tie the load securely to each bolster. Pipe, when stock piled, shall be placed on suitable skid to keep it clear of the ground and flood water. Care shall be exercised in handling or stock-piling pipes in order to avoid distortion, flattening, denting or other damages. The Contractor shall provide all necessary timber or other materials required for the stock-piling. While stacking, the number of allowable layers of bare pipes shall be calculated as per API RP 5L1 and shall be agreed with Company. The stacks must be properly secured against sliding and shall consist of pipes of the same diameter and wall thickness. Adjacent stacks of pipes having different dimensional characteristics shall be clearly separated.

Pipes which are damaged at the time of delivery or 'taking-over' (when line pipe is supplied by Company), particularly those which are dented, buckled, or otherwise permanently deformed, must be stacked separately and may be transported to the sites only when these defects have been repaired or eliminated.

7.3.2. CORROSION COATED PIPES

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

Use of vacuum lifting equipment's is preferred. Hooks may also be used for handling the pipes provided they have sufficient width and depth to fit the inside of the pipe and covered with soft material like rubber, Teflon or equivalent, so as not to cause damages to bevel or pipe ends. During hoisting cables/ wire ropes shall have sufficient inclination compared to pipe axis so that they do not come into contact with external coating.

Coated pipes may be handled by means of slings and belts of proper width (minimum 60 mm) made of non-metallic/ non-abrasive materials. In this case, pipes to be stacked shall be separated row by row to avoid damages by rubbing the coated surface in the process of taking off the slings. Use of round sectional slings is prohibited.

During handling, suitable handling equipment's with proper length of booms shall be used. Forklifts may be used provided that the arms of the forklifts are covered by suitable pads preferably rubber. Before lifting operations, it is essential to ensure that the pipe surface is free from foreign materials with sharp edges. Belts/ slings when used shall be cleaned to remove hard materials such as stone, gravel etc. Coated pipes shall not be bumped against any other pipe or any other objects. Rolling, skidding or dragging shall be strictly forbidden.

Coated pipes at all times shall be stacked completely clear from the ground so that the bottom row of pipes remains free from any surface water. The pipes shall be stacked at a slope so that during rain water does not collect inside the pipe.

The coated pipes may be stacked by placing them on ridges of sand free from stones and covered with a plastic film or on wooden supports provided with suitable cover. This cover can, for example, consist of dry, germ free straw with a plastic film, otherwise foam rubber may be used. The supports shall be spaced in such a manner as to avoid permanent bending of the pipes, particularly in case of small diameter pipes with low wall thickness. The pipes shall be stacked so that the uncoated beveled ends are in line at one end, thus making differences in lengths clearly noticeable.

Stacks shall consist of limited number of layers so that the pressure exercised by the pipes own weight does not cause damages to the coating. Each pipe section shall be separated by means of spacers suitably spaced for this purpose. Stacks shall be suitably secured against falling down and shall consist of pipe sections having the same diameter and wall thickness. The weld bead of pipes shall be positioned in such a manner so as not to touch the adjacent pipes.

Coated Pipes stacked in open storage yards/ dump yards shall be suitably covered on top to decrease direct exposure to sunlight. The ends of the pipes during handling and stacking shall always be protected with bevel protectors.

The trailers/ rail wagons shall be equipped with adequate pipe supports having as many round hollow beds as the number of pipes to be placed on the bottom of the trailer bed. Supports shall be provided for at least 10% of the pipe length. These supports shall be lined with a rubber protection and shall be spaced in a manner as to support equal load from the pipes. The rubber protection shall be free from all nails and staples where pipes are in contact. The

second layer and all subsequent layers shall be separated from each other with adequate number of separating layers of protective material such as straw in plastic covers or mineral wool strips or equivalent, to avoid direct touch between the coated pipes.

All stanchions of trailers/ rail wagons used for transportation shall be covered by non-abrasive material like rubber belts or equivalent. Care shall be exercised to properly cover the top of the stanchions and convex portions such as reinforcement of the truck/ rail wagon body, rivets etc. to prevent damage to the coated surface.

7.4 TEMPORARY STOCKPILES

The Contractor at his own cost shall arrange for the land required for temporary stockpile of pipes, whenever the pipes are to be stockpiled prior to stringing. Pipes shall be stacked minimum 300 mm clear off the ground so that the bottom of pipes remain free from any surface water. The pipes shall be stacked at a slope so that rain water does not collect inside the pipe.

The coated pipes may be stacked by placing them on ridges of sand free from stones and covered with a plastic film or on wooden supports provided with suitable cover. This cover can, for example, consist of dry, germ free straw covered with a sheet of plastic sheet or foam rubber. The supports spacing shall be such that prevents permanent bending of the pipes.

Stacks shall consist of limited number of layers so that the pressure exercised by the pipes own weight does not cause damages to the pipe as well as coating. Each pipe section shall be separated. The Contractor shall submit calculations for the number of tiers of pipes during stacking for approval by Company Representative. API RP 5L1 may be used as guidelines.

By means of spacers suitably spaced for the purpose, stacks shall be suitably secured against falling down and shall consist of pipe sections having the same diameter and wall thickness. Where applicable, the weld bead of pipes shall be positioned in such a manner so as not to touch the adjacent pipes.

The pipes shall be stacked in such a manner that the uncoated beveled ends are in line at one end, thus making differences in lengths clearly noticeable at the other end.

At such time as the temporary stockpile site is no longer needed, the site shall be cleaned up and the property restored to the satisfaction of the landowner and the clean-up as per of this Specification. The Contractor shall obtain letter from Land Owners clearly stating that the land has been returned and handed over to the Land Owners to their entire satisfaction.

7.5 STRINGING OF LINE PIPE ALONG ROU

7.5.1 Pipes shall be unloaded from the stringing trucks and lowered to the ground by means of side boom, Hydra Crane or swinging crane or other suitable equipment using lifting devices as per this specification. Pipe shall not be rolled, dragged or dropped from the stringing truck.

7.5.2 Stringing of pipe shall be carried out only in day light and after clearing and grading operations have been completed. Pipe shall not be strung on the ROU in rocky areas, where blasting may be required, until all blasting is complete and the area cleared of all debris. If pipe has already been strung in an area where blasting is subsequently found to be required, all previously strung pipe shall be removed to a safe area at Contractor's cost and time and protected from damage.

- 7.5.3** The stringing of the pipe on the ROU shall be done in such a manner as to cause the least interference with the normal use of the land crossed and to avoid damage to or interference with the pipes. The sequence of pipes must be interrupted at suitable intervals, spaced to coincide with passages, roads, railroads, water-bodies and at other places if requested by Land Owner or tenants to permit use of the land. Care shall be taken to provide safe working space between trench edge and the pipe.
- 7.5.4** Strung pipe shall be supported clear off the ground (minimum 300 mm) and in a manner that will not damage the pipe or coating. Pipe shall be strung on approved soft earth / sand filling bags & wedge.
- 7.5.5** Special precautions are to be taken and extreme care exercised where stringing operations are carried out in the vicinity of overhead power lines, including possible earthing of individual pipe joints.
- 7.5.6** The Contractor shall adequately anchor the pipe on steep slopes and where the ROU condition dictates, to prevent the pipe from sliding or rolling from skids.
- 7.5.7** It shall be the responsibility of the Contractor to ensure that pipe is strung in accordance with the approved drawings for the proper placement of pipe by size, thickness, grade and other specifications. Any additional handling of pipes resulting from failure to, comply with these requirements shall be at the Contractor's expense.
- 7.5.8** In case line pipe supply is by different Manufacturers, the, Contractor shall string all line pipe of one Manufacturer before commencing the stringing of the line pipe of another Manufacturer.
- 7.5.9** When parallel pipelines are being constructed, bumping against and contact with the strung sections of pipe shall be avoided, whether the stringing of the pipes for the individual lines is carried out separately or simultaneously.

7.6 REPAIR OF DAMAGED PIPES

After the pipe has been strung on the Right-of-Use, it shall be inspected by the Contractor and the Company and all defective pipe ends repaired. Defective pipes shall be repaired or rejected as the Company may direct as per the requirements of this Specification.

7.7 MATERIALS OTHER THAN LINE PIPE

- 7.7.1** Contractor shall receive and take over against requisition all Company supplied materials from Company's designated place(s) of delivery as defined in the contract. Contractor shall perform visual inspection and defects, if any noted, shall be recorded separately. The Contractor shall be entitled to extra compensation for repair and rectification of such defects at the rates set forth in the "contract". Contractor shall take permission from Company before start of such repair.
- 7.7.2** The Contractor shall perform the necessary loading, unloading, hauling from points designated by the Company and storing, if necessary, of all materials. The Contractor shall exercise care in handling, hauling, storing and distribution of materials in order to avoid damage and deterioration of these materials and prevent their theft or loss.
- 7.7.3** Materials excluding line pipe shall be stored in sheltered storage. Such materials shall not be strung on the Right-of-Use but shall be transported in covered conveyances for use only at

the time of installation.

- 7.7.4** Contractor shall ensure that all valves and whenever applicable, other materials are fitted with suitable end covers of the type approved by Company. Materials with worked surfaces such as flanges, pipe fittings etc. must be stacked and handled so as to avoid contact with the ground or with substances that could damage them.
- 7.7.5** The Manufacturer's instructions regarding temperature and procedure for storing materials, which are subject to alteration of the original properties and characteristics due to unsuitable storage, must be strictly complied with and, if required, an adequate heat conditioning shall be provided for these materials.
- 7.7.6** When material is supplied in containers and packages, it must not be thrown or dropped, nor handled using hooks which could damage the container or the materials, either during loading/ unloading or during successive handling, until their final use.
- 7.7.7** Coating materials, which are susceptible of deteriorating or suffering from damages especially due to humidity, exposure to high thermal excursions or other adverse weather conditions shall be suitably stored and protected. These materials shall be kept permanently in store, supported above the ground in a dry place protected against the weather and transported for use only at the time and in the quantities necessary for immediate application. Deteriorated materials shall not be used and replaced with no extra cost to Company.

8. TRENCHING

8.1 LOCATION

- 8.1.1** Contractor shall excavate and maintain the pipeline trench on the staked centerline of the pipeline taking into account the curves of the pipeline.
- 8.1.2** In case of common ROU, the centerline of the trench shall be established from the location of existing pipeline. In case of independent ROU, the centerline of the trench shall be established from the edge of ROU.

8.2 TRENCH EXCAVATION

- 8.2.1** Trenching shall include all excavation, whether by trenching machine, back-hoe, power shovel, by hand, by blasting or by other methods which may be necessary to prepare a trench for the pipe with the minimum cover between top of pipe and immediate ground level as set forth in this specification.
- 8.2.2** Contractor shall, by any method approved by Company, dig the pipeline trench on the cleared and graded Right-of-Use.
- 8.2.3** In cultivable land and other areas specifically designated by the Company, top 300mm of the arable soil on the pipeline trench top width shall be excavated and stored separately, to be replaced in original position, after backfilling and compacting rest of the trench.
- 8.2.4** Suitable crossings shall be provided and maintained over the open ROU, where necessary, to permit general public, property owners or his tenants to cross or move stock or equipment from one side of the trench to the other.
- 8.2.5** 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.

- 8.2.6** 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.
- 8.2.7** On slopes wherever there is danger of landslide, the pipeline trench shall be maintained open only for the time strictly necessary. Moreover, the Company may require manual excavation of trench, local route detouring and limiting the period of execution of the works. The Contractor shall make adequate arrangements for safe working of the personnel involved in manual excavation of trench.
- 8.2.8** In certain sloppy sections, before the trench cuts through the water table, proper drainage shall be ensured both near the ditch and the Right-of-Use in order to guarantee soil stability.
- 8.2.9** All sewers, drain ditches and other natural waterways involved in the execution of the works shall be maintained open and functional. The same applies to canals, irrigation canals, and pipelines and buried facilities crossed by the ditch for which temporary pipelines shall be laid, if required, and proper temporary installations provided.
- 8.2.10** All sewers drain ditches and other natural waterways involved in the execution of the works shall be maintained open and functional.

8.3 NORMAL COVER AND TRENCH DIMENSIONS

The trench shall be excavated to a minimum depth sufficient to provide the minimum cover as specified below. The dimensions in the table below shall govern except as noted herein or as shown on the job standards or detailed construction document/ drawings or as required by authorities having jurisdiction, whichever is stringent.

Location		Minimum Cover in (Mtr)	
		Gas Pipeline	Liquid Pipeline
1	Residential Area, Industrial, Commercial Area	1	1.2
2	Minor water crossing/ steam/ drain nala/ canals	1.5	
3	River crossing for which scour depth is defined (below scour)	2.5	
4	River crossing for Rocky strata	1.5	
5	Uncased/ Cased Road Crossing/ Station approach	1.2	
6	Rocky Terrain	1	
7	Cased Railway Crossing	1.7	
8	Marshy land and creek area	1.5	

9	Area under influence of tides	1.5
10	Drainage, ditches at road/ railway crossing	1.2

Note

- Minimum depth of cover shall be measured from the top of pipe corrosion/ concrete weight coating (as applicable) to the top of undisturbed surface of the soil or top of graded working strip or top of road or top of rail whichever is lower.
- Fill material in working strip shall not be considered to add to the depth of cover. However, surface of fill material placed to fill hollows may be used to determine the depth of cover subject to prior approval by Company.
- In case the Pipeline is located within 15 mtr from any dwelling unit, the cover shall be increased by 300mm over and above that specified.

8.4 EXTRA DEPTH AND CLEARANCE

8.4.1 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 the pipe or where a deep trench is required at the approaches to crossings of roadways, railroads, rivers, streams, drainage ditches, and the like and in transition between normal trench and deep trench, the Contractor shall excavate such additional depth as may be necessary.

8.4.2 The Contractor shall excavate to additional depth where the pipeline approaches and crosses other pipelines, sewers, drain pipes, water mains, telephone conduits and other underground structures, so that the pipeline may be laid with at least 500 mm free clearance from the obstacle or as specified in the standards, or greater as may be required by authorities having jurisdiction over it.

8.4.3 In those areas where trench to be padded with select soil such as rocky areas, seismic zone crossings, station approaches etc. the trench shall be made deeper, to accommodate specified thickness of bedding and/ or padding, than otherwise required to maintain specified cover. Thickness of bedding and/ or padding required shall be as specified in the Contract drawings and documents.

8.5 TRENCHING AT CROSSING

Before excavating the trench across thoroughfare such as roads, tracks, and wherever public access to be normally expected, approval of the crossing shall be obtained by the Contractor from the concerned authorities. Temporary diversions to permit the traffic shall be provided.

8.6 TRENCHING WITHIN OR ADJACENT TO OTHER UTILITIES

8.6.1 At locations, where pipeline is to be installed within the ROU or the body of a road, canal, dyke or other locations under jurisdiction of government/ public bodies, the Contractor shall perform such work, according to the requirement of concerned Authorities. When it becomes necessary, the Contractor shall resort to manual digging, well point drain, erection of sheet piling or any other special construction method in these areas without any extra cost to Company. The facilities damaged during trenching shall be restored; to their original

condition to the satisfaction of concerned authority.

- 8.6.2** In locations, where the pipeline has to be laid more or less parallel to an existing service such as pipeline, cable and/ or other utilities within the ROU, the Contractor shall carryout Trenching as per the requirements of the owners/ authorities of that service. At such locations; the Contractor shall perform the work in such a way that even under the worst weather and flooding conditions, the existing pipeline/ utilities remain stable.

8.7 ENCROACHMENTS AND WORKING NEAR EXISTING PIPELINE AND OTHER UTILITIES

Contractor shall be liable for any damage occurring to, or resulting from damage to other pipelines, underground structures/ utilities, as laid down in clause of this specification. Contractor shall make trial pits at minimum intervals of 100 m along the straight route and at suitable less intervals along the curves in the pipeline route to establish the centerline clearing the existing utilities to avoid damage to the existing utilities during the construction of new pipeline.

The location of a new buried pipeline, when running parallel to an existing buried pipeline, should be at a minimum clear distance of 5.0 meters from the existing underground pipeline when heavy conventional construction equipment is expected to be utilized. This distance may be reduced after careful assessment of construction methodologies so that it does not result in unsafe conditions during construction. In any case the minimum clear distance shall not be less than 3.0 meters.

Existing pipeline should be clearly marked on the ground during construction so as to avoid any machinery movement or dumping of excavated earth over the existing pipelines. Bi-language (local language and Hindi / English) caution signs should be installed while working in such areas. In case the movement of machinery over the existing pipelines is unavoidable, the required area over the existing pipeline need to be prepared with earth to ensure an additional cover of 1m. The machinery movement shall be restricted to such area only. The contractor has to do all such preparation with no additional cost to the Company.

8.8 PROVISIONS FOR NEGATIVE BUOYANCY TO THE PIPE

- 8.8.1** Contractor shall check if up-floating of Pipeline is present in open trench and then 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).
- 8.8.2** In the case 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 this inspection, the presence of water will be allowed provided its level does not cause sliding of the ditch sides and pipe floating before backfilling when no concrete weighing is provided.
- 8.8.3** The water pumped out of the ditch shall be discharged into a natural water course.
- 8.8.4** Whenever up-floating of the pipeline after backfilling is to be reckoned with, anti-buoyancy measures shall be provided by Contractor with Company's approval for such areas of

construction, using one or a combination of the following methods.

- Weighing by applying a continuous concrete coating around the pipe.
- Weighing by -installing gravel filled Geotextile bags.
- Installing of soil Bund over the pipeline in trench during lowering.
- Deeper burial of pipeline.
- Provision of select backfill material.

The above provisions shall be in accordance with the relevant specifications and/ or job standards/ drawings.

Contractor shall indicate the option(s) selected to Company for review and approval along with calculations, wherever applicable.

8.9 CUTTING AND REMOVAL OF PAVING

8.9.1 Whenever permitted by Authorities and/ or Company representative to open cut a trench in a paved road crossing or where the line is routed within the road pavement, the Contractor shall remove the paving in accordance with the restrictions and requirements of the Authorities having jurisdiction thereof or as directed by Company Representative. After laying the pipeline, in paved area, the trench shall be backfilled immediately to restore the area temporarily. Throughout the period of execution of work in such areas, the Contractor shall provide and use warning signs, traffic lights or lanterns, barricades, fencing, watchman, etc. as required by the local authorities having jurisdiction and/ or Company Representative.

8.9.2 For all roads, paths, walkways etc. which are open-cut, the Contractor shall provide temporary diversions properly constructed to allow the passage of normal traffic with the minimum of inconvenience and interruptions.

8.9.3 The paving shall be restored to its original condition after the pipeline is installed to the entire satisfaction of concerned authorities.

8.10 GRADES, BENDS AND FINISH OF TRENCH

8.10.1 The trench is to be well made to provide a firm, uniform and continuous support for the pipe. Bends shall be made in the pipe at significant changes in grade of the trench. Company reserves the right to set the grade of the trench at location of the bends if so desired, in which case Contractor shall excavate, at no extra cost, the trench and bend the pipe to such a grade. Company desires reduce to a minimum the required number of cold field bends to lay the pipe to conform to the general contour of the ground and maintain a normal cover. This can be accomplished by cutting the trench slightly deeper at the crest of ridges and by gradually deepening the trench in approaches to crossings. Such trenching work shall be done by Contractor at no extra cost to the Company.

8.10.2 Company intends that there will be a minimum of hand grading of the trench bottom. However, to achieve this, Contractor will have to dig as square a bottom of the trench as possible with the equipment. This in part can be obtained by adjusting and adopting the crumbing shoe and digging teeth of the trenching machines and by use of a drag behind the trenching machines or manually dressing-up the same. Contractor shall do such hand work in the trench as is necessary to free the bottom of the trench from loose rock and hard clay

and to trim protruding roots from the bottom and side walls of the trench.

8.11 PADDING

- 8.11.1** In all cases where rock or gravel or marram/ hard soil is encountered in the bottom of the trench, trench padding shall be provided. The thickness of padding shall be at least 200 mm or more throughout the trench so that thickness of compacted padding shall not be less than 150mm. In those areas, trench shall be suitably excavated to keep min cover as required. Company will decide the extent of trench padding required.
- 8.11.2** Acceptable padding shall be placed under the pipeline before its installation, and around after installation to establish at both sides and on top of the pipe a permanent layer of padding. The thickness of compacted padding on top of pipe corrosion coating shall be at least 150mm.
- 8.11.3** Padding materials that are approved by Company shall be graded soil/ sand and/ or other soft materials containing no gravel, rock, or lumps of hard soil. Sand used for padding shall-pass through sieve size ASTM C33 No. 16.
- 8.11.4** When specified in the Contract, rock shield may be used in place of or in addition to sand padding as indicated above. Such rock shield shall be in accordance with the specification issued for the purpose and shall be subject to Company approval.
- 8.11.5** Padding shall also be required at other locations where select backfill is specified in the drawings and documents such as seismic zone crossings, station approaches, etc. Type of padding soil and thickness of padding in such areas shall be as specified in drawings and documents.

8.12 TRENCH PROTECTION

- 8.12.1** The trench shall be maintained in good condition till such time the pipeline is laid. When required, lumber, sheet-piling jacks or other materials that may be necessary to shore the trench, in order to prevent caving, shall be provided and removed by the Contractor.
- 8.12.2** The Contractor shall dewater the trench, if necessary, using well point system or other suitable systems, or do what else might be required to excavate the trench, install the pipe in it and backfill the trench as per approved procedure with no extra cost to company.

9. BLASTING

9.1 GENERAL

- 9.1.1** Contractor shall be responsible for carryout of trenching in rocky areas by controlled blasting and removal of scattered rock and debris caused by the blasting from the Right-of-Use and/ or adjacent property, as part of his work. All necessary precautions shall be taken to prevent stones from falling outside the ROU and in cultivated areas and to avoid any damage to the installations and properties existing nearby. Blasting and removal of debris shall be carried out prior to stringing the pipes.
- 9.1.2** 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 the Contractor. National/ Local Laws and Regulations shall take precedence over this

specification in the event of conflict. The requirements stated herein, however, in no way relieve the Contractor of his responsibility of carrying out safe blasting operations and the Contractor shall be solely responsible for damages and claims thereof.

- 9.1.3** Every possible precaution shall be taken to prevent injuries and damages to persons and properties during blasting operations. The Contractor shall be responsible for removal of scattered rock and debris caused by the blasting from the ROU and/ or adjacent property.
- 9.1.4** The use of explosives requires an approval from the Chief Inspector 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.
- 9.1.5** Blasting and removal of debris shall be carried out prior to stringing the pipes.
- 9.1.6** Company reserves the right to refuse blasting where possible danger exists to property, existing utilities or other structures. In such locations other methods of extracting rock shall be proposed by Contractor and shall be approved by Company.

9.2 BLASTING CLOSE TO EXISTING SERVICES

Contractor shall prepare a detailed blasting procedure incorporating the following:

- 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
- Following approval by the Company representative, the procedures shall be closely followed by the Contractor and demos need to be shown by the contractor to assess the blasting impact on other existing services and / or facilities. Accordingly suitable modifications to be considered till the procedure is finally qualified and approved by the company. .

10. PIPE BEND/ BENDING

10.1 GENERAL

- 10.1.1** The Contractor shall preferably provide for changes of vertical and horizontal alignment by making elastic bends. Cold field bends may be provided, at the Contractor's option for change of direction and slope.
- 10.1.2** In general, elastic bends or one or more cold field bends will permit construction of most of the direction changes required, however where in the judgment of Company, due to site conditions, even cold field bends cannot be accommodated, the Company may allow use of

hot induction bends.

10.1.3 Use of miter bends for change in direction and slope is not permitted.

10.2 ELASTIC BENDS

The minimum allowable radius for elastic bends for corrosion coated as well as concrete coated buried pipeline shall be as indicated in relevant job standards document drawings elastic bend shall be continuously supported over its full length. A radius smaller than permitted in elastic bending shall require a cold field bend.

10.3 COLD FIELD BENDS

10.3.1 The minimum radius of cold field bends shall be as indicated in the below table:

Nominal Pipe Size (Inch)	Minimum Bend Radius
12 and below	21D
14 to 16	30D
18 and above	40D

10.3.2 Contractor shall use a pipe bending machine of adequate capacity and employ recognized 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.

10.3.3 Contractor shall, before the start of the work, submit and demonstrate to Company a bending procedure, which shall conform to the recommendations of the manufacturer of the bending machine. The Qualification shall be done for the maximum bend angle in one pipe length. The procedure shall include amongst other steps-lengths, maximum degree per pull and method and accuracy of measurement during pulling of the bend. The bending procedure and the equipment used shall be subject to Company's approval with regard to the quality of bend in terms of wrinkles / buckles, stretches and any other damages.

10.3.4 Pipes with longitudinal welds shall be bent in such a way that the weld lies in the plane passing through the neutral axis of the bend, which shall be installed positioning the longitudinal weld in the upper quadrants. If horizontal deviations are to be achieved by joining more adjacent bends, the bending of the pipe lengths shall be made by positioning the longitudinal welds alternatively 70mm above and below the plane passing through the neutral axis in-such a way that the bends are welded with the longitudinal welds displaced by about 150mm and situated in the upper quadrants. In case of vertical bends formed, from a number of pipe lengths, the longitudinal welds shall be positioned on the plane passing through the neutral axis of the bend to the right and left alternatively.

10.3.5 The pads, dies and rolls of the bending equipment shall have relatively soft surfaces to avoid damage to the pipe coating. Where applicable, fully retaining bending shoes shall be used. Roller type bending machines are preferred.

10.3.6 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 1.5m from the end of a pipe or within one meter of a girth weld.

10.3.7 The ovality caused on each pipe by bending shall be less than 2.5% of the specified 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 Company Representative by passing a gauge consisting of two metallic discs with a diameter equal to 95% of the nominal internal diameter of the pipe connected rigidly together at a distance equal to 300mm.

10.3.8 The wall thickness of finished bends, taking into account wall thinning at the outer radius, should not be less than the design thickness. An indication of wall thinning as a percentage is given by the following empirical formula.

$$\text{Wall thinning} = \frac{50}{n+1}$$

10.3.9 Where 'n' is the inner bend radius divided by pipe diameter. Pipes with measured wall thickness greater than the nominal wall thickness (i.e. with +ve tolerance) shall normally be used for making cold field bends.

10.3.10 Cold bend 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 dis-bonded from the pipe wall during bending by beating with a wooden mallet along the outer radius. Any defects or dis-bonding of the coating caused during bending (also forced ridges in the coating) shall be repaired at the Contractor's expense in accordance with Company approved procedures.

10.3.11 When pipelines are laid in parallel, the horizontal bends shall be concentric.

10.4 MITER 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 miter bends shall be permitted in the construction of the pipe line. Contractor shall cut out and remove any bend or bends, which do not meet the specifications and shall replace the same with bends complying with specification at no additional cost to the Company. In the event the contract provides for supply of line pipe by Company, the pipes required for replacement will be furnished by Company, but the cost of replacement of such pipes shall be borne by Contractor.

Cutting of cold field bends for any purpose are not permitted.

10.5 HOT INDUCTION BENDS

Use of Hot Induction bends is as indicated in alignment sheets, crossing drawings and station drawings. Cutting of factory made bends for any purpose is not permitted.

11. LINEUP AND WELDING

11.1 PIPE CLEANING

Prior to aligning and welding of pipes, each length of pipe shall be thoroughly examined

internally and externally to make sure that it is free from visual defects, damage, severe corrosion, 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 compressed air blowing or by other methods approved by Company Representative. Directions of Company Representative shall be followed in case of damaged/ corroded pipes. Each length of pipe shall be pulled through just before being welded.

11.2 REPAIR OF PIPE DEFECTS

It is Contractor's responsibility to repair all internal and/ or external defects.

- 11.2.1** Acceptability of defects in the pipe detected during inspection at the work site shall be determined in accordance with latest edition of Company's own material specification or code ASME B31.8/ B31.4 whichever is more stringent.
- 11.2.2** The maximum permissible depth of dents in pipes shall be as per applicable line pipe specification issued by Company.
- 11.2.3** Dents, which contain a stress concentrator such as scratch, gauge, arc burn or groove, and dents located at the longitudinal, spiral or circumferential weld shall be removed by cutting out the damaged portion of pipe as a cylinder.
- 11.2.4** Repair on line pipe shall be executed as specified in Company's material specification or Code ASME B 31.8/ B 31.4, whichever is more stringent. A record of all repairs shall be maintained by Contractor. This record, provided with the pipe identification number shall be submitted to the Company.
- 11.2.5** If due to cutting or repairs, the pipe identification number is removed, it shall be reprinted immediately by Contractor in the presence of Company. In the event, the Contract provides for supply of line pipe by Company, Contractor shall be charged for any pipe length due to loss of identification number. No pipe without identification number shall be transported and/ or welded into the pipeline.
- 11.2.6** Repair of damaged pipe ends by hammering and/ or heating is not allowed. If the dented area is minor and at least 200mm away from the pipe end, and the steel is not stretched, severed, or split in the Company's opinion, the pipe may be straightened with a proper jack.

11.3 PIPE HANDLING AND SKID SPACING

- 11.3.1** When lifting pipe, care must be taken not to kink or overstress it. Pipe slings approved by Company Representative shall be used. The Contractor shall submit the method of skidding and skid spacing to Company Representative for approval. A strip of soft material shall be placed in between skid and pipe to protect the external coating from damage.
- 11.3.2** Skids shall be used to raise the pipe sufficiently to accommodate welding and wrapping of joints. Skids shall be at least 1.20 meter long and of sufficient height to maintain pipe bottom at least 500 mm above ground. Width of skids in contact with the pipe shall be 200 mm and 150 mm for pipe with outside diameter (OD) ≥ 324 mm and OD < 324 mm respectively.
- 11.3.3** Crosses shall be installed at frequent intervals, at least every 10th support with greater number required at bends and undulating ground.

11.4 WELDING

11.4.1 All rust and foreign matters shall be removed from the beveled ends by power operated brush. This shall be effected inside & outside and for a minimum distance of 25 mm from edge of bevel. The bevel shall be thoroughly inspected at this stage. Should laminations, spilt ends or manufacturing defects in the pipe observed, the length of the pipe containing such defects shall be removed from the line in accordance with relevant specification.

11.4.2 The welding of the pipe ends shall be done strictly in compliance with the specification for welding.

11.4.3 The Contractor shall cover the open end of the pipe string during welding to prevent draft. The ends of the pipe string shall be located such that water, mud and debris cannot enter the pipe.

11.5 NIGHT CAPS

11.5.1 At the end of each day's working or every time when joining and welding operations are interrupted, the open ends on the welded strings of pipes shall be capped with mechanical metal cap or plug, approved by Company Representative, so as to prevent the entry of dirt or any foreign matter into the pipeline. These covers shall be removed just before resuming welding operations. Night caps shall also be fixed to the welding completed pipeline section which shall be removed only during Tie-in welding. Whenever the welded strings of pipes are left to be tied in later and at road, railroad, river, marshy crossings, etc, night caps shall be welded to the ends of the pipe. Work at these locations, the end caps shall be cut as a cylinder bevel end prepared. Cut shall be made at least 25 mm from the end.

12. LOWERING-IN

12.1 TRENCH CLEANING

Lowering can start after removal from ditch bottom of all off cuts, pipe supports, stones, roots, debris, stakes, rock projections below underside of pipe and any other rigid materials which could lead to perforation or tearing of the coating. Sand padding, graded soil and/ or other materials containing no gravel, rock shall be provided as required in accordance with clause 8.12 of this specification in such a way to get an even surface for pipe laying.

12.2 LOWERING-IN

12.2.1 Lowering shall follow as soon as possible, after completion of the joint coating of the pipe string, after the trench bottom is prepared and levels checked for proper fit and cover.

12.2.2 Before lowering in, visual inspection and holiday detection using a full circle holiday detector shall be carried out for the pipe coating as well as joint coating and all repairs carried out as per relevant Specification. All points on the pipeline where the coating has been in contact with either the skids or with the lifting equipment during lowering shall be carefully inspected for damages, dents or other defects and shall be completely repaired.

12.2.3 The Pipeline section which is made ready for lowering shall be checked for debris and if necessary, cleaned from inside using Pig with dry compressed air to remove debris.

12.2.4 The pipeline shall be lifted and lowered into trench using suitable equipment having flat belts of nonabrasive material. Care shall be exercised while removing the flat belts from around the coated pipe after it has been lowered into the trench to avoid any damage to coating. Lowering-in utilizing standard pipe cradles shall be permitted if the Contractor demonstrates

that pipe coating is not damaged. No sling shall be put around field joint coating.

- 12.2.5** Laying shall be carried out under safe conditions so as to avoid stresses and temporary deformations of the equipment's, which may cause damage to the pipeline itself and to the coating. In case of localized points where the right-of-use is restricted to the minimum necessary for the transit of mechanical equipment, the laying shall be carried out using other suitable means. The pipe shall be placed on the floor of the excavation, without jerking, falling, impact or other similar stresses. In particular, care must be taken that the deformation caused during the raising of the pipe from the supports, does not exceed the values for the minimum allowable radius of elastic curvature, so as to keep the stresses on the steel and on the coating within safe limits. The portion of the pipeline between trench and bank shall be supported by as many side-booms as required and approved by Company for holding the line in gentle S-curve maintaining minimum elastic bend radius -as specified in job standard. Lowering in and back-filling shall preferably be carried out at the highest ambient temperature.
- 12.2.6** Lowering-in shall preferably be carried out at the highest ambient temperature. Where water is present, no lowering is permitted until the ditch is drained to the extent and for the time necessary to make visual inspection possible of the bed. Following such inspection, the presence of water will be permitted, provided that it is not so high as to cause cave-in of the walls of the trench or floating of the pipeline before backfilling when anti-buoyancy measures are not provided for the pipe. Where water in the trench cannot be practically removed, the lowering-in of the pipeline shall be permitted only after ensuring pipe negative buoyancy is sufficiently increased by continuous concrete weight coating or by placement of gravel filled non degradable fabric bags as per requirements of the Contract and approved by Company representative. In any case, pipe shall not be lowered into a trench containing water until the longitudinal profile of the trench bottom has been fully surveyed by Contractor and approved by Company representative.
- 12.2.7** Contractor shall take precautions immediately after lowering in to prevent the movement of the pipe in trench.
- 12.2.8** Contractor shall close the two ends of the lowered section with night caps against ingress of water/ mud or any foreign material in the section.
- 12.2.9** When parallel pipelines are lowered into same trench, the minimum distances between the pipelines indicated in the approved drawings shall be maintained. Once the first pipeline has been positioned, it shall in no way be disturbed while lowering of the subsequent pipelines. At every seven meters along the trench sand/ earth filled bags shall be placed between the parallel pipelines so as to ensure maintenance of the minimum stipulated distance between the parallel lines.
- 12.2.10** Subsequent to lowering a pipe section, level of the trench bottom and level by the side of the trench shall be taken at those locations where levels were taken prior to lowering. Cover shall be ascertained based on the level difference. If the cover is not as per the requirements of this specification, the pipe section shall be removed from the trench and the trench rectified, so that the cover is as per the requirements of this specification is met.

12.3 OVERHEAD SECTIONS AND SECTIONS IN TUNNEL

- 12.3.1** The following works shall be completed before proceeding with the assembly and laying of overhead pipeline.

- Construction of the pipe support structures.
- Paints and/ or coating of the pipe work, as indicated in the engineering specification.

12.3.2 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.

12.3.3 In case roller supports are used, the rollers shall be lubricated, and 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 centered acting on the seat of the support's plates.

The above alignment operations shall be carried out before connecting the overhead section with the end of the buried section.

12.3.4 Lifting, moving and laying of the pipeline shall be carried out in accordance with the provisions of clause.

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 1 cm outside the saddles or clamps.

12.3.5 Moving supports, if any, shall be centered on their support and allow for a movement of at least 300mm in both directions.

12.3.6 A comprehensive report/ method statement on the laying operation to be used shall be submitted to the Company 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 including available pull force and FOS/ margin available w.r.t. calculated pulling load.
- Method of anchoring the pulling device.
- Characteristics of the pulling rope.
- Braking device, if any.
- Pipeline assembly system.

13. BACKFILLING

13.1 Backfilling shall not be done until the pipe and appurtenances have the proper fit and the pipe is following the trench profile at the required depth that will provide the required cover and has a bed which is free of extraneous material and which allows the pipe to rest smoothly and evenly. Contractors shall take Company's approval before start of backfilling. If any backfilling is done without Company's approval, Company will have the right to require removal of the backfill for examination, and the cost of such uncovering and refilling shall be borne by Contractor. Backfilling of trench in water courses shall be carried out as per the relevant specifications issued for the purpose.

- 13.2** Backfilling shall be carried out immediately after the pipeline has been laid in the trench, inspected and approved by the Company Representative, so as to provide a natural anchorage for the pipeline, thus avoiding long exposure of coating to sliding down of trench side's, damage of coating and pipe movement in the trench. If immediate back filling is not possible, a covering of at least 200mm of earth, free of rock and hard lumps shall be placed over and around the pipe and coating. On no account the top soil from the ROU be used for this purpose. In general, the trench shall be dry during backfilling. Deviations thereof must have prior approval of the Company.
- 13.3** The backfill material shall contain no extraneous material and/ or hard lumps of soil, which could damage the pipe and/ or coating or leave voids in the backfield trench.
- 13.4** After the initial backfill has been placed into the trench to a level slightly above the surrounding ground, Contractor shall compact the backfill material. The surplus material shall be neatly crowned directly over the trench and the adjacent excavated areas on both sides of the trench, to such a height, which will, in Company's opinion, provide adequately for future settlement of the trench backfill. The crown shall be high enough to prevent the formation of a depression in the soil when backfill has settled into its permanent position. Should depression occur after backfill, Contractor shall be responsible for remedial work at no extra cost to Company. Surplus material, including rock, left from this operation shall be disposed of to the satisfaction of land owner or authority having jurisdiction at no extra cost to the Company.
- 13.5** Rock, gravel, lumps of hard, soil or like materials shall not be backfield directly onto the pipe unless padding and/ or rock-shield has been provided as per the specification. Where rock, gravel, lumps of hard soil or like materials are encountered at the time of trench excavation, sufficient earth, sand or select backfill materials shall be placed around and over the pipe to form a protective cushion extending at least to a compacted height of 150mm above the top of the pipe.
- 13.6** In cases where pipeline crosses through seismic zone, as indicated in project document, the backfilling shall be done with select backfill as per the drawing provided elsewhere. Select backfill materials for padding that are acceptable to Company shall be soil, sand, clay or other material containing no gravel, rock or lumps of hard soil. All these works shall be carried out by Contractor at no extra cost to Company.
- 13.7** When the trench has been dug through driveways or roads, all backfills shall be executed with sand or a suitable material as approved by Company Representative and shall be thoroughly compacted. In certain cases, special compaction methods, such as moistening or ramming of the backfill in layers may be required by any public or private authority having jurisdiction over a road, street or driveway. Authorities may also require the top section of trench of such paved areas to be backfill with crushed rock or some other purchased material and surface repaved. The Contractor shall comply with said requirements at no extra cost to Company. Backfilling and compaction of trenches crossing public thoroughfares shall be carefully and expeditiously carried out so as to reduce to a minimum the time during which the public thoroughfare is out of service.
- 13.8** Trenches excavated in dikes which are the property of railways or which are parts of main roads shall be graded and backfield in their original profile and condition. If necessary, new and/ or special backfill materials shall be supplied and worked-up. The materials required may include gravel, special stabilization materials or stabilized mixtures. Moreover, special

processing and/ or compacting methods shall require the approval of Company and/ or competent authorities.

- 13.9** Stone-pitching/ cement lining of Dyke walls if dismantled during excavation shall be restored to its original condition after backfilling and compaction to the entire satisfaction of Company and concerned Authorities.
- 13.10** The trench in irrigated and paddy fields shall be backfilled to within 300mm of the top, then rammed and further backfilled until the trench is completely backfilled. Surplus material remaining after the operation shall be spread over the ROU.
- 13.11** At the end of each day's work, backfilling shall not be more than 500 meters behind the head end of lowered-in pipe, which has been padded and approved for backfill. The backfill shall be maintained by Contractor against washouts and spreading etc., until the completion and final acceptance of the work by Company.
- 13.12** The Contractor shall furnish materials and install breakers in the trench in steep areas (slope generally 10% and more) for the purpose of preventing erosion of the back fill. The type of breakers installed shall be as per applicable Contract drawings. Sacks filled with sand mixed with cement in the ratio of 6:1 shall be placed to act as a trench barrier. Such works shall be at no extra cost to Company. The Contractor shall pay attention to the direction of backfilling in such steep areas. Barrier consisting of two rows of sacks across the trench built on a staggered basis to provide maximum stability, and keyed into the trench wall may be used in gently sloping locations. The top of trench barriers shall be 200 mm - 300 mm below ground level. Trench barriers shall be bedded onto undisturbed ground. No voids shall be left in the trench barrier wall including between the wall and the pipe.
- 13.13** In addition to trench barriers when potential to backfill wash out exist due to water flow, shallow surface ditches shall be dug as necessary to channel water diverted by the trench barrier away from the pipe trench and into normal drainage followed before laying of the line. In no case, the water is to be drained via the trench or via channels other than those followed before the line was laid.
- 13.14** Stabilization of backfill shall be carried out by the Contractor in sandy areas and other such places, as directed by the Company representative. The Contractor shall carry out the stabilization to have a consolidated cover over the pipeline at no extra cost to Company.
- 13.15** The backfill shall be stabilized preferably with 150 mm layer of marl, mattresses of gatch other than straw or other stable materials. The width of stabilization shall be at least 3.0 meters on either side of the pipeline, plus one meter for every 10 meters height of sand dune (where the line passes through the dune areas).
- 13.16** Contractor shall leave the pipe uncovered at certain locations to allow Company to survey the top of the pipe and the level of the pipeline in the backfield trench. Within 48 hours after backfilling, Company shall have carried out such survey and informed Contractor of any realigning, if required. Thereafter Contractor shall compact the backfill.
- 13.17** Temporary markers shall be installed during backfilling and the survey as per specification to locate the pipeline axis. These markers shall then be replaced with permanent pipeline markers.
- 13.18** Backfilling shall be preferably carried out at the highest ambient temperature.

13.19 In certain areas like U/G pipeline crossings, overhead power cable crossings etc., special care to be taken by putting concrete slab/ plastic grating before backfilling. Size and thickness of concrete slab/ plastic grating shall comply applicable job standard and approved by Company.

14. TIE-IN

14.1 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 over lapping, uncovered pipe of sufficient length to absorb, without inducing excessive stresses in the steel, small displacements necessary for perfect alignment and connection of the ends.

14.2 Tie-in shall preferably be carried out at ambient temperatures corresponding to the average operating temperature in the case of a pipeline conveying fluids at normal temperatures and at the maximum ambient temperature in the case where the pipeline is carrying fluids at high temperature.

14.3 Contractor shall carry out tie-in-welding (including necessary cutting, beveling, grinding of pipe weld seams and line-up etc.) cleaning, priming, coating and backfilling for the tie-in portion as per relevant specifications. Contractor shall also excavate the required bell-holes for the welding. Bell holes made to facilitate welding shall provide adequate clearance to enable the welders to exercise normal welding ability and skill. All tie-in welds shall be radiographically examined.

14.4 The tie-in should be done in such a way as to leave a minimum of strain in the pipe. If necessary, with respect to the trench, realigning of the pipe shall be done to eliminate force strain in the pipe by the Contractor at no extra cost to Company.

14.5 If a pup end cannot be avoided for tie-in, the minimum length that shall be added is 1.0 meter and two or more such pups shall not be welded together. All cut-off lengths greater than 1.0 meter 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 meter and are separated by an entire length of pipe. In no case more than three (3) welds shall be permitted on a 10 meter length of pipeline.

14.6 In connecting pipes, special items, fittings and equipment where different wall thicknesses are to be welded, Contractor shall follow the procedures indicated in ASME B31.8/ ASME B31.4, as applicable. The required tapering shall be done by Contractor at no extra cost to Company.

14.7 For tie-in of adjacent sections of pipeline already pressure tested, the pup used for tie-in shall be of single length or off-cuts of pipe, which have already been hydrostatically tested. Contractor shall take care that sufficient number of pretested pipes with different wall. Thicknesses are readily available.

15. SPECIAL INSTALLATIONS ON THE PIPELINE

15.1 GENERAL

15.1.1 In addition to constructing the pipeline, Contractor shall also install certain other auxiliary facilities and appurtenances.

15.1.2 Contractor shall do all work necessary at each of the installations to provide facilities, which

are complete in all respects and ready for operations.

- 15.1.3** Without limiting the generality thereof, the work required to complete the installations shall, where applicable, include all site surveys, site preparation, filling, grading, fencing, foundations, installation of block valves, side valves, pipe work, pipe supports, pressure gauges, mechanical facilities, civil work, painting, installation of all electrical equipment's, motors, cables, conduit, wiring and fixtures and hooking up of same; installation of all instruments, piping, valves and fittings; mounting of all instruments and making all piping and electronic connections, etc.
- 15.1.4** On completion, all elements of each entire installation shall be checked out and tested for full and correct operation in the presence of, and to the satisfaction of Company. All work shall be carried out strictly in accordance with the appropriate codes, the approved drawings, and this and other related specifications.
- 15.1.5** Contractor shall fabricate all piping and install valves and fittings as required by the detailed engineering fabrication drawings prepared by him and approved by Company. Piping fabrication drawings shall be prepared by Contractor based on AFC drawings and approved by Company Representative at site.
- 15.1.6** Stainless steel lines will be "swaged" using permanent fittings installed with a hydraulic device.

15.2 MAINLINE VALVES STATIONS (MLV'S)

- 15.2.1** The Contractor shall install Mainline Valve assemblies as shown in the approved for construction drawings issued for the purpose and requirements of this specification. The Contractor shall completely assemble, test and make the MLV assembly including all related instruments etc. fully functional prior to installation in the pipeline.
- 15.2.2** The valve stem shall be installed in the vertical position. Valves with flow arrows shall be installed according to the normal flow in the pipeline. During welding the valve shall be in open position. Care shall be taken to avoid entry of sand particles etc. to valve body, seals etc. during assembly and installation.
- 15.2.3** Valve shall be installed in the pipeline in horizontal position only unless indicated otherwise in approved drawings. Installation shall be done in such a way that there is no strain in the welded joint while the pipeline at upstream and downstream side is straight.
- 15.2.4** The equipment and tools used for lifting and handling shall never be driven through hand wheel, valve stem, flange joints and other parts, which may cause damage / misalignment.
- 15.2.5** Entire MLV assembly, after fabrication, shall be tested hydrostatically ex-situ as per applicable specifications to a test pressure equal to 1.25/ 1.5 times the design pressure as applicable. As applicable all weld joints and piping components shall be inspected for leakage. Leakages if any shall be repaired and assembly retested.
- 15.2.6** Suitable reinforced concrete foundation(s) as per approved for construction drawings shall be constructed on which the valve assembly shall be firmly installed.
- 15.2.7** The Contractor shall carry out necessary excavation; cutting, beveling and welding of the tie-ins required for the installation of such assembly. The final tie-in shall not be made until the

valve is fixed in position.

- 15.2.8** The civil and structural work shall be carried out in accordance with the relevant specifications issued for the purpose and in accordance with the approved drawings, and as directed by Company representative. The work shall as a minimum include clearing, grading, filling, fencing, foundations, supports, etc. as required.

15.3 SCRAPER LAUNCHER AND RECEIVER FACILITIES AT STATIONS

- 15.3.1** Scraper launcher and receiver facilities at stations including the associated piping shall be fabricated and installed as per the approved for construction drawings. The Contractor shall completely assemble, test and make the scraper facilities including connected piping and all related instruments etc. fully functional prior to hook-up with the pipeline.
- 15.3.2** The Contractor shall maintain elevations shown on the approved drawings and carry out any pipe work adjustments, necessary for this purpose. Field cuts shall be square and accurate and field welds shall not be performed under stress of pipe ends.
- 15.3.3** The painting for the scraper stations shall be carried out as per relevant Specifications for Painting. The underground sections shall be coated with 3 Layer Polyethylene coating up to at least 300 mm above grade.
- 15.3.4** Entire scraper facilities including the associated piping, after fabrication, shall be tested hydrostatically to a test pressure equal to 1.5 times the design pressure as applicable. All weld joints and piping components shall be inspected for leakage. Leakages if any shall be repaired and assembly retested. Test pressure shall be maintained for minimum four (4) hours.
- 15.3.5** The Civil and structural works for the scraper stations shall be carried out as per the relevant specifications, in accordance With the approved for construction drawings. The work as a minimum shall include site survey, site preparation, clearing, grading, filling, fencing, foundations, etc. as required.

15.4 INSULATING JOINTS (IJS)

- 15.4.1** Pipeline insulating joints shall be installed in accordance with and at the locations specified in approved for construction drawings.
- 15.4.2** Pipe abutting insulating joints shall be aligned so that the joint is not subject to loads that induce bending or torsional moments in the joint during installation. During welding of in-line insulating joint, propagation of heat shall be avoided. To achieve this, the joint shall be kept cool by means of rags continuously wetted.
- 15.4.3** Insulating joints shall be electrically tested by the contractor prior to welding into the pipeline. The electrical conductance test shall be carried out using a Megger. Measurement of the insulation resistance across the joint shall be approx. one Mega Ohm. The test shall be repeated after installation and welding of the joint into the pipeline to verify that the insulating joint assembly is not damaged.

15.5 DIMENSIONAL TOLERANCES

These tolerances apply to inline items and corrections for other lines. These tolerances can be exceeded on items such as vents, drains, dummy supports, field supports, temperature and

pressure connections, where the deviation will not affect another spool.

- A. General dimensions such as face to face, face or end to end, face or end to center, and center to center: $\pm 3\text{mm}$.
- B. Inclination of flange face from true in any direction: 4mm per meter.
- C. Displacement of branch connection from indicated location: $\pm 1.6\text{mm}$. When multiple branches are involved, the displacement of the branches shall not exceed 3mm from a common point.

15.6 FLANGED CONNECTIONS

Contractor shall ensure that prior to final bolting, all flange faces are parallel and centered, according to standard practice. Contractor shall not use bolting forces as a means for attaining alignment. A gasket of required size and quality shall be installed between the flanges at each joint.

Bolts shall be tightened in diagonal sequence and shall be centered with equal amounts of thread visible on both sides. Bolts shall be uniformly tightened to produce a leak-proof joint. Bolts that yield during-tightening shall be removed and discarded. It is mandatory that a torque wrench is used for bolt tightening.

15.7 THREADED CONNECTIONS

Damaged threads shall be cut from the end of a run and the pipe shall be rethreaded. Contractor shall properly align all threaded joints. Pipe entering unions shall be true to centerline so the union will not be forced during make-up. The threaded pipe shall not project through fittings to cause interference with valves or other operating mechanisms.

Except for the threaded connections of instruments, which will require periodic testing and maintenance, all threaded joints shall be seal welded. The latter joints shall be made up without pipe joint compound and with a minimum of oil from the thread cutter. Seal welds should taper into the pipe with as little discontinuity as possible, and should cover all threads. All seal welds shall be tested with DP, MP testing.

15.8 WELDED CONNECTIONS

Where the ends of the piping components being welded have an internal surface misalignment exceeding 1.6mm, the wall of the component extending internally shall be trimmed by machining so that the adjoining internal surfaces will be approximately flush. All welding shall be performed in accordance relevant specification.

15.9 PAINTING

All exposed surfaces like piping, valves, structures, and miscellaneous appurtenances shall be painted in accordance with the specifications issued for this purpose.

15.10 COATING OF BURIED INSTALLATIONS, ETC.

All buried valves, insulating joints, flow tees, bends, other in-line fittings and appurtenances shall be coated with 100% solid high build epoxy (minimum 500 micron THK) or any other equivalent suitable Company approved coating at no extra cost to Company. For buried pipes and LR bends, heat shrink sleeves relevant specification for Field Joint Coating shall be used. Contractor shall submit to Company a report regarding the method of application and the materials used along with all test certificates. Only after obtaining written approval from the

Company, Contractor shall commence the work of coating.

15.11 CIVIL WORK

Civil work shall be performed in accordance with Specifications issued for the purpose.

16. THIRD PARTY FACILITIES

16.1 GENERAL

The proposed pipeline may be required to be constructed in or adjacent to easements established by others to carry services including overhead electric transmission cables, buried fiber optic transmission cables, telephone and power cables gas, water and other pipelines, etc. Though the Company has endeavored to identify and locate such services known to cross or closely run parallel to the pipeline, it is possible that some such services may not have been fully delineated during the surveys and/ or changes to the services identified have occurred since the Company's surveys. The Contractor shall be responsible for delineating and protecting all such services while executing the works.

Where the works covered under the Contract parallels or crosses an existing service, the requirements of the Authorities having jurisdiction over such a service related to protection of the service from damage during the construction activities shall be identified and complied with by the Contractor.

16.2 LOCATION AND PROTECTION OF BURIED SERVICES

The Contractor shall undertake an investigation to confirm the location of services identified by the Company, and to establish the location of any other services that may interfere with the pipeline construction.

Buried services when located shall be identified by hand excavation, and each service identified shall be marked with a stake and red flag. For all such services, location (UTM co-ordinates), angle of intersection, offset distance, size, depth of cover, etc. shall be recorded by the Contractor.

Temporary under-pinning or any other type of supports and other protective measures necessary to keep the interfering structure/ utility intact shall be provided by the Contractor at his own cost and shall be of such design as to ensure stability and safety against their possible failure.

Despite all precautions, should any damage to any structure/ utility occur, the owner/ authority shall be contacted by the Contractor and repair shall forthwith be carried out by the Contractor at his expense under the direction of Company representative and the concerned owner/ authority. If the Contractor fails to repair in reasonable time, Company reserves the right to have the repair executed at the cost of the Contractor.

16.3 PROTECTION AGAINST INDUCED VOLTAGE HAZARDS

Where the work covered under the Contract parallels or is in close proximity to overhead high voltage power transmission lines, potentially dangerous voltages may be induced in the pipeline and in the working environment posing danger to personnel working on the pipeline. NACE Standard RP0177 shall be followed to the extent applicable during construction for safety purposes. The Contractor shall undertake following precautions in this regard.

- i. Personnel performing work within the area influenced by the high voltage system must wear electrically insulated footwear (e.g., rubber knee-boots) and insulating rubber or plastic gloves so that metal parts of the pipeline can be touched.
- ii. During thunderstorms or whenever discharges are observed on insulators, all personnel must leave the area of the high voltage line and pipeline.
- iii. Vehicles and equipment must be earth-connected. This should be affected by connecting an uninsulated cable or chain of adequate length to the underside of the vehicles/equipment.
- iv. To prevent electrical voltage in a non-buried section of the pipeline from rising to dangerous levels, the length of the pipeline sections that have been welded together before lowering must not exceed the length at which the maximum admissible voltage may be induced. This length may be calculated using an appropriate calculation method.
- v. The welded connection between pipeline section yet to be lowered and section already buried must be at least 50 m from the nearest point of pylon base of a high voltage transmission line.

16.4 ADDITIONAL REQUIREMENTS WHEN WORKING AT LESS THAN 50 M FROM THE CENTRE OF THE HIGH VOLTAGE SYSTEM

When working at a distance less than 50 m from the center of a High Voltage system, following requirements shall be complied with.

- i. The work must not be started until agreement has been reached with the authorities, who control the high voltage system, with regard to the safety measures to be adopted.
- ii. Measures must be taken to prevent excavators and hoisting equipment from approaching high voltage lines within the following distances.

Voltage level	Radial distance
0- 50 kV	3 m
> 50 - 200 kV	5 m
> 200 - 380 kV	8 m

Measures to be taken in this regard may be as follows:

- Special selection of equipment, or limiting or blocking certain directions of movement, or limiting the operational area, thereby making it definitely impossible for any work to be done at a distance from the high voltage line of less than accepted minimum.
- In case the measures recommended above are not feasible, installation of clearly visible markers with no passage beyond this point' painted bright red and white must be done to prevent any work being done inside the danger area.

In the event that a vehicle, crane etc. should accidentally come into contact with a live line / conductor of a high voltage system or flash-over of electrical charge occurs, the driver must not get down from his vehicle because this will pose a serious threat to his life. The vehicle or crane must break the contact without any help from outside. The driver must not leave his vehicle until he has managed to leave the dangerous area, or alternatively, when the Electricity Authorities have given notice that the cable(s) have been put out of circuit. In case a serious fire starts in the vehicle, he is permitted to jump from the vehicle, clearing it as far

as possible, while the jump should be possible at a dry sport.

17. MARKER

The Contractor shall fabricate and install all types of pipeline markers along pipeline route. Number and type of pipeline markers shall be as per As-built survey/ alignment sheet & reference specification and as directed by the authorities having jurisdiction. The Contractor shall install all types of markers in accordance with Specification for Markers and approved for construction drawings.

18. FINAL CLEAN-UP OF THE CONSTRUCTION RIGHT-OF-USE (ROU)

18.1 Contractor shall restore the ROU and all sites used. for the construction of pipelines, water crossings and other structures in accordance with Company's instructions, and deliver them to the satisfaction of Company.

18.2 SURPLUS MATERIALS

For Company supplied materials, after completion of work, the Contractor shall return all surplus materials at Company's designated areas.

The reconciliation of surplus free issue line pipes shall be as per the requirement of commercial condition of contract.

18.3 DISPOSAL

18.3.1 All surplus and defective materials supplied by Contractor and all trash refuse and spoiled materials shall be collected and disposed of by Contractor.

18.3.2 The ROU shall be cleared of all rubbish, broken skids, empty cans, card board, sacks, stumps, trash, and leftover construction material. All burnable matter shall be burned, but only after obtaining appropriate permits for such burning. If burning is not allowed, Contractor shall haul the clean-up material to an approved dumping area. All scrap metal and unburnable material shall be disposed of, in an appropriate manner, but never be buried in the ROU.

18.3.3 Surplus soil can only be removed from the Owner's plot after authorization by Company.

18.3.4 All dumping fees and royalty connected with the disposal of materials shall be to the account of Contractor.

18.3.5 All loose stones and rock exposed by the construction operations and scattered over the ROU or adjacent grounds shall be removed by Contractor and be transported to a location considered suitable by the land-owner and/ or tenant, or by authorities have jurisdiction, for satisfactory disposal. For stones, gravel or other hard material, which may be buried in the trench the provisions of the specifications shall apply with the understanding that the use of the land by the land-owner and/ or tenant will not be interfered with.

18.4 TEMPORARY STRUCTURES

All auxiliary structures such as bridges, culverts, sheet piling, posts, signs, etc., which were erected or installed by Contractor as temporary measure, shall be removed. However, it may be necessary to remove the fence of ROU during the maintenance period.

18.5 REPAIR OF DAMAGES

- 18.5.1** Damages to roads, bridges, and private property shall be repaired by Contractor. All fences and other structures, which are damaged during construction, shall be restored to original.
- 18.5.2** Slopes, water course sides or banks which have been partially or totally demolished during the execution of the works shall be properly consolidated and restored (without waiting for their natural consolidation and setting) complying to requirement of the concern authorities. The bed of water-courses shall be restored to the original level. The banks and any excavated areas shall be restored to the original levels and contours. The banks shall also be stabilized.
- 18.5.3** All boundary stones, which have been moved or removed during the work, must be reset in their original location to the satisfaction of the landowner concerned.
- 18.5.4** On completion of clean-up, the ROU shall be restored to such stable and usable condition as may be reasonably consistent with the condition of the ROU prior to laying the pipeline. The Company shall be completely indemnified and held harmless by Contractor from any and against all claims, demands, losses, expenses etc. that may arise in this behalf or the Company may anyway suffer or sustain, relative to, arising out of, or in connection with same. The Company require from the Contractor signed releases from landowners regarding satisfactory indemnification and restoration of their lands.
- 18.5.5** Special precautions shall be taken near steep slopes prone to erosions and landslides. All necessary steps shall be taken to ensure the rapid growth of grass by providing wicker barriers and by regulating the drainage of surface waters.
- 18.5.6** All cadastral or geodetic markers, which may have been removed during the execution of the work, shall be restored in their exact position.
- 18.5.7** Ditches for which no instructions for their restoration have been issued, or restoration cannot be done due to absence of banks, shall be restored as instructed by Company. The bed of ditches crossed by the pipeline shall be cleaned over the full width of the ROU, also outside the ROU if necessary. This restoration might contain but is not limited to the supply and installation of proper materials for backfill and protection, the sodding or other precautions to prevent erosion or guarantee the stability. All work has to be done after deliberation and acceptance of the authorities and Company. Other field drains have to be restored over full width of ROU and if necessary, also outside the ROU by hand and/ or special equipment as soon as possible.
- 18.5.8** Any subsidence, cave-ins, wash-outs, which have been caused during the pipeline construction and maintenance, caused by whatever reason within the edge of ditches and open drains, shall be repaired by Contractor immediately or at first notice given by Company.
- 18.5.9** After the clean-up, the ROU of pastures has to remain fenced considered suitable by the tenant and to be removed during the maintenance period. When agricultural and other traffic (requested by tenant) have to cross the ROU the cross-over have to be fenced with the same material as the ROU. If necessary, special materials have to be used to allow traffic on the cross-over. Fencing of the right-of-use as specified shall not be removed until Contractor has obtained written permission by Company. In general, this has to be done during the maintenance period.
- 18.5.10** All openings in or damage to the fences or enclosures shall be repaired by installing new fencing of a quality, which shall be at least equal to the parts damaged or removed. Provisional gates shall be removed and replaced with new fencing. All repairs to fences and

enclosures shall be carried out by Contractor to the complete satisfaction of Company, landowner and/ or tenant.

18.5.11 If, in the opinion of Company, the sod in pasture land has been damaged by vehicles, and wheel tracks are visible, the ROU shall be tilled with a disc-harrow or rotary cultivator several times. The damaged sod shall be firmly cut up and thoroughly mixed through the top-soil. In general, the ROU has also to be ripped. After this procedure no closed-in layers must be found and sufficiently loose top-soil 25 to 30 cm thick must be present. The whole procedure must be approved by Company. Subsequently, the entire ROU, which is part of pasture land, shall be prepared for seeding and fertilized by Contractor according to the instructions of Company.

18.5.12 In crop fields the tillage shall consist of passing over the land several times with a disc harrow, cultivating with a spading machine, or plow, to a depth of approx. 20 cm. In general, the ROU has also to be ripped. After this cultivation process no closed-in layers must be found any more in the ROU. The equipment used and methods adopted shall require the approval of Company. Ripping has to be done with rippers with a distance of 50cm between the ripper blades. The type to be used shall be approved by Company.

18.5.13 Adequate numbers of saplings of any plant/ tree uprooted or cut during construction shall be planted along the route as per the direction of the Company and in accordance with the requirement of Authorities. The cost of sapling and its plantation shall be to Contractor's account.

The ROU and the backfilled trench in particular have to be finished in such a way that after settlement of the soil the fields are at their original level.

If during the maintenance period certain parts of the ROU are lower than the original level, Company can order Contractor to bring these parts to the original level.

In cases where heavy damage has occurred to the structure of the subsoil as a result of adverse circumstances, Company reserves the right to order Contractor to carry out special restoration work. Said special work can include:

- Spading with dragline (depth 30-80cm);
- Spading with dragline (depth 80-100cm);
- Fertilizing;
- Cover with sand.

If during clean-up operations, soil shortages become apparent outside the trench, Contractor shall supplement said soil shortage using suitable materials, approved by Company.

If site and/ or climatic conditions should render this necessary, Company shall have the right to order Contractor to suspend certain parts of the work related to the clean-up and postpone it to a later date.

18.6 SOIL SURPLUS

18.6.1 If on site, as a result of the work and after careful backfilling and compacting, a sub-soil surplus exists, this shall be worked up by grading and compacting below the sub-soil top layer and as a rule this shall be done in the same plot of land. It shall not be permitted to remove the surplus from the plot concerned, unless it concerns rejected soil, which has to be

removed. Working up surplus soil or removal of rejected soil shall be considered to pertain to the work.

18.6.2 To work a soil surplus into the ground, Contractor shall remove an additional strip of top soil beside the trench. Next, the upper layer of sub-soil shall also be removed. Both soil types shall be stored separately across the width depending on the size of the soil, surplus. The soil surplus shall then be distributed across the trench thus widened, after which it shall be graded and compacted and subsequently the top layer of sub-soil and the top-soil shall be replaced in the correct order, in accordance with the Specifications.

18.6.3 In case Company has given prior permission for mixed excavation of the sub-soil as well as in cases where Company deems mixed excavation permissible, the above provision of separate storage of the upper layer of sub- soil shall not apply to the working up to the soil surplus.

18.6.4 In cases where the soil surplus can be worked up in others plots where soil shortages have arisen due to the work, this shall only be done after prior permission by land-owner, land user and Company.

18.7 SOIL SHORTAGES

18.7.1 If due to unforeseen circumstances during backfilling and compacting there should not be enough soil to fill the trench properly, or to install the crown height as stipulated, Contractor shall supply the necessary backfill material.

18.7.2 Soil shortages shall be supplemented and applied before the top-soil is replaced.

18.7.3 The soil to be supplied shall be worked up in those locations and into those layers where a soil shortage has been established. The quality of the supplemented soil shall be equal to that of the shortage.

19. MAINTENANCE DURING DEFECTS LIABILITY PERIOD

Defects Liability Period as defined as period of liability in the Contract.

Company reserves the right to carry out instrumented pigging survey of the completed pipeline.

Contractor shall be responsible for making good with all possible speed at his expense any defect in or damage to any portion of the work which may appear or occur during the Defects Liability Period and which arises either:

- a) From any defective material (other than supplied by Company), workmanship or design, (other than a design made, furnished or specified by Company and for which Contractor has disclaimed responsibility in writing), or
- b) From any act or omission of Contractor done or omitted during the said period.

If such defect shall appear or damage occur, Company shall forthwith inform Contractor thereof stating in writing the nature of the defect or damage.

If any such defect or damage be not remedied within a reasonable time, Company may proceed to execute the work at Contractor's risk and expense provided that he does so in a reasonable manner. Such defect or damage can be, but is not limited to:

- Clean-up of ROU, including water courses.
- Sagging or sinking of site level or pipe supports.
- Sliding of ditch banks.
- Repair of fencing or removal of construction fencing.
- Repaving of pavements, repair of pavements and repair of Roads.
- Repair of coating, painting.
- Realigning markers, signs.
- Leak/ burst of pipe, leaking of flanges, washouts
- Short-circuit in casings

Construction defects such as dents, ovality, welding offsets/ defects, etc. detected during intelligent pigging survey, etc.

Company reserves the right to have the required Computerized Potential Logging Test executed during the Defects Liability Period and whenever weather conditions are more favorable for this job. The work shall (at or as soon as practicable after the expiration of the Defects Liability Period) be delivered to Company in the conditions required by the contractor, fair wear and tear excepted, to the satisfaction of Company. Contractor shall finish the work, if any outstanding, at the date of completion as soon as possible after such date and shall execute all such work.



ENERGISING QUALITY

VCS QUALITY SERVICES PVT. LTD.

STANDARD SPECIFICATION FOR CONSTRUCTION OF PIPELINE, CROSSING ROADS, RAIL ROADS & MINOR WATER CROSSING

VCS – SS – PP - 2002

					
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ABBREVIATIONS:

ASME	American Society of Mechanical Engineers
ASTM	American Society of Testing of Materials
API	American Petroleum Institute
OISD	Oil Industry Safety Directorate



CONTENTS

1.0	SCOPE	5
2.0	REFERENCE CODES, STANDARDS AND SPECIFICATIONS.....	5
3.0	GENERAL.....	6
4.0	ROAD AND RAILROAD CROSSINGS.....	8
5.0	MINOR WATER COURSE CROSSINGS	11
6.0	CROSSING OF BURIED SERVICES.....	13

1.0 SCOPE

This specification covers the minimum requirements for the various activities to be carried out by the Contractor for or about installation of pipelines crossing roads, railroads, minor water courses and other services.

The provision of this specification is not applicable for pipelines crossing water courses, which are specifically designated as "Major water Courses" in the CONTRACT.

This provision is formulated to protect the facilities crossed by the pipeline as well as to provide adequate design for installation and operation of pipeline.

Requirements related to installation of pipeline crossing including, but not limited to site preparation, supply of materials, string fabrication, joint coating application, boring / jacking, testing, tie-in, clean-up, restoration and as-built drawing are addressed in this specification.

2.0 REFERENCE CODES, STANDARDS AND SPECIFICATIONS

Reference has been made in this specification to the latest edition (edition in force at the time of floating the enquiry) of the following codes, standards and specifications.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

B31.4	:	Pipeline Transportation system for liquid Hydrocarbon & other liquids.
B31.8	:	Gas Transmission and Distribution Piping Systems.

AMERICAN PETROLEUM INSTITUTE (API)

API RP 1102	:	Recommended practice for liquid Petroleum Pipeline Crossing Railroads and Highway

PNGRB REGULATIONS:

G.S.R 808(E) T4S	:	Regulations for Natural Gas Pipelines
G.S.R. Infra/ T4S/ P&PPPL	:	Regulations for Petroleum and Petroleum products pipelines
G.S.R. 612(E) T4S	:	Regulations for CGD Network

SPECIFICATIONS

VPC-SS-PP-2001	:	Standards Specification for pipeline construction (onshore)
VPC-SS-PP-2014	:	Specification for Hydrostatic Testing of Onshore Pipeline.

2.1 In case of conflict between the requirements of above mentioned codes, standards, regulations, specifications and practices, the most stringent requirement shall govern. For the purpose of this specification the following definitions shall hold:

- Words 'Shall' and 'Must' where used indicate that a provision is mandatory.
- Words 'Should' and 'Will' where used indicate that a provision is not mandatory but is recommended as good practice.

3.0 GENERAL

3.1 Crossing of roads, railroads, buried services, canals and minor water courses with equipment and/ or personnel is allowed only after acquiring approval from the authorities having jurisdiction and after making arrangements for safeguarding the roads, etc. and the verges and/ or banks thereof and the buried services with appropriate provisions.

The carrier pipe shall be firmly supported on both sides of the crossing. The bottom of trench and pit for at least 12 m length at approaches to crossing shall be graded and filled with soil compacted up to 95% Proctor density to an elevation that will provide sufficient continuous support to the carrier pipe. Earth or sand filled bags may be used to firmly support the carrier pipe adjacent to the crossing. In case of cased crossing, carrier pipe shall be supported in such a manner that it remains correctly aligned at the casing ends during and after backfilling.

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 company and the 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.

3.2 Contractor shall submit the followings before start of any crossing works:

- Approval letter from concerned authorities
- Time Schedule
- Execution methodology with details of equipment
- Test procedure
- Manpower deployment
- Description of temporary works
- Design calculations for crossing (if any)
- Soil investigations etc.
- Construction drawings

Such works shall be without any extra cost to company.

3.3 SURVEYS AND INVESTIGATIONS

The Company may carry out surveys and soil investigations along pipeline route including crossing locations. The details of the surveys, soil investigations and other data collected

by the Company shall be presented in the drawings and documents enclosed with the Contract for the information of the Contractor.

The Contractor shall be deemed to have reviewed and satisfied himself with regard to the details provided in the Contract. It shall be the responsibility of the Contractor to assess requirement of any additional surveys and/ or soil investigations or any other data collection that may be deemed necessary for proper execution of the works in accordance with the drawings, specifications, other requirements of the Contract including requirements of concerned Authorities.

The Contractor shall be responsible for carrying out survey, soil investigation and data collection, as deemed necessary by the Contractor, for proper execution of the works. The Company shall not provide any additional details in this regard.

Whenever specified in the contract, contractor shall carryout all geotechnical investigation and Hydrological, scour calculate in case of water

3.4 PROTECTION OF UNDERGROUND UTILITIES

Contractor shall ensure that the crossing is not interfering with any of the existing underground utilities. Should any damage to any utility/ structure occur, the Owner/ Authority concerned shall be contacted by the Contractor and repair shall be carried out by the Contractor to entire satisfaction of the Owner/ Authority. All costs for reinstatement or incidental to reinstatement shall be settled and paid by the Contractor.

3.5 MINIMUM COVER REQUIREMENT

Within the limits of bored crossings, unless noted otherwise on the Contract drawings, minimum requirements of cover indicated in Table-1 shall be satisfied.

Table 1 – Minimum Cover Requirements for Crossings	
Utility Crossed	Minimum Cover
National Highways and Expressways	1.2 m from top of road to top of pipe
State Highways	1.2 m from top of road to top of pipe
Railroads	1.7 m from base of rail to top of pipe
Canal (Lined / Unlined)	1.5 m below the canal bed level
River	2.5 m (below scour depth/ Lowest bed level)
	1.5 m in case of rocky strata

In case any additional cover over and above the above minimum cover is stipulated by the Authorities, the Contractor shall ensure compliance with the requirements of the Authorities.

3.6 HYDROSTATIC TESTING

Pipeline crossings for road, railroad, canals and rivers etc., shall be hydrostatically pretested ex situ, prior to joint coating, whenever,

- Crossing is executed by boring of carrier pipe
- Casing pipe used in crossing installation

- River Crossing pipes which are to be continuously concrete weight coated (to be tested prior to concrete coating).
- Whenever, in company's opinion, the repair of pipeline at crossing, in case of a leak during final hydrostatic testing, would require inordinate number of efforts and/ or time
- Whenever pretesting is insisted upon by the Authorities having jurisdiction over the utility crossed.

The pipeline shall be hydrostatically tested to a minimum test pressure equal to 1.25 / 1.5 times the design pressure as applicable. The combined equivalent stress in the pipeline due to bending and test pressure shall not exceed 95% of the SMYS of pipe material. Test pressure shall be retained in the pipeline for minimum period of 2 hours. Test section shall be visually examined for leaks/ defects, etc.

4.0 ROAD AND RAILROAD CROSSINGS

- 4.1** The work under crossings shall include necessary clearing, grading and trenching to required depths and widths, welding of casing and carrier pipes, lowering-in, back filling, 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.

The work shall be carried out in accordance with the approved drawings and job standards, as directed by Company and to the satisfaction of Company 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.

Prior approval from the statutory authorities shall be obtained to lay the pipeline across the highway/ road either by boring or by open-cut- method. Installation of the crossing shall be by the method (i.e., boring/ open-cut) approved by Authorities having jurisdiction. Railroad crossings shall always be bored/ .

Before the installation work of crossings is started, the Contractor shall provide suitable barricades, temporary bridge/ bypass work (especially where roads are open cut) with railing, if required by Company for safety of traffic. Adequate traffic warning signals and/ or traffic lights and suitable diversions shall be provided as directed by Company/ Authority having jurisdiction over these areas. Such diversions shall not cross the pipeline where it has already been installed, unless proper safeguarding at Company opinion is ensured.

- 4.2** Boring/ jacking of carrier pipes for crossings is allowed only if the pipes for boring/ jacking are provided with a suitable corrosion coating and Contractor remains liable for the suitability of the pipe and weld coating of carrier pipes to be bored and type of coating and method of application are anyhow to be authorized by Company without prejudice to Contractor's liability. In all other cases the carrier pipes shall be cased.

Before start of the boring/ jacking, Contractor shall execute a soil investigation and determine the ground water table. Based on these investigations Contractor shall prepare

a construction drawing and submit to Company for approval including time schedule and soil investigation report.



During the execution of the boring, the ground water table over the length of the boring shall be lowered up to at least 0.50 M below bottom of the pipeline. This water table is to be regularly inspected and maintained by Contractor and reported to Company to safeguard the stability of the bore pit. Contractor shall, if necessary, in Company opinion, use a closed sheet piling, which shall extend at least over 50% of the length in undisturbed soil. The length of the boring shall be in accordance with the width of the ROU of the crossing (road, railroad, etc.) with minimum 0.6 M extra on either side.

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 as directed by the Company.

- 4.3** 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. If excessive void or too large hole results, or if it is necessary, in the opinion of Company, to abandon the bored hole, prompt remedial measures such as filling the hole with suitable material shall be taken to the entire satisfaction of the Company and Authorities having jurisdiction thereof at no extra cost to Company. Equipment used for installation of casing pipe shall be of the type approved by Company.

An installation consisting of hydraulic jacks shall be provided with easily readable pressure gauge (in bar) and sealable pressure limits. Their proper operation shall be demonstrated before the work is started. Company can request that the maximum pressing force be limited.

At the front of the pipe there may be a cutting ring which may be 12 MM larger than the outside diameter of the pipe or casing. A lubricating pipe can also be used in jacking, the nipples of which shall not protrude from the cutting ring. Said lubricating pipe shall not be fixed to the pipe or casing. When jacking, only biologically degradable lubricants shall be used.

The progress in the work, the readings of the gauge pipes, the jacking pressures observed, etc., shall be recorded in a log book, to be shown to Company upon request. All information shall be supplied to Company on completion of the work.

In case of jacking failure e.g., resulting in pipe buckling or the equipment being unable to push the pipe further, the pipe shall be left in the hole, filled with sand and plugged at both ends. Cost of pipe lost due to such failure shall be borne by the Contractor.

Company reserves 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 Company's inspection. If during inspection any defects are noticed, Contractor, in consultation with Company, shall carry out the remedial measures required.

- 4.4** After completion of the pipe laying, the trench shall be properly compacted by mechanical compactors to the satisfaction of the Authorities and restored back to the original.

While welding of the casing and vent/ drain pipes, internal high or low is not allowed. Welding of casing and vent/ drain pipes need not be radiographed; however, only normal

visual checks 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. When such defects are noticed, these must be completely removed before joining the pipes. If these defects cannot be repaired, the defective section shall be cut out.

- 4.5** In the case of crossings where excavation has been authorized, the welding for the casing pipe and for a continuous section of the pipeline corresponding to the expected length shall be carried out in the proximity of the crossing. Casing must be laid immediately after the trenching. Casing pipe must be laid with a single gradient in order to allow for an easy insertion.
- 4.6** The assembly of vent pipe units as approved by Company shall be carried out by direct insertion and welding to the ends of the casing pipe before introducing the carrier pipe to avoid damage to insulators from welding heat. 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 of the vent pipes shall be applied before backfilling as per relevant specifications.
- 4.7** Before installation of carrier pipe, the casing pipe shall be thoroughly cleaned to remove soil, mud, stones and other foreign material. A nose-piece having a diameter equal to that of the pipe shall be welded to the front end of the carrier pipe to facilitate correct installation of the carrier pipe in the casing. Pushing or pulling force is evenly and constantly applied to avoid damage to the insulators.
- 4.8** Insulators, as per specification as approved by Company, shall be securely fastened to the pipe with all bolts and fixtures firmly tightened. The number of insulators and spacing shall be as shown in Standard drawing No VCS-STD-2009 or 2.5 meters center (whichever is more stringent). At the end of both sides of the casing, a double set of insulators shall be installed.
- 4.9** 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.
- 4.10** In the event of failure, the pipe/ section removed from the installed pipeline shall be kept aside and preserved for further investigation of the reasons for failure.

After successful testing the ends of the pipeline section shall be capped and buried unless immediate tie-in is carried out. The location of the ends shall be marked on ground by installing markers.

- 4.11** After installation of the carrier pipe section, the casing and the appurtenances, but prior to making tie-in welds and backfilling, an electrical test shall be conducted by the Contractor in the presence of the Company, to determine the resistance between the casing and the carrier pipe or the carrier pipe and the soil. These tests shall show at least a resistance of 100,000 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 at his cost, unless a test to the satisfaction of the Company is obtained.

In case of failure of test, the Contractor shall assess the reasons for lower resistance and if it is established that casing and carrier pipe are electrically short circuited, the Contractor shall make the necessary repairs and verify that short circuiting has been successfully removed.

5.0 MINOR WATER COURSE CROSSINGS

- 5.1** Minor water crossings are crossings of (future) ditches, canals, water courses, rivers, streams etc. whether the bed(s) contain(s) water or not, and not being specified as "Major Water Crossings" in the CONTRACT.
- 5.2** For minor water crossings a standard drawing or a separate detailed approved drawing for individual crossing shall be applicable, and all further specifications are applicable.
- 5.3** Whenever minor water crossings in the ROU are to be crossed, Contractor shall install bridges and further comply with the provisions as laid down in this specification.
- 5.4** In crossings of water courses with either moderate flow rate or of torrential nature with marked and unpredictable flooding, an adequate survey shall be carried out before starting the work with the object of determining what precautions are necessary and the most favorable period for executing the work.
- 5.5** In case of crossings of water courses for which no special methods of laying are required, a pipe section of a size as per the approved drawings shall be assembled and subsequently laid. Bends shall be of cold field type.

The depth of the existing bottom of a minor water course crossing shall be determined in relation to the adjacent ground level by taking the average of four measurements. Measurements shall be taken with a gauge rod having a flat bottom. The minimum force to be exerted shall be 360N (36kgf).

Contractor shall take special care to check with the responsible authorities for special conditions applying to working on, over, under or thorough minor water crossings and Contractor shall comply with any such conditions. Written arrangements with authorities shall be drawn up in cooperation with Company.

- 5.6** Whenever required by Company, Contractor shall, before start of construction, execute a geo-technical and hydrological investigation. Based on these investigations Contractor shall also calculate scour level and prepare construction drawings, Contractor shall submit all reports, calculations and drawings for approval by Company.
- 5.7** The minimum cover over the pipe shall be as specified in the relevant approved drawings and job standard.
- 5.8** For crossing beneath the bed of water courses, the pipe section shall be made in such a way that it conforms to the existing or future bed as indicated in the approved drawings. In crossings for which an individual drawing has not been prepared, the minimum cover of the pipeline shall not be less than that indicated in- the standard drawings for a similar type. of crossing.
- 5.9** Whenever the crossing requires a straight section of pipe between the lower bends coinciding with the river bed, this section shall be laid at a single horizontal level.

- 5.10** For crossing of ditches, canals, banked channels, etc. by boring, the pipe section shall be prepared, laid and tested in accordance with the applicable clauses of Section 4.0 of this specification.
- 5.11** The Contractor shall arrange temporary installation of diversions as may be necessary, to ensure the effective functioning of these watercourses crossed, to the entire satisfaction of the concerned local Authorities as well as the Company.
- 5.12** Banks and trenches of minor water crossings shall be backfilled with soil which is to be approved by Company 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 the Company. Whenever boulders, rock, gravel 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 backfilled initially around and over the pipe to provide a protective padding or cushion extending to a minimum thickness of 30 centimeters around the pipe before backfilling remainder 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 ROU.

When specified in the CONTRACT, Contractor shall repair the ditch bank with materials to be supplied by himself as follows:

The excavation shall be backfilled with well compacted solid soil, followed by a minimum 0.25 M thick layer of properly shaped boulders (75-150 MM) encased in a net of galvanized iron wire of dia 3 MM spaced at a maximum distance of 50 MM to be laid over the backfilled, compacted and graded banks.

The width of the above protection shall be equal to the bank excavated and damage and extending 3 M on either side. The length of this protection on the slope shall be determined by the following:

- 2 M plus the highest water level.
- Up to the bottom of the crossing or 20 M below the highest water level whichever is smaller.

- 5.13** After completion of crossing, any temporary arrangements made for diversion flowing water shall be restored back to the original.

Where possible a gradual slope to the pipe shall be given on both sides to avoid use of sag bend at the crossing. Otherwise, single pipe sag bend suitable for each nala / stream shall be prepared by field cold bending and installed at the crossing.

- 5.14** 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 competent Authorities.



6.0 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 500 MM as per job standard.
- 6.2** Whenever buried services in the ROU are to be crossed by Contractor, Contractor shall safeguard the buried facilities and the required protecting precaution shall be executed as approved by Company of the buried services and by Company.



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VCS QUALITY SERVICES PVT.LTD.

STANDARD SPECIFICATION FOR PIPELINE BALL VALVES

VCS-SS-PP-2004

					
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ABBREVIATIONS:

ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
API	American Petroleum Institute
BHN	Brinell Hardness Number
DN	Nominal Size
HAZ	Heat Affected Zone
LC	Lock Close (valve locked in full close position)
LO	Lock Open (valve locked in full open position)
MSS-SP	Manufacturers Standardization Society - Standard Practice
NDT	Non Destructive Testing
NPS	Nominal Pipe Size
RTJ	Ring Type Joint
SSPC	Steel Structures Painting Council
MPI	Magnetic Particle Inspection
DP	Dye Penetrant

CONTENTS

1	SCOPE	5
2	REFERENCE DOCUMENTS	5
3	MATERIALS.....	6
4	DESIGN AND CONSTRUCTION REQUIREMENTS	7
5	INSPECTION & TESTS	13
6	TEST CERTIFICATES	16
7	PAINTING.....	16
8	MARKING & SHIPMENT.....	16
9	SPARES & ACCESSORIES	17
10	DOCUMENTATION	17

1 SCOPE

This specification covers the minimum requirements for design, manufacture, testing and supply of carbon steel ball valves of size DN 50 mm (2") and above and ASME pressure rating Class 150# thru 900# for use in onshore pipeline systems handling non-sour hydrocarbons in liquid or gaseous phase including Liquefied Petroleum Gas (LPG).

2 REFERENCE DOCUMENTS

All valves shall be manufactured and supplied in accordance with the American Petroleum Institute (API) Specification 6D, latest edition (edition in force at the time of issue of enquiry), Specification for Pipeline and Piping Valves, with additions and modifications as indicated in the following sections of this specification.

Reference has also been made in this specification to the latest edition (edition in force at the time of issue of enquiry) of the following Codes, Standards and Specifications.

2.1 American Society of Mechanical Engineers (ASME)

B31.3	:	Process Piping.
B31.4	:	Pipeline Transportation System for Liquid and Slurries.
B 31.8	:	Gas Transmission and Distribution Piping Systems.
B16.5	:	Pipe Flanges and Flanged Fittings.
B16.10	:	Face to Face and End to End Dimensions of Valves.
B 16.25	:	Butt Welding Ends.
B 16.34	:	Valves-Flanged, Threaded and Welding Ends.
B 16.47	:	Large Diameter Steel Flanges.
Section VIII	:	Boiler and Pressure Vessel Code - Rules for Construction of Pressure Vessels.
Section IX	:	Welding and Brazing Qualifications.

2.2 American Petroleum Institute (API)

1104	:	Specification for Welding of Pipelines and Related Facilities.

2.3 American Society for Testing and Materials (ASTM)

A370	:	Standard Test Methods and Definitions for Mechanical Testing of Steel Products.
B 733	:	Auto catalytic (Electro less) Nickel - Phosphorus Coatings on Metal.

2.4 Manufacturers Standardization Society (MSS)

- SP-6 : Standard Finishes for contact faces of Pipe Flanges and Connecting – End Flanges of Valves and Fittings.
- SP-44 : Steel Pipeline Flanges.

2.5 Steel Structures Painting Council (SSPC)

- SSPC-VIS-I : Steel Structures Painting Council Visual Standard-Guide and Reference Photographs for Steel Surfaces prepared by Dry Abrasive Blast Cleaning.

- 2.6** In case of conflict between the requirements of this specification, API 6D and the Codes, Standards and Specifications referred above, the requirements of this specification shall govern.

3 MATERIALS

- 3.1** The material of major components of the ball valves shall be as indicated in Valve Data Sheet. Remaining components shall be as per Manufacturer's standard (suitable for the service indicated in the data Sheet) and shall be subjected to approval by Company. In addition, the material shall also meet the requirement specified hereinafter.

All process-wetted parts, metallic and non-metallic, sealant and lubricants shall be suitable for the service specified by the Company. Manufacturer shall confirm that all wetted parts are suitable for treated water/ seawater environment, which may be used during field testing.

Non-metallic parts of the valves (including O-rings, soft seals etc.) intended for hydrocarbon gas service shall be resistant to explosive decompression.

- 3.2** Carbon steel used for the manufacture of valves shall be fully killed.
- 3.3** The carbon equivalent ($CE_{I\text{IW}}$) of valve end connections which are subject to further field welding by Company shall not exceed 0.43 on check analysis for each heat of steel used, as calculated by the following formula:

$$CE_{I\text{IW}} = C + \frac{Mn}{6} + \frac{Cr + Mo + V}{5} + \frac{Cu + Ni}{15}$$

3.4 Charpy V-Notch Test Requirements

Charpy V-notch test on each heat of base material shall be conducted for all pressure containing parts such as Body, End Flanges, Stem and Welding Ends as well as Bolting materials for pressure containing parts.

Test procedure for Charpy V-Notch Test shall conform to ASTM A370.

For Carbon Steel, alloy steel & Stainless Steel (except Austenitic Grades) Materials, The impact test temperature shall be 0 °C or minimum design temperature indicated in valve

data sheet / MR, whichever is lower. The average absorbed energy value of three full sized specimens shall be 27 J (for materials with Specified Minimum Tensile Strength $\leq 100,000$ psi) / 34 J (for materials with Specified Minimum Tensile Strength $> 100,000$ psi). The minimum impact energy value of any one specimen of the three specimens analysed as above, shall not be less than 22 J (for materials with Specified Minimum Tensile Strength $\leq 100,000$ psi) / 26 J (for materials with Specified Minimum Tensile Strength $> 100,000$ psi).

For Low Temperature Carbon Steel Materials, the impact test temperature shall be as per requirement of Material Standard or minimum design temperature indicated in valve data sheet/MR, whichever is lower. The average absorbed energy value of three full sized specimens shall be 27 J (for materials with Specified Minimum Tensile Strength $\leq 100,000$ psi) / 34 J (for materials with Specified Minimum Tensile Strength $> 100,000$ psi). The minimum impact energy value of any one specimen of the three specimens analysed as above, shall not be less than 22 J (for materials with Specified Minimum Tensile Strength $\leq 100,000$ psi) / 26 J (for materials with Specified Minimum Tensile Strength $> 100,000$ psi).

Where the material specification requires impact values to be higher than specified in the above paragraphs, the higher values shall apply.

For duplex & super duplex stainless steel the Charpy V-Notch test values and test temperature shall be as per API 6D.

3.5 Hardness Test Requirements

For valves specified to be used for Gas service or LPG service, Hardness test shall be carried out as per ASTM A370 for each method of manufacture and each heat of steel used in the manufacture of valves. A full thickness cross section shall be taken for this purpose and the maximum hardness of the materials of valve components shall not exceed 248 HV₁₀.

3.6 Electroless Nickel Plating Requirements

For all such valves where Carbon Steel/Low temperature carbon steel is used as ball material, the ball shall have 75 micrometers (0.003 inches) thick Electro less Nickel Plating (ENP) as per ASTM B 733 with following classification:

- SC2, Type II, Class 2.

The hardness of plating shall be minimum 50 RC.

4 DESIGN AND CONSTRUCTION REQUIREMENTS

4.1 General

Valve design shall meet the requirements of API Specification 6D and shall be suitable for the service conditions indicated in the Valve Data Sheet. The ASME Boiler & Pressure Vessel Code, Section VIII, Div 1 shall be used to design the valve body. Allowable stress requirements shall comply the provisions of above code. Also, corrosion allowance indicated in Valve Data Sheet shall be considered in valve design; however, the minimum wall thickness shall not be less than the minimum requirement of ASME B16.34. The

manufacturer shall have valid license to use API monogram on valves manufactured as per API 6D.

4.2 Valve Installation

Valves shall be suitable for either buried or above ground installation as indicated in Valve Data Sheet/ Material requisition.

4.3 Valve Body

4.3.1 For above ground valve, valve body design shall be either fully welded or bolted type. For buried valves, valve body design shall be fully welded type only. Valve body joints with threads are not permitted.

4.3.2 Ball mounting shall be trunnion or pivot type only. Valve design shall minimize the possibility of debris ingress into the trunnion as far as practicable

4.4 Ball

Ball shall be of single piece, solid type construction.

4.5 Valve Bore Configuration

Valves shall be Full bore (FB) or Reduced bore (RB) as indicated in the Valve Data Sheet.

Full Opening Valve

Full bore valves shall be suitable for the passage of all types of pipeline pigs including instrumented intelligent pigs and regular cleaning, batching and scraper pigs on regular basis without causing damage to either the valve component or the pig. The full bore, valve shall provide an unobstructed profile for pigging operations in either direction. Full bore valves shall be designed to minimize accumulation of debris in the seat ring region to ensure that valve movement is not impeded. The bore of full bore butt-welded & flanged valves shall be in line with Connecting pipe as stated in valve data sheet or Valve MR, however in any case it shall not be less than the minimum required shown in Client Ball Valve specification & API 6D.

Reduced Opening Valve

The bore size of reduced bore valve shall correspond to that of a full-bore valve of smaller nominal diameter as indicated in Table- 4.5 below. For sizes of a particular rating not covered in API 6D, the bore size of the reduced bore valve shall be as per manufacturer`s Standard.

TABLE – 4.5			
Nominal Valve Size	Nominal Valve Size for Reduced Bore	Nominal Valve Size	Nominal Valve Size for Reduced Bore
DN mm (NPS inches)	DN mm (NPS inches)	DNmm (NPSinches)	DNmm (NPS inches)
50 (2)	40 (1.5)	600 (24)	500 (20)

80 (3)	50 (2)	650 (26)	550 (22)
100 (4)	80 (3)	700 (28)	600 (24)
150 (6)	100 (4)	750 (30)	600 (24)
200 (8)	150 (6)	800 (32)	650 (26)
250 (10)	200 (8)	850 (34)	700 (28)
300 (12)	250 (10)	900 (36)	750 (30)
350 (14)	250 (10)	950 (38)	800 (32)
400 (16)	300 (12)	1000 (40)	850 (34)
450 (18)	350 (14)	1050 (42)	900 (36)
500 (20)	400 (16)	1200 (48)	1050 (42)
550 (22)	450 (18)		

4.6 Seat Design

The valves shall either be a soft seated valve or metal seated valve or with primary metal-to metal contact and secondary soft seats or seat design shall be as indicated in valve data sheet.

For soft seated valves, Metal seat rings may be provided with soft insert. The same shall be positively locked in position in Metal seat rings.

For valves with primary metal to metal contact and secondary soft seats, O-rings or other seals if used for drip tight sealing shall be encased in a suitable groove in such a manner that it cannot be removed from seat ring and there is no extrusion during opening or closing operation of valve at maximum differential pressure corresponding to valve class rating. The seat rings shall be so designed as to ensure sealing at low as well as high differential pressures.

4.7 Valves shall be designed to withstand a sustained internal vacuum of at least 1 (one) mille-bar in both open and closed positions.

4.8 Double Block & Bleed Design

Valves shall have double block and bleed feature to facilitate complete flush, drain and venting of the valve body cavity. Cavity relief pressure shall be as per API 6D.

4.9 Sealant Injection

Full bore valves of nominal valve size DN 200 mm (8") & above and Reduced Bore valves of nominal valve size DN 250 mm (10") & above, shall have provision for secondary sealant injection under full line pressure for seat and stem seals. All sealant injection connections shall be provided with block valve and an internal non-return valve. Valve design shall have a provision to replace the sealant injection fitting under full line pressure. Location and arrangement of sealant points shall be as per Fig 4.9.

4.10 Vent & Drain

Valves shall be provided with vent and drain connections. Location and arrangement of

vents and drains shall be as per Fig. 4.9. Body vent and drain shall be provided with valves (Ball or Plug type). Number and size shall be as per Fig. 4.9.

Valve design shall ensure repair of stem seals/ packing under full line pressure.

4.11 Support Foot

Full bore valves of nominal valve size DN 200 mm (8") & above and Reduced bore valves of nominal valve size DN 250 mm (10") & above, shall be equipped with support foot and lifting lugs unless specified otherwise. Tapped holes and eyebolts shall not be used for lifting lugs. Height of support foot shall be kept minimum. The location and size of support foot/ lifting lugs shall ensure unrestrictive operation of vent/ drain valves. The design of support foot shall be such that it shall take minimum double the weight of the valve assembly.

4.12 Valve design shall be such as to avoid bimetallic corrosion between carbon steel and high alloy steel components. Suitable insulation shall be provided as required.

4.13 The valve body cavity over-pressure shall be prevented by self-relieving seat rings/ assemblies. Valve Cavity relief pressure when added to the valve pressure rating shall not exceed 133% of the pressure rating of the valve at its maximum specified design temperature.

4.14 Valve Ends

Valve ends shall be either flanged/ or butt welded or one end flanged and one end butt welded as indicated in the Valve Data Sheet. Flanges of the flanged end cast/ forged body valves shall be integrally cast/ forged with the body of the valve. Face to face/ end to end dimensions shall conform to API 6D. Face-to-face and end-to-end dimensions for valve sizes not specified in API 6D shall be in accordance with ASME B 16.10. Face-to-face and end-to-end dimensions not shown in API 6D or in ASME B 16.10 shall be as per Manufacturer Standard and shall be subject to approval by Company.

Flanged ends, if specified, shall have flanges as per ASME B16.5 for valve sizes up to DN 600 mm (24") excluding DN 550 mm (22"), as per MSS-SP-44/ ASME B 16.47 Series A for valve sizes DN 550 mm (22") and for DN 650 mm (26 inches) and above. Flange face shall be either raised face or ring joint type (RTJ) as indicated in Valve Data Sheet. Flange face finish shall be serrated or smooth as indicated in Valve Data Sheet. In case of RTJ flanges, the groove hardness shall be minimum 140 BHN.

Butt weld end preparation shall be as per ASME B 16.25. The thickness of the pipe to which the valve has to be welded shall be as indicated in the Valve Data Sheet. In case difference exists between thickness of welding ends of valve and connecting pipe, the welding ends of valve shall have bevel preparation as per ASME B31.4 or ASME B31.8 as applicable.

In case of all Butt welded end valves (including soft seated valves or valves with primary metal to metal and secondary soft seats), actual yield strength of valve body shall not be less than $\frac{2}{3}$ rd of the specified minimum yield strength (SMYS) of the connecting pipe material.

For soft seated valves with Butt welded end, valves shall be provided with pup pieces on

either side of length 200 mm each for size up-to 8" & 250 mm for size 10" and above, with material as specified in valve data sheet. Length of pup piece shall be confirmed by manufacturer so as to avoid damage to seats during field welding or post weld heat treatment. Pup piece thickness shall be calculated for the class rating. Vendor shall provide for each type (considering size, grade and thickness of the pup pieces used for all offered valves) of pup piece, test rings (500 mm long) from pup piece material for field weld procedure qualification. Valves shall be tested along-with pup piece.

4.15 Design of weld end valves shall be such that during field welding operations, the soft seals or plastic components of the valve (where ever used) is not liable to be damaged. The manufacturer shall furnish necessary field welding instructions and post-weld test procedure to demonstrate integrity and leak-tightness of valves after field welding operations.

4.16 POSITION INDICATORS

Valve shall be provided with ball position indicator and stops of rugged construction at the fully open and fully closed positions. For actuated valves, additionally mechanical means of position indicator shall be provided.

4.17 STEM EXTENSIONS

When stem extension requirement is indicated in Valve Data Sheet, the valves shall have the following provisions.

- a. Valves provided with stem extension shall have water proof outer casing. Length of stem extension shall be as indicated in Valve Data Sheet. The length indicated corresponds to the distance between centerline of the valve opening and the top of mounting flange for valve operating device (gear operator/ power actuator as applicable).
- b. In case of below Ground LTCS valves, Stem extension material shall be equivalent to stem material.
- c. Vent and drain connections and sealant injection lines shall be terminated adjacent to the valve operator by means of suitable piping anchored to the valve body. The pipe used shall be API 5L Gr. B/ ASTM A 106 Gr. B, with Sch 160 for carbon steel valves and ASTM A 333 Gr 6, with Sch 160 for Low temperature carbon steel valves or the material shall be as specified in valve data sheet. The material of fittings for Carbon Steel valve shall be ASTM A105/ ASTM A234 Gr. WPB and material for the fittings for low temperature carbon steel valves shall be ASTM A 350 Gr LF2 Cl 1 or the material shall be as specified in valve data sheet. The fittings and valve end shall be Socket welded ANSI class 6000# as per ASME B 16.11 (For piping class up to 600#) and BW end (For Piping Class 900#).
- d. Stem extension and stem housing design shall be such that the complete assembly will form a rigid unit giving positive drive under all conditions with no-possibility of free movement between valve body, stem extension or its operator.
- e. Outer casing of stem extension shall have 3/8" or 1/2" NPT plugs at the top and bottom, for draining and filling with oil to prevent internal corrosion.
- f. The Stem Extension shall be self-relieving.

4.18 OPERATING DEVICES

- a. Valves shall have a power actuator or manual operator as indicated in the Valve Data Sheet. In case of manual operator, valve sizes, $DN \leq 100$ mm (4") shall be wrench operated and valve sizes, $DN \geq 150$ mm (6") shall be gear operated. The length of wrench shall not be longer than twice the face to face or end to end dimension of the valve. Each wrench operated valve shall be supplied with wrench. Valve design shall be such that damage due to malfunctioning of the operator or its controls will only occur in the operator gear train or power cylinder and that damaged parts can be replaced without the valve cover being removed.
- b. The power actuator shall be in accordance with the Company Specification issued for the purpose and as indicated in the Valve and Actuator Data Sheet. Operating time shall be as indicated in Valve Data Sheet. Valve operating time shall correspond to full close to full open/ full open to full close under maximum differential pressure corresponding to the valve rating. For actuated valves, the actuator's rated torque output shall be 1.25 times the break torque required to operate the ball valve under the maximum differential pressure corresponding to the Valve Class Rating.
- c. For the manual operator of all valves, the diameter of the hand wheel or the length of operating wrench shall be such that under the maximum differential pressure, the total force required to operate the valve does not exceed 350N. However, failing to meet above requirement, vendor shall offer gear operated valves. Manufacturer shall also indicate the number of turns of hand wheel in case of gear operators (along with their offer) required for Operating the valve from full open to full close position. The numbers of turn shall not exceed 250 for valves sizes up to 24" and 450 for valve size above 24".
- d. Direction of operation of hand wheel or wrench shall be in clock-wise direction while closing the valve. Hand wheels shall not have protruding spokes.
- e. Gear operators, when provided, shall have a self-locking provision and shall be fully encased in water proof/ splash proof enclosure and shall be filled with suitable grease.

4.19 The tolerance on internal diameter and out of roundness at the ends for welded ends valves shall be as per connected pipe specification as indicated in the Valve Data Sheet.

4.20 LOCKING DEVICES

When indicated in Material Requisition/Data sheet/ Tender, valves shall have locking devices to lock the valve either in full open (LO) or full close (LC) positions. Locking devices shall be permanently attached to the valve operator and shall not interfere with operation of the valve.

4.21 WELDING

All welds shall be made by welders and welding procedures qualified in accordance with the provisions of ASME Section IX. The procedure qualification shall also include impact test and hardness test when required as per Clause 3.4 to 3.5 of this specification and shall meet the requirements as specified therein.

4.22 REPAIR WELDING

Repair by welding is not permitted for fabricated and forged body valves. However, repair

by welding as per ASME B16.34 is permitted for cast body valves. Such repairs shall be carried out at casting supplier's care only. Repair shall be carried out before any heat treatment of casting is done. Repair welding procedure qualification shall also include impact test and hardness test when required as per Clause 3.4 to 3.5 of this specification and shall meet the requirements as specified therein. Heat treatment and radiography shall be repeated after the weld repair.

- 4.23** No Casting is permitted for stem and stem extended material of all valve. Valve stem shall be capable of withstanding the maximum operating torque required to operate the valve against the maximum differential pressure corresponding to applicable class rating. The combined stress shall not exceed the maximum allowable stresses specified in ASME section VIII, Division 1. For power actuated valves, the valve stem shall be designed for maximum output torque of the selected power actuator (including gear box, if any) at valve stem.
- 4.24** Wherever specified for the part of valve in valve data sheet, minimum thickness of stelliting shall be 1.6mm
- 4.25** All Soft seated valves shall be fire safe design and qualified as per API 6FA/ API 607/ ISO 10497.
- 4.26** Soft-seated valves shall have antistatic device.

5 INSPECTION & TESTS

- 5.1** The Manufacturer shall perform all inspection and tests as per the requirements of this specification and the relevant codes, prior to shipment, at his works. Such inspection and tests shall be, but not limited to, the following:
- 5.2** All valves shall be visually inspected. The internal and external surfaces of the valves shall be free from any strikes, gouges and other detrimental defects. The surfaces shall be thoroughly cleaned and free from dirt, rust and scales.
- 5.3** Dimensional check on all valves shall be carried out as per the Company approved drawings.
- 5.4** Chemical composition and mechanical properties shall be checked as per this specification and relevant material standards, for each heat of steel used.
- 5.5** Non-destructive examination of individual valve material and component consisting of but not limited to castings, forgings, plates and assembly welds shall be carried out by the Manufacturer.
 - a. Body castings of all valves shall be radio graphically examined as per ASME B16.34. Procedure and acceptance criteria shall be as per ASME B 16.34. The extent of the radiography shall be as under:

Pressure Class Rating	Valve Size	Extent of Radiography
ANSI 150 # Class	≤ DN 600 mm (24")	Nil
	≥ DN 650 mm (26")	100%

ANSI 300 # Class	≤ DN 400 mm (16")	Nil
	≥ DN 450 mm (18")	100%
ANSI 600 # Class and above	All sizes	100%

Radiography shall be performed after the final heat treatment also.

All castings shall be wet magnetic particle inspected 100% of the internal surfaces. Method and acceptance shall, comply with ASME B 16.34.

- b. All valves, with body fabricated from plates or made by, forgings, shall be ultrasonically examined in accordance with the procedure and acceptance standard as per ASME B16.34.

All forgings shall be Wet magnetic particle inspected 100% of the internal surfaces. Method and acceptance shall comply with ASME B16.34.

- c. Bodies and bonnets made by welded assembly of segments of castings, forgings, plates or combinations thereof shall be examined, as applicable, by methods of 5.5 (a) for cast components or 5.5 (b) for forged components and plates.

5.6 Full inspection by radiography shall be carried out on all welds of pressure containing parts. Acceptance criteria shall be as per ASME B 31.4 or ASME B31.8 as applicable and API 1104.

5.7 Welds, which in Company's opinion cannot be inspected, by radiographic methods, shall be checked by ultrasonic or magnetic particle methods and acceptance criteria shall be as per ASME Sec. VIII , Division 1, Appendix 12 and, Appendix 6 respectively.

5.8 All finished wrought weld ends subject to welding in field shall be 100% ultrasonically tested for lamination type defects for a distance of 50 mm from the end. Laminations shall not be acceptable.

- a. Weld ends of all cast valves subject to welding in field shall be 100% radio graphically examined and acceptance criteria shall be as per ASME B16.34.

- b. After final machining, all bevel surfaces shall be inspected by dye penetrant or wet magnetic particle methods. All defects longer than 6.35 mm are rejected, as are the defects between 6.35 mm and 1.59 mm that are separated by a distance less than 50 times their greatest length. Rejectable defects must be removed. Weld repair of bevel surface is not permitted.

5.9 All valves shall be tested in compliance with the requirements of API 6D. During pressure testing, valves shall not have sealant lines and other cavities filled with sealant, grease or other foreign material: The drain, vent and sealant lines shall be either included in the hydrostatic shell test or tested independently. Test pressure shall be held for at least 30 minutes for both Shell & seat Test. No leakage is permissible during hydrostatic testing. The body cavity self-relieving feature meeting the requirements of clause 4.13 of this specification shall also be checked.

5.10 A supplementary air seat test as per API 6D (Annex I, Para I.9 Type II) shall be carried

out for all valves. A bubble tight seal is required without the use of any sealant. No leakage is allowed. Test pressure shall be held for at least 15 minutes.

5.11 Valves shall be subjected to Operational Torque Test as per API 6D (Annex I, Para I.6) under hydraulic pressure equal to maximum differential pressure corresponding to the applicable ANSI class rating of valve. It shall be established that the force required to operate the valve does not exceed the requirements stated in section 4.18 (C) of this specification.

5.12 Power actuated valves shall be tested after assembly of the valve and actuator, at the valve Manufacturer's works. At least five Open-Close-Open cycles without internal pressure and five Open-Close-Open cycles with maximum differential pressure corresponding to the valve rating shall be performed on the valve actuator assembly. The time for Full Open to Full Close shall be recorded during testing. If required, the actuator shall be adjusted to ensure that the opening and closing time is within the limits stated in Valve Data Sheet.

Hand operator provided on the actuator shall also be checked after above testing, for satisfactory manual over-ride performance.

These tests shall be conducted on minimum one valve out of a lot of five (5) valves of the same size, rating and the actuator model/ type. In case, the tests do not meet the requirements, retesting/ rejection of the lot shall be decided by the Company's Inspector.

5.13 Subsequent to successful testing as specified in clause 5.11 and 5.12 above, one (1) valve out of the total ordered quantity shall be randomly selected by the Company Representative for cyclic testing as mentioned below:

- a. The valve shall be subjected to at least 100 Open-Close-Open cycles with maximum differential pressure corresponding to the valve rating.
- b. Subsequent to the above, the valve shall be subjected to hydrostatic test and supplementary air seat test in accordance with clause 5.9 and 5.10.

In case this valve fails to pass these tests, the valve shall be rejected and two more valves shall be selected randomly and subjected to testing as indicated above. If both valves pass these tests, all valves manufactured for the order (except the valve that failed) shall be deemed acceptable. If either of the two valves fails to pass these tests, all valves shall be rejected or each valve shall be tested at the option of manufacturer.

Previously carried out test of similar nature shall be considered acceptable if the same has been carried out by Manufacturer in last two years. Valves of two sizes below and two sizes above the size of valve previously tested, and rating similar or one rating lower of valve tested previously, shall be qualified.

5.14 Checks shall be carried out to demonstrate that the dissimilar metals used in the valves are successfully insulated as per the requirement of clause 4.12 of this specification.

5.15 Anti-Static testing for soft seated valves in accordance with L.5 of API 6D.

5.16 Company reserves the right to perform stage wise inspection and witness tests as indicated in clause 5.1 above at Manufacturer's works prior to shipment. Manufacturer shall give reasonable access and facilities required for inspection to the Company's

Inspector. Company reserves the right to require additional testing at any time to confirm or further investigate a suspected fault. The cost incurred shall be to Manufacturer's account.

In no case shall any action of Company or his inspector shall relieve the Manufacturer of his responsibility for material, design, quality or operation of valves.

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

6 TEST CERTIFICATES

Manufacturer shall submit the following certificates in accordance with EN 10204 3.2.

- a. Mill test certificates relevant to the chemical analysis and mechanical properties of the materials used for the valve construction as per the relevant standards.
- b. Report on heat treatment carried out.
- c. Test certificates of hydrostatic and pneumatic tests complete with records of timing and pressure of each test.
- d. Test reports of radiograph and ultrasonic inspection, MPI and DP Inspection
- e. Test report on operation of valves conforming to clause 5.11, 5.12 and 5.13 of this specification.
- f. All other test reports and certificates as required by API 6D and this specification.

The certificates shall be considered valid only when signed by Company's Inspector. Only those valves which have been certified by Company's Inspector shall be dispatched from Manufacturer's works.

7 PAINTING

Valve surface shall be thoroughly cleaned, freed from rust and grease and applied with sufficient coats of corrosion resistant paint. Surface preparation shall be carried out by shot blasting to SA-2 ½ / SSPC-SP10. For Coastal area, painting shall be suitable for industrial marine environment. For the valves to be installed underground, when indicated in Valve Data Sheet, the external surfaces of buried portion of the valve shall be painted with 100% Solid high build epoxy with a minimum dry film thickness of 1000 microns or 1.5 mm thick polyurethane coating.

8 MARKING & SHIPMENT

- 8.1** All valves shall be marked as per API 6D. The units of marking shall be metric except nominal diameter, which shall be in inches.
- 8.2** Valve ends shall be suitably protected to avoid any damage during transit. All threaded and machined surfaces subject to corrosion shall be well protected by a coat of grease or other suitable material. All valves shall be provided with suitable protectors for flange faces, securely attached to the valves. Bevel ends shall be protected with metallic or high impact plastic bevel protectors.
- 8.3** All sealant lines and other cavities of the valve shall be filled with sealant before shipment.

- 8.4** Packaging and shipping instructions shall be as per API 6D.
- 8.5** The serial number of each valve indicated on its name plate shall appear on all required documentation in accordance with EN 10204 3.2.
- 8.6** Name Plate material shall be minimum stainless steel. Marking shall be as per MSS-SP-25
- 8.7** All valves shall be transported with ball in fully opened condition
- 8.8** On packages, following shall be marked legibly with suitable marking ink:
- Order Number
 - Manufacturer's Name
 - Valve size and rating
 - Tag Number
 - Serial Number

9 SPARES & ACCESSORIES

- 9.1** Manufacturer shall furnish list of recommended spares and accessories for valves required during start-up and commissioning and supply of such spares shall be included in the price quoted by Manufacturer.
- 9.2** Manufacturer shall furnish list of recommended spares and accessories required for two years of normal operation and maintenance of valves and price for such spares shall be quoted separately.

10 DOCUMENTATION

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

- 10.1** At the time of bidding, Manufacturer shall submit the following documents:
- Reference list of similar ball valves manufactured and supplied in last seven years indicating all relevant details including project, year, client, location, size, rating, service etc.
 - Torque curves for the power actuated valves along with the break torque, running torque for the valve stem and maximum allowable stem torque.
 - Copy of valid API 6D Certificate.
 - Fire Safe test certificate qualifying the valves as per API 6FA/ API 607/ ISO 10497 carried out in last 10 years shall be furnished.
 - Details of support foot including dimensions and distance from valve centreline to bottom of support foot.
 - List of recommended spares required during start-up and commissioning & 2 years of normal operation and maintenance.

10.2 After placement of order, the Manufacturer shall submit the following drawings, documents and specifications for Company's approval:

- a. General arrangement & detailed sectional drawings showing all parts with reference numbers and material specifications, overall dimensions and features. Number of turns of hand wheel required for operating the valve from full open to full close position for Gear Operated valves, painting/ coating scheme, Complete dimensional details of support foot (where applicable), shall be indicated in the GA.

Manufacture of valves shall commence only after approval of the above documents. Once the approval has been given by Company, any changes in design, material and method of manufacture shall be notified to Company whose approval in writing of all changes shall be obtained before the valve is manufactured.

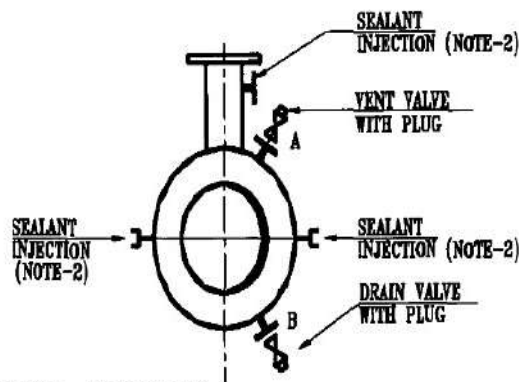
10.3 Within 30 days from the approval date, Manufacturer shall submit to Company the approved drawings, documents and specifications as listed in clause 10.2 above.

10.4 Prior to shipment, Manufacturer shall submit to Company following:

- a. Test certificates as per clause 6.0 of this specification.
- b. Manual for installation, erection, maintenance and operation instructions including a list of recommended spares for the valves.

10.5 All documents shall be in English language only.

ABOVE GROUND INSTALLATION



FULL BORE VALVES

VALVE SIZE, DN(mm)	A, DN(mm)	B, DN(mm)
50 TO 150	-	15
200 TO 800	15	25
650 & ABOVE	15	40

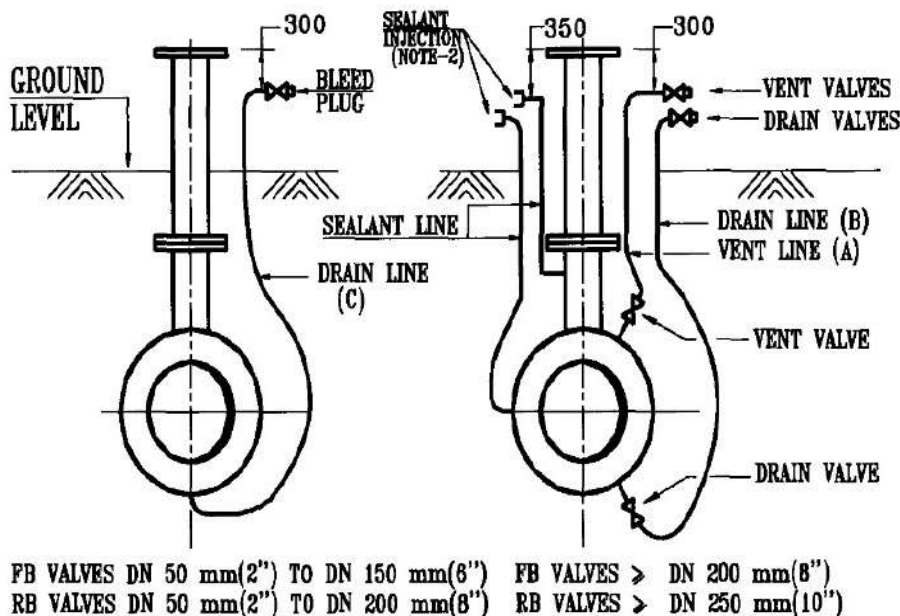
REDUCED BORE VALVES

VALVE SIZE, DN(mm)	A, DN(mm)	B, DN(mm)
50 TO 200	-	15
250 TO 750	15	25
ABOVE 750	15	40

NOTES:-

- 1 ALL VALVES (BALL OR PLUG) AND PLUGS FOR A AND B SHALL BE APPROVED BY THE PURCHASER.
- 2 SEALANT POINTS SHALL BE PROVIDED FOR FULL BORE VALVES OF NOMINAL VALVE SIZE 200 mm (8") & ABOVE AND REDUCED BORE VALVES OF NOMINAL VALVE SIZE, DN 250 mm (10") AND ABOVE ONLY. SEALANT LINES SHALL HAVE PROVISION TO REPLACE THE SEALANT INJECTION FITTING UNDER FULL LINE PRESSURE. SEALANT LINES SHALL HAVE BLOCK VALVE & INTERNAL NON RETURN VALVE.
- 3 ALL VENT/DRAIN CONNECTION SHALL BE WELDED WITH THE BODY.

UNDERGROUND INSTALLATION



FULL BORE (FB) VALVES

VALVE SIZE, DN(mm)	A, DN(mm)	B, DN(mm)	C, DN(mm)
50 TO 150	-	-	15
200 TO 300	25	25	-
350 TO 600	25	25	-
650 & ABOVE	40	40	-

REDUCED BORE (RB) VALVES

VALVE SIZE, DN(mm)	A, DN(mm)	B, DN(mm)	C, DN(mm)
50 TO 200	-	-	15
250 TO 400	25	25	-
450 TO 750	25	25	-
800 & ABOVE	40	40	-

NOTES:-

- 1 ALL VALVES (BALL OR PLUG) AND PLUGS FOR A AND B SHALL BE APPROVED BY THE PURCHASER.
- 2 SEALANT POINTS SHALL BE PROVIDED FOR FULL BORE VALVES OF NOMINAL VALVE SIZE 200 mm (8") & ABOVE AND REDUCED BORE VALVES OF NOMINAL VALVE SIZE, DN 250 mm (10") AND ABOVE ONLY. SEALANT LINES SHALL HAVE PROVISION TO REPLACE THE SEALANT INJECTION FITTING UNDER FULL LINE PRESSURE. SEALANT LINES SHALL HAVE BLOCK VALVE & INTERNAL NON RETURN VALVE.
- 3 ALL VENT/DRAIN CONNECTION IN BURIED SECTION SHALL BE OF WELDED CONSTRUCTION. ALL PIPING INCLUDING VALVE ENDS IN BURIED PORTIONS OF VENT & DRAIN SHALL BE WELDED TYPE.

FIGURE-4.9



VCS QUALITY SERVICES PVT. LTD.

STANDARD SPECIFICATION FOR WATER CROSSING (CONVENTIONAL TRENCHING)

VCS – SS – PP - 2005

					
04	29.04.2022	RP	MC	HK	GW
03	04.01.2022	SR	MC	HK	HK
Rev. No	Date	Prepared By	Checked By	Approved By	Authorized By

UNCONTROLLED COPY	:	If printed
CONTROLLED COPY	:	If in soft and signed

REVISION RECORD						
Rev.	Revision Date	Prepared by	Checked by	Approved by	Authorized by	Revision Description
00	23.06.2017					Issued as Standard Specification
		AS	SM	AD	SK	
01	19.09.2019					Document formatting, Cover Page, Doc numbering updated from SS-PL-001 to VPC-SS-PL-0001 keeping Revision Number Same)
		SSS	SM	AD	SK	
02	28.01.2020					Document numbering updated from VPC-SS-PL-0001 to VPC-SS-PP-2004
		MB	MC	AD	SK	
03	04.01.2022					Revised as marked, Doc No Change from 2004 to 2005
		SR	MC	HK	HK	
04	29.04.2022					
		RP	MC	HK	GW	VCS QMS Integration

ABBREVIATIONS:

ASME	American Society of Mechanical Engineers
ASTM	American Society of Testing of Materials
API	American Petroleum Institute
OISD	Oil Industry Safety Directorate

CONTENTS

1.0	SCOPE	5
2.0	REFERENCE CODES, STANDARDS AND SPECIFICATIONS	5
3.0	GENERAL REQUIREMENT	6
4.0	TRENCHING	9
5.0	POLLUTION CONTROL MEASURES	12
6.0	CONTINUOUS CONCRETE COATING	12
7.0	HYDROSTATIC PRE-TESTING	12
8.0	INSTALLATION	13
9.0	INSTALLATION OF PARALLEL PIPELINES	14
10.0	BACKFILLING AND BANK PROTECTION	14
11.0	POST-INSTALLATION HYDROSTATIC TEST	16
12.0	POST-CONSTRUCTION SURVEY	16
13.0	FINAL CLEAN-UP	16
14.0	DOCUMENTATION	17

1.0 SCOPE

This specification covers the minimum requirements for the various activities to be performed by Contractor for the construction of pipeline major water crossings by conventional trenching method. Provisions of this specification are applicable only for " Water Crossing" specifically named as such in the contract.

This specification shall be read in conjunction with the condition of all specifications and documents include in the contract between company and contractor.

2.0 REFERENCE CODES, STANDARDS AND SPECIFICATIONS

The latest edition(edition in force at the time of floating the enquiry) of following Codes, Standards and regulations are referenced in this specification and all provisions of these reference codes, standards and regulations shall be applicable.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

- B 31.4 : Pipeline Transportation system for liquid
Hydrocarbon & other liquids.
- B 31.8 : Gas Transmission and Distribution Piping
Systems.

AMERICAN PETROLEUM INSTITUTE (API)

- RP 1102 : Liquid Petroleum Pipeline Crossing Railroads and
Highways
- 1109 : Marking Liquid Petroleum Pipeline Facilities
- 1104 : Welding of Pipelines and Related Facilities

PNGRB REGULATIONS:

- G.S.R 808(E) T4S : Regulations for Natural Gas Pipelines
- G.S.R. Infra/ T4S/ P&PPPL : Regulations for Petroleum and Petroleum products
pipelines
- G.S.R. 612(E) T4S : Regulations for CGD Network

PIPE LINE SAFETY STANDARD

- Part 192, Title 49 : Transportation of Natural and other Gases by

Part 195 : Transportation of Liquid by Pipe Line

COMPANY STANDARD SPECIFICATIONS

Following Company specifications shall form integral part of this specification and shall be complied with when applicable to the works covered in the contract.

VPC-SS-PP-2001	Standard Specification for Pipeline Construction
VPC-SS-PP-2010	Standard Specification for Pipeline Concrete Weight Coating of Onshore Pipelines
VPC-SS-PP-2014	Standard Specification for Hydrostatic Testing of Onshore Pipelines
VPC-SS-PP-2015	Standard Specification for Pipeline Markers

In case of conflict between various requirements of this specification and reference standards mentioned above, more stringent requirement shall apply unless otherwise agreed by Company.

3.0 GENERAL REQUIREMENT

- If specified, Contractor shall carry out all geotechnical and hydrological investigation as per relevant specification. Contractor shall also carry out scour calculation based on the above and submit all reports and calculation to company for review and approval.
- 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, at his own responsibility, obtain necessary permits from the Authorities having jurisdiction, for performing its work.
- Contractor shall take full responsibility for the suitability, stability and safety of all operations and methods involved in the work.
- 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.

- e. Prior to start of any work, Contractor shall carry out a pre-construction survey of the major water crossings and. acquaint himself with site conditions and to collect any data regarding the water velocity and the tidal variation in the flow pattern and shall verify the suitability of his equipment and the method of construction.
- f. Contractor shall, with due care and diligence, execute the work in compliance with all laws, by-laws, ordinances, regulation etc., and provide all services and labor, inclusive of supervision thereof, all materials, excluding the materials indicated as "Company Supplied Materials", equipment appliances or other things of whatsoever nature required in or about the execution of the work, whether of a temporary or permanent nature.
- g. Contractor shall be deemed to have obtained all necessary information as above mentioned as to risks, contingencies and all other circumstances, which may influence the work.
- h. Contractor shall, in connection with the work, provide and maintain at his own-costs all lights, guards, fencing, watching etc., when and where necessary or required by Company or by any duly constituted Authority for the protection of the work and properties or for the safety and the convenience of public and/or others.
- i. If no public roads exist, Contractor shall arrange at his own for access to work areas at no extra time and cost to Company.
- j. Before start of the field construction work, Contractor shall submit the following for approval of each major water crossing
 - Installation method.
 - Proposed time schedule indicating start and finish dates with detailed break-up showing critical activities.
 - Layout, location and other drawings / sketch of work area.
 - Details of equipment (including number and capacity of equipment deployed)
 - Manpower deployment during construction
 - Proposed sub-contractors and / or vendors (if any) along with their scope of work.

The description of the installation method as a minimum shall include the following:

- a. Preparation of fabrication yard and launching area along with proposed Layouts.
- b. Pipeline construction details (including hauling, stringing, welding, NDT, concrete coating, etc.).
- c. Study of water currents in relation to the method of launching (on bottom and on surface)
- d. Preparation of sheet piling/Details of Dams/Coffer dams/diversion of water methodology proposed.
- e. Calculations For stability of pipeline during launching and final test.
- f. Grading of bank area & record of it original level for restoration purpose.
- g. Buoyancy Studies.
- h. Pre-test procedure.
- i. Pulling or other installation method and related calculations / analysis including rope test, checking of winch/crane pulling capacity etc.
- j. Pulling arrangement including launch way and anchoring and braking device.
- k. Trench correction before launching / lowering.
- 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 and bank protection.
- o. Final test procedure after backfilling. .
- p. Safety system adopted
- q. Communication system adopted during construction/testing/survey.
- r. Abandonment and recovery procedures in case of failure.
- s. Procedure for corrosion coating of field joint

Approval by Company of the methods used by Contractor shall in no way relieve Contractor from the sole responsibility for safe and satisfactory installation of the crossing.

4.0 TRENCHING

4.1 EXCAVATION

Contractor shall dredge or excavate the trench for the water crossing in conformity with the approved drawings. Dredging of the trench shall be executed as accurately as possible.

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 leveled. The trench shall be subject to inspection by Company prior to installation of the pipe.

Contractor will not be entitled for any compensation in terms of time and cost, if his work is hampered or delayed due to weather conditions, any obstacles / or any traffic on the spot, where work is executed.

Contractor is fully responsible for the execution of the blasting (wherever 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 Company.

Contractor may be obliged to dredge or excavate a trench deeper or wider than indicated in the drawings. in order to properly lay the pipeline in unstable (underwater) areas, or near and adjacent to the banks of water-courses. It shall be understood that Contractor is aware of such problems at the time of his Bid and that when such additional excavation is required, it shall be done by Contractor as part of the work and that he will install the necessary provisions and/or temporary works such as sheet-piling, special filling materials, etc. at no extra cost to Company.

Contractor, if so desired by Company, shall make cross profiles at intervals of not more than 10.0 m of the bottom of the watercourse along the surveyed centerline of the water crossing. In such a case, horizontal measurements shall be taken by triangulation or tapping between known points and shall be made with such accuracy that the location of each vertical measurements is known with 1.0 m. Vertical measurements shall be taken with a sonic recording device, or with line and rod, as directed by Company and shall be taken with such an accuracy that

each depth is known within 0.2 m. Vertical measurements shall be taken at points averaging not more than 5.0 m apart and no two measurements shall be more than 7.0 m apart. The cross profiles shall extend at least 10 m on both sides of the top of the trench.

All measurements shall be recorded by Contractor. Company may witness such measurements. The resulting profile, corrected to the elevation of the undisturbed watercourse, shall then be the reference profile. Said profile shall be plotted on a 1:200 vertical and horizontal scale.

Contractor shall keep the trench in good condition until the pipe is laid, and no claim is to be made to the Company by reason of its caving either before or after the pipe is laid. Contractor shall do whatever is required to excavate the trench, install the pipe in it and backfill the trench in accordance with the specifications at no extra cost to Company.

Immediately before installation of the water crossing in the excavated trench, Contractor shall prepare a profile of the trench bottom along the surveyed center 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 50 m. All profiles and cross section measurements shall be taken as specified and, if required, shall be witnessed by Company. These data shall be submitted to Company for approval.

Contractor shall grade the trench in such a manner as to give the maximum amount of uniform support to the pipeline when it is lowered or pulled into place. The maximum unsupported span shall not exceed 10.0 m.

In submerged sections, where rock or gravel is encountered in the bottom of the trench, padding is required. The thickness of the padding under the concrete coated pipe shall at least be 0.5 m and after installation at least 0.5 m around the pipe.

Blasting, if any, and padding shall be included in the Contractor's work.

In case of major rivers, Navigational traffic shall not be obstructed, unless permission has been given thereto. Contractor shall issue all necessary, publication according to the local requisitions. Instructions given by Authorities shall be followed accurately and immediately, so that traffic encounters no

shall render assistance for this purpose and make available for Company appropriate survey boats, fully manned and equipped, before the trench excavation work of the water crossing can be started-

4.2 PUMPING LINES

In case Contractor uses pumping lines to discharge the spoil, he shall take care of the necessary permits.

Pumping lines, discharges and siphons shall be installed by Contractor and removed before the completion of the work. At crossing 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 Company. The necessary provision to embank the dumping area and also the spoil basins shall be made by Contractor. Contractor is 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 over embankments, parcels or roads. Further more, Contractor shall safeguard Company from claims of compensation by third parties due to encountered damage.

4.3 SPOIL

Spoil which is not dumped on and including spoil acquired after cleaning the water crossing trench, shall be transported and dumped in places, designated thereto by agreement between Contractor and Authorities and approved by Company. Spoil shall be transported in (split), barges; only those barges shall be used that avoid spilling during transportation due to incorrect closing of the flaps, etc. Spoil, which is dumped outside the designated places, shall be removed by Contractor at first notice by Company.

4.4 DIKES, DAMS AND WEIRS

Contractor shall install temporary provision in the existing dikes, dams, etc. to prevent flooding of low areas.

Therefore, in general, 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

5.0 POLLUTION CONTROL MEASURES

Contractor shall take all necessary precautions not to pollute river water and banks during entire construction operation. Equipment deployed and, construction methodology adopted shall be such, that minimum damage is caused to the existing environmental conditions. Union and State Government requirements concerning pollution control and environmental protection shall be fully complied with.

6.0 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 the continuously concrete coated pipeline. However, the concrete coating shall be applied after the hydrostatic pretest.

7.0 HYDROSTATIC PRE-TESTING

Contractor shall hydrostatically pre-test the pipe string of each water crossing before installation as per approved procedure.

Joint coating of the welds shall be done after this pre-test.

The section of the pipeline corresponding to the crossing shall, before installation, be subjected to a minimum hydrostatic test pressure equal to 1.25 / 1.5 times design pressure as applicable. The combined equivalent stress in the pipeline due to bending and test pressure shall not exceed 95% of the SMYS of the pipe material.

After the temperature has been stabilized, the pressure shall be maintained in the pipeline for at least six hours and recorded by manothermograph. During test, the Contractor shall check all welds for leakage. Failure, if any, during the test shall be rectified by the Contractor. If the same is due to failure on account of any cause other than defect in materials supplied by Company, the repairs shall be done free of cost, to the satisfaction of Company.

8.0 INSTALLATION

Contractor shall submit a detailed scheme for the method, proposes to adopt for installing the pipeline to Company 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 Company for approval.

Contractor shall perform all work required to install the water crossings, including the possible appurtenances indicated in the drawings. The water crossings shall be installed in such a manner as to comply with the requirements and conditions stated by the Relevant Authorities issuing the permits. Contractor shall pay special attention to minimize any damage to embankments and dikes in the vicinity of water crossings.

The equipment for launching shall be arranged in such a way that the pipeline is 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.

During the launching the pipe shall have a submerged weight of 30 kg/meter with a tolerance of $\pm 10\%$.

After the water-crossing section has been installed in place, Contractor shall fill this pipeline section including the pertaining land pipeline sections with water for the final testing.

Contractor shall check if the position and depth of the water crossing are in accordance with the approved 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 by dredging or jetting the underlying ground.

The maximum allowed horizontal deviation from the required centre-line shall be limited by the following:

For pipeline dia up to including 500 mm : 300 mm

For pipeline dia greater than 500 mm : 500 mm

Prior to backfill the pipeline shall, when laid in the trench, conform to the bottom contour of the trench grade, so that it will be firmly, uniformly and continuously supported within the permissible limits of unsupported spans as specified in Para 4.1.

If the pipe does not properly fit 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 to trench so that the pipe, when finally in position in the trench, shall fully meet the specification, failing which Contractor may be asked to remove the pipeline. This shall be done at no extra time and cost to the Company.

9.0 INSTALLATION OF PARALLEL PIPELINES

When parallel pipelines are required to be installed across major water crossing, Contractor shall further comply with the following requirements.

Depending on the diameter of the parallel pipelines, the characteristics of the crossing and the limitation of Contractor's equipment, Contractor may propose installation of the parallel pipelines either together in a combined operation or separately in a common trench.

If the pipelines are installed together, the minimum clear distance between the parallel pipelines (measured from the outside diameters of the concrete coated pipes) shall be 500 mm. Contractor shall provide spacers (at sufficient intervals along the length of the pipe sections), 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 buoyancy of the combined installation (pipes spacers), shall be checked before installation. The spacers may be removed before the trench is backfilled.

Contractor shall furnish detailed drawings/calculations for the pipe assembly, showing the details of spacers/other arrangements for Company's approval before start of construction.

If the parallel pipelines are installed separately in a common trench, the minimum clear distance between the parallel pipelines in the trench shall be 5000 mm. Contractor shall ensure that this minimum spacing is maintained till the time the trench is backfilled.

CONSTRUCTION EQUIPMENT

All critical construction equipment deployed shall have a factor of safety of 2 (minimum) over the calculated loads/capacities.

CS Conduit shall be installed by the Contractor as per the requirements stipulated in the Tender at the River/ Major Water Crossings.

10.0 BACKFILLING AND BANK PROTECTION

10.1 BACKFILLING

Backfilling of the water-crossing section shall be performed as described in the following clauses.

The bottom of the water way shall be reinstated to its original level by backfilling the trench in a manner and with suitable material and as prescribed and approved by the Authorities and Company. In case material other than the original spoil is required, this shall be supplied by Contractor.

Wherever boulders, rock; gravel and other hard objects are encountered, they shall not be placed directly on the pipe.

Sufficient soft earth, sand or selected and approved back fill material shall be backfilled initially around and over the pipe to provide a protective padding or cushion extending to a minimum thickness of 0.5 m around the pipe before backfilling remainder of the trench with excavated or other material.

Wherever required by Company, Contractor shall cover the nearly backfilled trench with a layer of rock boulders to be approved by Company over a width equal to the width of excavated trench with an extra of 5m on either side at no extra cost to Company.

Backfilling progress of the trench shall be checked continuously and a daily progress report shall be made in three-fold and handed over to Company.

All embankments and/or dikes, bed and banks shall be reinstated to their original state and levels, unless otherwise prescribed in the drawings or by the competent Authorities or Company.

All remaining spoil-deposits shall be cleaned by Contractor to the satisfaction of Company.

10.2 BANK PROTECTION

- a. Trenches in banks of major water crossing shall be backfilled with soil approved by Company. The fill at the banks shall be compacted firmly and reinforced with sacked earth, rip-rap, or by other means as directed by Company to the satisfaction of Authorities having jurisdiction thereof. In areas where the backfilled soil is expected to be of loose type, which is prone to flow, the trench shall be backfilled with crushed rock of size approved by Company

and pipe shall be provided with adequate padding of soil of a quantity approved by Company. Slope breakers if required shall be provided in both the banks. After the trench has been backfilled and during the cleanup works, the water crossing shall be cleaned across the whole width of RoU.

- b. Unless stipulated otherwise by the Authority or by Company, Contractor shall protect the banks of the major water crossings by using gravel and boulders filled embankment mattresses of galvanized iron wire to be laid over the backfilled, compacted and graded banks. In case slope of the banks is 1:1 or

- c. more, bank protection shall be carried out using gabions. Bank protection works shall be carried out by Contractor in accordance with the relevant drawings. All materials required for such works shall be supplied by Contractor and all works carried out in accordance with specifications, approved drawings, c. instructions of Company and to the complete satisfaction of Authorities having jurisdiction at no extra cost to Company.
- d. The width of the above protection shall be equal to the width of trench excavated and damage and further extending 10 m on either side. The width of the restoration on the slope shall be determined by the levels.
- e. Length of Bank protection shall be as per standard.
- f. Before post installation hydrostatic testing, Contractor shall "prove" the Diameter of the pipeline by passing a gauging pig 95% of ID through the pipeline. The gauging pig shall be capable of locating and detecting defects permitted by governing code. Contractor shall supply and install all temporary test headers and other equipment, piping materials and other consumables for the purpose.

11 POST-INSTALLATION HYDROSTATIC TEST

The test pressure shall be same as adopted during pre-testing. The combined equivalent stress in the pipeline due to bending, static head and test pressure shall not exceed 95% of the SMYS of the pipe material. After temperature stabilization, 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 with approved procedures.

12 POST-CONSTRUCTION SURVEY

After laying of the pipeline, Contractor shall carry out a post-construction survey jointly with Company. Any defects brought to the notice of Contractor shall be promptly corrected by Contractor at his own expense to the complete satisfaction of Company.

13 FINAL CLEAN-UP

After completion of construction, Contractor shall clear the site of all balance material and debris. All balance pipe lengths, in case supplied by company, shall be returned to Company's designated stock yard(s). Site shall be cleared to the

complete satisfaction of Company and Authorities having jurisdiction. All such works shall be done at no extra cost to Company.

14 DOCUMENTATION

In addition to the documents specified elsewhere in this specification, Contractor shall submit to the Company six copies of each of the following documents/records.

- i. Pipe book of the crossing.
- ii. Copies of the permits obtained from Authorities having jurisdiction for the various works.
- iii. Clearance certificates from the land owners and Authorities having jurisdiction regarding satisfactory clean-up and restoration of pipeline ROU and work areas.
- iv. Pre and post installation Hydrotest Report.
- v. True profile of the bed and banks of water crossing along the pipeline after backfilling
- vi. True profile of the pipeline as installed and depth of cover at top of pipe at 10 m interval.
- vii. Location and angle of sag bends and over bends.
- viii. Cross section along the pipeline indicating nature and extent of backfill materials, thickness of concrete coating to pipe etc.
- ix. Method and extent of bank protection.



ENERGISING QUALITY

VCS QUALITY SERVICES PVT. LTD.

STANDARD SPECIFICATION FOR FLOW TEE

VCS – SS – PP - 2007

					
04	29.04.2022	RP	MC	HK	GW
03	03.01.2022	SR	MC	HK	HK
Rev. No	Date	Prepared By	Checked By	Approved By	Authorized By

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REVISION RECORD						
Rev.	Revision Date	Prepared by	Checked by	Approved by	Authorized by	Revision Description
00	23.06.2017					Issued as Standard Specification
		AS	SM	AD	SK	
01	24.05.2019					Re-Issued as Standard Specification
		BS	MC	AD	SK	
02	28.01.2020					Document formatting, numbering updated from SS-PL-021 to VPC-SS-PP-2007 other detail update as marked
		MB	MC	AD	SK	
03	03.01.2022					Revised as marked
		SR	MC	HK	HK	
04	29.04.2022					VCS QMS Integration
		RP	MC	HK	GW	

ABBREVIATIONS:

ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
API	American Petroleum Institute
BHN	Brinell Hardness Number
HAZ	Heat Affected Zone
MSS-SP	Manufacturers Standardization Society - Standard Practice
RTJ	Ring Type Joint
SSPC	Steel Structures Painting Council



CONTENTS

1.0	SCOPE	5
2.0	REFERENCE DOCUMENTS	5
3.0	MANUFACTURER’S QUALIFICATION	6
4.0	MATERIALS	6
5.0	DESIGN AND MANUFACTURE	7
5.1	GENERAL	7
5.2	DESIGN	7
6.0	WELDING	8
7.0	INSPECTION & TESTS	9

1.0 **SCOPE**

This specification covers the minimum requirements for the design, manufacture and supply of carbon steel flow tees to be installed in onshore pipeline systems handling non-sour hydrocarbons in liquid or gaseous phase including Liquefied Petroleum Gas (LPG).

2.0 **REFERENCE DOCUMENTS**

The design, fabrication and supply of Flow Tees shall comply with the latest edition(edition in force at the time of floating enquiry) of the applicable following codes, standards and regulations.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

- B 31.4 : Pipeline Transportation System for Liquid Hydrocarbons and Other Liquids.
- B 31.8 : Gas Transmission and Distribution Piping Systems
- B 16.25 : Butt Welding Ends
- B 16.9 : Factory made Wrought Steel Butt Welding Fittings
- BPV Code : Section VIII, Appendices 12 and 6.

AMERICAN PETROLEUM INSTITUTE (API)

- 1104 : Specification for Welding Pipelines and Related Facilities

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

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

MANUFACTURERS STANDARDIZATION SOCIETY (MSS)

- SP-25 : Standard Marking System for Valves, Fittings, Flanges and Unions
- SP-75 : Specification for High Test Wrought Butt Welding Fittings
- SP-53 : Quality Standard for Steel Castings and Forgings for Valves, Flanges and Fittings and Other Piping Components - Magnetic Particle Examination Method.

STEEL STRUCTURES PAINTING COUNCIL (SSPC)

- VIS-I : Visual Standard

PNGRB REGULATIONS:

G.S.R 808(E) T4S : Regulations for Natural Gas Pipelines

G.S.R. Infra/ T4S/ P&PPPL : Regulations for Petroleum and Petroleum products pipelines

G.S.R. 612(E) T4S : Regulations for CGD Network

In case of conflict between various requirements of this specification and reference standards and regulations mentioned above, more stringent requirement shall apply unless otherwise agreed by Purchaser.

3.0 MANUFACTURER'S QUALIFICATION

Manufacturers who intend bidding for flow tees must possess the records of a successful proof test for tees used in the fabrication of flow tees, in accordance with the provisions of ASME B 16.9/ MSS-SP-75, as applicable. These records shall be submitted at the time of bidding qualifying the entire range of fittings offered.

4.0 MATERIALS

- 4.1 Material for the pressure containing parts of the flow tee shall be as indicated in the Flow Tee Data Sheet. Other parts shall be as per the Manufacturer's standard suitable for the service conditions and shall be subject to approval by Company. In addition, the material shall also meet the requirements specified hereinafter.
- 4.2 All carbon steel used for fabrication of various components of Flow Tees shall be fully killed.
- 4.3 Each heat of steel used for the manufacture of pressure containing parts of the flow tees shall have Carbon Equivalent (CE) not greater than 0.45 based on check analysis calculated as per the following formula:

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

The Vendor shall submit the material test certificates and product analyses for materials used in the manufacture of the Flow Tees.

- 4.4 For flow tees specified to be used for Gas service or LPG service, Charpy V-notch test shall be conducted at 0°C or at temperature as specified on data sheet for each heat of steel used in the manufacture of pressure containing parts of flow tee. The test procedure shall conform to MSS-SP-75 / ASTM A370. The average absorbed impact energy values of three full-sized specimens of base metal, weld metal and HAZ shall be 27 joules, unless otherwise indicated in the Data Sheet. The minimum impact energy value of any one specimen shall not be less than 22J. Results of charpy test shall be recorded.

When Low Temperature Carbon Steel (LTCS) materials are specified in Data Sheet or offered by Manufacturer, the Charpy V-notch test requirements of applicable material standard shall be complied with.

- 4.5 For flow tees specified to be used for Gas service or LPG service, hardness test shall be carried out as per ASTM A370 for each heat of steel used in the manufacture of tees. A full thickness cross section shall be taken for this purpose and the maximum hardness of base metal, weld metal and HAZ of all the pressure containing parts shall not exceed 248 HV₁₀. Hardness shall be recorded.

5.0 DESIGN AND MANUFACTURE

5.1 GENERAL

Flow Tees shall generally conform to the Figure 4.1 and shall meet the following requirements.

- a. Tee used shall comply with ASME B 16.9/MSS-SP-75 and shall be of forged construction. Fabricated Tee (with or without reinforcement pads) shall not be used. Seamless Tee shall be used for run sizes ≤ 400 mm (16") NB. Tee shall be either welded or seamless type for run sizes ≥ 450 mm (18") NB.
- b. Size & wall thickness of connected pipeline, design factor, material & grade of material, and corrosion allowance to be considered in design of Flow Tees shall be as indicated in data sheets. Allowable stresses shall be as per applicable design code ASME B 31.4/ASME B 31.8.
- c. Inside diameter of internal pipe shall be same as connecting pipeline indicated in data sheet.
- d. The Flow Tee shall allow smooth passage of regular batching and cleaning pigs as well as instrumented pigs in both directions.
- e. Internal sleeve shall be fixed inside the Tee with suitably shaped forged steel end pieces. Machined end pieces shall not be used.
- f. Shape of the holes/slots in the sleeve shall be designed to prevent pig getting stuck or damaged during passage through Flow Tee.
- g. The size and number of holes in the internal sleeve shall be such that resulting area of openings is equal to inside area of branch. In case rectangular holes/slots are made, they shall be oriented at an angle of 45 degrees with respect to run centerline.
- h. No pups shall be provided on the run or branch unless specified in the Flow Tee Data Sheet.

5.2 DESIGN

- 5.2.1 Flow tees shall be designed and manufactured in accordance with the provisions of Codes, Standards and Specifications referred in Section 2.0 of this specification. In addition, design factor and corrosion allowance, as indicated in the Data Sheet, shall also be taken into account for design of Flow tees.
- 5.2.2 Flow tees shall generally conform to the figure shown in the Data Sheet and shall meet the following requirements:

- An internal pipe having the same internal diameter as the connecting pipeline allowing the passage of scraper/instrumented pigs, shall be provided with holes/slots located in the center line of the branch. The holes/slots shall be oriented at 45° angle. The number(s) and size of holes/slots shall be such as to prevent the pig getting stuck or damaged without affecting the flow through the branch line. The area of the holes/slots shall be at least equal to the internal area of branch size. Calculations for the area shall be furnished.
- A seamless/submerged arc welded "tee" as per ASME B 16.9/MSS-SP-75, enclosing the internal pipe and fixed to it by suitably shaped forged steel rings. Machined steel rings shall not be used. The center to end dimension of the outlet shall meet the minimum recommended dimension of the referred standard. Circumferential welding on the branch outlet is not acceptable. Pups shall not be provided either at the run or at the branch.
- Tees used for fabrication of flow tees shall be seamless type for run sizes $DN \leq 350\text{mm}$ (14") and shall be either welded or seamless type for run sizes $DN \geq 400\text{ mm}$ (16")

Tees shall conform to ASME B 16.9 for run size up to DN 350 (14"). For run size $DN \geq 400\text{ mm}$ (16"), the tees shall conform to MSS-SP-75/ASME B 16.9.

- 5.2.3 The flow tees run/branch diameter and wall thickness shall be as indicated in the Data Sheet, matching with the connecting pipeline. Butt weld ends of flow tees shall be bevelled as per MSS-SP-75.
- 5.2.4 All flow tees shall be completely stress relieved as per the provisions of MSS-SP-75.
- 5.2.5 Stub-in or pipe-to-pipe connection shall not be used in the manufacture of flow tees. Tees used for manufacturing of flow tees shall be manufactured by forging or extrusion methods only. In case flow tees are manufactured using welded tees, the longitudinal weld seam shall be oriented at least 90° to the branch connection.
- 5.2.6 All welds shall be made by welders and welding procedures qualified in accordance with the provisions of ASME Section IX. The procedure qualification shall include impact test and hardness test and shall meet the requirements of clause 4.4 and 4.5 of this specification respectively.
- 5.2.7 Repair by welding on parent metal of the flow tee is not permitted. Repair of weld seam by welding shall be carried out only after specific approval by Company's Inspector for each repair. The repair welding shall be carried out by the welders and welding procedures duly qualified as per ASME Section IX and records for each repair shall be maintained. Repair welding procedure qualification shall include all tests, which are applicable for regular production welding procedure qualification. All heat treatment and radiography shall be repeated after the weld repair.
- 5.2.8 The tolerance on internal diameter and out of roundness at the ends for welded flow tees shall be as per applicable connected pipe specification as indicated in the Data Sheet.

6.0 **WELDING**

- 6.1 All welding shall be carried out by welders and welding procedure qualified in

accordance with ASME Section IX. The Procedure qualification shall include impact test and hardness test and shall meet the requirement of clause 4.4 and 4.5 of this specification respectively.

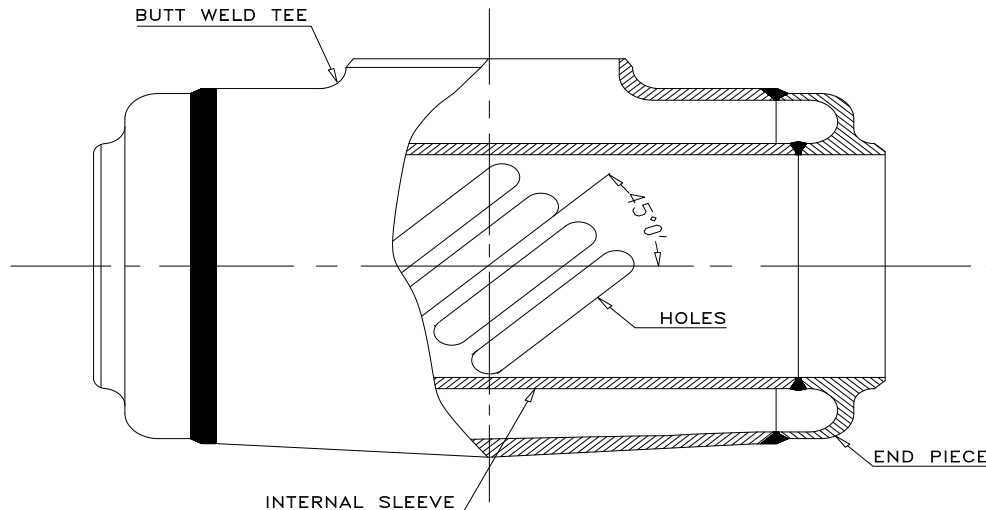


Figure 4.1

- 6.2 No repairs by welding shall be carried out on base metal of pressure containing components of Flow Tee. Manufacturer shall obtain Purchaser approval prior to carrying out any repair of welds. Repair welding shall be carried out by welders and welding procedures duly qualified as per ASME Section IX and records for each repair shall be maintained. Repair WPS and PQR must also be approved before performing repair welding.
- 6.3 All pressure containing welds made for fabrication of Flow Tees shall be butt welds. Other welds shall be full penetration girth or fillet welds.
- 6.4 All weld ends shall be checked for surface defects using dye penetrate prior to welding.
- 6.5 Bevel ends for field welding of Flow Tees shall be in accordance with ASME B31.4 or B31.8, as applicable.
- 6.6 All flow tees shall be completely stress relieved as per the provisions of MSS-SP-75.

7.0 INSPECTION & TESTS

- 7.1 The Manufacturer shall perform all inspections and tests as per the requirements of this specification and the relevant codes, standards and specifications, prior to shipment at his works. Such inspections and tests shall be, but not limited to, the following:
- 7.2 All flow tees shall be visually inspected for visible surface defects. The internal and external surfaces of the flow tees shall be free from any strikes, gauges and other detrimental defects. Bevels at butt weld ends shall show a smooth contour.
- 7.3 All dimensions shall be checked for conformance with approved drawings and/or datasheets.

- 7.4 Chemical composition and mechanical properties including yield strength, ultimate tensile strength, impact test, elongation and hardness shall be checked as per MSS-SP-75/relevant material standards, and this specification for each heat of steel used.
- 7.5 Non-destructive examination of individual flow tees shall be performed as given below:
- 100% inspection by radiography shall be carried out on all butt welds of pressure containing parts. Acceptance limits shall be as per API-1104. Radiography shall be performed after the final heat treatment.
 - All finished wrought weld ends shall be 100% ultrasonically tested for lamination type defects for a distance of 25 mm from the end. Any lamination larger than 6.35 mm shall not be acceptable.
 - Magnetic particle or liquid penetrant examination shall be performed on cold formed butt-welding tees with extruded outlets. The examination shall be carried out as per the Supplementary Requirement SR 14 of MSS-SP-75.
 - Welds, which, in Company's Inspector's opinion, cannot be inspected by radiographic methods, shall be checked by ultrasonic or magnetic particle methods. Acceptance criteria shall be as per ASME Section VIII Appendix 12 and Appendix 6 respectively.
 - All forgings shall be wet magnetic particle examined on 100 % of the forged surfaces. Method and acceptance shall comply with MSS-SP-53.
- 7.6 Company's Inspector reserves the right to perform stage wise inspection and witness tests, as indicated in clause 6.1 of this specification, at Manufacturer's works prior to shipment. Manufacturer shall give reasonable notice of time and shall provide without charge reasonable access and facilities required for inspection to the Company's Inspector.
- 7.7 Inspection and tests performed/witnessed by Company's Inspector shall in no way relieve the manufacturer's obligation to perform the required inspection and tests.
- 7.8 The Manufacturer shall submit an Inspection and Test Plan (ITP) for approval prior to commencement of manufacture.
- 7.9 The Purchaser will advise the Manufacturer, by marking up the Contract Inspection and Test Plan, of the specific inspection review, witness and hold points required. The Manufacturer shall give ten working days prior notice to the Purchaser of such item or hold point being reached.

Following stages will be subject to witness/hold/review by the Purchaser or third party inspector.

- Visual inspection of the Flow Tees.
- Full dimensional checks.
- Material certification checks.
- Inspection of radiographs and other NDT results.
- Pressure testing.

- Surface finish and profile verification at each phase of surface preparation and coating.

Where inspection or testing is to be performed by certified testing laboratories, the Manufacturer shall submit their proposed testing laboratory for approval.

The final inspection, before issue of a release note for the Flow Tees, shall include material certificates, test certificates, surface treatment, dimensional conformity, tagging and packing conformity.

8.0 HYDROSTATIC TESTING

In case factory hydrostatic is specified in the Datasheet, it shall be performed on the completed Flow Tee. Each tee shall be hydrostatically tested at a test pressure as indicated in Data Sheet. The test duration shall be of 15 minutes. No visible leakage or drop in pressure is permitted. After completion of the testing, closure shall be cut off and ends prepared.

9.0 TEST CERTIFICATES

Manufacturer shall submit the following certificates to Company's inspector:

- Test certificates relevant to the chemical analysis and mechanical properties including hardness of the materials used for construction as per this specification and relevant standards.
- Test reports on radiographic, ultrasonic inspection and wet magnetic particle examination.
- Test certificates for each flow tees stating that it is capable of withstanding without leakage a test pressure which results in a hoop stress equivalent to 95% of the specified minimum yield strength for the pipe with which the flow tee is to be attached without impairing its serviceability.
- Test reports on heat treatment carried out as per specification.
- Welding procedures and welder's qualification reports.
- Certified reports of dimensional tolerances.
- Certified report of painting/coating thickness checks.
- Certificates of all other tests specified in this specification.

All pressure retaining part (Tee and End Pieces) material certification shall be traceable to heat numbers. Certificates shall be available at final inspection in the Manufacturer's works.

10.0 PAINTING, MARKING & SHIPMENT

- 10.1 All Flow Tees shall be packed and prepared for shipment/transport in with the procedures included in the Material Requisition (MR)/ Tender.

- 10.2 The Manufacturer shall supply packing and shipping procedure with the tender.
- 10.3 After all inspection and tests required have been carried out/witnessed by Company's Inspector, entire surface of flow tees shall be thoroughly cleaned to remove grease, dust and rust and shall be applied with sufficient coats of standard mill coating/corrosion resistant paint, for protection against corrosion during transit and storage. The surface preparation shall be carried out by shot blasting to SP 10 in accordance with "Steel Structures Painting Council - Visual Standard - SSPC-VIS-I".
- 10.4 All buried flow tees as specified in data sheet shall be coated with 100% solid high build epoxy (minimum 1000-micron thk) or 1.5 mm thick polyurethane coating.
- 10.5 Manufacturer shall indicate the type of mill coating / corrosion resistant paint used in the drawings submitted for approval.
- 10.6 Ends of flow tees shall be suitably protected to avoid any damage during transit. Metallic or high impact plastic bevel protectors shall be provided for weld ends of flow tees.
- 10.7 Flow tees shall be marked with indelible paint with the following data:
- Manufacturer's name
 - Nominal diameter of run and branch
 - Nominal thickness of run and branch ends
 - Material of Construction / Tee and End Piece material and grade
 - Test Pressure.
 - Year of Manufacture.
 - Tag number

11.0 DOCUMENTATION

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

- 11.1 At the time of bidding, Bidder shall submit the following documents:
- Reference list of similar supplies including all relevant details viz. Project, Year of supply, Client, Location, Size, Rating and Service for the last five years.
 - Records of successful proof test for tees used for fabrication of flow tees, qualifying the range of sizes quoted.
- 11.2 After placement of order, the Manufacturer shall submit the following drawings, documents and specifications for company's review and information:
- General arrangement drawings of flow tees with overall dimensions and cross-sectional drawing including relevant calculations for pressure containing parts.
 - Method of manufacturer, welding procedure and heat treatment details.



- Quality Control Manual and Quality controls Plans.
- Type of mill coating/anti-corrosion/anti-fouling paint

Once the approval has been given by the company, any change in design, material and method of manufacturer shall be notified to the company whose approval in writing of all changes shall be obtained before the flow tees are manufactured.

11.3 All documents shall be in English Language.



VCS QUALITY SERVICES PVT.LTD.

STANDARD SPECIFICATION FOR LONG RADIUS BENDS

VCS-SS-PP-2009

					
04	28.11.2022	RP	MC	HK	GW
03	04.01.2022	SR	MC	HK	HK
Rev. No	Date	Prepared By	Checked By	Approved By	Authorized By

UNCONTROLLED COPY	: If printed
CONTROLLED COPY	: If in soft and signed

REVISION RECORD						
Rev.	Revision Date	Prepared by	Checked by	Approved by	Authorized by	Revision Description
00	23.06.2017					Issued as Standard
		AS	SM	AD	SK	
01	12.06.2019					Re-issued as Standard
		BS	MC	AD	SK	
02	28.01.2020					Document formatting, Doc numbering updated from SS-PL-013 to VPC-SS-PP-2009 & other detail update as marked
		MB	MC	AD	SK	
03	04.01.2022					Revised as marked
		SR	MC	HK	HK	
04	28.11.2022					VCS QMS integration
		RP	MC	HK	GW	



ABBREVIATIONS:

ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
API	American Petroleum Institute
BHN	Brinell hardness number
HAZ	Heat Affected Zone
MSS-SP	Manufacturers Standardization Society - Standard Practice
NB	Nominal Bore
NDT	Non Destructive Testing
OD	Outside Diameter
OLAC	Online Accelerated Cooling
SAW	Submerged Arc Welded
SMYS	Specified Minimum Yield Strength
TMCP	Thermo Mechanical Control Process



CONTENTS

1.0	SCOPE	5
2.0	REFERENCE DOCUMENTS	5
3.0	MATERIALS	6
4.0	MANUFACTURE	6
5.0	INSPECTION AND TESTS	10
6.0	TEST CERTIFICATES	11
7.0	MARKING, PACKING & SHIPMENT	11
8.0	DOCUMENTATION	12
9.0	BEND MANUFACTURING PROCEDURE QUALIFICATION	13

1.0 **SCOPE**

This specification covers minimum requirements for manufacture, testing and supply of long radius bends, made from carbon steel line pipe, for use in onshore pipeline systems handling hydrocarbons in liquid or gaseous phase including Liquefied Petroleum Gas (LPG).

This specification shall be used for fabrication of long radius bends of radii $R=6D$ & $R=3D$.

2.0 **REFERENCE DOCUMENTS**

Fabrication, testing and supply of hot induction bends shall comply with the applicable sections of the latest edition (edition in force at the time of issue of enquiry, unless specified otherwise) of the following codes and standards including their addenda.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

B31.4	:	Pipeline Transportation System for Liquids and Slurries
B 31.8	:	Gas Transmission and Distribution Piping Systems.
B16.25	:	Butt Welding Ends.
B16.49	:	Factory-Made wrought Steel Butt welding Induction Bends for transportation and distribution systems.

AMERICAN PETROLEUM INSTITUTE (API)

Specification 5L	:	Specification for Line Pipe.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

A370	:	Standard Test Methods and Definitions for Mechanical Testing of Steel Products.

MANUFACTURERS STANDARDIZATION SOCIETY (MSS)

SP-75	:	Specification for High Test Wrought Butt Welding Fittings.

PNGRB REGULATIONS:

G.S.R 808(E) T4S	:	Regulations for Natural Gas Pipelines
G.S.R. Infra/ T4S/ P&PPPL	:	Regulations for Petroleum and Petroleum products pipelines
G.S.R. 612(E) T4S	:	Regulations for CGD Network

PURCHASER'S SPECIFICATIONS FOR LINE PIPE

VCS-SS-PP-2045	:	Standard Specification for Longitudinal Seam Submerged Arc Welded Line Pipe.
VCS-SS-PP-2036	:	Standard Specification for Seamless Line Pipe
VCS-SS-PP-2008	:	Standard Specification for HFW Line Pipe

In case of conflict between various requirements of this specification and reference standards, codes and regulations mentioned above, more stringent requirement shall apply unless otherwise agreed by Purchaser.

3.0 **MATERIALS**

Bends shall be fabricated from steel line pipe manufactured in accordance with the latest revision of the Company's Specifications referred in Section 2.0 above. 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.

The finished product shall be evaluated for mechanical properties and micro structural stability.

Mechanical testing of test bends performed during the bend manufacturing procedure qualification as per Clause 9.0 of this specification shall ensure that, all bends made according to the Company approved bend manufacturing procedure, have the required mechanical properties. Destructive testing of production bend is not required. However, Company reserves the right to require destructive testing whenever production bending parameters or heat treatment parameters deviate from those established in the Company approved bend manufacturing procedure. However, deviations accepted during pipe production with respect to mechanical properties of line pipe shall be applicable for the bends.

4.0 **MANUFACTURE**

4.1 **GENERAL**

Material grade, bend size, bend radius and bend angle shall be as indicated in the Purchase Order/MR /Data sheet. The bending radius for bends shall be either six times the specified outside diameter ($R=6D$) or three times the specified outside diameter ($R=3D$), as applicable. The specified bend radius shall be measured at the bend neutral axis.

4.2 **MANUFACTURING PROCEDURE**

4.2.1 BENDING PROCESS

Bends shall be manufactured by high frequency continuous induction heating and forming method. A minimum of four temperature-monitoring probes shall be in continuous operation throughout all operations. The pipe to be bent shall be cleaned to remove any loose mill scale etc. 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 deviates from the Company approved bend manufacturing procedure, then the bend shall be discarded and another bend shall be made in its place. Cost of such discarded pipes shall be borne by the Manufacturer.

Heat treatment shall be carried out for all finished bends, only in case, it is established during bending procedure qualification that heat treatment is required to meet the specification requirements. Post hot bending heat treatment shall be carried out to the same cycle that the original material received for its production in order to bring the metallurgical condition back to its original state and 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 referred under clause 2.0. Heat treatment procedure shall be submitted and prior approval of company shall be obtained on heat treatment procedure.

When Thermo mechanically Control Process (TMCP) and online accelerated Cooling (OLAC) steels are used, specific approval of the proposed heat treatment shall be obtained before bending process is employed. 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.

Unless otherwise specified differently in the Purchase Order, the bevels at the ends shall be as per the relevant pipe specification.

4.3 INTERNAL TRANSITIONS

Bends shall have internal transitions at the tangent ends machined to suit the mating pipe in accordance with the specified wall thickness and the requirements of ASME B31.8/B 31.4.

4.4 CIRCUMFERENTIAL JOINTS

Bends shall not have any circumferential joints.

4.5 LOCATION OF WELD SEAM

When bending SAW or High Frequency Welded Pipes, the longitudinal seam shall be located in the plane of minimum deformation or neutral axis. Acceptable tolerance on location of the longitudinal weld seam shall be $\pm 5^\circ$.

4.6 WELD END BEVELS

Unless otherwise specified in Purchase Order, the bevels at the weld ends shall be as per ASME B 31.4/ ASME B 31.8. All cut pipe ends shall be bevelled by machining. 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, but shall not result in reduction of bend wall thickness below the minimum specified wall thickness requirement.

4.7 REPAIRS

No repair by welding is allowed on any part of the bends.

4.8 DEVIATIONS FROM ORIGINAL CONTOUR

Bulges, dents and flat areas shall not appear within 100 mm of each end of the bend. For the remaining part of these deviations from the original contour of the pipe are permitted provided these deviations do not exceed 2% of nominal outside diameter or 6.0 mm whichever is less. The same shall not extend (in any direction) over a distance of more than 25% of nominal outside diameter of the bend. Dents at the pipe weld seam shall not be acceptable irrespective of the size.

4.9 TANGENT LENGTH

All bends shall be provided with a tangent length at both ends. Tangent length shall be minimum 500 mm or equal to pipe outside diameter whichever is more.

In case, the total length of the bend arc ($R=6D$) including tangents exceeds one pipe length, tangent length shall be restricted to accommodate complete bend within one pipe length. In no case, tangent length shall be less than 250 mm.

4.10 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 referred in Clause 2.0.

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

- Weld Seam : $\pm 5^\circ$.
- Bend Angle : $\pm 0.5^\circ$ from the specified angle.
- Bend Radius : $\pm 1\%$ of Bending Radius. of bending nominal radius (radius as indicated in Clause 4.1 above)
- Wall Thickness : As per (A) below.
- Out of Roundness : As per (B) below.
- Off Plane : As per (C) below.

A. WALL THICKNESS

The Manufacturer shall measure the wall thickness of the pipe before bending along both the inside and outside radii of the bend between and including the start and stop points of the bend arc angle, at intervals approximately equal to pipe diameter or 300 mm whichever is less. The wall thickness shall be measured ultrasonically after bending at the same locations as measured before bending. In addition, the wall thickness of the tangents shall also be measured. These measurements shall be taken at four equally spaced locations around the pipe circumference. The measured wall thickness shall be at least equal to:

Method-1

$$t_{\min} = 0.95 (t_a - \Delta t).$$

t_a = Actual wall thickness before bending.

Δt = 0.35 mm for $t_a < 10$ mm.
= 0.5 mm for $t_a \geq 10$ mm.

Maximum percentage thinning allowed 10% & 18% for 6D and 3D bends respectively.

Method-2

Wall thinning & minimum thickness required shall be calculated as per BS 8010

More Stringent/ Largest value among above method shall be selected as minimum wall thickness required after bending.

When the pipes are free issue (or thickness of pipes is specified in MR) the thickness of finished bend shall comply with the requirement of 4.10 or as specified in data sheet whichever is higher. When pipes for manufacturing LR bends are to be procured by manufacturer and thickness of finished LR bends is specified in the MR, thickness specified of the bends shall be the minimum thickness achieved after bending with tolerance as (-) 0.0. Manufacturer shall procure pipes to achieve $t_{Min.}$ of LR bends. Higher value of $t_{Min.}$ shall be selected among as described in 4.10 above & as specified in data sheet.

B. Out of roundness tolerance on the body and ends of the bend shall be as follows:

Body

Measurements of the outside diameter shall be taken in the plane of the bend at locations where wrinkles are present ($OD_{Max.}$) and at locations where wrinkles are not present ($OD_{Min.}$). Out of roundness shall be considered acceptable, if the value of $((OD_{Max.} - OD_{Min.}) / OD_{Nom.})$ does not exceed 2.0%.

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

Ends

Out-of-roundness over a length of 100 mm from the end shall comply with the requirements of relevant company specification referred in Clause 2.0.

In case multiple bends are to be manufactured from single pipe, out of roundness tolerances applicable on pipe body shall be acceptable as end tolerances for bend ends fabricated from original body of line pipe.

C. 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.

D. Squareness

Bevel and squareness of bend ends shall comply with the requirements of relevant company specification referred in Clause 2.0.

5.0 **INSPECTION AND TESTS**

5.1 **GENERAL**

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:

- Verify that the unfinished product arriving at Manufacturer's shop is in full compliance with the pipe specification as referred in Clause 2.0 of this specification.
- Visual Inspection.
- Dimensional and tolerances check as per MSS-SP-75 and requirements of Clause 4.0 of this specification.
- Check heat treatment, if carried out, as required and maintain its records.
- Temperature against time recorder charts for each induction heating.
- The non-destructive inspection on the finished bend shall be carried out as given below:
 - All seam welds of bends manufactured from SAW pipes shall be 100% radiographed and seam welds of bends manufactured from HEW pipe shall be 100% ultrasonically tested. The acceptance criteria shall be same as given in applicable pipe specification referred under clause 2.0 of this specification.
 - The full circumference of both ends of each bend after bevelling shall be ultrasonically tested for laminations over a length of 100 mm and acceptance limits shall be as per pipe specification as referred in Clause 2.0 of this 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.
- 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 inside 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 Company.
- When specified in requisition for quotation, all bends shall be subjected to hydrostatic testing at a pressure capable of generating a hoop stress in pipe equal to 95% of Specified Minimum Yield Strength of pipe. Test pressure shall be maintained for a min. of 15 sec.

5.2 Company'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 Company's Inspector. Inspection and tests performed or witnessed by Company'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 Company's Inspector shall relieve the Manufacturer of his responsibility for the material and quality of the bends.

As a minimum the following stages will be subject to witness/hold/review by the Purchaser's Inspector:

- Bend Manufacturing Procedure Qualification.
- Heat Treatment.
- Destructive Testing of Test Bends.
- Inspection of Radiographs and Other NDT Results.
- Material Certification Checks.
- Full Dimensional Checks.
- Pre-release Inspection.

Where inspection or testing is to be performed by certified testing laboratories, the Manufacturer shall submit their proposed testing laboratory for approval.

The final inspection, before issue of a release note for the Induction Bends, shall include material certificates, test certificates, surface treatment, dimensional conformity, heat treatment, tagging and packing conformity.

6.0 TEST CERTIFICATES

Manufacturer shall submit the following Certificates:

- Test certificates of chemical analysis, mechanical tests, heat treatment, NDT, dimensional inspection and hydrotest carried out on pipe used for fabrication of bend.

These test certificates are not required when pipe is supplied as free issue by the Company.

- Certificates of non-destructive test/examination carried out on bends.
- Records of heat treatment, if carried out for bends.
- Certified reports of dimensional tolerance of bends.
- Certificates of all other tests as required in this specification.

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

7.0 MARKING, PACKING & SHIPMENT

Packing, shipping and handling of all materials to be in accordance with the instructions in the RFQ and as per following:

- All bends shall be marked as per MSS SP-75.
- All loose and foreign material i.e., rust, grease, etc. shall be removed from inside and outside of the bends prior to packing.

- 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 Company.
- 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.
- Bends shall be packed / crated or bundled for transportation or shipping to the agreed destination.

Package of bends shall be marked with following:

- Purchaser's Name.
- Order Number.
- Package Number.
- Size (Inches), Wall Thickness (mm)
- Bend Radius (mm).
- Manufacturer's Name and Place of Manufacture.
- Destination of dispatch.
- Any Additionally marking / shipping marks specified in Purchase order/MR.

In addition, each bend shall be paint stencilled with the same information in 25 mm (1 Inch) or larger letters on the inside surface within 150 mm (6 Inch) of each end.

8.0 **DOCUMENTATION**

Documentation to be submitted by Manufacturer to Company 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:
- Reference list of previous supplies of bends of similar specifications.
 - Brief description of manufacturing including heat treatment and quality control facilities of the Manufacturer's Works.
 - Brief description of manufacturing and quality control facilities of the Manufacturer's works.
- 8.3 Within two weeks of placement of order, the Manufacturer shall submit 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:

- Sequence of operation

- Induction forming process including bending temperature, temperature control, bending rate, cooling rate and cooling procedure;
- Temperature measurement and calibration
- Post bend heat treatment procedure including temperature and time.
- Dimensional control procedure
- Pipe material used for bend manufacture
- NDT procedures
- Quality Control and Quality Plans

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

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

- 8.4 Within two weeks from the approval date, Manufacturer shall submit to Company the approved drawings, documents and specifications as listed in Clause 8.3 above.
- 8.5 Prior to shipment, the Manufacturer shall submit test certificates as listed in Clause 6.0 of this specification.

9.0 BEND MANUFACTURING PROCEDURE QUALIFICATION

- 9.1 Prior to start of production bending, Manufacturer shall demonstrate the suitability of the proposed manufacturing procedures for producing pipe bends including the post-bending heat cycle, 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 Company Representative.
- 9.2 Test bends shall be made by using the pipe specified in Clause 2.0 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). In case, line pipes are free issued from multiple heat lots, heat lot having maximum numbers of pipes shall be considered for fabrication of test bend. The test bend shall be bent to an angle of 90°.

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 Clause 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

Company line pipe specifications referred in Section 2.0 of this specification. Test procedure and acceptance criteria shall be in accordance with the Company line pipe specification referred in Section 2.0 of this 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/Reverse Bend Test

For bends manufactured from SAW pipes one face and one root guided bend test shall be performed. For bends manufactured from HFW pipes, reverse bend test shall be carried out. Test method and acceptance criteria shall be same as given in applicable pipe specification referred under clause 2.0 of this specification.

d. Hardness Test

Hardness testing shall be performed "through 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/HFW 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 referred in Clause 2.0. 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 HFW 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 the outside radius of the bend. If multiple thicknesses are involved, testing shall be done on bend with maximum thickness.

f. Hydrostatic test

Bends shall be hydrostatically tested to test pressure that shall result in hoop stress Corresponding to 95% of SMYS of pipe material. Test pressure shall be calculated for minimum allowable thickness. Test pressure shall be held for a minimum period of fifteen (15) seconds.

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.



**STANDARD SPECIFICATION
FOR
LONG RADIUS BENDS**

**DOCNO: VCS-SS-PP-2009
Rev No : 04**

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.



VCS QUALITY SERVICES PVT. LTD.

STANDARD SPECIFICATION FOR CONCRETE WEIGHT COATING OF ONSHORE PIPELINES

VCS – SS – PP - 2010

					
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Rev. No	Date	Prepared By	Checked By	Approved By	Authorized By

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REVISION RECORD						
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		AS	SM	AD	SK	
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ABBREVIATIONS:

ASME	American Society of Mechanical Engineers
ASTM	American Society of Testing of Materials
API	American Petroleum Institute
OISD	Oil Industry Safety Directorate
IS	Indian Standard

CONTENTS

1.0	SCOPE	5
2.0	GENERAL REQUIREMENT	5
3.0	REFERENCE DOCUMENTS	5
4.0	MATERIALS	6
5.0	DESIGN REQUIREMENTS	7
6.0	CONSTRUCTION REQUIREMENTS	8
7.0	PROCEDURE QUALIFICATION	10
8.0	APPLICATION OF REINFORCEMENT AND CONCRETE COATING	11
9.0	TOLERANCES	13
10.0	WEIGHING	13
11.0	COATING OF FIELD WELDS	13
12.0	INSPECTION AND TESTS	14
13.0	REPAIRS	14
14.0	MARKING	15
15.0	HANDLING, UNLOADING, STORING AND TRANSPORTATION	15

1.0 SCOPE

- 1.1** This specification covers the minimum requirements for the materials, application, inspection, handling and other activities for external concrete weight coating of pipelines.
- 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 GENERAL REQUIREMENT

Contractor shall execute the work in compliance with all laws, by-laws, ordinances, regulation, etc. and shall provide all services and labor, inclusive of supervision thereof, materials, equipment, appliances or other things of whatsoever nature required in or about the execution of the work.

For the purpose of this specification the following definitions apply:

Words 'Shall' and 'Must' where used indicate that a provision is mandatory.

Words 'Should' and 'Will' where used indicate that a provision is not mandatory but is recommended as good practice.

3.0 REFERENCE DOCUMENTS

The latest Edition (edition in force at the time of floating the enquiry) of following Codes and Standards are referenced in this specification and all provisions of these reference codes and standards shall be applicable.

ASTM A-82 : Specification for Steel Wire, Plain, for concrete Reinforcement.

ASTM A-185 : Specification for Steel Welded Wire Fabric, Plain, for Concrete Reinforcement

ASTM A-641 : Specification for Zinc Coated (Galvanized) Carbon Steel wire

ASTM C-39 : Test Method for Compressive strength of cylindrical concrete specimens.

ASTM C-138 : Test Method for Unit weight, Yield and Air Content of Concrete.

ASTM C-309 : Specification for Liquid Membrane Forming Compounds for Curing Concrete.

ASTM C-642 : Test Method for Specific Gravity, Absorption and Voids in Hardened Concrete

INDIAN STANDARD (IS)

IS-269 : Indian Standard Specification for Ordinary Portland Cement

IS-516 : Method of Test for Strength of concrete.

IS-383 : Indian Standard Specification for Coarse and Fine Aggregates from

Natural Sources for Concrete.

IS-1199 : Method of Sampling and Analysis of Concrete.

IS-8041 : Indian Standard Specification for Rapid Hardening Ordinary Portland Cement

IS-8112 : Indian Standard Specification for 43 Grade Ordinary Portland Cement

IS-2386 (Parts-I: Indian Standard Methods of Test for Aggregates for Concrete.

thru' VIII)

IS-12269 : Indian Standard Specification for 53 Grade Ordinary Portland Cement.

In case of conflict between various requirements of this specification and reference codes, standards and specifications mentioned above, more stringent requirement shall apply.

4.0 MATERIALS

4.1 The Contractor shall supply necessary materials for application of concrete coating on line pipe duly applied with external corrosion coating.

Materials which in the opinion of Company, do not comply with the appropriate specifications shall be rejected and immediately removed from site by Contractor at his expense.

Material shall comply with following requirements:

4.2 CEMENT

Portland cement (conforming to IS-12269), or High Strength Ordinary Portland Cement (conforming to IS-8112) shall be used. Cement which has hardened or partially set or which has become lumpy shall not be used. Test certificates from the cement Manufacturer shall be supplied to the Company for all cement delivered to site.

In case concrete weight coating is to be provided at locations affected by sea water tidal flats etc., Portland cement in accordance with ASTM C-150 Type III or IS-8041 shall be used.

4.3 AGGREGATES

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

• Fine Aggregates

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

- Natural sand;

- Crushed stone sand;
- Crushed gravel sand.

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

- **Coarse Aggregates**

Use of coarse aggregates shall be subject to Company approval.

Aggregates (Fine and Coarse) shall be clean and free from injurious amounts of salt, alkali, deleterious substances or organic impurities.

4.4 WATER

The water used shall be 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 prior to its use and shall be approved by Company. Seawater or contaminated water shall not be used. Water from doubtful sources shall be tested by the Contractor at his expense and approved by Company before use.

4.5 REINFORCEMENT

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

- Reinforcement shall consist of welded steel wire fabric manufactured in flat sheets or in rolls (ribbon mesh) and shall conform ASTM A-185. Wires shall conform to ASTM A-82.
- Steel wire shall be galvanized at finished size as per ASTM A-641. The diameter of the wire and spacing of wires (mesh dimensions) shall be selected according to the following criteria.
- Wire fabric manufactured in flat sheets shall be 2 x 4 inches max. Steel wire mesh, 13 gauge U.S. Steel wire (2.4 mm) min. each way.
- 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 designs. 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.

5.0 DESIGN REQUIREMENTS

Pipes shall be concrete coated to a thickness as specified in the drawings and documents.

The concrete unit weight shall be minimum 2245 kg/m³ (140 pounds per cubic foot)

The compressive strength shall not be less than 200 kg/cm² in 28 days and 165 kg/cm² in 7 days.

Concrete coating shape shall be circular and concentric to pipe outside diameter. Other concrete coating shapes are not acceptable.

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

6.0 CONSTRUCTION REQUIREMENTS

6.1 APPLICATION METHOD

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

Concrete coating shape shall be circular and concentric to pipe outside diameter. Other concrete coating shapes are not acceptable.

Contractor shall submit to the Company, one month prior to commencement of work, the procedure/ method of application for approval.

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

6.2 QUALIFICATION TESTING OF CONCRETE MIX

Before commencement of the work, Contractor shall perform all tests, either in laboratory or in field and trials necessary to properly select type of mix which meets the requirements of relevant section of this specification.

The Correct combination of the cement, aggregates and water which results in the desired properties of concrete shall be determined for each mix.

Following shall be recorded:

- Proportion and weights of the respective materials used.
- The water/ cement ratio.
- The grading of the aggregates.

Samples shall be prepared and tested in accordance with ASTM C-642 to determine the dry specific gravity of the concrete.

In parallel, test according to ASTM C-138 shall be performed so as to determine the expected correlation between concrete weight after placing and dry specific gravity (28 days after placing).

Test for concrete specific gravity at Intermediate time (7 days after coating) shall be performed.

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.

The mix so determined, shall then be used for sampling of concrete to be

submitted to compressive strength tests as per ASTM C39.

Frequency of sampling for tests for density and compressive strength of concrete shall be as follows:

"Quantity" of Concrete in the Work (m ³)	Number of samples
Up to 25	3
26 to 50	4
51 and above	4
Plus one additional sample for each additional 50 m ³ or part thereof	

Quantity means the volume of concrete to be used for each qualified mix.

6.3 EQUIPMENT

The equipment used for performing the concrete coating shall be capable of doing so with a required degree of uniformity with respect to thickness, density and strength. The proportioning equipment and procedure shall be of the type to assure consistently proportioned material 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. Any equipment that tends to separate the ingredients shall not be used. Ready mixed concrete supplied by ready-mixed concrete plant shall be preferred.

6.4 MEASUREMENTS 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 results. A logbook shall refer to pipe lengths having the same nominal diameter, and steel wall thickness.

The following shall be subject to measurement and logging for each pipe length.

A LINE PIPE

- 1 Pipe number
- 2 Thickness
- 3 Length
- 4 Weight
- 5 Outside diameter

B. CORROSION COATING

- 6 Type of coating
- 7 Thickness of corrosion coating, mm
- 8 Weight of coated pipe, kg

C. CONCRETE COATING

- 10 Batch identification number
- 11 Date of placing the concrete coating
- 12 Average concrete coating thickness, mm

- 13 "Dry Weight" of concrete coated pipe (Weight and date of weighing or Related Weight 28 days after placing of concrete and so identifiable)
- 14 "Unit dry weight" of concrete coated pipe
- 15 "Negative Buoyancy" (unit) of concrete Coated pipe

No concrete placing shall be allowed before items 1 through 9 listed at clause A, B, have been logged.

7.0 PROCEDURE QUALIFICATION

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

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 at first determined for each mix and following shall be accurately checked and recorded:

- Proportion and weights of the respective materials used;
- The water/cement ratio;
- The grading of the aggregates.

Samples shall be prepared and tested in accordance with ASTM C-642 to determine the dry specific gravity of the concrete. In parallel, test according to ASTM C-138 shall be performed so as to determine the expected correlation between concrete weight after placing and dry specific gravity (28 days after placing). Test for concrete specific gravity at Intermediate time (7 days after coating) shall be performed.

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.

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

Frequency of sampling for tests for density and compressive strength of concrete shall be as follows:

"Quantity" of Concrete in the Work (m³)	Number of samples
Upto 25	3
26 to 50	4
51 and above	4 plus one additional sample for each additional 50 m ³ or part thereof

Quantity' means the volume of concrete to be used for each qualified mix.

8.0 APPLICATION OF REINFORCEMENT AND CONCRETE COATING

8.1 PIPE LENGTH PREPARATION

Prior to placing of reinforcement, the anti-corrosion coating of each pipe length shall be carefully inspected visually and by holiday detectors and, if damages are found, they shall be repaired in accordance with the relevant specification, before start of the work. Foreign matters, if any, shall be removed from the surface of the protective coating.

8.2 PLACEMENT OF REINFORCEMENT

- Reinforcement shall be placed around the pipe in such a way as to cover the whole pipe length or sections to be concrete coated. The reinforcement shall not protrude beyond the concrete coating ends.
- Reinforcement shall rest on synthetic resin spacers forming a "Crown" whose number shall be such as to avoid any contact with the pipe's protective coating. Spacing between the two consecutive "crown" centers shall be 500 to 1000 mm.
- Splices and attachments shall be done by binding with steel wire having 1.5 mm diameter. Circular and longitudinal joints of wire fabric in sheets shall be lapped at least for one mesh. When wire fabric in rolls (ribbon mesh) is used, the spiral lap shall be one mesh while and spliced lap shall be three meshes.
- One layer of reinforcement steel shall be provided for concrete thickness less than 50 mm. The reinforcing steel shall be embedded approximately midway in the concrete coating thickness. For concrete thickness 50 mm and above two layers of reinforcing steel shall be provided. If application method requires more than one pass concrete, one reinforcement layer for each pass is to be applied independently from concrete coating thickness.

In case of one layer of reinforcement, it shall be located approximately in the middle of the concrete thickness. In case of two layers of reinforcement, layers shall be located at 1/3rd and 2/3rd of the concrete thickness. In case of three layers of reinforcement, layer shall be located at 1/4th, 1/2 and 3/4th of concrete thickness. Contractor shall demonstrate that the procedure used ensures no physical contact between steel reinforcement and the pipe and the reinforcement is placed in position as mentioned above.

8.3 CONCRETE PLACING

- Concrete shall be placed within a maximum of 30 minutes from the time of mixing (i.e. after 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.
- 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 and coarse (if used) aggregates shall be made as frequently as possible, the frequency for a given job being determined by the Company Representative according to weather conditions.

- If casting method is used, once reinforcement and mould have been applied around the pipe, concrete mixture shall be poured through an opening on the upper section of the same mould. Concrete shall not be deposited from a height greater than 1 meter. During pouring of concrete, vibrator sets applied inside of pipe or outside the mould shall vibrate the mix so as to obtain the best possible compactness.
- 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.
- No casting shall be interrupted or 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.
- Suitable means shall be provided to ensure that the temperature of the concrete, when placed, does not exceed 32°C.
- All pipes shall be kept clean and free from cement concrete and grout either inside or outside of the uncoated sections.
- Bevel protectors shall be kept in place throughout the coating application and after.
- The coating at each end of the pipe shall be bevelled to a slope of approximately two-to-one. (2:1). It shall terminate about 50 mm short of the end of the corrosion coating applied on the pipe surface.

8.4 CURING

- 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 sections shall be handled gently by suitable means to prevent undue distortion.
- Curing shall be performed by application of an approved curing membrane using sealing compounds and shall meet the requirements of ASTM C-309. The 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, protective coating or pipe. The application of the curing compound shall take place 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.

Curing of concrete coating may also be done by using jute bags, provided continuous wetting is ensured by the Contractor.

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

9.0 TOLERANCES

- 9.1** Contractor shall maintain a surface tolerance of 8 mm (5/16") maximum for the radial distance between high and low areas of the surfaces. The diameter of each coated pipe shall be obtained at three (3) or more points, spaced at equal intervals between the end points.
- 9.2** The acceptable weight tolerance for any single pipe shall be limited to plus five (5) or minus two (2) percent of the calculated theoretical weight. The theoretical weight shall be calculated using total weight of the pipe with concrete and corrosion coating.

10.0 WEIGHING

- 10.1** The test specimen shall be selected at equal intervals during the course of production.
- 10.2** Contractor shall weigh each pipe when dry prior to transportation and 28 days after placing of concrete and mark the weight with paint on the inside of the pipe. The weight mark shall be followed with letters "DW" meaning Dry Weight.
- 10.3** The acceptable weight tolerance of any single pipe shall be limited to +5% or -2% of the calculated weight of concrete. Calculated weight shall consider only the weight of concrete coating based on approved concrete density and thickness.

In case Contractor opts not to weigh the pipes, the Contractor shall provide 20% extra concrete coating thickness over the specified concrete thickness at no extra cost and time to Company.

11.0 COATING OF FIELD WELDS

The Contractor shall coat the uncoated pipe surface at field welds in accordance with methods approved by Company. Contractor shall submit a detailed procedure for joint coating for Company's approval.

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 galvanized wire to the reinforcement extending from the existing coating.

The reinforcement shall not make direct or electrical contact with the pipe.

Synthetic resin spacer blocks may be used to keep the reinforcement free from the pipe coating. The moulds used for applying the concrete coating shall be supplied by the Contractor. The composition of the concrete shall be the same as that of the concrete coating of the pipe.

When using moulds, the Contractor shall prevent air being trapped by applying mechanical vibrators or by striking the outside of the moulds with sticks.

If the moulds remain around the pipe, e.g., in the case of submerged pipes floated into position, the Contractor shall take appropriate measures to prevent too much water entering the mould. After the mould has been filled with concrete the filling opening must also be closed off by clamping a strip to burlap under the sealing cover.

12.0 INSPECTION AND TESTS

- 12.1** Before application of concrete, two test cubes each per day shall be obtained from batches and tested at the end of 7 days after curing, for compressive strength and specific gravity.
- 12.2** After curing, every length of concrete coated pipe shall be non-destructively tested by 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 costing shall be removed from the pipe lengths.
- 12.3** 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. To this purpose provisions should be made during placing of concrete such as to leave at least a point of exposed steel reinforcement whenever the latter shall terminate inside of concrete coating.
- 12.4** During the tests as per clause 11.3 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 clause 12.0. Repairable concrete coatings shall be clearly marked while the non-repairable once shall be removed from the pipe lengths.

13.0 REPAIRS

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

- 13.1** 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 % of the total thickness of the coating at the point of damage.
- 13.2** Damage due to spalling of an area of less than 0.1 m² (1 square foot) where the remaining concrete is sound and reinforcement steel is not exposed, will be accepted without repairs.

- 13.3** Damage due to spalling of an area of less than 0.1 m² with reinforcement exposed; and area 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 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 and shall be moist cured for a minimum of thirty six (36) hours before further handling.
- 13.4** 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.

14.0 MARKING

- 14.1** Every concrete coated pipe length shall be clearly marked by a suitable type of paint. Markings 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.
- 14.2** 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.

15.0 HANDLING, UNLOADING, STORING AND TRANSPORTATION

- 15.1** Once the pipe sections have been taken on charge, the Contractor, complying with provisions of the contract, shall execute their transport together with other material, either supplied by him or by the Company, from the site of receipt to the coating yard and after concrete coating completion and acceptance, to delivery point at laying field or storage areas as previously established providing each time the necessary storages.
- 15.2** Materials other than pipes and which are susceptible of deteriorating or suffering from damages especially due to humidity or other adverse weather conditions, shall be suitably stored and protected.

- 15.3** 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.
- 15.4** During the operations of loading, unloading and stock-piling, the pipe sections shall be handled in such a way so as to avoid dents, cuts, cracks and other damages especially at beveled ends or damages to protective and/ or concrete coating.
- 15.5** Stacks shall consist of a limited number of layers such that the pressure exercised by the pipes own weight does not cause damage to coating. Stacking with more number of layers shall be agreed upon with the Company 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.



ENERGISING QUALITY

VCS QUALITY SERVICES PVT. LTD.

STANDARD SPECIFICATION FOR FIELD JOINT COATING

VCS – SS – PP - 2012

02	29.04.2022	VCS QMS Integration	RP	MC	HK
01	06.03.2020	RE-ISSUED AS STANDARD	MD	SK	SK
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ABBREVIATIONS:

ASME	American Society of Mechanical Engineers
ASTM	American Society of Testing of Materials
API	American Petroleum Institute
OISD	Oil Industry Safety Directorate

CONTENTS

1.0	SCOPE	5
2.0	REFERENCE DOCUMENTS	5
3.0	MATERIAL AND EQUIPMENT	6
4.0	HEAT SHRINK WRAPROUND SLEEVE SYSTEM PRE-QUALIFICATION	9
5.0	HEAT SHRINK WRAPROUND SLEEVE APPLICATION	8
6.0	INSPECTION AND TESTING	11
7.0	REPAIRS	13
8.0	DOCUMENTATION	13

1.0 SCOPE

This specification covers the minimum requirements of materials, equipment, application and inspection/ testing of the field joint anti-corrosion coating. This specification shall be applicable for buried onshore factory coated pipelines with either three layer polyethylene or fusion bonded epoxy coating by heat shrink wraparound sleeves.

The heat shrink wraparound sleeve shall conform to DIN EN 12068 and the requirements of this specification. Unless modified/ replaced by this specification, all requirements of DIN EN 12068 shall remain fully applicable and be complied with.

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

2.0 REFERENCE DOCUMENTS

The design, materials, fabrication, inspection, testing and supply of heat shrink sleeve shall comply with the latest edition of the following codes and standards.

AMERICAN SOCIETY OF TESTING OF MATERIALS (ASTM)

D – 149	:	Standard Test Methods of Dielectric Breakdown voltage and Dielectric strength of solid electrical insulating materials of commercial frequencies.
D - 257	:	Standard Test Method of D-C Resistance or conductance of insulating material
D – 570	:	Standard Method of Test for Water Absorption of Plastics.

INTERNATIONAL ORGANISATION FOR STANDARDIZATION (ISO)

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)
ISO 8503-1	:	Part 1: Specification and definitions for ISO surface profile comparator for the assessment of abrasive blast clean surfaces.
ISO 8503-4	:	Part 4: Methods for calibration of ISO surface profile comparator and for the determination of surface profile – Stylus instrument procedure

OTHER STANDARDS

DIN EN 12068	:	Cathodic Protection – External organic coatings for the corrosion protection of buried or immersed steel pipelines used in conjunction with cathodic protection-tapes and shrinkable materials
SSPC-SP1	:	Steel Structure Painting Council

COMPANY STANDARD SPECIFICATIONS

Following Company specifications shall form integral part of this specification and shall be complied with when applicable to the works covered in the contract.

VPC-SS-PP-2003 Standard Specification for 3-Layer polyethylene coating of Line Pipes

In case of conflict between various requirements of this specification and reference standards mentioned above, more stringent requirement shall apply unless otherwise agreed by Purchaser.

3.0 MATERIAL AND EQUIPMENT

3.1 GENERAL REQUIREMENTS

Field joint anti-corrosion coating material shall be a heat shrinkable wraparound sleeve 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 3.2 of this specification.

3.1.1 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 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 (Min.)	On Weld Bead (Min.)
< 4"	2.5	2.0
4" – 10"	2.5	2.0
12" – 18"	2.8	2.2
20" – 30"	3.0	2.4
≥ 32"	3.3	2.6

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 Manufacturer's details, HSS details/ Properties and the specific grade of field joint coating system meeting the requirements of this specification. Contractor shall propose only those coating systems that have been previously used for completed pipeline projects of same or higher size than the size indicated in tender, for a length of 50 km and above in a single project for similar operating conditions.

3.1.2 OTHER REQUIREMENTS

The backing material shall be provided with either dimple or other means to indicate that the desired heat during shrinking in the field is attained.

The heat shrink wraparound 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. The sleeve shall be supplied in pre-cut sizes to suit the pipe diameter and the specified overlap requirement.

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.

The pre-heat and application temperatures required for the application of the shrink sleeves shall not result in any damage to the applied mainline coating.

The Contractor shall obtain prior approval from Company regarding the Manufacturer of the field joint coating and the specific grade of the joint coating system proposed. Complete details along with test certificates shall be submitted to Company for this purpose. The said test certificate shall be from an independent DIN recognized/ approved laboratory for all the properties required for the specified EN designation of the field joint coating and the requirements of this specification.

3.2 PROPERTIES OF BACKING

Property of PE backing used as a part of heat shrink wraparound sleeve system shall comply the following:

S No	Property	Test Condition	Unit	Requirement	Test Method
a	Tensile Strength	(+)25°C	N/mm ²	12 min.	DIN EN 12068
b	Ultimate Elongation	(+) 25°C	%	250 min.	DIN EN 12068
c	Dielectric withstand	1000 volts/sec	KV	30 min.	ASTM D 149
d	Volume Resistivity	(+) 25°C	Ohm-cm	1015 min.	ASTM D 257
e	Water Absorption	(+)25°C for 24 hrs.	%	0.05 max.	ASTM D 570

3.3 INSTALLED FIELD JOINT COATING PROPERTIES

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:

- 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 .
- Peel Strength shall be as follows:

Peel Strength		Units	Required 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/min	5.0	Annexure C	
	@ T _{Max.}	N/mm	1.0		
To Factory Coating	@ 23°C	N/mm	5.0		
	@T _{Max.}	N/mm	1.0		
Notes					
T max shall be (+) 60 °C.					

3.4 TEST CERTIFICATES

The Contractor shall ensure that the Manufacturer has carried out all quality control tests on each batch of material and test certificates are provided as per the requirements of this specification. These documents shall be furnished to the Company prior to commencement of field joint coating application. Company reserves the right to have the materials tested by an independent laboratory.

3.5 MATERIAL IDENTIFICATION

All materials shall be identified by the batch number. It shall be the responsibility of the Contractor to ensure that the materials supplied are properly packed and marked with the Manufacturer's Name, material designation, batch number, date of manufacture and shelf life.

Random product batch sampling tests shall be performed at site by the Contractor and the results recorded for review by the Company. Tests shall include, but not be limited to, measurement of backing thickness, dimensional compliance and control batch records compliance.

3.6 MATERIAL STORAGE

All materials shall be stored as per the Manufacturer's recommendation. Sleeves shall upon receipt be examined to check their integrity and their compliance to the specification. The sleeves shall be stored, covered, sheltered from sunlight, and away from excessive heat. Sleeves, which for any reason have undergone visible distortion or contamination, shall be segregated and removed immediately from the installation site. Liquid materials shall be stored and handled such that their original properties are retained.

The material shall not be older than their period of validity at the time of application by the Contractor.

3.7 FACILITIES AND TOOLS FOR FIELD JOINT APPLICATION

The Contractor shall provide and maintain mobile facilities which contain all necessary equipment, tools, tackles, etc. for carrying out the surface preparation and application of field joint coating.

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

- Full circle adjustable 25 kV holiday detector with a visible and audible signal system
- Non-destructive type thickness gauge for measuring thickness of as-applied coating
- Contact type temperature recording thermometer
- Roughness profile measuring instrument

4.0 HEAT SHRINK WRAPROUND SLEEVE SYSTEM PRE-QUALIFICATION

The field joint coating system and its application procedure proposed by the Contractor shall be prequalified during the sleeve installation start-up phase. Five joints shall be coated in compliance with the requirements of this specification and then inspected and tested in respect of the following:

- Surface preparation, including cleanliness, roughness profile and dust contamination
- Pre-heat temperature
- Primer thickness
- Visual appearance and void after sleeve installation on the body, area-adjointing weld seam and adjoining factory applied coating. A strip of 50 mm wide X 200 mm long shall be removed for this purpose.
- Holiday testing
- As-applied coating thickness
- Peel strength test at 23°C and 60°C (between sleeve and pipe surface, between sleeve and factory applied coating & between overlap)

Company Representative shall witness the tests and inspection of coating. Regular application of field joint coating commences only after successful completion of the pre-qualification testing.

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

5.0 HEAT SHRINK WRAPROUND SLEEVE APPLICATION

5.1 GENERAL

The application procedure shall be in accordance with Manufacturer's instruction and the minimum requirements specified below whichever are most stringent and shall be demonstrated to and approved by Company. 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.

5.2 OPERATOR QUALIFICATION

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/ prequalified by the field joint coating manufacturer.

5.3 SURFACE PREPARATION

Oil, grease, salt and other contaminants shall be removed from steel surface by wiping with rags soaked with suitable solvents. Solvent cleaning shall be done in accordance with SSPC-SP1.

5.3.1 BLAST CLEANING

Each field joint shall be blast cleaned using a closed cycle blasting unit or open expendable blasting equipment. With the first equipment type, steel or chilled shot and iron grit shall be used and Garnet material with the second one (in case the authority having jurisdiction have no objection, the contractor may adopt sand blasting instead of garnet material). During blast cleaning the pipe surface temperature shall be simultaneously more than 5°C and more than 3°C above ambient dew point, while the ambient relative humidity shall not be greater than 85%. Prior to surface cleaning the surface shall be completely dry. The surface shall be cleaned to a grade Sa2 ½ 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 start of work in accordance with ISO 8503-3 or ISO 8503-4. The blast cleanliness shall be checked on every joint and the roughness profile shall be checked 1 in every 10 joints.

Dust, grit or foreign matter shall be removed from the cleaned surface by an industrial vacuum cleaner. The contamination allowed shall be of a rating max 2 as per ISO 8502-3. The frequency of checking for dust contamination shall be 1 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.

5.3.2 SURFACE INSPECTION

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 Company Representative and on permission from Company Representative, such defects shall be removed by filing or grinding. Pipes affected in this manner shall be then re-blast cleaned if the defective area is larger than 50 mm in diameter.

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.

5.3.3 PREPARATION OF EDGE OF FACTORY APPLIED COATING

The ends of existing factory applied mainline coating shall be inspected and chamfered. Disbanded portions of the coating shall be removed and then suitably trimmed. Portions where parent coating is removed shall be thoroughly cleaned. The adjacent chamfered areas of the line pipe coating shall also be cleaned and abraded, to expose a clean uniform fresh surface of uncontaminated factory applied coating.

Field joint coating shall be applied on the joints immediately after the completion of cleaning operation.

5.4 PREHEATING

Before placing 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 at minimum four (4) locations uniformly spaced around the pipe circumference.

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.

5.5 APPLICATION OF PRIMER

Upon pre-heating, the pipe surface shall be applied with two pack epoxy primer of wet film thickness of 200 microns or as per manufacturer's recommendation whichever is higher, to cover the exposed bare metal of the welded field joint and 10 mm minimum on to 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 in a shift.

5.6 APPLICATION OF HEAT SHRINK SLEEVE

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 on one side of the pipe at 10 or 2 O'clock position, with the edge of the undergoing layer facing upward and an overlap of minimum 50 mm. Gently heat by appropriate torch the backing and the adhesive of the closure and press it firmly into place.

A heat shrinking procedure using heating torch or induction heaters 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 and change in the visual indicator other means provided on the backing material, to signify proper shrinkage, shall be complete and uniform.

The complete shrinking of the entire sleeves shall be obtained without undue heating of existing pipe coating and providing due bonding between pipe, sleeve and pipe coating. The installed sleeve shall not be disturbed until the adhesive has solidified.

6.0 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

- 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 Company Representative.
- 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 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. Company representative reserves the right to ask for additional measurements at any location on the field joint coating, whenever doubt arises.

6.3 Holiday Detection

The entire surface of each joint shall be inspected by means of a full circle holiday detector approved by Company, set to a DC voltage applicable as per the requirements of factory applied mainline coating specification of Company. 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 Company.

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 Company Representative.

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 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 Company's Representative is satisfied. The test rate can then be reduced as per clause 6.4.1 at discretion of Company's Representative. If either or both of the adjacent two sleeves do not meet the requirements of clause 6.4.2, the field coating shall be stopped.

- 6.4.4** Company Representative reserve the right of 100% removal of sleeves if he is not convinced that the requirements of clause 6.4.2 are achieved.

7.0 REPAIRS

- 7.1** If a field 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.
- Mobilize the expert of manufacturer, if required.
- Test to the complete satisfaction of Company, already completed field coatings.
- Stop the field coating works until remedial measures are taken against the causes of such faults, to the entire satisfaction of the Company.

- 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 Company.

- 7.4** After the coating work on welded joints and repan 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** Company 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 or during CP survey. 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 cost to Company.

8.0 DOCUMENTATION

8.1 PRIOR TO PROCUREMENT

The Contractor shall furnish the following details for qualification of the heat shrink wraparound sleeve Manufacturer and the material, prior to commencement of procurement, for Company approval:

- Comprehensive information as per Section 5.2, DIN EN 12068 along with descriptive technical catalogues
- Test certificates and results of previously conducted tests, for all properties specified in this specification
- Reference list of previous supplies of similar material in the last five years, indicating the project name, pipeline diameter, operating temperature, year of supply, contact person and performance feedback

8.2 PRIOR TO SHIPMENT

- The Contractor shall furnish the following documents, prior to shipment of the materials:
- Test certificates and results as per Manufacturer's quality control procedure for each batch

of materials

- Specific application instructions
- Storage and handling instructions
- Recommended peel strength values corresponding to expected site conditions/ ambient temperatures.

8.3 PRIOR TO FIELD APPLICATION After successful qualification of field joint coating system and its application procedure, the Contractor shall submit a qualification report before commencement of production of field joint coating.



VCS QUALITY SERVICES PVT. LTD.

STANDARD SPECIFICATION FOR HORIZONTAL DIRECTIONAL DRILLED CROSSINGS

VCS – SS – PP - 2013

					
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ABBREVIATIONS

ASME	American Society of Mechanical Engineers
API	American Petroleum Institute
OISD	Oil Industry Safety Directorate (of India)
SMYS	Specified Minimum Yield Strength
PNGRB	Petroleum and Natural Gas Regulatory Board
SMYS	Specified Minimum Yield Strength



CONTENTS

1.0	SCOPE	5
2.0	REFERENCE DOCUMENTS	5
3.0	DESIGN AND ENGINEERING	6
4.0	CONSRUCTION.....	9
5.0	DOCUMENTATION.....	20

1.0 SCOPE

- 1.1. This specification covers minimum technical requirements related to various activities to be performed by an agency/ contractor entrusted with the responsibility to install pipeline at crossings (i.e., Major Rivers, Canals, Highways etc.) using Horizontal Directional Drilling (HDD) technique.
- 1.2. This specification shall be read in conjunction with the requirements of scope of work, all specifications, documents, drawings and other requirements included in the Contract between Company and Contractor.
- 1.3. Contractor shall, execute the work in compliance with laws, by-laws, ordinances and regulations. Contractor shall provide all services, labor, inclusive of supervision thereof, supply of all materials, (excluding "Company supplied Materials") equipment and appliances.
- 1.4. Contractor shall take full responsibility for the suitability and safety of all operations and methods involved in the work.
- 1.5. Contractor shall be deemed to have inspected and examined the work area and its surroundings and to have satisfied himself as far as practicable with 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.
- 1.6. Contractor shall be deemed to have obtained all necessary information with regard to risks, contingencies and all other circumstances, which may influence the work.
- 1.7. Contractor shall, in connection with the work, provide and maintain at his own costs all lights, guards, fencing, as necessary or directed by Company.
- 1.8. For the purpose of this specification, the following definitions shall hold:
 - The words 'Shall' and 'Must' are mandatory.
 - The words 'Should', 'May' and 'Will' are non- mandatory, advisory, or recommended.

2.0 REFERENCE DOCUMENTS

- 2.1 Reference has also been made in this specification to the latest edition (edition in force at the time of issue of enquiry) of the following Codes, Standards, regulations and Specifications.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

- B 31.4 : Pipeline Transportation System for Liquid Hydrocarbons and other Liquids
- B 31.8 : Gas Transmission and Distribution Piping Systems

AMERICAN PETROLEUM INSTITUTE (API)

- RP 1102 : Steel Pipeline Crossing Railroads and Highways

PNGRB REGULATIONS:

- G.S.R 808(E) T4S : Regulations for Natural Gas Pipelines
- G.S.R. Infra/ T4S/ P&PPPL : Regulations for Petroleum and Petroleum products pipelines
- G.S.R. 612(E) T4S : Regulations for CGD Network

COMPANY STANDARDS

- VPC-SS-PP-2001 : Specification for Pipeline Construction (Onshore)
- VPC-SS-PP-2003 : Specification for 3 Layer Polyethylene Coating
- VPC-SS-PP-2014: Specification for Hydro Testing of Onshore Pipelines

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

3.0 DESIGN AND ENGINEERING

- 3.1** The minimum requirements of limits of each river/ major water crossing shall be as defined in the CONTRACT drawings furnished by Company. Contractor may change the limits slightly to suit his equipment and installation technique, with prior written approval from Company.
- 3.2** Within the entire limits of crossing, as defined in the CONTRACT 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/ major water bodies with normal soil, and at least 1.5 meters below the "specified" minimum scour level profile for the river/ major water bodies with rock sub-strata.

3.3 The entry and exit points of the pipeline at ground level shall not come within the limits of crossing as defined for individual river/ major water crossings.

3.4 Wherever the drilled length for a river/ major water crossing includes the crossings of other obstacles such as roads, railroads, canals, streams, etc. Following minimum requirements of cover to the pipe shall be satisfied:

For Road Crossing : 1.2 m from top of road to top of pipe coating

For Railroad Crossing : 7 m from base of rail to top of pipe coating

For Canal/Stream Crossing : 1.5 m from lowest bed level to top of pipe coating

For Drainage Ditches at Road/Railroad : 1.2 m from bottom of ditch to top of pipe coating

3.5 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. Drilled hole shall be checked against collapse/caving under overburden and pipe shall be checked against buckling/collapse under axial tension and bending stresses. Contractor shall submit these calculations to Company for approval.

3.6 Pipeline Axis

As shown in the reference drawing at each crossing, the plane containing the pipe axis shall be perpendicular to the horizontal plane. There shall be no bending of longitudinal pipe axis at depths shallower than two meters below ground level.

3.7 Back-reamed Hole and Pipeline Interface For each crossing, Contractor shall devise a suitable combination of the following in order to optimize the crossing design in terms of pipeline stresses and pull force requirements.

- Back-reamed hole diameter
- Bentonite density
- Pipeline submerged weight in bentonite (and means to achieve that weight)

Contractor shall indicate the maximum shear stress in the pipeline coating that will result due to the above parameters and other design characteristics described in this section. Contractor shall furnish all calculations for Company's approval. If shear stress on pipe

coatings is, in the opinion of Company, beyond the permissible limits, Contractor shall revise the above parameters to reduce shear stress on pipe coating to permissible limits.

- 3.8** Contractor shall determine the minimum allowable elastic bend radius for the pipe from the following considerations:

3.8.1 Pipeline Longitudinal Stress during Installation

Total maximum longitudinal stress in the pipeline due to tension and bending 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.

3.8.2 Pipeline Equivalent Stress during Final Hydrotest

After installation, the pipeline shall be hydrostatically tested to a minimum test pressure equal to 1.5 times the design pressure for gas pipeline and 1.25 times the design pressure for liquid pipeline. The combined equivalent stress in the pipeline due to bending and test pressure shall not exceed 90 % of the SMYS of pipe material.

3.8.3 Pipeline Maximum Equivalent Stress during Service

Permissible values of pipeline maximum equivalent stress during service shall be governed by the requirements of ASME B31.8/ B31.4, as applicable.

- 3.8.4** The minimum allowable radius of curvature for the pipeline shall be the highest value of the minimum pipeline elastic bend radius as computed from the considerations outlined as above (Para 3.8.1 thru 3.8.3) after correction for drilling inaccuracies or multiplication by the factor 1.85 whichever result in the highest permissible value of minimum elastic bend radius.

- 3.8.5** Contractor shall submit all calculations for Company's approval.

3.9 Pipeline Configuration along the Supported 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 SMYS 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 tons. Contractor shall also furnish a drawing of the launching ramp indicating the pipeline configuration. The

distance between each roller shall also be specified. Calculations for roller in this respect shall be submitted.

3.10 Contractor shall, based on results of design and engineering carried out by him, prepare construction drawings for each river/ major water crossing and shall submit the same for Company's approval. Construction drawings shall indicate the pipeline profile with levels furnished at sufficient intervals for proper control during construction. Other relevant details viz. entry and exit angles, radii of bends, 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 Company

3.11 Before commencement of any field work, Contractor shall furnish for Company approval all design calculations as stipulated in Para 3.5, 3.7 thru 3.10 above and all construction drawings. Company shall inform Contractor within 21 calendar days of receipt of such calculations/drawings/data, of its comments/clarifications, if any on the same. Contractor shall incorporate the comments, if any and resubmit the documents for Company approval.

4.0 CONSRUCTION

Contractor shall comply with all the conditions and requirements issued by Authorities having jurisdiction in the area where the work is to be performed. If no public road exists to the crossing location, Contractor shall arrange on his own for access to his work area at no extra cost to Company.

4.1 Installation Procedure

Contractor shall, before commencing any work at site, submit for Company's approval a detailed installation procedure for each river/ major water crossing.

- a) Project Organization Chart indicating Contractor's organizational set-up at site and manpower deployment
- b) Preparation of fabrication yard and launching areas
- c) Details of all equipment to be deployed for preparation of pipe string and installation of crossing. Technical characteristics and capacity of each equipment including instrumentation, monitoring and control equipment shall be furnished in details.
- d) Pipeline string preparation details (hauling, stringing, welding, etc.)
- e) Method of installation covering all steps of construction, viz. rig

up, Calculations for maximum pulling force on the rig and recommended maximum pulling speed and rig anchoring.

- f) Hole collapse and pipe buckling calculations
- g) Pre/post-installation hydrostatic test procedure.
- h) Cold field bending and tie-in details.
- i) Time schedule for construction

Company shall inform Contractor within 21 calendar days of receipt of above installation procedure, of its comments/clarifications, if any, on the same. Contractor shall incorporate the comments, if any and resubmit the documents for Company approval.

The time schedule shall be in accordance with overall time schedule for the project.

Approval by Company of the methods used by Contractor shall in no way relieve the Contractor from the sole responsibility for safe and satisfactory installation of the crossing.

4.2 ROU Preparation

The Contractor is required to perform his construction activities within the width of ROU set aside for construction of pipeline, unless he has made other arrangements with the land owner and/or tenant for using extra land.

Contractor shall clear and grade the length of ROU required for installation of on land portion and drilled river-crossing portion in his scope. Contractor shall do such grading on ROU to provide access to the pipeline construction and to ensure safe construction of pipeline.

Contractor shall ensure that his construction activities shall neither cause inconvenience to public nor shall there be any undue interference with the normal use of the land and watercourses. Minimum necessary trees on ROU to be cut/ felled shall be identified, permissions obtained, recorded and record shall be handed over to Company. The ROU clearing and grading operations shall in no case involve damages/changes of embankment/structures of any type and class without prior approval of the authorities having jurisdiction over the same.

4.3 Taking-over, Handling, Hauling, Storing and Stringing of pipes and other materials

4.3.1 Contractor shall receive and take-over against requisition bare/corrosion coated

line pipes from Company's designated place(s) of issue, as defined elsewhere in the CONTRACT. Contractor shall be fully responsible for the pipe and pipe identification marking from the time of taking delivery from the Company, until such time that the pipes are installed in permanent installation.

4.3.2 Contractor shall perform visual inspection of the bare pipes and coating of the corrosion coated pipes in the presence of Company Representative and all damages shall be recorded. In the case of corrosion coated pipes, Contractor at his option may carry out holiday detection at a prescribed set voltage and record such holidays, in the presence of Company Representative at the time of "taking over". However, if Contractor proposes to perform only visual inspection of coating, then the repair of all the holidays found at the time of installation shall be carried out by the Contractor at no extra cost to Company.

4.3.3 Contractor shall perform visual inspection of the bare pipes and coating of the corrosion coated pipes in the presence of Company Representative and all damages shall be recorded. In the case of corrosion coated pipes, Contractor at his option may carry out holiday detection at a prescribed set voltage and record such holidays, in the presence of Company Representative at the time of "taking over". However, if Contractor proposes to perform only visual inspection of coating, then the repair of all the holidays found at the time of installation shall be carried out by the Contractor at no extra cost to Company.

The Contractor shall be entitled for extra compensation for repair and rectification of defects recorded at the time of taking delivery as per the rates set forth in the 'Schedule of Rates'. Repair of all damages beyond such record shall be the Contractor's responsibility at his cost. Contractor shall be fully responsible for arranging and paying for all/ any storage areas.

4.3.4 Materials which are susceptible of deteriorating or suffering from damages especially due to humidity, exposure to high thermal excursions or adverse weather conditions, shall be suitably stored and protected. Deteriorated materials shall not be used and shall be replaced with no extra cost to Company.

4.4 Pipe String

Complete pipe string shall be prepared as a single string for pulling.

4.5 Repair of Pipe Corrosion Coating

Repair of pipe corrosion coating shall be carried out by Contractor as per relevant specification included in the CONTRACT

4.6 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, 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, compressed air blowing or by other methods approved by the Company. Damaged/corroded pipes shall be kept separate. Each length of pipe shall be examined/ cleaned by pulling through just before being welded.

4.7 Pipe Defects and Repairs

It is Contractor's responsibility to repair all internal and/or external defects. Immediately prior to aligning pipe for welding, the beveled ends of each joint of pipe and the area immediately adjacent thereto (at least 25mm from the edge on the inside and outside of the pipe) shall be thoroughly cleaned of paint, rust, mill scale, dirt or other foreign matter by use of power driven wire buffing wheels, disc sanders, or by other methods approved by Company. This shall be done at no extra cost.

All damaged ends of pipes that are bent, cut or otherwise mutilated such that, in the opinion of the Company, faulty alignment or unacceptable welding would result, shall be repaired or cut-off and relevelled to the correct angle with a beveling machine of a type approved by Company.

Dents in bevels with a depth of less than 1 mm shall be removed by Contractor during cleaning and grinding, ahead of the welding in the field at no extra cost. Contractor shall rebevel dented bevel ends with a depth of dent between 1 mm and 3mm. Dents over 3mm depth shall be repaired by cutting and rebeveling.

4.8 WELDING

Welding of the Pipeline shall be in accordance with Welding Specification and Welding Specification Charts included in the Contract.

4.9 CORROSION COATING OF FIELD WELD JOINTS

The complete field joint shall be blast cleaned to near white metal finish to Swedish standard SIS 055900 Grade SA 2½. The coating edges shall be suitably roughed and chamfered to provide smooth transition. The joint coating material shall be Raychem's "DIRAX" or another Company approved equivalent. The

method of application shall be strictly as per manufacturer's recommendations and will be subject to Company approval prior to use. Coating of field weld joints shall be carried out after pre-installation hydrostatic testing.

4.10 Installation

- 4.10.1** Installation shall be carried out in accordance with approved installation procedures. The entire drilled crossing shall be accomplished in a single operation.
- 4.10.2** Contractor shall ensure that the type of cutting tools and drilling fluids mobilized at site is suitable for the sub-soil strata at the drilling location.
- 4.10.3** Starting of any drilling activity is subject to approval from Engineer-in-Charge based upon the inspection of the rig capacity, number of drilling pipes and other accessories mobilized at site to ensure that the capacity of equipment is in accordance to the approved design document and/ or profile drawings to execute the work successfully.
- 4.10.4** Tracking and locating equipment shall be calibrated by the Contractor in presence of Engineer-in-Charge before the start work. Contractor shall continuously monitor the drilling path, entry & exit angle including depth of profile to ensure that pilot hole drilling is being carried out as per approved profile drawing. The as-drilled pilot hole profile drawing shall be verified by Engineer-in-Charge.
- 4.10.5** The lateral offset of the actual exit point of the pilot hole from the calculated and theoretical exit point shall not exceed two percent 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 one per cent of the crossing length, subject to the condition that the actual exit point shall not be within the limits of crossing as defined in the Contract drawings/ documents.
- 4.10.6** 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 pullback of the pipeline.
- 4.10.7** Contractor shall be responsible for maintaining the drilled hole till such time the pipeline is pulled in.
- 4.10.8** 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.

4.10.9 Contractor shall provide free of charge reasonable facilities to Company's personnel to witness all stages of construction.

4.10.10 Contractor shall be responsible for the integrity of the corrosion coating.

4.10.11 Contractor shall be responsible for the integrity of the common coating and shall apply and necessary approved protective coatings:

Coating inspection of the pipeline after completion of pulling operation shall be made by:

- a. Pulling the pipe to the extent possible with normal rig set up at the exit point.
- b. Excavating the adjacent portion up to and including the first field joint at the exit point.

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 Company, the first pipe length/ joint shall be repaired and/ or replaced as directed by Company. If the coating of second pipe length/ joint is also found damaged, Contractor shall propose further course of action and Company's instructions shall be followed. All works shall be done at no extra cost to Company.

4.10.12 Before final hydrostatic testing, Contractor shall 'prove' the diameter of the pipeline by passing a gauging 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 headers and other equipment, piping and materials and consumable for the purpose.

4.11 Protection of Underground Utilities and Special Methods

Contractor shall obtain plans and full details of all existing and planned underground services from the relevant Local Authorities and be responsible for location and protection of the same.

Where the pipeline crosses other underground utilities/structures, Contractor shall first manually excavate to a depth and in such a manner that the utilities/structures are located. Should any damage to any structure/utility etc. occur, the Owner/Authority concerned shall be contacted by the Contractor and repair shall forthwith be carried out by the Contractor at his expense under the direction and to the satisfaction of Company and the concerned Owner/Authority.

Temporary underpinning or any other type of supports and other protective devices necessary to keep the interfering structure intact shall be provided by the Contractor at his own cost and shall be of such design as to ensure against their possible failure.

4.12 Bending

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 and a straight pipe length of 12 meters (one joint), such that the top of the pipeline is minimum 1.0 meter below the natural ground level.

The cold field bend shall be with minimum bend radius of 21 times the pipe diameter for pipe sizes 12" and below, 30 times the pipe outside diameter (OD) for pipe sizes 14" and 16" and 40 times the pipe diameter for pipe sizes 18" and above as applicable, unless specified otherwise.

Contractor shall use a bending machine and mandrel (if required) and employ approved and accepted methods of bending of coated pipe in accordance with good pipeline construction practice. The procedure shall include amongst other steps- lengths, maximum degree per pull and method and accuracy of measurement during pulling of the bend.

Cold field bends made from coated pipes shall be inspected visually and by holiday detector to locate damages, which shall be repaired by Contractor as per Company's approved Procedures.

The ends of each bent pipe length shall be straight and not involved anyway in the bending. In no event shall the end of the bend be closer than 1.5 meter from the end of a pipe or within one meter of a girth weld.

The ovality of the bent pipe shall not exceed 2.5% of the nominal diameter at any point. A check shall be performed on all bends in the presence of Company by passing a gauge 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 300 mm. Miter bends are not permitted.

4.13 Hydrostatic testing

4.13.1 Pre-Installation Hydrostatic Testing

Contractor shall hydrostatically test the complete pipe string of each river crossing before installation as per approved procedure.

The section of the pipeline corresponding to the crossing shall, before installation, be subjected to a minimum hydrostatic test pressure equal to 1.5 times design pressure for gas pipeline and 1.25 times design pressure for liquid pipeline. The combined equivalent stress in the pipeline due to bending and test pressure shall not exceed 95% of the SMYS of the pipe material.

After the temperature has been stabilized, the pressure shall be maintained in the pipeline for at least 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. If the same is due to failure on account of any cause other than defect in Company supplied material, the repairs shall be done free of cost, to the satisfaction of Company.

4.13.2 Final Hydrostatic Test

The complete water crossing shall be tested after installation. The pressure shall be the same as that specified for pre-installation hydrostatic test at Para 4.13.1 above. The combined equivalent stress in the pipeline due to bending, static head and test pressure shall not exceed 95% of the SMYS of the pipe material. After temperature stabilization, test pressure shall be maintained in the pipeline for a minimum twenty four (24) hours and recorded by manothermograph. The hydrostatic testing shall be carried out in accordance with approved procedures.

4.13.3 Test procedure

Contractor shall prepare for Company's approval a hydrostatic test procedure manual for pre-testing and post-installation testing of pipeline. The test procedure manual shall include, but shall not be limited to, the following items:

- a. For the pipe section to be tested, a diagram indicating all fittings, vents, valves, temporary connections, relevant elevations and ratings. The diagram shall also indicate injection locations and intake and discharge lines.
- b. Estimated amount of test water, water source, including required concentration of corrosion inhibitors and additives, procedure for inhibitor injection and control of concentration.
- c. Filling and flushing procedures, including a complete description of all proposed equipment and instruments (including spares), their location and set-up.
- d. The type and sequence of pigs and the pig tracking system for cleaning and removal of air pockets, pig inspection procedures, including procedure to be followed in case the gauging pig indicates damage.
- e. Procedures for levelling and stabilization after filling and for pressurization and to allow for temperature stabilization.
- 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. All calculations including air-volume calculations and pressure change due to temperature change calculations.
- h. Procedure for detection and location of leaks.
- i. Procedure for safe 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 specifications.
- j. Forms for recording the testing data.

4.13.2 Contractor shall furnish all necessary equipment & instrumentation for performing the work including all temporary piping, hydro test header and pigging headers etc.

4.13.3 The test medium shall be fresh water to be arranged by the Contractor. The water to be used shall be filtered, shall not be contaminated, and free from sand or silt. Contractor shall submit laboratory test reports of water used for testing. Contractor shall provide Company approved corrosion inhibitors, oxygen scavengers and bactericides to be added to

the test water. Contractor shall furnish and install all temporary piping, which may be necessary to connect from source of water to its pumps and manifolds/tankage.

4.13.4 Before filling operation, Contractor shall clean the pipeline by air driven pigs provided with spring loaded brushes and cups to remove all mill scale, rust/sand from the internal of pipe sections.

4.13.5 The hydrostatic test shall be considered as positive if pressure has kept a constant value throughout the test duration, except for changes due to temperature effects, and there is no abrupt pressure drop throughout the test duration.

If test section fails to maintain the specified test pressure after isolation, Contractor shall determine by searching the location of leakage or failure. All leaks and failures within the pipe wall or longitudinal seam shall be repaired by replacement of entire joint or joints in which leakage or failure occurs. In those cases where leaks occur in circumferential welds the method of repair shall be determined by Company. Contractor shall comply with instructions of the Company whether to replace a section of the line pipe that includes the line leak or whether to repair the circumferential weld. This repair should, however, meet the requirements of welding specification contained herein. Where failures occur in pipeline field bends, bends shall be replaced with same degree of bends. After completion of repairs, the hydrostatic test shall be repeated in full, as per the approved procedures.

4.13.6 All work of reinstating line pipe, to replace failures, shall be done in accordance with the specifications contained herein.

Contractor shall haul and stockpile all damaged and defective pipes to storage locations designated by the Company. All cracks and splits resulting from failures shall be coated with an application of grease to preserve the characteristics of failures from corrosion. Joints of failed pipes shall be marked with paint, with a tag indicating failure details, date and location of failure and pressure at which failure occurred.

4.13.7 After completion of successful hydrotest of the above portion, the pipeline shall be capped and buried. Pipeline end position on the banks shall be marked on the ground by installing location markers on both banks approved by Company.

4.14 Permanent Pipeline Markers

On both banks of each river/ major water crossing, Contractor shall install a Navigable Waterway Pipeline Crossing Warning Sign in accordance. Contractor shall supply all materials and fabricate and install the markers as per reference

drawing. Wherever feasible, the pipeline markers shall be installed on the embankments, however, exact location shall be decided based on site conditions and as directed by company.

4.15 Fencing

Wherever specified, Contractor shall supply all materials and install G.I. Wire Chain link security fencing of size 10m x 10m x 2.5m high with lockable steel gate around the pipe ends and test stations for temporary C.P. on both sides of each river/ major water crossing.

4.16 IDLE TIME PRESERVATION OF PIPELINE

When so stated in the Contract, Contractor shall supply all materials and consumable including water and inhibitor and shall install all piping connections, valves, instrumentation, etc., and perform all works for preservation of pipeline by pressurization with inhibited 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 subject to Company's approval prior to use.

4.17 FINAL CLEAN UP

After completion of construction, Contractor shall clear the sites of all balance material and debris. All balance pipe lengths supplied by Company shall be returned to Company's designated stock yard(s), as defined elsewhere in the Contract. Site shall be cleared to the complete satisfaction of Company and authorities having jurisdiction. All such works shall be done at no extra cost to Company. On completion of clean-up, the ROU shall be restored to such stable and usable conditions as may be reasonably consistent with conditions of the ROU prior to laying/ installation of the pipeline.

4.18 Disposal of surplus soil & bentonite slurry & corrosion inhibited test water

Contractor shall arrange for safe disposal of all surplus soil and bentonite slurry & corrosion inhibited test water so as to avoid any harm to the environment/ occupants at locations duly approved by authorities and pollution control boards having jurisdiction and/ or as instructed by Company without any extra cost.

5 DOCUMENTATION

In addition to the documents specified elsewhere in this specification, Contractor shall submit the following documents/ records to Company.

Complete record of pipes 'taken-over' from Company, number of pipe lengths used, and record of return of balance pipe lengths to Company's designated stock-yard(s).

During the course of execution of the crossing, Contractor shall generate/compile the following data and furnish the same whenever required to Company in hard copies and electronic files.

- a. Detailed drilling log and downhole data, including, but not limited to, the following:
 - i) Torque and pulling/pushing force
 - ii) Data on drilling fluid.
 - Density
 - Type of mud and additive employed.
 - Mixing, pumping and cleaning.
- b. Wash and drill pipe data, viz.
 - i) Dimension and material properties.
 - ii) Data on API classification.
 - iii) Age of and type of inspection previously carried out on these pipes.
- c. Permits obtained from authorities having jurisdiction for the various works.
- d. Plan & profile of the drilled hole along with the water level variations.
- e. Records of hydrostatic pre-testing and final testing.
- f. Record of Non-Destructive Testing of welds.
- g. Clearance certificates from the landowners and Authorities having jurisdiction regarding satisfactory clean-up and restoration of pipeline Right of Way and work areas

After completion of construction, Contractor shall prepare and furnish 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 and the 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.

All As-Built drawings shall be prepared using software AutoCAD or above. Manually drafted drawings are not acceptable to Company. In addition, to the hard copies, as built drawings shall also be submitted in electronic media i.e., CD/ DVD.

All documents shall be in English language.



VCS QUALITY SERVICES PVT. LTD.

STANDARD SPECIFICATION FOR HYDROSTATIC TESTING OF ONSHORE PIPELINES

VCS- SS – PP -2014

					
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ABBREVIATIONS

ASME	:	American Society of Mechanical Engineers
API	:	American Petroleum Institute
OISD	:	Oil Industry Safety Directorate (of India)
SMYS	:	Specified Minimum Yield Strength

CONTENTS

1.0	SCOPE	5
2.0	REFERENCE DOCUMENTS	5
3.0	GENERAL REQUIREMENT	6
4.0	TEST PROCEDURE	6
5.0	SAFETY PRECAUTIONS DURING THE HYDROTEST.....	7
6.0	TEST PRESSURE AND DURATION	8
7.0	EQUIPMENT AND INSTRUMENTATION	8
8.0	HYDROSTATIC TESTING.....	11
9.0	CALCULATIONS.....	17
10.0	ACCEPTANCE.....	18
11.0	TERMINATION	19
12.0	TEST REPORT	20
13.0	PRESERVATION OF PIPELINE.....	21
14.0	PRECAUTIONS DURING THE TEST	21
15.0	DOCUMENTATION	22
TABLE 1: DIFFERENCE BETWEEN THE WATER THERMAL EXPANSION FACTOR AND THE STEEL THERMAL EXPANSION		23
FIG. 1- WATER COMPRESSIBILITY FACTOR v/s PRESSURE AND TEMPERATURE.....		27

1.0 SCOPE

- 1.1** This specification covers the minimum requirements of supply and various activities to be performed by Contractor for hydrostatic testing of cross-country steel pipelines transporting hydrocarbons in liquid or gaseous phase under high pressure.

This specification does not cover the requirements of EGP/caliper pigging, drying/ pre-commissioning of the tested pipelines.

- 1.2** This specification shall be read in conjunction with scope of work, specifications, documents, drawings and other requirements indicated in and included in the Contract between the Company and the Contractor. Unless specified otherwise, all sections of this specification shall apply to all specifications referred in this specification

2.0 REFERENCE DOCUMENTS

- 2.1** The latest edition of following Codes and Standards are referenced in this specification and all provisions of these reference codes and standards shall be applicable.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

- ASME B 31.4 : Pipeline Transportation Systems for Liquid Hydrocarbons and Other Liquids.
- ASME B 31.8 : Gas Transmission and Distribution Piping Systems.
- ASME Sec. VIII Div. 1 : Boiler and Pressure Vessels Code - Rules for Construction of Pressure Vessels.

AMERICAN PETROLEUM INSTITUTE (API)

- API RP 1110 : Pressure Testing of Steel Pipelines for the Transportation of Gas, Petroleum Gas, Hazardous Liquids, Highly Volatile Liquids or Carbon Dioxide.

PNGRB REGULATIONS:

- G.S.R 808(E) T4S : Regulations for Natural Gas Pipelines
- G.S.R. Infra/ T4S/ P&PPPL: Regulations for Petroleum and Petroleum products pipelines
- G.S.R. 612(E) T4S : Regulations for CGD Network

- 2.2** In case of conflict between the various requirements of this specification and reference codes, standards, regulations and specifications mentioned above, more stringent requirement shall govern.

3.0 GENERAL REQUIREMENT

- 3.1** The Contractor shall ensure that the complete pipeline section undergoing hydrostatic test is mechanically complete in all respects, i.e welds have been accepted and the pipeline has been laid and backfilled, all mechanical and civil works completed. This has to be ensured keeping in view that, Once the section has been hydrotested, no one shall be authorized to re-open the pipeline section without prior approval of the company. Hydrostatic test shall include those sections which have been previously tested viz. Rail/ road crossings, major water crossings including test on banks and in place after installation.
- 3.2** Hydrostatic test shall be performed on the entire length of the pipeline in accordance with approved Hydrostatic Test procedure and Diagrams clearly indicating the number of test sections and minimum and maximum test pressures in each test sections. The maximum length of each test section shall not exceed 50 Kms.
- 3.3** For pipeline sections (i.e. River Crossing, Railway Crossing, HDD Crossing, National Highway Crossing, etc.) which in Company's opinion, once installed would require an inordinate amount of effort for repair in case of a leak, a provisional pre-test shall be conducted. However, after installation, such pre-tested sections shall be tested again along with the entire pipeline.
- 3.4** All works required for hydrostatic testing shall start only after obtaining prior approval from the Company.
- 3.5** The hydrostatic pressure testing operations shall be carried out by an experienced Test Engineer who shall have no other duty during the hydrostatic testing operations. The Test Engineer(s) shall be in full charge of all activities related to hydrostatic testing operations.
- 3.6** All headers, pre-test headers along with fittings, flanges and attachments shall be pre-tested before putting these for testing purpose.

4.0 TEST PROCEDURE

The Contractor shall submit a comprehensive hydrostatic test procedure to the Company for approval. The procedure shall also include all temporary materials and equipment to successfully complete hydro testing, but not be limited to the followings:

- a) A diagram for the system to be tested, indicating all fittings, vents, valves, temporary connection, relevant elevations and ratings. The diagram shall also indicate injection locations and intake and discharge lines.
- b) A diagram indicating the lengths, elevation charts, and locations of the test sections.
- c) Pipeline details of the test section pipe diameter, wall thickness and material

- d) Source of water for testing and test water discharge location for each test section
- e) Estimated quantity of water for filling and pressurizing
- f) Details of chemicals/ inhibitors and the dosage
- g) Cleaning, gauging, flushing, and filling procedures including type and number of pigs, details of gauging pig.
- h) Procedures for Pig Tracking System (which shall be used in case of pig getting stuck inside pipeline).
- i) Procedures for location and rectification of dents/ buckles/ other deformation, etc.
- j) Temperature stabilization procedure.
- k) Pressure testing procedure including all calculations and test section isolation details.
- l) Procedure for detection, location and rectification of leaks.
- m) Safety precautions and procedures.
- n) Repair procedures for coating damage at thermocouple locations.
- o) Formats to be used for recording the test data.
- p) Procedure for dewatering and neutralization of corrosion inhibitor of the pipeline sections(s) after testing.

The Contractor shall not commence hydrostatic testing activities until the testing procedure is approved.

5.0 SAFETY PRECAUTIONS DURING THE HYDROTEST

The Contractor shall take all necessary safety precautions during the hydrotest. As a minimum, the following shall be taken during the hydrostatic test:

- a) Provision shall be made for the installation of no-admittance signs to unauthorized personnel from the roads to the R.O.U.
- b) Warning signs stating 'PIPELINE UNDER TEST-KEEP OFF' with local language translation shall be placed where the pipeline is uncovered, and particularly where the provisional traps/ test headers and stations are located. Such areas shall be suitably fenced in such a way as to prevent access of unauthorised personnel and no unauthorised personnel shall be closer than 40 m to the testing equipment or pipeline under test. Warning tapes and signboards shall also be placed near the crossings and regular intervals along the route to warn the public around those areas.
- c) The test station shall be placed in such a location as to prevent it from being affected by a catastrophic failure in the test head.

- d) Once dewatering is over the sectionalizing valves and other valve assemblies tested previously, shall be installed at locations shown in the drawings and in accordance with the procedures contained in the relevant specifications.
- e) All thermocouples installed in the pipeline shall be removed and damage corrosion coating shall be repaired using Company approved materials and procedure.

6.0 TEST PRESSURE AND DURATION

6.1 TEST PRESSURE

Unless otherwise specified in the Contract, the minimum hydrostatic test pressure for different classes shall be as follows:

For pipeline handling hydrocarbon in gaseous phase:

Class 1	:	1.25 times the design pressure as per ASME 31.8
Class 2	:	1.25 times the design pressure as per ASME 31.8
Class 3 and Class 4	:	1.5 times the design pressure as per ASME 31.8

For pipeline handling hydrocarbon in liquid phase:

All Location	:	1.25 times the design pressure for pipeline Handling liquids including Liquefied Petroleum Gas (LPG).

The test pressure shall be generated at the highest point in the section under test. At any point in the test section, hoop-stress due to test pressure and static head shall not exceed 95% of the Specified Minimum Yield Strength (SMYS) of pipe material.

6.2 TEST DURATION

The duration of the hydrostatic test shall be 24 hours after thermal stabilization.

7.0 EQUIPMENT AND INSTRUMENTATION

The Contractor shall provide all necessary equipment and instrumentation for performing the work as stated in cleaning, flushing, filling, stabilizing, testing, dewatering procedures.

7.1 EQUIPMENT

The equipment to be provided shall include, but not be limited to, the following in sufficient numbers along with spares:

- a) Pigs for cleaning, gauging, flushing and filling.

Cleaning pigs with spring loaded steel wire brushes. For internally coated pipes, the pigs shall be provided with nylon/polyurethane brushes. . The first Cleaning pig shall be equipped with pig tracking device with a minimum battery span of 72 hours.

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- Four cup batching pigs / Bi Directional Pigs
 - Magnetic Pigs
 - Gauging pigs fitted with gauge plate.
- b) The Contractor shall provide a sufficient number of pigs, including spares Fill pumps:
- The Contractor shall determine the type and number of fill pumps in order to guarantee the following:
- Differential head : 20% greater than the maximum required
 - Flow rate : Minimum ~~400~~ 200 m³/hr; Maximum ~~1000~~ 500 m³/hr for 24" and above pipeline.
- : Minimum ~~200~~ 100 m³/ hr; Maximum 400 m³/ hr up to 18" Pipeline
- If a single pump is used, a standby unit must be available.
- c) Pressurizing pump:
- Variable speed positive displacement pumps equipped with a stroke counter to pressurize the pipeline, capable of generating pressure of 20 bar (g) over and above the required test pressure of the section. Contractor shall also ensure availability of standby pressurizing pump.
- d) Two Positive displacement meters/ Turbine meters to measure the volume of water used for filling the line. These meters shall be provided with a calibration certificate not older than three months.
- e) Portable tanks/ Break tanks of sufficient size to provide a continuous supply of water to the pump during filling and pressurizing.
- f) Injection facilities to inject chemicals/ inhibitors into the test medium in the required proportions.
- g) The temporary test header shall be installed at both ends of section. Proper piping and valving arrangements shall be available to allow launching and receiving of each pig independently

The test heads shall be sized in conformity with ASME specification Section VIII, Division 2 with particular reference to Appendices 4 and 5.

7.2 INSTRUMENTATION

The instrumentation to be provided shall include, but not be limited to, the following in sufficient numbers along with spares:

- a) Calibrated Bourdon pressure gauges of suitable pressure range and accuracy.
- b) Dead weight testers with an accuracy of 0.01 bar, measuring with least count of 0.05 bar and provided with a calibration certificate not older than three months.

- c) 48 hours recording pressure gauges complete with pressure recording charts duly tested with dead weight tester prior to use. These shall be installed at the test head. The gauge shall having following specification:

Accuracy : $\pm 0.1\%$ of the full-scale value

Recording : continuous on tape or disk, graph width 100 mm

Feed : 7.5 °/ hr for disk diagrams, 20 mm/ hr for tape diagrams

Recording : Range to be such as to record pressure between 50% and 90% of the diagram width

- d) Temperature recorders for fill water.

Accuracy : $\pm 1\%$ of the scale range

Scale -10 °C to +40 °C

recording : continuous on tape or disk, graph width 100 mm

Feed : 7.5 °/ hr for disk diagrams, 20 mm/ hr for tape diagrams

- e) Environmental temperature shall be recorded from the beginning of pressurization to the end of the test by means of a recording thermometer featuring the following characteristics:

Accuracy : $\pm 1\%$ of the scale range

Scale - 0 °C to + 60 °C

Recording : continuous on tape or disk, graph width 100 mm

Feed : 7.5 °/ hr for disk diagrams, 20 mm/ hr for tape diagrams

- f) Thermocouples for measuring the pipe wall temperatures, with an accuracy of ± 0.1 °C

- g) Two laboratory thermometers of range 0 °C to 60 °C and with accuracy of ± 0.2 °C to be used in thermo wells.

- h) Means to measure the volume of water necessary to drop the line pressure by 0.5 bar (container with scales or graduated cylinder).

- i) Injection facilities to inject additives into the test medium in the required proportions.

- j) Communications equipment stable for a continuous connection between the beginning and the end of test section and with the inspection team along the line, in accordance with the requirements of local authorities.

- k) The temporary scraper traps shall be installed according to the test section fixed in the test procedure manual. Proper piping and valve arrangements shall be available to

allow launching and receiving of each pig independently.

The test heads shall be sized in conformity with ASME specification Section VIII, Division 2.

l) Thermocouples for measuring the temperature of the pipe wall shall be installed on the pipeline to be tested at the following locations:

- One (1) thermocouple at about 500 m distance from the pumping head.
- One (1) thermocouple every 2500 m of the pipe. The spacing may be increased to maximum 5000 m depending on the terrain and nature of sub soil along the alignment of test section.
- One (1) thermocouple at about 500 m distance from the terminal head

Thermocouples shall be attached on the external surface of the pipe after removal of external coating and shall be adequately protected by padding with minimum 500 mm soil. After successful testing, the thermocouples shall be removed and damaged coating shall be repaired as per applicable coating repair procedure, approved by Company. For soil temperature measurements, the thermocouple shall be buried at pipe centerline depth at a distance of 500 mm from the pipe wall.

m) Digital pressure/ temperature monitoring and chart recording systems can be used in lieu of the components listed above provided that the individual pressure/ temperature sensors included in the system have a level of accuracy and can be field calibrated in a manner similar to those instruments listed above. Instruments shall be portable and rugged in construction with minimum weather proof rating of IP-66. They shall display pressure and temperature readings on the screen and shall have adequate memory for recording the same. The instrument shall have computer interface to export the stored data after completion of test.

8.0 HYDROSTATIC TESTING

8.1 Equipment and/ or parts which need not or must not be subjected to the test pressures or which must not be tested with water, must be disconnected or separated from the pipeline to be tested.

8.2 If the difference of minimum and maximum atmospheric temperature should cause thermal instability on the pipe section directly exposed to atmospheric condition, the test header and above ground pipeline shall be properly protected.

The pipeline test shall exclude long segments of line exposed to atmospheric conditions, viz. aerial lengths on piers, suspension bridges, etc. Such sections shall be tested separately.

8.3 TEST MEDIUM

The test medium shall be soft non-aggressive water supplied by the Contractor. The water to be used shall be filtered, shall not be contaminated and free from sand or silt. Contractor shall submit laboratory test reports of water used for testing. The possible use of sea water shall be subjected to its degree of cleanness, the possibility of obtaining a pre-determined salinity neutralization. The

Contractor shall furnish and install all temporary piping, which may be necessary to connect from source of water to its pump and manifolds/ tankages.

8.4 INHIBITORS

Contractor shall provide Company approved corrosion inhibitors, oxygen scavengers and bactericides to be added to the test water.

Contractor shall note the following:

- All chemicals for hydro testing shall be procured from approved vendors. Chemicals older than three months shall not be used.
- Company representative shall inspect the chemical containers and take random samples prior to its use. Contractor shall get the samples tested in a govt nominated Govt./PSU/other competent laboratories. Contractor shall get the samples tested, testing shall be carried out for accelerated % corrosion inhibition efficiency, % SRB and TBC killing efficiency test. Company reserves the right to witness the testing. The test report shall be submitted to Company for approval prior to undertaking hydro testing works.
- Only those chemicals which have passed the above tests shall be used for hydro testing.
- Chemicals shall be injected by dosing pump only and mixing in open tank shall not be allowed.

Inhibitors shall be uniformly mixed with the test water in the dosage recommended by the Manufacturer depending upon the water used and in sufficient concentration to ensure the inhibitor remains active for the duration of the test, and any possible delays to testing.

The following products are acceptable for corrosion inhibition of the water used for hydro testing:

- REMIDOL 4000 of M/s Chemtreat India Ltd., Navi Mumbai.
- HIBITOL 2000 of M/s Renkal Chemical, Navi Mumbai.
- INDION 175 of M/s Ion Exchange India Ltd., Hyderabad.
- VISCO 3900 of M/s NALCO EXXON

Indicative dosage for inhibitor is as follows:

• Upto 6 months	:	500 mg/l
• Above 6 months	:	750 mg/l

However, the exact dosage rates shall be as per the hydro test water analysis and manufacturer recommendations.

8.5 CLEANING

Before filling operation, the Contractor shall clean the pipeline by air driven pigs

provided with spring loaded nylon/polyurethane brushes for internal coated Pipes & wire brush cleaning pigs for internal uncoated pipes to remove all mill scale, rust, sand, etc. from the inside of pipe section. For this purpose, temporary headers for air cleaning shall be attached to the pipeline. The number of pig runs depends upon the cleaning results and shall be determined by the Owner/Consultant at site.

Water column of 1- 2% of test section shall be injected in front of the first cleaning Pig for flushing.

8.6 Magnetic Pigging

After the successful acceptance of cleaning, Magnetic pig run shall be used to clean "constructional metallic debris" of the pipeline.

For internally coated pipes, adequate care shall be taken by using soft cups so that no damage takes place to the internal coating of the pipe.

Contractor shall decide the number of magnet cleaning pig runs and the choice of the magnet cleaning pig for each cleaning run as suitable for the purpose to obtain internal condition adequately clean.

However, the ferrous debris permitted with magnetic cleaning pig shall not exceed 5 Kg/100KM. In case debris received is more than this amount, the Contractor shall be required to make subsequent run(s) until at least the above limit is achieved.

The cleaning pigs for successive cleaning pig runs shall be selected by the Contractor in such a manner that effective cleaning i.e. 3kg/100km ferrous debris is achieved.

The best accuracy offered and guaranteed by the Contractor shall be clearly spelt out. However, the tool should have minimum capabilities as under.

Type of pig: Uni-directional

Magnet power: Min 800 gauss

Nos. of magnets: 8/6 nos.

Min. bend radius pig can negotiate: 6D

Min dia pig can negotiate: 90% standard wall thickness ID

8.7 GAUGING

After cleaning the pipeline by using air and acceptance by Company, gauging shall be carried out by using gauging pig. The gauge plate diameter shall be equal to 95% of inside diameter of the heaviest wall pipe in the test section. While computing the Inside Diameter (ID) of heaviest wall pipe, pipe manufacturing tolerances shall not be considered. A 10 mm thick aluminum plate shall be used for making gauge plate. The gauging plates shall have 8 radial incisions at 45

degree interval. Compressed air shall be used to run Gauging pig.

After receipt of gauging pig at the other end, the gauge plate shall be inspected in the presence of Company representative. A deformed, bent or severally nicked plate or damaged pig shall be evidence of gauging pig run failure and the same shall not be acceptable to COMPANY. In such cases, the Contractor shall locate any obstruction and/ or faults such as dents, buckles, flat spots, etc. and rectify the same to the satisfaction of the Company. A written approval shall be obtained from Company regarding successful completion of gauging pig run. Photographs of the Gauge Plate before and after the gauging run shall be taken and included in the inspection report.

After acceptance of gauging operation, air header shall be cut and removed. Pre-tested test headers loaded with three numbers of four cup batching pigs shall be welded to test section.

The drawing of the test headers shall be submitted along with hydrotest procedure for approval. All fittings and flanges to be used in the test header fabrication shall be at least one ANSI rating higher than the line rating. The headers shall be pretested at line hydrotest pressure for duration of minimum 24 hours. The record shall be kept and shall be part of the final hydro test report.

8.8 WATER FILLING

After acceptance of gauging run, water filling of the testing section shall commence. For this purpose, pretested test headers loaded with three numbers of four cup batching / Bi -Directional pigs shall be welded to the test section. Weld joints between test header and pipeline shall be radiographed and accepted before filling operation starts.

Un-inhibited water equal to 10% of the volume of test section shall be filled ahead of the first pig. The first batching pig shall be launched using minimum un-inhibited water equivalent to 1.5 Km of test section for longer sections and 0.5 Km for short sections below 10 Km. Then the second pig shall be launched using inhibited water till the second pig is received at the other end. The Contractor shall continuously monitor the volume and pressure, the temperature of the fill water during the filling operation. When it has been confirmed that the filling pigs have arrived in the receiving test header, the thermal stabilization and pressurization operations can commence subsequently.

The temperature of the fill water should be recorded as it is introduced into the pipeline. This will aid in the determination of line temperature stability. Additionally, the flow rates and pressures should also be recorded or monitored to protect the pipeline from an over pressure situation.

8.9 THERMAL STABILIZATION

After a check has been made to confirm if the pressure has attained minimum 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 and in the soil.

Temperature readings shall be made at 2 hours-intervals. Thermal stabilization 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.

Thermal stabilization completion shall be approved by Company.

8.10 PRESSURIZATION

8.10.1 The pressurization shall be performed in the presence of Company at a moderate and constant rate not exceeding 2 bars/ min. One pressure recording gauge shall be installed in parallel with the dead weight tester. Volume required to reach the test pressure shall be recorded periodically throughout the pressurization as follows:

- Each 5 bar increments up to 80% of test pressure as recorded by the dead weight tester
- Each 2 bar increments between 80% to 100% of test pressure as recorded by the dead weight tester
- It is preferable for a pressure-volume plot to be initiated at the start of the pressurization process and continued until the test pressure is reached. The lower end of the pressure-volume plot can be used to determine the total amount of residual air in the test section. The upper end of the pressure volume plot can be used to determine if any pipe in the test segment may have reached its elastic limit.

8.10.2 The pressurization shall be cycled according to the following sequence:

- Pressurize to 50% of test pressure, hold pressure for 1 hour,
- Drop pressure to 10% of test pressure of test section at test head,
- Pressurize to 75% of test pressure, hold pressure for 1 hour
- Drop pressure to 10% of test pressure of test section at the test head
- Pressurize to test pressure.

During the pressurization to each test pressure (50% & 75%), two tests shall be carried out for the calculation of air volume in the pipeline under test.

In case, during the hold pressure periods indicated above, a decrease in pressure is observed, the above operations shall not be repeated more than twice, after which the line shall not be considered capable of test, until the Contractor has isolated and eliminated the cause for the lack of water tightness.

8.11 AIR VOLUME CALCULATION.

Two separate consecutive pressures lowering of 0.5 bar shall be carried out after pressurizing to test pressure in order to check the presence of air in the pipeline.

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_p) corresponding to the pressure lowering that has been carried out, by using the procedure outlined in clause 9.1 of this specification.

If no air is present in the length under test, then $\frac{V_I}{V_D} = 1$

In order that the above ratio is acceptable, it shall not differ by more than 6% (i.e. 1.06). If the air found in the pipeline is within the above established tolerance, then the pressurizing can continue. If the ratio V_I / V_D exceeds 1.06, the hydrostatic testing cannot go on and additional pig passages shall be performed to remove the air pockets.

The test shall be repeated as per the above procedure until above estimated tolerances are satisfied. The pressurizing can then continue, to reach the value of the test pressure.

8.12 TESTING

The section shall be pressurized to the test pressure after the air volume test has given acceptable results. When temperature and pressure has stabilized, the injection pump, pressuring pump shall be disconnected and all connections at the test heads shall be checked for leakage. The test pressure shall be held for a minimum of 24 hours after stabilization. The pressure recorders shall then be started with the charts in a real time orientation for continuous recording throughout the test.

During the testing period the following measurements shall be recorded

- Pressure measurements from dead weight tester: Every hour
- Soil temperature and the pipe temperature at the thermocouples: Every two hours

All data shall be recorded on appropriate forms attached to the hydrostatic test procedure manual. Care shall be taken that the maximum test pressures are not exceeded. Bleed-off water shall be accurately measured and recorded.

8.13 MEASUREMENTS

8.13.1 WATER AMOUNT MEASUREMENT

The quantity of water added to the test section shall be measured during the filling stage through a positive displacement meter (a turbine meter may also be used).

The quantity of water added during pressurization shall be measured during the pressurization stages.

8.13.2 PRESSURE MEASUREMENT

Pressure shall be measured with a dead weight tester that shall permit readings with least count of 0.05 bar. The pressure shall also be recorded by means of a recording pressure gauge. The recording pressure gauge shall be checked by means of a dead weight tester at the beginning, during and at the end of the hydrostatic test.

Accuracy : $\pm 0.1\%$ of the full-scale value

Recording : Continuous on tape or disk, graph width 100mm

Feed : 20mm/h for tape diagrams, 15°/h for disk diagrams

Recording range : To be such as to record pressure between 50% and 90% of the diagram width.

8.13.3 TEMPERATURE MEASUREMENT

- Water temperature shall be taken at every 2 hours through the thermocouples that have been installed on the pipe wall along the section.

In addition, the temperature measurement shall be taken during filling operation, thermal stabilization stage and during the pressure hold period.

The thermocouples' sensitivity shall enable temperature readings with the accuracy of $\pm 0.1^\circ\text{C}$.

- Water temperature shall also be measured at the pump delivery through a recording thermometer throughout the filling stage.

The recording thermometer shall feature the following characteristics:

Accuracy : $\pm 1\%$ of the scale range

Scale : -10° to $+40^\circ\text{C}$

Recording : Continuous on tape or disk, diagram width 100mm

Feed : 20mm/h for tape diagrams, 15°/h for disk diagram

- Ground temperature shall be taken by measuring soil temperature at the thermocouples prior to starting the filling operation.
- Ambient temperatures shall be recorded from the beginning of pressurization to the end of the test by means of a recording thermometer.

Accuracy : $\pm 1\%$ of the scale range

Scale : 0° to $+60^\circ\text{C}$

Recording : Continuous on tape or disk, diagram width 100mm

Feed : 20mm/h for tape diagrams, 15°/h for disk diagrams.

9.0 CALCULATIONS

- 9.1** 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 pressurizing the section shall be calculated by means of the following formula:

$$V_p = \left(0.884 \frac{\pi}{t} + A \right) \times 10^{-6} \times (V_t) \times (\Delta P) \times K$$

Where:

V_p = computed water amount required to raise by P the pressure in the section to be tested (m^3)

- V_t = geometrical volume of the section (m^3)
- ΔP = pressure rise (bar)
- r_i = 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}) $\times 10^6$ (Refer water compressibility factor v/s pressure and temperature charts. For temperature above 30°C the values may be extrapolated.)
- K = A dimensionless coefficient that is equal to a value of 1.02 for longitudinally welded pipe.

9.2 The pressure change due to a water temperature change shall be calculated through the following formula:

$$\Delta P = \frac{B}{0.884 \frac{\pi}{t} + A} \Delta T$$

Where:

- 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 ($^{\circ}C^{-1} \times 10^6$) (Refer Table1)
- A = Isothermal compressibility value of water as estimated at the pressure and temperature values obtained at the end of test (Refer Figure 1)
- K = A dimensionless coefficient that is equal to a value of 1.02 for longitudinally welded pipe.
- r_i = nominal inner radius of the pipe (mm)
(In case of the test section having multiple wall thicknesses, "ri" shall correspond to the wall thicknesses, having the maximum total length in the given test section.)
- t = nominal pipe thickness (mm)

10.0 ACCEPTANCE

10.1 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 under clause 9.2 of this

specification.

The pressure change value as a function of temperature change shall be algebraically added to the pressure value as read on the meters. The pressure value thus adjusted shall be compared with the initial value and the test shall be considered as acceptable if the difference is less than or equal to 0.3 bar. In case of doubt the testing, period shall be extended by 24 hours.

- 10.2** If test section fails to maintain the specified test pressure after isolation, Contractor shall determine the location of leakage or failure by suitable means. All leaks and failures within the pipe wall or weld seams shall be repaired by replacement of entire joint or joints in which leakage or failure occurs. In those cases where leaks occur in circumferential welds, the method of repair shall be determined by the Company. Contractor shall comply with instructions of the Company whether to replace a section of the line pipe that includes the line leak or whether to repair the circumferential weld. This repair should, however, meet the requirements of applicable welding specification enclosed with the Contract. Where failures occur in pipeline field bends, bends shall be replaced with same degree of bends. After completion of repairs, the hydrostatic test shall be repeated in full, as per this specification.
- 10.3** The cost of repairs or replacements, followed by refilling and depressurizing the line, due to poor workmanship, shall be borne by the Contractor. In the event of leaks or failures resulting from faulty Company furnished materials, Contractor shall be reimbursed as per the provisions of Contract. All work of reinstalling line pipe, to replace failures, shall be done in accordance with the relevant specifications included in the CONTRACT.
- 10.4** Contractor shall haul and stockpile all damaged and defective pipes to storage location designated by the Company. All cracks and splits resulting from failure shall be coated with an application of grease to preserve the characteristics of failures from corrosion. Joint of failed pipes shall be marked with paint, with a tag indicating failure details, date and location of failure and pressure at which failure occurred. Failed pipes shall have pipe number and heat number clearly marked on the outside surface along with warning sign to prevent re-usage.

11.0 TERMINATION

After the positive result of testing and all the data have been gathered, the test shall be terminated upon written approval given by the Company. The pipeline shall be slowly depressurized at a moderate and constant rate as instructed by Company. Subsequent operations such as installation of sectionalizing valves, caliper pigging, swabbing, pre-commissioning checks, purging/ inertising and commissioning shall be carried out as per the relevant specifications.

- 11.1** All thermocouples installed in the pipeline shall be removed and damaged coating shall be repaired using Company approved materials and procedure.
- 11.2** Contractor shall dewater the tested line as per the following requirement after test acceptance.

The dewatering shall be carried out by using four cup pigs and foam pigs driven by compressed air. The detailed dewatering procedure shall be deployed by the Contractor in such a way as to provide adequate control of pigs during dewatering. Pigs and equipment required for dewatering the line shall be furnished by Contractor and shall be approved in advance by the Company. Four cup pigs run shall be made through the line to displace the water. Foam pigs shall then be passed in order to complete the line dewatering. Contractor shall use a number of foam pigs each in different colors/ numbered for this purpose. The line shall be considered dewatered when a negligible amount of water is flushed out by the last foam pig and approval is given by the Company.

11.3 During dewatering, care shall be taken to properly dispose the discharging water in order to avoid pollution, damages to fields under cultivation and/ or existing structures and interference with the traffic. Before the start of dewatering and disposal of hydro test water, a procedure for treatment of inhibited water to prevent pollution shall be submitted by Contractor to Company for review and approval.

11.4 Upon completion of the testing and dewatering operation, any provisional traps/ headers for pigs and all other temporary installation relating to the test shall be removed. Subsequently, the individual sections of the line already tested shall be joined in accordance with the requirements of relevant specifications issued for the purpose.

12.0 TEST REPORT

A complete report signed by Contractor and the Company shall be submitted upon completion of the hydrostatic test for each test section.

This report shall contain as a minimum:

- Pressure at high and low elevations;
- Elevation & Pressure at test point;
- Water test certificate;
- Inhibitor test certificate;
- The cleaning, gauging, flushing, filling and testing procedures used;
- Schematic layout of cleaning, filling and testing facilities;
- Section Elevation Plot;
- Equipment's and Instruments calibration certificate;
- A profile of the pipeline that shows the test sites, all instrument and injection connections;
- Pipe filling logs and records;
- Additive specification, required concentration and additive injection records;
- Pig specifications;
- Pig inspection records including photographs of the damages; records of gauging pig survey and photographs;
- Pressurization and stabilization records;
- Pressure and temperature recording charts with appropriate information

inscribed thereon;

- Temperature data along the pipeline;
- Dead weight tester logs and recordings;
- Air volume calculations;
- Pressure Vs Volume plot
- Pressure changes due to temperature change calculations;
- Environmental data;
- Depressurization logs and records;
- Dewatering procedure and schematic layout of relevant facilities; dewatering logs and records;
- Records and photographs of all leaks, if applicable.

13.0 PRESERVATION OF PIPELINE

When so stated in the CONTRACT, to preserve/ conserve the pipeline for a specified duration, Contractor shall completely fill the pipeline with water, with sufficient quantity of corrosion inhibitors depending upon quality of water and the period of conservation, at a pressure as per relevant specification/ Contract. Contractor shall obtain necessary approval from the Company of the procedure, type and quality and quantity of inhibitors used before commencement of the works.

14.0 PRECAUTIONS DURING THE TEST

In addition to all that has been expressly described in the procedures for carrying out the tests, the following additional requirements shall be complied with:

1. Provision shall be made for the installation of no-admittance signs to unauthorised personnel from the roads to the R.O.U.
2. Signs stating 'PIPE UNDER TEST-KEEP OFF' with local language translation shall be placed where the pipeline is uncovered, and particularly where the provisional traps and stations are located. Such areas shall be suitably fenced in such a way as to prevent access of unauthorised personnel. No unauthorised personnel shall be closer than 40M to the pipeline or equipment under test.
3. Provisional scraper traps shall be installed in compliance with methods and suitable location so that their rupture cannot cause any injuries to the personnel or third parties
4. The test station shall be placed in such a location as to prevent it from being affected by a catastrophic failure in the test head.
5. Once dewatering is over the sectionalising valves and other valve assemblies tested previously, shall be installed at locations shown in the drawings and in accordance with the procedures contained in the relevant specifications. All thermocouples installed in the pipeline shall be removed and damaged corrosion coating shall be repaired using Company approved materials and procedure.

15.0 DOCUMENTATION

PRIOR TO COMMENCEMENT OF HYDROSTATIC TEST

The Contractor shall furnish the Hydrostatic Test Procedure at least six weeks prior to commencement of hydrostatic test operations for the approval of the Company Representative. Hydrostatic test operations shall commence only after obtaining written approval from Company.

Prior to commencement of the testing, copies of certifications, calibrations, etc of any equipment/ instrumentation to be incorporated in the test set-up shall be submitted to the Company Representative.

ON COMPLETION OF HYDROSTATIC TEST

The Contractor shall furnish the Test Report duly signed by both the Contractor and the Company Representative, immediately upon completion of successful hydrostatic test.

**TABLE 1: DIFFERENCE BETWEEN THE WATER THERMAL EXPANSION FACTOR AND
THE STEEL THERMAL EXPANSION**

FACTOR ($^{\circ}\text{C}^{-1} \times 10^6$)

$^{\circ}\text{C}$ 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	19.98
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	-70.4	-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	-81.9	-63.84	-46.43	-29.6	-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	-40.1	-23.54	-7.56	7.92	22.89	37.89
80	-71.6	-53.96	-36.94	-20.51	-4.65	10.7	25.55	39.94
90	-68.16	-50.66	-33.77	-17.47	-1.73	13.5	28.23	42.5
100	-64.72	-47.35	-30.6	-14.43	1.18	16.29	30.9	45.05
110	-61.28	-44.05	-27.43	-11.38	4.1	19.08	33.58	47.67
120	-57.84	-40.74	-24.26	-8.34	7.02	21.88	36.26	50.18
130	-54.4	-37.44	-21.08	-5.29	9.95	24.68	38.94	52.75
140	-50.96	-34.13	-17.9	-2.25	12.87	27.49	41.63	55.32
150	-47.53	-30.83	-14.73	0.8	15.79	30.29	44.31	57.89
160	-44.1	-27.53	-11.56	3.85	18.72	33.1	47	60.46
170	-40.67	-24.23	-8.4	6.89	21.64	35.9	49.69	63.04
180	-37.24	-20.94	-5.23	9.94	24.56	38.7	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	30.4	44.3	57.75	70.77
210	-27.02	-11.09	4.25	19.04	33.31	47.1	60.43	73.34
220	-23.63	-7.82	7.4	22.06	36.22	49.9	63.12	75.9
230	-20.24	-4.56	10.54	25.08	39.13	52.69	65.8	78.48
240	-16.87	-1.3	13.67	28.1	42.03	55.48	68.48	81.05
250	-13.5	1.94	16.79	31.11	44.92	58.26	71.15	83.61
260	-10.14	5.17	19.9	34.12	47.81	61.04	73.81	86.81
270	-6.8	8.39	23	37.11	50.69	63.8	76.48	88.73
280	-3.48	11.6	26.11	40.09	53.56	66.57	79.14	91.29
290	-0.17	14.8	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

**TABLE 1: DIFFERENCE BETWEEN THE WATER THERMAL EXPANSION FACTOR AND
THE STEEL THERMAL EXPANSION**

FACTOR ($^{\circ}\text{C}^{-1} \times 10^6$)

$^{\circ}\text{C}$ bar	9	10	11	12	13	14	15	
0.981	34.82	49.22	63.2	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	95.7	108.26	120.49	
40	44.18	58.14	71.7	84.87	97.68	110.14	122.28	
50	46.6	60.45	73.9	86.96	99.68	112.04	124.07	
60	49.02	62.76	76.1	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	67.4	80.53	93.29	105.69	117.76	129.5	
90	56.32	69.73	82.75	95.41	107.7	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	83.8	96.18	108.21	119.9	131.2	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	124.01	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	88.3	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	157.3	
240	93.22	105.03	116.48	127.6	138.42	148.93	159.18	
250	95.69	107.39	118.74	129.76	140.48	150.9	167.05	
260	98.14	109.74	121	131.92	142.54	152.87	162.93	
270	100.6	112.1	123.25	134.08	144.61	154.84	164.81	
280	103.05	114.44	125.5	136.24	146.67	156.84	166.69	
290	105.5	116.79	127.75	138.39	148.73	158.78	168.57	
300	107.94	119.13	130	140.54	150.79	160.75	170.45	

**TABLE 1: DIFFERENCE BETWEEN THE WATER THERMAL EXPANSION FACTOR AND
THE STEEL THERMAL EXPANSION**

FACTOR ($^{\circ}\text{C}^{-1} \times 10^6$)

$^{\circ}\text{C}$ bar	16	17	18	19	20	21	22	23
0.981	127.52	139.41	151	162.3	173.37	184.18	194.75	205.08
10	129.02	140.83	152.36	163.6	174.56	185.3	195.79	206.07
20	130.71	142.42	153.85	165	175.9	186.55	196.96	207.16
30	132.4	144.02	155.35	166.4	177.23	187.8	198.14	208.26
40	134.1	145.62	156.87	167.9	178.58	189.07	199.33	209.37
50	135.8	147.24	158.39	169.3	179.93	190.34	200.52	210.49
60	137.51	148.86	159.92	170.7	181.29	191.62	201.72	211.61
70	139.22	150.49	161.46	172.2	182.66	192.91	202.93	212.74
80	140.95	152.11	163	173.6	184.03	194.2	204.14	213.88
90	142.67	153.75	164.56	175.1	185.41	195.5	205.36	215.03
100	144.42	155.4	166.11	176.6	186.8	196.8	206.59	216.17
110	146.15	157.04	167.66	178.1	188.2	198.12	207.82	217.33
120	147.9	158.7	169.24	179.5	189.59	199.44	209.06	218.49
130	149.65	160.36	170.81	181	191	200.75	210.31	219.66
140	151.4	162.03	172.39	182.5	192.41	202.09	211.56	220.84
150	153.16	163.7	173.98	184	193.82	203.42	212.81	222.02
160	154.93	165.37	175.56	185.5	195.24	204.76	214.08	223.2
170	156.69	167.05	177.15	187	196.66	206.1	215.34	224.39
180	158.47	168.73	178.75	188.5	198.09	207.45	216.61	225.58
190	160.24	170.42	180.35	191.1	199.52	208.8	217.89	226.79
200	162.01	172.1	181.95	191.6	200.97	210.16	219.17	227.99
210	163.8	173.8	183.55	193.1	202.4	211.53	220.46	229.2
220	165.58	175.49	185.16	194.6	203.85	212.89	221.74	230.41
230	167.36	177.19	186.78	196.1	205.3	214.26	223.04	231.63
240	169.16	178.89	188.39	197.7	206.75	215.63	224.32	232.85
250	170.94	180.59	190.01	199.2	208.2	217	225.63	234.08
260	172.73	182.3	191.63	200.8	209.66	218.4	226.93	235.31
270	174.53	184	193.25	202.3	211.12	219.77	228.24	236.54
280	176.32	185.7	194.88	203.8	212.59	221.16	229.55	237.77
290	178.11	187.42	196.5	205.4	214.05	222.54	230.86	239.01
300	179.9	189.13	198.13	206.9	215.51	223.93	232.18	240.26

**TABLE 1: DIFFERENCE BETWEEN THE WATER THERMAL EXPANSION FACTOR AND
THE STEEL THERMAL EXPANSION**

FACTOR ($^{\circ}\text{C}^{-1} \times 10^6$)

$^{\circ}\text{C}$ bar	24	25	26	27	28	29	30	
0.981	215.2	215.14	234.88	244.41	253.79	263	272.03	
10	216.1	225.99	235.66	245.13	254.44	263.59	272.57	
20	217.2	226.94	236.53	245.94	255.18	264.27	273.18	
30	218.2	227.88	237.41	246.75	255.93	264.95	273.8	
40	219.2	228.85	238.3	247.58	256.69	265.64	274.42	
50	220.3	229.82	239.2	248.4	257.45	266.33	275.07	
60	221.3	230.79	240.11	249.24	258.22	267.04	275.7	
70	222.4	231.78	241.02	250.08	258.99	267.75	276.35	
80	223.4	232.77	241.94	250.93	259.78	268.47	277.01	
90	224.5	233.76	242.87	251.79	260.57	269.19	277.66	
100	225.6	234.76	243.79	252.66	261.36	269.92	278.33	
110	226.6	235.78	244.73	253.53	262.17	270.77	279.01	
120	227.7	236.79	245.68	254.4	262.98	271.41	279.69	
130	228.8	237.81	246.63	255.28	263.69	272.16	280.38	
140	229.9	238.84	247.59	256.18	264.62	272.92	281.08	
150	231	239.87	248.55	257.07	265.44	273.69	281.78	
160	232.1	240.91	249.52	257.97	266.28	274.46	282.49	
170	233.3	241.96	250.49	258.88	267.12	275.23	283.2	
180	234.4	243.01	251.47	259.79	267.97	276.01	283.92	
190	235.5	244.06	252.46	260.71	268.82	276.8	284.64	
200	236.6	245.12	253.45	261.63	269.67	277.59	285.37	
210	237.8	246.18	254.45	262.5	270.54	278.39	286.11	
220	238.9	247.26	255.45	263.49	271.4	279.19	286.85	
230	240.1	248.33	256.46	264.43	272.28	280	287.59	
240	241.2	249.41	257.46	265.37	273.16	280.82	288.35	
250	242.4	250.49	258.48	266.31	274.04	281.63	289.11	
260	243.5	251.58	259.49	267.27	274.92	282.46	289.86	
270	244.7	252.66	260.52	268.23	275.82	283.29	290.64	
280	245.8	253.76	261.54	269.18	276.71	284.12	291.4	
290	247	254.86	262.57	270.15	277.61	284.95	292.18	
300	248.2	255.96	263.6	271.11	278.51	285.79	292.95	

FIGURE – 1

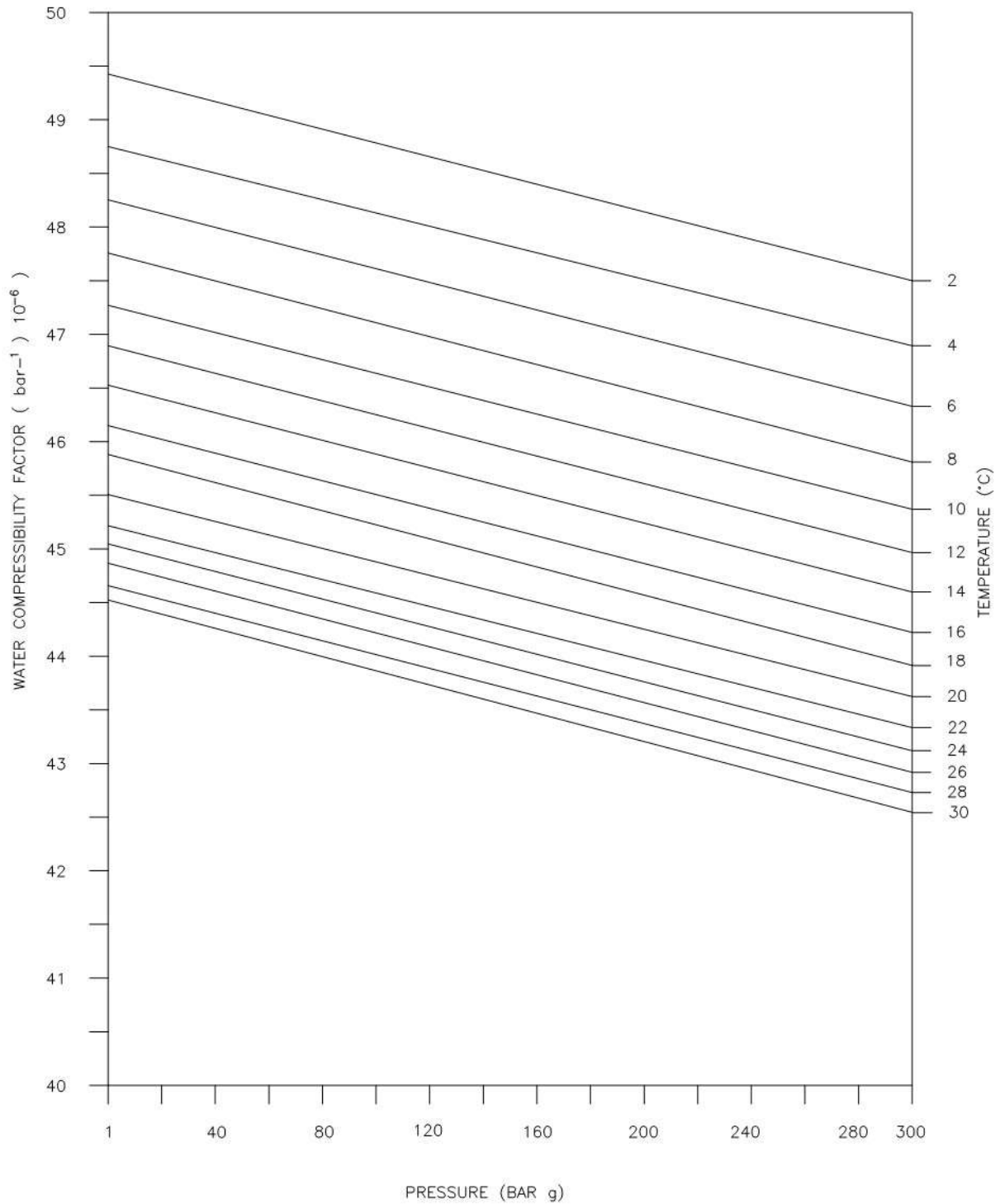


FIG. 1- WATER COMPRESSIBILITY FACTOR v/s PRESSURE AND
TEMPERATURE



ENERGISING QUALITY

VCS QUALITY SERVICES PVT. LTD.

STANDARD SPECIFICATION FOR PIPELINE MARKERS

VCS – SS – PP - 2015

					
02	29.04.2022	RP	MC	HK	GW
01	28.11.2019	MB	AK	AD	SK
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02	29.04.2022					VCS QMS Integration
		RP	MC	HK	GW	

ABBREVIATIONS:

API	American Petroleum Institute.
ASME	American Society of Mechanical Engineers.

CONTENTS

1.0	SCOPE	5
2.0	REFERENCE	5
3.0	GENERAL.....	5
4.0	KILOMETER MARKERS.....	5
5.0	AERIAL MARKER.....	6
6.0	PIPELINE WARNING SIGN.....	6
7.0	ROU BOUNDRY MARKER.....	6
8.0	DIRECTION MARKERS	7
9.0	NAVIGABLE WATERWAY PIPELINE CROSSING WARNING SIGN.....	7
10.0	SPECIAL MARKERS	7

1.0 SCOPE

- 1.1** This specification covers the minimum requirements of supply, fabrication and erection of pipeline markers to be installed by contractor at various locations along the proposed pipeline route of onshore pipelines carrying gas or liquid. The markers and signs may contain information to be used by the public when reporting emergencies and seeking assistance in determining precise location of a buried pipeline.

2.0 REFERENCE

The latest edition (edition in force at the time of issue of enquiry) of following additional references are included in this specification.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

- B31.4 : Pipeline Transportation Systems for Liquids and Slurries.
- B 31.8 : Gas Transmission and Distribution Piping Systems.

AMERICAN PETROLEUM INSTITUTE (API)

- RP 1109 : Recommended practice for Marking Liquid petroleum pipeline facilities.

3.0 GENERAL

- 3.1** Contractor shall supply, fabricate, install and paint the Pipeline Markers along the pipeline route. The location of markers as indicated in the approved drawings shall be treated for guidance purpose only and the exact location of the markers shall be as per requirement stipulated in this specification and as directed by the company. All the markers shall be painted in accordance with the requirement of relevant standard specification for shop and field painting.
- 3.2** The pipeline markers shall be fabricated and installed in accordance with VCS standard drawings included herein. Before start of fabrication of markers, the 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, to minimize hindrance to the regular use of land traffic.
- 3.4** The line marker's message should be presented on strong, durable material, finished to resist the effects of exposure and vandalism.

4.0 KILOMETER MARKERS

Kilometer Markers shall be installed along the pipeline at every one-kilometer interval. Markers shall indicate cumulative chainage in kilometers from the reference station, in the direction of flow. A kilometer marker is not required in the following locations:

1. If the relative length between the location and any pipeline warning sign is less than 200 meters.
2. Every five Kilometers where Areal Markers are installed.
For Kilometer Marker details refer VCS Standard Drawing

5.0 AERIAL MARKER

Aerial Marker shall in general be installed along the pipeline at every five (5) kilometers intervals and at places specified by the company. For Aerial Marker details refer VCS Standard Drawing.

6.0 PIPELINE WARNING SIGN

The pipeline crossing & pipeline facilities such as stations, terminals, valves, metering or pipeline junction manifolds should be marked with appropriate signs. Pipeline Warning Signs shall in general be installed at the following locations. Caution should be used when installing a marker anywhere other than directly over or in proximity to the buried pipeline to avoid any possible misinterpretation as to where the actual pipeline is located.

National and State Highway Crossings (at both ends)	2 Nos. min.
Other Road Crossings	1 No. min.
Railway Crossings (at both ends)	2 Nos. min.
Minor Water Crossings(less than 15 meter width)	1 No. min.
Minor Water Crossings (above 15 meter width)	2 Nos. min.
Major Water Crossings (at both ends)	2 Nos. min.
Valve Station / TOP / HOV's	1 No. min.
Any other location as shown in the approved drawings and as directed by the company.	

Pipeline warning sign shall indicate the pressure & pipeline facility and display the name of the Company with an emergency telephone number. For Pipeline Warning Sign details refer VCS Standard Drawing..

7.0 ROU BOUNDARY MARKER

Right of Use Boundary Markers shall be fabricated as per the drawings and shall be installed at every 250 meters interval along the entire pipeline route. These shall be installed on either side of the pipeline alignment to define the ROU boundary limits. These shall also be installed at pipeline turning points to maintain the continuity of the ROU limits. Due care shall be taken while installing ROU boundary marker. Boundary marker shall be preferably installed at the boundary of farmer plot as applicable, so that it does not get displaced during course of time. For ROU Marker details refer VCS Standard Drawing..

8.0 DIRECTION MARKERS

Direction Markers shall be installed to identify the significant Turning Points of the pipeline during aerial traverse, where there is change of pipeline direction. One direction marker shall be installed at such Turning Point; two more direction markers shall be installed along the pipeline alignment, one on either side of the Turning Point at 200 m from the Turning Point. For Direction Marker fabrication details refer VCS Standard Drawing.

9.0 NAVIGABLE WATERWAY PIPELINE CROSSING WARNING SIGN

The Navigable Waterway Pipeline Crossing Warning Sign shall be fabricated and installed one on each bank of navigable water courses at the pipeline crossing location, in lieu of the Pipeline Warning Sign should contain the words "Do not Anchor or Dredge". For Warning Sign fabrication details refer VCS Standard Drawing..

10.0 SPECIAL MARKERS

As directed by Company, Special Markers shall be installed at location where following changes take place:

- a) Change in pipeline diameter and wall thickness.
- b) Change in type of pipe.
- c) Change in class locations for pipelines (in case of gas pipelines)

The above data may be provided on other types of marker (except ROU boundary marker), if the relative distance between the two does not exceed 100 m.



VCS QUALITY SERVICES PVT. LTD.

STANDARD SPECIFICATION FOR CASING INSULATORS AND END SEALS

VCS – SS – PP - 2016

					
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03	29.04.2022					VCS QMS Integration
		RP	MC	HK	GW	

ABBREVIATIONS:

ASME	American Society of Mechanical Engineers
ASTM	American Society of Testing of Materials
API	American Petroleum Institute

CONTENTS

1.0	SCOPE	5
2.0	REFERENCE DOCUMENTS	5
3.0	FUNCTIONAL REQUIREMENTS	6
4.0	DESIGN AND MANUFACTURE	6
5.0	MATERIAL PROPERTIES.....	8
6.0	INSPECTIONS AND TESTING.....	8
7.0	INSTALLATION.....	9

1.0 SCOPE

This specification covers the minimum requirements of design, material, manufacture and supply of casing insulators and end seals intended to be used for cased pipeline crossings forming part of buried onshore pipeline.

This specification shall be read in conjunction with the condition of all specifications and documents include in the contract between company and contractor.

2.0 REFERENCE DOCUMENTS

The design, materials, fabrication, inspection, testing and supply of casing insulators and end seals shall comply with the latest edition of the following codes and standards.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

B31.4 : Pipeline Transportation System for Liquids and Slurries

B 31.8 : Gas Transmission and Distribution Piping Systems.

AMERICAN PETROLEUM INSTITUTE (API)

1102 : Steel Pipeline Crossing Railroads and Highways

PNGRB REGULATIONS:

G.S.R 808(E) T4S : Regulations for Natural Gas Pipelines

G.S.R. Infra/ T4S/ P&PPPL : Regulations for Petroleum and Petroleum products pipelines

G.S.R. 612(E) T4S : Regulations for CGD Network

COMPANY STANDARD SPECIFICATIONS

Following Company specifications shall form integral part of this specification and shall be complied with when applicable to the works covered in the contract.

VPC-SS-PP-2001: Standard Specification for Pipeline Construction (Onshore)

VPC-SS-PP-2002: Specification for Construction of Pipelines Crossing Roads, Railroad and Minor Water Crossing

In case of conflict between various requirements of this specification and reference standards and regulations mentioned above, more stringent requirement shall apply unless otherwise agreed by Purchaser.

3.0 FUNCTIONAL REQUIREMENTS

3.1 CASING INSULATORS

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

The casing insulators shall be made of injection molded high density polyethylene or other equivalent or superior material and shall meet the following properties:

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

PROPERTIES OF CASING INSULATORS

The material shall meet the following specifications:

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	4.0 ft.lb./inch of notch	D-256
Water Absorption	0.01%	D-570

3.2 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.

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 likely to be encountered during construction. End seals material shall be resistant to heat, cold, vibration, impact, abrasion, corrosive fluids, disbandment, organic and bio-deterioration. Manufacturer shall confirm compatibility of end seals with carrier pipe coating.

4.0 DESIGN AND MANUFACTURE

4.1 CASING INSULATOR

The arrangement of insulator shall be generally in accordance with Fig. 1.0. It shall be made in segments duly held together with cadmium plated bolts and nuts, to be supplied

with casing insulators.

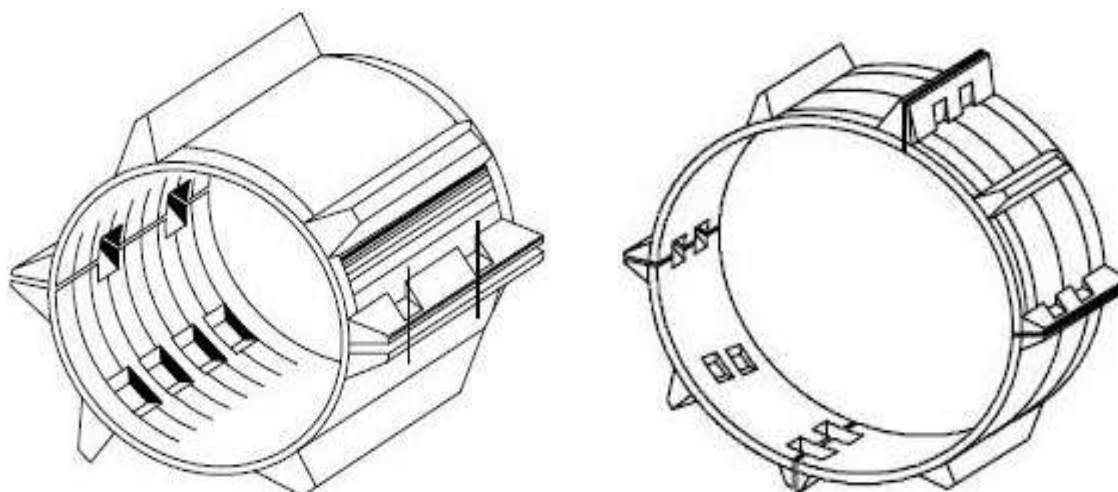
The number of segments shall be two for pipe diameters up to DN 300 mm (12"). For larger diameter, the number of segments may be more than two, but their number shall be kept minimum.

As an alternate design in accordance with the casing insulator element shall be a flexible section containing a toothed male butt strap at one end and an appropriately toothed female slot on the other end. The same shall be wrapped over the outer surface of the carrier pipe and locked positively. The insulator rings should be fastened onto the carrier pipe with the appropriate tool to be provided by the casing insulator manufacturer. No metallic parts or attachments should be considered in the casing insulator element assembly. The design of casing insulator should allow for onsite adjustments for any variances within the allowable O.D. range of pipeline and should grip the pipe firmly without any chances of horizontal movement or breakage of the insulator rings during installation.

The skid height shall be such that it is slightly less than the value obtained by following formula:

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

Manufacturer shall obtain prior approval from OWNER on casing insulators drawings/design.



TWO PIECE CONSTRUCTION

FOUR PIECE CONSTRUCTION

Fig 1.0 TYPICAL DETAILS OF CASING INSULATORS

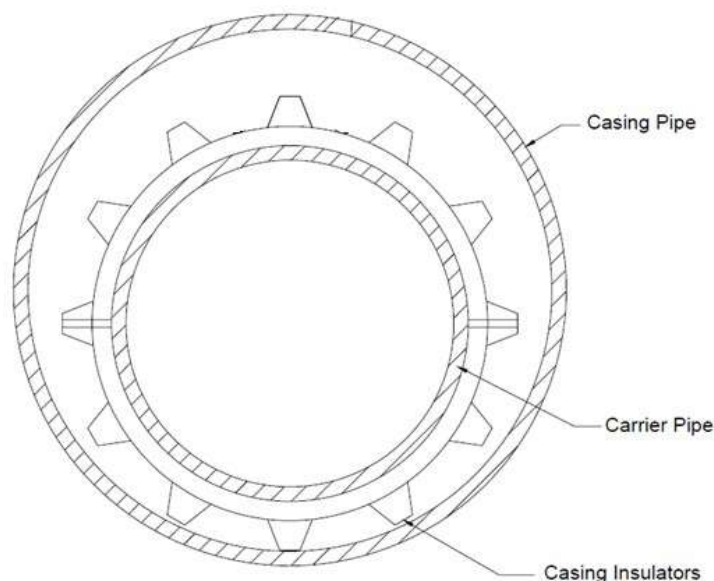


Fig 2.0 TYPICAL SKETCH OF CASING INSULATOR AND CASING PIPE

4.2 CASING END SEALS

The seals shall be suitable for the casing and carrier pipe diameters 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.

When HDPE ducts for OFC are also to be installed in the same casing pipe, the contractor shall install casing end seal in such a manner as to completely seal off the void between carrier pipe and HDPE ducts for OFC. Care shall be taken during installation of casing end seals so that after installation of casing end seals, neither HDPE ducts nor casing end seals are distorted or damaged.

The design of the casing end seals 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 burned pipeline.

Manufacturer shall obtain prior approval from OWNER on casing end seals design/drawings.

5.0 MATERIAL PROPERTIES OF CASING END SEALS

Casing end seals shall meet following minimum property requirements:

- a. BACKING (SLEEVE AND CLOSURE PATCH)

Property	Minimum Value	ASTM Test Method
Tensile strength	2200 psi	D 638

Ultimate Elongation	400 %	D 638
Heat Shock	No Visual Cracks, Flow or Drips at 250°C, 4 hours	D 2671

b. ADHESIVE

Property	Minimum Value	ASTM Test Method
Ring and Ball Softening Point	90°C	E 28
Lap Shear	60°C - 25 psi 23°C - 250 psi (2 inch/min.)	D 1002

c. SYSTEM (AS APPLIED)

Property	Minimum Value	ASTM Test Method
Peel strength (To casing and carrier pipe and closure patch)	5 pli (10 inch/min.)	D 1000

6.0 INSPECTION AND TESTING

Manufacturer/contractor shall furnish material test certificates of the components used in the assembly of casing insulators and end seal as per the requirements of clause 4.0 of this specification.

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

Manufacturer/contractor shall submit detailed specification of the materials used in the assemblies, along with instructions for handling, use and installation of the material for OWNER approval prior to procurement.

7.0 INSTALLATION

Casing insulators shall be installed on carrier pipe at spacing as recommended by manufacturer but in no case greater than. At both ends of cased crossing a set of two insulators shall be installed with outermost insulator at a maximum distance of mm from end. Figure 3.0 shows arrangement of casing insulators inside the casing pipe. All other requirements of installation shall be as per standard.

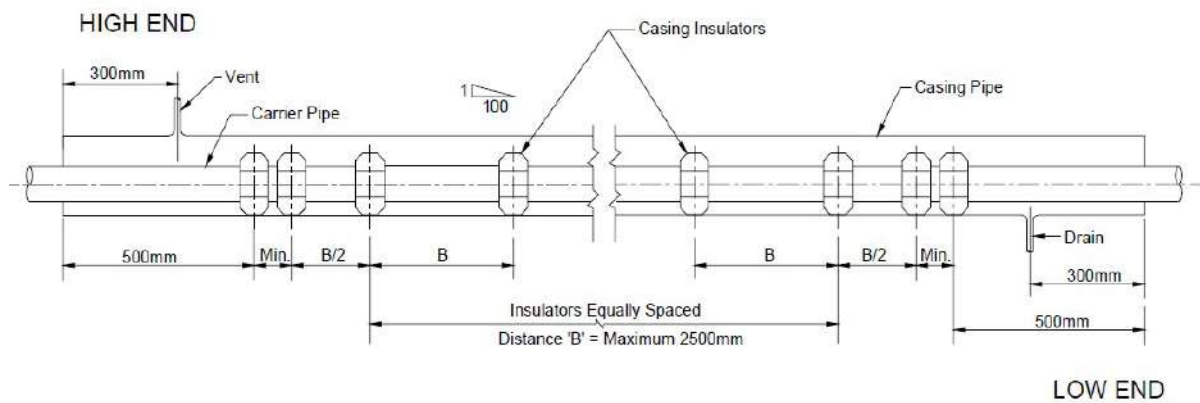


Fig 3.0 ARRANGEMENT OF CASING INSULATORS ON CARRIER PIPE



VCS QUALITY SERVICES PVT. LTD.

STANDARD SPECIFICATION FOR WELDING OF ONSHORE HYDROCARBON PIPELINE

VCS-SS-PP-2019

					
04	29.04.2022	RP	MC	HK	GW
03	04.01.2022	SR	MC	HK	HK
Rev. No	Date	Prepared By	Checked By	Approved By	Authorized By
UNCONTROLLED COPY : If printed					
CONTROLLED COPY : If in soft and signed					

REVISION RECORD						
Rev.	Revision Date	Prepared by	Checked by	Approved by	Authorized by	Revision Description
00	27.08.2018					Issued as Standard Specification.
		PK	MD	AD	SK	
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04						VCS QMS Integration
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ABBREVIATIONS:

ANSI	American National Standards Institute
API	American Petroleum Institute
ASME	American Society of Mechanical Engineers
BS	British Standard
CRT	Cathode Ray Tube
CTOD	Crack Tip Opening Displacement
GMAW	Gas Metal Arc Welding
GTAW	Gas Tungsten Arc Welding
HAZ	Heat Affected Zone
HV	Vickers Hardness
IIW	International Institute of Welding
IQI	Image Quality Indicator
ISO	International Organization for Standardization
MPI	Magnetic Particle Inspection
PQR	Procedure Qualification Record
SMAW	Shielded Metal Arc Welding
UT	Ultrasonic Testing
UTS	Ultimate Tensile Strength
WPS	Welding Procedure Specification

CONTENTS

1.0	SCOPE	5
2.0	APPLICABLE CODE AND STANDARDS	5
3.0	BASE MATERIAL	4
4.0	WELDING CONSUMABLES	5
5.0	EQUIPMENT & ACCESSORIES	6
6.0	WELDING PROCESSES.....	6
7.0	BEVEL CLEANING / BEVEL INSPECTION	7
8.0	ALIGNMENT AND SPACING	7
9.0	WEATHER CONDITIONS	8
10.0	WELDING	9
11.0	HEAT TREATMENT	11
12.0	INSPECTION & TESTING.....	13
13.0	REPAIRS OF WELDS.....	16
ANNEXURE-1	: DESTRUCTIVE TESTING.....	18
ANNEXURE-2	: ULTRASONIC INSPECTION.....	23
ANNEXURE-3	: RADIOGRAPHY.....	26
EXHIBIT-A	: ELECTRODE QUALIFICATION TEST RECORD.....	33
EXHIBIT -B	: STRESS RELIEF HEAT TREATMENT PROCEDURE SPECIFICATION.....	36
EXHIBIT-C	: WELDING PROCEDURE QUALIFICATION TEST RECORD.....	37
EXHIBIT-D	: WELDER QUALIFICATION TEST RECORD.....	40
EXHIBIT-E	: WELDER'S IDENTIFICATION CARD.....	41
EXHIBIT-F	: RADIOGRAPHIC PROCEDURE FOR PIPE WELDING.....	42

1.0 SCOPE

This specification covers the welding of carbon and low-alloy steel pipeline used in the transmission of hydrocarbons, covers welding of distribution systems. This specification applies to new construction of pipeline projects. The welding may be done by a shielded metal arc welding, submerged arc welding, gas tungsten arc welding, gas metal arc welding, flux cored arc welding, plasma arc welding or oxyacetylene welding process or by a combination of these processes using a manual, semiautomatic or mechanized welding technique or a combination of these techniques. The welds may be produced by position or roll welding or by a combination position and roll welding.

This specification also covers the procedures for radiographic, magnetic particle, liquid penetrant and ultrasonic testing as well as the acceptance standards for destructive testing in Procedure Qualification and Non-Destructive testing methods viz. Radiographic, Magnetic Particle, Liquid Penetrant, Ultrasonic and visual.

It is intended that all work performed in accordance with this specification meets or exceeds the requirements of this specification

Any approval granted by the COMPANY shall not relieve the CONTRACTOR of his Responsibilities and guarantees.

2.0 APPLICABLE CODE AND STANDARDS

All welding work, equipment for welding, heat treatment, other auxiliary functions and the welding personnel shall meet the requirements of the latest editions (editions in force at the time of floating the enquiry) of the codes, standards and specifications listed below:

- a) Code for Gas Transmission and Distribution Piping Systems, ASME B 31.8
- b) Standard for welding of Pipelines and Related Facilities, API 1104
- c) Specification for welding Electrodes and Filler Materials ASME Sec. II C
- d) Non-Destructive examination, ASME Sec. V

3.0 BASE MATERIAL

In general carbon steel is used in this specification. The details of material specifications are given in the welding Specification Chart attached along with

other project data sheets. The CONTRACTOR will arrange and maintain the record of test certificates of all the materials for the reference of the welding engineer.

4.0 WELDING CONSUMABLES

- a) The CONTRACTOR shall provide at his own expense all the welding consumables necessary for the execution of the job such as electrodes, oxygen, acetylene etc. and These shall bear the approval of the COMPANY.
- b) The welding electrodes / filler wires supplied by the CONTRACTOR shall conform to the class specified in the welding specification chart attached along with other project data sheets. The materials shall be of the make approved by the COMPANY.
- c) The electrode shall be suitable for the welding process recommended and the base metal used. Physical properties of the welds produced by an electrode recommended for the welding of a particular base metal shall not be lower than the minimum values specified for the base metal unless otherwise specified in the Welding Specification Chart and shall correspond to the physical properties of the class of electrode adopted. The choice of electrode shall be made after conducting the required tests on the electrodes as per relevant standards, and shall be the sole prerogative of the COMPANY.
- d) The CONTRACTOR shall submit batch test certificates from each electrode manufacturers giving details of physical and chemical tests carried out by them for each batch of electrodes to be used.
- e) Electrode Qualification test records shall be submitted as per the Exhibit-A (attached) in respect of the electrodes tested by the CONTRACTOR for obtaining the approval of the COMPANY.
- f) All electrodes shall be purchased in sealed containers and stored properly to prevent deterioration. The electrodes removed from the containers (except cellulosic coated electrodes) shall be kept in the holding ovens, at the temperature recommended by the electrode manufacturer. Ovens shall be used for the low hydrogen electrodes only. Out-of-the oven time of electrodes before they are consumed shall not exceed the limits recommended by the electrode manufacturer. The electrodes shall be handled with care to avoid any damage to the flux covering. Different grades of electrodes shall be stored separately. Cellulosic electrodes used shall however be used as per the specific recommendations of manufacturer.

- g) The electrodes used shall be free from rust, oil, grease, earth and other foreign matter, which affect the quality of welding.
- h) **Shielding Gas**: The composition and the purity of shielding gas when required by the welding
Processes other than shielded metal arc welding, when permitted by the COMPANY shall bear the approval of the COMPANY. Where appropriate, gases or gas mixture of the following quality shall be used.
- I. Argon gas complying with BS 4365.
 2. Carbon dioxide gas complying with type 1 specified in BS 4105
 3. Gas mixtures that have been proved to be satisfactory as a result of procedure approval tests.
- When a gas mixture is used, which has specified additions, e.g. 2% O₂, 5% CO₂ the variation of such addition shall not exceed $\pm 10\%$ of that stated. Moisture content shall correspond to a dew point of -30°C or lower.

5.0 EQUIPMENT & ACCESSORIES

The CONTRACTOR shall have sufficient number of welding and cutting equipment, Auxiliaries and accessories of sufficient capacities to meet the target schedules.

- 5.1 All the equipment for performing the heat treatment, including transformers, thermocouples, pyro-meters, automatic temperature recorders with suitable calibration arrangements, etc. shall be provided by the CONTRACTOR, at his own expense and these shall bear the approval of the COMPANY. Adequate means of measuring current and voltage shall be available.
- 5.2 Redoing of any work necessitated by faulty equipment or operation used by the CONTRACTOR, will be done at his own expense.

6.0 WELDING PROCESSES

- 6.1 Welding of various materials under this specification shall be carried out using Shielded Metal Arc Welding process (SMAW) with the approval of the COMPANY.
- 6.2 The welding processes to be employed are given in the welding specification chart attached along with other project data sheets. Any deviation desired by the CONTRACTOR shall be obtained through the express consent of the COMPANY.
- 6.3 Automatic process shall be employed only with the express approval of the COMPANY. The welding procedure adopted and the consumables used shall be specifically approved.
- 6.4 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 COMPANY.

7.0 BEVEL CLEANING / BEVEL INSPECTION

The Line Pipe supplied by COMPANY shall have bevel ends as specified in the applicable specification for the Line Pipe attached with the Bid Package. Any modification thereto, if required by the CONTRACTOR due to his special welding technique, shall be carried out by the CONTRACTOR at his own cost. Before welding, all the rust and the foreign matter shall be removed from the beveled ends by power operated tools. This shall be affected inside and outside and for a minimum distance of 25 mm from the edge of the weld bevel. The bevels shall be thoroughly inspected at this stage. If any of the ends of the pipe joints are damaged to the extent that, in the opinion of the COMPANY, satisfactory weld spacing cannot be obtained and local repair by grinding cannot be successfully done, the damaged ends shall be cut and beveled to the satisfaction of the COMPANY, with an approved beveling machine. Manual cutting and weld repairs of bevels is 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 COMPANY. 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 penetrant/MPI tested. A report shall be written for all the testing and records kept.

8.0 ALIGNMENT AND SPACING

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 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 approved by COMPANY, at least 500 mm above the ground unless approved by the COMPANY in specific cases.

Seam orientation of welded pipe shall be selected to ensure that at the circumferential welds, the longitudinal welds shall be staggered in the top 90° of the pipelines, or 250 mm whichever is the lesser. A longitudinal joint shall pass an appurtenance of a structural element at a minimum distance of 50 mm. Should a section of the line containing uncompleted welds fall from the skids, the CONTRACTOR shall immediately inform the COMPANY.

Every effort shall be made to reduce misalignment by the use of the clamp and rotation of the pipes to the best fit. For pipe of same nominal wall thickness the offset shall not exceed 1.6 mm. The offset may be checked from outside using dial gauges. Any branch connection sleeve, etc. shall be at least 150 mm from any other weld. The welds for fittings shall be so located that the toe of the weld shall not come within 50 mm 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 (as directed by COMPANY) a special 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 10" and above. However, in some cases (tie-in welds, flanges, fittings, diameter of pipe 10" 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 first pass has been completed.

When an external line-up clamp is used, all the spaces between the bars or at least 60% of the first pass shall be welded before the clamp is released and the pipe remaining 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 bead.

9.0 WEATHER CONDITIONS

The parts 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. The completed welds shall be suitably protected in case of bad weather conditions.

10.0 WELDING

10.1 Root Pass

- a) The root pass shall be made with the electrodes/filler wires recommended in the welding specification chart attached along with the other project data sheets. The size of the electrodes used shall be as per the approved welding procedure.
- b) Position or roll welding may be permitted. 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 downhill welding may be used for the 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) The root pass of butt joints shall be executed properly so as to achieve full penetration with complete fusion of the root edges. Weld projection inside the pipe shall not exceed 3 mm wherever not specified by the applicable code.
- d) Any deviations desired from the recommended welding technique and electrodes indicated in the welding specification chart shall be adopted only after obtaining express approval of the COMPANY.
- e) Welding shall be continuous and uninterrupted during a pass.
- f) On completion of each run, craters, welding irregularities, slag etc., shall be removed by grinding and chiseling.
- g) 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.
- h) Fillet welds shall be made by shielded metal arc welding process irrespective of the thickness and class of piping. Electrode size shall not exceed 3.25 mm diameter for the socket joints. At least two passes shall be made on the socket weld joints.
- i) Peening shall not be used.

10.2 Joint Completion

In case of manual welding, for sizes 12" and above, 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 pipe shall always be adequately supported and must not be bumped or shaken during welding. The clamp shall be removed, as indicated in clause 8.0 above. Before starting the second pass, the first pass shall be cleaned and flattened with rotating grinders.

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.

For crack prevention a top and bottom reinforcement of at least one electrode shall be applied before lowering the pipe on the skid.

The welding speed selected shall enable production of a bead which is sufficiently thick and which shows no under cutting.

The time lapse between the second and the third pass shall be as stated in the procedure specification, normally not exceeding five minutes. After completion of the third or following passes, welding operations may be suspended, so allowing the joint to cool down, provided that the thickness of the weld metal deposited is equal to at least 50% of the pipe thickness. Upon restarting, depending on the materials, wall thickness and welding process, a preheating of at least 100°C shall be applied. Subsequent passes up to weld completion shall be protected to avoid rapid cooling, if meteorological conditions so dictate. Cleaning between the passes shall be done carefully so as to reduce the possibility of inclusions.

The 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 the COMPANY and the repair checked by ultrasonic, radiographic, magnetic particle or dye penetrant tests which the COMPANY 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.

The completed weld shall be carefully brushed and cleaned and shall appear free from spatters, scales, etc.

These requirements apply not only to completed welds but also to the bare strip at least so wide as to allow full skid examination at both ends of the pipe to allow a good ultrasonic inspection when it is required.

11.0 HEAT TREATMENT

11.1 Preheating

- a) Preheating requirements for the various materials shall be as per the welding Specification chart attached along with other project data sheets.
- b) Preheating shall be performed using resistance or induction heating methods. Pre-heating for tie-in welds, repair welds or welds at point spreads may be done using a propane gas burner ring with prior approval from PMC/owner. The contractor may be asked to demonstrate the effectiveness of the arrangement.
- c) Preheating shall extend uniformly to at least three times the thickness of the joint, but not less than 50 mm, on both sides of the weld.
- d) 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.

11.2 Post Weld Heat Treatment

- a) Post weld heat treatment, wherever required for joints between pipes and fittings, pipe body and supports shall be carried out by the CONTRACTOR at his expense as per the relevant specifications, applicable standards and the instructions of the COMPANY.
- b) The heat treatment of welded joints shall be carried out as per the requirements laid down in ASME B31.8 and other special requirements mentioned in welding Specification chart.
- c) The CONTRACTOR shall submit for the approval of the COMPANY, well before Carrying out actual heat treatments the details of the post weld heat treatment Procedure, as per Exhibit 'B' attached, that he proposes to adopt for each of the Materials/assembly/part involved.
- d) Post weld heat treatment shall be done in a furnace or by using an electric resistance or induction heating equipment, as decided by the COMPANY.

- e) 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.
- f) The width of the heated band centered on the weld shall at least be equal to the width of weld plus 2" (50 mm). The temperature gradient shall be such that the length of the material on each side of the weld, at a temperature exceeding half the heat treatment temperature, is at least $2.5 \frac{rt}{t}$ where r is the bore radius and t is the pipe thickness at the weld.
- g) 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.
- h) The temperature attained by the portion under heat treatment shall be recorded by means of thermocouple pyrometers. Adequate number of thermocouples shall be attached to the pipe directly at equally spaced locations along the periphery of the pipe joint. The minimum number of thermocouples attached per joint shall be 2 up to 10" dia and 3 for 12" dia and above. However, the COMPANY can increase the required minimum number of thermocouples to be attached if found necessary.
- i) Automatic temperature recorders, which have been suitably calibrated, shall be Employed. The calibration chart of each recorder shall be submitted to the COMPANY prior to starting the heat treatment operation and its approval shall be Obtained.
- j) 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 COMPANY for its approval.
- k) Each joint shall bear an identification number, which shall be maintained in the piping sketch to be prepared by the CONTRACTOR. The joint identification number shall appear on the corresponding post weld heat treatment charts. The same identification numbers shall also be followed for identification of corresponding radiographic films. The chart containing the identification number and the piping sketch shall be submitted to the COMPANY in suitable folders.
- l) Vickers hardness/Brinell hardness of the heat affected zone as well as of the weld metal, after heat treatment shall be measured using a suitable hardness tester and shall not exceed the maximum hardness specified in the welding

specification chart. The weld joint shall be subjected to reheat treatment, when hardness measured exceeds the specified limit, at the CONTRACTOR'S own expense.

- m) The CONTRACTOR shall arrange for the hardness testing and shall maintain the Records of all the joints tested. These records shall be checked by the plant COMPANY'S inspector.

12.0 INSPECTION & TESTING

12.1 General

- a) The COMPANY'S Inspector shall have free access to all the concerned areas, where the actual work is being performed. The CONTRACTOR shall also afford the COMPANY'S inspector all means and facilities necessary to carry out inspection.
- b) The COMPANY is entitled to depute its own inspector to the shop or field where prefabrication and erection of pipelines are being done, with (but not limited to) the following objectives:
- i) To check the conformance to relevant standards and suitability of various Welding equipment and the welding performance.
 - ii) To supervise the welding procedure qualification.
 - iii) To supervise the welders' performance qualification.
 - iv) To check whether shop/field welding being executed is in conformity with the relevant specifications and codes of practice followed in pipe construction.
- c) CONTRACTOR shall intimate sufficiently in advance the commencement of the Qualification tests, welding works and acceptance tests, to enable the COMPANY'S inspector to be present to supervise them.

12.2 Welding Procedure Qualification

- a) Welding procedure qualification shall be carried out in accordance with the relevant requirements of API 1104 latest edition (edition in force at the time of floating the enquiry) or other applicable codes and other job requirements by the CONTRACTOR at his expense. The CONTRACTOR shall submit the welding procedure specifications in format as per Exhibit-C (attached) immediately after the receipt of the order.
- b) COMPANY'S inspector will review, check and approve the welding procedure submitted and shall release the procedure for procedure qualification tests. The Procedure qualification test shall be carried out by the CONTRACTOR under field conditions at his own expense. A complete set of the test results in format as per Exhibit-C (attached) shall be submitted to the COMPANY'S Inspector for approval immediately after completing the procedure qualification test and at least 2 weeks before the commencement of actual work. Standard tests as

specified in the code shall be carried out in all cases. In addition to these tests, other tests like radiography, macro/micro examination, hardness tests, dye penetrant examination, Charpy v-notch etc. shall be carried out on the specimens. It shall be the responsibility of the CONTRACTOR to carry out all the tests required to the satisfaction of the COMPANY'S Inspector. The destructive testing of welded joints shall be as per Annexure - 1.

12.3 Welder's Qualification

- a) Welders shall be qualified in accordance with the API 1104 and other applicable specifications by the CONTRACTOR at his expense. The butt weld test pieces of the qualification test shall meet the radiographic test requirements specified in Clause 12.5 and Annexure-3 of this specification. The COMPANY'S inspector shall witness the test and certify the qualification of each welder separately. Only those welders who have been approved by the COMPANY'S inspector shall be employed for welding. CONTRACTOR shall submit the welder qualification test reports in the standard format as shown in Exhibit - D and obtain express approval, before commencement of the work. It shall be the responsibility of CONTRACTOR to carry out qualification tests of welders.
- b) The welders shall always have in their possession the identification card as shown in Exhibit-E and shall produce it on demand by the COMPANY'S Inspector. It shall be the responsibility of the CONTRACTOR to issue the identity cards after the COMPANY has duly certified it.
- c) No welder shall be permitted to work without the possession of identity card.
- d) If a welder is found to perform a type of welding or in a position for which he is not qualified, he shall be debarred from doing any further work. All welds performed by an unqualified welder shall be cut and redone by a qualified welder at the expense of the CONTRACTOR.

12.4 Visual Inspection

COMP ANY shall carry out inspection of all welds as per the latest editions of the applicable codes and specifications. All finished welds shall be visually inspected for parallel and axial alignment of the work, excessive reinforcement, concavity, shrinkage, cracks, under-cuts, dimensions, surface porosity and other surface defects. Undercutting adjacent to the completed weld shall not exceed the limits specified in the applicable standard I code.

12.5 Non Destructive Examination

The non-destructive examination shall mainly consist of examination using x-ray radiography as detailed in Annexure 3.

Radiographic examination of one hundred percent (100%) girth welds will be required by the COMPANY. Welds shall meet the standards of acceptability as set forth in API 1104 and as well as the requirements laid in subsequent paragraphs.

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

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

All the requirements mentioned in the specification shall be arranged and executed by the CONTRACTOR through his own resources. In addition, ultrasonic inspection is required in the following cases as per Annexure - 2 of this Specification.

- a) When 20 mm or more are cut from the pipe end as supplied, the ends shall be ultrasonically inspected for an additional length of 20 mm to assure no laminations exist.
- b) When in the opinion of COMPANY, ultrasonic inspection is required to confirm or clarify defects indicated by radiography.
- c) When automatic procedure is used at least 10 cm on each weld shall be ultrasonically inspected at COMPANY's discretion.
- d) UT on Golden Joints.

All fillet and groove welds other than those radiographed shall be subjected to dye penetrant! MP inspection. The non- destructive test system used for inspecting welds must be approved by the COMPANY.

12.5.1 Acceptance Criteria

Weld quality as judged on the basis of the acceptability criteria mentioned below:

- i) Any weld, which as a result of radiographic and/or ultrasonic examination in the opinion of COMPANY exhibits imperfections greater than the limits, stated in API 1104 latest edition or as superseded in this article shall be considered defective and shall so be marked with an identification point marker.
- ii) In addition to the API 1104 requirements, the welds containing cracks including crater cracks regardless of size or location are unacceptable.

Lack of fusion and lack of root penetration may be permitted only up to a maximum individual length of 25mm. Cumulative length of the defect shall not exceed 25 mm in any 300 mm length of weld. For welds less than 300 mm length, the aggregate length shall not exceed 8 percent of the weld length. Defects situated in line and separated by less than the length of the shortest defect shall be considered as one defect. However, no Lack of fusion or lack of root penetration is permitted at any intersections of welds.

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

12.6 Destructive Testing

The COMPANY has the authority to order the cutting of up to 0.1 % of the total number of welds completed for subjecting to destructive tests at no extra cost to

COMPANY. The destructive testing of weld joints shall be made as per Annexure - 1. In addition, welds already cut out for defects for any reason may also be subjected to destructive testing. The sampling and the re-execution of welds shall be carried out by the CONTRACTOR at his own expense. If the results are unsatisfactory, welding operations shall be suspended and may not be restarted until the causes have been identified and the CONTRACTOR has adopted measures, which guarantee acceptable results. If it is necessary in the COMPANY's opinion the procedure shall be requalified. The weld joint represented by unsatisfactory welds shall stand rejected unless investigation proves otherwise.

13.0 REPAIRS OF WELDS

13.1 With the prior permission of COMPANY 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 (c) cover pass repair and (d) Double repair. Welders shall be qualified in advance for repairs. The root pass, for repairs opening the root, shall be replaced by the vertical uphill technique. The procedure shall be proven by satisfactory procedure test 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 be 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 shall be subjected, as a minimum requirement to the same testing and inspection requirements as the original weld. After the repair of the circumferential weld, re-radiography of the full joint shall be carried out. Any repaired area that is wide, irregular or rough shall be rejected and a full cut out shall be done.

Repairs are limited to a maximum of 30% of the weld length. Not more than two repairs are permitted on the same location. 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 COMPANY.

13.2 Weld Rejected by Accumulation of Defects

Where a weld is rejected by the accumulation of defect clause, as defined by API-1104 and this specification, repairs within these limitations are permitted. Defects in the filling and capping passes shall be repaired preferentially.

ANNEXURE-I

1.0 DESTRUCTIVE TESTING OF WELDED JOINT - BUTT WELDS

1.1 Preparation

Having passed 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 hours. No further work on the test weld and no cutting of test specimens from the weld shall be performed until a period of at least 24 hours has expired.

Weld specimens shall be taken from the positions indicated in fig.1, 2, 3 & 4 of this specification from areas as free from defects as possible; for this reason, it is necessary to take the previous non-destructive tests into account. The minimum number of tests to be carried out is given in Table - 1 of this specification.

The test shall be carried out at laboratories approved by the COMPANY. The specimens shall be prepared in accordance with the figures given in the paragraphs that refer to the individual test.

1.2 Tensile Strength

Specimens shall be taken from the position indicated in fig.1, 2, 3 & 4 of this specification and Table-1 of this specification.

1.2.1 Method

The test shall be carried out in accordance with API 1104.

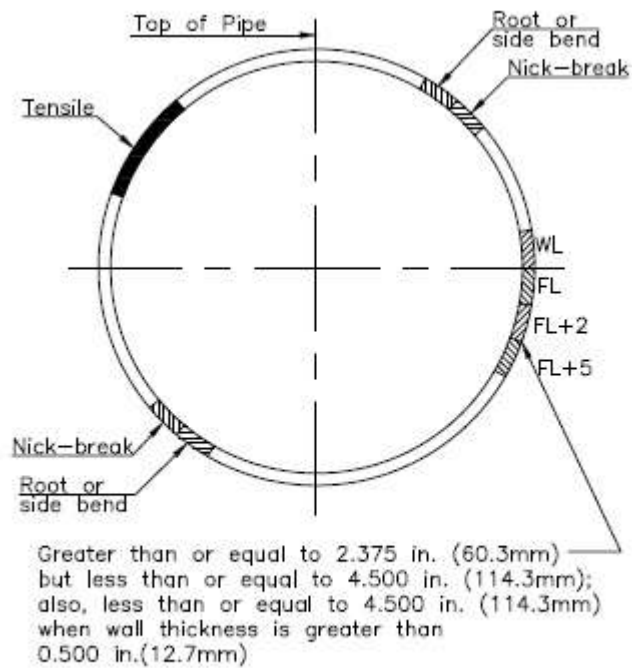
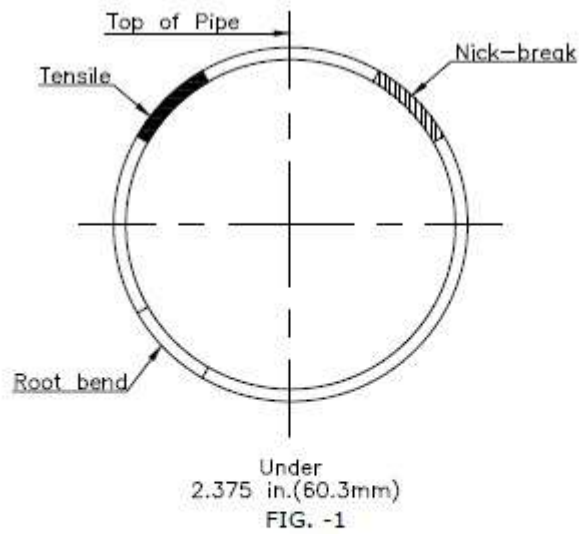


TABLE 1

OUTSIDE DIAMETER OF PIPE (mm)	NUMBER OF SPECIMENS							
	TENSILE STRENGTH	NICK BREAK	ROOT BEND	FACE BEND	SIDE BEND	MACRO & HARDNESS	IMPACT	TOTAL
	WALL THICKNESS $\leq$ (12.7 mm)							
<60.3	1	2	2	0	0	0	0	5
60.3 to 114.3	1	2	2	0	0	0	12	17
>114.3 to 323.9	2	2	2	2	0	2	12	22
>323.9	4	4	4	4	0	2	12	30
	WALL THICKNESS > (12.7 mm)							
$\leq$ 114.3	1	2	0	0	2	0	12	17
>114.3 to 323.9	2	2	0	0	4	2	12	20
>323.9	4	4	0	0	8	2	12	30

1.3 Nick-Break Test

1.3.1 Preparation

Specification 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 authorization by the COMPANY with a notch cut in the reinforcement of outside weld bead to a maximum depth of 1.5mm, measured from the surface of the weld bead.

1.4 Macroscopic Inspection

1.4.1 Preparation

Specimens shall be taken from the positions indicated in Fig. 1 of this specification and shall be prepared in accordance with ASTM E2 and E3. 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 affected zone.

1.4.2 Method

Specimens shall be carefully examined under the microscope, with a magnification of at least 25 times (25:1). The COMPANY may ask for a macrograph with 5 times (5:1) magnification, for DOCUMENTATION purposes.

1.4.3 Requirements

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 bream test

1.5 Hardness Test

1.5.1 Preparation

The prepared macro section is to be used for hardness testing using the vickers method with 10 kg load indentations are to be made along traverses each approximately 1 mm below the surface at both side of the weld.

In the weld metal a minimum of 6 indentations equally spaced along the traverses are to be made. The HAZ indentations are to be made along the traverses for approximately 0.5 mm each into unaffected material, and starting as close to the fusion line as possible.

One indentation at each side of the weld along each traverse has to be made on parent metal. Reference is made to Fig. 3 of this specification. The indentations are to be made in the adjacent region as well as on the opposite side of the macro section along the specified traverses.

1.5.2 Method

The test shall be carried out in accordance with recommendation ISO R81, Vickers hardness, using a laboratory type machine controlled as pre-recommendation ISO R 146 and using a diamond pyramid penetrator set at 2.37 rad (136") with a load of 10 kg.

1.5.3 Requirements

Hardness value shall not exceed the limit specified in welding specification chart. In case of a single reading strictly (+ IOHV) higher than the specified limit, further indentations shall be made to check if the high value was an isolated case.

All the hardness values contained from the heat-affected zone shall not exceed 100 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

1.6.1 Specimens shall be taken from the position indicated in Fig. 2, 3 & 4 of this specification. The test specimens will be prepared in accordance with API 1104. Charpy V-Notch specimens shall have dimensions as given in Fig. 6 of the specification. Three 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 as shown in Fig. 6 of this specification. The notch shall be to the roller surface perpendicular to the roller surface. The test shall be conducted at -29 deg C and as per ASTM A370.

1.6.2 Requirements (Note 1)

The impact energy shall be:

Test specimen in (mm)	Average of three specimen (Note 2) joule (Min.)	Minimum single value (Note 1)
10.0	27.0	22.0
7.5	21.5	17.5
5.0	18.5	15.0
2.5	10.0	8.0

Note:

- (1) These values are specified for resistance to brittle fracture only. Where additional requirements are specified in project data sheet (Ex. pipeline materials with arrest properties i.e., a higher upper shelf Charpy V energy for resistance against propagating ductile fractures) the same shall be followed.
- (2) Only one value is permitted to be lower than average value up to the value specified.

1.7 Bend Test Requirements

The Bend test Specimens shall be made and tested as per the requirements of API 1104 Latest edition (edition in force at the time of floating enquiry). The acceptance criteria shall be as per API 1104.

ANNEXURE-2

1.0 ULTRASONIC INSPECTION

In addition, the radiographic inspection, ultrasonic inspection is required as per conditions listed in paragraph 12.5 of this specification. This section concerns manual ultrasonic inspection. However ultrasonic inspection by automatic equipment may be used if approved by the COMPANY.

1.1 General:

The CONTRACTOR who carries out the ultrasonic inspections shall have sufficient no. of qualified personnel, equipment and instruments at his disposal to be able to affect the tests without hindering or delaying the pipeline assembly operations. The CONTRACTOR appointed to carry out ultrasonic inspections shall supply all the instruments necessary for their execution on site.

1.2 Specification for Ultrasonic Testing Procedure Qualification

Before work begins, the CONTRACTOR shall present a specification describing the proposed U.T. procedure qualification. This specification shall state, all the parameters described in API 1104 and the following information:

- a) Type of U.T. Equipment used;
- b) Type and dimensions of transducers
- c) Frequency range
- d) Details for calibration
- e) Coupling medium
- f) Inspection technique
- g) Record details
- h) Reference to the welding procedure where it is intended to adopt the specification
- I) Temperature range of the joints to be inspected.

1.3 Qualification of Ultrasonic Inspection Procedure

The ultrasonic inspection procedure shall be approved by the COMPANY. Before inspection begins, the COMPANY may require the qualification test of the ultrasonic inspection procedure. 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 COMPANY.

1.4 Test Procedure

Circumferential welds shall be inspected from both sides using angle 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 and anyhow the cleaned strip must be at least wide enough to allow one and a half 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.

By way of an example, the equipment shall include but not be limited to the following:

- a) Ultrasonic equipment and coupling medium
- b) Sample sections for calibration of instruments
- c) Equipment for cleaning of surface to be examined
- d) Rules calibrated in centimeters for exact location of the position of defects.

The characteristics of the above listed instruments and equipment shall guarantee:

- a) That the required standards of the inspection procedure, as previously established and approved by the COMPANY, are satisfied.
- b) Continuous operation

All the instruments and equipment shall be approved by the COMPANY before being used. The COMPANY has the authority to reject any item that is considered unsuitable. The decision of the COMPANY is final. The CONTRACTOR appointed to carry out ultrasonic inspections shall also ensure the operational efficiency and maintenance of the instruments and equipment, and shall immediately substitute any item rejected by the COMPANY.

All the instruments and equipment necessary for carrying out ultrasonic inspection on site shall satisfy the requirements laid down by the public boards of institutions that regulate 'safety at work'.

1.5 Ultrasonic Instruments

The ultrasonic instrument:

- a) Shall be pulse echo type, able to generate, receive and display, on the screen a Cathode Ray Tube (CRT), pulse at frequencies between 1 and 6 MHz. The useful part of the CRT screen shall be at least 70mm wide and at least 50mm high shall have variable amplification, with steps of 1 or 2 dB over a range of at least 60 dB.

- b) the regulation control shall be accurate to within ± 1 dB and this accuracy shall be certified by the instrument manufacturer.
- c) may be powered by a battery or an electric generator. In the first case, the autonomy of operation (endurance) of the instrument shall be sufficient to carry on working without frequent interruptions, and the instrument shall be equipped with an automatic switch which switches it off when the battery runs down; in the second case, there must be a voltage stabilizing device with a tolerance of ± 2 Volts.

1.6 Probes

The probes used shall have dimensions, frequencies, and a refraction angle suited to the type of steel, the diameter, and the thickness of the pipeline and to the joint design.

1.7 Reference Sample Pieces

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

For manual ultrasonic testing and automated ultrasonic testing, the reference sample pieces shall be as described in API 1104, Nineteenth Edition, para 11.4.5.

1.8 Calibration

The calibration, qualification of the testing procedure shall be done as provided in API 1104.

1.9 Regulation of Amplification during Production Testing

Scanning sensitivity shall be as provided in API 1104 para 11.4.7.2 & 11.4.7.3.

1.10 Qualification of Ultrasonic Testing Operators for Automatic UT. Before the inspection begins or during the same inspection, the COMPANY may require a qualification test for the ultrasonic equipment operators.

The operators shall be fully qualified as per a recognized standard (ASME Sec V or equivalent) and they shall have as minimum level II as described in API 1104. The operators shall be able to:

- a) calibrate the equipment;
- b) perform an operational test under production conditions;
- c) interpret the screen picture;
- d) evaluate the size and location of reflectors
- e) interpret the type of defects detected

The COMPANY has the option of checking the ability of personnel employed for ultrasonic

Testing by means of qualification tests.

1.11 Evaluation of Indications given by Ultrasonic Tests

Each time that echoes from the weld bead 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 clause 12.5 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 that 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 COMPANY. 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.

1.12 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 affected 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 (files, brushes, etc.) as well as the coupling liquid or paste appropriate for the temperature of the section to be examined.

ANNEXURE-3

RADIOGRAPHY

1.0 SCOPE

This annexure covers the radiographic inspection of all types of welded joints of the main pipeline.

The welded joints shall include the following:

- i) Full girth welds on the mainline construction including double jointing of pipe, if adopted.
- ii) Welds for installation of block valves, insulating joints and other appurtenances and tie-ins.
- iii) Welds at scraper launching and receiving barrels.
- iv) Terminal Piping

2.0 APPLICABLE STANDARDS

This specification shall apply in conjunction with the following (all latest editions):

- i) API 1104, Standard for welding Pipelines and Related Facilities
- ii) ANSI B 31.8, Code for Gas Transmission and Distribution Piping Systems.
- iii) ANSI B 31.4, Code for Transportation System for Hydrocarbons, Liquid Petroleum Gas, Anhydrous Ammonia and Alcohols.
- iv) ASTM E 94, Recommended practice for Radiographic Testing
- v) ASTM E 142, Standard Method for Controlling Quality of Radiographic Testing
- vi) The American Society for Nondestructive Testing. Recommended Practice no. SNT-TC-IA Supplement A.

3.0 PROCEDURE

3.1 The radiographic examination procedure to be adopted shall be submitted by the CONTRACTOR as per Exhibit-F.

3.2 The procedure of radiographic examination shall be qualified to the entire satisfaction of COMP ANY prior to use. It shall include but not be limited to the following requirements:

- i) 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 exceed 0.30.
 - iv) Radiographic identification system and documentation for radiographic interpretation reports and their recording system.
- 3.3 The CONTRACTOR shall qualify each procedure in the presence of the COMPANY prior to use.
- 3.4 The procedure of radiographic examination shall produce radiographs of sufficient density, clarity and contrast so that defects in the weld or in the pipe adjacent to the weld are clearly discernible.
- 3.5 One Check shot of the full joint on main line welds shall be taken per 100 circumferential welds or one per day of the production whichever is more for cross checking the correctness of the radiographs of weld joints executed by the contractors. For taking check shots on completed/accepted sections, contractor has to separately mobilize either internal crawler/external X-ray unit, as appropriate.
- 3.6 All the girth welds of mainline shall be subjected to 100% radiographic examination. The CONTRACTOR shall furnish all the radiographs to the COMPANY, immediately after processing them, together with the corresponding interpretation reports on approved format. The details of the radiographs along with the joint identification number shall be duly entered in a register and signed by the CONTRACTOR and submitted to the COMPANY for approval.
- 3.7 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. 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.
- 3.8 Three copies of each acceptable radiographic procedure (as per Exhibit-F) and three copies of radiographic qualification records shall be supplied to COMPANY. One set of the qualifying radiographs on the job shall be kept by the CONTRACTOR's authorized representative to be used as a standard for the quality of production radiographic during the job. The other two sets shall be retained by COMPANY for its permanent record.
- 3.9 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 COMPANY by the CONTRACTOR.
- 3.10 The CONTRACTOR shall, on a daily basis, record for each radiograph (1) radiograph's number, (2) approximate chainage of weld location, (3) whether or not the welds meet the specified acceptance standards and (4) the nature and approximate location of unacceptable defects observed. It must be possible to relate back to a particular butt weld and welder on piping drawing and pipeline alignment drawing.

- 3.11 Each day's production of processed radiographs shall be properly packaged separately, identified by at least the (1) date, (2) radiographic unit, (3) job locations, (4) starting and ending progress survey stations and (5) shall include original and three copies of the daily radiographic record. The package shall be submitted to the COMPANY daily when possible, but in no event later than noon of the following day.
- 3.12 The CONTRACTOR shall provide all the necessary facilities at site, such as a dark room with controlled temperature, film viewer etc. to enable the COMPANY to examine the radiographs.
- 3.13 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 Company.
- 3.14 COMPANY shall have free access to all the CONTRACTOR's work facilities in the field.
- 3.15 Any approval granted by the COMPANY shall not relieve the CONTRACTOR of his responsibilities and guarantees.

4.0 RADIATION SOURCE

- 4.1 Radiographic examination shall be carried out using X-radiations; radiographic examination by Gamma rays using slow speed films may be allowed, at the discretion of the COMPANY, in case of inaccessible joints. Radiography by Gamma ray for tie-in-joints shall be acceptable provided D4 AGF A film or equivalent is used and the required sensitivity obtained.
- 4.2 Whenever possible, pipeline welds will be inspected by placing the radiation source inside the pipe. on the pipeline axis. with a radiation of 6.28 red. (360).

5.0 LEVEL OF QUALITY

The quality level of Radiographic sensitivity required for radiographic inspection shall be at least equivalent to the values in Figure-7.

6.0 PENETRAMETERS

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 DIN-54109 or ISO-I 027. For radiographs made with the source on the outside, a Penetrameter shall be placed on each side of the film with the smaller wire of the Penetrameter turned towards the end of the film itself. When a complete weld is radiographed in a single exposure using a source inside the piping, four penetrameters approximately equally spaced around the circumference shall be used. During the procedure qualification, IQI shall be placed both on the source side and on the film side.

The sensitivity obtained with IQI on the source side shall not be less than the values shown in Fig. 7 of this specification. 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 COMPANY may authorize use of types of IQI other than those planned, provided that they conform with recognized 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 CONTRACTORS to show up the identification number and other details of the proposed IQI, which must be visible in the test radiograph.

7.0 FILM IDENTIFICATION 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.

8.0 PROTECTION AND CARE OF FILM

- 8.1 All unexposed films shall be protected and stored properly as per the requirements of API1104 standard and ASTM E.94.
- 8.2 The exposed and unexposed film shall be protected from heat, light, 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.

9.0 RE-RADIOGRAPHY

- 9.1 The weld joints shall be re-radiographed in case of unsatisfactory quality of the radiographs, at the expense of the CONTRACTOR.
- 9.2 All the repaired weld joints shall be re-radiographed at no extra cost to the COMPANY in the same manner as 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.
- 9.3 When evaluating repair film, radiographers shall compare each section (exposure) of the weld with the original film to assure repair was correctly marked and original defect removed.
- 9.4 The COMPANY will review prior to any repair of welds, all the radiographs of welds that contain, according to the CONTRACTOR's interpretation, unacceptable defects. The final disposition of all unacceptable welds shall be decided by the COMPANY.

10.0 QUALIFICATION OF RADIOGRAPHERS

- 10.1 Pipeline radiographers shall be qualified in accordance with the requirement of API 1104 and to the full satisfaction of COMPANY.
- 10.2 Certification of all the radiographers, qualified as per 10.1 above, shall be furnished by the CONTRACTOR to the COMPANY before a radiographer will be

permitted to perform production radiography. The certificate record shall include:

- i) Background and Experience Record
- ii) Training Course Record
- iii) Technical Examination Record
- iv) Doctor's report on radiographer's Jacque 0-1 acuity eye test
- v) Date of qualification

- 10.3 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.

11.0 PRESERVATION OF RADIOGRAPHS

- 11.1 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.
- 11.2 All radiographs shall become property of the COMPANY.

12.0 EQUIPMENT AND ACCESSORIES

- 12.1 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.
- 12.2 For carrying out the mainline radiographic examination the CONTRACTOR shall be equipped with suitable mobile/stationary type dark rooms. These shall have all the required facilities for film processing. Film viewer used shall be equipped with the film illuminator that has a light source of sufficient intensity and suitably controlled to allow viewing film densities up to 4.0 without damaging the film.

13.0 RADIATION PROTECTION

- 13.1 CONTRACTOR shall be responsible for the protection and personnel monitoring of every man with or near radiation sources.
- 13.2 The protection and monitoring shall comply with local regulations.
- 13.3 In view of visual hazards in the handling of Radioactive source of material, CONTRACTOR shall be solely responsible for complying with all rules and regulations set forth by Atomic Energy Commission or any other Government agencies of India in this regard and COMPANY shall not be responsible and shall be kept indemnified by the CONTRACTOR for default (s) of whatever nature by the CONTRACTOR. Safety equipment as considered adequate by the COMPANY

for all necessary personnel shall be made available for use and maintained for immediate and proper use by the CONTRACTOR.

14.0 DISPLAY OF 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.

15.0 ENFORCEMENT OF SAFETY REGULATIONS

To ensure effective enforcement of the rules and regulations relating to safety precautions, the arrangement made by the CONTRACTOR shall be open to inspection by COMPANY or its representatives.

16.0 FIRST AID AND INDUSTRIAL INJURIES

- 16.1 CONTRACTOR shall maintain first aid facilities for its employees and those of sub-Contractors.
- 16.2 CONTRACTOR shall make outside arrangements for ambulance service and for treatment of industrial injuries. Names of those providing these services shall be furnished to COMPANY prior to start of work and their telephone no. Shall be posted prominently in CONTRACTOR'S field office.
- 16.3 All critical industrial injuries shall be reported promptly to the COMPANY and a copy of CONTRACTOR's report covering each personal injury requiring the attention of physician shall be furnished to the COMPANY.

17.0 NO EXEMPTION

Notwithstanding the above there is nothing in these to exempt the CONTRACTOR from the operation of any other act or rules in force.

EXHIBIT- A

ELECTRODE QUALIFICATION TEST RECORD

- A.** Tested at (Site name) : Date:
- Manufacturer's Name :
- Brand Name: :
- Batch Number & Size tested :
- Classification & Code :
- Intended for welding in position: :
- In combination with (if any) :
- Code of Reference (used for testing) :
- Special Requirements (if any) :
- B.** All-weld Tensile Test :
- Base Material used :
- Pre-heat temperature :
- Post weld heat treatment details: :
- Visual examination :
- Radiographic examination results :
- Tensile test results :

Identification No.	U.T.S.	Yield Point	Elongation	Remarks
1.				
2.				

C. Impact Test Results

- Test Temperature : Notch in
- Type of Specimens (Charpy) :
- Size of Specimens

Specimen No.	Impact Value	Average
1		
2		
3		
4		
5		

D. Chemical Analysis Results

Electrode Size Result :

Batch No. :

%C	%S	%P	%Si	%Mn	%Cr	%Ni	%Mo	Other

PREPARED BY
(CONTRACTOR)

REVIEWED BY
(CONTRACTOR)

APPROVED
(PMC/OWNER)

EXHIBIT- B

STRESS RELIEF HEAT TREATMENT PROCEDURE SPECIFICATION

Name of the Heat-treater :
Name of the Project : Specification Reference No.

1. General Detail:
Name of the Equipment:
Name of the Assembly/Part:
Drawing No:
Material:
2. Furnace Details
Type of Heating : Gas/Oil/Elect.
Res/ induction Type of Heating
Capacity (Size)
Maximum Temp. (C) :
Method of temp. Measurement
Atmosphere Control :
3. Heat Treatment Cycle Details
Charging Temp. C
Rate of heating, C/Hr.
Soaking Temp. C
Soaking Time, hrs.
Rate of Cooling, C/Hr.
Mode of Cooling
4. Other Details, if any :
Notes:

The following documents shall be furnished along with the specifications:

- i) Material test certificates
- ii) Assembly/Part Drawing.

.....
**PREPARED BY
CONTRACTOR)**

.....
**REVIEWED BY
(CONTRACTOR)**

.....
**APPROVED BY
(PMC/OWNER)**

EXHIBIT- C

QUALIFICATION WELD REPORT													
Date _____		Test No. _____		Test Type: _____		Procedure _____		Welder _____					
Location _____		Welder (s) _____											
Material Grade 1 _____													
Material Grade 2 _____													
Outside Diameter _____				Wall Thickness _____									
Joint Type _____				Bevel Angle _____									
Backing Type (if applicable) _____				Roll or Fixed Position _____									
RECORDED WELDING PARAMETERS													
Pass	Process and Direction of Welding	Filler Metal Classification and Diameter	Shielding Gas type and flow rate or shielding flux	Preheat / Interpass Temperature	Voltage	Amperage	Travel Speed	Heat Input					
Root Bead													
Second Bead													
Note: Number of weld beads are not intended to be limited by this table and the table should be adjusted to present all required passes. Time between passes: Root Bead to 2 nd Bead: _____, 2 nd bead to 3 rd bead: _____ Cooling Method (if applicable) _____ PWHT _____													
MECHANICAL TEST RESULTS													
TENSILE TESTS Report Number : _____				NICK BREAK TEST Report Number : _____									
Specimen Number	Tensile 1	Tensile 2	Tensile 3	Tensile 4	Specimen Number	Nick 1	Nick 2	Nick 3	Nick 4	Nick 5	Nick 6	Nick 7	Nick 8
Location					Location								
Original specimen dimensions					Result								
Original specimen area					BEND TESTS Report Number: _____								
Maximum load					Specimen Type and Number								
Tensile strength					Location								
Fracture Location					Result								
Remarks													
Test made at _____						Date _____							
Tested by _____						Supervised by _____							

Sample Qualification Weld Report Form

WELDING PROCEDURE SPECIFICATION

WPS Number _____

Process(es)/Method of Application _____
 Material grade(s) _____
 Outside diameter _____ Wall thickness _____
 Joint type _____ Bevel angle _____
 Backing type (if applicable) _____ Roll or fixed position _____
 Direction of welding _____ Number of welders _____
 Preheat temperature _____ Interpass Temperature _____
 Method of Heating _____
 Filler metal(s) and Flux _____
 Flame characteristics _____ Cleaning and/or grinding tools _____
 Type and removal of lineup clamp _____ Minimum number of passes _____
 Maximum time between root pass and start of the second pass _____ Maximum time between second pass and start of third pass _____
 Method of cooling _____ PWHT procedure _____

JOINT DESIGN

SEQUENCE OF BEADS

WELDING PARAMETERS

Pass	Process / Electrical Characteristics	Filler Metal Group or Classification	Electrode Size	Shielding Gas Type and Flow Rate or Shielding Flux	Voltage Range	Amperage Range	Travel Speed Range	Heat Input Range
Root Bead								
Second Bead								

Note: Number of weld beads are not intended to be limited by this table and the table should be adjusted to present all required passes.

Supporting qualification weld report No(s) _____

Approved by: _____

Sample Qualification Weld Report Form

**PREPARED BY
CONTRACTOR)**

**REVIEWED BY
(CONTRACTOR)**

**APPROVED BY
(PMC/OWNER)**

EXHIBIT- D

Example of record form for welder qualification test

Welder test certificate	Test no
Project/Contract	Date
Contractor	Inspector
Welder's name	
Address	
Pipe material	
Pipe thickness	
Pipe outside diameter	
Welding process	Root
	Fill and Cap
Reason for failure	
Visual	
Non-destructive testing	
Butt joint	
Fillet weld	
'Number of attempts	
Comments	
Accepted date/Time	

Signed by Contractor

Signed by Inspector

*Delete as necessary



EXHIBIT- E

Welder's Identification Card

Name	:	
Identification	:	Photograph
Date of Testing	:	
Valid till	:	
Approval of Welding	:	
Welding Position	:	
Material	:	
Diameter	:	
Diameter range approved	:	
Wall thickness	:	
Thickness range approved	:	
Type of welding consumables	:	

Approved by:

Employers' Signature with seal

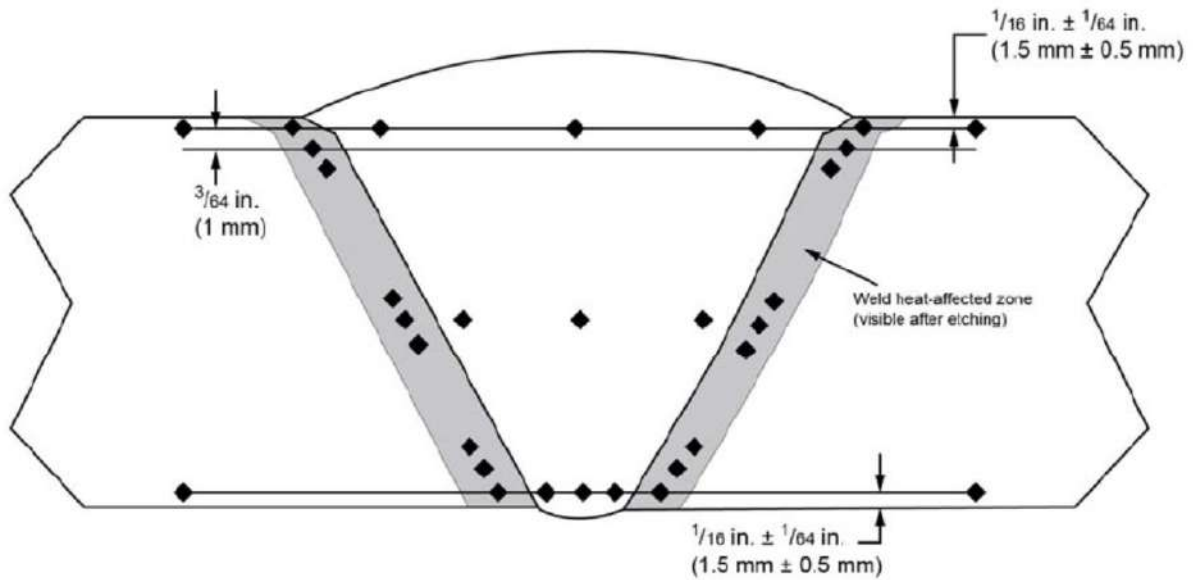
EXHIBIT- F

Radiographic Procedure for Pipe Welding

1. Location
2. Date of Testing
3. Name of Supervised Contractor
4. Material
5. Dia & Thickness
6. Type of weld joint
7. Radiation Source (X-ray, iridium)
8. Type of equipment (External/Internal)
9. Intensifying screens and material
10. Filter type and placement mask, Diaphragm Lead screen etc. adjacent to radiation source or specimen,
11. Exposure Geometry (Source focal spot size, object to film distance, radiation angle with respect to weld and film).
12. Limit of film coverage
13. Film type and make
14. Exposure Conditions (rna, KV, time)
15. Processing (time temperature for development stop bath or rinse, fixation, washing, drying etc.)
16. Density
17. Sensitivity
18. Type of penetrameter
19. Essential wire to be seen on source side:
20. Essential wire accepted for film side viewing:

Approval of the COMPANY

Signature of CONTRACTOR with seal



NOTE Heat-affected zone (HAZ) hardness impressions must be entirely within the HAZ and located as close as possible to the fusion boundary (between the weld metal and HAZ). The wall thickness of the specimen may prevent all the indents as shown from being made, particularly along the mid-point of the specimen.

HARDNESS TESTING – BUTT WELDS

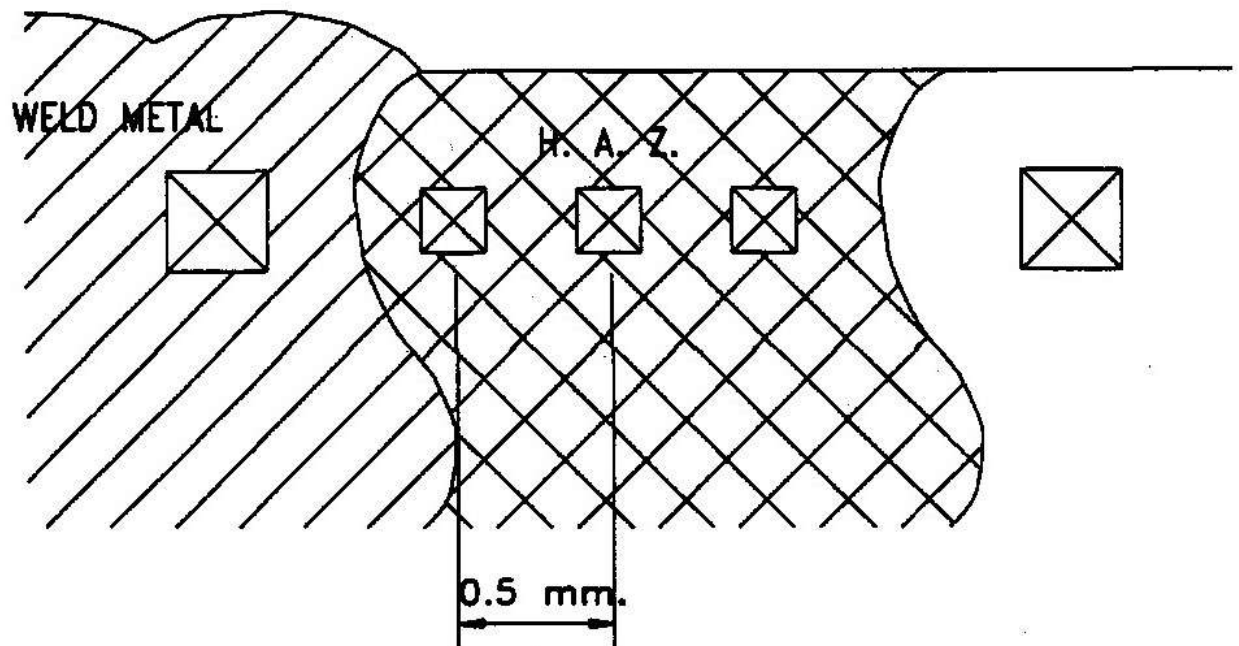


FIGURE 5
HARDNESS TESTING OF WELD JOINTS – SCHEMATIC

NOTCH POSITIONS

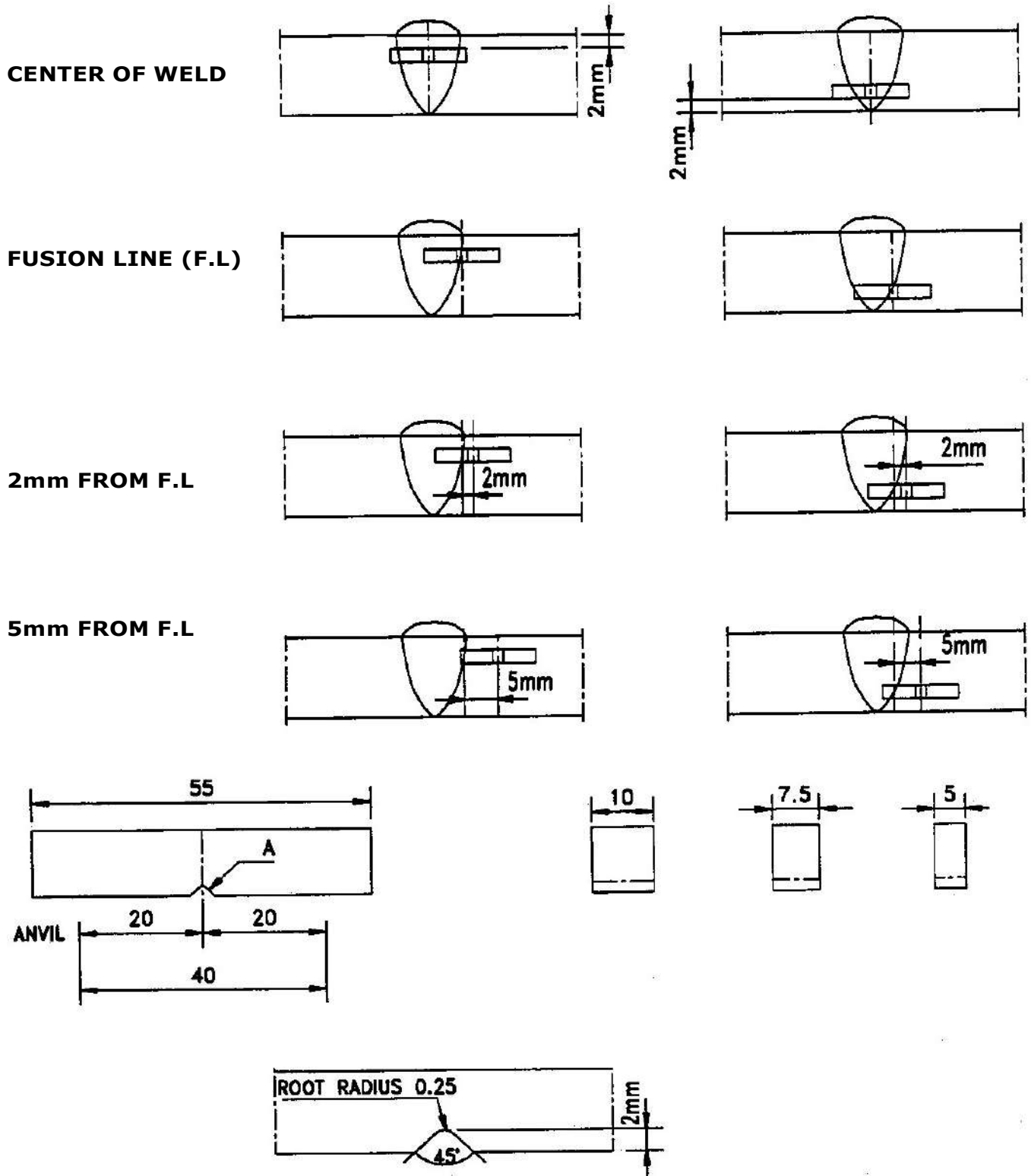


FIGURE 6
CHARPY V – NOTCH TEST SPECIMEN

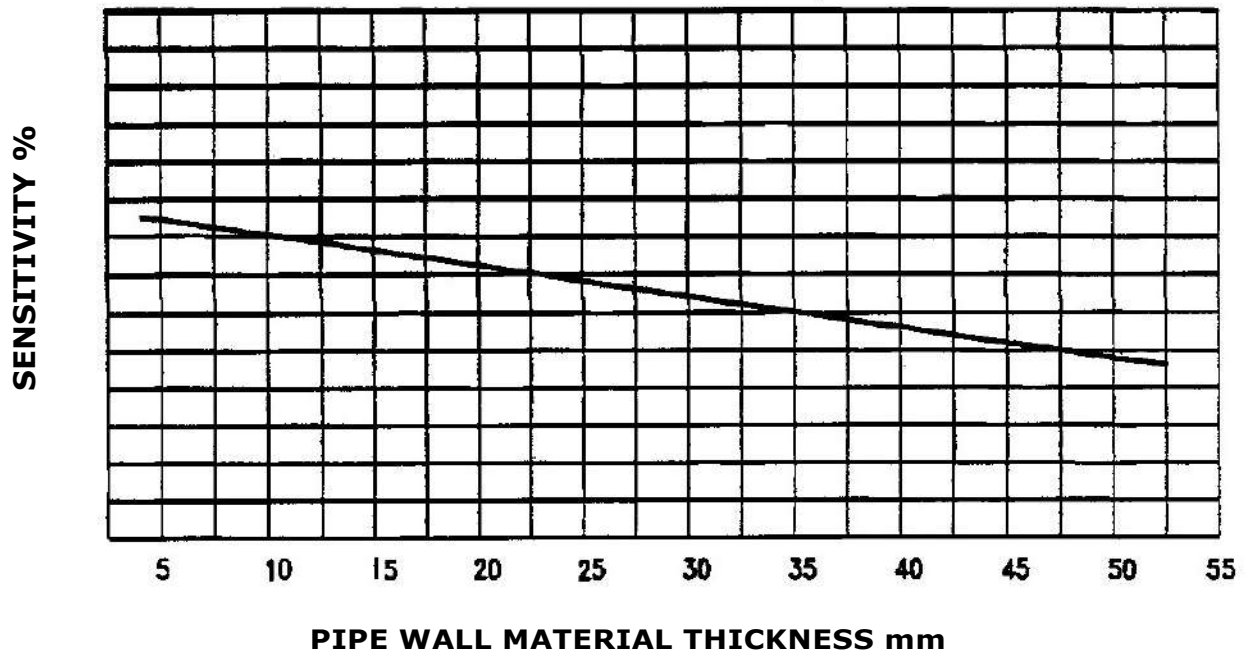


Figure-7

NOTE:-

FOR PRODUCTION RADIOGRAPHY, SENSITIVITY REDINGS BASED ON FILM ON SIDE PENTRAMETERS ARE TO BE JUDGED AS PER RESULT FROM THE PROCEDURE QUALIFICATION WITH PENTRAMETERS PLACED ON THE SOURE SIDE

WELDING SPECIFICATION CHARTS TO SPECIFICATION FOR WELDING OF ONSHORE GAS PIPELINES

4"/6" LINE PIPE THK RANGE 6.4 to 7.1 mm				
MATERIAL SPECIFICATIONS	PIPES	API 5L Gr X-52 PSL 2		
	FITTINGS	-		
	FLANGES	-		
	OTHERS	-		
BASE METAL 'P' NO	1			
WELDING PROCESS	GROOVE JOINTS SINGLE SIDE BEVEL			
	BUTT			
	OTHER THAN BUTT			
	ROOT PASS : SMAW	FILLER PASS : SMAW	ROOT PASS : N.A.	FILLER PASS : N.A.
FILLET JOINTS / SOCKET JOINTS : N.A.				
WELDING MATERIAL	GROOVE JOINTS			
	BUTT			
	OTHER THAN BUTT			
	ROOT PASS : E6010	FILLER PASS & CAPPING: E7010	ROOT PASS : N.A.	FILLER PASS : N.A.
	HOT PASS: E7010			
FILLET JOINTS / SOCKET JOINTS : N.A.				
BACKING RING : N.A.		CONSUMABLE INSERT : N.A.		
JOINT PREPARATION	API 1104 / ASME SEC. -IX, latest edition			
GASES	PURGING :	SHIELDING :		
GAS COMPOSITION	PURGING :	SHIELDING :		
PREHEATING	PREHEAT TEMP: 100°C MIN	POST HEATING :		
CONTINUITY OF WELDING AND PREHEAT : REFER TO SPECIFICATION				
POST WELD HEAT TREATMENT	HOLDING TEMP :	N.A.	HOLDING TIME :	
	RATE OF HEATING:	N.A.	MIN. HOLDING TIME :	
	METHOD OF COOLING :	N.A.	RATE OF COOLING :	
MECHANICAL PROPERTY REQUIREMENTS	CHARPY 'V' NOTCH VALUE :		WIRE SPEED	
	AT TEMPERATURE :		MIN: 22 J AVERAGE : 27 J	
	HARDNESS :		0°C	
CODE OF FABRICATION :	API 1104 / ASME SEC. -IX / B 31.8			
TECHNICAL NOTES :				
1. The Non-Destructive Testing (NDT) shall be examined by X-ray using internal crawlers.				

 ENERGISING QUALITY	WELDING SPECIFICATION CHART	Specification No. : VCS/WSC/01	Rev. 0

WELDING SPECIFICATION CHARTS TO SPECIFICATION FOR WELDING OF ONSHORE GAS PIPELINES

PIPING CLASS:		15HC, 30HC	
MATERIAL SPECIFICATIONS	PIPES	ASTM A106 GR.B, API 5L GR B PSL2, API 5L X52 PSL2 ASSORTED PIPES	
	FITTINGS	ASTM A105, ASTM A234 GR.WPB, ASTM A234 RG.WPB-W, MSS SP-75 GR.WPHY-52	
	FLANGES	ASTM A105, ASTM A694 GR.F-52	
	OTHERS	-	
BASE METAL 'P' NO		1	
WELDING PROCESS	GROOVE JOINTS SINGLE SIDE BEVEL		OTHER THAN BUTT
	BUTT		
	ROOT PASS : GTAW/SMAW	FILLER PASS : GTAW/SMAW	ROOT PASS : GTAW FILLER PASS : GTAW/SMAW
	FILLET JOINTS / SOCKET JOINTS : SMAW		
WELDING MATERIAL	GROOVE JOINTS		
	BUTT		OTHER THAN BUTT
	ROOT PASS : ER70S-2/ E6010	FILLER & CAP PASS ER70S-2/ E7018-1	ROOT PASS : ER70S-2 FILLER PASS : ER70S-2/ E7018-1
	FILLET JOINTS / SOCKET JOINTS : E7018-1		
	BACKING RING : N.A.		CONSUMABLE INSERT : N.A.
JOINT PREPARATION		API 1104 / ASME SEC. -IX	
GASES	PURGING :	SHIELDING : Argon	
GAS COMPOSITION	PURGING :	SHIELDING : 99.995%	
PREHEATING / INTER PASS	PREHEAT TEMP 10 -100 Deg INTERPASS : Max 200 Deg	POST HEATING : NA	
CONTINUITY OF WELDING AND PREHEAT : REFER TO SPECIFICATION			
POST WELD HEAT TREATMENT	HOLDING TEMP :	HOLDING TIME :	
	RATE OF HEATING:	MIN. HOLDING TIME :	
	METHOD OF COOLING :	RATE OF COOLING :	
MECHANICAL PROPERTY REQUIREMENTS	CHARPY 'V' NOTCH VALUE :	MIN:	AVERAGE :
	AT TEMPERATURE :	At 0°C	
	HARDNESS :		
CODE OF FABRICATION :		API 1104 / ASME SEC. -IX	
TECHNICAL NOTES :			
 ENERGISING QUALITY	WELDING SPECIFICATION CHART		Specification No. : VCS/WSC/02 Rev. 0

WELDING SPECIFICATION CHARTS TO SPECIFICATION FOR WELDING OF ONSHORE GAS PIPELINES

PIPING CLASS:		15HLT, 30HLT	
MATERIAL SPECIFICATIONS	PIPES	ASTM A 333 GR.6 ASSORTED PIPES	
	FITTINGS	ASTM A 350 GR.LF2, ASTM A 420 GR.WPL6, ASTM A 420 GR.WPL6-W	
	FLANGES	ASTM A 350 GR.LF2	
	OTHERS	-	
BASE METAL 'P' NO	1		
WELDING PROCESS	GROOVE JOINTS SINGLE SIDE BEVEL		
	BUTT		OTHER THAN BUTT
	ROOT PASS : GTAW	FILLER PASS : GTAW/SAW	ROOT PASS : GTAW FILLER PASS : SAW
	FILLET JOINTS / SOCKET JOINTS : SAW		
WELDING MATERIAL	GROOVE JOINTS		
	BUTT		OTHER THAN BUTT
	ROOT PASS : ER70S-2	FILLER & CAP PASS ER70S-2/ E7018-1	ROOT PASS : ER70S-2 FILLER PASS : ER70S-2/ E7018-1
	FILLET JOINTS / SOCKET JOINTS : E7018-1		
	BACKING RING : N.A.		CONSUMABLE INSERT : N.A.
JOINT PREPARATION	API 1104 / ASME SEC. -IX		
GASES	PURGING :	SHIELDING : Argon	
GAS COMPOSITION	PURGING :	SHIELDING : 99.995%	
PREHEATING	PREHEAT/ INTERPASS TEMP: 100°C max		POST HEATING :
CONTINUITY OF WELDING AND PREHEAT : REFER TO SPECIFICATION			
POST WELD HEAT TREATMENT	HOLDING TEMP :		HOLDING TIME :
	RATE OF HEATING:		MIN. HOLDING TIME :
	METHOD OF COOLING :		RATE OF COOLING :
MECHANICAL PROPERTY REQUIREMENTS	CHARPY 'V' NOTCH VALUE :		MIN: AVERAGE :
	AT TEMPERATURE :		At 0°C
	HARDNESS :		
CODE OF FABRICATION :		API 1104 / ASME SEC. -IX	
TECHNICAL NOTES :			

	WELDING SPECIFICATION CHART	Specification No. : VCS/WSC/02	Rev. 0



VCS QUALITY SERVICES PVT. LTD.

STANDARD SPECIFICATION FOR WARNING MAT

VCS – SS – PP -2020

					
04	29.04.2022	RP	MC	HK	GW
03	03.01.2022	SR	MC	HK	HK
Rev. No	Date	Prepared By	Checked By	Approved By	Authorized By

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CONTROLLED COPY	: If in soft and signed

REVISION RECORD						
Rev.	Revision Date	Prepared by	Checked by	Approved by	Authorized by	Revision Description
00	23.02.2019					Issued as Standard Specification
		PK	DG	AD	SK	
01	28.01.2020					Document numbering updated from VPC-SS-PL-0034 to VPC-SS-PP-2020
		MB	MC	AD	SK	
02	18.12.2020					Re-Issued as Standard Specification
		PNS	MC	AD	SK	
03	03.01.2022					Revised after VCS Internal Technical Review
		SR	MC	HK	HK	
04	29.04.2022					VCS QMS Integration
		RP	MC	HK	GW	

ABBREVIATIONS:

ASME	American Society of Mechanical Engineers
ASTM	American Society of Testing of Materials
API	American Petroleum Institute

TABLE OF CONTENTS

1.0	SCOPE	5
2.0	REFERENCE CODES, STANDARDS AND SPECIFICATIONS	5
3.0	FEATURES	6
3.1	MATERIAL	6
3.2	MECHANICAL PROPERTIES	6
3.3	COLOUR.....	6
3.4	DIMENSIONS	6
3.5	MARKING	6
3.6	TESTS.....	7
4.0	PACKING.....	8
5.0	QUALITY ASSURANCE (QA)	8
6.0	DEFECT LIABILITY	8
7.0	RECOMMENDED MANUFACTURER FOR RAW MATERIAL.....	8

1.0 SCOPE

This specification covers the minimum requirements for the various activities to be performed by for the procurement of Warning Mat.

Warning Mats shall be laid in the ground above the gas main line in order to indicate their presence.

This specification shall be read in conjunction with the condition of all specifications and documents included in the contract between company and contractor.

2.0 REFERENCE CODES, STANDARDS AND SPECIFICATIONS

The latest edition(edition in force at the time of floating enquiry) of following Codes, Standards and regulations are referenced in this specification and all provisions of these reference codes and standards shall be applicable.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

B31.4 : Pipeline Transportation system for liquid Hydrocarbon & other liquids.

B 31.8 : Gas Transmission and Distribution Piping Systems.

AMERICAN PETROLEUM INSTITUTE (API)

1102 : Pipeline Crossing Railroads and Highways

1109 : Marking Liquid Petroleum Pipeline Facilities

1104 : Welding of Pipelines and Related Facilities

PNGRB REGULATIONS :

G.S.R 808(E) T4S : Regulations for Natural Gas Pipelines

G.S.R. 612(E) T4S : Regulations for CGD Network

US DOT PIPE LINE SAFETY STANDARD

Part 192, Title 49 : Transportation of Natural and other Gases by Pipe Line

Part 195 : Transportation of Liquid by Pipe Line

3.0 FEATURES

Warning mat material shall be non-biodegradable type. It shall have non-toxic & anti-rodent properties.

3.1 MATERIAL

Warning Tape, Type 1 as per EN 12613 shall be used for the present project.

The material grade of Warning Mat shall be High density polyethylene (PE)/ PP material with warning sticker / stamp. The material shall be having the density between 0.913 to 0.923 g/cc at 27 deg. Celsius as per IS 2508.

The tape shall be uniform in colour, texture and finish and shall be free from holes and foreign materials.

Rodent repellent chemicals to be added to the plastic master batch for protection against rodents.

The material and colour, if used, for printing shall have no detrimental effects on the environment.

3.2 MECHANICAL PROPERTIES

Mechanical properties of the Warning Mat (Type I) shall be in accordance with the code EN 12613.

Minimum tensile withstand load in longitudinal direction shall not be less than 200 N. The test piece shall not exhibit a reduction of more than 20% of its width after removal of the specified load.

3.3 COLOUR

The Warning Mat shall be of bright golden yellow colour. This colour must not take any alteration in the course of time.

3.4 DIMENSIONS

Warning Mat shall have following dimensions:

Width	$(D+500) \pm 2 \text{ mm}$ (Note-1)
Thickness	1.0 mm (Minimum)

'D' is diameter of mainline pipe.

Negative tolerance on the thickness is not allowed.

Note: Width of Mat shall be finalized during drawing approval stage.

3.5 MARKING

3.5.1 The warning mat shall be marked at intervals not exceeding 1 meter. Marking on the mat shall be approved by owner. The marking shall be legible and durable. The

warning mat must be printed with "Caution: High Pressure Gas Pipeline Below" in English and Hindi/ Local Language, Chainage marking along with owner's logo and owner's 24 Hours Emergency Number -----, ----- at a frequency of every meter. In addition, name or trademark of the manufacturer, year of manufacture and reference of code of manufacture of warning mat shall be included in the marking.

3.5.2 Vendor shall submit proposed Artwork to be marked on the Warning Mat for approval from Owner / Owner's representative before start of production.

3.6 TESTS

All the tests and test procedures for Warning Mats shall be as per EN 12613 or as per required National/ International standards mentioned in EN 12613. In addition, all requirements pertaining to statutory requirements, if any, as specified from time to time shall be complied.

The required tests are briefed as below:

Colouring

Three separate tests shall be carried out in accordance with:

- As per normative annexure B of EN 12613, using 20% ammonium sulphide.
- As per EN ISO 175, using 10% nitric acid & 20% sodium carbonate solution.

The tests shall be repeated for each colour (if any).

There shall be no discolouration or change of the initial colour of the warning tape after the tests.

Tensile Withstand Strength

The test sample shall be selected as per mentioned in EN 12613. The test samples shall be preconditioned for not less than 12 h at 23 ± 2 °C. Static loads shall be carried out to the samples over a period of 10 s.

After the test, the test piece shall withstand without starting to separate at weak points (if any) for not less than 5 minutes. Also it should not exhibit a reduction of more than 20% of its width after removal of specified load.

The minimum tensile withstand load for the warning mat in the longitudinal direction shall be not less than 200 N.

Visual Warning Characteristics

The test shall be carried out in accordance with normative annexure A of EN 12613.

Permanence of Printing

The test shall be performed as per CL. 9.3 of IEC 60898:1995.

The test is made by rubbing the marking by hand for 15 sec with a piece of cotton soaked with water and again for 15 sec with a piece of cotton soaked with aliphatic solvent hexane with a content of aromatics of max. 0.1% by volume, a kauributanol value of 29, an initial boiling point value of approx. 65°C, a dry point of approx. 69°C and a density of approx. 0.68 gm/cm³.

After the test, the marking shall be easily legible.

Test of laying Characteristics

The test is for the assessment of transverse rigidity of the warning mats.

The test shall be performed as per EN 12613.

Warning Mat Virginity Test

Differential Scanning Calorimeter (DSC) Scan test along with the temperature of melting (T_m) shall be performed for the Warning Mat and its raw polymer i.e. virgin low density polyethylene (LDPE).

The Differential Scanning Calorimeter (DSC) Scan curve of the Warning Mat obtained from its DSC Scan test along with its Temperature of Melting (T_m) shall then be compared with the DSC Scan curve and the Temperature of Melting (T_m) of its raw polymer (i.e. virgin LDPE).

To ensure the virginity of the Warning mat, the DSC Scan curve and T_m of the Warning Mat (finished product manufactured from the raw polymer) shall match on overlapping with its corresponding raw polymer's DSC Scan curve and T_m.

4.0 PACKING

The warning mat shall be delivered in rolls of minimum 50 meters. Packing size to be mentioned to ensure uniformity in delivery conditions of the materials being procured. Packaging of the Warning Mat shall be such that there won't be any deterioration due to Ultraviolet (UV) effect during transportation and storage of the Warning Taps prior to use.

5.0 QUALITY ASSURANCE (QA)

Manufacturer shall prepare detailed Inspection Test Procedure (ITP) and submit for the approval from Owner / Owner's representative.

6.0 DEFECT LIABILITY

Defect liability period shall be as Specified in Tender.

7.0 RECOMMENDED MANUFACTURER FOR RAW MATERIAL

1. INEOS
2. BOREALIS
3. TOTAL PETROCHEMICALS
4. DOW
5. BASSELL



-
6. RELIANCE
 7. GAIL
 8. HALDIA

However, any other reputed national or international Manufacturer may also be considered for supply of Raw material with approval of Owner / Owner's representative.



ENERGISING QUALITY

VCS QUALITY SERVICES PVT. LTD.

STANDARD SPECIFICATION FOR PRE-COMMISSIONING & COMMISSIONING OF PIPELINE SYSTEM

VCS – SS – PP - 2022

					
03	29.04.2022	RP	MC	HK	GW
02	21.12.2020	MB	MC	AD	SK
Rev. No	Date	Prepared By	Checked By	Approved By	Authorized By

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REVISION RECORD						
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00	04.06.2019					Issued as Standard
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		MB	MC	AD	SK	
03	29.04.2022					VCS QMS Integration
		RP	MC	HK	GW	



ENERGISING QUALITY

**STANDARD SPECIFICATION
FOR PRE-COMMISSIONING AND
COMMISSIONING OF PIPELINE SYSTEM**

**DOCNO: VCS-SS-PP-2022
Rev No : 03**

ABBREVIATIONS:

NACE	National Association of Corrosion Engineers
ASME	American Society of Mechanical Engineers
ASTM	American Society of Testing of Materials
BHN	Brinell hardness number
MSS-SP	Manufacturers Standardization Society - Standard Practice
LTCS	Low temperature Carbon Steel AS Alloy Steel



CONTENTS

1.0	SCOPE.....	5
2.0	GENERAL.....	5
3.0	RESPONSIBILITY OF CONTRACTOR.....	5
4.0	DOCUMENTATION.....	17
5.0	SPARES AND CONSUMABLES	18
6.0	SAFETY	18
7.0	OTHERS	18

1.0 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.

2.0 GENERAL

The scope of work for testing & commissioning including Pre – Commissioning activities shall include but not 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 aspects 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 recognized practices in the onshore pipeline industry.

3.0 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.

3.1 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 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.
- 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 / caliper 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.

3.2 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 uninterrupted 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 Dispatch 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.
- 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 required by Owner / Consultant.
- Erection and supply of 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 onshore pipeline industry.

3.3 Pre-commissioning Activities

3.3.1 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 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.

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.

**3.3.2 PRE-COMMISSIONING WORKS FOR THE ABOVE GROUND PIPING/ UG PIPELINE
(DISPATCH STATION, METERING STATIONS, RECEIPT STATIONS ETC. UNDER THE SCOPE
OF WORK)**

3.3.2.1 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.

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.

Pipeline

The pipeline contractor has to dewater the pipeline section after hydrotest. After dewatering, swabbing shall be done.

The pipeline contractor should submit a plan/methodology for carrying out such activities detailing out each aspect/ step for review & Approval of Client /EIC/PMC.

The disposal of the water shall be performed such a way that no harm is done to the environment and animals and the Dewatering procedure should indicate this disposal methodology.

3.3.2.2 Swabbing

The swabbing operation, which shall be done subsequent to the dewatering operation, is meant to reduce the remaining water in the pipeline to acceptable condition and to ensure removal of free water left inside the pipeline prior to final drying/ purging and commissioning of the Pipeline system. This is done by driving number of foam pigs propelled by oil free compressed dry air, which can pick up free water in the pipeline.

- Acceptance Criteria

It is recommended that before foam pig run, number of batch pig run shall be done to minimize free water in the pipeline section. Then only foam pig run shall be started. Dewatering is considered as complete, when foam pig received is in touch dry condition & same is subjected approval of Client /EIC/PMC.

Dewatering & Swabbing procedure shall be submitted for review & approval of Client /EIC/PMC.

Contractor shall obtain approval of the Owner/ Consultant before proceeding to the next step.

3.3.2.3 Drying

The pipeline system including the underground pipeline and the above ground piping at dispatch and receipt stations, SV stations, all Terminal station, CGS/ PRS stations and hook-up / tap-of points needs to be dried prior to charging natural gas if specified in bid. Drying is required to prevent internal corrosion of the pipeline & to meet the supply specification and also as a means of preservation of the pipeline sections subsequent to the pre-commissioning activities. The pipeline shall be dried by using super dry air / vacuum method or by any other suitable method.

Contractor shall submit the detailed procedure and the duration of the drying operation and obtain Company's approval on the same prior to start of the drying operation.

Commissioning contractor shall assess any requirement of swabbing for entire pipeline to reduce the time for drying and shall carryout such activity.

- Acceptance Criteria

Contractor shall ensure that drying operation is complete before proceeding to the next step of inertization/ purging. The drying of the pipeline system shall be considered to be achieved on attaining a water dew point of -8°C at atmospheric pressure and this water dew point in pipeline shall be continuously maintained till inertisation or commissioning of the pipeline.

3.3.2.4 Internal Cleaning of Equipment

- General

Equipment's like filters, Corrosion Inhibitor Dosing Tanks, Sump Tanks 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.

3.3.2.5 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 Deg C.

3.3.2.4 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.

3.4 Commissioning Related Activities

3.4.1 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.

3.4.2 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. 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'.

Inertization/ Purging

Contractor shall carry out Inertization/ Purging of the entire pipeline system including the underground pipeline and the above ground piping at dispatch and receipt stations, SV stations, IP stations and hook-up / tap-of points).

Operational requirements:

During the Inertization/ Purging operation, the dry air left in all the pipeline shall be replaced by dry nitrogen before filling the natural gas into the pipeline for safe commissioning. Depending on the commissioning plan/ strategy, sections of the pipeline system may be taken up for commissioning in steps. One of the suggested methods for Inertization/ Purging of the underground pipeline is by the usage of nitrogen slugs separated by pigs. Depending on the length of the pipeline portion to be taken up for commissioning, the amount of the nitrogen use may vary. In general, the total volume of the nitrogen slug train must be at least 10% (by volume) of the total length of the pipeline under consideration. The last pig in the pig train shall be propelled by natural gas (during commissioning stage of the pipeline).

For above ground piping at dispatch and receipt stations, SV stations, IP stations and hook-up / tap-of points, the piping shall be purged with nitrogen

Nitrogen required for Inertization/ purging purpose of the pipeline and aboveground piping shall be supplied by the contractor and should be of purity level 99.9% or above. Nitrogen gas at ambient temperatures (AND NOT LIQUID NITROGEN) and in completely vaporized and gaseous state shall be used as the Energizing medium. In case, the source of gaseous nitrogen is from liquid nitrogen tankers, then all precautions (including verification of the lowest tolerable temperature of all components in the system under commissioning) should be ensured. All temporary connections required for nitrogen purging shall be done by contractor.

The contractor shall submit the detailed procedure (in line with the above suggested method or any other acceptable one) and the duration of the Inertization/ Purging operation and obtain approval of the company before starting the operation. Inertization/ Purging shall be followed immediately by charging of pipeline by natural gas.

- Acceptance Criteria

Inertization of the entire pipeline may be accepted to be complete when the required quantity of nitrogen has been introduced into the pipeline. The contractor has to ensure this condition for safe commissioning of the pipeline. For above ground piping at dispatch and receipt stations, SV stations, IP stations and hook-up / tap- of points, the inertization

may be accepted to be complete when the residual oxygen content in the piping is below 1% (vol/vol).

3.4.3 Commissioning and Pressure 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.

Pipeline shall be commissioned and stabilized in 2 phase, i.e. up to 5 kg/cm² g pressure and then up to operation pressure. Pipeline shall be kept for 24 hours after 1st phase for pressure stabilization.

Low Pressure leak check for aboveground piping

- General

The aboveground piping sections of the pipeline system shall be checked for leaks at flange points of piping and equipment, instrument impulse tubing points etc. This shall be done by pressurizing the system piping / equipment with dry compressed air (for this purpose, oil free air compressors shall be used) and testing the system by means of soap solution for leaks.

The contractor shall submit the detailed procedure and the duration of the leak check operations and obtain approval of the company before starting the operation.

- Acceptance Criteria

The leak check operation shall be considered to be completed when the piping system / equipment is free of leaks, after equipment pressure stabilization. This shall be subject to Company's approval.

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.

3.5 Commissioning Check List

Check list to be filled up for commissioning approval of the pipeline:

S. NO.	GENERAL INFORMATION	OBSERVATION/ COMMENTS		
		CONTRACTOR	CONSULTANT	CLIENT
a. GENERAL				
1	a) Name of the Pipeline: b) Services (NG) c) Design/ OISD code followed: d) Design capacity: e) Length of the Pipeline in kms:			



ENERGISING QUALITY

**STANDARD SPECIFICATION
FOR PRE-COMMISSIONING AND
COMMISSIONING OF PIPELINE SYSTEM**

DOCNO: VCS-SS-PP-2022
Rev No : 03

	f) Size - Outside Dia. / Wall Thickness / Grade of Pipeline: g) Is the pipeline designed for scrapper / intelligent pigging? h) No. & location of isolation Valve(s) with chainages: (i) Hand Operated valves (ii) Remote Operated valves i) No. of water bodies crossings with Chainages: (i) Name of River (ii) Pond / Lake crossings (iii) Canal crossings (iv) Marshy land / creek j) No. of cased crossings Railway k) No of Road crossings (NH & SH) i) Cased ii) Non cased			
b. CROSS COUNTRY PIPELINE DETAILS				
1	Design pressure of the pipeline (In Kg/Cm2).			
2	Maximum allowable operating pressure of the pipeline, and normal Operating Pressure (In Kg/Cm2).			
3	Corrosion allowance for the pipeline. (In mm)			
4	Whether the pipeline has been hydrostatically tested. (i) Hydrotest Pressure (In Kg/Cm2) (ii) Period of Hold			
5	Type of Sectionalizing Valves used on the pipeline.			
6	Whether the pigging facility has been installed and the pipeline is piggable by scraper pig.			



**STANDARD SPECIFICATION
FOR PRE-COMMISSIONING AND
COMMISSIONING OF PIPELINE SYSTEM**

**DOCNO: VCS-SS-PP-2022
Rev No : 03**

7	Whether the gauging pig was passed through the pipeline to prove its internal diameter and was it satisfactory.			
8	Whether EGP was carried out for the pipeline. Details to be provided.			
9	Whether the pipeline has been cleaned and swabbed.			
10	Whether adequate product is available for commissioning.			
11	Whether mechanical completion report for the pipeline is available.			
12	Whether ROU restoration completed.			
13	Whether following approvals have been obtained for pipeline before construction? - PESO (CCOE) approval for laying of pipeline/ construction of facilities. - State Pollution Control Board consent to establishment. - Registration of establishment from Central/ State Govt. labour commissioner under Contract Labour (Regulation and Abolition) Act'1970. - Permission from Irrigation/ PWD authority/ NHA etc.			
14	Whether following Clearances obtained before Commissioning? - Commissioning clearances from PESO (CCOE). - CCOE License as required. - Consent for operation from state pollution control board for Air and Water. - Factory License as required.			
15	Whether pre-tested Insurance Stock pipes earmarked and kept separately.			
COATING AND CATHODIC PROTECTION DETAILS				



ENERGISING QUALITY

**STANDARD SPECIFICATION
FOR PRE-COMMISSIONING AND
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DOCNO: VCS-SS-PP-2022
Rev No : 03

1	Type of External Coating used in the Pipeline (CTE/ 3LPE/ FBE/ Other) Coating (Thickness in mm).			
2	Whether the pipeline is adequately protected cathodically: Presently protected by TCP. Expected date of Commencing of PCP.			
3	Post Construction Coating Survey carried out or not?			
4	Whether Interference survey for the pipeline has been carried out and mitigation measures taken.			
5	Whether electrical Surge diverter provided across IJs?			
6	Whether corrosion coupons have been installed for internal corrosion monitoring.			
7	Whether all cased crossings have been checked and are free from any electrical shorting.			
8	Whether Natural PSP of the Pipeline has been taken?			
c. STATION PIPING				
1	Whether station piping has been provided as per the latest approved P&IDs.			
2	Whether mechanical completion certificate for the station is issued			
3	Whether all the flange connections have been checked for tightness and length of bolts are adequate. All short bolting have been checked?			
4	Whether flow direction has been marked on station piping and equipment.			
5	Whether proper direction for check valves and flow meters has been ensured.			



ENERGISING QUALITY

**STANDARD SPECIFICATION
FOR PRE-COMMISSIONING AND
COMMISSIONING OF PIPELINE SYSTEM**

DOCNO: VCS-SS-PP-2022
Rev No : 03

6	Whether adequate crossovers for crossing and platforms to operate valves have been provided with safety hand rails?			
7	Whether access to all operating equipment's including vessels, valves, sump pump, scraper barrel is adequate.			
8	Whether CI dosing facilities with adequate stock is available for dosing in water and product.			
9	Whether proper arrangement has been made for drainage and disposal of the water during commissioning.			
10	Whether alignment of motor with main pump/ compressor and suction/ discharge piping is done and acceptable to the vendor/ owner.			
11	<i>MOVs which are on remote operation have been functionally tested for opening and closing operation?</i>			
12	<i>Whether Vent lines have been provided as per code/ standard/ specifications.</i>			
MISCELLANEOUS				
1	Power System Details: i) Transformer Rating & Type ii) HT Breaker Type & Rating iii) DG Set's Details			
2	Communication system details: i) Telephones ii) PA/Paging iii) VHF iv) Walkie/ Talkie v) Hot Line vi) VCS vii) CCTV			



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**STANDARD SPECIFICATION
FOR PRE-COMMISSIONING AND
COMMISSIONING OF PIPELINE SYSTEM**

**DOCNO: VCS-SS-PP-2022
Rev No : 03**

3	Whether firefighting equipment are provided as per code/ standard/ specifications.			
4	Whether list of contact persons has been displayed with telephone nos.			
5	Check availability of Visitor/ attendance Registers at the gate.			
STATUTORY APPROVALS				
1	Whether following approvals have been obtained for construction. - PESO (CCOE) approval for construction of facilities (Ref no. and Date). - Environmental clearance for the project (No. & date) - Pollution control.			
2	Whether following licenses/ approvals are available before commissioning: - CCOE License No., date, validity. - Is there any change with respect to approved CCOE layout? - NOC from District Magistrate/ District Collector in case CCOE License is not applicable - Govt. Notification for protected area declaration - Clearance from CEA/ State Electrical Inspectorate. - DG Set Installation approval - Any other applicable statutory license/ approval			

4.0 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.

5.0 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.

6.0 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.

7.0 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.



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**STANDARD SPECIFICATION
FOR PRE-COMMISSIONING AND
COMMISSIONING OF PIPELINE SYSTEM**

**DOCNO: VCS-SS-PP-2022
Rev No : 03**

- Past experience of pre-commissioning and commissioning activities carried out for a similar pipeline system / network.



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VCS QUALITY SERVICES PVT. LTD.

STANDARD SPECIFICATION FOR MAGNETIC CLEANING AND ELECTRONIC GEOMETRY PIGGING VCS-SS-PP-2026

					
02	29.04.2022	RP	MC	HK	GW
01	05.01.2022	SR	MC	HK	HK
Rev. No	Date	Prepared By	Checked By	Approved By	Authorized By

UNCONTROLLED COPY	: If printed
CONTROLLED COPY	: If in soft and signed

REVISION RECORD						
Rev.	Revision Date	Prepared by	Checked by	Approved by	Authorized by	Revision Description
00	28.01.2020					Revised
		MB	MC	AD	SK	
01	05.01.2022					Revised as Marked
		SR	MC	HK	HK	
02	29.04.2022					VCS QMS Integration
		RP	MC	HK	GW	

SCOPE OF WORK AND TECHNICAL SPECIFICATIONS

PART I: SCOPE OF WORK

1.0 OBJECTIVE

The objective of the this post hydrotest EGP survey is to clean "constructional metallic debris" of the pipeline and obtain the record of internal geometry in "As laid" condition of the pipeline. It is therefore required to run the magnetic cleaning pig and Electronic Geometry Pig so as to identify, characterize (Sizing and Location), and evaluate any geometrical injurious defects that might have got introduced during installation and hydrotesting of pipeline.

2.0 SCOPE OF WORK

Essentially the Scope of Work comprises of running the Magnetic Cleaning Pig and Electronic Geometry Pig through each segment of the pipeline. Pipeline laying contractor shall carry out the cleaning and plate gauging operation to the satisfaction of EGP Contractor.

All facilities /services numerated below (not limited to) which the CONTRACTOR deems necessary to fulfil the WORK shall have to be arranged by laying contractor at no extra cost and time to the COMPANY.

2.1 Activities:

- (a) Mobilization of all equipment e.g. Magnet cleaning pigs, Electronic Geometry pigs, pig locating and pig tracking devices, spares, consumables, Communication system, transportation and personnel. It is expressly understood that this does 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) accessories, spares, and consumables need to be carefully evaluated by the bidder taking in to the consideration that Cleaning and Geometry inspection should be carried out without any constraint. CONTRACTOR is to mobilize all types of required pigs, accessories, spares, pig locating and tracking devices, in adequate number for completion of entire works within the contract price without depending turnaround time of bringing the pig received from previous run from receive station to launch station. As such no turn around period

shall be allowed. Contractor shall submit operation manual/procedure manual and data sheets for pigs before commencing the job for OWNER/CONSULTANT approval.

- (b) Carrying out adequate number of Magnet cleaning pig runs by running suitable Magnet cleaning pigs in pipeline/ pipeline segment covered under SCOPE OF WORK including pig tracking till such time CONTRACTOR is satisfied with himself about the degree of cleanliness of pipeline/Pipeline Segment and provide detailed daily site report for each run in the approved format before commencing the subsequent run.

However, the constructional ferrous debris permitted with magnetic cleaning pig shall not exceed 3 Kg/100KM. In case debris received is more than this amount, the contractor shall be required to make subsequent run(s) until at least the above limit is achieved.

- (c) CONTRACTOR to carry out adequate number of electronic geometry (Electronic Geometry) pig runs in each pipeline segment covered under SCOPE OF WORK including pig tracking for each pipeline segment to generate valid and interpretable geometry data of the pipeline and analysis of data of the Electronic Geometry survey to detect the nature, extent and location of geometry defect as detailed in Para 3.0 Part-II Technical Specifications. Contractor to provide detailed daily site report for each run in the approved format before commencing the subsequent run. The tool should be capable of inspecting entire length of the pipeline segment i. e. from launcher to receiver in a single run. Battery life should be adequate and commensurate with the run time required travelling 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.

- (d) Demobilization of all equipment, tools and personnel on completion of field activities for all segments.
- (e) Final data analysis of the Geometry Inspection record at the Contractor's data analysis center. The analysis shall consist minimum of following: -
- Defect sizing (Depth & length) for all "significant defects" (Deformation $\geq$ 2% of ID).
 - Identification of all pipeline permanent features e.g. valves, tees etc.

- Identification of potentially hazardous defects likely to affect structural integrity of the pipeline.
- Preparation of final processed inspection logs and preparation of complete WORK report giving interpretation of the inspection logs and giving defect sizing.
- The CONTRACTOR will transfer all the processed data generated on a CD with user-friendly operation on a compatible PC.
- Providing all the raw and processed data along with the software package for enabling COMPANY/CONSULTANT to study the data as required. The software should be user friendly.

(f) **BACK UP SERVICES**

The bidders are free to avail back up services from any international pigging company of repute for specialized services including special pigs, personnel, data analysis etc. However, the bidder in his bid shall clearly mention the name, address, contact person, telephone, fax, e-mail etc. of the company whose services are proposed to be availed by the bidder. Bidder to note that the main bidder shall be responsible for the entire SCOPE OF WORK in conformity with all provisions of the tender document.

2.1.1 CALIBRATION PROCEDURE

Calibration test of the electronic geometry tool to be deployed shall be performed at the tool owner's facilities prior to mobilization of the tool and submission of the calibration report by the contractor to owner/consultant. A machined ring of appropriate size shall be slipped over the sensing fingers. To simulate a dent, calibration blocks shall be placed under one sensing fingers in increments of 2.5mm upto the maximum of 100mm. Ovalities shall be simulated by two opposite sensing fingers with calibration blocks in increments of 5mm upto 100mm (200mm) are placed. Additionally for spider calibration, all sensing fingers shall be calibrated individually using blocks of 20mm or 40mm increments under each of the sensing fingers. The electronic components shall be checked both by a system test and functional test. Calibration procedure of the EGP tool shall be submitted by the contractor for owner/consultant's approval. Calibration test shall be witnessed and certified by the third party inspection agency. The consultant/owner shall review the report of the calibration test to ascertain the diagnostic capability. For each pipe size, separate calibration test shall be conducted. Tools having valid calibration tags including date of calibration shall be deployed at the site.

2.2 PROPELLING MEDIUM

Since pipeline is not commissioned, contractor shall use compressed air as propelling medium for which single compressor of 900 cfm capacity shall be used. The compressor should have the capacity to develop pressure upto 10KG/CM². Contractor shall also keep one compressor of the same capacity mentioned above as stand by. However, Contractor should mobilise higher capacity compressors in order to complete the magnetic cleaning and electronic geometry inspection to meet any contingency like stuck up pig/ early completion of pigging work. Contractor has to arrange all the facilities required for pressurizing air into the pipeline and running the pigs at required speed so that valid and interpretable data by running Electronic Geometry pig is generated by using the above media.

2.3 DEFECT VERIFICATION

At the discretion of the COMPANY/CONSULTANT Identify at least two verification dig sites (In case SIGNIFICANT defects are detected during Electronic Geometry Pigging) for each pipeline segment jointly with owner from the recorded data and provide VCS/owner defect sheet indicating 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 field log detected anomalies conform to sizing, including linear positions.

2.4 FINAL WORK REPORT

The final work report shall be for each segment including Magnet Cleaning and Electronic Geometry pig runs details with operational and functional parameters, daily detailed site report of each run with observations, individual feature report, velocity plot of Electronic Geometry pig, etc as detailed out at Para 7.0. of part II.

3.0 PIG TRACKING

The movement of any type of pig put into the pipeline during Magnetic cleaning and Electronic Geometry 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 2 to 10 KM intervals on each pipeline segment at preselected locations. The exact KM chainage of these locations shall be decided at site in consultation with the CONTRACTOR and CONSULTANT/COMPANY.

4.0 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 COMPANY has foreseen the following abnormal conditions. However, if the BIDDER foresees any other abnormal condition, he is free to make a mention of the same in his technical BID offer:

4.1 TOOL FAILURE

CONTRACTOR is required to get valid interpretable and verifiable data for each segment of the pipeline. In case CONTRACTOR'S equipment fails to perform electronic geometry inspection to generate valid data for any of the pipeline segment, CONTRACTOR will make extra runs to get valid and physically verifiable data without any additional cost and time implication to the company.

4.2 STUCK-UP TOOL

The BIDDER shall detail 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 fabrication and modification of pipe with new pipe piece after retrieval of pig shall be done by Contractor at no extra cost to the OWNER. Locating the stuckup pig and its retrieval shall be responsibility of the contractor.



After modification pigging Contractor shall run Gauge pig to check internal restriction, if any.

5.0 MISMATCH OF INSPECTION RESULTS WITH ACTUAL DEFECTS DURING SITE VERIFICATION:

- In case of variance between the results of physical defect verification and the results reported by the contractor on the basis of Electronic Geometry survey (after considering the tolerance as provided in the contract) segments, this shall be considered as a failed run and shall be dealt as per Cl.4.1 above.

PART II TECHNICAL SPECIFICATIONS

1.0 INTENT

The intent of the specification is to set-forth the requirements of the Electronic Geometry Survey of the pipelines to help bidder quote his unit rate price in the schedule of rates as applicable.

This requirement is not intended to be all inclusive and use of guidelines set-forth does not relieve the contractor of his responsibility of successfully carry out all activities and to obtain reliable and valid data from the EGP tool about condition of the pipeline as defined under Scope of work.

2.0 MAGNET CLEANING PIG RUNS

Prior to launching of Electronic Geometry pig, contractor shall complete all activities required to establish adequate cleanliness of pipeline to the satisfaction of the contractor and to verify the internal geometry of the pipeline with relation to ovality, dent etc. Contractor shall decide the number of Magnet cleaning pig runs and the choice of the Magnet cleaning pig for each cleaning run as suitable for the purpose to obtain internal condition adequately clean so as to obtain valid and interpretable inspection data from the Electronic Geometry pig and to safeguard Electronic Geometry pig against damage due to debris as detailed out at Para 2.1(c) Part-I Scope of Work and Technical Specifications.

The cleaning pigs for successive cleaning pig runs shall be selected by the contractor in such a manner that effective cleaning i.e. 3kg/100km ferrous debris is achieved. The detailed specifications of Magnet cleaning pig shall be furnished in the offer.

3.0 ELECTRONIC GEOMETRY PIG RUNS

The Electronic Geometry pig should be capable of recording the entire length of each segment i. e. from launcher to receiver in one single run and therefore its electronic recorder system should have requisite data storage capacity. Battery life therefore should be adequate to commensurate with the run time required to travel the pipe length of each segment and the drive cups should have requisite resistance to wear and tear to maintain effective sealing throughout the entire run time. Bidder to furnish a calibration certificate for EGP prior to mobilization of equipment. OWNER reserves the right of witnessing calibration test at Contractors designated location at Owner's expenses.

The measurement shall cover the entire 360° of internal pipe wall circumference using properly oriented and sufficient no of sensors. The tool shall be capable to identify and locate the following features as a minimum.

- Individual Girth weld
- Dent, ovality, buckles, or any other out of roundness, change in pipeline I.D. and difference of thickness.

BIDDER to supplement the following information in his BID. so that same can be checked w.r.t the parameters given in Para 4.0 below as required.

- a. Accuracy of locating indication/I.D. Reduction w.r.t to axial length (Meters).
- b. Max. % Of Nominal pipeline ID tool can pass (% ID)
- c. Minimum deformation level Reported (as % of ID)
- d. Accuracy of Measurement (% of ID)
- e. Bend radius tool able to negotiate

4.0 DEFECT SIGNIFICANCE

The following information/performance is expected out of the Electronic Geometry pig inspection:

- 4.1 Inspection of entire length of each segment to be completed in one single run.
- 4.2 Accuracy of defects:

The best accuracy offered and guaranteed by the BIDDER for each category of defect should be clearly spelt out. However, the tool should have minimum capabilities as under.

Minimum Detection level for dent: 2% of ID

Sizing Accuracy for dent: +0% of ID, -25% of measured value

Minimum detection level for Ovality: 5% of ID

Sizing Accuracy for Ovality: +/- 1% of ID

Location Accuracy Axial: 0.1% from Permanent Features.

The tool should be capable of negotiating minimum 3D bend and 15% reduction in Pipe ID.

5.0 MAX RUN LENGTH OF LIVE TOOL:

The BIDDER must specify in his offer the max. Length which can be inspected in one single continuous run by the tool proposed by him. It is required to complete the entire run length of each segment of the pipeline in a single run. The length of each pigging segment shall be based on the length of hydro testing of the pipeline. However, length of pigging segment up to 200 Km or distance between two pigging stations, whichever is more, shall be acceptable.

6.0 DATA ANALYSIS:

Bidder shall carry out the data analysis for EGP. BIDDER shall provide all raw and processed data and his software package along with his compatible hardware. The software package shall be user friendly. It should provide full capability for data study.

7.0 FINAL WORK REPORT

The BIDDER shall include in his offer the most appropriate reporting procedure envisaged for the subject pipeline. This will have to be mutually agreed between the successful bidder and consultant/company.

However, any reporting system shall include but not limited to the following:

- A detailed report in respect of each pipe segment of running each of the pre-inspection tools such as Magnet cleaning pig.
- Detailed report about running of the Electronic Geometry pig including but not limited to the operational and functional details. Details describing the type, size and location of individual mechanical defects. The location of each defect should be suitably listed with reference to permanent pipeline features, girth weld no., relative and absolute distance.

- A detailed report in respect of each defect for which sizing has to be done indicating its length, depth and axial location suitably referenced.
- Preliminary site report for each pipe segment for each running of Magnet cleaning, and Electronic Geometry pig runs stating comments/observations of each run, pig condition, operating parameters, and total time required.
- Velocity plot of the Electronic Geometry pig along the length of the segment.

The format and Performance of the above report shall be mutually agreed upon between the successful BIDDER and CONSULTANT/COMPANY.

All the data generated by the CONTRACTOR shall be compiled in CD having user-friendly operation on a Compatible PC along with the software necessary for review/analysis of data. This is required to facilitate selection of significant defects, their chainage and sizing. CONTRACTOR will furnish this floppy disk and CD as part of report.



VCS QUALITY SERVICES PVT. LTD.

STANDARD SPECIFICATION FOR REPAIR OF POLYTHYLENE COATING

VCS – SS – PP -2027

02	29.04.2022	RP	MC	HK	GW
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		SS	MC	AD	SK	
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02	29.04.2022					VCS QMS Integration
		RP	MC	HK	GW	

ABBREVIATIONS:

DC	:	Direct Current
EN	:	European Standard
KV	:	Kilo Volt

CONTENTS

1.0	SCOPE.....	5
2.0	MATERIAL AND EQUIPMENT	5
3.0	APPLICATION PROCEDURE	5
4.0	INSPECTION AND TEST	6
5.0	DOCUMENTATION	6

1.0 SCOPE

This specification covers the minimum requirements for materials and equipment, application procedure and inspection of repair of damaged Polyethylene coatings on steel pipes. This specification is applicable for repairing damages less than 100mm x 100 mm for pipe sizes less than 10", 150mm x 150mm for pipe sizes between 12" to 28" and 300mm x 300mm for pipe sizes more than 28".

If damaged area of coating of the pipeline is larger than above, heat shrinkable sleeve is recommended.

The repair shall be carried out using repair patch made of radiation cross-linked polyolefin backing, coated on the inside with semi-crystalline thermoplastic adhesive and filler mastic.

The repair patch shall have thermal indicators to ensure correct heat is being applied during application.

2.0 MATERIAL AND EQUIPMENT

2.1 The repair material shall be as under:

- a) Repair Patch: radiation cross-linked HDPE (Unexpanded High density polyethylene) with semi-crystalline thermoplastic adhesive.
- b) Mastic Filler
- c) Melt stick shall be Co-Polymer based and same shall be heat sensitive.
- d) Liquid Epoxy Primer (two pack)

2.2 The repair material shall be certified by DIN to meet the requirements of EN12068 Stress Class CHT 80

2.3 The material shall not be older than their period of validity at the time of application by the Contractor. Deteriorated/decomposed materials shall not be used.

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

2.5 Contractor shall supply all equipment and manpower required for a skilful application in the field in accordance with the specification.

3.0 APPLICATION PROCEDURE

3.1 The application procedure to be followed for holiday type of damage shall be in accordance with manufacturer's instruction and minimum requirement specified below whichever are the more stringent.

3.1.1 Preparation

Remove coating from damaged area with knife, scraper or power brush. Scrap off the damaged area and adjacent coating to remove oil, grease, rust, dirt and moisture. Pipe surface shall be prepared to SA 2½.

3.1.2 Preheating

Preheat the exposed bare metal surface to approx. 80° C and adjacent pipe coating to approx. 60° C with a torch moved back and forth over the surface. Upon preheating, the

pipe surface shall be applied with the two pack epoxy primer to ensure a minimum wet film thickness of not less than 200 microns to cover the exposed base metal.

3.1.3 Application of the Filler

Plastic filler shall be cut to size and applied to all exposed metal surface. The mastic shall be heated and smoothed down with a paint scraper to cover all bare metal in a manner such that all entrapped air is removed and mill applied coating thickness of the pipe is restored.

3.1.4 Application of repair tape

A patch shall be cut from the tape in a manner such that it extends 50 mm (2 inch) beyond the damaged area on all sides. The patch shall be positioned over the damaged area and heated until the temperature sensitive paint on the outside of the patch changes colour or dimples on the backing vanish. It shall be smoothed down to confirm with the contour of lap, and shall be freed of any air bubbles or wrinkles.

3.2 For cosmetic type of defects such as minor gouging, tearing, and/or scratches, which do not indicate holiday during holiday inspection, following procedure shall be adopted.

3.2.1 The defective area shall be roughened to remove loose polyethylene coating, oil, grease, dirt, etc.

3.2.2 This shall be followed by application of patch as detailed in clause 3.1.4.

4.0 INSPECTION AND TEST

4.1 A visual inspection shall be carried out for the following:

- Mastic extrusion on ends of the patch shall be examined.
- There shall be no sign of punctures or pinholes or bend failure. The external appearance of the patch shall be smooth, free from dimples, air entrapment or void formation.
- The entire closure patch shall have changed colour uniformly.

4.2 Holiday Inspection

The holiday detector used shall be checked and calibrated daily with an accurate D.C. Voltmeter. The detector electrode shall be in direct contact with the surface of coating to be inspected.

The entire surface of the repaired section shall be inspected by means of a full circle holiday detector approved by Owner set to a D.C. Voltage of at least 25 KV. Inspection of repaired patch shall be conducted only after it has cooled below 50° C.

4.3 Procedure qualification shall be carried out for repair patch. The value for peel strength to pipe surface and to factory coating carried out as per EN 12068 shall be 0.5 N/mm minimum at 60°C.

4.4 All repaired joint shall be approved by the Owner.

5.0 DOCUMENTATION

5.1 Prior to procurement of coating repair materials, Contractor shall furnish four copies of,

but not limited to, the following for qualification of the Manufacturer and material:

- i) Complete descriptive technical catalogs describing the materials offered along with samples of repair coating materials, its properties and installation instruction as applicable specifically to the project.
- ii) Test certificate and results of previously conducted tests from independent inspection agency, for properties listed in Para 4.3 of this specification.
- iii) Reference list of previous supplies of the similar material indicating the project details such as diameter, quantity, service conditions, year of supply, project name, contact person and feedback on performance.

Once the Company's approval has been given, any change in material or Manufacturer shall be notified to Company, whose approval in writing of all changes shall be obtained before the materials are manufactured.

5.2 Prior to shipment of materials from the Manufacturer's works, Contractor shall furnish six hard copies and an electronic copy of the following:

- i) Test certificates for each batch of materials.
- ii) Specific installation instruction with pictorial illustrations.
- iii) Specific storage and handling instructions.

5.3 All documents shall be in English Language only.



ENERGISING QUALITY

VCS QUALITY SERVICES PVT.LTD.

STANDARD SPECIFICATION FOR INSULATING JOINT

VCS-SS-PP-2029

					
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		SR	MC	HK	SK	
04	29.04.2022					VCS QMS Integration
		RP	MC	HK	GW	

ABBREVIATIONS:

ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
API	American Petroleum Institute
BHN	Brinell Hardness Number
HAZ	Heat Affected Zone
MSS-SP	Manufacturers Standardization Society - Standard Practice
RTJ	Ring Type Joint
SSPC	Steel Structures Painting Council

CONTENTS

1.0	SCOPE	5
2.0	REFERENCE DOCUMENTS	5
3.0	MATERIALS	6
4.0	DESIGN AND MANUFACTURE	8
5.0	INSPECTION AND TESTS	11
6.0	PAINTING	13
7.0	MARKING	13
8.0	TEST CERTIFICATES	13
9.0	PACKING & SHIPPING	13
10.0	DOCUMENTATION	14

1.0 **SCOPE**

This Specification covers the minimum requirement for the design, manufacture, testing and supply of carbon steel insulating joints to be installed in onshore pipeline systems handling non sour hydrocarbons in liquid or gaseous phase including Liquefied Petroleum Gas (LPG).

2.0 **REFERENCE DOCUMENTS**

The design, materials, fabrication, inspection, testing and supply of insulating joints shall comply with the latest edition of the following codes and standards.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

B31.4	:	Pipeline Transportation System for Liquid and slurries.
B 31.8	:	Gas Transmission and Distribution Piping Systems.
B16.9	:	Factory made Wrought Butt Weld Fittings.
B 16.25	:	Butt Welding Ends.
BPVC Section VIII	:	Boiler and Pressure Vessel Code - Rules for Construction of Pressure Vessels, Division 1.
BPVC Section IX	:	Welding and Brazing Qualifications.
BPVC Section V	:	Non-Destructive Examination.

AMERICAN PETROLEUM INSTITUTE (API)

Specification 5L	:	Specification for Line Pipe.
1104	:	Specification for Welding Pipelines and Related Facilities.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

A370	:	Standard Test Methods and Definitions for Mechanical Testing of Steel Products.
D2000	:	Classification System of Rubber Products.
D709	:	Laminated Thermosetting Material.

MANUFACTURERS STANDARDIZATION SOCIETY (MSS)

SP-25	:	Standard Marking System for Valves, Fittings, Flanges and Unions.
SP-75	:	Specification for High Test Wrought Butt Welding Fittings.
SP-53	:	Quality Standard for Steel Castings and Forgings for Valves, Flanges and Fittings and Other Piping Components - Magnetic Particle Examination Method.

National Association of Corrosion Engineers (NACE)

RP 0286 : Standard Recommended Practice, Electrical Isolation of Cathodically Protected Pipelines.

STEEL STRUCTURES PAINTING COUNCIL (SSPC)

VIS-I : Visual Standard.

SP-10 : Surface Preparation.

PNGRB REGULATIONS :

G.S.R 808(E) T4S : Regulations for Natural Gas Pipelines

G.S.R. Infra/ T4S/ P&PPPL : Regulations for Petroleum and Petroleum products pipelines

G.S.R. 612(E) T4S : Regulations for CGD Network

MISCELLANEOUS

NEC : National Electric Code.

ISO 2409 : Paints and Varnishes - Cross-Cut test.

In case of conflict between various requirements of this specification and reference standards, codes and regulations mentioned above, more stringent requirement shall apply unless otherwise agreed by Purchaser.

3.0 MATERIALS

3.1 METALLIC COMPONENTS

3.1.1 Material for the pressure containing parts of the insulating joints shall be as indicated in the Insulating joint Data Sheet. Other parts shall be as per the Manufacturer's standard (Suitable for the service conditions indicated in the Insulating Joint Data Sheets/Material requisition), which shall be subject to approval by Company. In addition, the material shall also meet the requirements specified hereinafter.

3.1.2 All process-wetted parts, metallic and non-metallic shall be suitable for the commissioning fluid and service specified by the Company. Manufacturer shall confirm that all wetted parts are suitable for treated water/seawater environment, which may be used during field testing.

3.1.3 All carbon steel used for fabrication of various components of insulating joints shall be fully killed.

3.1.4 For Insulating joints specified to be used for Gas Service or LPG Service, hardness test shall be carried out as per ASTM A370 for each heat of steel used for all pressure containing parts. A full thickness cross section shall be taken for this purpose and the maximum hardness of base metal, weld metal & HAZ of all the pressure containing parts shall not exceed 248 HV10. Hardness shall be recorded.

3.1.5 The carbon equivalent (CE) based on product analysis calculated by the formula shall not exceed 0.45 based on check analysis for each heat of steel used.

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

3.1.6 The Manufacturer shall select materials as indicated in the data sheet along with the defined operating (Temperature/ Pressure) parameters and in accordance with ASME B 31.4/ B 31.8, as applicable and ANSI B16.25 for butt welding ends. Internal bore of weld joints shall not impede the pigging process or represent potential pig damage. The Manufacturer shall perform post weld heat treatment (PWHT) if required by the corresponding approved weld procedures. The Manufacturer shall prove by calculations to ASME VIII Division 1 that the materials supplied satisfy the pressure/temperature rating as specified in Data Sheet.

3.1.7 For Insulating Joint Specified to be used for Gas Service or LPG Service. Charpy V-notch test shall be conducted on each heat of steel used in manufacturing of the pressure containing parts including pipe pups and retainer ring of Insulating joint in accordance with ASTM A370. Unless otherwise stated Charpy V-notch test shall be conducted at 0°C or at lower temperature as specified in data sheet / material requisition. The specimens shall be taken in the direction of principal grain flow and notch perpendicular to original sample of plate or forging.

The minimum average absorbed impact energy value of the set of three (3) full size specimens tested at 0°C shall be 27J. The minimum impact energy value of any one specimen of three specimen analyzed as above shall not be less than 22J. Result of Charpy shall be recorded.

In case of Low Temperature Carbon Steel (LTCS) material specified in data sheet or offered manufacturers, the Charpy-V notch test requirement of applicable material standard shall be compiled with.

3.2 NON METALLIC COMPONENTS

Minimum thickness requirement of insulating material shall comply with NACE RP 0286.

Epoxy resin filler material used shall be CIBA Araldite CY-220 & Araldite HT-951 hardener or an approved equivalent.

Insulating rings (Spacing Ring) and joint filler material shall be flame resistant and capable of safely withstanding the maximum operating temperature without distortion or loss of insulating properties. Non-metallic seal materials, if provided, shall be resistant to amine-based corrosion inhibitors and explosive decompression.

The spacing ring shall be of epoxy glass fiber reinforced laminate. It shall possess high insulating properties that would comply with ASTM D 709 Type IV, Group G-11 properties. The materials compressive properties shall be equal to or greater than 450 MPa. The epoxy glass fiber laminates material shall possess anti-aging properties. The spacing ring, sealing gasket / Ring and filling material shall be resistant to flames and diffusion of gases, absorption of moisture and shall be capable of maintaining their required compressive strength and insulating properties over the design life of the pipeline.

Adhesive sealant or a low viscosity, cold curing thermosetting resin shall be used as filling material. Its compressive strength shall be equal to or greater than 150 MPa.

Plastic material shall be compatible to the materials they are in contact with. The Manufacturer shall give the details of the plastic used and its mechanical, chemical and temperature resistance properties.

3.3 INSULATING MATERIAL

- The design of insulating material shall conform to following requirements

- The electric resistance does not decrease with time.
- The insulating material shall not deform.
- The insulating material shall be resistance to chemical attack by transferred fluid under design temperature and pressure.
- The transferred fluid does not penetrate into the structure of the insulating material under design conditions of pressure and temperature.

4.0 DESIGN AND MANUFACTURE

4.1 GENERAL

- a. The monolithic insulating joints as per figure shall be designed so as to provide an effective electrical barrier by isolation between the buried pipeline and the above ground pipeline and other pipelines. Suitable for above or below ground installation as defined in the data sheet. The Manufacturer shall provide a proven design.
- b. The insulating joints shall be of the monolithic bolt-less design comprising of forged sections assembled together by welding to form an integral unit. Insulating joint shall be fabricated by welding the forged retainer to pre-assembled insulating components and hub, under compression, so as to ensure effective sealing. Final assembly of joint shall be by welding only. Crimped and screwed closing joints are not permitted.
- c. The hydrostatic test pressure for the insulating joints shall be 1.5 times the design pressure.
- d. The insulating joints shall be designed for welding to the line pipe with weld ends. Bolted and flanged connections are not allowed.
- e. The insulating joint shall have a smooth clear bore and be suitable for uninterrupted passage of all type pigs, spheres and on-line inspection tools. The internal bore of insulating joint shall match the bore of connected pipe as indicated in data sheet.
- f. The design shall ensure that over the time of service the carrier product shall not permeate in the cavity.
- g. The selected seal material shall be resistant to the chemicals and the operating temperature and pressure of the pipe system. At least 90% of the gasket shall be in contact with bare metal surface. The sealing gasket shall be of sufficient thickness and shall be made out of one piece of material, no joints are permitted.
- h. The insulating joint shall be able to sustain an internal vacuum of one (1) millibar.
- i. No stress inducing recess, protrusions or notches, are permitted in the internal surface of the supplied joint. Additional fillers are not permitted to fill these flaws.
- j. The cavities inside the joint shall be filled with low viscosity dielectric material that solidifies on curing. Air pockets and impurities in the dielectric material shall not be accepted.
- k. The Manufacturer shall submit the detailed sectional drawing of the longitudinal face of the joint. The cross-sectional drawing shall show all parts, materials, dimensions surface finishes and tolerances.

- l. The electrical resistance of the joint shall not decrease with time. The joint shall include permanent terminals for survey lead connections.
- m. The insulating joint material shall be resistant to creep.
- n. The external fasteners shall be hot dip galvanized as per ASTM A 153.

4.2 **DESIGN**

4.2.1 **MECHANICAL DESIGN**

- a. Main components of insulating joints such as forged hub, the stub end and the retainer ring, gaskets etc. shall be designed in accordance with Section VIII, Division 1, Appendix-2 of ASME, Boiler and Pressure Vessel Code. Design factor shall be in accordance with the data sheet.
- b. Insulating joints shall be designed using the design principles of ASME Section VIII Div. 1. The design shall be checked for the following two cases:

CASE-1: Design pressure (as per Data Sheet) and Axial Force (F).

The Axial force shall be calculated as under:

$$F = 0.1 \times S \times A$$

Where S = SMYS of connected pipe (refer Data Sheet)

A = Metal cross-sectional area of connected pipe.

The allowable stress in this case shall be less than or equal to 0.5 x SMYS of insulating joint material.

CASE-2: Hydrostatic Test Design pressure

The allowable stress in this case shall be less than or equal to 90% of SMYS of insulating joint

material. All design parameters shall be as per Insulating Joint Data Sheet. Detailed design calculations shall be submitted for Company approval.

- c. A corrosion allowance, as indicated in data sheets, shall be considered in design for operating condition.
- d. Surfaces of the annular space between pup and retainer shall be abrasive blasted to a SA 2½ finish. Assembly of the insulating joint shall commence within two hours of completion of abrasive blasting. The annular space between the retainer and the spool shall be filled with epoxy resin.
- e. The joint shall be assembled in a way that the internal components are firmly locked in position. The completed joint shall be capable of withstanding the operating and testing stresses. The neck of the bell shall be sealed with mastic. The design shall consider the position of the spacing ring, sealing gasket and filling material, so that the temperature of these materials remains below 60°C during tie-in welding operation.

4.2.2 **PUPS**

- a. Insulating joints shall be supplied with pup pieces welded to each end by the Manufacturer. Pipe material used shall be as indicated in data sheets. The pup pieces shall be of equal length. The length of pup pieces shall be minimum 500mm or as specified on the data sheet.

- b. The end of the pups to be field welded shall be beveled in accordance with ASME B 31.4/31.8, as applicable. Pipe pups shall be welded to the insulation joint assembly prior to hydrostatic strength and leak testing.
- c. When LSAW pipes are used as pups, the reinforcement of inside weld seam shall be removed for a distance of at least 50 mm from each end.
- d. The joint between pipe pup pieces and main forging shall be full penetration butt weld type. Weld design shall be such as resulting in a weld joint factor of 1.0.
- e. The tolerance on internal diameter and out of roundness at the ends for Insulating joints shall be as per applicable connected pipe specification as indicated in the Data Sheet.

4.2.3 ELECTRICAL

- a. The average dielectric strength of the insulating joint shall be minimum 15 KV or more.
- b. Two cleats/cable terminators shall be welded on pups on each side of insulating joint. The cleats shall be suitable for connecting 10mm² and 50mm² cables for measurement/shorting purposes. Cleat Shall be attached to Insulating joint by welding. Refer Fig 4.1 for details.

4.2.4 WELDING

- a. All welds except closing weld shall be butt welds. The closing weld shall be full penetration girth weld in accordance with ASME BPVC Section VIII, Division 1. The weld design shall conform to the ASME acceptable standards. Fillet welds if required, shall have minimum two passes.
- b. Butt weld end shall have end prepared as per ASME B 16.25. However, end preparation for butt welding end having unequal thickness w.r.t connecting Pipe, shall be shall be prepared in accordance with ASME B31.4/ B31.8, as applicable. All butt weld ends shall be checked for surface defects using dye penetrate (As per Appendix 8 of ASME Section VIII) prior to welding.
- c. All welding shall be carried out by welders and welding procedure qualified in accordance with ASME Section IX. The procedure quantification to include hardness and impact test shall meet the requirement of clause 3.1.4 & 3.1.7.
- d. No repairs by welding shall be carried out on base metal of any component of insulating joint. Manufacturer shall obtain Purchaser approval prior to carrying out any repair of welds. The repair welding shall be carried out by welders and welding procedures duly qualified per ASME Section IX and records for each repair shall be maintained. Welding procedure and repair welding procedure qualification shall include requirements for impact testing & hardness test when required as per Clause 3.1.4 & 3.1.7 of this specification and shall meet the requirement therein. Radiography shall be performed after the repair
- e. Cold die stamping on insulating joints or pups is not permitted on the body. Cold die stamping can be done on the pipe bevel.
- f. The repair of the forging by welding is not permitted. All production welding, including tacking shall be done as per the qualified procedure by the qualified welder/ operators. The acceptable weld processes are:
 - Shielded Metal Arc Welding (SMAW)
 - Submerged Arc Welding (SAW)

- Gas Metal Arc Welding (GMAW)
- g. The Manufacturer shall ensure that all the mechanical works are completed prior to the post weld heat treatment and hydrostatic test. Any re-work (welding, cutting and grinding) on the surface of the material after the PWHT or hydrostatic testing is not permitted.
- h. The need for Post Weld Heat Treatment (PWHT) shall be assessed by the Manufacturer in accordance with the relevant weld procedure.

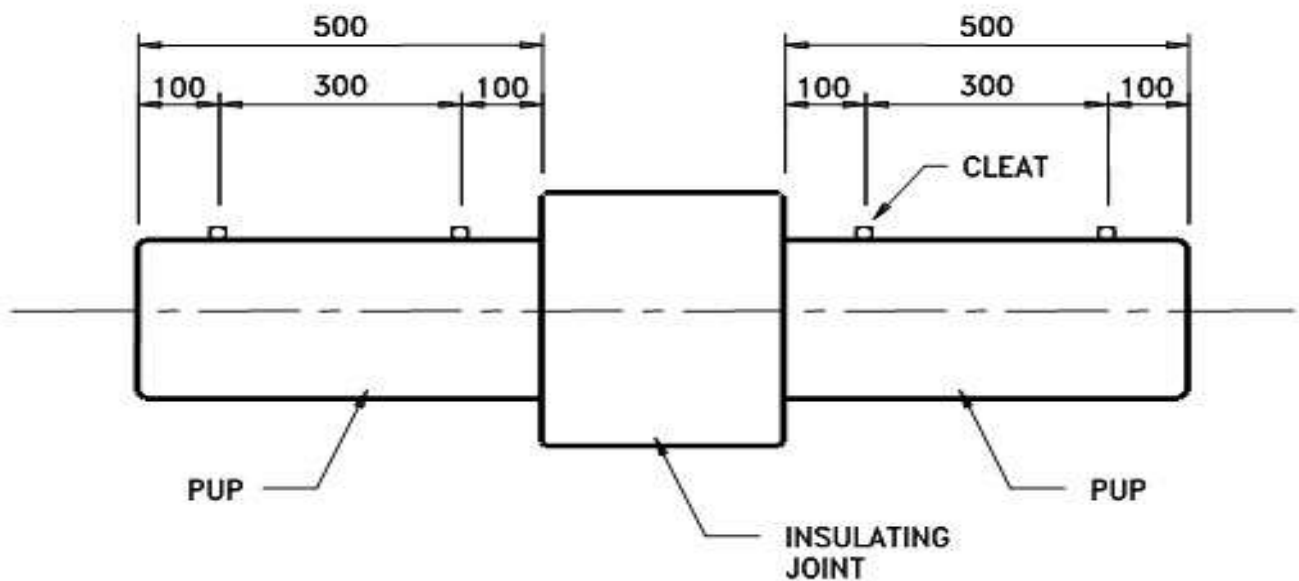


FIG. 4.1

5.0 INSPECTION AND TESTS

The Manufacturer shall ensure all equipment used for testing and inspection purposes is calibrated and certified accordingly. The Manufacturer shall record all inspection and testing activity on the appropriate inspection certificate. The following minimum inspection and testing shall be carried out prior to painting, marking and shipment of insulating joints.

5.1 TESTING OF MATERIALS

Chemical composition and mechanical tests including yield strength, ultimate tensile strength, impact test, elongation and hardness shall be carried out for each heat of steel used as per the applicable standard as referred to in this specification.

5.2 VISUAL INSPECTION AND DIMENSIONAL CHECK

All insulating joints shall be visually inspected for visible surface defects and compliance with related documents. The internal and external surfaces shall be free from any strikes, gouges and other detrimental defects. Bevels at butt weld ends shall show a smooth contour. All dimensions shall be checked for conformance with approved drawings.

5.3 NON-DESTRUCTIVE EXAMINATION

As a minimum all NDT shall be performed in accordance with ASME Section V and examination according to ASME Section VIII or as defined herein.

- a. Full length of all pressure containing butt welds, including welds that have been repaired, shall be examined 100% by radiography. Acceptance limits shall be as per API 1104
- b. Any other weld that, in Purchaser's opinion, cannot be radiographed shall be inspected by ultrasonic or magnetic particle methods. Acceptance criteria shall be as per ASME Section VIII Appendix 12 and Appendix 6 respectively. Root pass of joint closure weld shall be examined by magnetic particle inspection method.
- c. All forging shall be wet magnetic particle inspected on 100 % of forged surface. Method of inspection and acceptance shall comply MSS-SP-53.
- d. All finished weld ends shall be 100% ultrasonically tested for lamination type defects for a distance of 50 mm from the ends. Any lamination larger than 6.35 mm shall not be acceptable.
- e. All fillet welds shall be non-destructively examined as follows:

Fillet thickness < 6 mm	:	100% by magnetic particle inspection, acceptance criteria as per ASME Sec VIII Appendix 6.
Fillet Thickness $\geq$ 6 mm	:	100% by Ultrasonic Testing, acceptance criteria as per ASME Sec VIII Appendix 12 respectively.
- f. All NDT shall result shall documented and be available for Purchasers review.

5.4 HYDROSTATIC TEST

A hydrostatic test shall be carried out on each insulating joint complete in all respects. The test pressure as indicated in data sheets shall be held for a period of 15 min and the assembly visually inspected for leaks. Any pressure changes must correspond with temperature changes otherwise the test will not be acceptable. Test records to be maintained accordingly by Manufacturer.

After hydrostatic test, insulating joints shall be tested with air at 5 kg/cm² for 10 minutes. The tightness shall be checked by immersion or with a frothing agent. No leakage will be accepted.

5.5 DIELECTRIC TEST

Insulation resistance of each insulating joint shall be at least 25 Mega Ohms, when checked with 500-1000 V DC.

In addition, prior to and after hydro testing, each insulating joint shall be tested for dielectric integrity at 5000 V AC, 50 Hz for one minute and the leakage current before and after the hydrostatic test shall be equal. Testing time, voltage and leakage shall be recorded and certified.

No repair shall be permitted to the insulating joints failed in the above-mentioned tests.

Company reserves the right to perform stage wise inspection and witness tests as indicated in clause 5 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 by the Company's Inspector. Inspection and tests performed/witnessed by the Company's Inspector shall in no way relieve the Manufacturer's obligation to perform the required inspection and tests.

6.0 **PAINTING**

SURFACE PREPARATION

Surface preparation for all coated surfaces according standard SSPC-SP-10 by shot blasting

PAINTING

Exterior surfaces of all insulating joints shall be painted with a non-conducting epoxy, three layer paint coating system. The internal lining shall be of a two-pack (solvent free) non-conducting epoxy compound (cold or hot curing).

The internal coating shall be suitable for the service and design conditions indicated in data sheets, and shall neither be damaged by or cause damage to pipeline pigs including inspection and scraper pigs.

The internal and external coating/lining shall be cut back by 75mm from the weld-edge. Coating system and procedure shall be approved by Purchaser prior to manufacture.

7.0 **MARKING**

All insulating joints shall be fitted with a stainless-steel name plate with following markings die stamped or raised letters in metric units:

- Manufacturer's Name.
- Suitable for ____ Inch Nominal Diameter Pipeline.
- End Thickness in mm.
- Material.
- Design Pressure / Hydrostatic Test Pressure.
- ANSI Class Rating.
- Tag No.
- Year of Manufacture.

8.0 **TEST CERTIFICATES**

Manufacturer shall submit following certificates to Company's inspector:

- Test certificates relevant to the chemical analysis and mechanical properties of the materials used for construction of insulating joint as per this specification and relevant standards.
- Test reports on non-destructive testing.
- Test certificates for hydrostatic and air tests.
- Test certificate for electrical tests.

9.0 **PACKING & SHIPPING**

All butt weld ends shall be suitably protected to avoid any damage during transit by means of metallic or high impact plastic bevel protectors; and all assemblies shall be cleaned from inside of all foreign materials, grease, rust etc. prior to packing. Prior to shipment, parts and equipment which have bare metallic surfaces shall be protected with a rust preventative which will provide protection at temperatures up to 50°C. Sealing surfaces and moving parts to have a graphite grease coating applied.

The Manufacturer shall supply packing and shipping procedure with the tender. All Insulation joints shall be packed and prepared for shipment/transport in accordance with the procedures included in the Request for Quotation (RFQ) documentation, subsequently approved by the Purchaser.

Only those insulating joints, which have been inspected and certified by Company's Inspector, shall be shipped.

10.0 DOCUMENTATION

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

- 10.1 At the time of bidding, Bidder shall submit the following documents:
- Reference list of similar supplies including all relevant details viz. Project, Year of supply, Client, Location, Size, Rating and Service for the last seven years.
- 10.2 After placement of order, the Manufacturer shall submit the following drawings, documents and specifications for company's review and information:
- General arrangement drawings of flow tees with overall dimensions and cross-sectional drawing including relevant calculations for pressure containing parts.
- 10.3 All documents shall be in English Language.



ENERGISING QUALITY

VCS QUALITY SERVICES PVT. LTD.

STANDARD SPECIFICATION FOR THIRD PARTY INSPECTION AGENCY (TPIA)

VCS – SS – PP - 2031

					
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ABBREVIATIONS:

TPIA	THIRD PARTY INSPECTION AGENCY
QA	Quality Assurance
QC	Quality Control
LOI	Letter of Indent
QAP	Quality Assurance Procedure
ISS	International Standard Space
UPS	Uninterruptible Power Supply

CONTENTS

1.0	INTRODUCTION	4
2.0	SCOPE OF WORK.....	4
3.0	ROLE OF CONTRACTOR	5
4.0	CO-ORDINATION WITH TPIA.....	5
5.0	INVOLVEMENT OF TPIA	5

1.0 INTRODUCTION

The objective is to specify the role of Third-Party Inspection Agency (TPIA) appointed by Contractor for supply items and appointed by Owner for construction work.

The Contractor will appoint an independent approved Third-Party Inspection Agency (TPIA) whose role shall be to witness, review and certify all quality related issues for supply of material. The TPIA shall ensure that all quality related requirements during manufacturing are strictly followed as per Owner/Owner's representative specifications and approved documents. Owner shall appoint its TPIA for witness, review and certification of all the construction activities.

This Standard Specification also indicates general quality control requirements for various activities pertaining to Gas Pipeline Projects and the extent of TPIA involvement as indicated in tender shall be binding on the contractor.

2.0 SCOPE OF WORK

2.1 Role of TPIA for Supply Items

TPIA, as appointed by the Contractor from Owner's approved list, shall witness, review and certify all quality related activities for supply of material for Mechanical, Civil, Electrical and Instrumentation system. The extent of TPIA involvement as a minimum is indicated in the various Quality Control Sheets attached with the tender document and shall be as per final approved QA/QC procedures or as per codes and standards, wherever applicable.

2.2 Role of Owner / Owner's Representative for Supply Items

For supply items, Owner / Owner's Representative reserves the right to carryout independent inspection / audit of the plant during manufacturing. The extent of inspection shall be at the discretion of Owner / Owner's Representative. All costs related to the same (excluding travel expenses) shall be borne by Contractor

2.3 Role of TPIA for Construction Activity

TPIA, as appointed and paid by Owner will be involved in all inspection, witness & certify construction work. The extent of TPIA involvement will be shown in the various Quality control sheets prepared by Contractor and approved by Owner/Owner's representative.

Prior to commencement of any activity pertaining to construction at site, Owner/Owner's representatives shall get the documents reviewed by the TPIA.

2.4

The various Hold points' involvement as mentioned in various QC sheets is indicative minimum. However, actual involvement shall be decided by Owner/Owner's Representative during review of documents, and Contractor shall be bound by the same. Contractor shall also submit the calibration certificates of all the equipment/instruments, which are part of manufacturing/Inspection & testing for TPIA review TPIA shall also be responsible to check /witness the

necessary calibration of such equipment/Instruments during visit to contractor's works.

3.0 ROLE OF CONTRACTOR

Contractor shall have to carry out all necessary inspections and testing which are indicated in approved documents and shall have to provide all necessary latest tools & tackles, measuring instruments and facilities, which are required by the TPIA/Owner /Owner's representatives and all necessary assistance to carryout inspection/testing at contractor's cost. Owner/Owner's representative shall have a right to inspect any activity.

4.0 CO-ORDINATION WITH TPIA

Contractor on award of the Contract/LOI shall submit the detail procurement and construction schedules within fifteen (15) days to Owner/Owner's representative for their approval. The detail item wise Manufacturing schedule indicating dates and location of manufacturer works shall be submitted by the Contractor within One (1) week from the date of issue of their internal Indent /Purchase order to sub vendor.

Contractor shall inform in writing minimum One (1) week in advance to inform the Owner/Owner's representative for Inspection Notice/Call. All coordination among Owner/Owner's representative/TPIA and Contractor's/ Vendor's works shall be the responsibility of Contractor. In case the Contractor fails to honour its inspection calls/notice, contractor has to reimburse all costs incurred by the Owner/Owner representative at actual.

Inspection of site construction activities shall be coordinated on daily basis and adequate notice shall be given to Owner/Owner's representative to mobilize TPIA, this shall be as per site conditions and requirements.

5.0 INVOLVEMENT OF TPIA

5.1 The Minimum requirements are indicated in the Quality Control Tables attached in tender document.

5.2 Civil

All procured items required for execution activities for civil works should satisfy the following conditions:

- It should be of reputed make having proven record of being successfully used in similar works earlier and as per approval by Owner / Owner's Representative.
- All materials shall be of standard quality and shall be procured from renowned sources / manufacturers approved by Owner/ Owner's representative.
- All tests of the materials as specified by the relevant codes should be carried out by the contractor in an approved laboratory and the test reports should be

duly authenticated by the laboratory and should be submitted to TPIA for his approval. If so desired by Owner/ Owner's representative, tests shall be conducted in his presence or in presence of his authorized nominee.

- Quality and acceptance of materials not covered under general technical specifications shall be governed by relevant codes.
- The Contractor shall submit manufacturer's test reports on quality and suitability of any material procured from them and their recommendations on storages/ application/ workmanship etc. for the intended use. Submission of manufacturer's test reports does not restrict Owner/ representative from asking fresh test results from an approved laboratory of the actual materials supplied even from an approved manufacturer.
- Contractor shall furnish the QAP for all supply and construction works.

5.3 Electrical

All procured items for required execution activities for electrical works should satisfy the following conditions:

- Contractor shall furnish the QAP for Panels, Cables, UPS etc. for Owner's review.
- QA Plan will commence at the instigation of the requisition and follow through to equipment acceptance thus ensuring total conformity to the specifications.
- Type test certificates of similar equipment shall be provided.
- Routine tests shall be carried out on the panels, Cables, UPS, Flame proof equipment and other items as per ISS.
- Owner/Owner's Representative reserve the right to witness routine acceptance tests at the manufacturer works as indicated in QAP & ISS.
- Owner/Owner's Representative will witness the routine tests on Panels, UPS at the manufacturer works prior to despatch, to prove compliance with specifications.
- Owner/Owner's Representative shall carry out the inspection of the erection of equipment and witness the testing & commissioning of the equipment at site and approve the test certificates.

5.4 Instrumentation

All procured items for required execution activities for Instrumentation works should satisfy the following conditions:

- Contractor shall furnish the quality assurance procedure for field instruments and cables for review of Owner/ Owner's representative.
- QAP will commence at the instigation of the requisition and follows through to

equipment acceptance. Thus, ensuring total conformity to the specifications.

- Type test certificates of similar equipment shall be provided.
- Owner/Owner's Representative shall carryout the inspection of erection of the equipment and witness the testing and commissioning and approve the certificates.



VCS QUALITY SERVICES PVT.LTD.

STANDARD SPECIFICATION FOR SEAMLESS (SMLS) LINE PIPE (ONSHORE)

VCS-PP-SS-2036

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CONTENTS

1. SCOPE	4
3. NORMATIVE REFERENCES	4
6. PIPE GRADE, STEEL GRADE AND DELIVERY CONDITION	4
8 MANUFACTURING.....	5
9 ACCEPTANCE CRITERIA.....	5
10 INSPECTION	11
11 MARKING	14
12 COATINGS AND THREAD PROTECTORS	15
13 RETENTION OF RECORDS.....	15
14 PRODUCTION REPORT	15
15 INSPECTION OF FIELD TESTS & WARRANTY	16

1. SCOPE

This specification establishes the minimum requirements for the manufacture of seamless steel line pipe for onshore service in accordance with the requirements of API (American Petroleum Institute) Specification 5L, Forty-Fifth Edition, 2012 and makes restrictive amendments to API Specification 5L. Unless modified and/or deleted by this specification, the requirements of API Specification 5L shall remain applicable.

The sections, paragraphs and annexes contained herein have the same numbering as that of API Spec 5L in order to facilitate reference. Additional requirements, which are not specified in API Spec 5L, have also been numbered and marked as "(New)".

The coverage by this specification is limited to line pipe to be used in onshore pipelines transporting non-sour hydrocarbons in liquid or gaseous phase. The product specification level for line pipe to be supplied as per this specification shall be "PSL 2".

The Manufacturer shall have a valid license to use API Monogram in accordance with the requirements of Specification 5L, Forty-Fifth Edition, 2012 for line pipe as Product Specification Level PSL 2.

1.1 Pipe Size

This Specification shall be applied to line pipe of size 4.5" OD thru 16" OD (both sizes included).

3. NORMATIVE REFERENCES

The latest edition (edition enforce at the time of issue of enquiry) of following additional references are included in this specification:

ASTM

ASTM E112: Standard Test Methods for Determining Average Grain size

6. PIPE GRADE, STEEL GRADE AND DELIVERY CONDITION

6.1 PIPE GRADE AND STEEL GRADE

6.1.2 Line pipe supplied to this specification shall conform to Product Specification Level 2 (PSL2) as given in Table 1 of this specification and consists of an alpha or alphanumeric designation that identifies the strength level of the pipe. The steel name (designating a steel grade), linked to the chemical composition of the steel, additionally includes a suffix that consists of a single letter (N or Q) that identifies the delivery condition as per Table 3 of this specification.

Table 1 of API Spec 5L stands replaced by Table 1 of this specification.

Table 1- Pipe grades, steel grades and acceptable delivery conditions

PSL	Delivery Condition	Pipe grade! steel grade ^{a,b}
PSL -2	Normalized	BN, X42N, X46N, X52N
	Quenched and tempered	BQ, X42Q, X46Q, X52Q, X56Q, X60Q, X65Q & X70Q
a Deleted		
b The suffix (N or Q) for PSL 2 grades belongs to steel grade		

6.2 DELIVERY CONDITION

6.2.2 The delivery condition for starting material shall be in accordance with Table 1 of this specification.

8 MANUFACTURING

8.1 PROCESS OF MANUFACTURE

Pipe furnished to this specification shall be manufactured in accordance with the applicable requirements and limitations given in Table 2 of API Spec 5L and Table 3 of this specification.

Table 3 of API Spec 5L stands replaced by Table 3 of this specification.

Table 3 - Acceptable manufacturing routes for PSL 2 pipe

Type of Pipe	Starting Material	Pipe forming	Pipe heat treatment	Delivery condition
SMLS	Ingots, Bloom or billet	Normalising forming	None	N
		Hot forming	Normalising or Quenched & Tempered	N or Q
		Hot forming and cold finishing		N or Q

8.3 STARTING MATERIAL

8.3.2 Line pipe furnished to this specification shall be made from steel produced in basic oxygen or electric arc furnace. Steel shall be made by continuous casting only.

8.3.3 The steel used for manufacture of pipe shall be fully killed and fine grained with ASTM grain size number 7 or finer as per ASTM E 112.

8.9 COLD SIZING AND COLD EXPANSION

8.9.1 Pipes furnished to this specification shall be non-expanded.

8.11 JOINTERS

8.11.1 Joints on pipes are not permitted.

9 ACCEPTANCE CRITERIA

9.2 CHEMICAL COMPOSITION

9.2.2 For pipes supplied as per this specification, the chemical composition of each heat of steel on product analysis shall be as given in Table 5 of this specification.

Table 5 of API Spec 5L stands replaced by Table 5 of this specification.

Table 5 - Chemical composition for pipe

Element	Mass fraction based upon heat and product analyses (%)	
C ^b	0.16	max.
Si	0.15 ^{m(new)}	min.
	0.40	max. (For Grade B to X46)
	0.45	max. (For Grade X52 to X70)
Mn ^b	1.20	max. (For Grade B to X42)
	1.40	max. (For Grade X46 to X70) for delivery condition N
	1.50	max. (For Grade X46 to X 56) for delivery condition Q
	1.60	max. (For Grade X60 to X70) for delivery condition Q
P	0.020	max.
S	0.010	max.
V	c	(For Grade B)
	0.05	max. (For Grade X42 to X52)
	0.07 ^g	max. (For Grade X56)
	0.08 ^g	max. (For Grade X60 to X70)
Nb	c	(For Grade B)
	0.05 ^g	max. (For Grade X42 to X70)
Ti	0.04 ^g	max. (For Grade B to X60)
	0.06 ^g	max. (For Grade X65 & X70)
Al ^{n (new)}	0.07	max.
Cr	0.20	
Mo	0.10	
Cu ^{o (new)}	0.35	
Ni ^{o (new)}	0.20	
N ^{n (new)}	0.012	
B	0.0005	
a Based upon product analysis as per clause 9.2.4 and 9.2.5 of API Spec 5L, the CE_{Pcm} limits apply if C ≤ 0.12% and CE_{IW} limits apply if C > 0.12%. For pipes of all grades, sizes and wall thicknesses, Carbon Equivalent shall comply with the following limits: CE_{Pcm} ≤ 0.20 % CE_{IW} ≤ 0.40 % Boron content shall be considered in CE_{Pcm} formula even if it is less than 0.0005%. b Deleted c Nb + V ≤ 0.06% d Deleted e Deleted f Deleted g Nb + V + Ti ≤ 0.15% h Deleted. i Deleted		

j Deleted
k Deleted
l Deleted
(New) m Minimum for Si is not applicable for Al killed steel.
(New) n AI/N shall be minimum 2 (not applicable to titanium-killed steel or titanium-treated steel).
(New) o Cu + Ni ≤0.40%

- 9.2.3 For heat analysis and product analysis, all the elements listed in Table 5 of this specification shall be analysed and reported, even if those are not purposely added but are present as residuals only.
If alloying elements other than those specified in Table 5 of this specification are added to the steel, the limits of the additional components shall be agreed with the Purchaser.

9.3 TENSILE PROPERTIES

- 9.3.2 The finished pipe (after all heat treatment & sizing operations) shall conform to the requirements of Table 7 of API Spec 5L and as modified herein.

The actual yield strength shall be as close as possible to the specified minimum yield strength (SMYS) but in no case it shall exceed the limits specified here under:

API Spec 5L Grade	Permissible in excess of SMYS, MPa (psi)
Up to and including X46	131 (19,000)
X52 to X60	125 (18,000)
X65 to X70	120 (17,400)

The ratio of body yield strength and body tensile strength of each test pipe on which yield strength and ultimate tensile strength are determined, shall not exceed 0.90.

The minimum elongation of base metal shall be determined in accordance with the formula given in foot note (f) of Table 7 of API Spec 5L, however, minimum elongation shall be at least 20% for t ≤ 12.7 mm and 22% for t > 12.7 mm.

8 CVN IMPACT TEST FOR PSL 2 PIPE

9.8.1 General

- 9.8.1.2 From the set of three Charpy V-notch impact test pieces, only one is allowed to be below the specified average absorbed energy value and shall meet the minimum single absorbed energy value requirement as specified in Table 8 of this specification.

9.8.2 Pipe body tests

- 9.8.2.1 The average (set of three test pieces) absorbed energy value (KvT) for each pipe body test shall be as specified in Table 8 of this specification, based upon full sized test pieces at a test temperature of 0°C(32°F) or at a lower test temperature as specified in the Purchase Order/Material Requisition /Data sheets.

Table 8 of API Spec 5L stands replaced by Table 8 of this specification.

**Table 8 - CVN absorbed energy requirements
for pipe body of PSL 2 pipe**

Pipe Grade	Full-size CVN absorbed energy (KvT) ^{a,b} [J]	
	Average	Minimum
B	40	33
X42	40	33
X46	40	33
X52	40	33
X56	40	33
X60	42	35
X65	45	38
X70	50	40
a. The required KvL (longitudinal direction test pieces) values shall be 50% higher than the required KvT values. b. Testing shall be performed at a test temperature of 0° C (32°F) or at a lower temperature as specified in the Purchase Order/ Material Requisition/ Data sheet		

9.8.2.2 The minimum average (set of three test pieces) shear fracture area shall be at least 85 % with one minimum value of 75%, based at a test temperature of 0 °C (32 °F) or at a lower test temperature as specified in the Purchase Order /Material Requisition/Data sheet.

9.10 SURFACE CONDITIONS, IMPERFECTIONS AND DEFECTS

9.10.1 General

9.10.1.2 All pipes shall be free from cracks, sweats, leaks and slivers. Pipe containing such defects shall be treated in accordance with clause C.3 b) or C.3 c) of API Spec 5L.

9.10.4 Laminations

Any lamination or inclusion either extending into the face or bevel of the pipe or present within 50 mm from pipe ends shall be classified as defect. Pipes that contain such defects shall be rejected or cut back until no lamination or inclusion is present at the pipe ends and shall be treated in accordance with clause C.3 b) or C.3 c) of API Spec 5L.

9.10.5 Geometric deviations

9.10.5.2 For dents, the length in any direction shall be $\leq 0.5 D$ and the depth, measured as the gap between the extreme point of the dent and the prolongation of the normal contour of the pipe, shall not exceed the following:

a) 2 mm for types of dents and not encroaching upon the minimum specified wall thickness

Dents that exceed the above specified limits shall be considered as defect and shall be treated in accordance with clause C.3 b) or C.3 c) of API Spec 5L. Acceptable cold-formed dents with sharp-bottom gouges shall be treated in accordance with clause C.2 of API Spec 5L & as modified in this specification.

9.10.6 Hard Spots

Any hard spot larger than 50 mm (2.0 in) in any direction and hardness greater than 248HV 10 shall be classified as defect and treated in accordance with clause C.3 of API Spec 5L.

9.10.7 Other surface imperfection

Other surface imperfections found by visual inspection or non-destructive inspection shall be investigated, classified and treated as follows:

a) Imperfections that have a depth $\leq 0.05 t$ and do not encroach on the minimum specified wall thickness shall be classified as acceptable imperfections and shall be treated in accordance with Clause C.1 of this specification.

b) Imperfections that have a depth $> 0.05 t$ and do not encroach on the minimum specified wall thickness shall be classified as defects, and shall be dressed-out by grinding in accordance with Clause C.2 of API Spec 5L and as modified in this specification or shall be treated in accordance with clause C.3 of API Spec 5L.

c) Imperfections that have a depth $> 0.05 t$ and encroach on the minimum specified wall thickness shall be classified as defects and treated in accordance with clause C.3 of API Spec 5L.

9.11 DIMENSIONS, MASS AND TOLERANCES

9.11.3 Tolerances for diameter, wall thickness, length and straightness

9.11.3.1 The diameter and out-of-roundness shall be within the tolerances given in Table 10 of this specification.

Table 10 of API Spec 5L stands replaced by Table 10 of this specification.

Table 10 - Tolerances for diameter and out-of-roundness

Specified outside Diameter (D) mm (inch)	Diameter tolerances ^d		Out-of-roundness	
	Pipe except the end ^a	Pipe end ^{a,b,c}	Pipe except the end ^a	Pipe end ^{a,b,c}
114.3 (4 1/2) ≤ D ≤ 168.3 (6.625)	± 0.0075 D	-0.4 mm to + 1.6mm	0.020D	2.0mm
168.3 (6.625) < D ≤ 273.1 (10.750)		±0.005 D, but maximum of ± 1.6mm		2.0mm
273.1 (10.750) < D ≤ 406.4 (16)				3.0mm
a.	The pipe end includes a length of 100 mm at each of the pipe extremities.			
b.	Deleted			
c.	The diameter tolerance and out-of-roundness tolerance shall apply on inside diameter. The inside diameter, based on circumferential measurement, shall be calculated as ID = (D – 2t).			
d.	For determining compliance to the diameter tolerances, the pipe diameter is defined as the circumference of the pipe in any circumferential plane divided by Pi (π).			
e(new).	Out-of-roundness tolerances apply to maximum and minimum diameters as measured with bar gage, caliper, or device measuring actual, maximum and minimum diameters.			

- 9.11.3.2 In addition to API requirements, the wall thickness of each pipe shall be checked along the circumference at both ends and at the mid location of pipe body at 12 O' clock, 3 O' clock, 6 O' clock and 9 O' clock positions. The tolerances for wall thickness shall be as given in Table 11 of this specification.

Table 11 of API Spec 5L stands replaced by Table 11 of this specification.

Table 11- Tolerances for wall thickness

Wall thickness (mm)	Tolerances c, d (mm)
t < 10.0	+0.225 t -0.05 t
10.0 ≤ t < 25.0	+0.20 t -0.05 t
t ≥ 25.0	+5.00 -1.25
a Deleted b Deleted c The + ve tolerance for wall thickness does not apply to the weld area. d See 9.13.2 of API Spec 5L and as modified herein for additional restrictions.	

- 9.11.3.3 All pipes shall be supplied with length between 11.5 m and 12.5 m. However pipe with length between 10.0 m and 11.5 m can also be accepted for a maximum of 5% of the ordered quantity. The minimum average length of the entire ordered quantity in any case shall be 12.0 m. Overall length tolerance shall be (-) Zero and (+) One pipe length to complete the ordered quantity. Table 12 of API Spec 5L stands deleted.

- 9.11.3.4 The tolerances for straightness shall be as follows:

- a) The total deviation from a straight line over the entire pipe length shall not exceed 12 mm, as shown in Figure I of API Spec 5L.

b) The local deviation from straight line in 1.0 m (3.0 ft) portion at each pipe end shall be ≤ 3.0 mm (0.120 in), as shown in Figure 2 of API Spec 5L.

9.12 FINISH OF PIPE ENDS

9.12.5 Plain ends

9.12.5.6

(New) During removal of inside burrs at the pipe ends, care shall be taken not to remove excess metal and not to form an inside cavity on bevel. Removal of excess metal beyond the minimum wall thickness as indicated in clause 9.11.3.2 of this specification shall be a cause for re-bevelling. In case root face of bevel is less than that specified, the pipe ends shall be re-bevelled and rectification by filing or grinding shall not be done.

9.12.5.7

(New) Bevel Protectors

Both pipe ends of each pipe shall be provided with metallic or high impact plastic bevel protectors as per Manufacturer's standard. Bevel protectors shall be of a design such that they can be re-used by coating applicator for providing on externally anti-corrosion coated pipes subsequent to coating of line pipe.

10 INSPECTION

10.1 TYPES OF INSPECTION AND INSPECTION DOCUMENTS

10.1.3 Inspection documents for PSL 2 pipes

10.1.3.1 Inspection certificate 3.2 in accordance with EN 10204 shall be issued for each dispatched pipe by Purchaser's authorized representative.

10.2 SPECIFIC INSPECTION

10.2.1 Inspection frequency

10.2.1.2 For PSL 2 pipe, the inspection frequency shall be as given in Table 18 of this specification.

Table 18 of API Spec 5L stands replaced by Table 18 of this specification.

Table 18 - Inspection frequency of pipe

Sl. no.	Type of inspection	Frequency of inspection
1	Heat analysis ^a	One analysis per heat of steel
2	Product analysis ^b	Two pipes per lot (maximum 100 pipes) per heat
3	Tensile testing of the pipe body	Two pipes per lot (maximum 100 pipes) per heat
4	CVN impact testing of the pipe body	Once per test unit of not more than 100 pipes
5	Vickers hardness testing of Pipe body	Once per test unit of not more than 50 pipes

6	Hydrostatic testing	Each pipe
7	Visual inspection	Each pipe
8	Pipe diameter and out-of-roundness for pipe ^d	Each pipe
9	Wall thickness measurement ^d	Each pipe
10	Straightness ^d	At least 3 times per operating shift (12 hours maximum)
11	Other dimensional testing	Random testing, with the details left to the discretion of the manufacturer
12	Weighing of pipe	Each pipe shall be measured and recorded
13	Non-destructive inspection	In accordance with Annex E of API Spec 5L and as modified herein
14	Length	Each length of pipe shall be measured and recorded
a. Where the steel mill is not a part of an integrated pipe mill, heat analysis shall be reported by the Manufacturer prior to start of pipe production. b. Pipes selected shall be such that one at the beginning of the heat and one at the end of the heat are also represented. c. Deleted. d. Measurement shall be recorded at least 3 times per operating shift (12 hrs maximum). e. "Test unit" is as defined in clause 4.62 of API Spec 5L.		

10.2.2 Samples and test pieces for product analysis

Samples shall be taken, and test pieces prepared, in accordance with ISO 14284 or ASTM E1806. Samples used for product analysis shall be taken from finished pipes only.

10.2.3 Samples and test pieces for mechanical tests

10.2.3.1 General

In addition to API Spec 5L requirements, samples and test pieces for various types of tests shall be taken from Figure 5 a) of API Spec 5L and Figure 10.2.4.8.1 of this specification, whichever is applicable, and as given in Table 20 of this specification.

Table 20 of API Spec 5L stands replaced by Table 20 of this specification.

Table 20 - Number, orientation and location of test pieces per sample for mechanical tests

Sample Location	Type of test	Number, Orientation and location of test pieces per sample ^a
Pipe body	Tensile	1L, 1T ^b

	CVN	3T
	Hardness	1T
a See figure 5 (b) of API Spec 5L for an explanation of the symbols used to designate orientation and location.		
b The transverse tensile tests shall be carried out on pipes of $D \geq 219.1$ mm.		

10.2.3.2 Test pieces for the tensile test

Tensile test specimens shall be taken from finished pipes only. Heating or artificial ageing of tests pieces is not permitted.

Transverse test pieces shall have a round cross-section and shall be obtained from non - flattened samples prepared according to ASTM A370.

Longitudinal tensile tests shall be carried out on a strip specimen representing full wall thickness of the pipe prepared according to ASTM A370.

10.2.3.3 Test pieces for the CVN impact test

In addition to the API Spec 5L requirements, following shall also be applicable:

The test pieces shall be prepared in accordance with ASTM A370. Non-flattened test pieces shall be used. Test specimen shall be taken from the body of the finished pipe only. The axis of the notch shall be perpendicular to the pipe surface.

Charpy V-notch impact testing shall be performed on full-sized test pieces. However, if preparation of full size test piece is not possible, then standard sub-sized test pieces shall be prepared as per ASTM A370.

In case of lower pipe sizes wherein preparation of transverse sub-sized specimen is not possible, CVN impact testing shall be carried out on longitudinal test specimen [see Note 'a' of Table 8 of this specification].

10.2.3.8 Samples for hardness tests

(New) Samples for hardness tests shall be taken transverse to the pipe body [see Figure 5 a) key 2] from the pipe ends.

10.2.4 Test methods

10.2.4.3 CVN impact test

The Charpy test shall be carried out in accordance with ASTM A370.

10.2.4.8 Hardness test

In addition to the requirements of API Spec 5L, following shall also be applicable:

Vickers hardness tests shall be carried out in accordance with ISO 6507-1. The resulting Vickers hardness value at any point shall not exceed 248 HV₁₀. Hardness test locations shall be as shown in Figure 10.2.4.8.1 of this specification.

Modalities of retest shall be in accordance with clause 10.2.12.7 of API Spec 5L.

10.2.6 Hydrostatic test

10.2.6.1 Test pressure shall be held for a minimum period of 15 seconds for all sizes and grades of pipes.

10.2.6.2 In addition to the requirements of API Spec 5L, following shall also be applicable:

The pressure gauge used for hydrostatic testing shall have a minimum range of 1.5 times and maximum range of 4 times the test pressure. The test-pressure measuring device shall be calibrated by means of a dead-weight tester only. The test configuration shall permit bleeding of trapped air prior to pressurization of the pipe.

10.2.6.5 The test pressure for all sizes and grades of pipe shall be such that hoop stress (fibre stress) generated is at least 95% of SMYS, computed based on the Equation (6) indicated in clause 10.2.6.5 of API Spec 5L. Table 26 of API Spec 5L stands deleted.

10.2.7 Visual inspection

10.2.7.1 Each pipe shall be visually examined for entire external surface and internal surface to the extent feasible and shall be free of defects in finished condition. Visual examination shall be carried out in a sufficiently illuminated area; minimum 1000 1x. If required additional lights shall be used to obtain good contrast and relief effect between imperfections and backgrounds.

10.2.8 Dimensional testing

10.2.8.1 Diameter measurements shall be made with a circumferential tape only.

10.2.8.7 The measuring equipment requiring calibration or verification under the provisions of API Spec 5L shall be calibrated with manual instruments at least once per operating shift (12 hours maximum). Such calibration records shall be furnished to Purchaser's Representative on request.

10.2.10 Non-destructive inspection

Non-destructive inspection shall be performed in accordance with Annex E of API Spec 5L and as modified herein.

10.2.11 Reprocessing

This clause of API Spec 5L stands cancelled.

10.2.12 Retesting

10.2.12.1 Recheck analyses

Modalities of recheck analysis shall be as per API Spec 5L as applicable to the lot being tested (see Table 18 of this specification). However, during individual testing, each pipe shall be fully analysed to meet the requirements of Table 5 of this specification.

11 MARKING

11.1 GENERAL

11.1.1 Pipe manufactured in accordance with this specification shall be marked by the manufacturer as per the requirements of API Spec 5L and as modified herein. Marking shall be in English language and International System (SI) of Units.

11.1.5(New) Marking shall also include Purchase Order number, item number, pipe number and heat number.

11.2 Pipe markings

- 11.2.1 k) (New). Actual length in metres and actual pipe weight in kg shall be marked
- 11.2.2 c) (New). Paint used for stencil marking shall withstand a temperature up to 250°C expected to be experienced during further external anti-corrosion coating operations of line pipe by coating applicator.
- 11.2.3 The pipe number shall be placed by cold rolling or low stress dot marking or vibro-etching on the outside surface of the pipe at an approximate distance of 50 mm from both ends. In case of non-availability of either cold rolling or low stress dot marking facility in pipe mill, an alternative marking scheme of a permanent nature may be proposed by the Manufacturer
- 11.2.7 A colour code band shall be marked on inside surface of finished pipe for identification of pipes of same diameter but different wall thickness, as indicated in the Purchase Order.
- The colour code band shall be 50 mm wide and shall be marked at a distance of 150 mm from the pipe ends.

12 COATINGS AND THREAD PROTECTORS

- 12.1.1 Unless otherwise specified in the Purchase Order, the pipes shall be delivered bare, free of any trace of oil, stain, grease and paint. Varnish coating shall be applied on the marking area. Bevels shall be free of any coating.

13 RETENTION OF RECORDS

In addition to the records indicated in API Spec 5L, the Manufacturer shall retain the records of all additional tests and calibration records mentioned in this specification including the hard copy records of ultrasonic testing carried out on pipe/coil as well as pipe ends.

14 PRODUCTION REPORT

- (New) The Manufacturer shall provide one electronic copy and six hard copies of production report in English language indicating at least the following for each pipe. International system of units (SI) shall be adopted.

- Pipe number
- Heat number from which pipe is produced
- Pipe length and weight
- Pipe grade

The Manufacturer shall provide one electronic copy and six hard copies of acceptance certificates which shall include the results of all tests required as per this specification and performed on delivered material giving details of, but not limited to, the following:

- All test certificates as per clause 10.1.3 of API Spec 5L and as modified herein.
- Certified reports of dimensional inspection, surface imperfections & defects.
- Data on test failures, rejected heats/lots, etc.
- Information on production and shipping
- All other reports and results required as per this specification.

The certificates shall be valid only when signed by the Purchaser's Representative. Only those pipes, which have been certified by the Purchaser's Representative, shall be dispatched from the pipe mill.

In the event of small quantities of pipes supplied against this specification, the production report may consist of only test certificates required as per clause 10.1.3 of API Spec 5L and as modified herein and other test reports/results required as per this specification.

15 INSPECTION OF FIELD TESTS & WARRANTY

(New) Purchaser shall be reimbursed by Manufacturer for any pipe furnished on this order that fails under field hydrostatic test if such failure is caused by a material/ manufacturing defect in the pipe. The reimbursement cost shall include pipe, labour and equipment rental for finding, excavating, cutting out and installation of replaced pipe in position. The field hydrostatic test pressure will not exceed that value which will cause a calculated hoop stress equivalent to 95 percent of specified minimum yield strength.

In case Manufacturer so desires, he will be advised at least two weeks in advance so that his Representative may witness the hydrostatic test in field, however, the testing and leak (if any) finding and repair operation shall not be postponed because of absence of the Manufacturer's Representative.

Annex B

Manufacturing Procedure Qualification for PSL 2 Pipe

B.1 INTRODUCTION

B.1.1 This annex specifies additional provisions that apply for the PSL 2 pipes ordered as per this specification.

B.1.2 Two lengths each of completely finished pipes from two different heats (i.e. a total of four pipe lengths) shall be selected at random for testing as per clause B.5.1 of this specification to verify that the manufacturing procedure results in the quality of pipes which are in complete compliance with this specification. The pipes thus tested shall be considered to be the test pipes required per heat or per lot as per relevant clauses of this specification.

These manufacturing procedure qualification tests (MPQT) shall be repeated upon any change in the manufacturing procedure as deemed necessary by Purchaser's Representative. The manufacturing procedure qualification tests shall be carried out on pipes for each wall thickness, each diameter and each grade of steel.

B.1.3 Verification of the manufacturing procedure shall be by qualification in accordance with clause B.3, B.4 and B.5 of API Spec 5L and as modified herein.

Note: In the event of small quantities of pipes ordered against this specification, like those for bends and other similar applications, as specifically called out in the Purchase Order, the manufacturing procedure qualification test as per clause B.5.1 of this specification shall not be carried out. Pipes in such case shall be accepted based on regular production tests.

B.3 CHARACTERISTICS OF THE MANUFACTURING PROCEDURE SPECIFICATION

Before pipe production commences, Manufacturing Procedure Specification (MPS) for manufacturing of pipes and Statistical process control charts shall be prepared by pipe manufacturer and submitted for approval of the Purchaser.

B.5 MANUFACTURING PROCEDURE QUALIFICATION TESTS (MPQT)

B.5.1 For the qualification of the manufacturing procedure, all tests & inspections specified in Table 18 and clause B.5.2 of this specification shall be conducted on all the pipes selected for testing as per clause B.1.2 of this specification.

B.5.2 The Manufacturer shall submit to Purchaser a report giving the results of all tests mentioned below. The report shall be agreed and signed by Purchaser's Representative, prior to start of regular production.

The various tests to be conducted on each pipe shall be as follows. The test method and acceptance values shall be as per this specification unless specified differently in this Annex.

a. Visual Examination

All pipes shall be examined visually for dimensional tolerances and apparent surface defects.

b. Ultrasonic Examination

The weld seam of all pipes shall be examined ultrasonically by automatic ultrasonic equipment.

c. **Mechanical Properties**

The mechanical properties of all pipes shall be tested and shall meet the requirements of this specification. Purchaser's Representative will select the places in pipe from where the test pieces shall be extracted.

The following tests shall be conducted:

i. Tensile test

Tensile tests as per Table 20 and clause 10.2.3.2 of this specification shall be conducted on:

- Two (2) transverse test pieces for pipe of $D \geq 219.1$ mm (8.625 inch):
- Two (2) longitudinal test pieces

ii. CVN impact testing

Four sets of three transverse specimens shall be extracted from base metal for CVN impact tests including fracture toughness testing. The specimen shall be tested at - 40°C, -10°C, 0°C, +20°C for shear area and absorbed energy to produce full transition curve. The value for shear area and absorbed energy at the test temperature specified in clause 9.8 and Table 8 of this specification respectively shall be complied with. For other temperatures, test values shall be for information only.

iii. Hardness test

Hardness test shall be conducted on selected pipes as per requirement of clause 10.2.4.8 of this specification.

In addition to the above tests, all the tests and inspections required to be conducted as per this specification shall be conducted on all the pipes selected for testing during MPQT.

Annex C

Treatment of surface imperfections and defects

C.1 TREATMENT OF SURFACE IMPERFECTIONS

Surface imperfection not classified as defect as per this specification shall be cosmetically dressed-out by grinding.

C.2 TREATMENT OF DRESSABLE SURFACE DEFECTS

- C.2.3 Complete removal of defects shall be verified by local visual inspection and by suitable non-destructive inspection. To be acceptable, the wall thickness in the ground area shall be in accordance with clause 9.11.3.2 of this specification.

Annex E

Non-destructive inspection for other than sour service or offshore service

The Purchaser reserves the right to depute its Representative(s) to perform inspection and witness tests in all phases of manufacturing and testing starting from steelmaking to finished line pipe ready for shipment. Manufacturer shall comply with the provisions regarding inspection notice, plant access, compliance and rejection mentioned in the Annex Q (New) of this specification. The Manufacturer shall give the Purchaser reasonable notice of the starting date of normal production and the work schedule. Any action or omission on part of Purchaser's Representative shall not relieve the Manufacturer of his responsibility and obligation to supply material in strict accordance with this specification.

E.1 QUALIFICATION OF PERSONNEL

E.1.1 All personnel performing NOT activities shall be qualified in the technique applied, in accordance with latest edition of ISO 9712, ISO 11484 or ASNT No. ASNT-TC-1A or equivalent

All NDT shall be performed in accordance with written procedures. These procedures shall have prior approval of the Purchaser.

Inspector Qualification

Acceptable qualification for NOT inspectors shall be as specified below:

(i) For UT

For UT, at least one Level III qualified inspector shall be available to the mill for overall supervision. Level III inspectors shall be ASNT Level III or ACCP Professional Level III and certified in applicable method.

A level II inspector is required for shift supervision, manual weld inspection and calibration of all systems (both manual and automated).

(ii) For all other NDT methods

Evaluation of indications: Level II & Level III inspector

E.3 METHODS OF INSPECTION

E.3.1 General

E.3.1.2 All SMLS pipes shall be non-destructively inspected full length (100%) in accordance with applicable methods given in Table E.2 of API Spec 5L using automatic ultrasonic equipment in accordance with clause E.5 and as modified herein.

E.3.3 Pipe End Inspection - Welded Pipe

E.3.3.1 Pipe ends including weld at the pipe ends not covered by automatic ultrasonic equipment shall be inspected by manual ultrasonic equipment with same sensitivity and capability as automatic equipment, or, such non-inspected pipe end shall be cut-off. Records in accordance with E.5.4 of API Spec 5L shall be maintained.

E.3.3.2 Ultrasonic inspection in accordance with the method described in ISO 10893-8 shall be used to verify that the 50 mm (2.0 in) wide zone at each pipe end is free of any laminar imperfections in the circumferential direction.

E.3.3.3(New) Bevel face of each pipe end shall be magnetic particle inspected for the detection of laminar imperfections in accordance with ISO 10893-5

E.5 ULTRASONIC AND ELECTROMAGNETIC INSPECTION

E.5.1 Equipment

E.5.1.1 In addition to the API Spec 5L requirements, all automatic ultrasonic equipment shall have an alarm device, which continuously monitors the effectiveness of the coupling. The equipment for the automatic inspection shall allow the localization of both longitudinal and transverse defects corresponding to the signals exceeding the acceptance limits of the reference standard. The equipment shall be fitted with a paint spray or automatic marking device and alarm device for areas giving unacceptable ultrasonic indications. All ultrasonic testing equipment shall be provided with recording device.

E.5.2 Ultrasonic and electromagnetic inspection reference standards

E.5.2.1 The reference standard shall be, according to the cases, taken from the production to be controlled, and of such dimensions as to allow the static and dynamic calibration of the control system.

E.5.2.3 Reference standards

The primary reference sensitivity level shall be adjusted on the following reference reflectors:

Examination Type	Seamless
Lamination Detection	FBH (6.4mm)
Surface defect detection	Notch N5
Defect detection of body and pipe ends	Notch N5

Flat Bottomed Holes (FBH) for lamination detection shall have 6.4 mm (1/4inch) diameter and depth 0.5 t, where 't' is the specified wall thickness.

E.5.3 Instrument standardization

E.5.3.2 The instrument shall be calibrated with appropriate reference standard (refer E.5.2 of API Spec 5L and as modified herein) under the same inspection conditions of pipes of normal production at following intervals::

- Once at the beginning of each operating shift (12 hours maximum).
- Once in between of each operating shift i.e, 3 hrs to 4 hrs after the first
- Every time there is change in probes or working condition of the UT machine.
- Every time the running of the system gives rise to doubts on its efficiency.
- If during the calibration verification, it is found that notches or holes of the reference standard are not revealed or if the signals caused by notches and holes of the calibration samples do not switch on the automatic alarm or marking and selection device, all pipes already checked from the previous verification shall be re-inspected at manufacturer's cost.

E.5.5 Acceptance limits

E.5.5.2 For all examination types, indications exceeding the acceptance limit signals are unacceptable. For lamination detection in seamless pipe body and pipe ends, the acceptance limits shall be based on the lamination size and frequency as given below:

Any lamination in the body of the pipe exceeding both of the following is considered a defect:

- a) Greater than or equal to 12.0 mm in the minor dimension.
- b) Greater than or equal to 5000 mm² in area.

E.5.6 Disposition of defects found by ultrasonic and electromagnetic inspection

Disposition of any imperfection in pipe/coil that produces an indication greater than the acceptable limits of this specification shall be classified as defect and shall be given disposition as specified in (e) or (f) of E.10 of API Spec 5L.

E.5.8 LAMINAR IMPERFECTIONS IN THE PIPE BODY

(New) The individual laminations exceeding the acceptance limits as given in clause E.5.5.1 of this specification shall be classified as defects.

Compliance with such requirements shall be verified by ultrasonic inspection in accordance with ISO 10893-8 amended as follows:

- The distance between adjacent scanning tracks shall be sufficiently small to ensure detection of minimum allowed imperfection size.

The minimum coverage during automatic inspection shall be $\geq 25\%$ of the pipe surface.

E.5.9 Suspect pipe

(New) Pipe giving rise to indications producing a trigger/ alarm condition as a result of the specified non-destructive inspection operation shall be deemed suspect. Locations showing indications above the acceptance limits during ultrasonic inspection shall be re-examined by radiography. If no defects are located during re-examination, the original findings may be ignored. Additional scanning may be requested by the Purchaser Representative to check questionable areas.

E.7 RESIDUAL MAGNETISM

E.7.2 The longitudinal magnetic field shall be measured on all sizes of pipes. Measurement on pipe in stack shall not be considered valid. Such measurements shall be taken on the root face or square cut face of finished plain-end pipes.

E.7.3 Measurements shall be made using Hall- effect gaussmeter only.

E.7.4 Measurements shall be made on each end of a pipe for 5% of the pipes produced but at least once per 4 hr per operating shift (12 hrs maximum).

E.7.6 Four readings shall be taken approximately 90° apart around the circumference of each end of the pipe. The average of the four readings shall not exceed 2.0 mT (20 gauss) and no single reading shall exceed 2.5 mT (25 gauss). All residual magnetism measurements shall be recorded.

E.10 DISPOSITION OF PIPES CONTAINING DEFECTS

- c) The repaired area shall be 100% rechecked by magnetic particle or ultrasonic inspection to ensure complete removal of defects. However, for repair of cosmetic type of defects, MPI may not be conducted if so directed by Purchaser's Representative on case to case basis. The pipes having a thickness less than the minimum allowed in accordance with this specification, after repair by grinding shall be treated for disposition in accordance with (e) or (f) of clause E.10 of API Spec 5L.

E.11 SUPPLEMENTARY NON-DESTRUCTIVE INSPECTION

(New)

- E.11.1^(new) Pipe shall be 100% ultrasonically inspected for the detection of transverse imperfections and inclined embedded defects in accordance with ISO 10893-10 acceptance level U2/C.
- E.11.2^(new) Pipe shall be full-body inspected using the flux leakage method in accordance with ISO 10893-3 acceptance level F2 for the surface testing of the pipes for longitudinal and transverse imperfections.

Annex Q (New)

Purchaser Inspection

Q.1 INSPECTION NOTICE

Advance notice shall be given by the manufacturer prior to the start of production to the purchaser to inspect/witness the manufacturing activities including tests.

Q.2 PLANT ACCESS

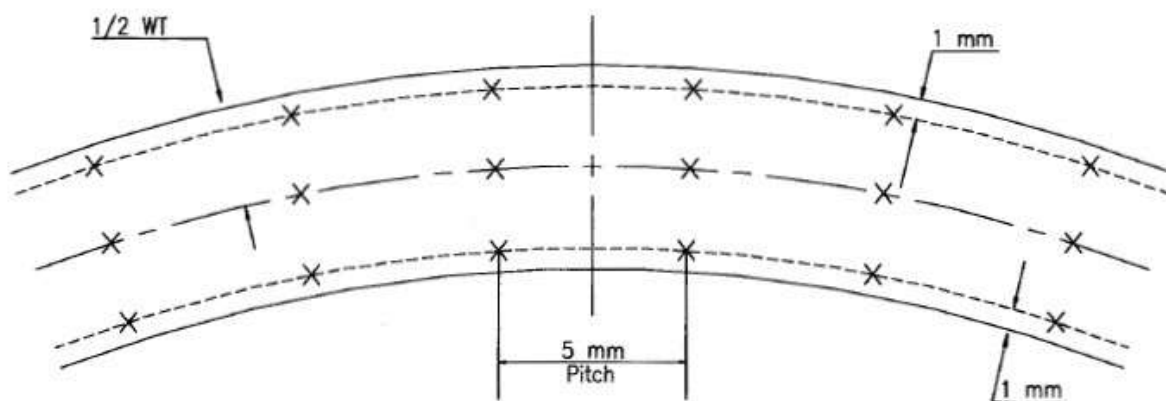
The inspector representing the purchaser shall have unrestricted access, at all times while work of the contract of the purchaser is being performed, to all parts of the manufacturer's works that will concern the manufacture of the pipe ordered. The manufacturer shall afford the inspector all reasonable facilities to satisfy the inspector that the pipe is being manufactured in accordance with this specification. All inspections should be made at the place of manufacture prior to shipment, unless otherwise specified on the purchase order, and shall be so conducted as not to interfere unnecessarily with the operation of the works.

Q.3 COMPLIANCE

The manufacturer is responsible for complying with all of the provisions of this specification. The purchaser may make any investigation necessary to be satisfied of compliance by the manufacturer and any reject any material that does not comply with this specification.

Q.4 REJECTION

If the Purchaser Representative rejects pipes repeatedly for any recurring cause, this shall be adequate reason to refuse final inspection of subsequent pipes until the cause has been investigated and corrective action taken by the Manufacturer.



Notes:

1. Number of hardness measurement required on each specimen shall be min. 12.

FIGURE: 10.2.4.8.1
LOCATIONS FOR HARDNESS MEASUREMENT



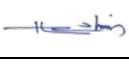
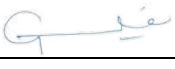
VCS QUALITY SERVICES PVT. LTD.

STANDARD SPECIFICATION FOR DOCUMENTATION REQUIREMENTS FROM SUPPLIERS

VCS – SS – PP - 2043

					
01	30.07.2022	RKP	MC	HK	GW
00	20.07.2020	MB	MC	AD	SK
Rev. No	Date	Prepared By	Checked By	Approved By	Authorized By

UNCONTROLLED COPY	: If printed
CONTROLLED COPY	: If in soft and signed

REVISION RECORD						
Rev.	Revision Date	Prepared by	Checked by	Approved by	Authorized by	Revision Description
00	20.07.2020					
		MB	MC	AD	SK	
01	30.07.2022					VCS QMS Integration
		RKP	MC	HK	GW	

Abbreviations:

DCI	:	Document Control Index
edms	:	Electronic Document Management System
FOA	:	Fax of Acceptance
HOD	:	Head of Division / Department
IC	:	Inspection Certificate
IRN	:	Inspection Release Note
ITP	:	Inspection and Test Plan
LOA	:	Letter of Acceptance
MOU	:	Memorandum of Understanding
MR	:	Material Requisition
PO	:	Purchase Order
PR	:	Purchase Requisition
PVC	:	Polyvinyl Chloride
QMS	:	Quality Management System
TPIA	:	Third Party Inspection Agency
URL	:	Universal Resource Locator

CONTENTS

1.0 SCOPE..... 4

2.0 DEFINITIONS 4

3.0 REFERENCE DOCUMENTS 4

4.0 DOCUMENTATION REQUIREMENTS 4

Attachments

Format for completeness of Final Documentation

Annexure-1

1.0 SCOPE

This specification establishes the Documentation Requirements from Suppliers. All documents/data against the PO / PR / MR shall be developed and submitted to OWNER by the suppliers for review / records, in line with this specification.

2.0 DEFINITIONS

2.1 Supplier

For the purpose of this specification, the word "SUPPLIER" means the person(s), firm, company or organization who is under the process of being contracted by OWNER for delivery of some products (including service). The word is considered synonymous to bidder, contractor or vendor.

2.2 Owner

Owner means the owner of the project for which services / products are being purchased and includes their representatives, successors and assignees.

3.0 REFERENCE DOCUMENTS

VCS-SS-PP-2044 Standard Specification for Quality Management System Requirements from Vendors

4.0 DOCUMENTATION REQUIREMENTS

4.1 Documents/Data to be Submitted by the Supplier

4.1.1 The Supplier shall submit the documents and data against the PO/PR/MR as per the list given in respective PO/PR/MR.

4.1.2 Review of the supplier drawings by PMC/ OWNER would be only to review the compatibility with basic designs and concepts and in no way absolve the supplier of his responsibility/contractual obligation to comply with PR requirements, applicable codes, specifications and statutory rules/regulations. Any error/deficiency noticed during any stage of manufacturing/execution/installation shall be promptly corrected by the supplier without any time and cost implications, irrespective of comments on the same were received from OWNER during the drawing review stage or not.

4.1.3 Unless otherwise specified, submission of documents for Review/Records shall commence as follows from the date of Fax of Intent / Letter of Intent/ Fax of Acceptance (FOA)/ Letter of Acceptance (LOA):

QMS - 1 week

Drawing/Document Control Index - 2 weeks

Other Documents/Drawings - As per approved Drawing/Document Control

Index/Schedule

4.1.4 Documents as specified in PO/PR/MR are minimum requirements. Supplier shall submit any other document/data required for completion of the job as per OWNERs instructions.

4.2 Style and Formatting

4.2.1 All Documents shall be in ENGLISH language and in M.K.S System of units.

4.2.2 Before forwarding the drawings and documents, contractor shall ensure that the following information are properly mentioned in each drawing:

Purchase Requisition Number

Name of Equipment / Package

Equipment / Package Tag No.

Name of Project

Client

Drawing / Document Title

Drawing / Document No.

Drawing / Document Revision No. and Date

4.3 Review and Approval of Documents by Supplier

4.3.1 The Drawing/Documents shall be reviewed, checked, approved and duly signed/stamped by supplier before submission. Revision number shall be changed during submission of the revised supplier documents and all revisions shall be highlighted by clouds. Whenever the supplier requires any sub-supplier drawings to be reviewed by OWNER, the same shall be submitted by the supplier after duly reviewed, approved and stamped by the supplier. Direct submission of sub-supplier's drawings without contractor's approval shall not be entertained.

4.4 Document Category

4.4.1 Review Category

Following review codes shall be used for review of supplier Drawings/Documents:

Review Code A	-	No comments. Proceed with manufacture/fabrication as per the document.
Review Code B	-	Proceed with manufacture/fabrication as per commented document. Revised document required.
Review Code C	-	Document does not conform to basic requirements as marked. Resubmit for review
Review Code D	-	Document Rejected
Review Code F	-	For information
R	-	Document is retained for Records. Proceed with manufacture/fabrication.
V	-	Void

4.5 Methodology for Submission of Documents to PMC/Owner

4.5.1 Document Control Index (DCI)

Supplier shall create and submit Document Control Index (DCI) for review based on PO/PR/MR along with schedule date of submission of each drawing/document on OWNERs eDMS. The DCI shall be specific with regard to drawing/document no. and the exact title. Proper sequencing of the drawings/documents should be ensured in scheduled date of submission on of the job as per OWNER.

4.5.2 Submission of Drawings/Documents

Drawings/documents and data shall be uploaded on the eDMS Portal as per DCI

4.5.3 Statutory Approvals

Wherever approval by any statutory body is required to be taken by Supplier, the Supplier shall submit copy of approval by the authority to PMC/OWNER.

4.5.4 Details of Contact Persons of Supplier

After placement of order supplier shall assign a Project Manager for that order. The details are to be filled online through the portal. The details include e-mail address, mailing address, telephone nos., fax nos. and name of Project Manager. All the system generated emails pertaining to that order shall be sent to the assigned Project Manager.

4.5.5 Schedule and Progress Reporting

Supplier shall submit monthly progress report and updated procurement, engineering and manufacturing status (schedule vs. actual) every month, beginning within 2 weeks from FOA/LOA . In case of exigencies, PMC/Owner can ask for report submission as required on weekly/fortnightly/adhoc basis depending upon supply status and supplier shall furnish such reports promptly without any price implication. Format for progress report shall be submitted by the Supplier during kick off meeting or within one week of receiving FOA/LOA, whichever is earlier.

4.5.6 Quality Assurance Plan/Inspection and Test Plan

Inspection and test plans (ITP) attached if any, to the MR/PR are to be followed.

However for cases wherein ITPs have not been attached with MR/PR, Supplier shall submit within one week of receiving FOA/LOA, the Quality Assurance Plan for manufacturing, covering quality control of critical bought out items/materials, inspection & testing at various stages of production, quality control records and site assembly & testing as may be applicable to the specific order and obtain approval from OWNER /PMC/ third party inspection agency, as applicable.

For Package equipment contracts, the supplier shall prepare a list of items/ equipment's and their inspection categorization plan for all items included in the scope of supply immediately after receipt of order and obtains approval for the same from OWNER. The

items shall be categorized into different categories depending upon their criticality for the scope of inspection of TPIA and/or OWNER/ OWNER appointed PMC.

4.5.7 Inspection Release Note (IRN)/ Inspection Certificate (IC)

IRN/ IC shall be issued by PMC Inspector/ third party inspection agency on the basis of successful inspection, review of certificates as per specifications & agreed quality plan (as applicable) and only after all the drawings/documents as per DCI are submitted and are accepted under review code-A or code R. Supplier shall ensure that necessary documents/manufacturing and test certificates are made available to PMC/TPIA as and when desired.

Note: Non fulfilling above requirement shall result into appropriate penalty or withholding of payment as per conditions of PO/PR/MR.

Transportation Plan for Over Dimensional Consignments (ODC), if any, shall be submitted within 2 weeks of receiving FOA/LOA, for approval. Consignment with parameters greater than following shall be considered as over dimensional.

Dimensions: 4 meters width x 4 meters height x 20 meters length

Weight: 32 MT

4.6 Final Documentation

4.6.1 As Built Drawings

Shop changes made by Supplier after approval of drawings under 'Code A' by OWNER/OWNER appointed PMC and deviations granted through online system , if any, shall be marked in hard copies of drawings which shall then be stamped 'As-built' by the supplier. These 'As-built' drawings shall be reviewed and stamped by PMC Inspector/TPIA also. Supplier shall prepare scanned images files of all marked — up 'As — built drawings. Simultaneously Supplier shall incorporate the shop changes in the native soft files of the drawings also.

4.6.2 As Built Final Documents

As built final documents shall be submitted as listed in PO/PR/MR.

4.6.3 Packing/Presentation of Final Documents

Final Documents shall be legible photocopies in A4, A3 size only. Drawings will be inserted in plastic pockets (both sides transparent, sheet thickness minimum 0.1 mm) with an extra strip of 12 mm wide for punching so that drawings are well placed.

Final Documentation shall be bound in Hard board Plastic folder(s) of size 265 mm x 315 mm (10 1/2 inch x 12 1/2 inch) and shall not be more than 75 mm thick. It may be of several volumes and each volume shall have a volume number, index of volumes and index of contents of that particular volume. Where number of volumes are more, 90mm thickness can be used. Each volume shall have top PVC sheet of minimum 0.15mm thick duly fixed and pressed on folder cover and will have 2 lever clips. In case of imported items documents, 4 lever clips shall also be accepted. All four corners of folders shall be properly metal clamped. Indexing of contents with page numbering must be incorporated by supplier. Spiral/Spico bound documents shall not be acceptable. As mentioned above,

books should be in hard board plastic folders with sheets punched and having 2/4 lever clips arrangement.

Each volume shall contain on cover a Title Block indicating package Equipment Tag No. & Name, PO/Purchase Requisition No., Name of Project and Name of Customer. Each volume will have hard front cover and a reinforced spine to fit thickness of book. These spines will also have the title printed on them. Title shall include also volume number (say 11 of 15) etc.

4.6.4 Submission of Soft Copies

Supplier shall submit to OWNER, the scanned images files as well as the native files of Drawings / documents, along with proper index.

In addition to hard copies, Supplier shall submit electronic file (CD-ROM) covering soft copies of all the final drawings and documents, all text documents prepared on computer, scanned images of all important documents (not available as soft files), all relevant catalogues, manuals available as soft files (editable copies of drawings/text documents, while for catalogues/manuals/proprietary information and data, PDF files can be furnished).

All the above documents shall also be uploaded on the OWNERs eDMS portal.

4.6.5 Completeness of Final Documentation

Supplier shall get the completeness of final documentation verified by PMC appointed TPIA and attach the Format for Completeness of Final Documentation Format duly signed by OWNER/ OWNER appointed PMC/ Inspector or TPIA as applicable to the document folder.

ANNEUXRE-1

COMPLETENESS OF FINAL DOCUMENTATION

Name of Supplier/Contractor :

Customer :

Project :

OWNER's Job No. :

Purchase Order No./

Contract No. :

Purchase Requisition No./

Tender No. :

Rev. No. :

Name of the Work/

Equipment :

Tag. No. :

Supplier's/ Contractor's

Works Order No. :

Certified that the Engineering Documents/ Manufacturing & Test Certificates submitted by the supplier is complete in accordance with the Vendor Data Requirements of Purchase Requisition.

Signature :.....

Signature:.....

Date :.....

Date:.....

Name :.....

Name:.....

Designation :.....

Designation:.....

Department :.....

Department:.....

Supplier/Contractor

OWNER/PMC/TPIA



VCS QUALITY SERVICES PVT. LTD.

STANDARD SPECIFICATION FOR QUALITY MANAGEMENT SYSTEM REQUIREMENT FROM VENDORS

VCS – SS – PP - 2044

					
01	30.07.2022	RKP	MC	HK	GW
00	20.07.2020	MB	MC	AD	SK
Rev. No	Date	Prepared By	Checked By	Approved By	Authorized By

UNCONTROLLED COPY : If printed

CONTROLLED COPY : If in soft and signed

REVISION RECORD						
Rev.	Revision Date	Prepared by	Checked by	Approved by	Authorized by	Revision Description
00	20.07.2020					
		MB	MC	AD	SK	
01	30.07.2022					VCS QMS Integration
		RKP	MC	HK	GW	

Abbreviations:

CV	:	Curriculum Vitae
ISO	:	International Organization for Standardization
MR	:	Material Requisition
PO	:	Purchase Order
PR	:	Purchase Requisition
QA	:	Quality Assurance
QMS	:	Quality Management System

CONTENTS

1.0	SCOPE.....	4
2.0	DEFINITIONS	4
3.0	REFERENCE DOCUMENTS	4
4.0	QUALITY MANAGEMENT SYSTEM - GENERAL	4
5.0	QUALITY SYSTEM REQUIREMENTS	4
6.0	AUDITS.....	6
7.0	DOCUMENTATION REQUIREMENTS.....	7

1.0 SCOPE

This specification establishes the Quality Management System requirements to be met by BIDDER for following purpose:

- QMS requirements to be met by suppliers/contractors after award of work/ during contract execution.

2.0 DEFINITIONS

2.1 Bidder

For the purpose of this specification, the word "BIDDER" means the person(s), firm, company or organization who is under the process of being contracted by Owner for delivery of some products (including service). The word is considered synonymous to supplier, contractor or vendor.

2.2 Project Quality Plan

Document tailored from Standard Quality Management System Manual of BIDDER, specifying how the quality requirements of the project will be met.

2.3 Owner

Owner means the owner of the project for which services / products are being purchased and includes their representatives, successors and assignees.

3.0 REFERENCE DOCUMENTS

VCS-SS-PP-2043 Standard Specification for Documentation Requirements from Suppliers

4.0 QUALITY MANAGEMENT SYSTEM — GENERAL

Unless otherwise agreed with PMC / Owner, the BIDDER proposed quality system shall fully satisfy all relevant requirements of ISO 9001 "Quality Management Systems - Requirements." Evidence of compliance shall be current certificate of quality system registration to ISO 9001 or a recent compliance audit recommending registration from a certification agency. The quality system shall provide the planned and systematic control of all quality related activities for execution of contract. Implementation of the system shall be in accordance with BIDDER'S Quality Manual and PROJECT specific Quality Plan.

5.0 QUALITY SYSTEM REQUIREMENTS

- 5.1 BIDDER shall prepare and submit for review / record, Project Quality Plan / Quality Assurance Plan for contracted scope / job. The BIDDER'S Quality Plan shall address all of the applicable elements of ISO 9001, identify responsible parties within BIDDER'S organization, for the implementation / control of each area, reference the applicable procedures used to control / assure each area, and verify the documents produced for

each area. The Project Quality Plan shall necessarily define control or make reference to the relevant procedures, for design and engineering, purchase, documentation, record control, bid evaluation, inspection, production/manufacturing, preservation, packaging and storage, quality control at construction site, pre-commissioning, commissioning and handing over (as applicable) in line with contract requirement and scope of work.

- 5.2 BIDDER shall identify all specified or implied statutory and regulatory requirements and communicate the same to all concerned in his organization and his sub contractor's organization for compliance.
- 5.3 BIDDER shall deploy competent and trained personnel for various activities for fulfilment of PO / contract. BIDDER shall arrange adequate infrastructure and work environment to ensure that the specification and quality of the deliverable are maintained.
- 5.4 BIDDER shall do the quality planning for all activities involved in delivery of order. The quality planning shall cover as minimum the following:
- Resources
 - Product / deliverable characteristics to be controlled.
 - Process characteristics to ensure the identified product characteristics are realized
 - Identification of any measurement requirements, acceptance criteria
 - Records to be generated
 - Need for any documented procedure

The quality planning shall result into the quality assurance plan, inspection and test plans (ITPs) and job procedures for the project activities in the scope of bidder.

These documents shall be submitted to PMC/Owner for review/approval, before commencement of work.

- 5.5 Requirements for sub-contracting / purchasing of services specified in contract / tender shall be adhered to. In general, all outsourced items will be from approved vendors of OWNER. Wherever requirements are not specified, or approved sub vendors do not exist, the sub-contractor shall establish and maintain a system for purchasing / sub-contracting to ensure that purchased product / service conforms to specified requirements. Criteria for selection of sub-contractor, evaluation, re-evaluation, maintenance of purchasing data and verification of purchased product (subcontractor services), constitute important components of this requirement.
- 5.6 BIDDER shall plan and carry production and service provision under controlled conditions. Controlled conditions shall include, as applicable the availability of information that describes the characteristics of the product the availability of work instructions the use of suitable equipment the availability and use of monitoring and measuring devices the implementation of monitoring and measurement the implementation of release, delivery and post-delivery activities.

- 5.7 BIDDER shall validate any processes for production and service provision where resulting output cannot be verified by subsequent monitoring and measurement. This includes any process where deficiencies become apparent only after the product is in use or service has been delivered.
- 5.8 BIDDER shall establish a system for identification and traceability of product /deliverable throughout product realization. Product status with respect to inspection and testing requirements shall be identified.
- 5.9 BIDDER shall identify, verify, protect and safeguard PMC / Owner property (material / document) provided for use or incorporation into the product. If any OWNER/ PMC property is lost, damaged or otherwise found to be unsuitable for use, this shall be reported to the OWNER/ PMC.
- 5.10 BIDDER shall ensure the conformity of product / deliverable during internal processing and delivery to the intended destination. Requirements mentioned in the tender shall be adhered to.
- 5.11 BIDDER shall establish system to ensure that inspection and testing activities are carried out in line with requirements. Where necessary, measuring equipment's shall be calibrated at specified frequency, against national or international measurement standards; where no such standard exists, the basis used for calibration shall be recorded. The measuring equipment's shall be protected from damage during handling, maintenance and storage.
- 5.12 BIDDER shall ensure effective monitoring, using suitable methods, of the processes involved in production and other related processes for delivery of the scope of contract.
- 5.13 BIDDER shall monitor and measure the characteristics of the product/deliverable to verify that product requirement has been met. The inspection (stage as well as final) by BIDDER and OWNER / Owner personnel shall be carried out strictly as per the ITPs forming part of the contract. Product release or service delivery shall not proceed until the planned arrangements have been satisfactorily completed, unless otherwise approved by relevant authority and where applicable by Owner / PMC.
- 5.14 BIDDER shall establish and maintain a documented procedure to ensure that the product which does not conform to requirements is identified and controlled to prevent its unintended use or delivery.
- 5.15 All non-conformities (NCs) / deficiencies found by the BIDDER'S inspection /surveillance staff shall be duly recorded, including their disposal action shall be recorded and resolved suitably. Effective corrective and preventive action shall be implemented by the BIDDER so that similar NCs including deficiencies do not recur.
- 5.16 All deficiencies noticed and reported by PMC / OWNER shall be analysed by the BIDDER and appropriate corrective and preventive actions shall be implemented. BIDDER shall intimate PMC / OWNER of all such corrective and preventive action implemented by him.

- 5.17 BIDDER should follow the standards, specifications and approved drawings. Concessions/Deviations shall be allowed only in case of unavoidable circumstances. In such situations Concession/deviation request must be made by the BIDDER through online system of OWNER/ PMCs eDMS.
- 5.18 BIDDER shall have documented procedure for control of documents.
- 5.19 All project records shall be carefully kept, maintained and protected for any damage or loss until the project completion, then handed over to PMC / Owner as per contract requirement (VCS-SS-PL-0047 Specification for Documentation Requirements from Suppliers), or disposed as per relevant project procedure.

6.0 AUDITS

BIDDER shall plan and carry out the QMS audit for the job. Quality audit programme shall cover design, procurement, construction management and commissioning as applicable including activities carried out by sub-vendors and sub-contractors. This shall be additional to the certification body surveillance audits carried out under BIDDER'S own ISO 9001 certification scheme.

The audit programmes and audit reports shall be available with bidder for scrutiny by PMC / OWNER. PMC or OWNER representative reserves the right to attend, as a witness, any audit conducted during the execution of the WORKS.

In addition to above OWNER, PMC and third party appointed by PMC/Owner may also perform Quality and Technical compliance audits. BIDDER shall provide assistance and access to their systems and sub-contractor / vendor systems as required for this purpose. Any deficiencies noted shall be immediately rectified by BIDDER.

7.0 DOCUMENTATION REQUIREMENTS

BIDDER shall submit following QMS documents immediately after award of work (Within one week) for record / review by PMC/ Owner.

- Organization chart (for complete organization structure and for the project)
- Project Quality Plan/Quality Assurance Plan
- Job specific Inspection Test Plans, if not attached with PR
- Job Procedures
- Inspection/Test Formats

In addition to above QMS documents, following documentation shall be maintained by the BIDDER for submission to PMC / Owner on demand at any point of time during execution of the project.

- Quality Manual
- Certificate of approval for compliance to ISO: 9001 standards
- Procedure for Control of Non-conforming Product



- Procedure for Control of Documents
- Sample audit report of the QMS internal and external audits conducted during last one year
- Customer satisfaction reports from at least 2 customers, during the last one year
- Project QMS audit report
- Technical audit reports for the project
- Corrective action report on the audits

Documents as specified above are minimum requirements. BIDDER shall submit any other document/data required for completion of the job as per PMC/Owner instructions.



VCS QUALITY SERVICES PVT. LTD.

STANDARD SPECIFICATION FOR PLUG VALVES

VCS – SS – PP - 2051

00	03.05.2022	SR	MC	HK	HK
Rev. No	Date	Prepared By	Checked By	Approved By	Authorized By

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ABBREVIATIONS:

ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
API	American Petroleum Institute
BHN	Brinell Hardness Number
DN	Nominal Size
HAZ	Heat Affected Zone
LC	Lock Close (valve locked in full close position)
LO	Lock Open (valve locked in full open position)
MSS-SP	Manufacturers Standardization Society - Standard Practice
NDT	Non Destructive Testing
NPS	Nominal Pipe Size
RTJ	Ring Type Joint
SSPC	Steel Structures Painting Council
MPI	Magnetic Particle Inspection
DP	Dye Penetrant

CONTENTS

1.0	SCOPE	4
2.0	REFERENCE DOCUMENTS.....	4
3.0	MATERIALS	5
4.0	DESIGN AND CONSTRUCTION REQUIREMENTS	6
5.0	INSPECTION AND TESTS	10
6.0	TEST CERTIFICATES.....	12
7.0	PAINTING	12
8.0	MARKING & SHIPMENT	13
9.0	SPARES AND ACCESSORIES.....	13
10.0	DOCUMENTATION.....	13

1.0 **SCOPE**

This Specification covers the minimum requirements for design, manufacture, testing and supply of carbon steel plug valves of size DN 50 mm (2") and above and ANSI pressure rating Class 150# thru 900# for use in onshore pipeline systems handling non-sour hydrocarbons in liquid or gaseous phase including Liquefied Petroleum Gas (LPG).

2.0 **REFERENCE DOCUMENTS**

- 2.1 All valves shall be manufactured and supplied in accordance with the American Petroleum Institute (API) Specification 6D, Latest Edition with additions and modifications as indicated in the following sections of this specification.
- 2.2 Reference has also been made in this specification to the latest edition (edition enforce at the time of issue of enquiry unless specified otherwise) of the following Codes, Standards and Specification.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

B31.3	:	Process Piping.
B31.4	:	Pipeline Transportation System for Liquid Hydrocarbon & Other Liquids.
B 31.8	:	Gas Transmission and Distribution Piping Systems.
B16.5	:	Pipe Flanges and Flanged Fittings.
B16.10	:	Face to Face and End to End Dimensions of Valves.
B 16.25	:	Butt Welding Ends.
B 16.34	:	Valves-Flanged, Threaded and Welding Ends.
B 16.47	:	Large Diameter Steel Flanges.
Section VIII	:	Boiler and Pressure Vessel Code - Rules for Construction of Pressure Vessels.
Section IX	:	Welding and Brazing Qualifications.

AMERICAN PETROLEUM INSTITUTE (API)

1104	:	Specification for Welding Pipelines and Related Facilities.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

A370	:	Standard Test Methods and Definitions for Mechanical Testing of Steel Products.

B 733 : Auto catalytic (Electroless) Nickel - Phosphorus Coatings on Metal.

MANUFACTURERS STANDARDIZATION SOCIETY (MSS)

SP-6 : Standard Finishes for Contact Faces of Pipe Flanges and Connecting – End Flanges of Valves and Fittings.

SP-44 : Steel Pipeline Flanges.

STEEL STRUCTURES PAINTING COUNCIL (SSPC)

VIS-I : Visual Standard.

2.3 In case of conflict between the requirements of this specification, API 6D and the Codes, Standards and Specifications referred in clause 2.2 above, the requirements of this specification shall govern.

Order of precedence shall be as follows:

- Data Sheets
- This Specification
- API 6D Specification
- Other Referred Codes & Standards
- Manufacturer's Standard

3.0 MATERIALS

3.1 The Material for Construction of major components of the Plug valves shall be as indicated in Valve Data Sheet. Other components shall be as per Manufacturer's standard (suitable for the service conditions indicated in the Valve Data Sheet) and shall be subject to approval by Company.

All process-wetted parts, metallic and non-metallic, and lubricants shall be suitable for the service specified by the Company. Manufacturer shall confirm that all wetted parts are suitable for treated water/ seawater environment, which may be used during field testing.

3.2 Carbon steel used in the manufacture of valves shall be fully killed.

3.3 The carbon equivalent (CE) of valve end connections which are subject to further field welding by Company shall not exceed 0.45 on check analysis for each heat of steel used, as calculated by the following formula:

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

3.4 CHARPY V-NOTCH TEST REQUIREMENTS

3.4.1 For valves specified to be used for Gas service or LPG service, Charpy V-notch test, on each heat of base material shall be conducted as per API 6D, for all pressure containing parts such as body,

end flanges and welding ends as well as bolting material for pressure containing parts. Unless specified otherwise, the Charpy Impact test shall be conducted at 0°C or minimum design temperature indicated in valve data sheet / MR, whichever is lower. Test procedure shall conform to ASTM A 370. The average absorbed energy value of three full sized specimens shall be 27 J. The minimum impact energy value of any one specimen of the three specimens analyzed as above shall not be less than 22 J.

- 3.4.2 When Low Temperature Carbon Steel (LTCS) materials are specified in Valve Data Sheet or offered by Manufacturer, the Charpy V-notch test requirements of applicable material standard shall be complied with.

3.5 HARDNESS TEST REQUIREMENTS

For Valves specified to be used for Gas service or LPG service, Hardness test shall be carried out as per ASTM A 370 for each method of manufacture and each heat of steel used in the manufacture of valves. A full thickness cross section shall be taken for this purpose and the maximum hardness of the materials of valve components such as base material of body and principal parts of the valve such as plug, stem, etc shall not exceed 248 HV₁₀.

3.6 ELECTROLESS PLATING REQUIREMENTS

For all such valves where Carbon Steel is used as plug material, the plug shall have 75 micrometers (0.003 inches) thick Electroless Nickel Plating (ENP) as per ASTM B 733 with following classification:

- SC2, Type II, Class 2.

The hardness of plating shall be minimum 50 RC.

Manufacturer shall ensure that the adhesive strength of plating is sufficient so as to prevent peeling of plating during operation of the valve.

4.0 DESIGN AND CONSTRUCTION REQUIREMENTS

4.1 GENERAL

Valve design shall meet the requirements of API Specification 6D and shall be suitable for the service conditions indicated in the Valve Data Sheet. The valve body and other pressure containing parts shall be designed in compliance with ASME Boiler & Pressure Vessel Code, Section VIII, Div1. Allowable stress requirements shall comply the provisions of ASME B31.3. Also corrosion allowance indicated in Valve Data Sheet shall be considered in valve design. However, the minimum wall thickness shall not be less than the minimum requirement of ASME B16.34. The manufacturer shall have valid license to use API monogram on valves manufactured as per API 6D.

All process-wetted parts, metallic and non-metallic, shall be suitable for the fluids and service specified by the Purchaser

4.2 VALVE PATTERN

Valve pattern area shall be as specified in the following table:-

ANSI Pressure Rating	SIZE RANGE, DN MM (INCH)	PATTERN
Class 150 #	50-100 (2- 4)	Short
	150-300 (6 – 12)	Regular
	350(14) & above	Venturi
Class 300 #	50 -100(2 – 4)	Short
	150 - 250 (6 -10)	Regular
	300 (12) & above	Venturi
Class 600 #	50 - 250 (2 – 10)	Regular
	300 (12) & above	Venturi
Class 900 #	50 - 250 (2 – 10)	Regular
	300 (12) & above	Venturi

4.3 PLUG DESIGN

The valves shall have an inherent feature to ensure that under line pressure cannot cause taper locking of plug/ plug movement in to the taper, i.e. valves shall be of “Pressure-Balanced” design type.

4.4 Cover shall be bolted to the valve body and screwed connections are not acceptable.

4.5 Soft seats to achieve a seal between plug and body are not permitted.

4.6 SEALANT INJECTION REQUIREMENT

All valves shall have the provision for secondary sealant injection under full line pressure for seat and stem seals. All sealant injection connection shall be provided with an internal non-return valve. Valve design shall have a provision (e.g. Ball Type Check Valve/ Needle Valve) to replace the sealant injector fitting under full line pressure. Location and arrangement of sealant injection points shall be as per Fig - 4.6. Valves shall have vent and drain connections as per API 6D.

4.7 Valves shall be designed to withstand a sustained internal vacuum of at least 1 (one) milli-bar in both open and closed positions.

4.8 Valve design shall ensure repair of gland packing under full line pressure.

4.9 VALVE ENDS

a. Valve ends shall be either flanged/ or butt welded or one end flanged and one end butt welded as indicated in the Valve Data Sheet. Flanges of the flanged end cast/ forged body valves shall be integrally cast/ forged with the body of the valve. Face to face/ end to end dimensions shall conform to API 6D. Face-to-face and end-to-end dimensions for valve sizes not specified in API 6D shall be in accordance with ASME B 16.10. Face-to-face and end-to-end

dimensions not shown in API 6D or in ASME B 16.10 shall be as per Manufacturer Standard and shall be subject to approval by Company.

- b. Flanged ends, if specified, shall have flanges as per ASME B16.5 for valve sizes up to DN 600 mm (24") excluding DN 550 mm (22") and as per MSS-SP-44/ ASME B 16.47 Series A for valve sizes DN 550 mm (22") and for DN 650 mm (26") and above. Flange face shall be either raised face or ring joint type (RTJ) as indicated in Valve Data Sheet. Flange face finish shall be serrated or smooth as indicated in Valve Data Sheet. In case of RTJ flanges, the groove hardness shall be minimum 140 BHN.
- c. Butt weld end preparation shall be as per ASME B 16.25. The thickness of the pipe to which the valve has to be welded shall be as indicated in the Valve Data Sheet. Valves shall be without transition pups. In case difference exists between thickness of welding ends of valve and connecting pipe, the welding ends of valve shall have bevel preparation as per ASME B31.4 or ASME B31.8 as applicable.

4.10 POSITION INDICATORS

Valve shall be provided with Plug position indicator and stops of rugged construction at the fully open and fully closed positions.

4.11 VALVE INSTALLATION

Valves shall be suitable for either buried or above ground installation as indicated in Valve Data Sheet, material Requisition & P&IDs

4.12 LOCKING DEVICES

When indicated in Material Requisition, valves shall have locking devices to lock the valve either in full open (LO) or full close (LC) positions. Locking devices shall be permanently attached to the valve operator and shall not interfere with operation of the valve.

- 4.13 Valves of size NPS 8" and larger shall be equipped with lifting lugs. Tapped holes and eye bolts shall not be used for lifting lugs.

4.14 STEM EXTENSIONS

When stem extension requirement is indicated in Valve Data Sheet, the valves shall have the following provisions.

- a. Valves provided with stem extension shall have water proof outer casing. Length of stem extension shall be as indicated in Valve Data Sheet. The length indicated corresponds to the distance between centerline of the valve opening and the top of mounting flange for valve operating device (gear operator/ power actuator as applicable).
- b. Seat sealant injection lines shall be extended and terminated adjacent to the valve operator by means of suitable piping anchored to the valve body/ stem housing. The pipe used shall be API 5L Gr. B/ ASTM A 106 Gr. B, with Sch 160. Fittings shall be ASTM A105/ ASTM A 234 Gr. WPB, Socket welded ANSI class 6000.
- c. Sealant injection lines shall be extended and terminated adjacent to the valve operator in manner as indicated in (b) above

- d. Stem extension and stem housing design shall be such that the complete assembly will form a rigid unit giving positive drive under all conditions with no-possibility of free movement between valve body, stem extension or its operator.
- e. Outer casing of stem extension shall have 3/8" or 1/2" NPT plugs at the top and bottom, for draining and filling with oil to prevent internal corrosion.

4.15 The valve stem shall be capable of withstanding the maximum operating torque required to operate the valve against the maximum differential pressure as per the appropriate class. The combined stress shall not exceed the maximum allowable stresses specified in the ASME Section VIII Div 1.

For Power Actuated Valves, the valve stem shall be designed for maximum output torque of the selected power actuator (including gear box, if any) at the valves stem

The valve stem shall have anti-blowout feature with antistatic device. The valve stem may be integral with plug or be a separate component.

4.16 OPERATING DEVICES

- a. Valves shall have a power actuator or manual operator as indicated in the Valve Data Sheet. In case of manual operator, valve sizes, $DN \leq 100$ mm (4") shall be wrench operated and valve sizes, $DN \geq 150$ mm (6") shall be gear operated. Each wrench operated valve shall be supplied with wrench. Valve design shall be such that damage due to malfunctioning of the operator or its controls will only occur in the operator gear train or power cylinder and that damaged parts can be replaced without the valve cover being removed.
- b. The power actuator shall be in accordance with the Company Specification issued for the purpose and as indicated in the Valve and Actuator Data Sheet. Operating time shall be as indicated in Valve Data Sheet. Valve operating time shall correspond to full close to full open/ full open to full close under maximum differential pressure corresponding to the valve rating. For actuated valves, the actuator's rated torque output shall be at least 1.25 times the break torque required to operate the valve under the maximum differential pressure corresponding to the valve class rating.
- c. For the manual operator of all valves, the diameter of the hand wheel or the length of operating wrench shall be such that under the maximum differential pressure, the total force required to operate the valve does not exceed 350N. Manufacturer shall also indicate the number of turns of hand wheel (In case of gear operators) required for operating the valve from full open to full close position. Operating device shall be designed for easy operation of valve under maximum differential pressure corresponding to the valve rating
- d. Direction of operation of hand wheel or wrench shall be in clock-wise direction while closing the valve. Hand wheels shall not have protruding spokes.
- e. Gear operators, when provided, shall have a self-locking provision and shall be fully encased in water proof/ splash proof enclosure and shall be filled with suitable grease.

4.17 WELDING

All welds shall be made by welders and welding procedures qualified in accordance with the provisions of ASME Section IX, except that only positions 5G and 2G shall qualify all-positional welding. The procedure qualification shall also include impact test and hardness test when

required as per Clause 3.4 and 3.5 of this specification and shall meet the requirements as specified therein.

4.18 REPAIR WELDING

Repair by welding is not permitted for fabricated and forged body valves. However repair by welding as per ASME B16.34 is permitted for cast body valves. Such repairs shall be carried out at casting supplier's care only. Repair shall be carried out before any heat treatment of casting is done. Repair welding procedure qualification shall also include impact test and hardness test when required as per Clause 3.4 and 3.5 of this specification and shall meet the requirements as specified therein.

- 4.19 The tolerance on internal diameter and out of roundness at the ends for welded ends valves shall be as per connected pipe specification as indicated in the Valve Data Sheet

5.0 INSPECTION AND TESTS

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

- 5.2 All valves shall be visually inspected. The internal and external surfaces of the valves shall be free from any strikes, gouges and other detrimental defects. The surfaces shall be thoroughly cleaned and free from dirt, rust and scales.

- 5.3 Dimensional check on all valves shall be carried out as per the Company approved drawings.

- 5.4 Chemical composition and mechanical properties shall be checked as per this specification and relevant material standards, for each heat of steel used.

- 5.5 Non-destructive examination of individual valve material and component consisting of but not limited to castings, forgings, plates and assembly welds shall be carried out by the Manufacturer.

- a. Valve castings of all valves shall be radiographically examined at the cover and body portion, seat location, flanged body ends and circumference of ends to be field welded as per ASME B 16.34. Procedure and acceptance criteria shall be as per ASME B 16.34. The extent of the radiography shall be as under:

PRESSURE CLASS RATING	VALVE SIZE	EXTENT OF RADIOGRAPHY
ANSI 150 # Class	All Sizes	Nil
ANSI 300 # Class	≤ DN 400 mm (16")	Nil
	≤ DN 450 mm (18")	100%
ANSI 600 # Class above	All Sizes	100%

All castings shall be wet magnetic particle inspected 100% of the internal surfaces. Method and acceptance shall, comply with ASME B 16.34.

b. All forgings shall be by ultrasonic method. Inspection procedure and acceptance shall comply with Annexure E of ASME B16.34.

5.6 Areas, which in Company's opinion cannot be inspected, by radiographic methods, shall be checked by ultrasonic or magnetic particle methods and acceptance criteria shall be as per ASME Sec. VIII (2007 edition), Division 1, Appendix 12 and Appendix 6 respectively.

5.7 Weld ends of all cast valves subject to welding in field shall be 100% radiographically examined and acceptance criteria shall be as per ASME B16.34.

After final machining, all bevel surfaces shall be inspected by dye penetrate or wet magnetic particle methods. All defects longer than 6.35 mm are rejected, as are the defects between 6.35 mm and 1.59 mm that are separated by a distance less than 50 times their greatest length. Rejectable defects must be removed. Weld repair of bevel surface is not permitted.

All finished wrought weld ends subject to welding in field shall be 100% ultrasonically tested for lamination type defects for a distance of 50 mm from the end. Laminations shall not be acceptable.

5.8 All valves shall be tested in compliance with the requirements of API 6D. The drain, vent and sealant lines shall be either included in the hydrostatic shell test or tested independently. Test pressure shall be held for duration mentioned in API 6D. Hydrostatic shell testing shall ensure that the whole of the shell is subjected to the test pressure. If necessary, the empty shell shall be pressure tested prior to assembly of the plug. The drain, vent and sealant lines shall be either included in the hydrostatic shell test or tested independently

5.9 No leakage is permissible during hydrostatic testing. After pressure testing and acceptance, valves shall be thoroughly drained and dried. Drying of valves internal shall be with compressed air and lint free rags. The internal surfaces shall be coated with suitable water dispelling anti-corrosion fluid. To ensure total coverage, the valve shall be placed in the half open position, filled with the fluid and drained.

5.10 A supplementary air seat test as per API 6D shall be carried out for all valves. No leakage is allowed. Test pressure shall be held for at least 15 minutes.

5.11 Manufacturer who intends bidding must submit at bid stage, certificate and report for successful fire safe tests for all types of valves in accordance with BS:6755 (Part-II)/ API 6FA, as applicable in Valve Data Sheet. Failure to comply with the requirement shall be a cause of rejection of the offer

5.12 Valves shall be subjected to an Operational Torque Test as per API 6D under hydraulic pressure equal to maximum differential pressure corresponding to the applicable ANSI class rating of valve. For manually operated valves, testing shall confirm that the torque required to operate the valve does not exceed 4.16 (c) of this specification.

5.13 Power actuated valves shall be tested after assembly of the valve and actuator, at the valve Manufacturer's works. At least five Open-Close-Open cycles without internal pressure and five Open-Close-Open cycles with maximum differential pressure corresponding to the valve rating shall be performed on the valve actuator assembly. The time for Full Open to Full Close shall be

recorded during testing. If required, the actuator shall be adjusted to ensure that the opening and closing time is within the limits stated in Valve Data Sheet.

Hand operator provided on the actuator shall also be checked after above cyclic testing, for satisfactory manual over-ride performance.

These tests shall be conducted on minimum one valve out of a lot of five (5) valves of the same size, rating and the actuator model/ type. In case, the tests do not meet the requirements, retesting/ rejection of the lot shall be decided by the Company's Inspector.

- 5.14** Company reserves the right to perform stage wise inspection and witness tests as indicated in clause 5.1 above at Manufacturer's works prior to shipment. Manufacturer shall give reasonable access and facilities required for inspection to the Company's Inspector. Company reserves the right to require additional testing at any time to confirm or further investigate a suspected fault. The cost incurred shall be to Manufacturer's account.

In no case shall any action of Company or his inspector shall relieve the Manufacturer of his responsibility for material, design, quality or operation of valves.

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

6.0 TEST CERTIFICATES

Manufacturer shall submit the following certificates in accordance with EN10204 3.2.

- a. Mill test certificates relevant to the chemical analysis and mechanical properties of the materials used for the valve construction as per the relevant standards.
- b. Report on heat treatment carried out.
- c. Test certificates of hydrostatic and pneumatic tests complete with records of timing and pressure of each test.
- d. Test reports of radiograph and ultrasonic inspection, MPI and DP Inspection.
- e. Test report on operation of valves conforming to clause 5.0 of this specification.
- f. All other test reports and certificates as required by API 6D and this specification.

The certificates shall be considered valid only when signed by Company's Inspector. Only those valves which have been certified by Company's Inspector shall be dispatched from Manufacturer's works.

7.0 PAINTING

Valve surface shall be thoroughly cleaned, freed from rust and grease and applied with sufficient coats of corrosion resistant paint. Surface preparation shall be carried out by shot blasting to SP-6 in accordance with "Steel Structures Painting Council - Visual Standard SSPC-VIS-1". For the valves to be installed underground, when indicated in Valve Data Sheet, the external surfaces of buried portion of the valve shall be painted with three coats of suitable coal tar epoxy resin with a minimum dry film thickness of 300 microns.

Manufacturer shall indicate the type of corrosion resistant paint used, in the drawings submitted for approval

8.0 MARKING & SHIPMENT

- 8.1** All valves shall be marked as per API 6D. The units of marking shall be metric except nominal diameter, which shall be in inches. Marking shall be done by die-stamping on the bonnet or on the housing. However, for buried valves the marking shall be done on the above ground portion of the stem housing only.
- 8.2** Valve ends shall be suitably protected to avoid any damage during transit. All threaded and machined surfaces subject to corrosion shall be well protected by a coat of grease or other suitable material. All valves shall be provided with suitable protectors for flange faces, securely attached to the valves. Bevel ends shall be protected with metallic or high impact plastic bevel protectors.
- 8.3** All sealant lines and other cavities of the valve shall be filled with sealant before shipment.
- 8.4** Packaging and shipping instructions shall be as per API 6D.
- 8.5** On packages, following shall be marked legibly with suitable marking ink:
- a. Order Number
 - b. Manufacturer's Name
 - c. Valve size and rating
 - d. Tag Number
 - e. Serial Number

9.0 SPARES AND ACCESSORIES

- 9.1** Manufacturer shall furnish list of recommended spares and accessories for valves required during start-up and commissioning and supply of such spares shall be included in the price quoted by Manufacturer.
- 9.2** Manufacturer shall furnish list of recommended spares and accessories required for two years of normal operation and maintenance of valves and price for such spares shall be quoted separately.

10.0 DOCUMENTATION

- 10.1.** The Manufacturer shall supply documentation in accordance with the Vendor Data Requirements List (VDRL) as attached with Purchase Order/ Material requisition. If not mentioned below minimum documentation shall be followed.

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

- a) General arrangement/ assembly drawings showing all features and relative positions & sizes of vents, drains, gear box & other external parts together with overall dimensions.

- b) Sectional drawing showing major parts with reference numbers and material specification.
- c) Reference list of similar plug valves manufactured and supplied in last five years, indicating all relevant details including project, year, client, location, size rating, service, etc.
- d) Torque curves for the power actuated valves along with break torque and maximum allowable stem torque. In addition, sizing criteria and torque calculations shall also be submitted for power actuated valves.
- e) Descriptive technical catalogues of the Manufacturer.
- f) Copy of valid API 6D certificate, wherever applicable.
- g) Details of support foot, including dimensions and distance from valve centre line to bottom of support foot.
- h) Quality Assurance Plan enclosed with this tender duly signed, stamped and accepted.

The drawings to be submitted alongwith the bid shall be in total compliance with the requirement of technical specification and data sheets of the valves with no exception & deviation.

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

- a) Design drawings and relevant calculations for pressure containing parts and other principle parts.
- b) Detailed sectional arrangement drawing showing all parts with reference numbers and materials specification.
- c) Assembly drawings with overall dimensions & clearances required and showing all features. Drawing shall also indicate the numbers of turns of handwheel (in case of gear operator) required for operating the valve from full open to full close position and the painting scheme.
- d) Welding, heat treatment, testing and quality control procedures.
- e) Details of corrosion resistant paint to be applied on the valves.
- f) Design calculation for pressure containing parts.

Manufacture of valves shall commence only after approval of the above documents. Once approval has been given by Purchaser, any change in design, material and method of manufacture shall be notified to the Purchaser, whose approval in writing for all changes shall be obtained before the valves are manufactured.

10.3. Within 30 days from the approval date, Manufacturer shall submit one reproducible and six copies of the approved drawings, documents and specification as listed in clause 10.2 of this specification.

10.4. Prior to shipment, Manufacturer shall submit one reproducible and six copies of following

t certificates as listed in clause 7.0 of this specification.

- b) Manual for installation, erection instructions, maintenance and operation instructions, including a list of recommended spares for the valves

10.5. All documents shall be in English Language.

11.0 GUARANTEE

11.1 Manufacturer shall guarantee that the materials and machining of valves and fittings comply with the requirements in this specification and in the Purchase Order.

11.2 Manufacturer is bound to replace or repair all valve parts which should result defective due to inadequate engineering or to the quality of materials and machining.

11.3 If valve defect or malfunctioning cannot be eliminated, Manufacturer shall replace the valve without delay.

11.4 Any defect occurring during the period of Guarantee shall be attended to by making all necessary modifications and repair of defective parts free of charge to the Purchaser as per the relevant clause of the bid document.

11.5 All expenses shall be to Manufacturer's account.

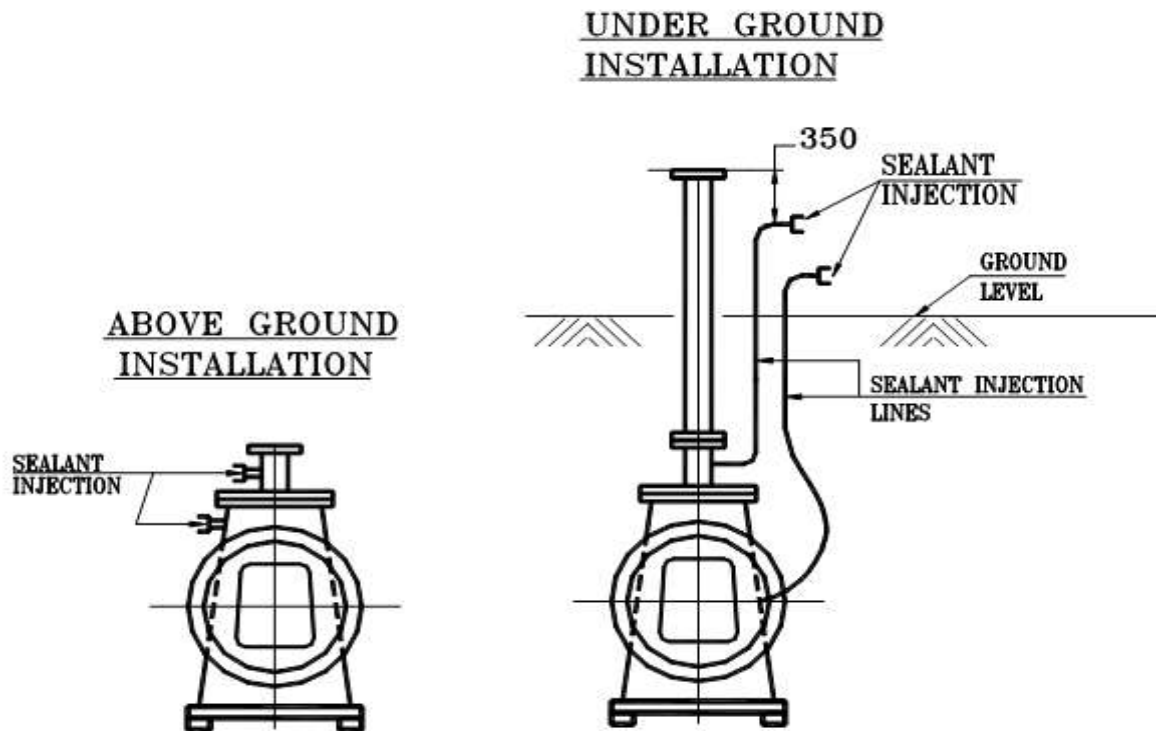


FIGURE- 4.6



ENERGISING QUALITY

VCS Quality Services Pvt. Ltd.

STANDARD SPECIFICATION FOR INSPECTION, FLUSHING & TESTING OF PIPING SYSTEM

VCS – SS – PP - 2501

01	27.01.2022	SR	MC	HK	GW
Rev. No	Date	Prepared By	Checked By	Approved By	Authorized By

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CONTROLLED COPY : If in soft and signed

REVISION RECORD						
Rev.	Revision Date	Prepared by	Checked by	Approved by	Authorized by	Revision Description
00	12.10.2019					
		MB	AK	AD	SK	
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		SR	MC	HK	GW	

ABBREVIATIONS:

ASME	American Society of Mechanical Engineers
ASTM	American Society of Testing of Materials
API	American Petroleum Institute
LPG	Liquefied Petroleum Gas

CONTENTS

1.0	SCOPE	4
2.0	REFERENCE CODES, STANDARDS AND SPECIFICATIONS	4
3.0	INSPECTION	4
4.0	FLUSHING	4
5.0	EXTENT OF TESTING.....	5

1.0 SCOPE

This specification covers the general requirements for inspection, flushing and testing of piping systems.

Flushing and testing of all piping systems shall be witnessed by the Company Representative.

2.0 REFERENCE CODES, STANDARDS AND SPECIFICATIONS

Reference has been made in this specification to the latest edition (edition in force at the time of floating the enquiry) of the following codes.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

B31.4 : Pipeline Transportation system for liquids
and Slurries
B31.8 : Gas Transmission and Distribution Piping
Systems. B31.3
: Process piping

3.0 INSPECTION

During various stages and after completion of fabrication and erection, the piping system shall be inspected by the Company representative to ensure that:

- Proper piping material has been used.
- Piping has been erected as per drawings and instructions.
- All supports have been installed correctly.
- Test preparations mentioned in this specification have been carried out.

4.0 FLUSHING

- Flushing of all lines shall be done before pressure testing.
- Flushing shall be done by 'fresh potable water' or by dry compressed air wherever water flushing is not desirable to clean the pipe of all dirt, debris or loose foreign material.
- Required pressure for water flushing shall meet the fire hydrant pressure or utility water pressure. For air flushing, the line/ system shall be pressurized by compressed air at the required pressure which shall be 50 psi maximum. The pressure shall then be released by quick opening of a valve, already in line or installed temporarily for this purpose. This procedure shall be repeated as many times as required till the inside of the pipe is fully cleaned.
- In line instruments like control valves, orifice plates, rotameters, safety valves and other instruments like thermowells which may interfere with flushing shall not be included in flushing circuit.
- The screens/ meshes shall be removed from all permanent strainers before flushing. Screens/ meshes shall be reinstalled after flushing but before testing.
- During flushing temporary strainers shall be retained. These shall be removed, cleaned and reinstalled after flushing, but, before testing.
- In case any equipment such as Filter, Scrubbers column, vessel etc. form part of

piping circuit during flushing, this shall be done with the approval of Company representative. However, equipments thus included in the circuit shall be completely drained and dried with compressed air after flushing is completed.

- During flushing discharged water/ air shall be drained to the place directed by the
- Company representative. If necessary, proper temporary drainage shall be provided by the contractor.
- Care shall be taken during flushing so as not to damage/ spoil work of other agencies. Precautions shall also be taken to prevent entry of water/ foreign matter into equipment's, electric motors, instruments, electrical installations etc. in the vicinity of lines being flushed.
- The contractor shall carry out all the activities required before, during and after the flushing operation, arising because of flushing requirements, such as but not limited to the following:
- Dropping of valves, specials, distance pieces, inline instruments and any other piping part before flushing. The flanges to be disengaged for this purpose shall be envisaged by the contractor and approved by the Company representative. These flanges shall be provided with temporary gaskets at the time of flushing.
- After flushing is completed and approved, the valve distance pieces, piping specials etc. shall be reinstalled by the contractor with permanent gaskets. However, flanges at equipment nozzles and other places where isolation is required during testing, only temporary gaskets shall be provided.

5.0 EXTENT OF TESTING

- With the exclusion of instrumentation, piping systems fabricated or assembled in the field shall be tested irrespective of whether or not they have been pressure tested prior to site welding or fabrication.
- To facilitate the testing of piping systems, vessels and other equipments may be included in the system with the prior approval of Company representative if the test pressure specified is equal to or less than that for the vessels and other equipments.
- Pumps, compressors and other rotary equipments shall not be subjected to field test pressure. Lines which are directly open to atmosphere such as vents, drains, safety valves discharge need not be tested, but all joints shall be visually inspected. Wherever necessary, such lines shall be tested by continuous flow of fluid to eliminate the possibility of blockage.
- However, such lines if provided with block valve shall be pressure tested up to the last block valve.
- Seats of all valves shall not be subjected to a pressure in excess of the maximum cold working pressure of the valve. Test pressure applied to valves shall not be greater than the manufacturer's recommendation nor less than that required by the applicable code. Where allowable seat pressure is less than test pressure, test shall be made through an open valve.

- Instruments in the system to be tested shall be excluded from the test by isolation or removals, unless approved otherwise by the Company representative. Restrictions which interfere with filling, venting, draining such as orifice plates etc. shall not be installed unless testing is complete.
- Control valves shall not be included in the test system. Where bypasses are provided test shall be performed through the bypass and/ or necessary spool shall be used in place of the control valve.
- Pressure gauges which are part of the finished system, but cannot withstand test pressure shall not be installed until the system has been tested. Where piping systems to be tested are directly connected at the battery limits to piping for which the responsibility-rests with other agencies, the piping to be tested shall be isolated from such piping by physical disconnection such as valve or blinds.

5.1 GENERAL REQUIREMENTS / TEST-PREPARATION FOR TESTING

- Testing shall be carried out with permanent gaskets installed unless specified otherwise or instructed by the Company representative.
- No pressure test shall be carried out against closed valve unless approved by the Company representative.
- The Company representative shall be notified in advance by the Contractor, of the testing sequence and programme, to enable him to be present for witnessing the test.
- Before testing, all piping shall be cleaned by flushing to make it free from dirt, loose scale, debris and other loose foreign materials.
- All piping systems to be hydrostatically tested shall be vented at the high points and the systems purged of air before the test pressure is applied.
- Wherever in the line any void exists due to any reasons, like absence of control valves, safety valves, check valves etc. it shall be fitted with temporary spools.
- All joints welded, screwed or flanged shall be left exposed for examination during the test. Before pressurizing the lines, each weld joint shall be cleaned by wire brush to free it from -rust and any other foreign matter.
- Where a system is to be isolated at a pair of companion flanges, a blank shall be inserted between the companion flanges. Minimum thickness of the blank shall be designed in accordance with applicable design code.
- Open ends of piping system where blanks cannot be used, such as pumps, compressors, turbines or wherever equipment or pipe spools have been recovered or disconnected prior to hydrostatic testing, shall be blinded off by using standard blind flanges of same rating as the piping system being tested.
- Pressure gauges used in testing shall be installed as close as possible to the lowest point in the piping system to be tested, to avoid overstressing of any of the lower portions of the system.

- For longer lines and vertical lines, two or more pressure gauges shall be installed at locations decided by the Company representative.
- For lines containing check valves any of the following alternatives shall be adopted for pressure testing:
 - Whenever possible pressurize up-stream side of valve.
 - Replace the valve by a temporary spool and reinstall the valve after testing.
- Provide blind on valve flanges and test the upstream and downstream of the line separately and remove the blind after testing. At these flanges, temporary gaskets shall be provided during testing and shall be replaced by-permanent gaskets subsequently.
- For check valves in lines 1 1/2" and below flapper or seat shall be removed during testing (if possible). After completion of testing the flapper/ seat shall be refitted.
- Gas lines when hydrostatically tested shall be provided with additional temporary supports during testing as directed by the Company representative.
- Piping which is spring or counter-weight supported shall be temporarily supported, where the weight of the fluid would overload the support. Retaining pins for spring supports shall be removed only after testing is completed and test fluid is completely drained.
- When testing any piping system, air or steam of approximately 2 kg/ cm²g may be used as preliminary test to detect missing gaskets etc. as this avoids the necessity of draining the line to make repairs. However, steam shall not be used for this purpose, if the steam temperature is more than the design temperature of the line.
- For jacketed pipes testing of core pipes shall be done on individual pieces where the pipe is continuously jacketed, before it is jacketed. The outer jacket shall be tested separately as a system. For piping with discontinuous jacketing, the core pipe and the jacket shall be tested as separate continuous systems.

5.2 TESTING MEDIA, TEST PRESSURE AND TEST PRESSURE GAUGES

5.2.1 TESTING MEDIA

In general, all pressure tests shall be hydrostatic using iron free water, which is clean and free of silt. Maximum chloride content in water for hydrostatic testing for SS piping shall be 15-20 ppm.

Air shall be used for testing only if water would cause corrosion of the system or overloading of supports etc. in special cases as directed by Company representative.

If operating fluid in the line is much lighter than testing fluid, the additional weight of testing fluid may render piping supports (as designed) inadequate. This will call for additional temporary supports. The typical examples are flare and vapour lines. It is preferable that hydrostatic testing is avoided in such systems and instead pneumatic testing may be specified.

Where air/ water tests are undesirable, substitute fluids such as gas oil, kerosene, methanol etc. shall be used as the testing medium, with due consideration to the hazards

involved. These test fluids shall be specified in the line list given to the contractor.

5.2.2 TEST PRESSURE

The hydrostatic/ pneumatic test. pressure shall be as indicated in the line list or as per the instruction of Company representative.

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

- Test pressure required as per line list. Maximum allowable pressure for the material of construction of piping.
- Depending upon the above-requirements and based on construction progress, maximum length of piping shall be included in each test.

5.2.3 TEST PRESSURE GAUGE

All gauges used for field; testing shall have suitable range so that the test pressure of various systems falls in 35% to 65% of gauge scale range. Pressure gage dial shall be minimum of 150 mm. Size of Bourdon shall not be less than 75% of nominal diameter of dial range. Gauge shall be of a good quality and in first class working condition.

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

5.3 TESTING PROCEDURE

5.3.1 HYDROSTATIC TEST

All vents and other connections used as vents shall be left open while filling the line with test fluid for complete removal of air. In all lines for pressurizing and depressurizing the system, temporary isolation valves shall be provided if valved vents, drains do not exist in the system.

Pressure shall be applied only after the system/ line is ready and approved by the Company representative.

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

A pressure gauge shall be provided at the pump discharge for guidance in bringing the system to the required pressure.

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

Test pressure shall be maintained for a sufficient length of time to permit thorough inspection of all joints for leakage or signs of failure. Any joint found leaking during a

pressure test shall be retested to the specified pressure after repair. Test period shall be maintained for a minimum of four hours.

The pump and the piping system to be tested are to be provided with separate pressure indicating test gauges.

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

5.3.2 PNEUMATIC TEST

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

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

All other details shall be same as per hydrostatic testing procedure (specified above).

5.4 COMPLETION OF TESTING

After the hydrostatic test has been completed, pressure shall be released by opening the vents, in a manner and at a rate so as not to endanger personnel or damage equipments. All vents shall be opened before the system is to be drained and shall remain open till all draining is complete, so as to prevent formation of vacuum in the system. After draining, lines/ systems shall be dried by air. In services like dry air, ethylene etc., small traces of water can cause problem. For such lines hot air drying is to be done after hydro test.

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

Pressure test shall be considered complete only after approved by the Company representative. Defects, if any, noticed during testing shall be rectified immediately and retesting of the system/ line shall be done by the contractor at his cost.

5.5 TEST RECORDS

Records in triplicate shall be prepared and submitted by the contractor for each piping system, for the pressure test done in the Performa provided/ approved by the Company representative.



ENERGISING QUALITY

VCS QUALITY SERVICES PVT. LTD.

STANDARD SPECIFICATION FOR PAINTING

VCS – SS – PP - 2502

					
04	30.06.2022	RP	MC	HK	GW
03	28.01.2020	MB	AK	AD	SK
02	19.02.2018	ADE	RNR	AD	SK
01	15.05.2017	ADE	RNR	AD	SK
Rev. No	Date	Prepared By	Checked By	Approved By	Authorized By

UNCONTROLLED COPY : If printed

CONTROLLED COPY : If in soft and signed

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CONTENTS

1.0	GENERAL	2
2.0	CODES & STANDARDS	4
3.0	CONDITIONS OF DELIVERY	6
4.0	COMPOSITION OF THE PAINT PRODUCTS USED	6
5.0	IDENTIFICATION	7
6.0	SURFACE PREPARATION STANDARDS	8
7.0	PREPARATION OF THE SURFACES	8
8.0	METALLISATION	16
9.0	CARRYING OUT THE PAINTWORK	16

1.0 **GENERAL**

- 1.1 This technical specification shall be applicable for the work covered by the contract, and without prejudice to the provisions of various codes of practice, standard specifications etc. It is understood that contractor shall carry out the work in all respects with the best quality of materials and workmanship and in accordance with the best engineering practice and instructions of Engineer-In-Charge.

Wherever it is stated in the specification that a specific material is to be supplied or a specific work is to be done, it shall be deemed that the same shall be supplied or carried out by the contractor. Any deviation from this standard without written deviation permit from appropriate authority will result in rejection of job.

1.2 SCOPE

- 1.2.1 Scope of work covered in the specification shall include, without being limited to the following.

- 1.2.2 This specification defines the requirements for surface preparation, selection and application of primers and paints on external surfaces of equipment, vessels, machinery, piping, ducts, steel structures, external & internal protection of storage tanks for all services, MS Chimney without Refractory lining and Flare lines etc. The items listed in the heading of tables of paint systems is indicative only, however, the contractor is fully responsible for carrying out all the necessary painting, coating and lining on external and internal surfaces as per the tender requirement.

1.2.3 Extent of Work

- 1.2.3.1 The following surfaces and materials shall require shop, pre-erection and field painting:

- a. All un-insulated C.S. & A.S. equipment like columns, vessels, drums, storage tanks (both external & internal surfaces), heat exchangers, pumps, compressors, electrical panels and motors etc.
- b. All un-insulated carbon and low alloy piping, fittings and valves (including painting of identification marks), furnace ducts and stacks.
- c. All items contained in a package unit as necessary.
- d. All structural steel work, pipe, structural steel supports, walkways, handrails, ladders, platforms etc.
- e. Flare lines, external surfaces of MS chimney with or without refractory lining and internal surfaces of MS chimney without refractory lining.

- f. Identification colour bands on all piping as required including insulated aluminium clad, galvanised, SS and nonferrous piping.
- g. Identification lettering/numbering on all painted surfaces of equipment/piping insulated aluminium clad, galvanized, SS and non-ferrous piping.
- h. Marking / identification signs on painted surfaces of equipment/piping including hazardous service.
- i. Supply of all primers, paints and all other materials required for painting (other than Owner supplied materials)
- j. Over insulation surface of equipments and pipes wherever required.
- k. Painting under insulation for carbon steel, alloy steel and stainless steel as specified.
- l. Painting of pre-erection/fabrication and Shop primer.
- m. Repair work of damaged pre-erection/fabrication and shop primer and weld joints in the field/site before and after erection as required.
- n. All CS Piping, equipments, storage tanks and internal surfaces of RCC tanks in ETP plant.

1.2.3.2 The following surfaces and materials shall not require painting in general. However, if there is any specific requirement by the owner, the same shall be painted as per the relevant specifications:

- a. Un-insulated austenitic stainless steel.
- b. Plastic and/or plastic coated materials
- c. Non-ferrous materials like aluminum.

1.2.4 Documents

1.2.4.1 The contractor shall perform the work in accordance with the following documents issued to him for execution of work.

- a. Bill of quantities for piping, equipment, machinery and structures etc.
- b. Piping Line List.
- e. Painting specifications including special civil defence requirements.

1.2.5 Unless otherwise instructed, final painting on pre-erection/ shop primed pipes and equipments shall be painted in the field, only after the mechanical completion, testing on systems are completed as well as after completion of steam purging wherever required.

- 1.2.6 Changes and deviations required for any specific job due to clients requirement or otherwise shall be referred to VCS for deviation permit.

2.0 **CODES & STANDARDS**

Without prejudice to the specifications of the contract, the following codes and standards shall be followed for the work covered by this contract.

IS: 5 Colors for ready mixed paints and enamels.

RAL DUTCH International Standard for colour shade (Dutch Standard)

IS: 101 Methods of test for ready mixed paints and enamels,

IS: 161 Heat resistant paints.

IS: 2074 Specifications for ready mixed paint, red oxide zinc chrome priming.

IS: 2379 Color code for identification of pipelines.

IS: 2932 Specification for enamel, synthetic, exterior (a) undercoating. (b) Finishing.

3.0 **CONDITIONS OF DELIVERY**

Packaging

Every recipient will be fitted with a hermetically-sealed lid with an opening that is sufficiently large to allow the contents to be stirred: the outside and inside are protected against oxidation, and, the lid, are marked with a strip of color identical to the contents.

4.0 **COMPOSITION OF THE PAINT PRODUCTS USED**

a) Quality

The composition and quality of the products may not differ from batch to batch. A batch is all of the products of a specified manufacture. If the analyses of products bring to light that the composition does not conform to the specifications of the paint manufacturer, the OWNER may refuse to use this batch of products. The paint products must comply with the following conditions

- They must have the viscosity necessary for the described use and the established condition: use of the brush - paint roller (spray gun only for special cases and in the workshop)

b) Quality control - Sampling

While the works are in progress on the construction site, the OWNER may carry out sampling on the paint being used for the purpose of checking conformity. The paint products must be made available free of charge to the laboratory or the approved supervisory body in sufficient quantities so that all the tests can be carried out on the same batch.

If analyses reveal a non-conformity in the composition of the products used (tolerance of ± 3 % of the dosage of every component), the OWNER may refuse application of the product under consideration, halt the work and have the nonconforming product already applied removed.

Before proceeding the work, a product that does conform will be required. The only Purpose of the analysis is to reveal any nonconformity of the composition of the products. Their purpose is therefore not to assess the quality of the different components. The analyses concerned are not acceptance tests of the products supplied and in no way affect the obligations of the contractor specified in the contract towards the OWNER.

5.0 **IDENTIFICATION**

Every recipient will bear the following information:

- Name of the manufacturer
- Date and number of manufactures
- Name of the product type
- Batch no
- Net weight of the produced or the contents of the recipient
- Date of the expiry.

At the time of delivery, this packaging must bear labels in conformity with the legal stipulations in force.

Leaving the site after work

After completion of a job a general clean-up shall be carried out by the Contractor to remove all debris, materials or irregularities that his work has brought to the site so that it is left tidy:

The restoration work includes among other things:

- The removal of abrasives.
- The removal of the different protective coverings.

- The Contractor will make the required repairs to any damage after refitting the supports.
- The removal of paint and cleaning of the stains on the floor.

6.0 **SURFACE PREPARATION STANDARDS**

Following latest edition of standards shall be followed for surface preparations:

1. Swedish Standard Institution- SIS-05 5900-1967/ISO 8501-1
2. Steel Structures Painting Council, U.S.A. (Surface Preparation Specifications (SSPC-SP)
3. British Standards Institution (Surface Finish of Blast-cleaned for Painting) BS-4232.
4. National Association of Corrosion Engineers. U.S.A. (NACE).
5. IS-1477-1971 (Part-1) - Code of Practice for Painting of Ferrous metals in Buildings. (Part 1, Pre-treatment)
 - a) The contractor shall arrange, at his own cost to keep a set of latest edition of above standards and codes at site.
 - b) The paint manufacturer's instruction shall be followed as far as practicable at all times. Particular attention shall be paid to the following:
 - Proper storage to avoid exposure as well as extremes of temperature.
 - Surface preparation prior to painting.
 - Mixing and thinning.
 - Application of paints and the recommended limit on time intervals between coats.
 - c) Any painting work (including surface preparation) on piping or equipment shall be commenced only after the system tests have been completed and clearance for taking up painting work is given by the OWNER, who may, however, at his discretion authorize in writing, the taking up of surface preparation or painting work in any specific location, even prior to completion of system test.

7.0 **PREPARATION OF THE SURFACES**

7.1 General Specifications

The cases that occur in practice on building sites, with regard to painted surfaces, can be broken down as follows:

- Material of which the oxide content disappears by natural oxidation.
- Material that has already been covered with a layer of paint in the workshop.
- Material that is covered with old paint layers that show different degrees of weathering.

Good preparation of surface is the best guarantee for good anti-corrosion protection.

Paintwork may never begin until the surface to be treated is dry and is independent of the base coat and cleared of dirt, dust, rust, scale, grease, salt attack, cement powder, cement mud-scale, sand, oil, etc.

Based on the environmental conditions of coastal and saline nature, the Painting specification for station pipes defines the complete requirements like:

- Surface preparation standards like NACE etc.
- Sand blasting process
- Color Codes for piping
- Paint materials types and their DFT measurement.
- Selection and application of paints on external surfaces.

The pipeline passes through the coastal and marine environment, the **Table-4** of this specification to be followed for the painting works.

The method of preparation of the surface will be implemented in accordance with the preparation methods described below:

- Bright blast-cleaning
- Mechanical or Power tool cleaning
- Manual or hand tool cleaning

The Contractor should have the required material at his disposal to clean the surfaces to be coated thoroughly in accordance with the preparation methods regardless of the form or the condition of such surfaces. The cleaning devices that might be damaged during the surface preparation shall be screened off by the Contractor.

7.2 Air blast cleaning with abrasive

Before beginning cleaning by blasting, the person carrying out the work will take the following measures:

- Clear the steel surface of oil and/or grease;
- Ensure that each flange collar (section where the sealing is applied) is properly screened off against the blasting and the subsequent works;
- Check that no blasting grains can act into the pipes during this process. Any openings not sealed off must be screened off;

- Where there are valves, regulators and other devices, the manufacturer's identification plate will be dismantled so that all surfaces can be treated. The plate will then be put back again.
- Screen off all non-metal structures such as rubber where there is a filter;
- With valves, operators and other devices, care should be taken to ensure that no metal filings or paint get into the apparatus:
- The OWNER reserves the right to carry out part or all of these works himself.

To prevent rust forming quickly as the result of humidity on the blasted surface, cleaning by blasting may only be carried out when the temperature of the steel surface is at least 3°C higher than the dew-point of the ambient air.

Blasting may not be carried out if the relative degree of humidity exceeds 80%. The choice of the type of blasting medium used depends on local circumstances such as the possible presence of gas and the material to be blasted.

The abrasive to be used must conform to the local law i.e. it may contain no carbon and less than 1% free silicon dioxide. The Sa 3 will always be requested and must at least reach Sa 2½ during the initial stage of the paintwork. For blasting followed by metallization, the surface preparation degree to be achieved is always Sa 3. The degree of cleanliness to be obtained will be inspected in accordance with the Swedish standard SVENSK STANDARD ISO 8501-1-1988 SIS 05.5900.

- Sa 3: surface blasted down to the bare metal; when the surface is inspected with a magnifying glass, scale, rust and foreign bodies must be completely removed and it should be possible to raise a metallic -shine on the treated surface.
- Sa 2 1/2: blasted very carefully. Scale, rust and foreign bodies must be removed in such a way that anything left behind will only be visible as nuances (shading) or strips.

The blast-cleaning will be carried out by means of compressed air free of water and oil.

After the blasting and before painting, the surface should be completely cleaned of blasting material and so forth with a soft brush, a dry cloth or dry compressed air.

7.3 Mechanical or Power tool cleaning

If sandblasting is not permitted or if the metal structures are not easily accessible for blasting or blasting for one reason or other is technically unfeasible, mechanical de rusting can be used instead. With mechanical cleaning by means of chipping, rotating steel brushes and sanding discs, a degree of cleanliness St. 3 should be reached.

St 3 : removal of the old paint layers of which the adhesion leaves something to be desired and/or of which the paint layer no longer fulfills the requirements.

If parts are present that are so corroded that St 3 is difficult to achieve, this should be notified to the OWNER representative prior to the start of the works.

N.B:

St. 3 : means removal of every old paint layer. Retouching means local polishing with St. 3 or Sa 3 followed by application of the desired painting system.

After mechanical cleaning, the surface should be made dust-free with a cloth or a soft brush, washed with an organic solvent and thoroughly dried off with a dry cloth (e.g. with 1.1.1. Trichloroethane such as Solvethane, Chloroethene).

7.4 Manual or Hand tool cleaning

Manual derusting with the aid of scrapers, steel brushes, sandpaper etc. shall only be permitted in exceptional cases for local repairs. Any deviation there from must be requested from the OWNER/ OWNER 's Representative.

With manual derusting, a surface preparation degree St 3 must be obtained. The length of the handles of the equipment used may not exceed 50 cm.

7.5 Preparation of a surface covered with a layer of paint in the workshop.

This layer is in general applied by the manufacturer, for example, on valves, regulators etc. Layers of this kind will be checked for their proper adhesion in accordance with ASTM D 3359, method A (Standard Test Method for measuring adhesion by tape test). The adhesion should be at least.

If the paint layer shows less adhesion or is incompatible with the rest of the system it should be completely removed. If the paint layer is not removed, the Contractor accepts it in the state in which the coating is found and the guarantee remains in force. The adhesion does not have to be examined if system 63 has already been applied in the workshop on behalf of the OWNER.

The Contractor, who must provide for the protection on the construction site, must therefore obtain the information regarding the treatment of the surface and the quality of the paint that was used and must, moreover, examine the adhesion of the layer on the construction site, the percentage of damage and weathering as well as the value of the preparation of the surface in the workshop together with the thickness thereof that must be supplemented if necessary.

a) Galvanized surface

Galvanized surfaces, both old and new will be carefully roughened up. Every foreign body (concrete splatters, chalk marks, grease and oil stains, etc.) will be removed. Thereafter, rub the surfaces with abundant water and, if necessary, with cleaning products.

To this end, nylon brushes will be used for every kind of dirt as well as for removing zinc salt residue. Thereafter, the surfaces will be treated in accordance with system 21. Where the zinc layer is lacking, it will be derusted manually to a degree of cleanliness St 3, after which a primer coat will be applied in accordance with system 22.

b) Metallized surfaces treated with an impregnation layer

- Degrease with the desired degreasing product:
- Clean under high pressure or with a product prescribed by the paint supplier.

If the paint layer adheres well and is applied on a clean base, the painting system described may be continued. If the percentage of damage and weathering does not exceed 5 % m. retouching may be considered. These partial repairs will be carried out.

If on the other hand, the percentage of damage does exceed 5 %/m or if the layer applied in the workshop comes loose the Contractor must draw the attention of the OWNER to this and carry out the complete application system.

7.6 Preparation of surfaces covered with earlier paint layers that show different degrees of weathering.

If the surfaces do not show deep weathering limited to the spread of rust by small pitted areas or non-penetrative rust in spots, it will very often be sufficient to clean the surfaces with abrasives or with an abrasive disc, then to rub them down with steel wool, remove the dust and wash off. If thick rust appears, in spots, scale rust and active rust canker, this should be removed with needle hammers or stripped away directly by blasting, removing the dust and washing off.

7.7 Preparation of concrete or cement plaster surfaces

Remove unsound paint layers and loose components with scrapers, blades or rotating steel brushes. Thoroughly clean the entire surface with water containing ammonia. Thoroughly remove moss, algae and fungal growths. Where these growths have been removed, treat the area with a fungicide in accordance with the instructions for use.

Once the entire area is completely dry, brush off the dead residue of moss, algae and fungus with a hard brush. In the case of reinforcement steel that has been laid bare, remove as rust, dust and grease as possible and treat with a primer coat. When painting concrete surfaces, they must first be checked for cracks. Cracks larger than 0.3 mm must be repaired with an appropriate system in accordance with the type and extent of the repairs (e.g. injection with epoxy mortar). Repair damage such as cracks and bursts to concrete parts with a two-component mortar or preferably with micro-mortars. Finally check the alkalinity of the surface with the aid of litmus paper and neutralize it if necessary.

7.8 Use of solvents

It is sometimes necessary to use solvents when the surfaces to be painted are streaked with grease or oil. In this case a suitable organic solvent should be applied. The operation should be carried out with the aid of clean brushes or rags and clean solvent.

All the legal specifications in connection with solvents etc. must be adhered to. The OWNER/OWNER's Representative will be informed in advance of any toxicity or flammability. All measures must be taken to prevent any risk of fire and to nick out any possibility of poisoning (ventilation). The Contractor will provide drip collectors to keep the environment free of pollution.

7.9 Condition of the metal after stripping

The Contractor must call in a representative of the OWNER/OWNER's representative or of the Approved supervisory Body responsible for checking the condition of the metal during stripping and informing the OWNER/OWNER's representative immediately of any damage that he might have noticed.

- Deep corrosion of the plates - rivets - bolts
- Faulty welding
- Fittings that appear to be dangerous because of their age.

7.10 Removing coating from surface pipelines

The Contractor must have the equipment necessary for the removal of asphalt from the pipe without damaging the latter (scratching, impact, etc.). The Contractor undertakes to carry out the work in accordance with an approved procedure.

TABLE-1 (FOR CLAUSE 7.0)
SURFACE PREPARATION STANDARDS

SL. NO.	DESCRIPTION	VARIOUS INTERNATIONAL STANDARDS (EQUIVALENT)			REMARKS
		ISO 8501-1/ SIS-05 59 00	SSPC-SP, USA	NACE, USA	
1	Manual or hand tool cleaning Removal of loose rust, loose mill scale and loose paint, chipping, scrapping, standing and wire brushing. Surface should have a faint metallic sheen	ST.2	SSPC-SP-2	-	This method is applied when the surface is exposed to normal atmospheric conditions when other methods cannot be adopted and also for spot cleaning during maintenance painting.
2	Mechanical or power tool cleaning Removal of loose rust loose mill scale and loose paint to degree specified by power tool chipping, de-scaling, sanding, wire brushing and grinding, after removal of dust, surface should have a pronounced metallic sheen.	ST.3	SSPC-SP-3	-	
3	Dry abrasive Blast cleaning There are four common grades of blast cleaning				

3.1	White metal Blast cleaning to white metal cleanliness. Removal of all visible rust. Mill scale, paint & foreign matter 100% cleanliness with desired surface profile.	SA 3	SSPC-SP-5	NACE#1	Where extremely clean surface can be expected for prolong life of paint system.
3.2	Near white metal Blast cleaning to near white metal cleanliness, until at least 95% of each element of surface area is free of all visible residues with desired surface profile.	SA 2½	SSPC-SP-10	NACE#2	The minimum requirement for chemically resistant paint systems such as epoxy, vinyl, polyurethane based and inorganic zinc silicate paints, also for conventional paint systems used under fairly corrosive conditions to obtain desired life of paint system.
3.3	Commercial Blast Blast cleaning until at least two-third of each element of surface area is free of all visible residues with desired surface profile.	SA 2	SSPC-SP-6	NO.3	For steel required to be painted with conventional paints for exposure to mildly corrosive atmosphere for longer life of the paint systems.
3.4	Brush-off Blast Blast cleaning to white metal cleanliness, removal of all visible rust, mill scale, paint & foreign matter. Surface profile is not so important.	SA 1	SSPC-SP-7	NO.4	

8.0 **METALLISATION**

8.1 Applying the metallization

Metallization must be carried out in accordance with ISO 2063,

Metallization is carried out as rapidly as possible after blasting in order to limit corrosion of the pipes (max. 3 hours later). With metallization, a surface preparation degree Sa 3 is compulsory. The roughness of the blasted surfaces should be from 25 to 50µ R_{Max}.

- The metallizing is always carried out on dry parts in good weather conditions (maximum relative humidity 80 %);
- For metallization, a wire composed of 85 % zinc and 15 % aluminum with a minimum guaranteed degree of purity of 99.5 % is used (subject to other specifications). The application thereof is always carried out in accordance with the conditions of the manufacturer and may at all times be submitted to the OWNER's representative.
- The sealant should be applied maximum 3 hours alter metallization.
- The sealant must be thinned and applied as per the present specifications. A visual inspection whereby the sealant completely covers the metallization will suffice here.
- When evaluating the metallization, a negative deviation from the minimum coating thickness, to 80 µ for 20% of the measurements will be permitted.

9.0 **COATING PROCEDURE AND APPLICATION**

9.1 Conditions for carrying out paintwork

Painting may not be carried out in unsuitable conditions.

All preparatory work and painting may only be carried out in dry weather and at a minimum temperature of 10°C, except for special cases requested by the OWNER's Representative.

Unless otherwise stipulated in the specifications of the paint supplier, application of the paint is forbidden if it is forecast that the temperature will fall to below 0°C before the paint is dry. The temperature of the surface to be painted must be at least 3°C higher than the dew point of the ambient air. Application of the paint is also not permitted if there is a danger that the coat of paint will not be dry before dew or condensation sets in.

The work must be stopped:

- If the temperature of the surface to be painted is higher than that described by the supplier.
- In rain, snow, mist or fog or when the relative humidity is higher than 80 %.

Coats that have not yet dried and have been exposed to frost, mist, snow or rain and might thereby be damaged must be removed after drying and the surfaces must be repainted at the expense of the Contractor.

Working in direct sunlight or in hot weather must be avoided,

The first coat of paint must be applied maximum 3 hours after the preparation of the surface of the relative humidity of the air is between 50% and 80%. This time span may be increased to 6 hours if the relative humidity is less than 50%. In all cases, the preparation of the surface must exhibit degree Sa 3 and at the very least the appearance of degree Sa 2 ½ at the time of painting.

The coats of paint may only be applied on carefully cleaned surfaces that must be dry and free of grease and dust.

9.2 Special conditions

Painting may be carried out when the Contractor can be sure that the instructions of the paint supplier have been scrupulously followed with regard to the parameters in the following (non-exhaustive) list:

- Ambient temperature.
- Surface temperature.
- Relative humidity.
- Dew point.
- Drying times.

The Contractor must in this respect be able to produce the instructions for the paint on the site. The OWNER/CONSULTANT will guarantee 100% supervision in this regard during the execution of the work.

In addition, the paintwork may only be carried out to a minimum ambient temperature of 5°C and/or to a maximum relative degree of humidity of 85 %. Application of the paint is also not permitted if there is a danger that the coat of paint will not be dry before dew or condensation sets in.

10.0 PAINT MATERIAL

Manufacturers shall furnish the characteristics of all paints indicating the suitability for the required service conditions. Primer and finish coats shall be of class-I quality and shall conform to the following:

a) Primer (P-1)

Red oxide Zinc Chromate Primer

Type and Composition	Single pack, Modified phenolic alkyd medium pigmented with red oxide and zinc chromate.
Volume solids	30 - 35% (min)
DFT	25 microns/coat (min)
Covering capacity	12 - 13 M ² /Lit/coat

b) Primer (P-2)

High build chlorinated rubber zinc phosphate primer

Type and Composition	Single pack, Air Drying Chlorinated rubber medium Plasticized with unsaponifiable plasticiser pigmented with zinc phosphate
Volume solids	35 - 40% (min)
DFT	30 - 40 microns/coat (min)
Covering capacity	7 - 8 M ² /Lit/Coat

c) Primer (P-3)

High build zinc phosphate primer

Type and Composition	Single Pack, Synthetic medium, pigmented with zinc phosphate.
Volume solids	40 - 45% (min)
DFT	35 - 50 microns/coat (min)
Covering capacity	10 - 12 M ² /Lit/coat
Heat resistance	Upto 80 °C (dry)

d) Primer (P-4)

Etch Primer / Wash Primer

	Type and Composition	Two pack Poly vinyl butyral resin medium cured with phosphoric acid solution pigmented with zinc tetroxy chromate.
	Volume solids	7 - 8% (min)
	DFT	8 - 10 microns/coat (min)
	Covering capacity	7 - 8 M ² /lit/coat
e)	Primer (P-5)	
	Epoxy Zinc Chromate Primer	
	Type and Composition	Two packs, Polyamide cured epoxy resin medium pigmented with zinc chromate.
	Volume solids	40 % (min)
	DFT	35 microns/coat (min)
	Covering capacity	11 - 12 M ² /lit/Coat
f)	Primer (P-6)	
	Epoxy Zinc Phosphate Primer	
	Type and Composition	Two packs, Polyamide cured Epoxy resin medium pigmented with zinc phosphate.
	Volume solids	40% (min)
	DFT	35 - 50 microns/coat (min)
	Covering capacity	11 - 12 M ² /lit/coat
g)	Primer (P-7)	
	Epoxy high build M10 Paint (Intermediate Coat)	
	Type and composition	two pack Poly Polyamide cured epoxy resin medium pigmented with micaceous iron oxide. Volume solids 7- 8%
	Volume Solids	50% (min)
	DFT	100 microns/coat (min)
	Covering capacity	5.0 M ² /lit/coat
h)	Primer (P-8)	
	Epoxy Red Oxide zinc phosphate primer	

	Type and Composition	two pack. Polyamine cured epoxy resin pigmented with Red oxide and Zinc phosphate.
	Volume solids	42% (min)
	DFT	30 microns/coat (min)
	Covering capacity	13 - 14 M ² /lit/coat
i)	Primer (P-9)	
	Epoxy based tie coat (suitable for conventional alkyd based coating prior to application of acrylic polyurethane epoxy finishing coat)	
	Type and Composition	Two packs, Polyamide cured epoxy resin medium suitably pigmented.
	Volume solids	50 - 60% (min)
	DFT	50 microns/coat (min)
	Covering capacity	10 - 12 M ² /Lit/Coat
j)	Finish Coats (F-1)	
	Synthetic Enamel	
	Type and Composition	Single pack, Alkyd medium pigmented with superior quality water and weather resistant pigments
	Volume solids	30 - 40% (min)
	DFT	20 - 25 microns/coat
	Covering capacity	16 - 18 M ² /lit/Coat
k)	Finish coat (F-2)	
	Acrylic Polyurethane paint	
	Type and Composition	Two pack, Acrylic resin and iso-cyanate hardener suitably pigmented.
	Volume Solids	40% (min)
	DFT	30 - 40 microns / coat
	Covering Capacity	10 - 12 M ² /lit/ coat
l)	Finish Coat (F-3)	
	Chlorinated Rubber Paint	

	Type and Composition	Single pack, Plasticised chlorinated rubber medium with chemical & weather resistant pigments.
	Volume solids	40% (min)
	DFT	30 - 40 microns/coat (min)
	Covering capacity	8 - 10 M ² /lit /coat
- m) Finish Coat (F-4)
- High build chlorinated rubber M10 paint.
- | | | |
|--|----------------------|--|
| | Type and Composition | Single pack Chlorinated rubber based high build pigmented with micaceous iron oxide. |
| | Volume solids | 40 - 50% (min) |
| | DFT | 65 - 75 microns/coat |
| | Covering capacity | 6.0 - 7.0 M ² /lit/coat |
- n) Finish coat (F-5)
- Chemical Resistant Phenolic based Enamel
- | | | |
|--|----------------------|---|
| | Type and Composition | Single pack phenolic medium suitably pigmented. |
| | Volume solids | 35 - 40% (min) |
| | DFT | 25 microns/ coat |
| | Covering capacity | 15.0 M ² /lit/coat |
- o) Finish Coat (F-6)
- Epoxy High Building Coating
- | | | |
|--|----------------------|--|
| | Type and Composition | Two pack. Polyamide-amine cured epoxy resin medium suitably pigmented. |
| | Volume solids | 60 - 65% (min) |
| | DFT | 100 microns/coat (min) |
| | Covering capacity | 6.0 - 6.5 M ² /lit/coat |
- p) Finish Coat (F-7)
- High build Coal Tar Epoxy

	Type and Composition	Two pack, Polyamine cured epoxy resin blended with Coal Tar.
	Volume solids	65% (min)
	DFT	100 - 125 microns/coat
	Covering capacity	6.0 - 6.5 M ² /lit/coat
q)	Finish Coat (F-8)	
	Self-priming epoxy high build coating (complete rust control coating)	
	Type and Composition	Two packs. Polyamide-amine cured epoxy resin suitably pigmented. Capable of adhering to manually prepared surface and old coatings.
	Volume solids	65 - 80% (min)
	DFT	125 - 150 microns/coat
	Covering capacity	4 - 5 M ² /lit/coat
r)	Finish Coat (F-9)	
	Inorganic Zinc Silicate coating	
	Type and Composition	Two packs, self-cured solvent based inorganic zinc silicate coating.
	Volume solids	60% (min)
	DFT	65 - 75 microns/coat
	Covering capacity	8 - 9 M ² /lit/coat
s)	Finish coat (F-10)	
	High build Black	
	Type and Composition	Single pack. Reinforced bituminous composition phenol based resin.
	Volume solids	55 - 60% (min)
	DFT	100 microns/coat (min)
	Covering capacity	5.5 - 6.0 M ² /lit/coat
t)	Finish Coat (F-11)	
	Heat Resistant Aluminium Paint Suitable up to 250°C.	

	Type and Composition	Duel container (paste & medium). Heat resistant spec varnish medium combined with aluminium flakes.
	Volume solids	20 - 25% (min)
	DFT	20 microns/coat (min)
	Covering capacity	10 - 12 M ² /lit/coat
u)	Finish Coat (F-12)	
	Heat Resistant Silicon Paint suitable up to 400° C.	
	Type and Composition	Single pack Silicone resin based with aluminium flakes.
	Volume solids	20 - 25% (min)
	DFT	20 microns/coat (min)
	Covering capacity	10 - 12 M ² /lit/coat
v)	Finish Coat (F-13)	
	Synthetic Rubber Based Aluminium Paint Suitable up to 150°C.	
	Type and Composition	Single Pack, Synthetic medium rubber medium combined with leafing Aluminium,
	DFT	25 microns/coat (min)
	Covering capacity	9.5 M ² /lit/coat

Notes:

1. Covering capacity and DFT depends on method of application. Covering capacity specified above is theoretical. Allowing the losses during application, min specified DFT should be maintained.
2. All paints shall be applied in accordance with manufacturer's instructions for surface preparation, intervals, curing and application. The surface preparation quality and workmanship should be ensured.
3. Selected chlorinated rubber paint should have resistance to corrosive atmosphere and suitable for marine environment,
4. All primers and finish coats should be cold cured and air-drying unless otherwise specified.

5. Technical data sheets for all paints shall be supplied at the time of submission of quotations.
6. In case of use of epoxy tie coat, manufacturer should demonstrate satisfactory test for inter coat adhesion. In case of limited availability of epoxy tie coat (P-9) alternate system may be used taking into the service requirement of the system.
7. In case of F-6, F-9, F-1 1 & F-1 2 Finish Coats, No Primer are required.

MANUFACTURERS

The paints shall conform to the specifications given above and Class-I quality in their products range of any of the-following manufacturer or other approved vendors:

- i) Asian Paints (India) Ltd.
- ii) Bombay Paints
- iii) Berger Paints India Ltd.
- iv) Akzo Nobel
- v) Jenson & Nicholson
- vi) Shalimar Paints

STORAGE

All paints and painting material shall be stored only in rooms to be provided by contractor and approved by OWNER/ OWNER 's Representative for the purpose. All necessary precautions shall be taken to prevent fire. The storage building shall preferably be separate from adjacent, building.

A signboard bearing the words given below shall be clearly displayed outside:
PAINT STORAGE No NAKED LIGHT highly -inflammable

12.0 COLOR CODE FOR PIPING:

- i) For identification of pipelines, the color code as per Table -1 shall be used.
- ii) The color code scheme is intended for identification of the individual group of the pipeline. The system of color coding consists of a ground color and color bands superimposed on it.
- iii) Colors (Ground) as given in Table-2 shall be applied throughout the entire length of un insulated pipes, on the metal cladding & on surfaces. Ground color coating of minimum 2m length or of adequate length not to be mistaken as color band shall be applied at places requiring color bands. Color bands shall be applied as per approved procedure.
- iv) Line coating shall meet DIN 30670 standard for external coating and API 5L RP – 2 for internal coating.

- v) The thickness for the epoxy should be 180 microns, adhesive 200 microns and balance should be PE .
- vi) The minimum coating thickness on weld seam shall be 3.2 mm and minimum coating thickness on body should be 3.2.
- vii) Minimum thickness for liquid epoxy for internal coating should be 100 ± 20 microns. Max design temperature for coating should be considered $+80^{\circ}\text{C}$.

COLOR CODE:

- A) Ball Valve (Above Ground) : Off White
- B) Globe Valve (Above Ground) : Oxford Blue-RAL 5005, IS-519941005
- C) Check Valve(Above Ground) : Oxford Blue-RAL 5005, IS-519941005
- D) Launcher / Receiver : Yellow Golden
- E) Jib Crane / Trolley : Yellow Golden
- F) All underground valves shall have epoxy base coating after surface finish of SA 2:5
- G) Valves and above ground pipes need to be properly blasted to achieve surface finish of Sa 2:5 before the application of paints.

Table 12.1 Colour Coding Scheme for Pipes and Equipment

SI. No	Description	Ground Color	First Color Band	Second Color Band
1	COMPRESSED AIR			
a)	Plant Air	Sky Blue	Silver Grey	-
b)	Instrument Air	Sea Green	Black	-
2	GASES			
a)	Charge Gas	Canary Yellow	Signal Red	Smoke Grey
b)	Regeneration Gas	Canary Yellow	White	Dark Violet
c)	Residue Gas	Canary Yellow	White	French Blue
d)	LPG	Canary Yellow	Brilliant Green	White
e)	Acetylene	Canary Yellow	Dark violet	-
	Flare Lines	Heat resistant aluminium		
f)	Fire water and Foam & Extinguisher	Post office red		
3	ALL EQUIPMENT			
a)	Vessels. Columns, exchangers, etc. containing non- hazardous fluids.	Light Grey		
b)	Base Frame/Structure	Black		
b)	All equipment containing hazardous fluids	Canary Yellow		

c)	Pipe carrying hazardous fluids	Bar is to be replaced by Hazardous Marking as per IS:2379 Clause 7.1C		

IDENTIFICATION SIGN

- i) Colors of arrows shall be black or white and in contrast to the color on which they are superimposed.
- ii) Product names shall be marked at pump inlet, outlet and battery limit in a suitable size as approved by OWNER.
- iii) Size of arrow shall be either of the following:

- a) Color Bands

Minimum width of color band shall be as per approved procedure.

- b) Whenever it is required by the OWNER to indicate that a pipeline carries a hazardous material, a hazard marking of diagonal stripes of black and golden, yellow as per IS:2379 shall be painted on the ground color.

IDENTIFICATION OF EQUIPMENT

All equipment shall be stenciled in black or white on each vessels, column, equipment, and painting as per approved procedure.

INSPECTION AND TESTING

1. All painting materials including primers and thinners brought to site by contractor for application shall be procured directly from manufactures as per specifications and shall be accompanied by manufacturer's test certificates Paint formulations without certificates are not acceptable.
2. The painting work shall be subject to inspection by OWNER/ OWNER's Representative at all times. In particular, following stage wise inspection will be performed and contractor shall offer the work for inspection and approval at every stage before proceeding with the next stage.

In addition to above. record should include type of shop primer already applied on equipment e.g. Red oxide zinc chromate or zinc chromate or Red lead primer etc.

Any defect noticed during the various stages of inspection shall be rectified by the contractor to the entire satisfaction of OWNER/ OWNER's Representative before proceeding further. Irrespective of the inspection, repair and approval at intermediate stages of work. Contractor shall be responsible for making good any defects found during final inspection/guarantee period/defect liability period as defined in general condition of contract. Dry film thickness (DFT) shall be checked and recorded after application of each coat and extra coat of paint should be applied to make-up the DFT specified without any extra cost to OWNER.

PRIMER APPLICATION

- i. The contractor shall provide standard thickness measurement instrument with appropriate range(s) for measuring.

Dry film thickness of each coat, surface profile gauge for checking of surface profile in case of sand blasting. Holiday detectors and pinhole detector and protector whenever required for checking in case of immerse conditions.

- ii. At the discretion of OWNER/ OWNER's Representative, contractor has to provide the paint manufacturers expert technical service at site as and when required. For this service, there should not be any extra cost to the OWNER.
- iii. Final Inspection shall include measurement of paint dry film thickness, check of finish and workmanship. The thickness should be measured at as many points/ locations as decided by OWNER/ OWNER's Representative and shall be within +10% of the dry film thickness.
- iv. The contractor shall produce test reports from manufacturer regarding the quality of the particular batch of paint supplied. The OWNER shall have the right to test wet samples of paint at random for quality of same. Batch test reports of the manufacturer's for each batch of paints supplied shall be made available by the contractor.

18.0 PAINT SYSTEMS

The paint system should vary, with type of environment envisaged in and around the plants. The types of environment as given below are considered for selection of paint system. The paint system is also given for specific requirements.

- a) Normal Industrial Environment, Table 18.2.
- b) Corrosive industrial Environment, Table 18.3
- c) Coastal & Marine Environment, Table 18.4

Notes 1. Primers and finish coats for any particular paint systems shall be from same manufacturer in order to ensure compatibility.

TABLE 18.1: LIST OF PRIMERS & FINISH PAINTS

PRIMERS	
P-1	Red oxide Zinc chromate Primer
P-2	Chlorinated rubber zinc Phosphate Primer
P-3	High build Zinc phosphate Primer
P-4	Etch Primer/Wash Primer
P-5	Epoxy Zinc Chromate Primer
P-6	Two component Epoxy Zinc Phosphate Primer cured with polyamine hardener
P-8	Epoxy red oxide zinc phosphate primer
FINISH COATS / PAINTS	
F-1	Synthetic Enamel
F-2	Two component Acrylic – Polyurethane finish paint
F-3	Chlorinated Rubber finish paint
F-5	Chemical resistant phenolic based enamel
F-6	High Build Epoxy finish coating cured with polyamide hardener
F-7	High build Coal Tar Epoxy coating cured with polyamine hardener
F-8	Self priming surface Tolerant High Build epoxy coating. cured with polyamine hardener
F-9	Two component Inorganic Zinc Silicate coating
F-10	High build Reinforced bituminous composition phenol based resin.
F-11	Heat resistant synthetic medium based Aluminium paint suitable for 250 deg C
F-12	Two component Heat resistant Silicone Aluminium paint. suitable for 400 deg C
F-13	Synthetic based aluminium Paint suitable for 150 deg C

Table – 18.2: Painting System for Normal Industrial Environment for Piping and Equipment (Above Ground)

Sl. No.	Temp. Range	Surface Preparation	Primer	Finish Coat	Total DFT	Remarks
1	-10 to 20	SSPC-SP-3	One coat P-2 50 microns / coat (min)	One coat F-4 65 microns/ coat (min) Two coats F-3, 30 Microns/coa t (min)	175	Primer and Finish coat can be applied at ambient temp.
2	21 to 60	SSPC-SP-6	Two coats P-1, 25 microns/ coat (min.)	Two coats of F-1, 20 microns/coa t (min)	90	-
3	61 to 80	SSPC-SP-6	Two coats P-3, 50 microns/ coat (min)	Two coats of F-13, 25 microns/coa t (min)	150	-
4	81 to 250	SSPC-SP-6	-	Three coats of F-11, 20 microns/ coat (min)	60	Paint application at ambient temp. curing at elevated temp. during start-up.
5	251 to 400	SSPC-SP-10	-	Three coats of F-12, 20 microns/ coat (min)	60	-do-

Table – 18.3: Painting System for Corrosive Industrial Environment for Piping and Equipment (Above Ground)

SI. No.	Temp. Range	Surface preparation	Primer	Finish Coat	Total DFT	Remarks
1	-14 to 80	SSPC-SP-10	Two coats P-6, 35 microns / coat (min.)	One coats F- 6, 100 microns coat (min.) and one coats F- 2 40 microns coat (min.)	210	Paint application at ambient temp.
2	81 to 250	SSPC-SP-10	-	Three coats F- 11, 20 Microns / coat (min.)	60	Paint application at ambient temp. and curing at 250°C for 4 hours
3	81 to 400	SSPC-SP-10	-	Three coats F- 12, 20 Microns / coat (min.)	60	Paint application at ambient temp. and curing at 250°C for 4 hours

Table – 18.4 :Painting System for Coastal and Marine Environment for Piping and Equipment (Above Ground)

SI. No.	Temp. Range	Surface Preparation	Primer	Finish Coat	Total DFT	Remarks
1	-14 to 80	SSPC-SP-10	Two coats P-6. 35 Microns. coat (Min.)	Two coats F- 6, 100 microns /coat (min.) and one coats F-2 40 Microns /coat (min.)	310	Primer and Finish coat application at Ambient temp.
2	81 to 400	SSPC-SP-I0	-	- Three coats F- 12, 20 Microns / coat (min.)	60	Paint application. at ambient temp, and curing at 250°C for 4 hours
3	401 to 550	SSPC-SP- 10	-	Three coats F- 12, 20 Microns / coat (min.)	60	Paint application. at ambient temp, and curing at 250°C for 4 hours

Table – 18.5 : Painting System for External Side of Underground Tanks in all areas.

SI. No.	Temp. Range	Surface Preparation	Primer	Finish Coat	Total DFT	Remarks
External side of un-insulated underground storage tanks:						
1	-40 to 80	SSPC-SP-10	1 coat of F-9 @ 65-75μ DFT/ coat	3 coats of F-7 @ 100μ DFT/coat (3x100=300)	365-375	

18.2 Precautions to be taken

Neither the environment of the site nor the marking labels of devices may be covered with paint and they must be kept free of paint splashes. To this end, it is advisable to use removable masking tape.

Paint splashes, leaks, etc. on any adjacent installations such as measuring apparatus, valves, pipes. Sources of light, insulation, heat insulators, walls, concrete, etc, must immediately be wiped up and the damage repaired before the paint is dry.

Otherwise, the OWNER will be obliged to have the cleaning carried out at the expense of the Contractor. The paint recipient will only be opened at the time of use (unless otherwise specified by the manufacturer).

The product will be mixed in the recipient with the aid of suitable tools and thus homogenized.

18.3 Method of application

Normally, three methods of application will be used on the construction site for the paint products. i.e. with a brush, with a roller or with a spray gun.

- The brush method makes it possible to obtain good penetration of the paint over irregularities in the metal.
- Only this method will be used for application of the base coats, for retouching and for protrusions, welded areas, riveted joints or bolted joints:
- The roller method may be used on large flat surfaces for the intermediate and topcoats.
- The spray gun method must be used in accordance with the instructions of the manufacturer and carried out by qualified personnel.

The Contractor must guarantee that all safety measures have been taken for such work. The spray gun method may only be used on site for places that are difficult to reach with the brush. In this case, a request must be made to the OWNER/ OWNER's Representative for a deviation.

All paintwork will be carried out with good brushes or rollers that are suitable for the type of paint being used and for the form of the material to be painted and fitted with short handles. The maximum length of the brush and roller handles will be 50 cm; longer handles may only be used for places that are absolutely inaccessible. The maximum width of a brush will be 13 cm.

18.4 Application of the coating

Application of the paint will be carried out in accordance with best practice in order to obtain a homogeneous and continuous layer. The OWNER or the Approved Supervisory body demands that painting of a layer will only be started after acceptance by them of the surface preparation or of the previous layer of paint.

The layers of paint must have a uniform thickness. They must be spread in such a way that all concave parts are dried out and that the surface is completely covered and has a

glossy appearance without leaving brush marks and without exhibiting bubbles, foam, wrinkles, drips, craters, skins or gums that arise from weathered paint,

Each layer must have the color stipulated in the tables of the present specifications, which clearly differs from the previous layer, taking account of the Color of the top layer, all of which for the purpose of being able to identify the number of coats and their order of sequence. If the color of the coats is not mentioned in the tables the color difference in consecutive coats must, if possible, be at least 100 RAL. The color of the top layer is given in the table.

The coating power should be such that the underlying layer is not visible. Only 1 layer per day may be applied, unless otherwise specified by the OWNER or the Approved Supervisory Body.

The drying times prescribed by the paint manufacturer must be strictly observed in relation to the environmental conditions before proceeding with the application of the next layer.

The dry coating thickness indicated in the description of the paint systems are minimum thickness. In this connection, the Contractor is obliged to contact the paint manufacturer and conform to his guidelines. The Contractor must respect the thickness specified by the supplier.

18.5 Transporting treated items

In the case of works being carried out in a workshop, the metal structures will be surrounded by ventilated contraction film that prevents damage during transportation. This film may only be applied after complete polymerization of the paint.

19.0 GROUND-LEVEL TRANSITION POINT

19.1 Polyester protection system

The Contractor will provide system 02 over the entire length of the pipes above ground and below ground and up to a height of 20 cm and a depth of 40 cm. perpendicular to the ground level mark. In each case, he must ensure that the jointing below the asphalt is in good condition and assures' faultless adhesion. He will apply the following products over the entire surface area, prepared in accordance with is Sa 3:

- 1) The primer of system 01.
- 2) Reinforced polyester $\pm$ 20 cm above the ground level marker and $\pm$ 5 cm on the asphalt cleaned beforehand (application of reinforced polyester is carried out in accordance with the work method prescribed by the manufacturer). Moreover, in the case of PE, in contrast to asphalt, he will apply a polygon primer to PE immediately before applying the reinforced polyester.

- 3) He will then apply the other coats of system 01a to the surface section and thus cover the reinforced polyester with about 5 cm.
- 4) For new constructions, the polygon primer will be applied to PE and then subsequently processed as described under point 2.

20.0 USE OF SCAFFOLDING

Mounting, maintenance and dismantling of scaffolding for carrying out adaptation and/or paintwork to surface gas pipes or gas transport installations in use;

- The Contractor will specify the cost of scaffolding in the price list.
- The supplementary rental price for delays attributable to the Contractor will be charged to him:
- In his price quotation the Contractor should present the OWNER with diagrams of the scaffolding that he intends to install for carrying out the works of the OWNER.

21.0 QUALITY CONTROLS AND GUARANTEE

- 21.1 The Contractor is responsible for checking the weather conditions to ascertain whether the paintwork can be carried out within the technical specifications.

The Contractor should have the required calibrated monitoring apparatus for this purpose on site (with calibration certificates). The personnel who will have to use this apparatus should have the training for this purpose.

The OWNER or his representative and possibly the approved supervisory body indicated by the OWNER will maintain supervision during the works and inspect the works with random checks. A daily report will be drawn up in relation to the department that maintains supervision of these works.

The supplementary inspection and the supervision by the OWNER or the approved supervisory body do not diminish in any way the liability of the Contractor. The proper execution of the work and the materials used may be checked at any time.

21.2 Reference Surfaces

At the start of the works. The OWNER or the approved supervisory body will indicate a few surfaces that the Contractor will prepare and cover in accordance with the recognized method of operation under the inspection and to the satisfaction of all parties; the OWNER or his representative, the approved supervisory body, the contractor and possibly the paint manufacturer. These reference surfaces will serve as a point of comparison for the good adhesion of the paint on the installations as a whole. The parties will together

work out a system for the identification of these surfaces in order to be able to monitor the conditions of the coatings over time. If the paintwork on a section of the installations is in a worse condition than the reference surfaces, the Contractor may be obliged to treat these parts again.

21.3 Measures to be taken in the event of a dispute

If on delivery of the works no agreement can be reached between the Contractor and the OWNER regarding the conformity of the works to the requirements of these specifications, an Approved Supervisory Body will be Called in. The Approved Supervisory Body will then carry out inspections' on site whereby the following assessment criteria will be used:

- The Swedish standards ISO 8501-1 1988 SS 05.5900 concerning the degree of cleanliness of the areas derusted by blasting, by machine or by hand.
- The wet film thickness of the paint will be measured in accordance with ISO 2808 or ASTM DI 212;
- The dry layer thickness of the film will be measured electronically, will complete statistical information. in accordance will, ISO 2808 or ASTM D 1186.
- The thickness of each layer will be measured in accordance with ISO 2808. ASTM 4138 or DIN 50986.
- Adhesion tests will be carried out in accordance with ISO 2409. ASTM 3359 or DIN 53151.
- Traction tests will be carried out in conformity with ISO 4624 or ASTM D 4541.
- The rugosity will be measured electronically in accordance with DIN 4768;
- The non-porosity will be measured with a test tension depending on the type of coating, the layer thickness and after consultation with the Paint manufacturer.
- Any defects in the paint film may be inspected visually by means of a magnifying glass or microscope. If necessary a photographic report may be drawn up in accordance with ASTM Standard D 4121-82.

The final judgment of the Approved Supervisory Body is irrevocable and binding for the Contractor and the OWNER. In the event of non-conformity of the works with the criteria of these specifications, all costs arising from the inspection by the Approved Supervisory Body shall be borne by the Contractor.

21.4 Guarantee

a) General Principles

The Contractor declares that he is aware of:

- The maximum operating temperature of the surfaces to be covered.
 - The maximum permitted degree of humidity of the bearing surface.
 - The properties of the environment to which the surfaces to be covered are: subject.
- b) Summary of the Guarantee.

The contractor fully guarantees the following without reservation:

- The observance of all stipulations of the specifications for paintwork regarding, among other things:
 - The preparation of the surfaces.
 - The thickness of each layer.
 - The total thickness of the covering.
- The uniformity of the materials used.
- The repair of all defects before delivery of the works.

The Contractor will carry out the requested repair work as promptly as possible.



VCS QUALITY SERVICES PVT. LTD.

STANDARD SPECIFICATION FOR ASSORTED PIPES

VCS – SS – PP - 2503

					
01	30.06.2022	RP	MC	HK	GW
00	28.01.2020	MB	AK	AD	SK
Rev. No	Date	Prepared By	Checked By	Approved By	Authorized By

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REVISION RECORD

Rev.	Revision Date	Prepared by	Checked by	Approved by	Authorized by	Revision Description
00	12.10.2019					
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ABBREVIATIONS:

ANSI	American National Standards Institute
API	American Petroleum Institute
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing & Materials
BHN	Brinell Hardness Number
BIS	Bureau of Indian Standards
E.FS.W	Electric Fusion Weld
E.R.W	Electric Resistance Weld
HAZ	Heat Affected Zone
HIC	Hydrogen Induced Cracking
IBR	Indian Boiler Regulations
IGC	Inter Granular Corrosion
IS	Indian Standard
LT	Low Temperature
MR	Material Requisition
NACE MR	National Association of Corrosion Engineers : Material Requirement
NB	Nominal Bore
NPT	Nominal Pipe Thread
PMI	Positive Material Identification
PR	Purchase Requisition
SMYS	Specified Minimum Yield Strength
SS	Stainless Steel

CONTENTS

1.0 GENERAL.....	1
2.0 IBR PIPES.....	7
3.0 ACCEPTABLE DEVIATION.....	8
4.0 HYDROSTATIC TEST.....	8
5.0 MARKING AND DESPATCH.....	11

1. GENERAL

1.1. All pipes and their dimensions, tolerances, chemical composition, physical properties, heat treatment, hydrostatic test and other testing and marking requirements shall conform to the latest codes and standards specified in the material requisition (MR). Supplier shall strictly comply with MR/ PR stipulations and no deviations shall be permitted.

1.2. Testing

1.2.1. Test reports shall be supplied for all mandatory tests as per the applicable material specifications. Test reports shall also be furnished for any supplementary tests as specified in the MR & Clauses 1.10 & 1.11.

1.2.2. Material test certificates (physical property, chemical composition & heat treatment report) shall also be furnished for the pipes supplied.

1.2.3. PMI shall be performed as per the scope and procedures at supplier's work.

1.3. Manufacturing Processes

1.3.1. Steel made by acid Bessemer process shall not be acceptable.

1.3.2. All longitudinally welded pipes should employ only automatic welding.

1.4. Pipe shall be supplied in single or double random length of 4 to 7 and 7 to 14 meters respectively.

1.5. a. Seamless and E.R.W. pipes shall not have any circumferential seam joint in a random length. However, in case of E.F.S.W pipe, in one random length one welded circumferential seam of same quality as longitudinal weld is permitted. This weld shall be at least 2.5 m from either end. The longitudinal seams of the two portions shall be staggered by 90°. Single random length in such cases shall be 5 to 7 m.

b. Unless otherwise mentioned in the respective material code, E.F.S.W pipes < 36" shall not have more than one longitudinal seam joint and E.F.S.W pipes ≥ 36" shall not have more than two longitudinal seam joints.

1.6. Pipe with screwed ends shall have NPT external taper pipe threads conforming to ASME/ANSI B1.20.1 up to 1.5" NB & IS 554 for 2" to 6" NB.

1.7. Pipe with beveled ends shall be in accordance with ASME B16.25. Weld contours shall be as follows

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

- 1.8. Galvanized pipes shall be coated with zinc by hot dip process conforming to IS 4736 / ASTM A 153.
- 1.9. All austenitic stainless steel pipes shall be supplied in solution annealed condition. All types of 321 or 347 stainless steel pipes shall be in a stabilized heat treated condition. Stabilizing heat treatment shall be carried out subsequent to the normal solution annealing. Soaking time & holding temp. for stabilizing heat treatment shall be 4 hrs & 900°C respectively.
- 1.10. **I.G.C. (Inter Granular Corrosion) Test for Stainless Steels**
- 1.10.1. For all austenitic stainless steel pipes inter-granular corrosion test shall have to be conducted as per following:
ASTM A262 Practice "B" with acceptance criteria of "60 mils/year (max.)".
OR
ASTM A262 Practice E with acceptance criteria of no cracks at 20X magnification and microstructure to be observed at 250X magnification shall ensure the absence of any cracks/ fissures. When testing is conducted as per practice 'E' photograph of microstructure shall be submitted for record.
- 1.10.2. When specifically asked for in MR for high temperature application of some grades of austenitic stainless steel (eg.SS 309, 310, 316, 316H etc.) ASTM A262 Practice "C" with acceptance criteria of "15 mils/year (max.)" shall have to be conducted
- 1.10.3. For the IGC test as described in 1.10.1 & 1.10.2, two sets of samples shall be drawn from each solution annealing lot; one set corresponding to highest carbon content and the other set corresponding to the highest pipe thickness.
- 1.11. All welded pipes indicated as 'CRYO' & 'LT' in MR shall be impact tested per requirement & acceptance criteria of ASME B31.3. The impact test temperature shall be -196°C & -45°C for stainless steel and carbon steel respectively unless specifically mentioned otherwise in MR.
- 1.12. **NACE/HIC Requirements**

- 1.12.1. Pipes under "NACE" category and those designated as "HIC1" shall meet the requirements given in NACE MR-0103 unless mentioned otherwise.
- 1.12.2. Pipes made from plates and designated as "HIC1" shall meet the HIC requirements of specification unless mentioned otherwise
- 1.13. Specified heat treatment for carbon steel and alloy steel and solution annealing for stainless steel pipes shall be carried out after weld repairs. Number of weld repairs at the same spot shall be restricted to maximum two by approved repair procedure.
- 1.14. For black or galvanized pipes to IS 1239, the minimum percentage of elongation shall be 20%.
- 1.15. All 1Cr-1/2Mo and 1 ¼ Cr-1/2Mo seamless pipes shall be normalized and tempered.
- 1.16. For all welded alloy steel pipes with mandatory requirement of heat treatment and radiography, radiography shall be performed after heat treatment.
- 1.17. For Hydrogen service pipes following special requirements shall also be met:
 - 1.17.1. All carbon steel pipes having wall thickness 9.53 mm (0.375") and above shall be normalized. Cold drawn pipes shall be normalized after the final cold draw pass for all thicknesses.
 - 1.17.2. All alloy steel (Cr-Mo) pipes shall be normalized and tempered. The normalizing and tempering shall be a separate heating operation and not a part of the hot forming operation. The maximum room temperature tensile strength shall be 100,000 psig.
 - 1.17.3. For carbon steel Pipes, hardness of weld and HAZ shall be 200 BHN (max.). For alloy steel Pipes, hardness of weld and HAZ shall be 225 BHN (max.).
 - 1.17.4. For all austenitic stainless steels, the weld deposit shall be checked for ferrite content. A Ferrite No.(FN) not less than 3% and not more than 10% is required to avoid sigma phase embrittlement during heat treatment. FN shall be determined by Ferrite scope prior to post weld heat treatment.
 - 1.17.5. For all Carbon steel and Alloy steel pipes with wall thickness over 20mm, Charpy-V Notch impact testing shall be carried out in accordance with paragraph UG-84 of ASME Section VIII, Div-1 for weld metal and base metal from the thickest item per heat of material and per heat treating batch. Impact test specimen shall be in complete heat treated condition and accordance with ASTM A370. Impact energies at 0°Celsius shall average greater than 27J (20 ft-lb) per set of three specimens, with a minimum of 19J (15 ft-lb).
- 1.18. For dual grades of SS where specified, chemical composition and mechanical

properties of both grades specified shall be ensured.

2. IBR PIPES

2.1. IBR Documentation

- 2.1.1. Pipes under purview of IBR shall be accompanied with IBR certificate original in Form III-A duly approved and countersigned by IBR authority/local authority empowered by the Central Boiler Board of India (Photocopy of the original certificate duly attested by the local boiler inspector where the supplier is located is the minimum requirement for acceptance) or Form III-D [for well-known pipe manufacturers as per IBR] signed by Manufacturer's authorized representative. Well known pipe manufacturers, as recognized by IBR, shall submit a duly attested copy of Form XVI-G along with Form III-D.
- 2.1.2. For materials 1¼ Cr - ½ Mo (ASTM A335 Gr.P11 / A691 Gr. 1¼Cr), 2¼Cr - 1Mo (ASTM A335 Gr.P22 / A691 Gr. 2¼Cr) & 9Cr -1Mo-V (A335 Gr.P91/A691 Gr.91), Form III-A approved by IBR shall include the tabulation of Et, Sc & Sr values for the entire temperature range given below. Et, Sc & Sr values shall be such that throughout the temperature range

$$\begin{array}{lcl} E_t/1.5 & \geq & \\ S_r/1.5 & \geq & S_A \\ S_c & \geq & \end{array}$$

where,

- S_A Allowable stress at the working metal temperature.
- E_t Yield point (0.2% proof stress at the working metal temperature)
- S_c The average stress to produce elongation of 1%(creep) in 100000 hrs at the working metal temperature.
- S_r The average stress to produce rupture in 100000 hrs at the working metal temperature and in no case more than 1.33 times the lowest stress to produce rupture at this temperature

Temp (°F) Material	SA (psi)											
	500	600	650	700	750	800	850	900	950	1000	1050	1100
A335 Gr.P11	17200	16700	16200	15600	15200	15000	14500	12800	9300	6300	4200	2800
A691	18900	18300	18000	17600	17300	16800	16300	15000	9900	6300	4200	2800

Temp (°F) Material	SA (psi)											
	500	600	650	700	750	800	850	900	950	1000	1050	1100
Gr. 1½ Cr												
A335 Gr.P22 / A691 Gr. 2½ Cr	17900	17900	17900	17900	17900	17800	14500	12800	10800	7800	5100	3200
A335 Gr.P91/ A691 Gr.91	28100	27700	27300	26700	25900	24900	23700	22300	20700	18000	14000	10300

Note : S_A values shall be as per the latest edition prevailing.

2.2. For carbon steel pipes under IBR the chemical composition shall conform to the following:

Carbon (max) : 0.25%

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

The chemical composition as indicated in this clause is not applicable for pipes other than IBR services.

3. ACCEPTABLE DEVIATIONS

3.1. Pipes to IS 3589 Gr.410 are acceptable in place of IS 3589 Gr.330.

3.2. Pipes of Grades SS317 of corresponding material are acceptable in place of Grades SS316 or SS316(2.5 Mo min.).

3.3. Pipes of Grades SS317L of corresponding material are acceptable in place of Grades SS316L or SS316L(2.5Mo min.).

3.4. Seamless pipes are acceptable in place of welded pipes except in the case of welded SS321/SS321H pipes with nominal thickness greater than 9.53mm.

4. HYDROSTATIC TEST

4.1. All pipes shall be hydrostatically tested.

4.2. The mill test pressure shall be as follows:

4.2.1. Seamless, E.R.W. & Spiral Welded

a) Carbon Steel

Material Std.	Test Pressure Std.
ASTM A106 Gr.B	ASTM A530
API 5L Gr.B, Seamless	API 5L
API 5L, E.R.W.	API 5L
API 5L, Spiral	API 5L
ASTM A333 Gr.3 & 6, Seamless	ASTM A530
ASTM A333 Gr.3 & 6, E.R.W.	ASTM A530

b) Seamless Alloy Steel

Material Std.	Test Pressure Std.
ASTM A335 Gr.P1, P12, P11, P22, P5, P9	ASTM A530
ASTM A268 TP 405, TP410	ASTM A530

c) Seamless Stainless Steel

Material Std.	Test Pressure Std.
ASTM A312 Gr.TP 304, 304L, 304H, 316, 316L, 316H, 321, 347.	ASTM A999

d) Seamless Nickel Alloy

Material Std.	Test Pressure Std.
ASTM B161 UNS No. 2200	ASTM B161
ASTM B165 UNS No. 4400	ASTM B165
ASTM B167 UNS No. 6600	ASTM B167
ASTM B407 UNS No. 8800	ASTM B407

e) Welded Nickel Alloy

Material Std.	Test Pressure Std.
ASTM B725 UNS No. 2200,4400	ASTM B725
ASTM B517 UNS No. 6600	ASTM B517

ASTM B514 UNS No. 8800	ASTM B514

4.2.2. Electric Fusion Weld

a) Carbon Steel & Alloy Steel E.FS.W (16" & above)

Material Std	Test Pressure Std.
API 5L Gr.B ASTM A671 Gr.CC65, 70 (Cl.32) ASTM A672 Gr.C60, 65, 70 (Cl.12,22) ASTM A671 Gr.CF60, 65, 66, 70 (Cl.32) ASTM A691 Gr. ½ Cr, 1Cr, 1¼ Cr, 2¼ Cr, 5Cr, 9Cr (Cl.42)	P = 2ST/D S = 90% of SMYS Except for API 5L Gr.B S = 85% of SMYS For API 5L Gr.B T = Nominal Wall Thickness D = O.D of Pipe

b) Stainless Steel E.FS.W (2" to 6")

The hydrostatic test pressure in kg/cm² for the following materials shall be as given below :

Material Gr.1 :ASTM A312 TP 304 / 304H / 316 / 316H / 321 / 347 welded.

Material Gr.2 :ASTM A312 TP 304L / 316L welded.

Size	Pipe Schedule : 10S		Pipe Schedule : 40S		Pipe Schedule : 80S	
	Material Gr. 1	Material Gr.2	Material Gr.1	Material Gr.2	Material Gr.1	Material Gr.2
2"	100	80	155	130	230	190
3"	80	60	155	130	230	190
4"	80	50	155	130	230	190
6"	65	35	90	75	155	130

c) Stainless Steel E.FS.W (8" and above).

Material Std	Test Pressure Std.
ASTM A358 TP 304L, 304, 304H, 316L,316, 316H, 321, 347 (Classes 1, 3 & 4)	P = 2ST/D S = 85% of SMYS T = Nominal Wall Thickness D = O.D of Pipe

ASTM A358 TP 304L, 304, 304H, 316L, 316, 316H, 321, 347 (Classes 2 & 5)	P = 2ST/D S = 72% of SMYS T = Nominal Wall Thickness D = O.D of Pipe

4.2.3. Carbon Steel Pipe to BIS Standards

Material Std	Test Pressure Std.
IS 1239	IS 1239
IS 3589	IS 3589

- 4.3. Hydrostatic pressure testing shall be performed using iron free water, which is clean and free of silt. Maximum chloride content in water for hydrostatic testing for SS piping shall be 50 ppm.

5. MARKING AND DESPATCH

- 5.1. All pipes shall be marked in accordance with the applicable codes, standards and specifications. In addition the purchase order number, the item code & special conditions like "IBR", "CRYO", "NACE", "H2" etc. shall also be marked.
- 5.2. Pipes under "IBR", "CRYO", "NACE" & "H2" shall be painted with one circumferential stripe of colour red, light purple brown, canary yellow & white respectively for easy identification. Width of stripe shall be 12mm for pipe sizes less than 3" and 25mm for pipes 3" and above.
- 5.3. Paint or ink for marking shall not contain any harmful metal or metallic salts such as zinc, lead or copper which cause corrosive attack on heating.
- 5.4. Pipes shall be dry, clean and free from moisture, dirt and loose foreign materials of any kind.
- 5.5. Pipes shall be protected from rust & corrosion
- 5.6. Rust preventive used on machined surfaces to be welded shall be easily removable with a petroleum solvent and the same shall not be harmful to welding.
- 5.7. Both ends of the pipe shall be protected with the following material:
- Plain end : Plastic cap
- Bevel end : Wood, Metal or plastic cover
- Threaded end : Metal or plastic threaded cap
- 5.8. Pipes may be provided with plastic push-fit type end caps/ steel caps without belt wire.

- 5.9. Steel end protectors to be used on galvanized pipes shall be galvanized. Plastic caps can also be used as end protectors for galvanised pipe ends.



VCS QUALITY SERVICES PVT.LTD.

STANDARD SPECIFICATION FOR ASSORTED VALVES

VCS – SS – PP - 2504

					
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00	28.01.2020					
		MB	AK	AD	SK	
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ABBREVIATIONS:

AARH	:	Arithmetic Average Roughness Height
ANSI	:	American National Standards Institute
API	:	American Petroleum Institute
ASME	:	American Society of Mechanical Engineers
ASTM	:	American Society for Testing & Materials
BGO	:	Bevel Gear Operator
BHN	:	Brinell Hardness Number
BIS	:	Bureau of Indian Standards
BS	:	British Standard
BVIS	:	Bureau Veritas Industrial Services
BW	:	Butt Weld
CAT	:	Category
CS	:	Carbon Steel
DFT	:	Dry Film Thickness
DNV	:	Det Norske Veritas
DP	:	Dye-Penetrant
IBR	:	Indian Boiler Regulations
IGC	:	Inter Granular Corrosion
IS	:	Indian Standard
LT	:	Low Temperature
LTCS	:	Low Temperature Carbon Steel
MOV	:	Motor Operated Valve
MP	:	Magnetic Particle
MR	:	Material Requisition
NDT	:	Non Destructive Testing
PM	:	Positive Material Identification
PO	:	Purchase Order
PR	:	Purchase Requisition
RFQ	:	Request for Quotation
SCRD	:	Screwed
SS	:	Stainless Steel
SW	:	Socket Weld

CONTENTS

1. GENERAL.....	5
2. DOCUMENTATION	5
3. DESIGN AND CONSTRUCTION.....	5
4. OPERATION	9
5. INSPECTION AND TESTING.....	10
6. RADIOGRAPHY OF CAST VALVES	11
7. IBR CERTIFICATION	11
8. MARKING	12
9. DESPATCH.....	12
10. ATTACHMENTS	12

1. GENERAL

- 1.1** Vendor shall supply valves in accordance with the valve specification sheets along with auxiliaries, if any, such as gear operator, bypasses, drains, locking arrangements etc. wherever specified in the specification sheets, subject notes and other enclosures to the material requisition (MR).
- 1.2** Vendor shall quote in strict accordance with the valve data/ specification sheets, subject technical notes and all other enclosures to the MR. For all valves, no deviations whatsoever shall be accepted.
- 1.3** All codes and standards for manufacture, testing, inspection etc. shall be of latest editions as on issue date of Material Requisition.

2. DOCUMENTATION

- 2.1** For all valves, vendor shall submit the following documents with the offer:
- 2.1.1 Manufacturers complete descriptive and illustrative catalogue/ literature.
- 2.1.2 Detailed dimensioned cross section drawing with parts/ material lists, weight etc.
- 2.1.3 Drawings for valves with accessories like gear operator, hydraulic/ pneumatic operator, motor, extension bonnet, extended stems with stands, bypass etc. giving major salient dimensions.
- 2.1.4 One copy of the valve specification sheets signed as "Accepted" by the manufacturer. Deviations, if any shall be marked as applicable on the valve specification sheet.
- 2.1.5 If the valve is regretted or has no deviation, the manufacturer shall write clearly on valve specification sheets as "Regret" or "No Deviation".
- 2.1.6 On failure to submit documents as specified in clauses 2.2.1 to 2.2.6 above, the offer is likely to be rejected.
- 2.2** The following documents shall be submitted in soft and hard copy after placement of the order.
- 2.2.1 For all valves to manufacturers' standard specified in MR/valve specification sheet, detailed dimensioned cross section drawing with parts, materials, weight, etc. shall be submitted for records/information/ review.
- 2.2.2 Test report shall be supplied for all mandatory tests as per the applicable code. Test reports shall also be furnished for any supplementary tests as specified in clauses 3.15.
- 2.2.3 Material test certificates (physical properties, chemical composition & heat treatment report) of the pressure containing parts shall be furnished for the valves supplied. Material test certificates for the other parts shall also be furnished for verification during inspection.
- 2.3** Catalogues/Drawings (6 sets) shall be submitted in hard copies (6 sets) and soft copies (2 CDs/DVDs) along with delivery for Purchaser's record for all categories/ types of valves.

3. DESIGN AND CONSTRUCTION

- 3.1** Valve shall be designed, manufactured, tested, inspected and marked as per the manufacturing standards, design codes and standards indicated in the respective valve specification sheets. Any conflict between the requisition, enclosures, specification

sheets and referred standards/ codes shall be brought to the notice of the purchaser for clarifications and resolution, before proceeding with the manufacture. The purchaser's decision shall be final and binding to the vendor. The drawings submitted for review shall not include any deviations except as communicated in writing in Deviation permits. The Drawings shall be reviewed only for design and construction features.

- 3.2** All flanged valves shall have flanges integral (except forged valves) with the valve body. Flange face finish shall be normally specified in the valve specification sheet as 125 AARH etc. The interpretation for range of face finish shall be as follows:

Stock Finish	: 1000 p. in AARH max.
125 AARH	: Serrations with 125 to 250 p in AARH
63 AARH	: 32 to 63 p. in AARH

- 3.3** For all weld end valves with bevel end as per ASME B 16.25, the contour of bevel shall be as follows:

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

Valve ends shall match thickness of the connecting pipe. Sloping of inside contour of valves shall be done wherever necessary to achieve this.

- 3.4** For flanged valves with ring joint flanges the hardness shall be as follows:

Flange Material	Min. Hardness of Groove (BHN)
Carbon Steel	140
1% Cr to 5% Cr, 9% Cr	150
Type 304, 316, 321, 347	160
Type 304L, 316L	140

- 3.5** Following requirements for check valves shall be met over and above the valve specification sheet requirements:

- 3.5.1** Unless specified otherwise in the data sheet all check valves 3" & above (except in 900#, 1500# & 2500# rating) shall have a drain boss at location "G" (Refer Fig.No.1 of ASME B16.34) where pocket is formed in valve body. A tapped drain hole with plug shall be provided as per ASME B 16.34. Threads shall be as per ASME B 1.20.1 (Taper) NPT.
- 3.5.2** For heavy check valves, provisions shall be available for lifting by way of lugs, eye bolts and other such standard devices.

3.6 If an overlay weld-deposit is used for the body seat ring seating surface, the corrosion resistance of the seat ring base material shall be at least equal to the corrosion resistance of the material of the shell.

3.7 Following valve bypass requirements shall be met:

3.7.1 By-pass requirement for Gate valves shall be as follows unless otherwise mentioned.

ASME 150 Class	On sizes 26" and above
ASME 300 Class	On sizes 16" and above
ASME 600 Class	On sizes 6" and above
ASME 900 Class	On sizes 4" and above
ASME 1500 Class	On sizes 4" and above
ASME 2500 Class	On sizes 3" and above

3.7.2 The by-pass piping arrangement shall be such that clearance between main valve body and bypass assembly shall be the minimum possible for layout reasons. Vendor shall follow the sketch enclosed in this Specification No. SS-PI-012_A1.

3.7.3 By-pass valve shall be a globe valve. The sizes shall be as under:

On main valve ≤ 4"	:	1/2"
On main valve 6" to 8"	:	3/4"
On main valve 10" & above	:	1"

By-pass piping shall be of same metallurgy as main valve. The by-pass piping, fittings and valve tag numbers shall be as specified in Piping Material Specification (PMS).

3.8 Vendor shall supply the by-pass valve duly tested and fitted to the main valve. Valves with by-pass shall have the direction of flow marked on the main valve. By-pass attachment to the main valve body shall not be screwed. All fillet welds for by-pass installation shall be 100% examined by DP/MP test and Butt-weld joints shall be 100% examined by radiography.

3.9 Valve body / bonnet shall be forged / cast as specified. Forgings are acceptable in place of casting but not vice-versa.

3.10 Stem shall be forged or machined from forged / rolled bar. No casting is permitted. However, integral stem of cast material is acceptable for Plug valves.

3.11 Stellite/ hardfacing by deposition shall be minimum 1.6 mm.

3.12 Renewable seat rings shall be seal welded for valves of size 3" and above to prevent loosening in service.

3.13 For Low Temperature & Cryogenic valve requirements, refer Specification. No. SS-PI-012_A2 unless otherwise specified.

3.14 For all austenitic stainless steel valves Inter Granular Corrosion (IGC) test shall be conducted as per the following:

3.14.1 ASTM A262 Practice 'B' with acceptance criteria of '60 mils/year (max.)' for all

materials forged, rolled, wrought and casting.

Or

ASTM A262 Practice 'E' with acceptance criteria of 'No cracks as observed from 20X magnification' for all materials other than castings. Microscopic structure to be observed from 250X magnification' in addition.

3.14.2 When specifically asked for in MR for high temperature application of some grades of austenitic stainless steel (eg. SS309, 310, 316, 316H etc) ASTM A262 Practice 'C' with acceptance criteria of '15 mils/year (max.)' shall be conducted.

3.14.3 For the IGC test as described in Clauses 3.15.1 & 3.15.2, two sets of samples shall be drawn from each solution annealing lot. One set shall correspond to the highest Carbon content and the other to the highest pressure rating. When testing is conducted as per practice 'E', of the microscopic structure shall be submitted for record.

3.15 All types of 321 or 347 stainless steel valves shall be in a stabilized heat treated condition. Stabilizing heat treatment shall be carried out subsequent to the normal solution annealing. Soaking temperature and holding time for stabilizing heat treatment shall be 900°C and 4 hours respectively.

3.16 Spiral wound bonnet gaskets are to be provided with inner/ outer ring except when encapsulated gaskets type body-bonnet joints are employed. Outer ring may be avoided case of non-circular spiral wound gasket used in 150# valve provided the outermost layer of spiral touches the bolts ascertaining the centering.

3.17 All Stainless Steel Castings shall be solution heat treated.

3.18 Only normalized and tempered material shall be used in the following specifications:

Castings : A217 Gr.WC1, A217 Gr.WC4, A217 Gr.WC5, A217 Gr.WC6, A217 Gr.WC9, A217 Gr.C5, A217 Gr.C12

Forgings : A182 Gr.F11 C1.2, A182 Gr.F12 C1.2

3.19 Ball / Plug / Butterfly Valves

3.19.1 As a prequalification, fire safe test as per API 607/ API 6FA/ BS EN ISO 10497 (Supersedes BS 6755 Part II) shall be carried out on soft seated ball, plug & butterfly valves and also on lubricated plug valves The test shall be witnessed and certified by a approved third party inspection agency unless otherwise specified. The vendor has to submit test certificate for the particular design of the valve offered, if fire safe design is required as per the Valve Material Specification sheet.

3.19.2 Each valve shall be supplied with a lever / wrench except for gear operated / motor operated valves.

3.19.3 Soft-seated ball, plug & butterfly valves shall be supplied with antistatic devices.

3.19.4 BW / SW end ball valves shall have pipe nipple/ pup piece welded to each end of the valve. As specified in valve datasheets nipples/ pup piece are to be welded prior to assembling Teflon seats / seals. Specifications of the nipples shall be as indicated in the MR.

3.19.5 The face-to-face dimensions of all ball valves shall be same as those of gate valves of the corresponding ANSI class (except 10" onwards in Class 150 where the face-to-face dimensions shall be as per API 6D long patterns).

3.19.6 The ball of ball valve shall not protrude outside the end flanges of valve.

3.19.7 All Ball valves shall be of floating ball/ trunnion mounted type as per following:

150#	8" & below 10" & above	Floating ball Trunnion mounted
300#	4" & below 6" & above	Floating ball Trunnion mounted
600# & above	1.5" & below 2" & above	Floating ball Trunnion mounted

3.19.8 Unless otherwise specified in the data sheets/ MR, bore of all reduced bore ball valves shall be limited to one size lower than the nominal bore.

3.20 The MOVs are to be installed in an open area and the actuators shall be suitable for all weather conditions. The testing of complete assemblies of MOVs along with the actuators shall be done by the supplier at his works.

3.21 Ends of flanged valves of 22" size shall match corresponding flanges to MSS-SP44 unless otherwise specified.

3.22 Yoke material shall be same as bonnet material where maximum temperature specified is more than 427°C.

4. OPERATION

4.1 Gear operation shall be provided as under:

Valve Type	Class	Size Requiring Gear-Operator
Gate Valve, Globe Valve & Diaphragm Valve	150 Class	12" and larger
	300 Class	12" and larger
	600 Class	10" and larger
	900 Class	6" and larger
	1500 Class	3" and larger
	2500 Class	3" and larger
Ball Valve / Plug Valve (Other than pressure balance plug valves)	150 Class	6" and larger
	300 Class	6" and larger
	600 Class	4" and larger
	900 Class	3" and larger
	1500 Class	3" and larger
Butterfly Valve	150, 300 Class	6" and larger

For sizes lower than these ranges, hand wheel / lever / wrench shall be provided. For pressure balance plug valves manufacturer's recommendation shall be acceptable provided the requirements specified in clause 4.6 are met.

- 4.2** Gear operator shall be provided, with position indicators for open / close positions and with limit stops. (Limit stops are not applicable for gate and globe valves).
- 4.3** Where gear operator is not called for as per Clause 4.1 but vendor recommends a gear operator, the same shall be highlighted.
- 4.4** Gear operator shall be so designed as to operate effectively with the differential pressure across the closed valve equal to the cold non-shock pressure rating.
- 4.5** Ball, plug and butterfly valves, shall have "Open" position indicators with limit stops.
- 4.6** Hand wheel diameter shall not exceed 750mm and lever length shall not exceed 500mm on either side. Effort to operate shall not exceed 35 Kg at hand wheel periphery. However, failing to meet the above requirements, vendor shall offer gear operated valve and quote as per clause 4.3.

5. INSPECTION AND TESTING

- 5.1** Every valve shall be subjected to all the mandatory tests and checks called in the respective codes/ data sheet by any third party as approved by the purchaser. For IBR valves refer clause 7.0.
- 5.2** Every valve, its components and auxiliaries must be subjected to all the mandatory tests and checks called for in the respective codes, data sheets etc. by the manufacturer.
- 5.3** Though the extent of inspection shall be as under, exact extent withhold points shall be decided by company/ company representative and recorded in the form of inspection plan. In case of third party inspection, the inspection plan shall be approved by the purchaser.

Forged Valves:

1. Visual and dimensional inspection.
2. Review of material test certificates.
3. Any mandatory or supplementary test.
4. Hydrostatic test on 10% valves selected on random basis.
5. Strip check is required for 1% of total ordered quantity of Gate & Globe valves (min. 1 No.) for each Valve sheet no., however, strip check is not required for CS/ Brass/ Bronze material valves with 13% Cr/ Brass/ Bronze trims.

Cast Steel Valves:

1. Visual and dimensional inspection.
2. Review of material test certificates.
3. Review of radiographs/radiographic reports or any other NDT tests wherever applicable as per data sheet.
4. Any mandatory or supplementary test.
5. Hydrostatic test 100% for body, 10% other test.
6. Strip check is required for 1% of total ordered quantity of Gate & Globe valves (min. 1 No.) for each Valve sheet no., however, strip check is not required for CS/ Brass/ Bronze material valves with 13% Cr/ Brass/ Bronze trims.

Samples for strip check shall be selected at random and shall generally be in the highest size in the lot.

- 5.4** In case of motor operated or actuator operated valves, functional/ operational checks as per the requirements of the specifications shall be made on each valve.

6. RADIOGRAPHY OF CAST VALVES

- 6.1** Valve castings shall undergo radiographic examination as specified below.

Material	Rating	Size Range	Radiography
All	150#	24" and below	NIL**
		26" and above*	100%
	300#	16" and below	NIL**
		18" and above	100%
	600# & above	All sizes	100%

* No radiography is required for valves of size 26" and above in cooling water service.

**For sizes 24" & below in 150# and 16" & below in 300#, radiography percentage if specifically mentioned in individual valve material spec sheet shall govern.

Radiography specified as random 10% or 20% etc. in the respective valve data sheet implies 10% or 20% etc. of number of valves ordered against each item number with a minimum of one valve against each item.

- 6.2** Radiography procedure, areas of casting to be radiographed shall be as per ASME B 16.34 and acceptance criteria shall be as per ASME B 16.34 Annexure-B. However for areas of casting to be radiographed for types of valves not covered in ASME B 16.34, vendor shall radiograph castings in line with ASME B 16.34.
- 6.3** For random radiography wherever specified in individual data sheets, the sampling shall be per size of the quantity ordered for each foundry.
- 6.4** Radiography wherever specified in the data sheets or as per clause 6.1 shall be done by X-ray / Gamma-ray to get the required sensitivity.

7. IBR CERTIFICATION

- 7.1** For valves described "IBR", valves shall be in accordance with the latest IBR (Indian Boiler Regulation) including the requirements specified in the specification.
- 7.2** For SW / BW end carbon steel valves under IBR, the chemical composition shall conform to the following:

Carbon (Max) : **0.25%**

Others (S, P, Mn) : **As per IBR**

- 7.3** Valves coming under the purview of "IBR"(Indian Boiler Regulations) shall each be individually accompanied by IBR certificate original in Form III-C duly approved by IBR authority / local authority empowered by the Central Boiler Board of India. Photocopy

of original certificate duly attested by the local boiler inspector where the supplier is located is the minimum requirement for acceptance.

7.4 All "IBR" valves shall be painted red in body-bonnet / body-cover joint.

8. MARKING

8.1 Valve markings, symbols, abbreviations etc. shall be in accordance with MSS-SP-25 or the standard referred in specification sheet as applicable. Vendor's name, valve rating, material designation, nominal size, direction of flow (if any) etc. shall be integral on the body.

8.2 Each valve shall have a corrosion resistant tag giving size, valve tag / code no., securely attached to the valve body.

8.3 Paint or ink for marking shall not contain any harmful metal or metal salts such as zinc, lead or copper which cause corrosive attack on heating.

8.4 Carbon Steel / Alloy Steel valves shall be painted with one coat of inorganic zinc silicate (minimum DFT 65 to 75 microns).

9. DESPATCH

9.1 Valve shall be dry, clean and free from moisture, dirt and loose foreign materials of any kind.

9.2 Valves shall be protected from rust, corrosion and any mechanical damage during transportation, shipment and storage.

9.3 Rust preventive on machined surfaces to be welded shall be easily removable with a petroleum solvent or shall not be harmful to welding.

9.4 Each end of valve shall be protected with the following materials:

Flange Face	:	Wood or Plastic Cover
Bevelled End	:	Wood or Plastic Cover
SW & SCRD. End	:	Plastic Cap

9.5 End protectors of wood / plastic to be used on flange faces shall be attached by at least three bolts and shall not be smaller than the outside diameter of the flange. However, plastic caps for SW & SCRD end valves shall be press fit type.

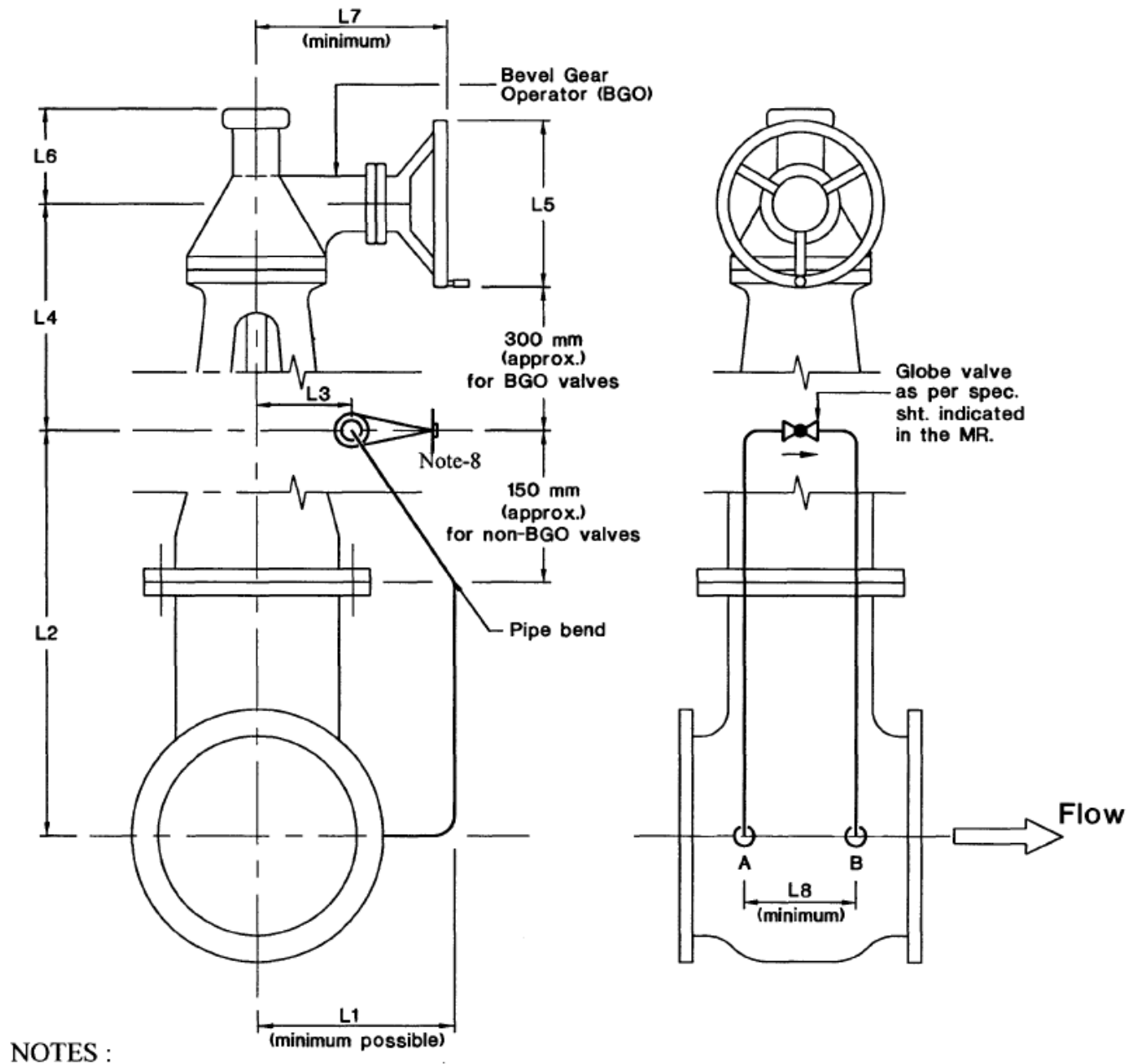
9.6 End protectors to be used on beveled end shall be securely and tightly attached.

9.7 For special service valves additional requirement for dispatch shall be as prescribed in data sheet.

10. ATTACHMENTS

SS-PI-012_A1	:	Bypass Piping Arrangement
SS-PI-012_A2	:	Special Requirements for Low Temperature and Cryogenic Valves

**BYPASS PIPING ARRANGEMENT
(SS-PI-012-A1)**



1. The orientation & location of hand wheel of bevel gear operator & the bypass arrangement shall be strictly as per this sketch.
2. The bypass connection ends shall be socket welded up to 600# and butt welded for 900# and above rating.
3. The bypass arrangement shall be properly clamped to & supported by the body of the main valve.
4. Basic design of bypass shall be to MSS-SP-45.
5. Material of bypass pipe & 90° elbows shall be same or equivalent to the body material.
6. Sketch is applicable for both BGO & NON-BGO Valves.

7. Vendor shall furnish dimensions L1 to L8.
8. Stem shall not be horizontal in the case of CRYO Valves

SPECIAL REQUIREMENTS FOR LOW TEMPERATURE & CRYOGENIC VALVES (SS-PI-012-A2)

11. SCOPE

All valves of Low Temperature Carbon Steel (LTCS) and all grades of austenitic (CRYO) materials are categorized as cryogenic valves. All these valves shall have extended bonnet as per BS 6364 except check valves.

Following qualification criteria shall be met by the valve vendors to quote valves for cryogenic services:

12. QUALIFICATION CRITERIA

- I. Both cryogenic test (clause 2.1) and reference list (clause 2.2) together shall be for vendor qualification and vendor shall furnish the same, along with his offer.
- II. Vendors who do not have cryogenic test reports and reference list covering valves of all materials and ratings required by MR, should confirm / furnish the following for consideration of their offer:
 - a. Evidence of having conducted successfully at least one cryogenic test as per BS 6364. Test certificate shall be furnished with the offer.
 - b. Vendor shall confirm to conduct cryogenic test per clauses 2.1 & 2.3 for the remaining valves not later than 12 weeks from the date of purchase order.
 - c. Vendor shall also furnish reference list for valves supplied for non-cryo service if reference list referred in 2.2.1 does not cover all the sizes of MR.

Offers of vendors who do not comply with above requirements would be rejected.

12.1 Cryogenic Test

Vendors to furnish copies of cryogenic test certificate for tests conducted as per given below:

- 12.1.1 Test shall be as per BS 6364.
- 12.1.2 Test temperature, unless specifically called for otherwise in the individual MR, shall be -45°C for LTCS and -196°C for all grades of austenitic stainless steel.
- 12.1.3 Tests carried out on a particular size of one type of valve, pressure rating and material shall qualify all sizes equal to and below the test valve size for the same type, pressure rating and material. In case of austenitic SS any one grade would qualify for all other grades of austenitic SS.
- 12.1.4 Tests should have been witnessed and certified by approved third party inspection agencies.
- 12.1.5 Cryogenic test need not be conducted for every order. Test conducted previously and witnessed by inspection agencies listed above shall be considered acceptable and need not be repeated.

12.2 Reference List

Vendor shall furnish reference list for valves supplied for cryogenic service indicating the name of client, year of supply, size, material, pressure rating, type of valve and quantity.

12.3 Post Order Testing Procedure

12.3.1 Before conducting post order testing, vendor shall submit the following for approval:

- a. Test procedure (as per BS 6364).
- b. Cross-section drawing of the valve with material of construction.
- c. Schematic of test rig (as per BS 6364) with complete details.

12.3.2 Test has to be conducted irrespective of the service on largest size for each type of valve and for each material and class rating. Vendor shall offer one, two or three valves for selection of test valve by inspector depending upon whether quantity of largest valve in the order is one, two or three and more than three respectively.

In the event of failure of the test valve to meet the specification requirements, the vendor shall conduct test on two more valves. These two valves which pass test successfully, are of lower size, then the qualification will be valid only to sizes upto which test has been conducted successfully.

12.3.3 In case of non-conductance of cryogenic test(s) within 12 weeks or failure in the test(s) conducted after receipt of order, the owner reserves the right to invoke any of the of the purchase order including cancellation of the purchase order at the risk and cost of vendor.

- 13.** Bonnet extension, wherever specified in the valve sheet to BS 6364 shall be for "non cold box application" unless otherwise specified in the MR. Even if not called for in valve sheet, valves indicated as "LT" or "CRYO" shall be supplied with bonnet extension.
- 14.** Bonnet and Gland extension joints shall be of butt welded/integrally cast construction.
- 15.** Repair welding procedure for austenitic stainless steel valves in "CRYO" service shall have to be qualified for impact test as per ASME B31.3. Minimum acceptable impact energy shall be 20 J or lateral expansion of 0.38 mm at temperature of -196°C.
- 16.** Wherever impact test of SS studs / nuts is called for in the data sheet, the impact value shall be 27 J at the intended service temperature specified in the data sheets.



ENERGISING QUALITY

VCS QUALITY SERVICES PVT. LTD.

STANDARD SPECIFICATION FOR FABRICATION AND ERECTION OF PIPING

VCS-SS-PP-2507

					
01	30.06.2022	RP	MC	HK	GW
00	13.05.2017	CM	SM	AD	SK
Rev. No	Date	Prepared By	Checked By	Approved By	Authorized By
UNCONTROLLED COPY : If printed					
CONTROLLED COPY : If in soft and signed					

REVISION RECORD

Rev.	Revision Date	Prepared by	Checked by	Approved by	Authorized by	Revision Description
00	28.01.2020					
		MB	AK	AD	SK	
01	30.06.2022					VCS QMS Integration
		RP	MC	HK	GW	

Abbreviations:

AS	:	Alloy Steel
ASME	:	American Society of Mechanical Engineers
CI	:	Cast Iron
CS	:	Carbon Steel
HMTD	:	Heat & Mass Transfer Division
IBR	:	Indian Boiler Regulations
LTCS	:	Low Temperature Carbon Steel
NACE	:	National Association of Corrosion Engineers
NB	:	Nominal Bore
NDT	:	Non Destructive Testing
P & ID	:	Piping and Instrumentation Diagram
PMI	:	Positive Material Identification
SS	:	Stainless Steel
SMMS	:	Specialist Material & Maintenance Services

CONTENTS

1.0	SCOPE.....	4
2.0	SCOPE OF WORK OF CONTRACTOR	4
3.0	BASIS FOR WORK	6
4.0	FABRICATION.....	7
5.0	ERECTION	10

1.0 SCOPE

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

2.0 SCOPE OF WORK OF CONTRACTOR

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

2.1 Transportation of required piping materials (as described in C1.2.1.1), pipe support (material as described in C1. 2.3) and all other necessary piping materials from Owner's storage point or Contractor's storage point (in case of Contractor's scope of supply) to work site/shop including raising store requisitions for issue of materials in the prescribed format & maintaining an account of the materials received from Owner's stores.

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

- a. Pipes (All sizes and schedule)
- b. Flanges (All sizes, types & Pressure ratings).
- c. Fittings (All sizes, types and schedule)
- d. Valves (All sizes, types and Ratings)
- e. Gaskets (All sizes, types & Ratings)
- f. Bolts, Nuts or M/C Bolts (All types)
- g. Expansion Joint/Bellows (All types)
- h. Specialty items like online filters, ejectors, sample coolers, steam traps, strainers, air traps, springs, silencers, snubbers, steam and condensate manifolds, injection nozzles, MOVs, sight glass, spray nozzles, integrated steam traps, hoses, hose couplings, etc.
- i. Online instruments like control valve, orifice flange, rotameter, safety valves, restriction orifice, rupture disc, de-super heaters, corrosion probes, annubar, magnetic flow meter, ultrasonic flow meter, Coriolis mass flow meters, venturi PG/PT/ Flow transmitter, ejectors, static mixers, flame arrestors, thermal flow switches, pre-fabricated hook-ups etc.
- j. Shutdown Valves with and without fire box.

2.2 Shop & field fabrication and erection of piping in accordance with documents listed under C1.3.0 i.e. 'BASIS OF WORK' including erection of all piping materials enumerated above.

2.3 Fabrication and erection of pipe supports like shoe, saddle, guide, stops, anchors, clips, cradles, hangers, tum-buckles, supporting fixtures, bracket cantilevers, struts, tee-posts including erection of spring supports, sway braces, dummy pipes, corrosion pads/protection shields, low friction pads, clamps, special support, expansion bellows, steam and condensate manifolds supports etc. Corrosion Pads/Protection shields, stiffeners and stiffening rings, if not covered in the specifications/standards, shall be of the same material as of parent pipes.

2.4 Site fabrication of Piping items

Site fabrication of Piping items shall include but not be limited to the following

- 2.4.1 Fabrication of piping specials like special radius bends, reducers, mitres etc.
- 2.4.2 Fabrication of plain and threaded nipples from pipes as required during erection.
- 2.4.3 Fabrication of swage nipples as and when required.
- 2.4.4 Fabrication of odd angle elbow like 60°, 30° or any other angle from 90°/45° elbows as and when required.
- 2.4.5 Fabrication of flange, reducing flange, blind flange, spectacle blinds as and when required.
- 2.4.6 Fabrication of stub-in connection with or without reinforcement.
- 2.4.7 Grinding of edges of pipes, fittings, flanges etc. to match mating edges of uneven/different thickness wherever required.
- 2.4.8 Fabrication of circular pipe for steam rings, fire water lines, utility lines.
- 2.4.9 Threading of all small bore piping as per piping material specifications.
- 2.4.10 Drilling on blind flange for inserting / joining small bore lines.
- 2.4.11 Fabrication and welding of reinforcement pads at branch pipe locations wherever required.
- 2.4.12 Equipment nozzle reinforcement with pads, jacket & stiffeners wherever required.
- 2.4.13 Fabrication of injection nozzles as per details provided wherever required.
- 2.4.14 Fabrication of chain operation arrangement for valves, wherever required. All material required for this modification shall be supplied by Contractor.
- 2.4.15 Fabrication and erection in position of funnels required for OWS/ SS/ Condensate blow down system as per direction of Engineer-in-charge.
- 2.4.16 Grinding & finishing of uneven surfaces/ joints after welding. Internal grinding of welds of orifice flanges to render smooth surface.
- 2.4.17 Tapping and drilling of holes in flanges, blind flanges, piping connections for jack screw, if required.
- 2.4.18 Providing bird screens at the outlet of lines open to atmosphere.
- 2.5 Modifications like providing additional cleats, extension of stem of valve, locking arrangement of valves etc. as and when required.
- 2.6 Piping isometrics for main process/utility lines shall be provided to the Contractor.

Preparation of miscellaneous small bore isometrics with bill of materials for process and utility lines (up to 1½" size) like instruments & pump flushing / cooling, sample connection, purging, pump casing vents & drains, pump base plate drains, control valve drains / vent to flare, instrument drains & vents, steam tracing (non-IBR) from steam supply stations up to condensate recovery station, and lines specified as field routed within the Unit battery limit as and when required are in Contractor's scope of work. Approval for these isometrics prepared by the Contractor shall be taken from Engineer-in-charge before erection.

Small bore piping isometrics given by Owner shall be rechecked by Contractor before erection and installation.
- 2.7 Obtaining approval for drawings prepared by Contractor from statutory authority, if required.
- 2.8 Spun concrete lining of the inside of pipes 3" NB & above including fittings and flanges as

required in accordance with specification.

- 2.9 Rubber lining inside pipes, fittings, flanges as and when required, in accordance with specification.
- 2.10 Radiography, stress relieving, dye penetration, magnetic particle test etc. as required in specification.
- 2.11 Performing PMI using alloy analysers as per Standard Specification for Positive Material Identification at Construction Sites, VCS-SS-PP-2502.
- 2.12 Casting of concrete pedestals and Fabrication and erection of small structures/ platforms for pipe supports and valve operation / attending some instruments, spectacle blinds etc., providing brackets, modification / extension of platforms, providing additional platforms / ladders for improving / providing accessibility.
- 2.13 Providing insert plates with anchor fasteners in concrete structures / paved floors and repair of platform gratings around pipe openings and providing suitable members for support under the platform grating.
- 2.14 Making material reconciliation statement and return of Owner's supply left over materials to Owner's storage.
- 2.15 Flushing and testing of all piping systems as per standard specification for inspection, flushing and testing of piping systems (Specification No. 6-44-0013). The accessories required for blinding the line like flange, blind flange, gasket (all sizes, type and rating), stud-bolts, flexible hoses etc. are to be arranged by the Contractor. During flushing the discharged water / air shall be drained / routed as directed by the Engineer - In Charge.
- 2.16 Contractor shall prepare welding specifications for all weld joints where dissimilar welding will be performed, and obtain approval from VCS.
- 2.17 Contractor to ensure meeting all requirements for carrying out work in shutdown/running plant.
- 2.18 Pickling (as and when applicable) as per Job specification(s) for chemical cleaning of CS suction piping of compressors, SS Piping, Weldment etc., as applicable.
- 2.19 Chemical Cleaning/ Hydro jet cleaning as per marked-up P&IDs with supply of chemicals, consumables, DM water, equipment's, boilers, coupons, tools & tackles and other testing equipment's required for the same.

3.0 BASIS FOR WORK

- 3.1 The complete piping work shall be carried out in accordance with the following:
 - 3.1.1 "Approved for Construction" drawings and sketches issued by VCS to the Contractor - Plans and/or Isometrics.
 - 3.1.2 "Approved for Construction" drawings and sketches issued by Turn-key bidders to the Contractor - Plans and/or Isometrics.
 - 3.1.3 Approved Process Licensor's standards and specifications.
 - 3.1.4 Drawings, sketches and documents prepared by Contractor duly approved by Engineer-in-Charge (such as isometrics of small bore piping and offsite piping etc.).
 - 3.1.5 VCS specifications / documents as below:

- a. Process and Instrument Diagram.
- b. Job Piping Materials Specification (****-6-44-0005). **** denotes job number.
- c. Piping support, engineering standards.
- d. Line list
- e. Piping support indices (only in offsite), if supports are not shown in plan.
- f. Job specification of Non-destructive Requirement of Piping (VCS-SS-PP-0036)
- g. Job Welding specification for fabrication of piping (VCS-SS-PP-0040).
- h. Any other VCS or OTHER specifications attached with Piping Material Specification or special condition of contract (such as standard for cement lining of pipe, standard of jacketed piping, standard for steam tracing, Dimensional Tolerances etc.)
- i. Standard specification for positive material identification (PMI) at construction sites, 6-82-0002
- j. Standard Spec for application of torque & hydraulic bolt tension for flange joints (6-76-0002) and its addendum, if any.

3.1.6 Following codes, standards and regulations

a.	ASME B 31.3	:	Process Piping
b.	ASME Sec. VIII	:	Code for unfired pressure vessel.
c.	IBR Regulations		
d.	ASME Sec. IX	:	Qualification standard for welding and brazing procedures, welders, brazers and welding and brazing operators.
e.	NACE Std.	:	Code for Sour Services material requirements MR-0175/MR0103/Job spec(NACE), as applicable

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

3.2 Deviations

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

4.0 FABRICATION

4.1 Piping Material

Pipe, pipe fittings, flanges, valves, gaskets, studs bolts etc. used in a given piping system shall be strictly as per the "Piping Material Specification" for the "Pipe Class" specified for that system. To ensure the above requirement, all piping material supplied by the Owner / Contractor shall have proper identification marks as per relevant standards / VCS specifications / Licensors specification. Contractor shall provide identification marks on left over pipe lengths wherever marked up pipe lengths have been fabricated / erected. Material-

traceability is to be maintained for A.S., S.S., NACE, L TCS, material for Hydrogen service and other exotic materials by way of transferring heat number, etc. (hard punching) as per approved procedure. This shall be in addition to colour coding for all piping materials to avoid mix-up.

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

Maximizing prefabrication, inspection and testing at fabrication shop with minimum field joints.

Positive material identification, handling, storage & preservation.

4.2 Dimensional Tolerances

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

4.3 IBR Piping

- 4.3.1 Contractor shall obtain approval for the piping systems falling under purview of IBR from the statutory Indian Boiler Regulations (IBR) authority of the state where the plant is situated. The Owner shall provide documentation for the IBR System. The Contractor shall carry out the fabrications, erection and testing of this piping as per requirements of Indian Boiler Regulations and to the entire satisfaction of the local Boiler Inspector. The Contractor shall also get the approval of IBR inspector for all fabrication and testing done by him at his own cost. All certificates of approval shall be in proper IBR forms.
- 4.3.2 IBR Package for residual, field routed and site modified steam lines shall be prepared by the Contractor. IBR approval for the same shall be in Contractor's scope, at his own cost.

4.4 Pipe Joints

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

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

4.5 Butt Welded and Socket Welded Piping

End preparation, alignment and fit-up of pipe pieces to be welded, welding, pre-heating, post-heating and heat treatment shall be as described in the Job welding specification (VCS-SS-PP-0040) and NDT specification (VCS-SS-PP-0036).

4.6 Screwed Piping

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

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

During assembly of threaded joints, all threads of pipes and fittings shall be thoroughly cleaned of cuttings, dirt, oil or any other foreign matter. The male threads shall be coated with thread sealant and the joint tightened sufficiently for the threads to seize and give a leak-proof joint. Threaded joints to be seal-welded shall be cleaned of all foreign matter, including sealant and made up to full thread engagement before seal welding.

4.7 Flange Connections

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

Wherever jack screws are to be provided, drilling and tapping for the jack screws in the flange, shall be done as per VCS Standard before welding it to the pipe.

4.8 Branch Connections

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

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

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

4.9 Bending

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

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

The completed bend shall have a smooth surface, free from cracks, buckles, wrinkles, bulges, flat spots and other serious defects. They shall be true to dimensions. The flattening of a bend, as measured by the difference between the maximum and minimum diameters at any

cross-section, shall not exceed 8% and 3% of the nominal outside diameter, for internal and external pressure respectively.

4.10 Forging and Forming

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

4.11 Mitre Bends and Fabricated Reducers

The specific application of welded mitre bends and fabricated reducers shall be governed by the Piping Material Specifications. Reducers shall be fabricated as per directions of Engineer-in-Charge. The radiographic requirements shall be as per Material Specifications for process and utility systems and NDT Specification for steam piping under IBR, radiographic requirements of IBR shall be complied with.

4.12 Cutting and Trimming of Standard Fittings & Pipes

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

4.13 Galvanized Piping

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

4.14 Jacketed Piping

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

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

4.15 Shop Fabrication / Prefabrication

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

4.16 Miscellaneous

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

4.16.2 Spun Concrete Lining

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

4.16.3 Fabrication of pipes from plate

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

5.0 ERECTION

5.1 Cleaning of Piping before Erection

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

5.2 Piping Routing

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

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

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

5.3 Cold Pull

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

5.4 Slopes

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

5.5 Expansion Joints / Bellows

Installation of Expansion Joints/Bellows shall be as follows:

- 5.5.1. All Expansion joints / Bellows shall be installed in accordance with the specification and installation drawings, supplied to the Contractor.
- 5.5.2. a. Upon receipt, the Contractor shall remove the Expansion Joints / Bellows from the case(s) and check for any damage occurred during transit.

- b. The Contractor shall bring to the notice of the Engineer-in- Charge any damage done to the bellows / corrugations, hinges, tie-rods, flanges/ weld ends etc.
 - c. Each Expansion Joint / Bellow shall be blown free of dust / foreign matter with compressed air or cleaned with a piece of cloth.
- 5.5.3. a. For handling and installation of Expansion Joints, great care shall be taken while aligning. An Expansion Joints shall never be slinged from bellows corrugations/ external shrouds, tie / rods, angles.
- b. An Expansion Joints / Bellow shall preferably be slinged from the end pipes / flanges or on the middle pipe.
- 5.5.4. a. All Expansion Joints shall be delivered to the Contractor at "Installation length", maintained by means of shipping rods, angles welded to the flanges or weld ends or by wooden or metallic stops.
- b. Expansion Joints stop blocks shall be carefully removed after hydrostatic testing. Angles welded to the flanges or weld ends shall be trimmed by saw as per manufacturer's instructions and the flanges or weld ends shall be ground smooth.
- 5.5.5. a. The pipe ends in which the Expansion Joint is to be installed shall be perfectly aligned or shall have specified lateral deflection as noted on the relevant drawings.
- b. The pipe ends / flanges shall be spaced at a distance specified in the drawings.
- 5.5.6. The Expansion Joint shall be placed between the mating pipe ends / flanges and shall be tack welded/bolted. The mating pipes shall again be checked for correct alignment.
- 5.5.7. Butt-welding shall be carried out at each end of the expansion joint. For flanged Expansion Joint, the mating flanges shall be bolted.
- 5.5.8. After the Expansion Joint is installed the Contractor shall ensure that the mating pipes and Expansion Joints are in correct alignment and that the pipes are well supported and guided.
- 5.5.9. The Expansion Joint shall not have any lateral deflection. The Contractor shall maintain parallelism of restraining rings or bellows convolutions.
- 5.5.10. Precautions
- a. For carrying out welding, earthing lead shall not be attached with the Expansion Joint.
 - b. The Expansion bellow shall be protected from arc weld spot and welding spatter.
 - c. Hydrostatic Testing of the system having Expansion Joint shall be performed with shipping lugs in position. These lugs shall be removed after testing and certification IS over.

5.6 Flange Connections

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

approval of Engineer-in-Charge.

Hydraulic bolt tensioning & torque tensioning shall be performed on flange joints as per the requirements specified in "standard Specification for application of Torque & bolt Tension for flange joints,VCS-SS-PP-0041 and its addendum, if any.

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

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

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

5.7 Vents and Drains

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

5.8 Valves

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

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

5.9 Instruments

Installation of in-line instruments such as control valve, orifice flange, rotameter, safety valves, restriction orifice, rupture disc, de-super heaters, corrosion probes, annubar, magnetic flow meter, ultrasonic flow meter, Coriolis mass flow meters, venturi PG/PTI Flow transmitter, ejectors, etc. and Shut Down Valves with fireboxes shall form a part of piping erection work.

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

Flushing and testing of piping systems which include instruments mentioned above and the precautions to be taken are covered in flushing, testing and inspection of piping (VCS Spec.

VCS-SS-PI-0007). Care shall be exercised and adequate precautions taken to avoid damage and entry foreign matter into instruments during transportation, installation, testing etc.

5.10 Line Mounted Equipment's / Items

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

5.11 Bolts and Nuts

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

5.12 Pipe Supports

Pipe supports are designed and located to effectively sustain the weight and thermal effects of the piping system and to prevent its vibrations. Location and design of pipe supports will be shown in drawings for lines 2" NB & above. For lines 1½"NB & below Contractor shall locate and design pipe supports in line with VCS Std's. In case of IBR Lines 1½"NB & below only indicative supporting shall be provided & detailing of such supports is in Contractor's scope. Contractor shall obtain approval of Engineer - in - Charge on drawings prepared by Contractor, before erection. However, any extra supports desired by Engineer- in-Charge shall also be installed.

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

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

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

All restraints have been installed correctly.

Clearances have been maintained as per support drawings.

Insulation does not restrict thermal expansion.

All temporary tack welds provided during erection have been fully removed.

All welded supports have been fully welded.



VCS QUALITY SERVICES PVT. LTD.

STANDARD SPECIFICATION FOR NON-DESTRUCTIVE EXAMINATION REQUIREMENTS OF PIPING

VCS – SS – PP - 2508

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Rev.	Revision Date	Prepared by	Checked by	Approved by	Authorized by	Revision Description
00	28.01.2020					
		MB	AK	AD	SK	
01	30.06.2022					VCS QMS Integration
		RP	MC	HK	GW	

Abbreviations:

AS	:	Alloy Steel
ASME	:	American Society of Mechanical Engineers
ASTM	:	American Society for Testing & Materials
CS	:	Carbon Steel
DP/LP	:	Dye/Liquid Penetrant
IBR	:	Indian Boiler Regulations
MP	:	Magnetic Particle
PMS	:	Piping Material Specification
SS	:	Stainless Steel

CONTENTS

1.0	GENERAL	4
2.0	VISUAL EXAMINATION	4
3.0	NON-DESTRUCTIVE EXAMINATION	6
4.0	TABLE-1 (with applicable notes)	7



1.0 GENERAL

1.1 Scope

This specification covers the general requirements for non-destructive examination of shop & field fabricated piping.

1.2 Related Codes & Engineering Standards

Referred codes/ standards are as follows. Latest editions of the Codes/Standards referred to shall be followed.

- a) ASME Boiler & Pressure Vessel Codes, Section V & VIII (Div.1) including addenda.
- b) ASME B31.3
- c) ASME B16.5
- d) ASME B16.34
- e) Standard Piping Material Specification; XXXX-XX-XX-XXX
- f) Standard Specification for Fabrication & Erection of Piping; VCS-SS-PP-2507
- g) ASTM E10
- h) Design Guide for Radiography Requirements; VCS-SS-PP-2506
- i) Indian Boiler Regulations (IBR)

2.0 VISUAL EXAMINATION

2.1 Weld shall be visually inspected wherever accessible in accordance with the following requirements:

a) Internal misalignment	1.5 mm or less
b) Cracks or lack of fusion	not permitted
c) Incomplete penetration	Depth shall not exceed the lesser of 0.8mm or 0.2 times thickness of thinner component joined by butt-weld. The total length of such imperfections shall not exceed 38 mm in any 150 mm of weld length.
d) Surface porosity and exposed slag inclusions (For nom. wall thickness 4.7 mm and less)	not permitted
e) Concave root surface (Suck up)	For single sided welded joints, concavity of the root surface shall not reduce the total thickness of joint, including reinforcement, to less than the thickness of the thinner of the components being joined.
f) Weld ripples irregularities	2.5 mm or less.



- g) Lack of uniformity in bead width 2.5 mm or less.
- h) Lack of uniformity of leg length 2.5 mm or less.
- i) Unevenness of bead 2.0 mm or less
- j) Weld undercutting 0.8 mm or 1/4 thickness of thinner components joined by butt weld, whichever is less. (shall be smooth finished)
- k) Overlap 1.5mm or less
- l) Bead deflection 2.5 mm or less

- m) External weld reinforcement and internal weld protrusion (when backing rings are not used) shall be fused with and shall merge smoothly into the component surfaces. The height of the lesser projection of external weld reinforcement or internal weld protrusion from the adjacent Base material surface shall not exceed the following limits:

Wall thickness of thinner component joined by butt Weld (mm)	Weld reinforcement or internal protrusion (mm) max
6.4 and under	1.6
Over 6.4 -12.7	1.2
Over 12.7 -25.4	4.0
Over 25.4	4.8

- n) Throat thickness of fillet welds:

Nominal thickness of the thinner component x 0.7 or more.

- o) Flattening

Flattening of a bend, as measured by difference between the nominal outside diameter and minimum or maximum diameter at any cross section shall not exceed 5 % of the nominal outside diameter of pipe.

- p) Reduction of wall thickness

Reduction of wall thickness of a bend, as measured by difference between the nominal thickness and minimum thickness shall not exceed 10 % of the nominal wall thickness of pipe.

2.2 Welds having any of imperfections which exceed the limitations specified in various clauses of 2.1 shall be repaired by welding, grinding or overlaying etc. Number of times of repair welding for the same weld, however shall conform to applicable notes to Table 1- Note 6(b) b.5.



3.0 NON-DESTRUCTIVE EXAMINATION

- 3.1 The type and extent of weld examination shall be in accordance with Table-1. A11 visual and supplementary methods of girth weld examination shall be in accordance with ASME B31.3 & the requirements of this standard specification.
- 3.2 Welds between dissimilar materials shall be examined by method & to the extent required for the material having the more stringent examination.



4.0 TABLE-1 (with applicable notes)

TABLE 1: CLASS, TYPE & EXTENT OF WELD EXAMINATION (CONTD.)

INSPECTION CLASS: II

INSP N. CLA SS	SERVICE	MATERI AL (NOTE 3)	P.NO .	TEMP . DEG. C	PRESS. CLASS B16.5/ B16.34	APPLICA- BLE PIPING CLASS	TYPE OF EXAMINATION	TYPE OF WELD EXAMINED				
								GIRTH BUTT WELD	SOCKET WELD (NOTE 2)	ATTAC- HMENT T WELD	FAB. BRANCH WELD (NOTE 1)	FAB. WELDS OF MITRES / REDUC.
1	2	3	4	5	6	7	8	9	10	11	12	13
II	a) ALL SERVICES COVERED UNDER INSPECTIONCLASS-1, BUT, EXCEEDING CATEGORY 'D' PR/T EMP LIMITATIONS.	CARBON STEEL	1	-29 TO 427	150# TO 60#	15HC, 30HC, 60HC						
	b) ALL SERVICES OTHER THAN COVERED UNDER INSPECTIONCLASS-1, BUT NON-TOXIC, NOT SUBJECT TO SEVERE CYCLIC CONDITIONS.						a) VISUAL	100%	100%	100%	100%	100%
	c) TOXIC, NON-LETHAL & FLAMMABLE						b) RADIOGRAPHY (NOTE 5,6)	5%	---	---	---	20%
	d) FLAMMABLE/NON FLAMMABLE & TOXIC/NON-TOXIC; NOT SUBJECT TO SEVERE CYCLIC CONDITIONS						c) MP / LP (NOTE 4,6,10,11)	---	5%	---	5%	20%
		LTCS		-45 TO 204		15HLT, 30HLT, 60HLT	d) HARDNESS	NOTE-7	NOTE-7	NOTE-7	NOTE-7	NOTE-7

REMARKS FOR ABOVE TABLE:

- i. MITRES & FABRICATED REDUCERS ARE PERMITTED ONLY IF SPECIFIED IN PMS.
- ii. NOTE- 7 FOR HARDNESS IS NOT VALID FOR P. NO. 8.



Applicable Notes to Table-1

1. Branch welds shall consist of the welds between the pipe & reinforcing element (if any), nozzles & reinforcing element and the pipe & nozzle under the reinforcing element. Reinforcing element to be interpreted as pads, saddles, weldolets, sockolets etc.
2. Seal welds of threaded joints shall be given the same examination as socket welds.
3. Unless specifically stated, all materials shall be for "Non-IBR" service.
4. Magnetic Particle & the Liquid Penetrant method of examination shall be in accordance with Section V of the ASME Boiler and Pressure Vessel Code, Article VII and VI respectively. The entire area of the accessible finished weld surface shall be examined. Selected root runs, subject to a maximum of 10%, before finished weld, may also be examined, at the discretion of the engineer-in-charge.
 - a) Wherever MP / LP testing is specified, either MP or LP test may be used. But wherever only MP test is specified, LP method of examination may be used only if MP examination is impracticable in the field as concurred by PMC/ Company site-in charge.
 - b) "Random 5%" of Liquid Penetrant / Magnetic Particle test shall mean testing, by applicable test, one weld for each twenty welds or less made by the same welding procedure. "Random 10%" shall mean testing, by applicable test, one weld for each ten welds or less made by the same welding procedure. Similarly "Random 20%" shall mean testing, by applicable test, one weld for each five welds or less made by the same welding procedure.
 - c) When Liquid Penetrant examination is specified, the surface shall be free of peened discontinuities.
 - d) Inspection shall be performed in the welds excluding those for which radiography has been done.
 - e) Girth weld, branch weld, attachment weld & socket weld of 3-1/2% Ni steel shall be Liquid Penetrant tested only when welded with austenitic material where MP test has been specified.
5. Radiography:
 - a) "Random 5%, 10% or 20% radiography" shall mean examining not less than one from each 20 welds or less in case of "Random 5% radiography", 10 welds or less in case of "Random 10% radiography", one from each five welds or less in case of "Random 20% radiography" made by the same welding procedure. Irrespective of percentage, no. of welds to be radiographed shall be minimum 1. However first two welds made by each welder shall also be radiographed in case of "Random radiography". Welds selected for examination shall not include flange welds and shall be radiographed for their entire length. However, where it is impossible or impracticable to examine the entire weld length of field welds for either random or 100% radiography, and if the same impossibility is agreeable to site-in-charge, then a single 120 deg. exposure of the weld length may be given a Magnetic Particle test or Liquid Penetrant test.



However in such cases for ferro-magnetic materials, only MP test shall be acceptable for classes higher than 600#.

- b) In-process examination shall not be substituted for any required radiographic examination.
- c) Number of radiography per one circumferential weld shall be as per ASME Sec.V Articles 2 and 22.

6. When radiography or other non-destructive inspection is specified, acceptance criteria for repairs or defects shall be as follows:

- a) In case of 100% examination, any unacceptable weld shall be repaired and re inspected.
- b) If required random examination reveals a defect requiring repair, then:
 - i. Two additional examinations of same type shall be made of the same kind of item (if welded joint, then by the same welding procedure or operator or both).
 - ii. If the group of items examined as required by b.1 above is acceptable, the items requiring repair shall be repaired or replaced and re-examined as required and all items represented by this additional examination shall be accepted.
 - iii. If any of the items examined as required by b.1 above reveals a defect requiring repair, two further comparable items shall be examined for each defective item found by examination.
 - iv. If all the items examined as required by b.3 are acceptable, the items requiring repair shall be repaired or replaced and re-examined as required, and all items represented by this further examination shall be accepted.
 - v. Number of times repair welding could be done for the same weld before acceptance shall be as follows:

Material	No. of times repair welding is allowed
C.S. up to 300#	3 or less
C.S. above 300#	2 or less
Killed steel	2 or less
Low alloy steel	2 or less
Austenitic S.S.	2 or less
3.5 Ni steel	2 or less
Al & Al base alloy	2 or less



Cu & Cu base alloy 2 or less

Others 2 or less

- vi. Welds not found acceptable for allowed number of times of repair as per b.5 above shall be replaced and re-examined.
- vii. If any of the items examined as required by b.4 above reveals a defect requiring repair, all items represented by these examinations shall be either :
- Repaired or replaced and re-examined as required.
 - Fully examined and repaired or replaced as necessary, and re-examined as necessary.

7. Hardness Test:

- a) Hardness test shall be in accordance with ASTM specification E10. Hardness tests of the heat affected zone shall be made at a point as near as practicable to the edge of the weld. One test per weld shall be performed.
- b) Hardness test where specifically called out in Table-1 of this specification or in PMS, shall be carried out irrespective of thickness and to the extent (%age) as mentioned therein.
- c) All welds which are given heat treatment shall be hardness tested. Hardness test shall be performed after final heat treatment.
- d) A minimum of 10% of welds, hot bends, and hot formed components in each furnace heat treated batch and 100% of those which are locally heat treated shall be hardness tested.
- e) Hardness test requirement not covered in this specification shall be as per ASME B31.3.
- f) The hardness limit applies to the weld and heat affected zone. Following hardness values shall be maintained:

Base Metal Group	Maximum Hardness (BHN/RC)
CS	238BHN/RC22
CS (NACE), Caustic, Amine, H ₂	200BHN
Cr Up to 2%	225BHN
Cr 2.25%-10%	241BHN
18/8 SS (NACE)	RC22

8. For IBR service lines, following IBR requirements shall apply in addition to the notes 4, 5, 6, 7, 12 and Table 1. In case of conflict between above notes and these requirements, the more stringent ones shall apply. IBR piping shall be erected of IBR inspector approved



material and construction procedure. Erected piping shall be hydro tested, inspected and approved by IBR inspector.

a) Piping over 102 mm (4") bore:

10% of welds made by each welder on a pipeline with a minimum of two welds per welder, selected at random, shall be subjected to radiography.

b) Piping 102 mm (4") bore and under, but not less than 38 mm (1-1/2") bore:

Two percent of welds made by each welder on a pipeline with a minimum of one weld per welder, selected at random, shall be subjected to radiography or may be cut for visual examination and tests.

c) Piping less than 38 mm (1.5") bore:

Special tests are not normally required but 2% of welds by each welder on a pipe line may be cut out from the pipeline for the visual examination and bend tests.

d) Retests:

If any test specimen is unsatisfactory, two further weld specimens for retests shall be selected from the production welds and subjected to tests. In the event of failure of any retest specimens, the production welds carried out by this welder subsequent to the previous test shall be given special consideration.

9. For fabricated fittings LP test shall be done on the final pass of welding only, in addition to visual examination.
10. For mitres and fabricated reducers, LP / MP test shall be done on root pass in addition to radiography applicable to circumferential joint of respective piping class.
11. For branch connections, LP/MP test shall be done on root pass and final pass.
12. 10% of the butt weld joints shall be radiographed, however, 50% of these butt weld joints shall be field weld joints.
13. For lined specs, testing (MP/LP/Radiography etc.) shall be performed before lining.



VCS QUALITY SERVICES PVT. LTD.

WELDING SPECIFICATION FOR FABRICATION OF PIPING

VCS-SS-PP-2509

01	30.06.2022	RP	MC	HK	GW
00	28.01.2020	MB	AK	AD	SK
Rev. No	Date	Prepared By	Checked By	Approved By	Authorized By

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REVISION RECORD

Rev.	Revision Date	Prepared by	Checked by	Approved by	Authorized by	Revision Description
00	28.01.2020					
		MB	AK	AD	SK	
01	30.06.2022					VCS QMS Integration
		RP	MC	Hk	GW	

Abbreviations:

ASME	:	American Society of Mechanical Engineers
ASNT	:	American Society for Non-destructive
Testing AWS	:	American Welding Society
BPVC	:	Boiler & Pressure Vessel Code
CFH	:	Cubic Feet per Hour
DWDI	:	Double Wall Double Image
DWSI	:	Double Wall Single Image
GTA	:	Gas Tungsten Arc
GTAW	:	Gas Tungsten Arc Welding
IBR	:	Indian Boiler Regulations
IQI	:	Image Quality Indicator
NDT	:	Non Destructive Testing
PQR	:	Procedure Qualification Record
RT	:	Radiographic Testing
SMAW	:	Shielded Metal Arc Welding
SWSI	:	Single Wall Single Image
UTS	:	Ultimate Tensile Strength

CONTENTS

1.0	GENERAL	4
2.0	APPLICABLE CODES & STANDARDS	4
3.0	BASE METAL	4
4.0	WELDING CONSUMABLES	5
5.0	SHIELDING & PURGING GAS	5
6.0	EQUIPMENTS & ACCESSORIES	6
7.0	WELDING PROCESS	6
8.0	EDGE PREPARATION	6
9.0	ALIGNMENT & SPACING.....	7
10.0	WEATHER CONDITIONS.....	7
11.0	WELDING TECHNIQUE.....	7
12.0	HEAT TREATMENT.....	8
13.0	CLEANING OF THE WELD JOINT.....	10
14.0	INSPECTION AND TESTING	10
15.0	REPAIRS OF WELDS	13
16.0	DOCUMENTS TO BE SUBMITTED BY CONTRACTOR (4 COPIES EACH)	14
	FORMATS EXHIBIT A TO EXHIBIT H	

(This specification shall be used in conjunction with Welding Specification Charts).

1.0 GENERAL

This specification shall be followed for the fabrication of all types to welded joints of piping system within the battery limits of the plant.

The welded pipe joints shall include the following:

- a) All pipe joints, longitudinal butt welds, circumferential butt welds and socket welds.
- b) Attachments of forgings, flanges and other supports to pipes.
- c) Welded manifold headers and other sub-assemblies.
- d) Welded branch connections with or without reinforcing pads.
- e) Joints in welded/fabricated piping components.
- f) The attachments of smaller connections for vents drain drips and other instrument tapping's.

Any approval granted by the Engineer-in-Charge or Owner's inspector, shall not relieve the Contractor of his responsibilities and guarantee.

This specification shall not be applicable for welding of pipelines for transportation of liquid petroleum, gas and other similar products in onshore and off shore.

2.0 APPLICABLE CODES & STANDARDS

All welding work, equipment's for welding, heat treatment, other auxiliary functions and the welding personnel shall meet the requirements of the latest editions of the following accepted standards and procedures unless otherwise specified in the Welding Specification Chart and the Technical Notes attached thereof. In the case of conflicting requirements, the requirements mentioned in Welding Specification Chart/Technical Notes shall be applicable.

- i. ASME Code for Pressure Piping - ASME B31.3
- ii. ASME Boiler & Pressure Vessel Code, Sec II Part C, Material Specifications: Welding Rods, Electrodes and Filler metals.
- iii. ASME Boiler & Pressure Vessel Code, Section V, Non-destructive examination.
- iv. ASME Boiler & Pressure Vessel Code, Section VIII, Rules for Construction of Pressure Vessels.
- v. ASME Boiler & Pressure Vessel Code, Section IX, Welding and Brazing Qualifications.
- vi. The Indian Boiler Regulations - I.B.R.

In the event of any differences due to the additional requirements mentioned in this specification, over and above those obligatory as per codes, this specification shall be binding.

3.0 BASE METAL

3.1 In general, use of carbon steel, alloy steel and stainless steel is envisaged. The details of the material specifications are given in the Welding Specification Chart.

3.2 The Contractor shall provide the manufacturer's test certificates for every heat of the materials

supplied by him.

4.0 WELDING CONSUMABLES

- 4.1** The Contractor shall provide, at his own expense, all the welding consumables necessary for the execution of the job such as electrodes, filler wires, argon etc. and these should bear the approval of the Engineer-in-Charge.
- 4.2** The welding electrodes and filler wires supplied by the Contractor shall conform to the class specified in the Welding Specification Chart. The materials shall be of the make approved by the Engineer-in-Charge.
- 4.3** Electrode qualification test records should be submitted as per the Exhibit-A (attached) in respect of the electrodes tested by the Contractor, for obtaining the approval of the Engineer-in-Charge.
- 4.4** 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.
- 4.5** All electrodes shall be purchased in sealed containers and stored properly to prevent deterioration. The electrodes removed from the containers shall be kept in holding ovens at temperatures recommended by the electrode manufacturer. "Out of the oven time" or electrodes, before they are consumed, shall not exceed the limits recommended by the electrode manufacturer. The electrodes shall be handled with care to avoid any damage to the flux covering.
- 4.6** All low hydrogen type of electrodes shall be rebaked at 350°C for 1 hour minimum and stored in ovens kept at 80-100°C before use. Recommendations of the electrode manufacturer shall be followed, if available.
- 4.7** The electrodes, filler wires and flux used shall be free from rust, oil, grease, earth and other foreign matter which affect the quality of welding.
- 4.8** Tungsten electrodes used shall conform to ASME Sec. II C SFA 5.12 specification. Thoriated Tungsten electrodes shall not be permitted due to possible radiation hazard. Instead, ceriated Tungsten Electrodes (EWCe-2 or equivalent) shall be used for GTA Welding.

5.0 SHIELDING & PURGING GAS

- 5.1** Argon gas used in GTA welding for shielding purposes shall be 99.995% pure. The purity of the gas shall be certified by the manufacturer. The rate of flow for shielding purposes shall be established through procedure qualification tests. Normally this rate may be 12-20 CFH.
- 5.2** Argon gas with a purity level of 99.995% shall be used for purging.
- 5.3** When GTAW process alone or a combination of GTAW and SMAW processes is recommended for the production of a particular joint, the purging shall be maintained during the root pass and for the first filling pass to minimize oxidation on the inner side of the pipe, unless otherwise specified in Welding Specification Chart.
- 5.4** Initial purging shall be maintained for sufficient period of time so that at least 4-5 times the volume between the dams is displaced, in order to completely remove the entrapped air. In no case should the initial purging period be less than 10 minutes. High gas pressure should be avoided.

5.5 After initial purging, the flow of the backing gas should be reduced to a point where only a slight positive pressure prevails. For systems, which have a small volume (up to 1/2 cubic foot) to be purged, a gas flow rate of 6-CFH is usually adequate. Systems of larger volume may require higher flow rates and these should be established during procedure qualification tests.

5.6 Gas backing (purging) is not required for socket type of welded joints.

5.7 Dams, used for conserving inert gas during purging, shall be removed after completion of the welding, and shall be accounted for. Wherever, removal of dams is not possible after welding, use of water-soluble dams should be made.

6.0 EQUIPMENTS & ACCESSORIES

6.1 The Contractor should have the arrangement of sufficient number of welding and cutting equipment's, auxiliaries, and accessories of sufficient capacities so as to meet the target/schedule.

6.2 All the equipment's for performing the heat treatment, including transformers, thermocouples, pyro-meters, automatic temperature recorders (with suitable calibration arrangement etc.) shall be provided by the Contractor at his own expenses and these should bear the approval of the Engineer-in-Charge.

6.3 Contractor shall make arrangements at his own expense, for providing the radiographic equipment's radiographic films, processing equipment all other darkroom facilities and all the equipment's/aterials required for carrying out the dye-penetrant/magnetic particle test/ultrasonic testing for satisfactory and timely completion of the job.

6.4 Redoing of any work, necessitated by faulty equipment's or operation used by the Contractor, will be done at his own expense.

7.0 WELDING PROCESS

7.1 Welding of various materials under this specification shall be carried out using one or more of the following processes with the approval of the Engineer-in-Charge.

- Shielded Metal Arc Welding Process (SMAW)
- Gas Tungsten Arc Welding Process (GTAW)

7.2 The welding processes to be employed are given in the Welding Specification Chart. Any deviation desired by the Contractor shall be obtained through the express consent of the Engineer-in-Charge.

7.3 Automatic and semi-automatic welding processes shall be employed only with the express approval of the Engineer-in-Charge. The welding procedure adopted and consumables used shall be specifically approved.

7.4 A combination of different welding processes could be employed for a particular joint only after duly qualifying the welding procedure to be adopted and obtaining the approval of Engineer-in-Charge.

8.0 EDGE PREPARATION

8.1 General

The edges to be welded shall be prepared to meet the joint design requirements by any of the following methods recommended:

a) Carbon Steel

Gas cutting, machining or grinding methods shall be used. After gas cutting, oxides shall be removed by chipping or grinding.

b) Low Alloy Steels (containing up to 5% Chromium).

Gas cutting, machining or grinding methods shall be used. After gas cutting, machining or grinding shall be carried out on the cut surface.

c) High alloy steel (> 5% Chromium) and stainless steels, nickel alloys:

Plasma cutting, machining or grinding methods shall be used. After plasma cutting, cut surfaces shall be machined or ground smooth.

8.2 Cleaning

a) The ends to be welded shall be properly cleaned to remove paint, oil, grease, rust, oxides, sand, earth and other foreign matter. The ends shall be completely dry before the welding commences.

b) On completion of each run, craters, welding irregularities, slag etc., shall be removed by grinding and chiseling. Wire brushes used for cleaning stainless steel joints shall have stainless steel wires and the grinding wheels used for grinding stainless steel shall be of a suitable type. Separate grinding wheels and wire brushes should be used for carbon steels and stainless steels.

9.0 ALIGNMENT & SPACING

9.1 Components to be welded shall be aligned and spaced as per the requirements laid down in applicable code. Special care must be taken to ensure proper fitting and alignment when the welding is performed by GTAW process. Flame heating for adjustment and correction of ends is not permitted unless specifically approved by the Engineer-in-Charge.

9.2 A wire spacer of suitable diameter may be used for maintaining the weld root opening while tacking, but it must be removed after tack welding and before laying the root bead.

9.3 For pipes of wall thickness 5 mm and above, the ends to be welded shall be secured in position with the aid of couplers, yokes and 'C' clamps, to maintain perfect alignment. Yokes shall be detached after the completion of weld, without causing any surface irregularity. Any irregularity caused on the pipe surface must be suitably repaired to the satisfaction of the Engineer-in-Charge.

9.4 Tack welds, for maintaining the alignment, of pipe joints shall be made only by qualified welders using approved WPS. Since the tack welds become part of the final weldment they shall be executed carefully and shall be free from defects. Defective tack welds must be removed prior to the actual welding of the joints.

9.5 Tacks should be equally spaced. Minimum number of tacks shall be:

3 tacks	-	for 2 1/2" and smaller dia. pipes
4 tacks	-	for 3" to 12" dia. pipes
6 tacks	-	for 14" and larger dia. pipes

9.6 Welding shall commence only after approval of fit-up by the Engineer-In-Charge.

10.0 WEATHER CONDITIONS

- 10.1** The parts being welded and the welding personnel should be adequately protected from rain and strong winds. In the absence of such a protection no welding shall be carried out.
- 10.2** During field welding using GTAW process, particular care shall be exercised to prevent any air current affecting the welding process.

11.0 WELDING TECHNIQUE

11.1 Root Pass

- a) Root pass shall be made with electrodes/filler wires recommended in the welding specification chart. For fillet welding, root welding shall be done with consumables recommended for filler passes. The preferred size of the electrodes is 2.5 mm diameter (12 SWG) but in any case not greater than 3.25 mm (10 SWG).
- b) Upward technique shall be adopted for welding pipe held fixed with its axis horizontal.
- c) The root pass of butt joints should be executed so as to achieve full penetration with complete fusion of the root edges. Weld projection inside the pipe shall be as per applicable code. It shall be limited 3mm max. When the applicable code does not place any restriction.
- d) Any deviation desired from the recommended welding technique and electrodes indicated in the welding specification chart should be adopted only after obtaining express approval of the Engineer-in-Charge.
- e) Welding shall be uninterrupted.
- f) While the welding is in progress care should be taken to avoid any kind of movement of the components, shocks, vibrations and stresses to prevent occurrence of weld cracks.
- g) Peening shall not be used.

11.2 Joint Completion

- a) Joint shall be completed using the class of electrodes, recommended in the Welding Specification Chart. Size of the electrode shall not exceed 4 mm in diameter for stainless steels and alloy steels used for low temperature applications.
- b) Two weld beads shall not be started at the same point in different layers.
- c) Butt joints shall be completed with a cover layer that would affect good fusion at the joint edges and a gradual notch free surface.
- d) Each weld joint shall have a workmanship like finish. Weld identification work shall be stamped clearly at each joint, just adjacent to the weld. Metal stamping shall not be used on thin pipe having wall thickness less than 3.5mm. Suitable paint shall be used on thin wall pipes for identification.
- e) Rust preventive/protective painting shall be done after the weld joint has been approved.

11.3 Dissimilar Welds

Where welds are to be produced between carbon steels and alloy steels preheat and post weld heat treatment requirements shall be those specified for corresponding alloy steels and filler

wire/electrodes shall correspond to ER 70 S-G or AWS E-7016/7018 type. For welds between two dissimilar Cr-Mo low alloy steels, preheat and post weld heat treatments shall be those specified for higher alloy steel and electrodes used shall correspond to those specified for steel of lower alloy content. For carbon steel or alloy steel to stainless welds, use of filler wire/electrodes EIER-309/E-310/E NiCr Fe-3 shall be made. The welding procedure, electrodes/filler wires to be used shall be approved by the Engineer-in-Charge.

12.0 HEAT TREATMENT

12.1 Preheating

- a) No welding shall be performed without preheating the joint to 10°C (50°F) when the ambient temperature is below 10 degree.
- b) Preheating requirements for the various materials shall be as per the Welding Specification Chart attached.
- c) Preheating shall be performed using resistance or induction heating methods. Preheating by gas burners, utilizing oxy-acetylene or oxy-propane gas mixtures, with neutral flame may also be carried when permitted by the Engineer-in-Charge.
- d) Preheating shall extend uniformly to at least three times the thickness of the joint, but not less than 50 mm, on both sides of the weld.
- e) Preheating temperature shall be maintained over the whole length of the joint during welding. Temperature recorders shall be provided by the Contractor to record the temperature.

12.2 Post Heating

In case of alloy steel materials such as Cr-Mo steels, if the post weld heat treatment is not performed immediately after welding, the weld joint and adjacent portion of pipe, at least 50 mm on either side of weld, shall be uniformly heated to 300°C. This temperature shall be maintained for half an hour minimum, and then wrapped with mineral wool before allowing it to cool to room temperature. If the Post Heating temperature specified in the Welding Specification Charts exceeds 300°C, the same shall be followed. Similarly, if the welding specification chart specifies post-heat time, the same shall be applicable. Post weld heat treatment as specified in the Welding Specification Chart shall be carried out later on.

12.3 Post Weld Heat Treatment (PWHT)

- a) Post weld heat treatment, wherever required for joints between pipes, pipes and fittings, pipe body and supports shall be carried out as per the welding specification chart, applicable codes standards and the instructions of the Engineer-in-Charge. In this regard procedure qualification to be done before carrying out PWHT in production welds.
- b) The Contractor shall submit for the approval of the Engineer-in-Charge, well before carrying out actual heat treatment, the details of the post weld heat treatment procedure as per Exhibit B attached, that he proposes to adopt for each of the materials/assembly/part involved.
- c) Post weld heat treatment shall be done in a furnace or by using an electric resistance or induction-heating equipment, as decided by the Engineer-in-Charge.
- d) 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 attained is at least that specified in the relevant applicable standards/codes. Control of temperature shall be done using microprocessor/computer controlled system. The desired time-temperature cycle shall be entered into the microprocessor/computer.

- e) Throughout the cycle of heat treatment, the portion outside the heated. 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 should not be allowed to exceed 50% of the peak temperature.
- f) The temperature attained by the portion under heat treatment shall be recorded by means of thermocouple pyrometers. Adequate number of thermocouples should be attached to the pipe directly at equally spaced location along the periphery of the pipe joint. The minimum number of thermocouples attached per joint shall be 1 up to 6" dia., 2 up to 10" dia. and 3 for 12" dia. and above. However, the Engineer-in-Charge can increase the required number of thermocouples to be attached if found necessary.
- g) Automatic temperature recorders, which have been suitably calibrated, shall be employed for measuring & recording temperature. Both, the actual time-temperature graph and the designed time temperature graph shall be available on every chart. The time-temp graph shall be submitted to Engineer-in-Charge immediately on completion of Stress Relieving Cycle the calibration record of each recorder should be submitted to the Engineer-in-Charge prior to starting the heat treatment operations and his approval should be obtained.
- h) Manufacturer's test certificate shall be submitted for the thermocouples materials and record shall be maintained by the Contractor.
- i) Immediately on completion of the Heat Treatment, the Post Weld Heat Treatment charts/records along with the hardness test results on the weld points, wherever required as per the Welding Specification Chart, shall be submitted to Engineer-in- Charge for his approval.
- j) Each weld joint shall bear a unique identification number, which shall be maintained in the piping sketch to be prepared by the Contractor. The weld joint identification number should appear on the corresponding post weld heat treatment charts. The chart containing the identification numbers and piping sketch shall be submitted to the Engineer-in-Charge in suitable folders.

13.0 CLEANING OF THE WELD JOINT

All weld joints shall be free from adherent weld spatters slag, sward, dirt or foreign matter. This can be achieved by brushing. For stainless steels, brushes with only stainless steel bristles shall be used.

14.0 INSPECTION AND TESTING

14.1 General

- a) The Owner's inspector shall have free access to all concerned areas, where the actual work is being performed. The contractor shall also accord the Owner's Inspector all means and facilities necessary to carry out inspection.
- b) The Owner is entitled to depute his own inspector to the shop or field where prefabrication and erection of pipe lines is in progress for (but not limited to) the following objectives:

- i. To check the conformance to relevant standards and suitability of various welding equipment's and the welding performance.
 - ii. To witness the welding procedure qualification.
 - iii. To witness the welder performance qualification.
 - iv. To check whether shop/field welding being executed is in conformity with the relevant specifications and codes of practice followed in piping construction.
- c) Contractor shall intimate sufficiently in advance the commencement of qualification tests, welding works and acceptance tests, to enable the Owner's inspector to be present to supervise them, as decided by the Engineer-In-Charge.

14.2 Welding Procedure Qualification

Welding procedure qualification shall be carried out in accordance with the applicable requirements of ASME Sec. IX latest edition and/or other applicable codes and the job requirements. The contractor shall submit the welding procedure specification in format as per Exhibit-C (attached) immediately after the receipt of the order. Owner's inspector will review, check and approve the welding procedure submitted and shall release the procedure for qualification tests. The procedure qualification test shall be carried out by the Contractor at his own expense. A complete set of test results in the format as per Exhibit-D attached) shall be submitted to the Owner's inspector for his approval immediately after completing the procedure qualification test and at least 2 weeks before the commencement of actual work. Standard test as specified in the code shall be carried out in all cases. In addition to these tests, other tests like macro/micro examination, hardness tests, dye penetrant examination, charpy V-notch, Corrosion tests, impact tests etc. shall be carried out on specimens depending upon the type of base material, operating conditions and requirements laid down in the detailed drawings and specifications. It shall be the responsibility of the Contractor to carry out all the tests required to the satisfaction of the Owner's inspector.

14.3 Welder's Qualification

- a) Welders shall be qualified in accordance with the ASME Section-IX or other applicable codes. The Owners inspector reserves the right to witness the test and certify/approve the qualification of each welder separately. Only those welders who have been approved by the Owner's Inspector shall be employed for welding. Contractor shall submit the welder qualification test reports in the format as per Exhibit-E (attached) and obtain express approval before commencement of work. It shall be the responsibility of Contractor to carry out qualification tests of welders. For welding of the steam piping, falling under the purview of Indian Boiler Regulations, only those welders with IBR Certification, qualified by Boiler Inspectorate, and acceptable to the local Boiler Inspector authority shall be employed.
- b) The welders shall always have in their possession; an identification card containing information contained in Exhibit-G and shall produce it on demand by the Engineer-In-Charge or his representative. It shall be the responsibility of the Contractor to issue the identify cards after it has been duly certified by the, owner's Inspector.
- c) No welder shall be permitted to work without the possession of the identify card.
- d) If a welder is found to perform a type of welding or in a position for which he is not

qualified, he shall be debarred from doing any further work. All welds performed by an unqualified welder shall be cut and redone by a qualified welder at the expense of the Contractor.

14.4 Visual Examination

Visual Examination of all welds shall be carried out as per the latest editions of the applicable codes and specifications. All finished welds shall be visually inspected for parallel and axial alignment of the work, excessive reinforcement, concavity of welds, shrinkage cracks, inadequate penetration, unrepaired burn-through, under cuts, dimensions of the weld, surface porosity and other surface defects. Undercutting adjacent to the completed weld shall not exceed the limits specified in the applicable standard/code.

14.5 Radiographic Examination

- a) Contractor shall appoint agency for carrying out the radiography works at site from the list of agency enclosed in the bid document or separately supplied by owner/ VCS.
- b) The Radiographic Examination procedures to be adopted shall be submitted by the contractor as per Exhibit-F and shall be got approved from the Owner's Inspector prior to employment. A person qualified to ASNT Level-II or ASNT Level-III in Radiographic testing shall prepare the procedure. The Radiography Procedure shall be established to demonstrate that the required sensitivity can be consistently achieved under the most unfavorable parameters (e.g. source to film distance, geometric unsharpness, thickness etc.). The radiographic technique and procedure adopted shall conform of the requirements mentioned in Article 2 as well as Article 22 of ASME Sec. V. The IQI sensitivity obtained shall be equal to or better than the requirements mentioned in Article 2 of ASME Sec. V. Source side penetrameter shall be used in establishing radiographic procedure/ technique. The acceptance criteria shall be as per the relevant codes of Fabrication and overriding requirements if mentioned elsewhere in the technical specifications of the contract. The Contractor shall be responsible for carrying out Radiography; rectification of defects and re-radiography of welds repaired/rectified at his cost.
- c) The extent of Radiography shall be as per specifications to be supplied to the Contractor. For welds between dissimilar materials, the extent of Radiographic Examination shall be the more stringent of the two recommended for the materials being welded. Wherever random Radiography is called for, in a particular piping class, the dissimilar materials weld joints shall essentially be included.
- d) Type of Radiation source and film to be used shall be as per Exhibit-H for carrying out radiographic examination. However if specifications (as given elsewhere in the contract) for some critical material require usage of X-Radiation, then Radiography shall be done using X-Rays only.
- e) The Contractor shall fulfill all the statutory and owner's safety requirements while handling X-ray and Gamma-ray equipment's.
- f) In case of random radiography, the joints for Radiography shall be selected by the Owner's Inspector and the Radiography shall be performed in his presence, if he instructs the contractor to do so. The contractor shall furnish all the radiographs, to the Owner's Inspector immediately after processing along with evaluation by a person qualified to ASNT

Level-II in Radiographic testing, in line with Article 2 of ASME Sec. V. The certificate of ASNT/ISNT Level II qualification of the NDT personnel shall be submitted to owner's inspector for his approval prior to start of job.

- g) The Contractor shall provide the Owner's Inspector, all the necessary facilities at site such as a dark room with controlled temperature, illuminator (viewer) suitable for varying densities, a duly calibrated electronic densitometer with batteries, magnifying glass, tracing papers, ruler, marking pencils etc. to enable him to review the radiographs.
- h) Where random radiography is specified, the first weld of each welder shall be completely radiographed. In the case of pipe of size 6" and below, the first two welds shall be completely radiographed.
- i) For each weld performed by a welder found unacceptable, two additional checks shall be carried out on welds performed by the same welder. This operation is iterative and the of two additional welds for each weld deemed unsatisfactory shall be continued till such time that two consecutive welds of satisfactory quality are found for every defective weld.
- j) The Contractor shall carry out these additional radiographic testing at his own expense. To avoid the possibility of too many defective welds by a single welder remaining undetected for a long period to time, the Contractor shall promptly arrange for Radiographic Examination so that there is no accumulation of defective joints.
- k) Contractor shall quote rates for X-ray as well as Gamma Ray for joints indicated to be radiographed by X-ray in Table of Exhibit-H.

14.5.1 Check shots

- a) Owner / Engineer - in - charge or his representative shall select 5% of the total joints radiographed on a day for check shots. Contractor shall carry out check shots as directed.
- b) Weld profiles of check shots shall be compared with weld profile observed in the earlier Radiographs. In the event of anyone variation in the check shots and earlier Radiographs, contractor shall re-shoot the entire lot of joints radiographed by particular Radiography agency on the particular date. All the re-shot films shall be compared with the originally submitted films.

14.6 Liquid Penetrant and Magnetic Particle Examination

- a) Whenever such tests are specified, the tests shall be carried out on joints chosen by the Owner's inspector, as per ASME Section V article 6 and 7 respectively. The tests are to be performed by a person possessing a valid ASNT/ISNT Level-II qualification in the method being used.
- b) For austenitic stainless steels and other nonmagnetic materials, liquid (dye) penetrant test shall be carried out. For carrying out this test, the materials shall be brought within a temperature limit of 15°to 50°C.

14.7 Hardness Test

Hardness requirements for welds shall be as per the Welding Specification Chart Non Destructive Examination Specification attached elsewhere in the contract. Hardness testing shall be carried out by Vickers Hardness Tester during welding procedure qualification and shall be cross sectional. For production welds, hardness testing shall be carried out by portable

digital hardness testers. Poldi hardness tester shall not be permitted. Contractor shall produce documentary evidence/calibration certificate to the Owner's Inspector and obtain approval of the hardness testing equipment.

14.8 Proof Tests

Hydrostatic and pneumatic tests shall be performed as per the requirements laid down by respective flushing and Testing specification/applicable codes to demonstrate the soundness of the welds. The tests shall be conducted after fulfilling the requirement of visual examinations radiography etc. and after the entire work has been certified by the Owner's inspector to be fit for being subjected to such tests.

15.0 REPAIRS OF WELDS

- a) Defects ascertained, through the inspection methods, which are beyond acceptable limits shall be removed after the joint is completely radiographed by the process of chipping and grinding.
- b) When the entire joint is judged unacceptable, the welding shall be completely cut and edges suitably prepared as per required alignment tolerances. The re-welded joint shall again be examined following standard practices.
- c) No repair shall be carried out without prior permission of the Owner's inspector.
- d) Repairs and/or work of defective welds shall be done in time to avoid difficulties in meeting the construction schedules.

16.0 DOCUMENTS TO BE SUBMITTED BY CONTRACTOR (4 COPIES EACH)

- a) Electrode and Welding Consumable Qualification Records as per Exhibit-A, for the Welding Consumables tested and approved for the work.
- b) Batch Test Certificates, for the Electrodes used, obtained from the Electrode Manufacturers.
- c) Proposed Heat Treatment Procedure as per Exhibit-B
- d) Heat Treatment Charts.
- e) Weld joint hardness test results.
- f) Welding Procedure Specifications as per Exhibit-C immediately after receipt of the order.
- g) Welding Procedure Qualification records as per Exhibit-D.
- h) Welder Performance Qualification records as per Exhibit-E immediately after conducting Welder Qualification Tests.
- i) Radiography Procedure as per Exhibit-F and other NDT procedures.
- j) Radiographic test Report along with Radiographs and other NDT reports.
- k) Piping Sketch (Isometric) giving all the details regarding the pipe specifications, welded joints, joints radiographed magnetic particle, tested, ultrasonic tested, penetrant tested, joints heat treated, WPS used, welders identification number, etc.



EXHIBIT -A

Sheet 1 of3

ELECTRODE QUALIFICATION TEST RECORD

- A) Tested at (Site name) : Date:
- Manufacturer's Name :
- Brand Name :
- Batch Number & Size tested :
- Classification & Code :
- Intended for welding in position :
- In combination with (if any) :
- Code of Reference (used for testing) :
- Special Requirements (if any) :
- B) All-weld Tensile Test :
- Base Material used :
- Pre-heat temperature :
- Post welds heat treatment details :
- Visual examination :
- Radiographic examination results :
- Tensile test results :

Identification No.	U.T.S.	Yield Point	Elongation	Remarks
1.				
2.				

EXHIBIT-A

Sheet 2 of 3

C) Impact Test Results

Test Temperature : Notch in :
Type of Specimens (Charpy) : Size of Specimens :

Specimen No.	Impact Value	Average
1.		
2.		
3.		
4.		
5.		

D) Chemical Analysis Results

Electrode Size Result :
Batch No. :

%C	%S	%P	%Si	%Mn	%Cr	%Ni	%Mn	Other

E) Fillet Weld Test Results :

Welding Positions :

Base Materials :

Size of electrode used :

Visual Inspection Results :

1)

2)

3)

EXHIBIT-A

Sheet 3 of3

Macro Test Results :
Fracture Test Results :
Remarks :

F) Other Test Results

1. Transverse tensile test :

In combination with :
Base material used :
Position of welding :
Preheat temperature :
Post weld heat treatment :
Radiography :

Identification No.	U.T.S	Fracture in	Remarks

2. Guided Bend Test :

Position	Identification No.	Root, Face or Side Bend	Remarks
	1.		
	2.		
	3.		
	4.		
	5.		

G) Any other tests :

H) Conclusions :

.....
PREPARED BY
(CONTRACTOR)

.....
REVIEWD
(CONTRACTOR)

.....
APPROVED BY
(VCS/OWNER)

EXHIBIT-B

Sheet 1 of 1

STRESS RELIEF HEAT TREATMENT PROCEDURE SPECIFICATION

Contractor : _____

Name of the Heat treater : _____

Name of the Project : _____ Specification

Reference No. _____

1. General Details _____ Other Details

Name of the

Equipment: _____

Type of Heating: Elec. Res. / Induction

(Tick mark applicable method) Maximum
Permissible Temp at Uncovered Parent
Metal _____

Width of heated band _____

Width of Insulation _____

2. Material: _____

No. of Thermocouples (Dia wise)

Type of Thermo couples _____

3. Heat Treatment Cycle Details

Charging temp °C _____

Rate of heating ° C /Hr. _____

Soaking Temperature, °C _____

Soaking Time, Hrs. _____

Rate of Cooling ° C/Hr. _____

Method of Cooling _____

4. Other details, if any _____

EXHIBIT -C
SHEET 1 OF 3

FORMAT FOR WELDING PROCEDURE SPECIFICATION (WPS)

Company Name _____ by _____
Welding Procedure Specification No. _____ Date _____
Welding Process (es) _____ Type (s) _____
(Automatic, Manual, Machines or Semi Auto)

JOINTS

Joint Design _____
Backing (Yes) _____ (No) _____
Backing Material (Type) _____

Sketches Production Drawings. Weld Symbols Written

Description should show the general arrangement of the parts to be welded. Where applicable, the root spacing and the details of weld groove may be specified.

(At the option of the Manufacturer sketches may be attached to illustrate joint design weld layers and bead sequence e.g. for notch toughness procedures, for multiple process procedures, etc.)

BASE METALS

P.No. _____ Group No. _____ to P. No. _____ Group No. _____
OR

Specification type and grade _____
to Specification type and grade _____

OR

Chem. Analysis and Mech. Prop. _____
to Chem. Analysis and Mech. Prop. _____

Thickness Range:

Base Metal: Groove _____ Fillet _____

Deposited Weld Metal: Groove _____ Fillet _____

Pipe Dia Range: Groove: _____ Fillet _____
Other _____

EXHIBIT -C
SHEET 2 OF 3

**FILLER
METALS**

F.No. _____ Other _____
A.No. _____ Other _____
Spec. No. (SFA) _____
AWS No.(Class) _____
Size of filler metals _____

(Electrodes, Cold Wire, Hot Wire etc.)

Electrode-Flux (Class) _____
Flux Trade Name _____
Consumable Inset _____
Each base metal/filler metal combination should be recorded individually.
WPSNO _____ Rev. _____

POSITIONS: Position(s) of Groove _____ Welding Progression: UP _____ Down _____ Positions of fillet _____	POSTWELDED HEAT TREATMENT Temperature Range _____ Time Range _____
PREHEAT Preheat Temp. Mon. _____ Interpass Temp. Max. _____ Preheat Maintenance _____	GAS Shielding Gas (es) _____ Percent Composition (mixtures) _____ Flow Rate _____ Gas Backing _____ Trailing Shielding Gas Composition _____

ELECTRICAL CHARACTERISTICS

Current AC or DC _____ Polarity _____
Amps (Range) _____ Volts (Range) _____
(Amps and volts range should be recorded for each electrode size, position, and thickness, etc.
This information may be listed in a tabular form similar to that shown below).
Tungsten Electrode Size and Type _____
(Pure Tungsten, 2% Ceriated, etc.)
Mode of Metal Transfer for GMA W _____
(Spray arc, short circuiting arc, etc.)
Electrode Wire feed speed range _____

EXHIBIT-C
SHEET 3 OF 3

TECHNIQUE

String or Weave Bead _____

Orifice or Gas Cup Size _____

Initial and Interpass Cleaning (Brushing, Grinding, etc.) _____

Method of Back Gouging _____

Oscillation _____

Contact Tube to Work Distance _____

Multiple or Single Pass (per side) _____

Multiple or Single Electrodes _____

Travel Speed (Range) _____

Peening _____

Other _____

Weld Layer(s)	Process	Filler metal		Current		Volt Range	Travel Speed Range	Other
		Class.	Dia.	Type polarity	Amp. Range			
								e.g. Remarks, Comments, Hot wire Addition, Technique Torch Angle, etc.

FORMAT FOR PROCEDURE QUALIFICATION RECORD (PQR)
RECORD ACTUAL CONDITIONS USED TO WELD TEST
COUPON

Company Name _____

Procedure Qualification Record No. _____ Date _____

WPS No. _____

Welding Process (es) _____

Types (Manual, Automatic, Semi-Auto) _____

JOINTS

Groove Design of Test Coupon

(For combination qualification the deposited weld metal thickness shall be recorded for each Filler metal or process weld)

BASE METALS Material Spec. _____ Type of Grade _____ P.No. _____ to P.No. _____ Thickness of Test Coupon _____ Diameter of Test Coupon _____ Other _____	POSTWELD HEAT TREATMENT Temperature _____ Time _____ Other _____
FILLER METALS Weld Metal Analysis A No _____ Size of Filler Metal _____ Filler Metal E.No. _____ SFA Specification _____ AWS Classification _____ Other _____	GAS Type of Gas on Gases _____ Composition of Gas Mixture _____ Other _____
POSITION Position of Groove _____ Weld Progression (Uphill, Downhill) _____ Other _____	ELECTRICAL CHARACTERISTICS Current _____ Polarity _____ Amps _____ Tungsten Electrode Size _____ Other _____



**WELDING SPECIFICATION FOR FABRICATION OF
PIPING**

**DOCNO: VCS-SS-PP-2509
Rev No : 01**

PREHEAT Preheat Temp. _____ Inter pass Temp. _____	TECHNIQUE Travel Speed _____ String or Weave Bead _____ Oscillation _____ Multi pass or Single Pass (per side) _____ Single or Multiple Electrodes _____ Other _____



EXHIBIT-D

SHEET 2 OF 2

GUIDED BEND TESTS

Type of Figure No	Result

TOUGHNESS TESTS

Specimen No.	Notch Location	Notch Type	Test Temp.	Impact Value	Lateral Exp.		Drop Weight	
					% Shear	Mils	Break	No Break

FILLET WELD TEST

Result – Satisfactory: Yes ____ No ____ Penetration into Parent Metal: Yes ____ No ____

Macro – Results _____

OTHER TESTS

Type of Test _____

Deposit Analysis _____

Other _____

Welder's Name _____ Clock No. _____ Stamp No. _____

Test Conducted by _____ Laboratory Test No. _____

We certified that the statements in this record are correct and test welds were prepared, welded and tested in accordance with the requirements of Section IX of the ASME Code.

Date _____ Manufacturer _____

By _____

(Detail of record of tests are illustrative only and may be molded to conform to the type and number of tests required by codes and specifications).



EXHIBIT-E

SHEET 1 OF 2

FORMAT FOR MANUFACTURER'S RECORD FOR WELDER OR WELDING OPERATOR
QUALIFICATION TESTS

Welder Name _____ Check No. _____ Stamp No. _____

Using WPS No. _____ Rev. _____

The above welder is qualified for the following ranges

<u>Variable</u>	<u>Record Actual Values Used in Qualification</u>	<u>Qualification Range</u>
Process	_____	_____
Process Type	_____	_____
Backing (metal, Weld metal, flux, etc.,)	_____	_____
Material Spec.	_____ to _____	_____ to _____
Thickness		
Groove	_____	_____
Filler	_____	_____
Diameter		
Groove	_____	_____
Filler	_____	_____
Filler Metal		
Spec. No.	_____	_____
Class	_____	_____
F. No.	_____	_____
Position	_____	=====
Weld Progression	_____	_____
Gas Type	_____	_____
Electrical Characteristics		_____
Current	_____	_____
Polarity	_____	_____

EXHIBIT-E

SHEET 2 OF 2

Guided Bend Test Results

Type and Fig.No.	Result

Radiographic Test Results

For alternative qualification of groove welds by radiography

Radiographic Results _____

Fillet Weld Test Results

Fracture Test (Describe the location, nature and size of any crack or tearing of the specimen _____

Length and Per Cent of Defects _____ inches _____ %

Macro Test – Fusion _____

Appearance - Fillet Size (ing) _____ x _____ Convexity or Concavity _____

Test Conducted by _____ Laboratory - Test No. _____

We certify that the statements in this record are correct and that the test welds were prepared.
Welded and tested in accordance with the requirements of Section IX of the ASME Code.

Date _____

Organization _____

By _____

(Details of record tests are illustrative only and may be modified to conformation to the type & number of tests required by the Code).

Note: Any essential variables in addition to those above shall be recorded

EXHIBIT – F

RADIOGRAPHIC PROCEDURE QUALIFICATION RECORD FOR PIPE

WELDING

1. Location
2. Date of Testing
3. Name of the Contractor/Agency
4. Material: Carbon steel/Alloy Steel/Stainless
4. Technique: DWSIISWSI/DWDI
5. Diameter & Thickness
6. Type of Weld Joint
7. Radiation Source
8. Intensifying Screens/Lead Screens
9. Geometric Relationship:
10. Limit of Film Coverage:
11. Film Type and Make:
12. Exposure Time:
13. Processing:
14. Density:
15. Sensitivity:
- 16.* Type of penetrameter:
(Source side)
- 17.* Type of penetrameter:
(Film side)

Signature of Contractor/Agency with Seal

Approval of VCS's Inspector

Ref. Para regarding recommended practice on placement of penetrameters Article 22, SE 142, ASME Sec. V.

For "Random Radiography" lines placement of penetrameters as per Article 2, ASME, Sec. V is permitted.

EXHIBIT - G

WELDER'S IDENTIFICATION CARD

1. Name
2. Identification
3. Date of Testing
4. Process
5. Thickness Range
6. Diameter Range
7. F. No.
8. Date of approval of welding
9. Position(s)

Photograph

Approved by:

Employer's Signature with Seal

EXHIBIT - H

Type of Source and Films to be used for RADIOGRAPHY

NOMINAL WALL THICKNESS(T) IN mm		SHOP WELDED JOINTS		IN-SITU WELDS	
		SOURCE	FILM : CEN Class	SOURCE	FILM : CEN Class
T≥19	All Materials	Gamma Ray	C5	Gamma ray	C5
8≤T<19	Carbon steel	Gamma ray	C4	Gamma ray	C4
<8	All other materials	Gamma ray	C3	Gamma ray	C3
	Carbon Steel Other than Inspection Class IV *	Gamma ray	C3	Gamma ray	C3/C1
	All Other Materials and Carbon Steel of Inspection Class IV *	X-Ray	C4	X-ray with C4 or Equivalent to be used. Gamma Ray (Se 75 Source only) with C3/C2 Equivalent may be allowed only if in the assessment of owner's inspector, Joints are in accessible for X-ray equipment and radiographic sensitivity is achieved.	

Note: Integral to above table

- 1) Films slower than the above may have to be used, if required radiographic sensitivity is not achieved consistently.

COMPARISION OF FILM FROM DIFFERENT MANUFACTURERS.

CEN Classification	KODAK	AGFA	FUJI
---	CX	D8	---
C5	AA400	D7	IX100
C4	T200	D5	IX80
C3	MX125	D4	IX50
C2	M100	D3	---
C1	DR50	D2	IX25
---	SR**	---	---

****Special films, extremely fine grain & very high resolution**



ENERGISING QUALITY

VCS PROJECT CONSULTANTS PVT. LTD.

STANDARD SPECIFICATION FOR LAYING OF POLYETHYLENE MAIN PIPELINES AND SERVICE PIPELINE FOR DOMESTIC CONNECTIONS VPC – SS – PE - 0001

00	18.06.18	ISSUED AS STANDARD	BS	MVK	AD
REV.	DATE	Purpose	Prepared By	Checked By	Approved By



CONTENTS

1.0	DEFINITIONS	3
2.0	SCOPE OF WORK.....	3
3.0	MATERIAL, MANPOWER, EQUIPMENT AND MACHINERY.....	6
4.0	PROGRESS OF WORK	9
5.0	APPROVALS & PERMISSIONS FOR PIPELINE LAYING	9
6.0	REFERENCE SPECIFICATION, CODES AND STANDARD	10
7.0	QUALITY OF WORK	10
8.0	SAFETY.....	10
9.0	ROUTE SURVEY	11
10.0	ORGANISATION STRUCTURE.....	12
11.0	STRUCTURES, SERVICES AND OTHER PROPERTY.....	13
12.0	TRENCHING	14
13.0	LAYING.....	18
14.0	JOINTING OF POLYETHYLENE PIPE.....	21
15.0	BACKFILLING	22
16.0	MOLING.....	24
17.0	HORIZONTAL DIRECTIONAL DRILLING (HDD)	25
18.0	CASING PIPE.....	25
19.0	RESTORATION.....	26
20.0	TESTING.....	27
21.0	PURGING.....	28
22.0	VALVE PITS.....	28
23.0	CONSTRUCTION OF TRENCHES AND OTHER SCOPE OF WORK IN BUILDER SEGMENT-	29
24.0	ROUTE MARKERS.....	30
25.0	GUIDELINES:	30
26.0	ASSISTANCE IN COMMISSIONING	31
27.0	STANDARD OF WORK.....	31
28.0	RECORDING (AS-BUILT DRAWINGS)	31
29.0	CIVIL WORKS.....	32
31.0	TESTING OF CONSTRUCTION MATERIALS.....	38
33.0	INSPECTION BY THIRD PARTY INSPECTION (TPI) AGENCIES NOMINATED BY LAND OWNING AGENCIES	39

GENERAL INFORMATION

The main scope of this Specification comprises of laying of underground Medium Density Polyethylene (MDPE) main pipelines and service pipeline. The scope covers all the activities associated with the purchasing (specified items only), laying, testing and commissioning of MDPE main pipelines and service pipelines in new & existing gas charged areas of sizes ranging from 20mm up to 180mm OD, which includes PE/GI transition fitting above ground level and above ground laying and commissioning of powder coated GI/ CU pipe line, meter regulator etc. including burner conversion and commissioning.

This technical specification defines the basic guidelines to develop an acceptable design and suitable construction methodology for carrying out different activities listed out in the schedule of rates of this tender.

Compliance with these specifications and/ or approval of any of the Contractor's documents shall in no case relieve the Contractor of his contractual obligations.

1.0 DEFINITIONS

OWNER	
PMC	VCS QUALITY SERVICES PVT. LTD. (VCSQSPL)
SS	STANDARD SPECIFICATION
TPIA	THIRD PARTY INSPECTION AGENCY (TO BE APPOINTED BY CLIENT)
EIC	ENGINEER-IN-CHARGE

2.0 SCOPE OF WORK

Generally, the following shall constitute the contractor's scope of work but not limited to:

Plan and prepare a schedule for execution and work implementation as per QA/QC plans to be issued by Owner/Owner's representative. Contractor has to submit the Construction/Execution procedures before commencement of work to Owner/ Owner's representative for approval.

Prior to start of construction activity, contractor shall prepare route survey drawing marked for proposed gas pipe line laying and submit to CLIENT/PMC for approval

Obtaining permissions from respective land-owning agencies such as Municipal Corporation of State, PWD, Development Authority of State, NHAI, Railway Irrigation department etc. road cutting for laying of the pipelines, liaison with the concerned authorities during execution of the job, obtaining NOC from concerned authorities once the work is completed. Getting back/refund of bank guarantee/security deposits made to the agencies for laying of the pipelines.

Obtaining clearances and coordination with concerned RWA of the allotted area

for internal network laying and obtaining NOC from RWA after completion of work.

Transportation of Free Issue Material from CLIENT stores to contractor stores, proper storing, and stacking, providing security, transit insurance cover during storage, laying, commissioning and handling over pipelines to owner.

Obtaining the approval for optimum route and ROU from the concerned authority.

Making trial pits to determine the underground utilities/services such as existing pipelines, cables (electrical/communication), conduits, U/G drainage, sewers, tunnels, subways foundations etc. for deciding optimum feasible route and depths for laying the pipelines based on the route plans indicated by Owner.

Wherever required the grass/turfing, pavement, linings, drains, roads and other such 'pucca' area shall be locally removed to facilitate trenching and pipe laying works. The same is to be reinstated as original.

Installation of safety/warning signs and barricading of the entire route to be trenched. Pits to be similarly barricaded along with warning signs and caution boards.

To make trenches with stable slopes but restricting minimum disturbance to above ground/underground services/installation as per specifications and approved route plans keeping the trenches free from water and soil till placement of pipes.

Uncoiling/stringing the MDPE pipes of required sizes (i.e. 180, 125, 63, 32 & 20 mm) pipes into trenches as per approved procedure.

Joining the pipe ends with fittings of valves by approved automated electro-fusion techniques only as per tender specification.

Installation of pipe fittings like elbow, tees, reducers, couplers, tapping saddles, transition fittings, valves etc., including construction of supports, valves pits, inspection chambers etc. as per specification & satisfaction of the EIC.

Laying pipelines by any methodology including trenchless technology methods with or without casing pipes (HDPE pipes) as per specifications and as directed by EIC.

Fabrication, supply and inspection of approved quality GI sleeve and half concrete sleeves and other materials, fittings to be supplied by the contractors as per the provisions of tender.

Back filling and compaction by jumping jack compactor wherever required, using approved 'good' soil or using excavated earth or borrow earth as per requirement

and specifications and replacement of the tiles, slabs removed during the excavation. Cleaning all unserviceable materials, debris, excess earth trenches etc. to designated disposal area.

Carrying out pneumatic testing and purging as per specifications and approved procedures, providing all tools & tackles, instruments, manpower and other related accessories for carrying out the testing of pipes.

Supply, fabrication & installation of Stone route marker, Pole marker with foundations, Plate markers, valve chamber etc. as per the directions of the EIC/Owner's representative.

Commissioning of gas in the tested PE line shall be done as per the approved procedure.

Restoration of existing ground features such as grass/turfing, paving, roads, drains, concrete, floral beds, fencing, tiles, marbles, flooring masonry etc. to original condition and to match with adjoining conditions, functionally and aesthetically up to the entire satisfaction of Owner/ Owner's representative /any other third party agency designated by owner and local authorities, failing which, it will be done at the risk and cost of the contractor. Obtaining No Objection Certificates for the restoration work done from the concerned authorities.

Returning surplus material to Owner stores after obtaining clearance from TPIA/Consultant/ Owner, reconciliation of free issue material/consumables.

Handing over the completed works to owner for their operation/use purposes.

Rectification of defects arising due to poor workmanship during defect liability period of pipelines/installations handed over to Owner.

Preparation and submission of all documents like Pit wise As graph, As-built drawings, details of crossings, utility graphs, PE cards for service line and deviation statements on completion/commissioning of work by way of drawing, sketches and tables in soft & hard copy.

Providing adequate manpower, minimum 2 no's each such as data entry operator, customer care executive etc. for data logging like new connection request, NG conversion request & GI tracking, attending complaints, day to day interaction with customers and residents so that work can be executed within defined time period (TAT) Turnaround Time. At present TAT period is 90 days which may vary time to time as per guidelines of PNGRB and CLIENT policy. Data entry operator & customer care executive should be minimum 12th pass (intermediate) with minimum experience of 2 years in relevant field.

Providing adequate manpower for carrying out laying for PNG installation for emergency cases as and when required. Providing adequate manpower for

material for carrying out laying for PNG installation for emergency cases as and when required, as per instruction of EIC.

Following activities are also in contractor's scope:

- Receive Customer's request and complaints logged on CLIENT's CRM/ Offline.
- Carry out joint technical feasibility survey for requests received.
- Attend and resolve customer complaints.
- Maintain and update the request and complaint status in CLIENT's CRM.
- Maintain new connection tracking on CLIENT's CRM.

The warehousing of bulk supply items should be in laying contractor scope. Vendor to mobilize yard/ covers immediately on award, and takeover after checking, on arrival of materials from MDPE supplier.

Any other activities not mentioned/covered explicitly above, but otherwise required for satisfactory completion/operation/ safety/ statutory/ maintenance of the works shall also be covered under the Scope of work and has to be completed by the Contractor within specified schedule at no extra cost to Owner.

3.0 MATERIAL, MANPOWER, EQUIPMENT AND MACHINERY

Material to be supplied by Owner as Free Issue.

Unless otherwise specified, owner will supply following material such as MDPE - pipes, fittings, valves, transition fittings, HDPE pipe as casing material to contractor (of all sizes) and all materials other than mentioned above shall be supplied by contractor as per technical specification to complete the laying of gas main pipelines and service pipelines.

The free issue material shall not be procured from any other source by contractor. Material reconciliation statement of free issue material duly certified by Owner and PMC shall be submitted to CLIENT on monthly basis.

Material to be supplied by the contractor:

The supply of items as indicated in SOR but not limited to shall be strictly as per relevant technical specifications enclosed with the Tender and as per guidelines of various clauses of SCC and SOR.

All materials shall be handled safely and stored in a permanent, covered, lockable store/ ware house preferably near site in such a manner as to prevent any damage to the materials from scratching, gouging, indentation, excessive heat or by contact with any sharp objects or chemicals. The MDPE pipes and fittings shall be stored in covered storage to protect material from sunshine, rain etc. Pipe should be stacked with clearance from ground level.

3.1 Backfilling Material

The contractor shall be responsible to arrange the supply of approved coarse sand (size 0.6 - 2 mm as per IS-383) free from any impurities like clay, mica, and soft flaky pieces, as per the instructions of EIC/ Owner's representative. For supply of sand in trench for rocky terrain, no separate charges are payable and is included in rates. Also supply of sand in valve chambers, Normal surface & built up surface, if required, as per the instructions of EIC is not separately payable.

In case specified trench depths are not achieved or if directed by Engineer-In-Charge Contractor has to provide concrete casing pipes/ slabs, extra rate of PCC may be payable with prior approval of EIC/ PMC.

Other materials: The contractor shall supply the following items wherever required:

- All materials required for framework, trench support and temporary trench Crossings.
- All sign boards, barricades, tin sheets, lighting arrangement and protective equipment.
- All minor items not mentioned in the specification but necessary for the satisfactory completion and performance of the work.
- Material required for installation of valve chambers.
- GI, Half Round Concrete Sleeves. (Refer enclosed drawing no.- VPC-STD-PP-2016)
- Permanent markers (Refer enclosed drawing no.- VPC-STD-PP-2011, 2012, 2013, 2014)
- Warning Mat

3.2 Manpower

The contractor shall provide the skilled labour, tools, material and equipment necessary for the proper execution of the work.

3.3 Equipment, Machinery & Tools

This will include but is not limited to the list of specialized items included in Annexure# I

All vehicular type machinery shall be in good working order and shall not cause spillage of oil or grease. To avoid damage to paved surfaces, the Contractor will provide pads of timber or thick rubber under the hydraulic feet or outriggers of machinery.

Contractor must also have to arrange his own equipment for restoration work like water tanker and jumping jack compactor for compaction of backfilled trenches and roller and other required equipment/ machinery for asphaltting/ road works.

In case there is non-availability of approved equipment's, tools and tackles during the work at site, suitable penalties, as per special terms and conditions of the contract, will be

levied and deducted from the running bills.

3.4 Acquisition, Receipt & Storage of Materials

The Contractor shall collect all materials from CLIENT during stores working hours following all documentation procedures laid down and as directed by the EIC. The Contractor shall carry pipe in such a manner as to preclude damage during transportation and handling. PE pipes supplied in straight lengths may be carried in straight pipe racks.

The contractor shall at the time of receipt of material physically examine all materials and notify the EIC immediately of any damage or defect noticed by the contractor. Any damage not so recorded will be deemed not to have existed at the time of receipt of material by the contractor and the cost of repair or replacement or rectification shall be borne by the contractor. Any material once issued from CLIENT store, if found in non-working condition at site shall be brought to the notice of EIC with PO reference in written within 15 days and after subsequent approval shall return defective material in CLIENT stores within 30 days.

If delay is more than 30 days and material is under warranty, the material will be accepted with a penalty, else the material will not be reconciled and amount of the same will be deducted from bills. Penalty shall be levied as per SCC. The contractor shall ensure that no defective material shall be returned to store at the time of closure of contract. The format for defective materials returning to stores will be made available by EIC.

The contractor shall maintain locked store preferably near at site so that all the materials are stored in such a manner so as to prevent any damage to the materials from scratching, gouging, indentation, excessive heat or by contact with any sharp objects or chemicals. The PE pipes and fittings shall be stored in covered storage to protect material from sunshine, rain, water logging etc. The contractor shall make adequate security arrangements for the stacked material & any loss to the material on account of theft on improper storage is attributable to the contractor.

The Contractor shall maintain log book at their respective stores stating issue and availability of free issue material at a given day. Further, it is mandatory that the contractor is required to undertake and submit inventory details of free issue and purchased materials on monthly basis to Owner/ Owner's representative as per the approved format of the owner. The inventory details shall be in correlation with the Daily progress chart and material reconciliation sheet.

In case of non-submission of material reconciliation on first week of every month, applicable penalties shall be levied as per SCC from the running bills. In case if shortage in free issue material is observed at the time of quarterly physical verification by CLIENT, equivalent value of material found short shall be withheld from running bills, same shall be released after settlement of free issue material.

4.0 PROGRESS OF WORK

The contractor shall proceed with the work under the contract with due expedition and without delay. The EIC may direct in what order and at what time, the various stages or parts of the work under the contract shall be performed. Contractor has to regularly submit daily progress reports, weekly progress reports, graphs with utilities, testing reports, material consumption and inventory reports, deviation statements, completion schedule etc.

5.0 APPROVALS & PERMISSIONS FOR PIPELINE LAYING

Contractor has to obtain permissions from statutory bodies for laying of pipelines. Statutory bodies in this case are Municipal Corporation of State, PWD, NHAI, CPWD, AAI, Indian railways and any other government agencies who maintain the public lands and accord permissions for laying of the utilities. The contractor shall obtain demand note (road restoration charges) from these statutory bodies. Contractor shall ensure that the road restoration charges are to the minimum against the work to be carried out. CLIENT may return back the demand note, if the charges are not found reasonable and contractor shall not be liable for any liaison charges against the same.

However, CLIENT will pay the road restoration / Departmental charges / security deposit/ Bank guarantees for getting the clearances from statutory bodies. It is the contractor's responsibility to inform and co-ordinate the concerned local authorities and also other utility agencies before and after the commencement of work at site. To ensure smooth execution of the work on a day-do-day basis, the contractor has to liaison with respective authorities. The contractor shall plan and ensure that work taken up under a single permission shall be completed within the stipulated time period and revalidation process is avoided. No separate liaison charges are liable to CLIENT for revalidation cases.

It is the responsibility of the contractor to obtain "No Objection Certificate" (NOC) from land owing agencies/ Statutory bodies after completion of the restoration to their satisfaction and getting released the security deposit/ bank guarantees submitted by CLIENT for obtaining permissions on production of documentary evidence. Separate payment in running meters will be made on account of approvals/permissions as per specified in SOR, based on total applied length, where the rates are inclusive of liaison rates. In case of any deviation/ change in the route/ additional laying, CLIENT shall pay the additional Road Restoration Charges only after receiving of revised estimate and further to written confirmation from the concerned Owner site-in-charge.

On behalf of the Owner, contractor shall prepare in advance and submit the proposed route plan complete in all respect and well ahead of time so that the actual construction work is not delayed because of approval/inspection/permission by concerned authorities. Further, the contractor shall also coordinate with the relevant authorities for necessary approvals of these proposed pipeline route drawings/certificates. The inspection of work by statutory authorities shall be the responsibility of the contractor without any extra cost to CLIENT.

In case contractor delays laying of pipeline work under a single permission, the work or part of work may be offloaded to some other contractor on his risk and cost. Any change / addition required to made to meet the requirements of the statutory authorities shall be carried out by the contractor without any extra cost to CLIENT. The inspection and acceptance of the work by statutory authorities shall however, not absolve the contract from any of his responsibilities under this contract.

6.0 REFERENCE SPECIFICATION, CODES AND STANDARD

The contractor shall carry out the work in accordance with the requirement of latest relevant applicable standards, this specification, Owner's Engineering Standards; relevant Oil Indian Safety Directorate (OISD) norms, PNGRB Regulations, ASME B31.8-Gas Transmission and Distribution Piping Systems; Australian Standard 3723-Installation and Maintenance of Plastics Pipe Systems for Gas; and the American Gas Association Document - Purging Principles and Practice. ISO-4437/JS: 14885 for underground polyethylene pipes and OWNER's approved procedures.

Should the contractor find any discrepancy, ambiguity or conflict in or between any of the standards and the contract documents, then this should be promptly referred to the Engineer-In-Charge (EIC) for his decision, which shall be considered binding on the contractor.

7.0 QUALITY OF WORK

All works carried out under this contract shall confirm to applicable standards, codes of practice, construction procedures and other technical requirements as defined in the technical specifications.

The manpower deployed on the respective activities shall be adequately trained & shall have necessary skills to execute / supervise the work. However, the assessment on the qualification of the personnel shall be at the discretion of EIC.

Fusion operators and other skilled personnel shall be approved by Owner/ Owner's representative and identification cards duly signed by EIC shall be issued to them. Only those personnel who are approved by shall be allowed to execute the critical activities like electro fusion jointing of MDPE pipes & fittings. CLIENT may provide training and certification on chargeable basis where the cost shall be borne by contractor.

8.0 SAFETY

The Contractor shall conform to the safety requirements outlined elsewhere in the tender document. In addition, the Contractor shall observe safe working practices in the storage and handling of cleaning fluids, flammable fluids, etc., and ensure smoking or naked flames are not permitted in the vicinity when these materials are being used.

Trench walls shall be battered with sufficient slope in order to minimize a trench collapse. Where there is a danger of an earth slide or collapse, the trench shall remain open for the minimum time possible with proper barricading. The Contractor is to ensure that no person enters a trench, which is of a depth of 1.5 meters or greater, unless the trench has adequate shoring or the sides are battered to such an extent as to prevent a trench collapse.

The Contractor shall also protect all work sites with warning signs, barricades and night lighting. The Contractor shall inspect all fenced excavations daily, and maintain them in good order.

The trenches/ pits shall not be kept open in night times. However in case the same is essential the same shall be properly barricaded with proper lighting arrangements & manned.

The Contractor shall provide PPE's like helmets, safety shoes, etc. to the labour which are necessary for safe working practice.

Any accident causing injury to any person or damage to property or equipment shall be reported to the EIC and the cost of repair / replacement of the damage equipment shall be borne by the contractor. Where the EIC determines that the work is being performed by the Contractor in an unsafe manner, he may suspend the Work until corrective action is taken by the Contractor.

PPE, Continuous Barricades and caution tapes along the trenches as per approved drawing in tender, Use of Safety Boots, Hand gloves, Reflective jackets, Hard hats(helmets), Safety shoes, eye and ear safety equipment, Fire extinguishers and as per the detailed scope of work in tender specifications.

measurement sheet of laying should also include length of barricading. Refer drawing number no. VPC-STD-PP-2008. For further details Refer "Special Terms and conditions of Contract" & SOR.

9.0 ROUTE SURVEY

Planning, detailing the size, route survey drawings, identification of underground utilities, foreign pipelines, crossings, and location of valve chamber, FRS, DRS, MRS as well as service line location is in scope of contractor.

9.1 Mainlines

The final alignment of mainlines will be worked out at site in consultations with the Owner/Owner's representatives after route survey and trial pits, at contractor cost. Any change in routing from the issued drawings due to site constraint will be notified to EIC & his specific written approval shall be obtained before carrying out the job.

9.2 Service lines

Consultant/Third Party Inspection Agency and the contractor will conduct a joint survey at each probable premise/ housing colony/pockets/area to be supplied with gas. The survey

record will note customer's detailed potential gas supply points, proposed regulator positions and estimates of material quantities. The contractor's representatives will make sketch of the agreed pipe routes.

The contractor will be responsible for contacting the customer and making the necessary arrangements for access and appointments to carry out the work. Contractor shall maintain job card and complaint books at site. Owner will not be responsible for time lost due to failed appointments or disputes with customers.

10.0 ORGANISATION STRUCTURE

Contractor shall designate Project Manager / Coordinator who will be responsible to interact with EIC/Consultant/TPIA and authorized to attend review meetings, receive material, authorized to sign documents, claims and receive payments etc. Contractor shall employ a Project Manager Coordinator on company roll. Project manager / coordinator & Site Engineers on company roll. The Project Manager/ Coordinator must have qualification of BE Mech. /Diploma in Mech. Engg. with min. 2-5 years & Site Engineer must have minimum Diploma in Mechanical Engineering with 3 years of work experience in gas pipe line job. He shall be single point of contact for all the works and must represent company in the review meetings.

All construction work will be carried out as per direction of EIC, and this will be the primary point of contact between the contractor and Owner on site. All work will be issued and sanctioned through the EIC and site control exercised by Site Engineers. The contractor shall ensure that technical quality standards are maintained, that construction is carried out cost effectively and that a good customer and public image is maintained for Owner.

The contractor will deploy his own supervisors as directed by site engineers/EIC. These personnel will be reporting to the Site Engineer for monitoring construction standards and for ensuring that all technical requirements are met for the job being carried out. The contractor's supervisor(s) will have day-to-day liaison with the Site Engineer, and will provide the Site Engineer with technical reports and audits, and other management information as is required on work progress and construction quality standards.

The contractor's supervisor shall have mobile telephones to ensure that they can be contacted at all times. The contractor will also nominate one person who can be contacted if necessary in odd hours, for the duration of the works. The contractor's supervisor will have access to transport at all times to allow them to visit sites and attend meetings with Owner. Supervisor shall attend to normal day-to-day issue of work instructions, communication between Owner and the contractor's supervisor and the Site Engineer.

Contractor shall maintain a Customer Care Centre, Project Site Office, and Material Store in their allotted site with following facilities:

- Telephone, Mobile Phones, Fax machines, Printers/Scanning/Xerox machines, Computers with internet facility.

- One Nos. - Four wheeler with driver, he shall be well equipped with tools and tackles for attending any emergency complaints and ongoing execution work.
- On award of the contract, the contractor shall establish and submit documentary evidence for above, which will be verified by the owner before award of the work order.

11.0 STRUCTURES, SERVICES AND OTHER PROPERTY

11.1 Location of Underground Utilities

The contractor shall locate all buried utility pipes, underground cables, water mains and other obstructions intersecting or adjacent to the Works, and shall make available the necessary labour to expose and record the depth of cover over all obstructions in advance of excavation. This shall be done far enough in advance of excavation to facilitate gradual change in grade or position found necessary to clear any obstructions.

In addition, the contractor shall excavate trial pits as necessary to determine the pipe route. The number of trial pits will be agreed with the Site Engineer in advance of any excavation. In any event, trial pits shall be made at intervals of a maximum of 30 meters. Restoration of the abandoned trial pits and trenches shall be the contractor's responsibility. No payments shall be made for such type of jobs. The trial pits shall be excavated to minimum depth of 1.5 meters so as to locate any utilities present in the trench.

It is contractor's responsibility to interact with other utility agencies regarding their existing utilities and finalize the route along with these agencies and Owner/ Owner's representative.

There will be no additional payments in respect of abandoned trenches incurred because of insufficient or inadequate trial pits, or any associated loss of time or delays.

Contractor must ensure that before starting the execution of laying of pipeline, the intimation/information must cascade to all utilities agencies seeking the information about the existing utility in the proposed route.

11.2 Protection of Structures and Utilities

The Contractor shall at his own cost support and protect all buildings, walls, fences or other structures and all utilities e.g. Electrical cables, Telephone Cables, Water pipelines, Sewer pipelines etc., and property which may be damaged as a result of the execution of the works. He shall also comply with the requirements in the specification relating to protective measures applicable to particular operations or kind of work. Special care shall be taken while laying of pipelines near the trees.

11.3 Interference with Traffic, Street Drainage and General Public

The Work shall be executed in such a manner so as to cause a minimum inconvenience to persons using public or private roads, lanes, thoroughfares, walkways, rights-of use or passages through which the Works are to be executed. The trench shall be back filled; compacted, leveled and extra soil shall be removed immediately after laying of pipeline to avoid public inconvenience. Closure of roads, etc., shall not be permitted without the approval of the EIC.

The Contractor shall comply with all local Authorities requirements to traffic and keep roads open to traffic and maintain access to and within any private property.

Wherever the pipe route crosses driveways, access tracks or entrances to private properties the Contractor shall give the owner, occupier or relevant authority at least 24 hours prior notice of intended commencement of excavation and shall be restricted to pass through.

The Contractor shall not use a private driveway, access track or entrance without the prior approval of the EIC in any circumstance.

The Contractor shall provide suitable access wherever necessary in the form of temporary bridges, culverts, flumes, etc., of a size and type approved by the EIC.

The Contractor shall comply with all relevant road Laws. Where limits and/or speed limits have been placed in the vicinity of the Works, the Contractor shall provide for the necessary movement of plant and equipment in accordance with the requirements of the relevant authority.

The Contractor shall not obstruct any drainage pipes or channels in any road but shall divert them wherever necessary and use all proper measures to provide for the free passage of water.

The Contractor shall handover the completed works after proper cleaning of the site. The contractor shall conduct his operation at all times, with a view to minimize as far as practicable noise and other objectionable nuisances (e.g. oil leakage, spillage, debris etc.)

12.0 TRENCHING

The schematic drawing with the details of trench is enclosed in the tender as per drawing No.VPC-STD-PP-2001

The Contractor shall perform the excavation works so as to enable the pipe to be laid in conformity with the levels, depths, slopes, curves, dimensions and instructions shown in the Drawings, Specifications or as otherwise directed by the EIC.

Contractor shall excavate and maintain the pipeline trench on staked center line as per approved drawing taking into account the horizontal curves of the pipelines.

While trenching, care shall be taken to ensure that all underground structures and utilities are disturbed to the minimum. Suitable crossing shall be provided and maintained over the ROU wherever necessary to permit general public, property owners or his tenants to cross or move stock or equipment from side of the trench or another.

Trenching shall be made with sufficient slopes on sides in order to minimize collapsing of the trench. On slopes wherever there is danger of landslides, the pipeline trench shall be maintained open only for the time strictly necessary. Owner may require excavation by hand, local route and detouring and limiting the period of executing of the works. Before trench cuts through water table, proper drainage shall be ensured, both near the ditch and ROU in order to guarantee the soil stability.

The Contractor shall ensure that trench bottom is maintained in the square form as far as possible, with equipment, so as to avoid/minimize the hand grading at the bottom of the trench. The Contractor shall do all such handwork in the trench as required to free the bottom of trench from loose rock, pebbles and to trim protruding roots the bottom and sidewalls of the trench.

12.1 Depth of Trench

The minimum depth of cover shall be measured from top of pipe to the top of undisturbed surface of the soil or top of the graded working strip or top of road or top of rail, whichever is lower.

In case of crossing of water bodies the minimum depth shall be measured from the top of the pipe to the bottom of Scour level.

The depth of the trench will be such as to provide minimum cover as stipulated below:

For Distribution and service lines:

Minor Water Crossing/Canal	1.5 Meter
Uncased/Cased Road Crossing	1.2 Meter
Rail/Road Cased Crossing	1.7 Meter
Normal Areas	1.0 Meter

The minimum depth may be greater than as mentioned above as may be required by Government/Public authorities under jurisdictions. The Contractor shall perform such work without extra compensation, according to the requirement of concerned authorities.

Also, in case of Drains/Culverts/Utilities crossing through open cut where excavation cut is more than 1.5m, the extra excavation is inclusive in the laying rates. No separate payment is chargeable for extra excavation and includes backfilling as well.

In case, the depth could not be achieved due to practical problems and the same is demonstrated, EIC after examining thoroughly and considering the codes and standards

may allow the contractor to provide suitable protection by way of concrete casing pipes or slabs.

12.2 Width of Trench

The width of the trench shall be wide enough to provide bedding around the pipe as specified and to prevent damage to the pipe inside the trench. Unless otherwise directed by the EIC and where ground conditions permit, the minimum distance from the inside edge of the trench wall to the outside of the pipe shall be as per the Drawing no.:

VPC-STD-PP-2001

12.3 Trench Base

The trench bottom shall be cut or trimmed to provide a uniform bedding for the pipe and shall be free from stones, metal, wood, vegetation, clods of earth or other debris before placement of the pipe.

In case trenching is done in rocky terrain, a bedding of soft soil or sand shall be provided in the trench base at no extra cost to the satisfaction of EIC.

12.4 Hard Rock:

Hard rock is defined as trench material with a single piece of rock, dimension exceeding 1.0 m in any direction, which requires cutting only by use of chisel/pneumatic chisel/drill or sledge hammer or removal of the same by additional excavation technique approved by EIC. Additional rates shall be payable for hard rock excavation over and above the pipe -line laying rates. Excavation through soil mixed with small boulders that have been used for a road base will not be considered as hard rock for the purpose of payment.

12.5 Morrum

Morrum shall be defined as the type of soil, whose excavation is not possible manually, but it can be excavated mechanical means such as sludge hammer, excavator, pneumatic breaker hammer etc. This item shall be applicable only after recommendation from PMC and prior approval from EIC. These rates will be over and above pipeline rates.

12.6 Boulder

It is a rock with grain size of usually not less than 300mm (12 inches) diameter. Additional rates shall be payable for Boulders excavation as per the SOR over and above the pipeline laying rates.

12.7 Clearances

Unless otherwise approved, the following clearances shall be maintained between the external wall of the gas pipe and the external surface of other underground assets/utilities in the vicinity of the Works.

- 150 - 300 mm where the gas pipe crosses other assets/utilities, etc., for electric cables, the clearance shall be 300mm minimum or special protection shall be provided as per approval of EIC.
- 300mm where the gas pipe is on a similar alignment to the other assets/utilities.

Where the above clearances cannot be achieved, or in other special circumstances, the EIC may approve/specify protection with concrete/ MS coated pipe, etc. The protective material shall be supplied and installed by the Contractor at his cost subject to discretion of EIC.

12.8 Under Ground Interferences

The Contractor shall locate and expose manually all underground facilities if any during trenching. Safety barriers shall be erected along the trench to prevent any damages or accident. On locations where pipeline is laid under the existing facilities and near the approaches of the crossing, the trench shall be gradually deepened to avoid sharp bends.

All sewers, drains, ditches and other natural waterways encountered while trenching shall be maintained open and functional by providing proper temporary installations if required. Suitable dewatering pumps shall be deployed to dewater, if required.

Whenever it is permitted by Authorities and/or Owner to open cut paved road crossing, or where the line is routed within the road pavement, the Contractor shall remove the paving in accordance with the restrictions and requirements of the authorities having jurisdiction thereof as directed by Owner. After laying the pipeline, backfilling shall be immediately performed and all the areas affected connected with the excavation works shall be temporarily restored.

In case of damage to any of above referred structures/utilities the Contractor shall be responsible for repairs/replacement at his own cost, which shall be carried out to the satisfaction of concerned authorities, resident and Owner.

12.9 Others

Throughout the period of execution of such work, the Contractor shall provide and use warning signs, traffic lights or lanterns, barricades, fencing, watchman etc. As required by the local authorities' jurisdiction and/or Owner.

For all roads, paths, walkways etc. which are open-cut, the Contractor shall provide temporary diversions properly constructed to allow the passage of normal traffic with the minimum inconvenience and interruptions.

The paving shall be resorted to its original condition after the pipeline is installed.

The Contractor shall excavate to additional depth at all the points where the contour of the earth may require extra depth, or where deep trench is required at the approaches to crossings of roadways, railroads, rivers, streams, drainage and ditches without any extra cost implication to Owner.

The Contractor shall excavate all such aforesaid depths as may be required at no extra cost to Owner. The trench shall be cut to a grade that will provide a firm, uniform and continuous support for the pipe.

The Contractor shall take conducive measures to ensure the protection of underground utilities as per the instructions of Owner or relevant authorities.

Where the pipeline crosses underground utilities/structures, Contractor shall first manually excavate to a depth and in such a manner that the utilities/structures are located, then proceed with the conventional methods.

The locations, where the pipeline has to be laid more or less parallel to an existing pipeline cable and/or other utilities in the Right-of-way the Contractor shall perform the work to the satisfaction of the Owner of the existing pipeline/cable/utility. In such locations, the Contractor shall perform work in such a way that even under the worst weather and flooding conditions, the existing pipeline/utilities remain stable and shall neither become undermined nor have the tendency to slide towards the trench.

12.10 Bedding

The Contractor shall ensure that the pipe when placed in the trench is supported and surrounded by a bed of screened excavated soil, which shall be stone free and have a maximum grit size of 5mm, in order to ensure no damage occurs to the pipe. However, in case of rocky soil the bedding shall be done with approved good quality packing sand subject to the approval of the Site Engineer. The packing sand shall be placed to a minimum thickness of 150mm around the pipe in case of rocky terrain.

Unless directed by the EIC the quantity of bedding and surrounding sand shall confirm specifications. There shall be no void space in the packing sand around the pipe.

13.0 LAYING

13.1 Main line

Laying of MDPE pipelines shall be commenced only after ensuring proper dimensions and clean surface of the trench. The trench bottom shall be free from the presence of cuts, stones, roots, debris, stakes, rock projections up to 150mm below underside of pipe and any other material, which could lead of perforation/tearing of the pipe wall. After ensuring above, the MDPE pipe coil shall be uncoiled smoothly through proper equipment's/care before laying pipe inside the trench ensuring no damage to pipe.

The contractor must ensure that Pipe caps are provided before lowering of Pipeline. The trench after this can be released for back filling leaving adequate lengths open at the ends for jointing.

Contractors shall ensure open ends of pipe placed in the trench shall be securely capped or plugged to prevent the ingress of water or other matter. The Contractor is to ensure that nothing enters inside the pipe during the laying process as this could cause a future blockage or regulator malfunction due to dust, etc.

In case of open cuts and moiling, where two pipes are to be laid parallel in same trench or same pits, 30% of the respective SOR of the lower size pipe for the laid length shall be paid extra.

Valves shall be installed at locations shown in the Design Plan or as directed by the EIC and joined with PE pipes by electro fusion techniques. The valves shall be placed on a concrete square block at the bottom to achieve equivalent support of the incoming and outgoing pipe.

Laying graphs/As-graphs with details of depth, length, offsets from minimum three (03) fixed different references, other utility crossings, fittings, sizes of the casing pipe used for the pipeline shall be prepared on daily basis and to be submitted to CLIENT representative/ EIC for approval. These details will further be incorporated in to As-Built Drawings.

Pipe may pass through an open drain or nallah with prior approval from EIC. Where this is permitted, the PE pipe shall be installed inside a concrete or steel sleeve for protection with no cost implications to the owner. The sleeve material shall be procured and laid by the Contractor with prior inspection and approval of the EIC for the quality of material. In general, the GI Sleeve material specification shall be confirming to IS 1239 (Heavy Duty) specification of reputed make; cost of GI sleeve shall be paid to contractor as extra item.

In case of service line laying, where the excavated pit for mainline is used for laying of service line, the length of service pipe laid in the same pit and vertical pipe which rises out of the ground with transition fittings shall be paid as per SOR

The contractor shall excavate a minimum pit of size 0.5 meter x 0.5 meter (L X W) on any kind of surface along the wall at the customer premises for the service pipe which rises out of the ground with transition fittings through GI pipe sleeve/Half Round Concrete sleeve. This excavation along with other work necessary to break through the walls of the obstruction, insertion of MDPE pipe, sealing of the annulus between the pipe and the sleeve, sleeve and the wall, installation of sleeve, making of pedestal as per provided drawing , min. Size 300 x 150 x 150 mm for GI Sleeve, min. Size 550 x 230 x 150 mm for Half Round Concrete Sleeve Drawing No.: VPC-STD-PP-2016 and simultaneous restoration of these pits shall be deemed included in the laying rates of pipes respectively. No separate payment of GI Sleeve / Half round concrete sleeve shall be charged to the owner. The material shall be inspected by TPIA / Consultant before installation. Also, the material test certificates, inspection reports approved by TPI/Consultant shall be

submitted at the time of submission of bill. Any installation without inspection & approval may lead to penalties as per Special Conditions of Contract.

In case of service lines, EIC shall decide either half round concrete sleeve or GI pipe sleeve shall be installed at any particular site depending upon site condition. The half round concrete sleeve shall be preferred over GI Sleeve, however in case where the installation of half round Concrete Sleeve is not possible due to technical feasibility and site conditions, GI sleeves shall be installed only after written approval from EIC. The rate of GI Sleeve / half round concrete sleeve shall be included in laying of 20/32 mm dia. As per respective SOR, depending upon surface condition.

13.2 GI Sleeve

The contractor shall supply the minimum dia. Size of 2.5" & 3", 300 mm in length, GI sleeves (Heavy Duty reputed make) respectively for domestic & commercial / industrial installations. The material shall be inspected by TPIA / Consultant before installation. The material test certificates/ inspection reports shall be submitted at the time of submission of bill.

The installation of GI sleeve for service lines shall be done by sealing the annulus between pipe and sleeve, firm fixing of the GI sleeves by concrete mix pedestal, clamping, sand filling, etc.

The vertical portion of the sleeves shall be fixed to the wall of the premises in a secure manner. The Service lines shall be installed in accordance with the drawing enclosed in the tender.

13.3 Half Round Concrete Sleeve

The installation of Half Round Concrete sleeve for service lines shall be done by sealing the annulus between pipe and sleeve, firm fixing of the Concrete sleeves by concrete mix pedestal, clamping, sand filling, etc. Half round concrete sleeve shall be made as per attached drawing no.VPC-STD-PP-2016. As per instructions of EIC. The dimensions shown are tentative and may vary depending upon the site conditions. The material shall be inspected by TPIA / Consultant at the fabrication stage & prior to final dispatch at site for installation. The material test certificates/ inspection reports shall be submitted at the time of submission of bill.

13.4 Crush Guard/ half Round Concrete Sleeve: - (For O&M and Project)

The installation of pre-cast RCC crush guard over Half Round Concrete Sleeve/ Pedestal shall be done by installing it resting on wall of building by fixing it with grouting nut and bolts in wall that may be detached during the event of leakage/testing. The material shall be inspected by TPIA / Consultant at the fabrication stage & prior to final dispatch at site

for installation. The material test certificates/ inspection reports shall be submitted at the time of submission of bill.

The Crush Guard shall be installed in accordance with the standard drawing, enclosed in the tender as per instruction of EIC.

13.5 LAYING OF SERVICE LINE IN PROJECT AND O&M AREA:

O&M area shall be defined as those areas where PE line is already charged and handed over to owner.

Laying of pipeline (for 20 & 32mm) in all type of surface i.e. all kinds including Kutcha, metal, concrete (PCC/RCC), bituminous, tiled, brick lined etc. after racking up of hard surface of any type by any methodology. Roads, Pavement, Footpaths etc. shall be made motor able once the pipeline is laid. Supply & installation of GI Sleeve / Half round Concrete sleeve shall be included in laying rates. The rate includes liasoning with statutory bodies and no separate rates are payable. Wherever service lines are to be laid after dismantling nallah / drain, additional cost for dismantling and repairing shall be payable under respective SOR item no.

All service lines left out initially during mainline laying and laid by same contractor within six months of gas charging of that particular area shall be paid as per respective SOR item no.

All service lines left out initially during mainline laying and laid by same contractor after six months of gas charging of that particular area shall be paid as per respective SOR item no.

All service lines left out initially during mainline laying and laid by other contractor after gas charging shall be paid as per respective SOR

13.6 MDPE PIPE LINE LAYING (20MM / 32 MM / 63MM) IN ALREADY EXCAVATED TRENCH IN BUILDER SEGMENT

Scope includes laying of MDPE pipeline in already excavated trench with or without casing ; insertion of the carrier pipe in casing pipe (on case to case basis) laying of warning mat electro-fusion of joints and re-installation of pre-cast slabs as per specification after instruction of EIC / Site Engineer of Owner.

14.0 JOINTING OF POLYETHYLENE PIPE

The procedure for jointing of PE pipe and fittings machines is attached as Annexure #2 and as per Specification for ELECTROFUSION FOR PE PIPES AND FITTINGS. Only Bar coded into electro-fusion machine (Automatically Readable) that can read the bar code of the fittings automatically shall be used for joining of the MDPE pipes/fittings. Manual feeding Electro-fusion machines are not acceptable for jointing purpose. The contractor has to submit the certificate of calibration of Fusion machine at the time of start of work and at fixed intervals as per the instructions of Owner. Contractor shall ensure that the machines are always available at site. No stoppage of work due to the non-availability of machines shall be allowed.

The contractor shall flush the Pipeline with air to remove dust, water, mud etc. before fusing the joints. Before jointing, the Contractor shall place packing sand under the pipes on both sides of the joint to keep the pipes in line and at the correct alignment during the jointing process. The jointing process shall start only after Alignment clamps with the correct size are aligned with the pipe and coupler during the electro-fusion cycle.

The Contractor shall ensure that polyethylene pipe is only cut with an approved plastic pipe-cutting tool (Rotary Cutter up to 63mm/Guillotine Cutter for 63mm and above). Before fusion is attempted, the contractor shall remove the oxidized surface of the pipe using Universal Scraper up to 63mm/Rotary Peeler for 63 mm and above before inserting into the electro-fusion coupler. The tool must remove a layer of 0.1mm to 0.4mm from the outer surface of the polyethylene pipe. No fusion will be allowed without clamping device and the approved cutting tools (Hack saw shall not be allowed for cutting the pipe).

The contractor has to supply all the consumables required for carrying fusion of the joints (like tissue paper, napkin, acetone etc.).

If, upon inspection, the EIC determines a joint is defective, Contractor shall remove the joint by an approved method. The cost of replacing joint shall be borne by the Contractor including the cost of pipe and fittings removed.

For electro-fusion joining, the contractor must bring own tools, tackles and equipment's. Only, approved Jointers shall carry out fusion of all joints. Contractors shall provide the list of jointers to be used on the job and make arrangements for Qualification Testing of the jointers in presence of Owner / Owner's representative as per the standard procedures. All approved Jointers shall bear identity cards signed by Owner / Owner's representative during fusion job and shall furnish the same on demand by Owner / Owner's representative. Applicable penalties shall be levied, in case; it is found that fusion is being carried by non-qualified jointers as per the provisions made in Special Conditions of the Contract.

Contractor shall arrange generator along with voltage stabilizer for power supply to fusion machine. Taking power connection from electric poles, connections without written permission from the concerned authorities or residential premises is strictly not permitted.

15.0 BACKFILLING

Backfilling shall be done after ensuring that appurtenance have been properly fitted and the pipe is following the trench profile at the required depth that will provide the required cover and has a bed which is free of extraneous material and which allows the pipe to rest smoothly and evenly. Dewatering shall be carried out prior to backfilling. No backfilling shall be allowed if the trench is not completely dewatered.

Prior to backfilling it should be ensured that the post padding of compacted thickness 150 mm is put over and around the pipe immediately after lowering where required.

Backfilling shall be carried out immediately after the post padding where required has been completed in the trench, inspected and approved by Owner/ Owner's representative, so as to provide a natural anchorage for the pipe avoiding sliding down of trench sides and pipe moment in the trench. If immediate backfilling is not possible, a padding of at least 300mm of earth, free of rock and hard lumps shall be placed over and around the pipe and coating.

The backfill material shall contain no extraneous material and/or hard lumps of soil, which could damage the pipe and/or coating or leave voids in the backfilled trench. In case, it is required and directed by EIC screening of the backfill material shall be carried out with specified equipment before backfilling the trench.

The surplus material shall be neatly crowned directly over the trench and the adjacent excavated areas on both sides of the trench to such a height which will, in Owner/Owner's representative opinion of provide adequately for future settlement of the trench backfill during the maintenance period and thereafter. The down shall be high enough to prevent the formation of the depression in the soil when backfill has settled into its permanent position should depression occur after backfill, Contractor shall be responsible for remedial work at no extra cost to Company. Surplus material, including rock left from this operation shall be disposed off to the satisfaction of landowner or authority having jurisdiction at no extra cost to Owner.

Where rock, gravel, lumps of hard soil or like materials are encountered at the time of trench excavation, sufficient earth, sand or select backfill materials shall be placed around and over the pipe to form a protective cushion extending at least to a height of 150 mm above the top of the pipe. Select backfill materials for padding that area acceptable shall be soil, sand, clay or other material containing no gravel, required selected backfill material has been placed, provided the rock or lumps of hard soil. The padding earth shall not contain any stones, i.e. the earth shall be screened for sand padding of the Pipeline in order to avoid damage to the pipeline. Contractor shall carry out all these works at no extra cost to Owner. Loose rock may be returned to the trench after the required selected backfill material has been placed, provided the rock placed in the ditch will not interfere with the use of the land by landowner, or tenant.

In case where hard rock is encountered or as desired by EIC / site engineer sand padding is to be provided up to height of 150 mm around the pipe.

When the trench has been dug through driveways or roads, all backfilling shall be executed with sand/suitable material in layers as approved by Owner /Owner's representative and shall be thoroughly compacted. Special compaction methods as specified may be adopted. All costs incurred there upon shall be borne by the Contractor. Trenches excavated in dikes which are the properties of railways or which are parts of main roads shall be graded and backfilled in their original profile and condition. If necessary, new and/or special backfill materials shall be supplied and worked-up to.

PE Warning Grid/Mat shall be placed on distribution main and service line inside premises, after backfill of the trench up to a height of 300mm on the top of the carrier pipes. The warning grid is to be unrolled centrally over the pipe section and thereafter further backfilling will commence.

Backfilling activity shall include proper compaction by jumping jack compactor, wherever required and as per instruction of EIC, and watering in layers of 150mm above the warning mat. Proper crowning of not more than 150mm shall be done. All the excavated material that could be used during the Restoration process shall be stacked and kept separately and properly. Wherever Road cutting/Tiles removal/PCC cutting has been done during excavation for laying, the area shall be back filled and compacted immediately so that no inconvenience is caused to the general public.

Electro-fusion of joints is to be undertaken immediately after lowering and the activity shall not be kept pending for lack of Electro-fusion jointing. The backfilling shall be considered complete only after the jointing of pipes.

Debris and other surplus material shall be removed immediately after the back filling.

The contractor shall not be entitled for payment as defined in commercial on laying and backfilling till the above activities are completed.

16.0 MOLING

The Manual Moling shall be carried out as per the requirement specified by Owner / Owner's representative and approved procedures. The contractor has to carry out survey of the underground utilities before going for the Moling to avoid any damage to other utilities. No extra payment will be made for any trial/abandoned pits made during the survey. The supply of all equipment required for carrying out moling work is in contractor's scope. The type of moling to be carried out i.e. with or without casing shall be at the discretion of Owner and prior approval is to be taken before starting the Moling.

For Moling the contractor shall ensure that the size of the hole shall not be more than 20% of the size of the casing/carrier pipes whichever is applicable. After completion of Moling the hole shall be properly compacted / filled with soil by watering and by approved procedures.

The moling rates are payable as per the SOR and the moling rates are common for MDPE pipe laying with or without casing pipe through the hole. The length of the Hole (excluding the sizes of the pits on both ends) shall be considered for the measurement of Moling length. However, the extra length of casing shall be considered for material consumption purpose only. In case of moling, where partial laying is carried out in casing and rest without casing, the SOR Shall be applicable for both. Further, the payment for the pipeline laying in the excavated pits for Moling purpose will be made as per the SOR for normal laying.

Any damage occurred to other utilities during the moling operation shall be immediately, notified and rectified by the contractor without any cost implication to owner.

17.0 HORIZONTAL DIRECTIONAL DRILLING (HDD)

HDD is required to be carried out by the Contractor where conventional Trenching/Moling is not possible viz. Railways, major waterways, highways, roads, congested areas etc. The Contractor shall obtain details of such crossings and the Contractor in consultation with Owner shall prepare construction drawings. Execution of the work shall be based on the Owner / Owner's representative approved drawings. The contractor has to do the thorough survey of the underground utilities before commencement of HDD to avoid the damage to the other utilities. No other extra payment will be made for any trail/abandoned pits made during the survey. The supply of all equipment required for carrying out the HDD is in contractor's scope. The HDD operation shall be carried out in accordance with API-1102. The type and availability of machines is sole responsibility of the contractor and as per the site conditions & requirements to entire satisfaction of EIC.

Once the work is allotted, any delay in mobilizing / non-availability of HDD machines as per site requirement and conditions shall result in levying of penalties on daily basis as per SCC. However, in such cases, owner shall mobilize HDD machines and carry out execution of work on the contractor's risk and cost and as per SCC.

The type of HDD to be carried out with or without casing shall be at the discretion of Owner and prior approval is to be taken before starting the HDD.

The rates for HDD, as indicated in SOR, are payable as per the size of the carrier pipe and inclusive of excavation of pits, jointing, pilot boring, bentonite cleaning, reaming, inse-rtion of carrier pipe backfilling, compaction, etc.

As per the specification, HDD to be carried out with or without casing pipe depends on the type of crossing as per instruction of Owner/ Consultant.

Any damages occurred to other utilities during the HDD operation shall be immediately notified and rectified by the contractor without any cost implication to OWNER.

The measurement for the payment shall be measured as per the span for which the beacon/sensing source which is attached to the reamer at the time of pulling carrier pipe for HDD. HDD profiles should be properly marked in the as built drawing in scale.

18.0 CASING PIPE

The tentative sizes of the HDPE casing pipe for Moling/ Horizontal Directional Drilling shall be as follows:

S.No.	MDPE Carrier Pipe Dia. size (mm)	Min. Dia. of HDPE Casing Pipe (mm)	Max. Dia. of HDPE Casing Pipe (mm)
1	20	40	80
2	32	50	90
3	63	125	160
4	125	200	250
5	180	250	315

However, the size of the casing pipe may vary according to the length of the carrier pipe and requirement of laying of HDPE duct & OFC cable, if required. Also, the higher size of HDPE casing pipe shall be preferred over lower size casing pipe without any extra cost to the Owner.

19.0 RESTORATION

Wherever the restoration to the original surface condition is in the scope of Owner or as directed by EIC, all roads, footpaths (including roads and footpaths inside colonies) shall be restored to its original condition and the same shall be done as per CPWD/IRC norms and to the satisfaction of the concerned local Authority/Third Party Agencies designated by Owner. To retard curing of the installed concrete, wet sackcloth is to be placed on the finished surface and kept damp for a period of 7 days.

Where slabs and blocks are to be restored, the level of the compacted sub-base is to be adjusted according to the slab/block thickness. The slabs or blocks should be laid on moist bedding material, which should be graded sand, mortar or mortar mix. The slabs or blocks should be tapped into position to ensure they do not rock after lying.

The restored slabs or blocks should match the surrounding surface levels. Joint widths should match the existing conditions, and be filled with a dry or wet mix of mortar.

The procedure for restoration of Road/Footpath is just indicative. However, the restoration shall be done in accordance with the norms of the concerned Land owning agencies.

Turf shall be replaced in highly developed grassed area. In lesser-developed grassed areas top soil should be replaced during the restoration process.

Where permanent surface restoration cannot be completed immediately, the Contractor shall provide and maintain a suitable temporary running surface for vehicular traffic and pedestrians. The Contractor will be responsible for the maintenance of all restoration carried out, for the duration of the Contract guarantee period.

The Contractor is to ensure the restoration work is properly supervised and that the material used is suitable for the purpose and properly compacted. Where the required standards are not achieved, the Contractor will be required to restore the defective work.

Payment to the restoration shall be paid as per SOR , Further, the rate of restoration includes WBM, Asphalted /Bituminous, concrete pavement, Agra Stone/ Kota stone/ Tiles (Chequered/ any other type of tiles), interlocking paver blocks, Dry brick pavements etc. and payable under one SOR.

Note that payment for restoration will be released only after satisfactory completion and certification by Third party/Consultant.

Contractor has to obtain the No Objection Certificate (NOC) from the concerned local authorities/RWA after completion of the restoration work. The restoration specification specified in the tender is only a typical specification and the contractor has to carry out restoration as per the latest version CPWD/IRC/ MUNICIPAL CORPORATION OF STATE specification to its original condition and also to the entire satisfaction of landowner (Private/Public).

The expenditure incurred towards testing of the material used for restoration, as per the applicable standards, shall be borne by contractor.

20.0 TESTING

Pressure testing will be carried out with compressed air (free from oil and greases). Compressed air will be provided by Contractor for testing purposes and is to be included in the laying rates.

For main pipeline laying, the Contractor shall perform progressive pressure testing to ensure no leaks in long lengths of pipe. The test pressure shall be 6.0 bar (g), and there shall be no unaccountable pressure loss during the test period.

Overall scheme drawing for pressure testing shall be prepared by the contractor and get approval from Owner/Owner representative.

For main line the test duration shall be 24 Hrs. with these tests, the pressure should be allowed to stabilize for a period of 30 minutes after pressurization. The holding period may then commence and continue for 24 hours. Measuring instruments shall have been calibrated and their accuracy and sensitivity confirmed. For testing of Network, calibrated pressure gauges of suitable range shall be supplied by the contractor. The pressure gauges shall be calibrated from time to time as desired by EIC. All testing shall be witnessed and approved by the EIC or his delegated representative. Tie-in joints may be tested at working pressure following commissioning. In special cases, where the mainline length is less than 500 mtrs, holding period for testing may be reduced to 4 hrs.

For service lines up to a length of 15 mtrs testing will be carried out independently of the testing of the mains (if service line is laid separately after commissioning of mainline) for which the test duration may be reduced to 30 minutes at 6 bar (g) pressure. The service line testing in this case will be performed after the service line installation is complete but

The excavation work shall be done at a location given by Engineer-in-Charge. All care shall be taken not to damage existing facilities and surface of construction shall be restored to its original state.

Sand bags to be placed below pipeline without disturbing the laid pipe. Gunny bags and Sand should be of approved quality.

PCC to be placed below the pipe as indicated. Once PCC is set sand is to be filled and properly rammed so that pipe and pre-cast concrete blocks are firmly place.

Valve will be supplied without the operating stem. Approved quality sand is to be placed in between area. The supply of sand is included in the rates.

Surrounding area to be properly cleared and PCC to be placed around the location where pre-cast slab with RCC Manhole cover is placed. The RCC pre-cast slab to be laid in level and finished smooth.

23.0 CONSTRUCTION OF TRENCHES AND OTHER SCOPE OF WORK IN BUILDER SEGMENT-

23.1 Construction of dedicated trench (as per approved drawing)

Trench Dimension- 0.6m x 0.66m x 1.0m (d x w x l)

Scope includes excavation of trench in any type of surface, construction of brick wall, waterproofing of trench(If required), removal of surplus malba, plastering of walls, watering and curing including supply & installation of precast RCC slab covers Site cleaning and restoration of all damaged surfaces during construction activity. Contractor should submit NOC through concerned RWA/Builder/Authority. For other details please refer drawing no. VPC-STD-PP-2017

23.2 Construction of dedicated trench (as per approved drawing)

Trench Dimension- 0.375m x 0.66m x 1.0m (d x w x l)

Scope includes excavation of trench in any type of surface, construction of brick wall, waterproofing of trench(If required), removal of surplus malba, plastering of walls, watering and curing including supply & installation of precast RCC slab covers Site cleaning and restoration of all damaged surfaces during construction activity. Contractor should submit NOC through concerned RWA/Builder/Authority. For other details please refer drawing no.- VPC-STD-PP-2018

23.3 Excavation of trench and installation of casing pipe by any method (Open /Moling)

Scope includes excavation of trench/moling in any type of surface and installation of 6" GI Pipe C Class as casing pipe, restoration for road crossing up-to 7.0 m inside society and obtaining NOC through concerned RWA/Builder/Authority.

23.4 Sand Filling in any type of trenches in builder segment only;

Scope includes supply and filling of coarse sand (Size 0.6 To 2.0mm) as per IS 383 free from impurity like clay, mica and soft flaky pieces in the trench as per instruction of EIC/Owners representatives.

Note- In all of the above items 10% amount shall be withheld till availability of NOC from concerned authority.

24.0 ROUTE MARKERS

Route Markers shall be fabricated, supplied and installed on the ROU at regular intervals as per the instructions of the EIC immediately after laying of the Pipeline. The installation of the type of the Permanent Marker shall be decided by the EIC depending on the site condition. The contractor shall also ensure that a sample of all type of markers shall be inspected and approved by Owner / Owner representative before shipment of the lot at site and prior to installation at the site. The inspection of all types of markers shall be carried out lot wise.

The Stone Markers shall be painted before installation as per the approved procedure. Whereas the Pole marker (Markers with foundation) and plate marker are to be supplied with powder coated Golden Yellow paint the supply of the paint as per drawing no.VPC-STD-PP-2014 and application. The supply of paint and application as per the specification is in contractor's scope. Payment shall be paid as per relevant SOR Contractor shall obtain the approval lot wise & before installation at site from the Consultant / TPIA.

25.0 GUIDELINES:

- The installation of these markers shall be such that in between two pole markers two Stone markers are installed with spacing of 50 mtrs on either side. However, Pole markers shall be installed at all the Tapping /Branching points in the mainline.
- Interval between any two Stone Route markers for mainline (180mm to 63mm) shall not be more than 50m.
- A Pole marker shall be installed near to valve chambers on Mainline & inside the pockets respectively for indication.
- Pole markers with foundations (As per the Drawings in Tender document) shall be installed after two Stone markers.
- The entry and exit pits for laying of pipeline by HDD / Moling for Road crossings shall be marked by Pole markers or Stone markers depending upon the site conditions.

In addition to above, Pole markers with foundation (As per drawings in Tender document) shall be installed outside of individual societies/areas as per the instructions of the Owner

representative.

- For the distribution network 32mm & 20mm pipe, Stone / plate markers shall be installed as per the site conditions and directions of the Site-in-Charge.
- The artwork is typical for all the markers, with Owner's logo on it. The contractor must take prior approval for the artwork from EIC before installation of Markers. The lot wise approval shall be attached with bills.

26.0 ASSISTANCE IN COMMISSIONING

Contractor shall provide the required personnel, Vehicles, labour, supervision, tools, equipment, instruments and technical assistance for performance tests and commissioning activities as per requirement/ satisfaction of Owner /Owner's representative.

27.0 STANDARD OF WORK

All work carried out under this contract shall be to standards, codes of practice construction procedures and other technical requirements as defined in the technical specifications. The manpower deployed on the respective work shall be adequately trained and shall have necessary skills to execute/supervise the work. However, the assessment on the qualification of the personal shall be at the discretion of EIC.

Fusion Operators and other skilled personnel like plumbers, conversion techniques shall be approved by Consultant/ Owner. Simultaneously Identification Cards duly signed by Consultant/ Owner shall be issued to them. The contractor shall maintain proper record for the identification cards issued to their workers.

28.0 RECORDING (AS-BUILT DRAWINGS)

- The following points shall be taken care to the preparation of as built drawings.
- The as built drawings should be in the scale of 1:200 and shall be submitted in an A-0 sheet. The drawings shall be in layers according the AUTOCAD features category.
- Pipeline feature shall be shown as a continuous line, breaks only at joints, fittings, valves, tee point, etc. Diameter, Pipe material, length, and location of pipeline whether on the road or footpath, should be clearly indicated.
- Minimum three (03) offsets of every joint, from permanent structure shall be recorded on As Built.
- Distance of pipeline from permanent property/structure should be provided at least every 20 mtrs. If there is any change in alignment / orientation and offset distances etc. Of the pipeline in between the above said 20 mtrs, the same shall be clearly mentioned in the as laid. Gas objects (off valves, tees, elbows, couplers, transition

fittings etc.,) shall be shown as block objects (which form a single node to connect) with respect to Owner symbols / legend. The As laid drawings shall be as per the approved legends provided by EIC.

- Details & offset distances from other utilities present (e.g. MTNL, Electricity Board of State, Water/ Sewage Board of State, etc.) should be given in as laid drawing. If there is any change in depth of the pipeline, the same shall be clearly marked with details in the as laid drawings. The details (material, size & Length) of additional protection provided to pipeline shall also be clearly indicated.
- Details of the PE stop off valves &. Other fittings used (i.e. tees, elbows, couplers, transition fittings, etc.) should be shown with adequate information orientation &. Offsets from permanent structures in the immediate vicinity.
- Technical deviations (if any) should be provided with reference to the buildings permanent structures around, and the same should be cited clearly with all the relevant details, including separate sketches/Blowups / sectioned drawings / exploded view.
- Total as laid-length (size wise), bill of materials should be mentioned in each sheet.
- Complete details of nallah crossings should be shown in a separate sketch.
- Names of roads, major landmarks and buildings should be mentioned appropriately for reference.
- Proper chainage shall be mentioned on all the drawings to be referred with continuation reference.
- Direction of gas flow shall be indicated in each of the drawings.
- Text on the as laid drawing should be clearly visible.
- Land base features shown on the drawing shall match the exact distance as they were on real ground with respect to scale (1:200).
- As built drawings shall be duly signed & stamped by area TPIA / Consultant.
- The details shall be prepared in standard format using MAP INFO/ AUTOCAD MAP and submitted CD RAM. Contractor shall also make the item wise material consumption report for the respective areas in a soft copy and to be submitted along with the as-built drawings.

29.0 CIVIL WORKS

The contractor has to supply the adequate materials and skilled manpower for the completion of all the civil works. The contractor shall also ensure that the work is carried out as per the details mentioned in the Schedule of rates.

Special cares shall be taken at the time of labours working in depths/lifting of the skids by



ENERGISING QUALITY

**STANDARD SPECIFICATION
FOR LAYING OF POLYETHYLENE MAIN PIPELINES AND
SERVICE PIPELINE FOR DOMESTIC CONNECTIONS**

**DOCNO: VPC-SS-PE-0001
Rev No : 00**

hydras/ cranes considering all the safety guidelines.

The contractor has to ensure that sample of the all the materials shall be inspected and approved by EIC before carrying out installation or erection work. The contractor has to submit the test certificates for all the materials to be used at the site. The construction shall be carried out strictly as per the drawings provided by the CLIENT/Consultant. The contractor shall ensure extra / surplus materials/ malba shall be immediately removed from the site after completion of the job. Separate payments shall be made as per the SOR

ANNEXURE # 1

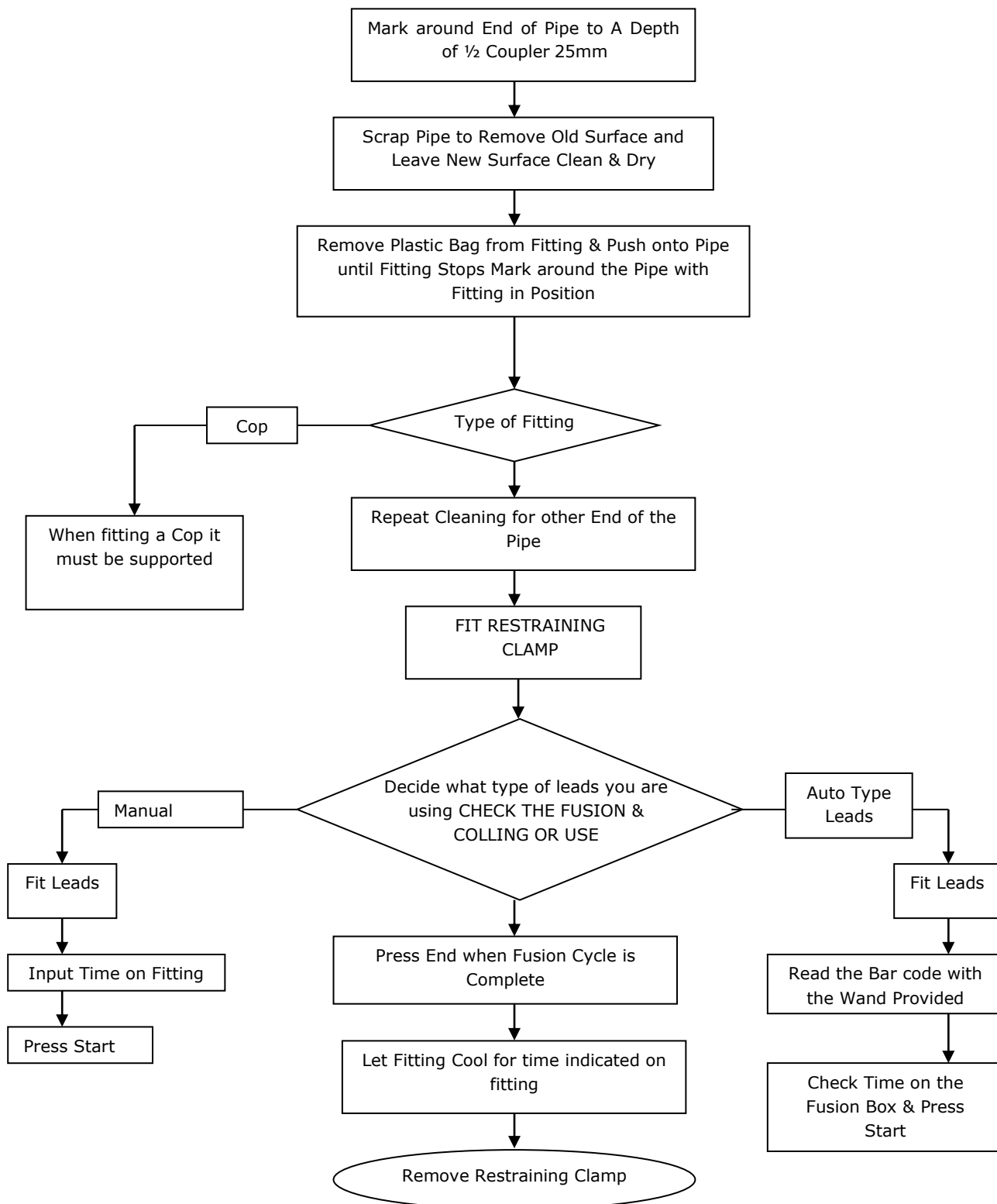
TOOLS & EQUIPMENTS TO BE PROVIDED BY THE CONTRACTOR FOR PRE LAYING

Sl. No.	Equipment Details	Minimum Requirement (In Nos.)
1	Electro Fusion Box (Automatically readable)	2
2	Voltage Stabilizer	1
3	Generator (5.5 KVA)	2
4	Moiling Equipment (for all sizes)	As and when required
5	HDD Machines & Equipment (for all types & sizes)	As and when required
6	Squeeze Tools (Manual) up to 63 mm	2
7	Squeeze Tools (Hydraulic) from 63 mm up to 180 mm	2
8	Rotary Peelers	2
9	Universal Scrapers	3
10	Tapping Tools/Allen Keys	Two sets of all sizes
11	Pipe Cutter (Round)	2
12	Pipe Cutter (Guillotine)	1
13	Pipe Cutter (ratchet type)	2
14	Gas Detection Unit	As and when required
15	Cable and Pipe Locator	As and when required
16	Test Ends	One set of all sizes
17	Pipe Alignment Clamps	As and when required
18	Joining Clamps for Coupler (All sizes)	2
19	Joining Clamps for Saddle (All sizes)	2
20	Pipe Straightness	As and when required
21	Re-rounding Tools (All sizes)	As and when required
22	Jumping Jack Compactor	As and when required
23	Roller for Asphaltting	As and when required
24	Calibrated Pressure Gauges (0-6 Bar)	6
25	Water Tankers	As and when required
26	Automatic Thread cutting machine	As and when required
27	GI Pipe cutter	As and when required
28	Heating Element for HDPE Butt joint along with clamping, roller and other accessories	As and when required



ANNEXURE # 2

FUSION COUPLERS FROM 20MM TO 180MM



ANNEXURE # 3

RESTORATION PROCEDURE/GUIDELINES FOR ROAD CUTS OF MUNICIPAL CORPORATION OF STATE AND OTHER LANDOWNING AGENCIES

PURPOSE AND OBJECTIVE

The main purpose and objective of this document is to ensure that all the work are carried out with proper specifications and standards with high quality and timely accomplishment, and the restoration of infrastructure is according to standards Aimed at achieving the original condition of the road infrastructure.

DOCUMENTS/FILES TO BE MAINTAINED:

The following documents shall be maintained during execution of the job and shall be handed over to OWNER/ Consultant/ TPI after completion of the job;

- Copy of permission letter obtained from Municipal Corporation of State.
- Drawing/ Sketch showing the details of stretch to be cut, highlighting the type of surfaces and its chainage/ length (area)
- Stage wise Photographs of the stretch.
- Test Certificates of the Construction materials to be used.
- Routine Test Certificates for construction materials during progress of job.

30.0 RESTORATION OF TRENCHES/PITS:

After laying pipeline, backfill material without containing extraneous material or hard lumps of soil or stones shall be filled and watered in layers of 150mm. Warning mats shall be placed as per specification. Earth shall be filled watered and compacted in layers with the help of earth compactor (Jumping jack compactor where ever space is available). After backfilling, the crown of the earth shall be between 50mm and 100mm above road surface and shall be free from sharp-edge stone and boulders.

After consolidation of backfill, the surplus earth shall be removed and disposed at place directed by OWNER (at suitable locations, as per direction of Municipal Corporation of State)

Further, depending upon the Surface types of following specification shall be adopted:



ENERGISING QUALITY

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**DOCNO: VPC-SS-PE-0001
Rev No : 00**

Sl. No.	Surface Types	Specification Recommended
1	Cement Concrete Surface	Top Surface – PCC 1:2:4, 100 mm Thick Compacted with Plate Vibrator shall be laid over base course. Base Course – PCC 1:5:10, 75 mm Thick laid over compacted backfilled earth.
2	Brick Soiling	Top Surface – Brick Soiling (as per original type) shall be laid over base course. Base Course – PCC 1:5:10, 75 mm Thick laid over compacted backfilled earth.
3	Interlocking CC Paver Block	Top Surface – Interlocking CC Paver Blocks (as per original type) shall be laid over compacted fine sand 50 mm Thick over base course. Base Course – PCC 1:5:10, 75 mm Thick laid over compacted backfilled earth.
4	Chequered Cement Concrete Tiles/Pre-cast CC Tiles/Kota Stone Floor/Red Stone Floor	Top Surface – Tiles/Floor (as per original type) shall be laid over Cement Sand Mortar 1:6, 20mm Thick over base course, Joints shall be pointed/finished to match colour. Base Course – PCC 1:5:10, 75 mm Thick laid over compacted backfilled earth.
5	Bituminous Surface (for Category D Roads i.e.; Roads less than 13.70 M width)	Top Surface – 40mm Thick Bituminous Concrete (as per original type) shall be laid over PCC 1:2:4, 100 mm Thick over base course. Base Course – PCC 1:5:10, 75 mm Thick laid over compacted backfilled earth.
6	Bituminous Surface (for Category C Roads i.e.; Roads less than 18 M width but greater than 13.70 M width.)	Top Surface – 40mm Thick Bituminous Concrete (as per original type) shall be laid over PCC 1:2:4, 150mm Thick over base course. Base Course – PCC 1:5:10, 150 mm Thick laid over compacted backfilled earth.

The specification mentioned above may be modified in line with relevant Municipal Corporation of State/ CPWD/ IRC specifications. Contractor has to follow the changes as informed to them time and again.

NOTE:

Wherever the Bituminous portion is cut in small patches or isolated location where area of Bituminous portion is very less due to constraints like other utilities, the

surface shall be restored, same as specified for the cement concrete surface, with prior approval of EIC/TPI.

31.0 TESTING OF CONSTRUCTION MATERIALS

For the different construction materials proposed to be used the following tests are required to be carried out for approval:

Sl.No.	Material	Test	Method of Testing	Frequency of Test
1	Cement	Setting time, soundness, compressive strength and fineness	As per IS: 4031	Once for each consignment or as and when required/directed
2	Bricks	Compressive strength, water absorption and efflorescence	As per IS: 3495	Minimum five samples or as per IS: 5454
3	Coarse Aggregates	Sieve analysis, flakiness index, estimation of deleterious materials, organic impurities, moisture contents and specific gravity	As per IS: 2386	One test per source of supply and routine test regularly as directed
4	Fine Aggregates	Sieve analysis, clay silt and moisture contents and specific gravity	As per IS: 2386	One test per source of supply and routine test regularly as directed

In addition to the above construction materials such as inter locking paver blocks, chequered cement concrete tiles, Pre-cast CC tiles, Kota/Red Stones Flooring samples shall be arranged for approval before use and if required testing shall be arranged.

For Cement concrete works the minimum frequency of sampling of concrete (CC cubes) shall be as follows:

Sl.No.	Quantity of concrete in Cu.M	No. of Samples
1	1 – 5	1
2	6 – 15	2
3	16 – 30	3
4	31 – 50	4
5	51 and above	4 + 1 additional sample for each additional 50 Cu. M and part thereof.



The cement concrete cubes shall be tested for 7 & 28 days as per relevant IS code.

33.0 INSPECTION BY THIRD PARTY INSPECTION (TPI) AGENCIES NOMINATED BY LAND OWNING AGENCIES

It is the responsibility of the contractor to give inspection call, at least one week in advance to OWNER, to arrange for inspection by TPI nominated by land owning agencies along with the file containing all documents mentioned in Clause No. 2 of this document. Before inspection by TPI nominated by land owning agencies, contractor has to arrange for the inspection of the restored area by OWNER/Consultant/TPI and get the work certified. Contractor has to arrange for all necessary equipment, tools & tackles, labour for carrying out the inspection of the restored area. It is the responsibility of the contractor to obtain "No Objection Certificate" (NOC) from the TPI nominated by the land owning agencies and further NOC from Land Owning Agencies and to get the securities/Bank Guarantees paid to them, for obtaining the permissions.



ENERGISING QUALITY

VCS PROJECT CONSULTANTS PVT. LTD.

STANDARD SPECIFICATION - INSTALLATION OF ABOVE GROUND GI/COPPER PIPING & FITTINGS IN LOW RISE DOMESTIC CONNECTIONS

VPC – SS – PE - 0003

00	18.06.18	ISSUED AS STANDARD	BS	MVK	AD
REV	DATE	Purpose	Prepared By	Checked By	Approved By



CONTENTS

1.0	GENERAL INFORMATION	3
2.0	DEFINITIONS.....	3
3.0	SCOPE OF WORK.....	3
4.0	MATERIAL, MANPOWER EQUIPMENT AND MACHINERY	6
5.0	ISSUE OF WORK INSTRUCTIONS.....	9
6.0	PROGRESS OF WORK.....	10
7.0	WORK SHEETS.....	10
8.0	PERMISSIONS / APPROVALS	10
9.0	REFERENCE SPECIFICATION, CODES AND STANDARDS	11
10.0	RIGHT-OF-USE SURVEY AND MARKING.....	11
11.0	PROTECTION OF STRUCTURES AND UTILITIES.....	12
12.0	POWDER COATED GI AND COPPER ABOVE GROUND SERVICE PIPE.....	12
14.0	INSPECTION	17
15.0	PURGING & COMMISSIONING	17
16.0	CONVERSION OF DOMESTIC APPLIANCES.....	18
17.0	RESTORATION.....	18
18.0	SUBMISSION OF FINAL RECORDS	19
19.0	COMPLIANCE TO HEALTH, SAFETY & ENVIRONMENT (HSE) FOR LOW RISE GI:	19



1.0 GENERAL INFORMATION

The main scope of this contract comprises the installation of above ground pipes from the outlet of 'PE/ GI transition fitting' up to the domestic/ commercial Customers 'Appliance/ stove/ oven valve' as per the Distribution schedule placed in enclosed drawing No:VPC-STD-PP-2026 in New as well as in Existing Gas charged areas.

The scope includes installation & procurement of above ground GI/Cu pipes and associated fittings for commercial/domestic consumers. However, the piping may have to be carried out up to Appliance Valve, in case of some commercial/ domestic customers required.

Except domestic meter, regulator, Isolation and appliance valve, Contractor shall procure the each material (GI fittings, GI Pipes, Cu Pipes, Cu/ Brass fittings, etc.) which is required from the out of PE/ GI transition fitting up to the Domestic/ Commercial Customers "Appliance/ stove/ oven valve".

This technical specification defines the basic guidelines to develop an acceptable design and suitable construction methodology for carrying out different activities listed out in the schedule of rates of this tender.

Compliance with these specifications and/or approval of any of the Contractor's documents shall in no case relive the contractor of his contractual obligations.

2.0 DEFINITIONS

PMC	VCS Quality Services Pvt. Ltd. (VCSQSPL)
SS	Present <<Standard Specification>> and its entire appendix, if any
TPIA	Third Party Inspection Agency to be appointed by CLIENT
EIC	Engineer-in-charge
CUMULATIVE LENGTH	The riser length (excluding lateral tapping) shall be considered and averaged out among all the households, whereas the lateral piping shall be included only for one particular connection
REGULATOR PIECE	The GI pipe from transition fittings to Regulator

3.0 SCOPE OF WORK

Generally the following shall constitute the Contractor's scope of work but not limited to:

- Plan and prepare a schedule for execution and work implementation as per QA/QC plans to be issued by Owner/ Owner's representative. Contractor has to submit the Construction/ Execution procedures before commencement of work to Owner/ Owner's representative for approval.
- Contractor shall submit the QCT/procedure/drawing etc. of all the material to be



procured by him for approval before procuring the items. If, QCT/ procedure/ drawing etc. are not approved from client/consultant then owner has the authority to refuse /reject the same lot material.

- Receipt of regulators, domestic meters, Isolation and Appliance Valve as a free issue items from Owner's stores, loading, transportation, unloads at project site. Proper storing, stacking, identification, providing security and insurance during and before installation and commissioning of pipelines. Obtaining the approval for optimum route and permission for work from the concerned authority and EIC.
- Selection of route with the EIC/ Consultant and marking the same on walls/floors between 'transition fitting' to 'cooking oven/ stove/ appliance', making openings and making provisions for fixing clamps. Making temporary but stable platforms scaffolding/ rope ladder etc., required for installation of pipes/fittings at all heights/multi storied flats and locations.
- Contractor shall procure all material except free issue items for installation at the outlet of PE/ GI transition fitting up to the Domestic customers "Appliance/ stove/ oven for satisfactory completion to the owner/owner's representative.
- Supply and Installation of powder coated GI pipes of 1/2", 3/4" dia. between transition fittings to customers kitchen appliances including NPT threading of GI pipes, supply of proper seal outs for threads to join fittings such as elbows, tees, connectors, regulators, meters, appliances & isolation valves etc., as per laid procedures and specifications including clamping and sealing etc. The powder coated GI pipe shall be painted after the testing of the GI installation wherever touching is required to eliminate any coating defects during installation. Where all GI fittings shall be fully painted after testing as per defined Specification.
- Supply & Installation of Copper pipes including supply of lead free solder wire and flux to join fittings such as elbows, tees, connectors, meters, valves etc., complete as per procedures and specifications including clamping and sealing etc.
- Supply of clamps for fixing pipes, Meters wherever required, painting of pipes and fittings. Providing consumables grout material, repair/restoration of walls/floors changes for the pipes including the materials required for conversions and tools and tackles etc. shall be completed as per specification.
- Conversion of all types of LPG kitchen appliances to NG based appliances & to take Sign on RFC card& Joint Meter Records (JMRs) of customer.
- To demonstrate the Customer regarding use, safety and maintenance related aspects to



NG based appliances and installations.

- Cleaning, flushing, pneumatic testing and commissioning to the GI/Cu pipe & fittings, meters, valves etc. as per specification and hand over the same to Owner/Customer to the entire satisfaction of EIC/CONSULTANT.
- Dismantling of scaffolding/temporary structures and cleaning of site & restore the site as per its original condition.
- Restoration of walls, flooring and other damages while executing the above ground installation up to satisfaction of properly owner.
- Preparation and submission of above ground installation card for each house indicating the laid GI/ Cu pipe including fittings, mentioned the reasons, if connecting, testing, etc. is not provided to the customers and deviation statements on completion /commissioning of work.
- Any other activities not mentioned/covered explicitly above, but otherwise required for satisfactory completion/operation/safety/statutory/maintenance of the works in new & existing gas charged areas shall also be covered under the Scope of work and has to be completed by the Contractor within specified schedule at no extra cost to Owner.
- Following activities are also in Contractor's Scope:
 - Receive Customer's request and complaints logged on CLIENT's portal/Offline.
 - Carry out joint technical feasibility survey for requests received.
 - Attend and resolve customer complaints within defined TAT (Turn Around Time).
 - Maintain and update the request and complaint status in CLIENT's portal.
- Maintain new connection tracking on CLIENT's portal. Providing adequate manpower, minimum 2 no's each such as data entry operator, customer care executive etc. for data logging like new connection request & GI tracking, attending complaints, day to day interaction with customers and residents so that work can be executed within defined time period (TAT) Turn Around Time.
- Providing adequate manpower for carrying out laying for PNG installation for emergency cases as and when required. The TAT period for carrying out such emergency cases are defined in tender document.
- Printable material i.e. RFC book, sticker & safety Guidelines shall be provided by owner. All other printable materials like feasibility report etc. shall be in contractor's scope.
- All size of GI pipes shall be powder coated before installation and it is in the scope of contractors. Contractor shall submit powder coating procedure to EIC/ Consultants before powder coating of pipes.



4.0 MATERIAL, MANPOWER EQUIPMENT AND MACHINERY

4.1 Material to be supplied as a free issue material

Domestic meter, Regulator, Isolation and Appliance valve shall be supplied as a free issue material to the contractor. The contractor shall not use any other material from any other source of supply other than owner's supplied material without any written approval from EIC.

4.2 Material/Equipment & machinery to be supplied by contractor

Contractor shall procure/ purchase GI Pipe & fittings, Brass fittings, Cu pipe & fittings, and Reinforced rubber hose with other material which is required to satisfactory completion/safety/statutory of the works as per tender at no extra cost to Owner. The CLIENT logo shall be marked on the material supplied by contractor. The contractor shall take approval from owner/owner representative for marking on the material to be procured by contractor before placement of order.

The Contractor shall provide labour, tools (such as Hammer Drill, Piston Drill, Pipe Cutters, Dies for threading, Pipe wrenches, spanners, conversion kits, solder torch, copper tube Cutters, tube benders, lacquering, thinner etc.) in specified numbers, all types of clamps, Plant and equipment necessary for the proper execution of the work. This will include but not limited to list of specialized tools and tackles indicated in Annexure #1.

Special tools shall be required at site for carrying out drilling work in walls other than Brick or RCC (Ex. Granite, Marble, Wooden, Glass Cutting etc.)

The contractor has to ensure the availability of DG sets for continuous power supply. In case the power supply is availed at the site from societies, individual residents, contractor shall settle the claims raised by the electricity providers without any cost implication to OWNER. In case contractor doesn't settle the claims for using the electricity from societies/individual residents, on demand by the providers, OWNER will settle the claims and the same will be deducted from the contractor's bills. The progress of work shall not hamper due to non-availability of power supply.

The contractor has to submit the valid calibration certificate for Pressure gauges.

Contractor shall submit the manufacturer test certificate slab test certificate for all items procured by him for approval before commencing the execution.

No hiring of equipment's, tools and tackles by the contractors is allowed at the site. In case any contractor is found not in possession of enlisted required tools and tackles,



penalty will be levied as per the SCC which shall be deducted from the running bills.

4.3 Plant and Equipment

All vehicular type machinery shall be in good working condition and shall not cause spillage of oil or grease. To avoid damage to paved surfaces, the contractor will provide pads of timber or thick rubber under the hydraulic feet or outriggers of machinery.

4.4 Sealant, Grout

The contractor shall be responsible to arrange the supply of any consumable sealant or ready mix grout material required for restoration of holes. The sealant/grout supplied by the contractor shall be compatible with the area to be restored/ rectified. No separate payment for the supply of sealant and grout shall be made to the contractor.

4.5 Clamps, Rawal Plugs, Screws and Nozzles etc.

The Clamps, Brackets for meter, Rawal Plugs, SS-304 Screws (2" length), Nozzles, etc. shall be approved lot wise by EIC prior to installation. Re-drilling of existing appliance (burners) nozzles is strictly not permitted. The quality of materials procured will be got approved and will be as directed by EIC.

The indicative sketch of the Brackets for Meter, and GI/Copper Pipe Clamps is enclosed with the tender. No separate payment for the supply of Meter Brackets and GI/Copper clamps shall be made to the contractor.

4.6 Consumable Items

- Special Consumables such as Teflon Tapes, solder wire, flux, lacquer, thinner shall be supplied by the contractor and are included in installation rates.
- These consumables shall be of reputed make companies and required grades/class

4.7 Other Materials

The contractor shall supply the following items where required:

4.7.1 All materials required for work, NPT threading, copper pipe jointing, testing etc.

4.7.2 All signs, barricades, lights and protective equipment.



- 4.7.3 All material required for working at higher floor levels (i.e., scaffolding, Ladder, Safety Belts, Self-Locking Safety Harness Belts etc.).
- 4.7.4 Special consumable such as grease for maintenance of domestic appliances, all paints for painting of GI Pipes, Consumables such as Teflon Tapes, Solder- wire, Flux, Lacquer, Thinner, Petrol, Diesel, Fuels and Oils required are to be supplied by the contractor and are included for within the rates.
- 4.7.5 All minor items not expressly mentioned in the contract but which are necessary for the satisfactory completion and performance of the work under this contract.

4.8 Acquisition, Receipt and Storage of Materials

The Contractor shall collect Domestic meter, Regulators, Isolation and Appliance Valve from Owner's designated stores in between the hours to be advised by the EIC.

The contractor shall carry out assessment of material required for GI/Copper installation in allocated area. After approval from Owner, contractor shall place order for purchasing of GI Pipes & fittings, Copper pipes & fittings, Brass Fittings, and Reinforced Rubber hose (Technical specifications attached in the tender document) to anyone of approved vendors as per the list attached in the tender document. The contractor shall also ensure that the QCT for these materials shall be approved before the start of production activity. Once QCT is approved, contractor shall forward inspection call to the Owner depending upon the material requirement at the site. The inspection of these materials shall be carried out by Owner appointed third party inspection agency. It is contractor's responsibility for document submission, arranging dispatch clearance, handling, loading, transportation and unloading of these materials at their own respective store.

Any other activity not mentioned/covered, explicitly, but otherwise required for satisfactory completion/operation/safety/statutory/maintenance of works shall also be covered under scope of work and has to be completed by contractor within specified schedule at no extra cost to Owner. The Contractor shall carry free issue material in such a manner as to preclude damage using transportation and handling.

The Contractor shall physically examine all materials at the time of acceptance the material in store and notify the EIC immediately of any damage or defect noticed by the Contractor. The CLIENT representative shall duly note any damage or defect in a site instruction book and both parties shall counter sign the entry.

Any damage not so recorded will be deemed not to have existed at the time of acceptance of material in store by the Contractor and the cost of repair or replacement or rectification shall be borne by the Contractor.



All materials shall be stored in contractor's stores near site in such a manner so as to prevent any damage to the materials from scratching, gouging, indentation, excessive heat or by contact with any sharp objects or chemicals.

The Contractor shall be required to submit inventory details of materials every month.

The Contractor shall maintain log book at their respective stores stating issue and availability of free issue material at a given day. Further, it is mandatory that the contractor is required to undertake and submit inventory details of free issue and purchased materials on monthly basis to Owner/ Owner's representative as per the approved format of the owner. The inventory details shall be in correlation with the Daily progress chart and material reconciliation sheet.

Material reconciliation indicating issue of material, consumptions and defective material shall be submitted on every three months basis.

5.0 ISSUE OF WORK INSTRUCTIONS

- The contractor will be required to carry out GI installation in the areas where MDPE laying is under progress. However, testing of GI installation shall be done in conjunction with laying of MDPE Service Lines to respective premises. A general scheme of distribution to domestic consumer is indicated in enclosed drawing No:VPC-STD-PP-2026 for reference. It may vary in case of individual and multi storied flats.
- All skilled personnel like jointers, conversion technicians will be approved and certified by EIC. The technicians who will carry out joining of copper material and conversions will undergo a test by Owner. Those who clear the test will be issued identity cards duly signed by EIC. These technicians shall be only authorized to take up respective jobs. In case it is found that contractor personnel other than authorized are carrying out these works, applicable penalty will be levied to the contractor as per contract.
- The rates to be quoted by contractor shall be inclusive of all preparatory/bye works, platform materials, labour, supervision, tools, taxes, duties, levies, salaries, wages, overheads, profits, escalations, fluctuations in exchange rates and no change in the rates shall be admissible during tenancy of the contract.
- The schedule of items of GI/Cu installations have been described in brief and shall be held to be completed in all respect including safety requirements as per Standard Specification of HSE, tests, inspection, QA/QC works, enabling and sundry works. The payment shall be made against completed and measured works only. No extra works



whatsoever shall be considered in execution of these items.

6.0 PROGRESS OF WORK

The contractor shall proceed with the work under the contract with due expedition and without delay. Contractor shall assess the material requirement of the allotted area and submit the schedule plan for execution & purchasing before start of actual work.

The EIC may direct in what order and at what time the various stages or parts of the work under the contract shall be performed. Weekly progress reports shall be submitted in the formats approved by Owner, indicating broadly the laying, testing, RFC, conversions and extra piping.

7.0 WORK SHEETS

- The quantities of GI/Cu pipe and other details will be checked by Owner's site engineer and the same shall be incorporated in RFC cards, signed & dated as certified, on site. The cards will then be approved by the EIC.
- Measurement sheets shall be prepared based on the RFC cards and checked and certified by the site engineers for billing purpose.
- If measurement sheets submitted are illegible, incomplete or incorrectly booked they will be returned to the contractor.

8.0 PERMISSIONS / APPROVALS

- Contractor shall be responsible for obtaining permissions from society management, RWA, individual residents and any other concerned authority, if required, for completion of the work. Contractor must take the prior appointment from the residents for carrying out the work.
- The prospective bidder shall work in close consultation/coordination with the EIC.
- The prospective bidder shall not sign/execute any agreement and/or undertaking on any such documents which amounts to be under taken by Owner. The same shall only be signed and executed by Owner; however, the prospective bidder shall also liaison and coordinates for the same.
- The necessary coordination, liaison and arrangements for inspection and approval shall be the contractor's responsibility. Inspection and acceptance of the work by authority shall not relieve the contractor from any of these responsibilities under this contract. The contractor shall plan the execution of work in such a manner so that all the registered customers are attended in phased manner. However, it is the contractor's responsibility to fix a firm appointment with the consumer for carrying out the work.



- A log book/job card for such appointments with Consumer/any other agencies shall be maintained and the schedule/appointment once taken shall be adhered to by the contractor. PMC/EIC shall review the records every week. The contractor shall submit the detailed list of RFC/Conversions and balance work on Registrations at least once a week as per approved format.
- The contractor is also required to obtain a "Labour License" from the Assistant Labour Commissioner of respective Administration/Central Govt.
- It will be the contractor's responsibility to familiarize himself and comply with, any other local rules, regulations or statutory requirements applicable to the work.
- The contractor has to take responsibility of the action of supervisors, plumbers and helpers provided by him.

9.0 REFERENCE SPECIFICATION, CODES AND STANDARDS

The contractor shall carry out the work in accordance with this specification, Owner's Engineering Standards: ASME B31.8 - Gas Transmission and Distribution Piping Systems; Oil Indian Safety Directorate Norms(OISD), the American Gas Association Document - Purging Principles and Practice and PNGRB Guidelines.

If the contractor find any discrepancy, ambiguity or conflict in between any of the Standards and the contract documents, then this should be promptly referred to the Engineer -in-Charge (EIC) for his decision, which shall be considered binding on the contractor.

10.0 RIGHT-OF-USE SERVEY AND MARKING

The route of the pipeline to be installed shall be decided with consent of the consumer and Site Engineer/EIC. Contractor must ensure that the persons/workers/supervisors/ working at site shall have proper identity cards prior to entering the premises of the consumer.

No temporary or permanent deposit of any kind of material resulting from the work shall be permitted in the approach or any other position, which might hinder the passage and/ or natural water drainage, or any area where there is objection from consumer.

The contractor shall obtain necessary permissions from land Owners and tenants and shall be responsible for all damages caused by the construction and use of such approaches, pavements, gardens, rooms, walls, roof etc., at no extra cost to Owner.

Owner/Consultant and the contractor at each premises or housing colony to be supplied with gas will conduct a joint survey. The survey record will note Customer details, the potential gas supply points and proposed meter positions and estimates of material quantities. The contractor's representatives will make a sketch of the agreed pipe routes, if necessary.



The contractor will be responsible for contacting the Customer and making the necessary arrangements for access and appointments to carry out the work. Owner will not be responsible for any time lost due to failed appointments or disputes with Customer.

The contractor shall confine its operations within limits of the Right in use. The contractor shall restore any damage to property outside ROU.

The contractor shall also carry-out all necessary preparatory work if needed to permit the passage of men and equipment. Lights, Curbs, signs shall be provided wherever and/or required by the Owner necessary to protect the public.

11.0 PROTECTION OF STRUCTURES AND UTILITIES

The contractor shall at his own cost, support and protect all buildings, walls, fences or other structures and all utilities and property which may, unless so protected, be damaged as a result of the execution of the works. He shall also comply with the requirements in the specification relating to protective measures applicable to particular operations or kind of work.

While painting, contractor must take care of the consumer premises while carrying out the job such as spillage on floor, walls, ceilings, sun shades etc. If the same does occur, the contractor has to immediately make things to original.

12.0 POWDER COATED GI AND COPPER ABOVE GROUND SERVICE PIPE

The powder coated GI service pipe installation work includes all work necessary to connect from the PE/GI transition fitting on the down-stream of the PE service, to the Customers appliance, including the installation of regulator, valves, fittings, meters, clamps etc. The contractor shall be required to provide all equipment, tools and materials necessary to execute the work in an efficient and effective manner. Along with ladders, scaffolding pipe, dies, tripods, vices, fittings and Teflon tape, drills for concrete and other masonry, drills for timber, Granite, Marble Stones and laminated surfaces inside Customers property, bending tools, clamps, sleeves to facilitate the pipe passing through floors and walls, paint for marking etc.

All powder coated GI risers at the outside of buildings shall be fully supported to carry the weight of piping. A flanged foot or similar device, capable of supporting the total weight of the riser, shall support risers. The riser shall be installed in a vertical line from its point of support to its highest point with a minimum of changes in direction. The threading of GI pipe shall be NPT and conforming to ANSI B 1 20.1

Contractor has to supply different types/sizes of approved powder coated clamps (Mild Steel) for fixing GI pipes suiting to the site conditions. The contractor shall get approval from EIC for every fresh lot of the clamps, brackets, regulator boxes and other consumables, prior to start of installation. The detailed cross sectional of GI Pipe Clamps/Meter brackets are as per Drawing No.VPC-STD-PP-2051



All riser and lateral pipe shall be clamped to the building at intervals not exceeding 1.5 mtrs. Maximum distance between clamps shall be 1.0 - 1.5m when pipe goes to the straight, if any tee or fittings lies in between the pipe then clamp shall be placed 150 mm far away from center line of fittings at every sides. However, the same may be changed as per site conditions/as directed by EIC. Minimum gap between pipe & wall shall be 25 mm. The joints/ fittings of the GI installation shall be painted only after carrying out testing of the installation.

Where pipe passes through the balcony and the surface is slightly elevated around the service pipe or its surrounding sleeve to prevent the accumulation of water at that point. Where a short piece of sleeve is used around the gas pipe, the sleeve should be embedded in the concrete with a mix of mortar and the void between the pipe and sleeve filled with a suitable sealant. The sealant should be beveled such as to prevent an accumulation of water. Supply of clamps for all sizes of the GI pipes is in contractor's scope. Contractor has to take prior approval for design/types of clamps, paintings etc. Pipe shall preferably be entered into building above ground and remain in a ventilated location. The location for entry shall be such that it can be easily routed to the usage points by the shortest practicable route.

12.1 NON LMC

Non LMC GI Pipe shall be defined as the GI pipe installed from transition fitting to lateral isolation valves.

Regulator piece: Regulator Piece: Powder coated GI pipe of 1/2" dia installed of length 1.5m from transition fitting up to inlet of regulator. Its length may vary as per site situation subject to prior approval from Site In-Charge or as per instruction of EIC. The Laying of GI Pipe from the transition fittings to regulators shall be payable in the numbers as per SOR item no.11a

- **Riser for Bungalow /Apartments having floors up to G+3:** Powder coated GI riser pipe of 1/2" dia shall be installed from regulator isolation valve to lateral isolation valve for G+3 Apt and Individual kothi /Bungalow. Refer Drawing No.VPC-STD-PP-2027, 2029
- **Riser for Bungalow/Apartments having floors more than G+3:** Powder coated GI riser pipe of 3/4" dia shall be installed from regular isolation valve to lateral isolation valve for Apt and Individual Kothi/Bungalow having floors more than G+3. Drawing No. VPC-STD-PP-2028.

12.2 LMC

LMC GI/CU pipe shall be defined as the GI pipe installed from lateral isolation valve to appliance valve.

- **PNG CONNECTIONS IN PROJECT AREA**

Supply and installations from riser (lateral isolation valve)-.The cumulative length of 1/2" dia powder coated GI pipe with in 2m & Cu pipe within 2m or (GI+CU) within 4m after



lateral isolation valve up to appliance valve up to appliance valve along with installation of meter, supply of steel reinforced rubber hose with clamps and conversion of burner. Additional quantity above 4 meter (GI+CU) shall be payable only in case , if cumulative length exceeds 4 m .payment against additional length of (GI/Cu) shall be against SOR.

- **PNG CONNECTIONS IN O&M AREA (ON EXISTING RISER)**

Supply and installations from existing riser- The cumulative length of ½” dia. powder coated GI Pipe within 2 m & Cu pipe within 2m or (GI+CU) within 4 m after lateral isolation valve up to appliance along with installation of meter , supply of steel reinforced rubber hose with clamps and conversion of burner. Additional quantity above 4 meter (GI+CU) shall be payable only in case if cumulative length exceeds 4 m. Payment against additional length of (GI/CU) shall be against SOR. This SOR is applicable only if the riser is commissioned by other contractor or riser is commissioned by same contractor six month ago.

The GI/Cu/brass fittings shall not be counted separately & shall be measured along with GI & Cu pipe.

Except Meter, Regulator, Isolation and appliance valve, Contractor shall procure all other materials (i.e. Pipe, fittings, clamps etc.) as per attached specification for installation and to the entire satisfaction of EIC/consultant.

The contractor shall also ensure that gas supply shall not be provided to the customer in any Concealed Piping

The Copper service pipe installation work includes all work necessary to connect downstream of the meter to the Customers appliances. The contractor shall be required to provide all equipment, tools and materials necessary to execute the work in an efficient and effective manner. Along with these, he will be required to provide ladders, scaffolding pipe, drills for concrete and other masonry, special drills for timber, Granite, Marble Stones and laminated surfaces inside Customers property, bending tools, sleeves to facilitate the pipe passing through floors and walls, etc. Copper pipes & fittings shall be provided by Contractor.

During installation the Copper pipe is to be cut to proper length with tube Cutter, the burrs removed with a file, cleaning of outside surface of pipe & inside surface of fitting, applying flux to the tube and fitting around the outer/inner ends, inserting the tube in to the fitting, applying heat to the assembled joints using conventional blow torch to melt solder wire. Contractor shall submit the joining procedure of Cu pipe & Fitting to the approval or as per the instructions of EIC.



Contractor has to supply different types/sizes of approved clamps (PE 80/PVC) for fixing Copper pipes suiting to the site conditions Contractor has to take prior approval of EIC for quality of the clamps, solder, flux, lacquer, thinner etc. The approval shall be taken for every fresh lot of clamps from EIC before installation at site.

All copper piping shall be clamped to the walls at intervals not exceeding 500 mm. The solder wire shall be of reputed company of diameter size 3.25mm, Lead free as per BS 29453:1994 (Soft solder alloys) and supplied in coils. The detail specification is attached in tender for reference. Solders for use with copper tube & fittings generally melt within the temperature range 180°C- 250°C. The contractor has to furnish the certificate of confirmation of standards before start of work.

- **Installation of Meter**

Installation of domestic meters with associated inlet and outlet connections (GI/Brass fittings), on the wall with approved powder coated meter brackets and angles in new & existing gas charged areas ensure a clear gap between meter and wall.

The contractor shall supply approved powder coated meter brackets and angle brackets. A sketch of the brackets is referred from the enclosed drawing for reference. It is required that one sample of each type of bracket is approved before the work is started.

Firmly secure the meters on the wall with good quality Rawal Plugs, screws etc. In case the Rawal Plugs are not holding then wooden blocks or other fixing arrangements like cement etc. to be used for proper grouting.

The Meter installation will be preferred in open/ventilated space so as to prevent Gas accumulation and easy dispensation of gas to atmosphere in case of any smell/leakage of gas. The Meter installations will not be provided in any fixed enclosures, cabinets (below or above the slab) or confined space in the customer premises.

The Contractor shall ensure that GI installations and rubber hoses shall not be exposed to direct heat of Gas burners. The installation should have minimum clearance of about 1 meter from electric point mains & switches. Minimum distance between Appliance Valve & Gas Burners shall be 0.3 Meters. The isolation valve shall be installed after entering the customer premises/kitchen but before the meter installation.

The above activities along with restoration of the area to original shall be carried out to the complete satisfaction of consumer and EIC.

Powder Coating /Painting of GI Pipes

The entire lengths of the pipeline along with fittings are to be painted / powder coated after proper surface preparation as follows:



(a) **Painted (for scratched powder coated pipes and fitting only) :**

- One coat of Primer Application (Appropriate Zinc based primer)
- Two coats of synthetic enamel paint- canary yellow of minimum of 30 microns per coat of reputed make like Asian, Berger, and Nerolac. (No other make shall be used for painting).

All painting materials including primers and thinners brought to site by contractor for application shall be procured directly from manufacturers/dealers as per specifications and shall be accompanied by manufacturer's test certificates. The contractor shall ensure that smooth finish is attained after carrying out painting.

Engineer-in-Charge at his discretion may call for test for paint formulations. Contractor shall arrange to have such tests performed including batch wise test of wet paints for physical and chemical analysis. All costs there shall be borne by the contractor.

The painting work shall be subject to inspection and certification by Engineer-in-Charge at all times. Painting of GI pipe shall be paid with installation of GI pipes.

(b) **Powder coating (refer attached Specification for powder coating)**

Contractor will be required to install powder coated GI pipes shall submit detailed procedure of powder coating for approval to Consultant prior to supply of GI pipes. After installation of the entire piping system, final touching shall be done to the satisfaction of EIC.

13.0 TESTING OF GI / COPPER INSTALLATION

- The installation from PE/GI transition fitting up to regulator shall be tested at the pressure of 6.0bar (g).
- The testing of GI riser pipe up to regulator shall be done with the isolation valve in open condition and open end plugged.
- The GI/Copper installation from regulator outlet to appliance valve (except meter) shall be tested at a pressure of 2.0 bar (g) for a holding period of 2 hour with no pressure drop. All the joints in the installation shall be checked with soap solution.
- The meter shall be removed while carrying out the testing at 2 bar (g) and joints of the meter shall be tested on line with soap solution after completion of the work. For testing proper test ends shall be made along with gauges and subsequently approved by EIC. For the installation to be tested by manometer or diaphragm gauge the meter shall not be dismantled/removed and testing shall be carried out at 100 m bar with holding period of 15 min with no pressure drop.



- The contractor shall supply the Calibrated Pressure Gauges/ Manometer/Diaphragm Gauges of suitable range for testing of GI/Copper Installations ranging from 0-4 bars/0-150 m bar/0-250 m bar respectively. The calibration certificate shall be submitted before the start of the execution work.
- The pressure gauges shall be calibrated from time-to-time as desired by EIC but positively once in every six months.
- The details of testing shall be properly recorded in the GI/Copper cards.
- The ends/joints shall be painted only after carrying out testing of the installation. Powder coating to GI pipes shall be carried out in factory/ shop, and repair/ touching shall be carried out at site.

14.0 INSPECTION

The contractor to the entire satisfaction of EIC before proceeding further shall rectify any defect noticed during the various stages of inspection. Irrespective of the inspection, repair and approval at intermediate stages of work, contractor shall be responsible for making good any defects found during final inspection/guarantee period/defect liability period as defined in general condition of contract.

15.0 PURGING & COMMISSIONING

The rate for purging & commissioning shall be included in the GI/Cu installations.

Care shall be taken to ensure that the outlet is so located that vent gas cannot drift into buildings.

The commissioning of the GI installation should be performed as follows:

- Ensure the method of purging is such that no pockets of air are left in any part of the Customer's piping.
- Ensure that all appliance connections are gas tight, all appliance gas valves are turned off and there are no open ends.
- Where possible, select an appliance with an open burner at which to commence the purge i.e., a hotplate burner.
- Ensure the area is well ventilated, and free from ignition sources.
- Ensure branches that do not have an appliance connected are fitted with a plug or cap.
- Turn on one burner control valve until the presence of gas is detected. A change in the audible tone and smell is a good indication that gas is at the burner. Let the gas flow for a few seconds longer, then turn off and allow sufficient time for any accumulated



gas to disperse.

- Turn on one gas control valve again and keep a continuous flame at the burner until the gas is a light and the flame is stable.
- Continue to purge until gas is available at other appliances.

16.0 CONVERSION OF DOMESTIC APPLIANCES

The work in this section includes:

- The changing of nozzles and associated controls in accordance with manufacturer's instructions for both domestic and imported burners/ovens/grills/hotplate.
- The changing of old appliance connection Reinforced rubber hoses and nozzles and re-greasing taps as necessary.
- The contractor shall supply the Reinforced rubber hoses at the time of conversions.
- The contractor has to supply all types of nozzles/jets required for all types of appliances including imported burners, Grills, Ovens.
- Cleaning and performing minor maintenance of appliances.
- Testing for gas escapes, soundness and performance of appliances.
- Instructing the Customer for safe use of natural gas and for fixing of safety and conversion labels.
- Contractor must attend the complaints regarding appliances, leakage, fire etc. till the total area is handed over to Owner's operation and maintenance.
- All consumables (Nozzles, greases etc.) Are in contractor's scope.
- Changing or repairing of any items damaged during conversion.

It may be noted that the rates as per SOR will apply to conversion of all type of domestic appliances under the rates, the contractor will have to provide both Pin gauges and standard sized nozzles. The payment shall be released only after submission of necessary documents (i.e. JMR Card and its updation in online portal) of the individual house to owner.

NG of the connection is mandatory after RFC of the installation. However in case of reasons not attributable to the contractor, a minimum amount of 10% of connection rates will be withheld in RA bill against all such non covered cases. This amount shall be released once the contractor converts the connection on NG.

If the connection is not converted till closure of purchase order, due to reason not attributable to contractor, the withheld amount will be released after deduction of 5% amount of respective connection rates.

17.0 RESTORATION



Contractor has to restore the area wherever he has carried out drilling, clamping etc. to its original condition to the satisfaction of the consumer and to ensure no passage to the premises and seepage. If the work was carried out in Govt. Flats (CPWD/NDMC/Institutional areas), contractor has to restore the area according to CPWD specifications and obtain a NOC/Clearance certificate from the concerned authorities maintaining the flats, after completion of the work.

The restored slabs or brickwork should match the surrounding surface levels. Joint widths should match the existing conditions and be filled with a dry or wet mix of mortar.

Wherever any items of the consumer is damaged/broken during working, the same will be made good or replace to the total satisfaction of the consumer.

The contractor will be responsible for the maintenance of all restoration carried out, for the duration of the contract guarantee period.

The contractor is to ensure the restoration work is properly supervised, and that the material used is suitable for the purpose. Wherever the required standards are not achieved the contractor will be required to replace the defective reinstatement work.

Note that Payment for GI/Copper installation will be released only after satisfactory restoration and clearing of the sites of all surplus materials etc.

18.0 SUBMISSION OF FINAL RECORDS

Contractor shall submit three sets each of the following documents in hard & soft copy:

- Total list of houses in the area allotted to him giving details of connections provided & reasons where connection could not be given completed.
- The details recorded in RFC cards of every domestic house.
- Details of houses where piping done along with materials used.
- Total material consumption report.
- Material reconciliation with respect to the materials issued.
- Test reports & calibration certificates of gauges etc.
- Any other documents/records required.
- Extra Piping details

19.0 COMPLIANCE TO HEALTH, SAFETY & ENVIRONMENT (HSE) FOR LOW RISE GI:

Scope include use of Fall arrestor, Ascenders/ descenders, PPE, Barricades/ Warning Boards (03 No's) connected with warning board & Caution tapes (Refer drawing no. VPC-STD-PP-2009, 2015) in areas where piping work is in progress, Use of Safety shoes,



**STANDARD SPECIFICATION - INSTALLATION OF ABOVE
GROUND GI/COPPER PIPING & FITTINGS IN LOW RISE
DOMESTIC CONNECTIONS**

**DOCNO: VPC-SS-PE-0003
Rev No : 00**

ENERGISING QUALITY

Walky talky, Hand gloves, Reflective jackets, Hard hats (helmets), eye and ear safety equipment, Fire extinguishers and as per the detailed scope of work in tender specifications. Contractor shall also prepare and submit duly certified Safety check list signed by TPIA/PMC. In case of non-compliance, penalty shall be applicable as per SCC clause.

This set-up is applicable up to 4th (G+4) floor and full body safety harness with accessories shall be of KARAM or equivalent make.



ENERGISING QUALITY

**STANDARD SPECIFICATION - INSTALLATION OF ABOVE
GROUND GI/COPPER PIPING & FITTINGS IN LOW RISE
DOMESTIC CONNECTIONS**

DOCNO: VPC-SS-PE-0003
Rev No : 00

**20.0 ANNEXURE-1
TOOLS & EQUIPMENT TO BE PROVIDED BY CONTRACTOR FOR
GI/COPPER WORK**

S. No.	Hand Tools Description	Per Technician	Per Team
1	Pipe Wrench 250 mm	1	4
2	Pipe Wrench 350 mm	1	4
3	Pipe Wrench 450 mm	-	2
4	Adjustable Spanner 50 mm	-	4
5	Adjustable Spanner 150 mm	1	2
6	Adjustable Spanner 250 mm	1	2
7	Set of combination spanner 3/16"- 11/4"AF	1	1
8	Set of combination spanners 5mm-30mm	1	1
9	Large tool boxes	1	2
10	Set flat – headed screw drivers	1	2
11	Set Philips screw drivers	1	2
12	Small hammer	1	2
13	Combination pliers/mole grips	1	2
14	Set of files	1	2
15	Drill bits for 1"pipe	-	2
16	Stocks and dies for NPT threading 1/2", 3/4", GI pipe	-	3
17	Blowtorch	-	1
18	Soldering Iron	-	2
19	Copper Pipe Bending Machine	-	2
20	Hand drill 3/8"chuck	-	2
21	Portable electric drill 240v, heavy duty	-	2
22	Spare blades	4	4
23	Batter Powered torches	2	2
24	Measuring Tape 30m	1	2
25	Wire Brush	1	2
26	Portable Pipe vice & tripod	-	2
27	Set steel twist drills 0.5-2.0mm (for appliance conversion)	-	1
28	Set steel twist drill 1mm-10mm	-	2
29	Set masonry drills 1mm-10mm	1	2
30	Graphite based grease	As required	As required
31	Lubricating Oil	As required	As required
32	Hand Cleaner	As required	As required
33	Copper pipe cutter 12mm	-	4
34	GI Pipe Cutters 1/2"	-	2
	Gas Detection Equipment	As required	-
	Power Generator 2.5 KVA	As required	-
	Pressure Gauge (0-10 bar)	2	4
	Pressure Gauge (0-4 bar)	2	8
	Diaphragm Gauge (0-400m bar)	1	2
	Manometer (0-150m bar)	1	1
35	Automatic Thread Cutting Machine	-	As required
36	GI Pipe Cutter	-	2



ENERGISING QUALITY

VCS PROJECT CONSULTANTS PVT. LTD.

STANDARD SPECIFICATION FOR WELDED RISER & GI/COPPER INSTALLATIONS FOR PNG CONNECTIONS IN HIGH RISE BUILDINGS

VPC-SS-PE-0004

00	18.06.18	ISSUED AS STANDARD	BS	MVK	AD
REV. No	DATE	Purpose	Prepared By	Checked By	Approved By

CONTENTS

1.0	INTRODUCTION	3
2.0	DEFINITIONS	3
3.0	SCOPE OF WORK	3
4.0	MATERIAL, MANPOWER, EQUIPMENT AND MACHINERY.....	7
5.0	ISSUE OF WORK INSTRUCTIONS	10
6.0	PROGRESS OF WORK	11
7.0	WORK SHEETS	11
8.0	PERMISSIONS / APPROVALS	11
9.0	REFERENCE SPECIFICATION, CODES AND STANDARDS	12
10.0	RIGHT-OF-USE SURVEY AND MARKING	12
11.0	PROTECTION OF STRUCTURES AND UTILITIES:	13
12.0	GI AND COPPER ABOVE GROUND SERVICE PIPE	13
13.0	TESTING OF GI/ COPPER INSTALLATION.....	21
14.0	INSPECTION.....	21
15.0	PURGING & COMMISSIONING	21
16.0	CONVERSION OF DOMESTIC APPLIANCES	22
17.0	RESTORATION.....	23
18.0	SUBMISSION OF FINAL RECORDS.....	23
19.0	COMPLIANCE TO HEALTH, SAFETY & ENVIRONMENT (HSE) HIGH RISE:	24
20.0	ANNEXURE # 1.....	25

1.0 INTRODUCTION

The main scope of this contract comprises the installation of above ground pipes from the outlet of 'PE/ GI transition fitting' up to the domestic/commercial Customers 'Appliance/stove/oven valve' as per the Distribution schedule placed in enclosed drawing no. VPC-STD-PP-2026.

The scope includes installation & procurement of above ground GI/Cu pipes and associated fittings for Domestic Customers in High Rise Buildings above fourteen floors.

Except service regulator, domestic meter, meter regulator, Isolation and appliance valve, Contractor shall procure each material (GI fittings, GI pipes, Wrought steel fittings (forged fittings), Cu pipe, Cu/Brass fittings, MS/PVC clamps using SS304/brass screws, super hold nylon raw plug anchor etc.) which is required from the outlet of PE / GI transition fitting up to the Domestic customers "Appliance / stove /oven").

This technical specification defines the basic guidelines to develop an acceptable design and suitable construction methodology for carrying out different activities listed out in the schedule of rates of this tender.

Compliance with these specifications and/or approval of any of the Contractor's documents shall in no case relieve the Contractor of his contractual obligations.

2.0 DEFINITIONS

OWNER

PMC

TPIA

EIC

CUMULATIVE LENGTH

VCS QUALITY SERVICES PVT. LTD. (VCSQSPL)

Third Party Inspection Agency to be appointed by Client.
Engineer-In-Charge

The riser length (excluding lateral tapping) shall be considered and averaged out among all the households, whereas the lateral piping shall be included only for one particular connection

3.0 SCOPE OF WORK

Generally the following shall constitute the Contractor's scope of work but not limited to:

- Plan and prepare a schedule for execution and work implementation as per QA/QC plans to be issued by Owner / Owner's representative. Contractor has to submit the Construction/Execution procedures before commencement of work to Owner / Owner's representative for approval.
- Contractor shall submit the ITP/procedure/drawing etc. of all the material to be

procured by him for approval before procuring the items. If, ITP/procedure/drawing etc are not approved from client/consultant then owner has the authority to refuse /reject the material.

- Receipt of Service Regulators, Domestic Meters, Meter Regulators, Isolation and Appliance Valve as a free issue items from Owner's stores, loading, transportation, unloading at project site. Proper storing, stacking, identification, providing security and insurance during and before installation and commissioning of pipelines. Obtaining the approval for optimum route and permission for work from the concerned authority and EIC.
- Selection of route with the EIC /Consultant and marking the same on walls/floors between 'transition fitting' to 'cooking oven/stove/appliance' with preparation of isometric drawings, making openings and making provisions for fixing clamps. Making temporary but stable platforms/scaffolding/rope ladder etc., required for installation of pipes / fittings at all heights / multi storied flats and locations.
- Contractor shall procure all material except free issue items for installation at the outlet of PE/ GI transition fitting up to the Domestic customers "Appliance /stove / oven for satisfactory completion to the owner/owner's representative.
- Installation of Service Regulators as per attached drawing no.: VPC-STD-PP-2042.
- Supply and Installation of Regulator Box including fabrication as per drawing no. VPC-STD-PP-2051.
- Supply and Installation of ¾" to 2" Welded Riser from Transition Fittings (installed by PE Contractor) to last floor : Assessment of material requirement for installation of riser & header at site, Procurement of GI Pipes (heavy duty) as per IS-1239 Part-I duly powder coated & wrought steel fittings(forged fittings) conforming to IS-1239 Part-II from any of the approved vendors of Client.

Scheduling, Planning of material & forwarding inspection call, Getting Dispatch clearance from Client/PMC, Handling, loading, transportation and unloading of these materials at contractor's store / site.

Preparation and approval of sketches, schedules, execution procedures & WPS as per technical specification. All consumables e.g. electrodes, flux etc. for welding pipes and fittings are under contractor's scope. Finalizing optimum route in consent to Client

representative from transition fitting to last floor of building including lateral piece with isolation valve as per Drawing No.VPC-STD-PP-2026.

Erection, Fabrication, Socket Welding, Testing & Installation of welded GI Pipes & Fittings etc., including NPT threading as per technical specification.

Supply & fixing of MS angle clamps, Ceiling clamps & dowel plugs with screws, grout material, suitable thread sealant i.e. Teflon Tape / lock tight, Supply and fixing of studs & bolts of various sizes ranging from ½" to 2" and ¾" to 2", Jointing of transition fittings to above ground GI pipes, purging, testing and commissioning of the complete installation.

Welded riser shall be installed after successful testing at ground level. Riser shall be then pulled with pulley for vertical installation. Pneumatic testing shall be carried out for entire riser length after installation of riser as per technical specification. All the safety equipment's, tools and tackles required for satisfactory execution of welding/installation work are under contractor's scope.

Any other material & activities not mentioned/covered above, but otherwise required for satisfactory completion/safety of work as defined in tender has to be supplied / done by contractor within specified schedule at no extra cost to owner.

Supply and Installation of Powder Coated GI pipes of ½" to 2" dia. from welded riser tapping TEE (Isolation Valve) to customer's kitchen appliances including NPT threading of GI pipes, supply of proper seal outs for threads to join fittings such as elbows, tees, connectors, regulators, meters, appliance & isolation valves etc., as per laid procedures and specification including clamping and sealing etc. The Powder Coated GI pipe shall be finally touched up (painted) where the powder coating vanished and fitting joints after the testing of the GI installation.

- Supply & Installation of Copper pipes including supply of solder wire and flux to join fittings such as elbows, tees, connectors, meters, valves etc., complete as per procedures and specifications including clamping and sealing etc.
- Supply of clamps for fixing pipes, Meters wherever required, painting of pipes and fittings. Providing consumables grout material, repair/restoration of walls/floors changes for the pipes including the materials required for conversions and tools and tackles etc. shall be completed as per specification.

Cleaning, flushing, pneumatic testing and commissioning to the GI/Cu pipe & fittings, meters, valves etc as per specification and hand over the same to Owner/Customer to the entire satisfaction of EIC/ CONSULTANT.

- Conversion of all types of LPG kitchen appliances to NG based appliances. & to take Sign on RFC card & Joint Meter Records (JMRs) of customer.
- To demonstrate the Customer regarding use, safety and maintenance related aspects of NG based appliances and installations.
- Dismantling of scaffolding/temporary structures and cleaning of site & restore the site as per its original condition.
- Restoration of walls, flooring and other damages while executing the above ground installation.
- Preparation and submission of above ground installation card for each house indicating the laid GI/Cu pipe including fittings. Reason for not providing the connection to the customers and deviation statements/ consent form on completion/ commissioning of work in a particular society/ block.
- Any other activities not mentioned/covered explicitly above, but otherwise required for satisfactory completion/operation/safety/statutory/maintenance of the works shall also be covered under the Scope of work and has to be completed by the Contractor with in specified schedule at no extra cost to Owner.
- Following activities are also in Contractor's Scope:
 - a. Receive Customer's request and complaints logged on Client's portal / Offline.
 - b. Carry out joint technical feasibility survey for requests received.
 - c. Attend and resolve customer complaints.
 - d. Maintain and update the request and complaint status in Client's portal.
 - e. Maintain new connection tracking on Client's portal.
- Providing adequate manpower, minimum 2 nos. such as data entry operator, customer care executive etc. for data logging like new connection request & GI tracking, attending complaints, day to day interaction with customers and residents so that work can be executed within defined time period (TAT) Turn Around Time.

- Providing adequate manpower for carrying out laying for PNG installation for emergency cases as and when required. The TAT period for carrying out such emergency cases are defined in tender document.

4.0 MATERIAL, MANPOWER, EQUIPMENT AND MACHINERY

- **Material to be supplied as a free issue material**

Service Regulators, Domestic Meters, Meter Regulators, Isolation and Appliance valves shall be supplied as a free issue material to the contractor. The contractor shall not use any other material from any other source of supply other than owner's supplied material without any written approval from EIC.

- **Material / Equipment & machinery to be supplied by contractor**

Contractor shall procure / purchase GI Pipe & fittings, Wrought Steel Fittings (Forged Fittings), Brass fittings, Cu pipe & fittings and Reinforced rubber hose with other material which is required for satisfactory completion / safety / statutory of the works as per tender at no extra cost to Owner. Client shall be marked on the material supplied by contractor. The contractor shall take approval from owner / owner representative for marking on the material to be procured by contractor before placement of order.

The Contractor shall provide labour, tools (such as Hammer Drill, Piston Drill, Pipe Cutters, Dies for threading, Pipe wrenches, spanners, conversion kits, solder torch, copper tube Cutters, tube benders, lacquering, thinner etc.) in specified numbers, all types of clamps, Plant and equipment necessary for the proper execution of the work. This will include but not limited to list of specialized tools and tackles indicated in Annexure # 1.

Special tools shall be required at site for carrying out drilling work in walls other than Brick or RCC (Ex. Granite, Marble, Wooden, Glass Cutting etc.)

The contractor has to ensure the availability of DG sets for continuous power supply. In case the power supply is availed at the site from societies, individual residents, contractor shall settle the claims raised by the electricity providers without any cost implication to OWNER. In case contractor doesn't settle the claims for using the electricity from societies/individual residents, on demand by the providers, OWNER will

settle the claims and the same will be deducted from the contractor's bills. The progress of work shall not hamper due to non-availability of power supply.

The contractor has to submit the valid calibration certificate for Pressure gauges.

Contractor shall submit the manufacturer test certificate / lab test certificate for all items procured by him for approval before commencing the execution.

No hiring of equipments, tools and tackles by the contractors is allowed at the site. In case, any contractor is found not in possession of enlisted required tools and tackles, penalty will be levied as per SCC which shall be deducted from the running bill.

- **Plant and Equipment**

All vehicular type machinery shall be in good working condition and shall not cause spillage of oil or grease. To avoid damage to paved surfaces, the contractor will provide pads of timber or thick rubber under the hydraulic feet or outriggers of machinery.

- **Sealant, Grout**

The contractor shall be responsible to arrange the supply of any consumable sealant or ready mix grout material required for restoration of holes. The sealant/grout supplied by the contractor shall be compatible with the area to be restored / rectified. No separate payment for the supply of sealant and grout shall be made to the contractor.

- **Clamps, Rawal Plugs, Screws and Nozzles etc.**

The Clamps, Brackets for meter, Nylon Rawal Plugs, SS/Brass Screws, Nozzles, etc. shall be approved lot wise by EIC prior to installation. Re-drilling of existing appliance (burners) nozzles is strictly not permitted. The quality of materials procured will be approved by Owner/Owner's representative or as directed by EIC.

The indicative sketch of the Brackets for Meter, Regulator Boxes and GI/Copper Pipe Clamps is enclosed with the tender. No separate payment for the supply of Meter Brackets and GI/Copper clamps shall be made to the contractor.

- **Consumables Items**

- Consumables such as Electrodes, Teflon Tapes, solder wire, flux, lacquer; thinner shall be supplied by the contractor and are included in installation rates.
- These consumables shall be of reputed make companies and required grades/class.

- **Other Materials**

The contractor shall supply the following items wherever required:

- All materials required for work, NPT threading, copper pipe jointing, testing etc.
- All signs, barricades, lights and protective equipment.

- All material required for working at height (i.e. scaffolding, Ladder, Safety Belts).
 - Self-Locking Safety Harness Belts PETZL make as mentioned in safety procedure are mandatory.). Contractor shall provide but not limited to ascender, descended and pulley system essentially to carry out work at height.
 - Motorized suspended platform with skilled operator shall be preferred for installation above 25th storey building.
 - Special consumable such as grease for maintenance of domestic appliances, all paints for painting of GI Pipes, Regulator Boxes, Consumables such as Teflon Tapes, Solder-wire, Flux, Lacquer, Thinner, Petrol, Diesel, Fuels and Oils required are to be supplied by the contractor and are included within the rates.
 - All minor items not expressly mentioned in the contract but which are necessary for the satisfactory completion and performance of the work under this contract.
- **Acquisition, Receipt and Storage of Materials**

The Contractor shall collect Service Regulators, Domestic Meter, Meter Regulators, Isolation and Appliance Valve estimated for maximum one month from Owner's designated stores in between the hours to be advised by the EIC.

The Contractor shall carry out assessment of material required for GI/Copper installation in allocated area. After approval from Owner, contractor shall place order for purchasing of GI Pipes & fittings, Wrought Steel Fittings (Forged Fittings), Copper pipes & fittings, Brass Fittings and Reinforced Rubber hose (Technical specifications attached in the tender document), MS/PVC clamps using SS304/brass screws, super hold nylon rawl plug anchor to any of the approved vendors as per the list attached in the tender document. The contractor shall also ensure that the ITP for these materials shall be approved before the start of production activity. Once ITP is approved, contractor shall forward inspection call to the Owner depending upon the material requirement at the site. The inspection of these materials shall be carried out by Owner appointed third party inspection agency. It is contractor's responsibility to submit documents, arranging dispatch clearance, handling, loading, transportation and unloading of these materials at their own respective stores. In case of any defective material found shall be returned to Client store within one month of issue.

Any other activity not mentioned / covered, explicitly, but otherwise required for satisfactory completion / operation / safety / statutory / maintenance of works shall also be covered under scope of work and has to be completed by contractor within

specified schedule at no extra cost to Owner. The Contractor shall carry free issue material in such a manner as to preclude damage during transportation and handling.

The Contractor shall physically examine all free issue materials at the time of acceptance of the material in Client' store.

Any damage not so recorded will be deemed not to have existed at the time of acceptance of material in store by the Contractor and the cost of repair or replacement or rectification shall be borne by the Contractor.

All materials shall be stored in contractor's stores near site in such a manner so as to prevent any damage to the materials from scratching, gouging, indentation, excessive heat or by contact with any sharp objects or chemicals.

The Contractor shall be required to submit material reconciliation statement every month/ before issuing any free issue material from Clients store duly certified by Client representative.

The Contractor shall maintain stock register at their respective stores stating issue and availability of free issue material at a given day. Further, it is mandatory that the contractor is required to undertake and submit inventory details of free issue and purchased materials on monthly basis to Owner/ Owner's representative as per the approved format of the owner. The inventory details shall be in correlation with the Daily progress chart and material reconciliation sheet.

Material reconciliation indicating issue of material, consumptions and defective material shall be submitted on monthly basis.

5.0 ISSUE OF WORK INSTRUCTIONS

- The contractor will be required to carry out GI installation as per instructions of EIC.
- All skilled personnel like welders, jointers, conversion technicians will be approved and certified by Owner/Owner's Representative. The technicians who will carry out welding of Risers, joining of copper material and conversions will undergo a test by Owner. Those who clear the test will be issued identity cards duly signed by Owner/Owner's representative. Approved technicians shall be only authorized to take up respective jobs. In case it is found that contractor personnel other than authorized are carrying out these works, applicable penalty will be levied to the contractor as per contract.
- The rates to be quoted by contractor shall be inclusive of all preparatory/bye works, platform materials, labour, supervision, tools, taxes, duties, levies, salaries, wages, overheads, profits, escalations, fluctuations in exchange rates and no change in the rates shall be admissible during tenancy of the contract.
- The schedule of items of GI/Cu installations have been described in brief and shall be

held to be completed in all respect including safety requirements as per Technical specification of HSE, tests, inspection, QA/QC works, enabling and sundry works. The payment shall be made against completed and measured works only. No extra works

whatsoever shall be considered in execution of these items.

6.0 PROGRESS OF WORK

The contractor shall proceed with the work under the contract with due expedition and without delay.

Contractor shall assess the material requirement of the allotted area and submit the schedule plan for execution & purchasing before start of actual work.

The EIC may direct in what order and at what time the various stages or parts of the work under the contract shall be performed. Daily and Weekly progress reports shall be submitted in the formats approved by Owner, indicating broadly the laying, testing, RFC, conversions and extra piping.

The penalty and incentives will be calculated and applied on basis of monthly target as per SCC of Tender.

7.0 WORK SHEETS

- The quantities of GI/Cu pipe and other details will be checked by Owner's site engineer and the same shall be incorporated in RFC cards, signed & dated as certified, on site. The cards will then be approved by the Owner/Owner's Representative.
- Measurement sheets shall be prepared based on the RFC cards and checked and certified by the site engineers for billing purpose.
- If measurement sheets submitted are illegible, incomplete or incorrectly booked, it will be returned to the contractor.

8.0 PERMISSIONS / APPROVALS

- Contractor shall be responsible for obtaining permissions from society management, RWA, individual residents and any other concerned authority, if required, for completion of the work. Contractor must take the prior appointment from the residents for carrying out the work.
- The Contractor shall work in close consultation/ co-ordination with the Owner/ Owner's Representative.
- The Contractor shall not sign/execute any agreement and/or undertaking on any such

documents which amounts to be undertaken by Owner. The same shall only be signed and executed by Owner; however, the prospective bidders shall also liaison and

coordinate for the same.

- The necessary coordination, liaison and arrangements for inspection and approval shall be the contractor's responsibility. Inspection and acceptance of the work by authority shall not relieve the contractor from any of these responsibilities under this contract. The contractor shall plan the execution of work in such a manner so that all the registered customers are attended in phased manner. However, it is the contractor's responsibility to fix a firm appointment with the consumer for carrying out the work.

A log book/job card for such appointments with Consumer/any other agencies shall be maintained and the schedule/appointment once taken shall be adhered to by the contractor. Owner/Owner's Representative shall review the records every week. The contractor shall submit the detailed list of RFC/Conversions and balance work on Registrations at least once a week as per approved format.

- The contractor is also required to obtain a "Labour License" and BOCW registration from the Assistant Labour Commissioner of respective Administration/Central Govt.
- It will be the contractor's responsibility to familiarise himself and comply with, any other local rules, regulations or statutory requirements applicable to the work.
- The contractor has to take responsibility of the actions of supervisors, plumbers and helpers provided by him.

9.0 REFERENCE SPECIFICATION, CODES AND STANDARDS

The contractor shall carry out the work in accordance with this specification, Owner's Engineering Standards: ASME B31.8 – Gas Transmission and Distribution Piping Systems; Oil Indian Safety Directorate Norms (OISD), the American Gas Association Document – Purging Principles and Practice and PNGRB Guidelines.

If the contractor find any discrepancy, ambiguity or conflict in between any of the Standards and the contract documents, then this should be promptly referred to the Engineer-in-Charge (EIC) for his decision, which shall be considered binding on the contractor.

10.0 RIGHT-OF-USE SURVEY AND MARKING

The route of the pipeline to be installed shall be decided with consent of the consumer and Owner/Owner's Representative. Contractor must ensure that the persons/workers/supervisors/ working at site shall have proper identity cards prior to entering the premises of the consumer.

No temporary or permanent deposit of any kind of material resulting from the work shall be permitted in the approach or any other position, which might hinder the passage and / or natural water drainage, or any area where there is objection from consumer.

The contractor shall obtain necessary permissions from land Owners and tenants and shall be responsible for all damages caused by the construction and use of such approaches, pavements, gardens, rooms, walls, roof etc., at no extra cost to Owner.

Owner/Owner's Representative and the contractor will conduct a joint survey at each premises or housing colony to be supplied with gas. The survey record will note Customer details, the potential gas supply points and proposed meter positions and estimates of material quantities. The Contractor will make a sketch of the agreed pipe routes.

The Contractor will be responsible for contacting the Customer and making the necessary arrangements for access and appointments to carry out the work. Owner will not be responsible for any time lost due to failed appointments or disputes with Customer.

The Contractor shall confine its operations within limits of the Right in use. The contractor shall restore any damage to property.

The Contractor shall also carry out all necessary preparatory work if needed to permit the passage of men and equipment. Lights, Curbs, signs shall be provided wherever and/or required by the Owner necessary to protect the public.

11.0 PROTECTION OF STRUCTURES AND UTILITIES:

The contractor shall at his own cost, support and protect all buildings, walls, fences or other structures and all utilities and property which may, unless so protected, be damaged as a result of the execution of the works. He shall also comply with the requirements in the specification relating to protective measures applicable to particular operations or kind of work.

During painting, contractor must take care of the consumer premises while carrying out the job such as spillage on floor, walls, ceilings, such shades etc. If the same does occur, the contractor has to immediately make things to original.

12.0 GI AND COPPER ABOVE GROUND SERVICE PIPE

- **Definitions:**

- a. High Rise Buildings – A building having fourteen or more storey's above ground level. (i.e. of G + 14 orientation)
- b. Riser - A riser is the vertical section of a service pipe laid up a building which supplies a number of laterals.
- c. Lateral-A lateral is a horizontal off-take from a riser, which supplies a single

customer/dwelling.

- d. Service Regulator (SR) – Service Regulator is a regulator installed on a gas service line to control the pressure from 4 bar to 100 mbar that, in an emergency automatically assumes control of the pressure downstream of the station, in case that pressure exceeds a set maximum.
- e. Meter Regulator (MR) – Meter regulator is a pressure regulator installed in series with another pressure regulator which reduces the pressure from 100 mbar to 21mbar.
- f. Riser Isolation Valve (RIV) - Riser Isolation valve is fitted at the bottom of the riser to isolate the riser from the underground gas supply network.
- g. Lateral Isolation Valve (LIV) – Lateral Isolation Valve is fitted on horizontal riser (lateral) after TEE to facilitate online Tapping's and other maintenance works.
- h. Meter Control Valve (MCV) - A Meter Control Valve is fitted immediately upstream of the meter to enable the internal pipe work inside the property to be isolated from the upstream gas supply network. It must be fitted in a manner that the consumer can easily operate the valve handle.

- **Specification For Welding**

The requirements stated herein shall be followed for the fabrication of fillet type of welded joints of GI (IS 1239 heavy class) piping systems connected with pipe line and related facilities.

The welded pipe joints shall include the followings:

- a. All line pipe joints of the Circumferential fillet welded type
- b. Attachments of fitting and other supports pipes

Welding Consumables:

The Welding electrodes shall conform to the class AWS E 6013. All electrodes shall be purchased in sealed containers stored properly to prevent deterioration. The electrodes shall be handled with care to avoid damage.

Welding Process:

Welding of GI material under this specification shall be carried out using Shielded Metal Arc Welding Process (SMAW).

Welding

Root pass and final pass shall be done with 2.5 mm dia. Electrode. Welding to be carried out in line with PQR / WPS approved by Client/PMC .Welding to be done by qualified welders only.

- **Planning and Design of GI Welded Riser**

- a. Risers and laterals must be designed to run through the optimal possible route approved by Client representatives, taking into consideration potential meter positions, design regulations and access for future maintenance.
- b. The riser and associated laterals must be constructed in the most economical manner using the minimum no. of fittings, minimum pipe and considering future maintenance requirements.
- c. For buildings above 14 floors - for ease in construction and maintenance the preferred method will be welded pipe –work laid in a purpose designed and built ventilated utilities shaft.
- d. Risers and laterals must be laid a minimum of 300 mm from any electrical equipment or installations. On occasions where the pipe has to cross over a cable, this has to be done at right angles and a minimum gap of 25 mm must be maintained between the pipe and cable. Consideration may be given to wrapping the pipe with electrical insulation tape for protection against electrical short circuiting.
- e. Provision for access to the riser for future maintenance must be made at the design stage & involved undertaking a risk assessment for undertaking future maintenance work.
- f. The GI service pipe installation work includes all work necessary to connect from the PE/GI transition fitting on the down-stream of the PE service, to the Customers appliance, including the installation of service regulator, meter regulator, valves, fittings, meters, clamps etc. The contractor shall be required to provide all equipment, tools and materials necessary to execute the work in an efficient and effective manner. Along with ladders, scaffolding pipe, dies, tripods, vices, fittings and Teflon tape, drills for concrete and other masonry, drills for timber, Granite, Marble Stones and laminated surfaces inside Customers property, bending tools, clamps, sleeves to facilitate the pipe passing through floors and walls, paint for marking etc.

- g. All Welded GI risers at the outside of buildings shall be fully supported to carry the weight of piping. A flanged foot or similar device, capable of supporting the total weight of the riser, shall support risers. The riser shall be installed in a vertical line from its point of support to its highest point with a minimum of changes in direction. The threading of GI pipe shall be NPT and conforming to ANSI B1 20.1
- h. Contractor has to supply different types/sizes of approved powder coated clamps (Mild Steel) for fixing GI pipes suiting to the site conditions. The contractor shall get approval from Owner/Owner's Representative for every fresh lot of the clamps, brackets, regulator boxes and other consumables, prior to start of installation.
- i. All riser and lateral pipe shall be clamped to the building at intervals not exceeding 1.5 mtrs. Maximum distance between clamps shall be 1.0 - 1.5 m when pipe goes to the straight, if any tee or fittings lies in between the pipe then clamp shall be placed 150 mm far away from center line of fittings at every sides. However, the same may be changed as per site conditions/as directed by EIC. Minimum gap between pipe & wall shall be 25 mm. The joints/ fittings of the GI installation shall be painted only after carrying out testing of the installation.
- j. Where pipe passes through the balcony and the surface is slightly elevated around the service pipe or its surrounding, sleeves to be provided to prevent the accumulation of water at that point. Where a short piece of sleeve is used around the gas pipe, the sleeve should be embedded in the concrete with a mix of mortar and the void between the pipe and sleeve filled with a suitable sealant. The sealant should be beveled such as to prevent an accumulation of water. Supply of clamps for all sizes of the GI pipes is in contractor's scope. Contractor has to take prior approval for design/types of clamps, paintings etc.
- k. Pipe shall preferably be entered into building above ground and remain in a ventilated location. The location for entry shall be such that it can be easily routed to the usage points by the shortest practicable route.
- l. For welded riser, riser length (excluding lateral tapping) shall be considered and averaged out among all the households, whereas the lateral piping shall be included only for one particular connection. The payment shall be done through running meter rates as per SOR
- m. The rates of GI Pipe and Copper pipe including installation of valves and fitting etc. from Lateral isolation valve till home appliances are payable as per SOR

-
- n. Installation of Meter and Meter Regulators with associated inlet and outlet connections/fittings shall be connected with meter and the payment shall be done as per SOR. The rate also includes testing of joints till commissioning.
- o. Installation of Service Regulator with support and supply and installation of regulator boxes having locking arrangement with base frame, including fabrication as per attached drawing no. VPC-STD-PP-2046, 2047, 2048, 2049, 2050. The payment shall be done as per SOR.
- p. Foundation works for service regulators includes providing and laying of Plain Cement Concrete (PCC- 1:2:4) as per attached drawing no. VPC-STD-PP-2046, 2047 the payment shall be done as per SOR
- q. Except Service Regulator, Meter, Meter Regulator, Isolation and appliance valve, Contractor shall procure all other materials (i.e. Pipe, fittings, clamps, SS screws etc.) as per attached specification for installation and to the entire satisfaction of Owner/ Owner's Representative.
- r. The contractor shall also ensure that gas supply shall not be provided to the customer in any Concealed Piping.
- s. The Copper service pipe installation work includes all work necessary to connect downstream of the meter (inside the kitchen) to the Customers appliances. The contractor shall be required to provide all equipment, tools and materials necessary to execute the work in an efficient and effective manner. Along with these, he will be required to provide ladders, scaffolding pipe, drills for concrete and other masonry, special drills for timber, Granite, Marble Stones and laminated surfaces, provisions for cutting glass of window inside Customers property, bending tools, sleeves to facilitate the pipe passing through floors and walls, etc. Copper pipes & fittings shall be provided by Contractor.
- t. During installation the Copper pipe is to be cut to proper length with tube Cutter, the burrs removed with a file, cleaning of outside surface of pipe & inside surface of fitting, applying flux to the tube and fitting around the outer/inner ends, inserting the tube in to the fitting, applying heat to the assembled joints using conventional blow torch to melt solder wire. Contractor shall submit the joining procedure of Cu pipe & Fitting for approval or as per the instructions of EIC.
- u. Contractor has to supply different types/sizes of approved clamps (PE 80/PVC) for fixing Copper pipes suiting to the site conditions. Contractor has to take prior approval of EIC for quality of the clamps, solder, flux, lacquer, thinner etc. The
-

approval shall be taken for every fresh lot of clamps from EIC before installation at site.

- v. All copper piping shall be clamped to the walls at intervals not exceeding 500 mm. The solder wire shall be of reputed company of diameter size 3.25mm, Lead free as per BS 29453:1994 (Soft solder alloys) and supplied in coils. The detail

specification is attached in tender for reference. Solders for use with copper tube & fittings generally melt within the temperature range 180°C - 250°C. The contractor has to furnish the certificate of confirmation of standards before start of work.

- **Riser and Laterals Fabrication, Installation and Testing:-**

Heavy class Galvanized Iron (GI) pipes, conforming to IS 1239- Part 1 duly Polyester powder Coated with 70 microns thickness and Wrought Steel fittings(Forged fittings) conforming to IS-1239 Part 2 shall be used for welded riser.

Powder and Galvanized (Zinc) coating shall be removed by light duty grinder or by any other suitable tool at both ends of riser pipe at about 25mm in length where welding is to be performed.

Pipe and required fittings shall be first coupled with threaded (NPT) joints. The threaded joints to be made using male tapered thread and female parallel thread fittings. Teflon/ PTFE Tape or any other joining compound shall not be used in threaded joints for welded riser. Alternatively plain ended pipes and fitting can also be used for welding in welded riser.

The entire riser assembly shall be fabricated with socket welds both for threaded riser assembly and plain ended pipes. Threaded joints are permitted after first isolation valve on laterals where riser is not approachable from balcony and in case if riser is in approach of balcony within 300 mm gap from balcony laterals may be threaded with tee of welded riser on account of workability and future maintenance considerations.

The Welding electrodes shall conform to the class AWS E 6013 of reputed make such as Advani, Lincoln, ESAB or equivalent.

Welding to be carried out in line with PQR / WPS approved by Client/PMC. Welding to be done by qualified welders approved by Client / PMC only.

A riser must not be constructed so that the laterals face directly into the wall from the riser. All laterals must extend a minimum of 400 mm from the riser.

Ventilation is provided to prevent gas leaks from causing the atmosphere to become unsafe. Ventilation shall be natural. It is not permitted to use mechanical ventilation to achieve the required ventilation levels. Special Safety Harness and Protective

equipment's of PETZL make are mandatory for riser installation. Details would be as per approved Safety Job Procedure. Ensure that all equipment's and safety devices used are inspected, certified by competent authority valid & suitable for use. Plumber deployed for riser installation for high rise buildings shall be certified and prequalified with medical tests as per Safety Job Procedure.

- **Meter & Meter Regulator Positions**

Meters will normally be located inside the property at approachable location. The kitchen / utility balcony is the preferred place to install the meter – thereby minimizing the length of the outlet pipe work.

The Meter installation will be preferred in open/ventilated space so as to prevent Gas accumulation and easy dispensation of gas to atmosphere in case of any smell/leakage of gas. The Meter installations will not be provided in any fixed enclosures, cabinets (below or above the slab) or confined space in the customer premises.

Meter Regulators will be installed as per enclosed drawing no.: VPC-STD-PP-2046, 2047

Only pretested riser shall be erected using pulley. Pretesting shall be done with compressed air @ 2 bar (g) for minimum duration of 30 minutes.

Risers and laterals up to Isolation Valves shall be Leak tested with compressed air @ 2 bar (g) for minimum 2 hrs after vertical installation.

Once testing is satisfactorily completed, uncoated portion (weldment) of risers and laterals shall be painted as per painting procedure.

For the laterals beyond eighth floor, shall be used in compliance to the material specification of SS316, fittings shall be used with brass connections conforming to IS 319, in order to account for the temperature induced stresses.

- **Installation of Meter**

Installation of domestic meters with associated inlet and outlet connections (GI/Brass fittings), on the wall with approved powder coated meter brackets and angles in new & existing gas charged areas.

The contractor shall supply approved powder coated meter brackets and angle brackets. A sketch of the brackets is referred from the enclosed drawing for reference. It is required that one sample of each type of bracket is approved before the work is started.

Firmly secure the meters on the wall with good quality super hold nylon anchor Rawl Plugs, SS 304/brass screws etc. In case the Rawl Plugs are not holding then wooden blocks or other fixing arrangements like cement etc. to be used for proper grouting.

The Meter installation will be preferred in open/ventilated space so as to prevent Gas accumulation and easy dispensation of gas to atmosphere in case of any smell/leakage of gas. The Meter installations will not be provided in any fixed enclosures, cabinets (below or above the slab) or confined space in the customer premises.

The contractor shall ensure that GI installations and rubber hoses shall not be exposed to direct heat of Gas burners & chimney vents. The installation should have minimum clearance of about 1 meter from electric point mains & switches. Minimum distance between Appliance Valve & Gas Burners shall be 0.3 Meters. The isolation valves shall be installed after entering the customer premises/kitchen but before the meter installation.

The above activities along with restoration of the area to original shall be carried out to the complete satisfaction of consumer and EIC.

- **Laterals**

The lateral extending from the riser at right- angles must extend a minimum of 400 mm from the riser before passing through a wall.

- **Ventilation**

Ventilation is provided to prevent gas leaks from causing the atmosphere to become unsafe. Ventilation shall be natural. It is not permitted to use mechanical ventilation to achieve the required ventilation levels.

- **Pipes Passing Through Walls**

Where risers or laterals pass through walls the following requirements must be observed:

- a. The pipe must be sleeved in a continuous non corrosive sleeve. Joints or any other part of a joint shall not be enclosed within the sleeve.
- b. Pre-sleeved wall pieces are the preferred method for passing through walls and floors.

- **Painting of GI Pipes**

Contractor shall install powder coated GI pipes in consultation with EIC. Contractor

shall submit detailed procedure of powder coating for approval to PMC prior to supply of GI pipes.

13.0 TESTING OF GI/ COPPER INSTALLATION

- Only pretested riser shall be erected using pulley arrangement. Pretesting shall be done with compressed air at 2 bar (g) for minimum duration of 30minutes.
- Risers and laterals shall be Leak tested with compressed air at 2bar (g) for minimum 2hrs after vertical installation.
- Once testing is satisfactorily completed, uncoated portion (welded) of risers and laterals shall be painted as per painting procedure.
- The GI/Copper installation from lateral valve to appliance valve shall be tested at a pressure of 200 mbar (g) for a holding period of 30 minutes with no pressure drop. All the joints in the installation shall be checked with soap solution.
- The contractor shall supply the Calibrated Pressure Gauges / Manometer / Diaphragm Gauges of suitable range for testing of GI/Copper Installations ranging from 0-4bars / 0-500mbar respectively. The calibration certificate shall be submitted before the start of the execution work.
- The pressure gauges shall be calibrated from time-to-time as desired by EIC but positively once in every six months.
- The details of testing shall be properly recorded in the GI/Copper cards.

14.0 INSPECTION

The contractor to the entire satisfaction of EIC before proceeding further shall rectify any defect noticed during the various stages of inspection. Irrespective of the inspection, repair and approval at intermediate stages of work, contractor shall be responsible for making good any defects found during final inspection/guarantee period/defect liability period as defined in general condition of contract.

15.0 PURGING & COMMISSIONING

The rate for purging & commissioning shall be included in the GI/Cu installations.

Care shall be taken to ensure that the outlet is so located that vent gas cannot drift into buildings. The commissioning of the GI installation should be performed as follows:

-
- Ensure the method of purging is such that no pockets of air are left in any part of the Customer's piping.
 - Ensure that all appliance connections are gas tight, all appliance gas valves are turned off and there are no open ends.
 - Where possible, select an appliance with an open burner at which to commence the purge i.e., a hotplate burner.
 - Ensure the area is well ventilated and free from ignition sources.
 - Ensure branches that do not have an appliance connected are fitted with a plug or cap.
-
- Turn on one burner control valve until the presence of gas is detected. A change in the audible tone and smell is a good indication that gas is at the burner. Let the gas flow for a few seconds longer, then turn off and allow sufficient time for any accumulated gas to disperse.
 - Turn on one gas control valve again and keep a continuous flame at the burner until the gas is a light and the flame is stable.
 - Continue to purge until gas is available at other appliances.

16.0 CONVERSION OF DOMESTIC APPLIANCES

The work in this section includes:

- The changing of nozzles and associated controls in accordance with manufactures instructions for both domestic and imported burners/ovens/grills/hotplate.
- The changing and handing over old appliance connection Reinforced rubber hoses and nozzles to Customers and re-greasing taps as necessary.
- The contractor shall supply the Reinforced rubber hoses at the time of conversions.
- The contractor has to supply all types of nozzles/jets required for all types of appliances including imported burners, Grills, Ovens.
- Cleaning and performing minor maintenance of appliances.
- Testing for gas escapes, soundness and performance of appliances.
- Instructing the Customer for safe use of natural gas and for fixing of safety and conversion labels.
- Contractor must attend the complaints regarding appliances, leakage, fire etc. till the

total area is handed over to Owner's operation and maintenance.

- All consumables (Nozzles, greases etc.) are in contractor's scope.
- Changing or repairing of any items damaged during conversion are in Contractor's scope.
- In case at the time of RFC if the customer is not getting the NG conversion done then the contractor shall obtain written consent about the same from customer and submit the same to Client.

17.0 RESTORATION

Contractor has to restore the area wherever he has carried out drilling, clamping etc. to its original condition to the satisfaction of the consumer and to ensure no passage to the

premises and seepage. If the work was carried out in Govt. Flats (CPWD/ Municipal Corporation of State/ Institutional areas), contractor has to restore the area according to CPWD specifications and obtain a NOC/ Clearance certificate from the concerned authorities/RWA maintaining the flats, after completion of the work.

The restored slabs or brickwork should match the surrounding surface levels. Joint widths should match the existing conditions and be filled with a dry or wet mix of mortar.

Wherever any items of the consumer is damaged/ broken during working, the same will be made good or replace to the total satisfaction of the consumer.

The contractor will be responsible for the maintenance of all restoration carried out, for the duration of the contract guarantee period.

The contractor is to ensure the restoration work is properly supervised, and that the material used is suitable for the purpose. Wherever the required standards are not achieved the contractor will be required to replace the defective reinstatement work.

Note that Payment for GI/Copper installation will be released only after satisfactory restoration and clearing of the sites of all surplus materials etc.

18.0 SUBMISSION OF FINAL RECORDS

Contractor shall submit three sets each of the following documents in hard & soft copy:

- Total list of houses in the area allotted to him giving details of connections provided & reasons where connection could not be given /completed.
- The details recorded in RFC cards of every domestic house.
- Details of houses where piping done along with materials used.

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- Total material consumption report.
 - Material reconciliation with respect to the materials issued.
 - Test reports & calibration certificates of gauges etc.
 - Any other documents/records required.
 - Extra Piping details

19.0 Compliance to Health, Safety & Environment (HSE) High Rise:

Scope includes use of fall arrestor, Ascenders / descended, PPE, Barricades/ Warning Boards (03 No's) connected with warning board/Caution tapes (Refer drawing no. VPC-STD-PP-2009, 2015) in areas where piping work is in progress, Use of Safety shoes, Wacky talky, Hand gloves, Reflective jackets, Hard hats (helmets), eye and ear safety equipment, Fire extinguishers and as per the detailed scope of work in tender specifications. Contractor shall also prepare and submit duly certified Safety

check list signed by TPIA/PMC. In case of non-compliance, penalty shall be applicable as per SCC clause.

This set-up is applicable for more than 5th (G+5) and above including high rise. Above 4th floor full body safety harness & accessories of PETZL make is compulsory.

20.0 ANNEXURE # 1

TOOLS & EQUIPMENT TO BE PROVIDED BY CONTRACTOR FOR GI/COPPER WORK

S.NO.	HAND TOOLS DESCRIPTION	PER TECHNICIAN	PER TEAM
1	Pipe wrench 250 mm	1	4
2	Pipe wrench 350 mm	1	4
3	Pipe wrench 450 mm	-	2
4	Adjustable spanner 50 mm	-	4
5	Adjustable spanner 150 mm	1	2
6	Adjustable spanner 250 mm	1	2
7	Set of combination spanner 3/16"-11/4" AF	1	1
8	Set of combination spanners 5mm - 30mm	1	1
9	Large tool boxes	1	2
10	Set flat-headed screw drivers	1	2
11	Set Philips screw drivers	1	2
12	Small hammer	1	2
13	Combination pliers/mole grips	1	2
14	Set of files	1	2
15	Drill bits for 1" pipe	-	2
16	Stocks and dies for NPT threading 1/2", 3/4", GI Pipe	-	3
17	Blowtorch	-	1
18	Soldering iron	-	2
19	Copper Pipe Bending Machine	-	2
20	Hand drill 3/8" chuck	-	2
21	Portable electric drill 240V, heavy duty	-	2
22	Spare blades	4	4
23	Battery powered torches	2	2
24	Measuring tape 30 m	1	2
25	Wire brush	1	2
26	Portable pipe vice & tripod	-	2
27	Set steel twist drills 0.5-2.0 mm (for appliance conversion)	-	1
28	Set steel twist drills 1mm-10mm	-	2
29	Set masonry drills 1mm-10mm	1	2
30	Graphite based grease	As required	As required

31	Lubricating oil	As required	As required
32	Hand cleaner	As required	As required
33	Copper pipe Cutter 12mm	-	4
34	GI Pipe Cutters ½"	-	2
	Gas Detection Equipment	As required	-
	Power Generator 2.5 KVA	1	-
	Pressure Gauge (0-10 bar)	2	4
	Pressure Gauge (0-4 bar)	2	8
	Diaphragm Gauge (0-400 m bar)	1	2
	Manometer (0-150 m bar)	1	1
35	Automatic Thread cutting machine	-	2
36	GI Pipe Cutter	-	2
37	Welding Equipment	01 set per site	01 set per site
38	Full Body Safety Harness like PETZL or Equivalent	03 set per site	03 set per site
39	Motorized Suspended Platform	As required	As required



ENERGISING QUALITY

VCS PROJECT CONSULTANTS PVT.LTD.

STANDARD SPECIFICATION ELECTRO FUSION FOR PE PIPES & FITTINGS

VPC – SS – PE - 0002

00	19.06.18	ISSUED AS STANDARD	BS	MVK	AD
REV.	DATE	Purpose	Prepared By	Checked By	Approved By

CONTENTS

1.0	ELECTRO FUSION FOR PE PIPE	3
1.1	ELECTRO FUSION FITTING JOINTING	3
1.2	ELECTRO FUSION JOINTING METHOD / PROCEDURE	4
1.3	RECORDS.....	5
1.4	TRAINING.....	5
1.5	ELECTRO FUSION SADDLE JOINTING.....	6
1.6	ELECTRO FUSION SADDLE JOINTING METHOD/ PROCEDURE	6
1.7	RECORDS.....	8
1.8	TRAINING.....	8
1.9	STOPPING THE GAS FLOW.....	8
1.10	SQUEEZE-OFF	8
1.11	BENDING-BACK.....	9

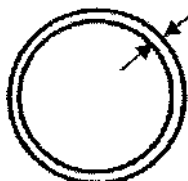


1.0 ELECTRO FUSION FOR PE PIPE

1.1 ELECTRO FUSION FITTING JOINTING

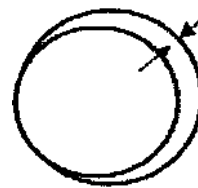
- 1.1.1** For electro fusion fitting jointing, an electrical resistance element is incorporated in the socket of the fitting which, when connected to an appropriate power supply, melts and fuses the materials of the pipe and fitting together.
- 1.1.2** The effectiveness of this technique depends on attention to the preparation of the jointing surfaces, in particular the removal of the oxidized surface of the pipe over the socket depth and ensuring the jointing surfaces area clean. Also, the pipe should be checked for ovality. If ovality causes a gap between concentrically located pipe and the fitting to exceed 1% of the pipe OD, the pipe must be re-rounded to ensure correct welding. If the gap still exceeds 1% of the pipe OD after re-rounding then a check should be made of the pipe OD dimensions to determine if it meets specification.

Max gap 1% of pipe OD



Concentrically Located

Max gap 2% of pipe OD



Eccentrically Located

- 1.1.3** The maximum gap between eccentrically located pipe and fitting i.e. Pipe touching fitting at one point, must not exceed 2% of the pipe OD.
- 1.1.4** Sometimes coiled pipes may be too oval to fit into couplers, or the end of the pipe may make the alignment of the ends impossible. In such circumstances the use of a mechanical pipe straightener or rounding tool is necessary.
- 1.1.5** The equipment and procedures following relate to fittings with center stops. If fittings without center stops are used, the maximum insertion depth must be clearly marked on the pipe ends prior to joining (felt tip pen).

Equipment

- The control box input supply to be from a nominal 240V generator, which is normally of approximately 5kVA capacity. The nominal output of the generator is to be 240V +15%, I 0% between no load and full load. Control boxes are to include safety devices to prevent excessive voltages being present at the control box output. The safety device shall operate in less than 0.5s.

Note that extension leads are not to be used on the control box outlet connections.

WARNING: Control boxes are not intrinsically safe and must therefore not be taken into the trench.



- A mechanical pipe surface preparation tool is to be used before fusion is attempted. The tool is to be capable of removing the oxidized surface of the pipe in excess of the insertion depth. The tool is to remove a layer of surface material 0.20.4 mm thick from the outer surface of the pipe preferably in a continuous strip of swarf over that length and round of the pipe.
- Pipe clamps for restraining, aligning and re-rounding the pipes in the fusion process are to be used.
- Pipe cutters with saw and saw guide.
- Protection against adverse weather conditions.

1.2 ELECTRO FUSION JOINTING METHOD / PROCEDURE

Preparation

- Ensure there is sufficient space to permit access to the jointing area. In a trench, a minimum clearance of 150 mm is required.
- Check that the pipe ends to be jointed are cut square to the axis of the pipe and any burrs removed.
- Wipe pipe ends using clean lint-free material to remove traces of dirt or mud, etc...
- Mark the area over which the oxidized pipe surface is to be removed, i.e. In excess of the insertion depth, on each pipe to be joined by placing the socket of the bagged fitting alongside the pipe end. Trace a line round the circumference at the appropriate distance from the end of the pipe using a felt tip pen or similar.

Note that the fitting should not be removed from the packaging at this stage.

- Connect the electro fusion control box input leads to the generator.
- Check that the reset stop button, if fitted on the control box, is in the correct mode.
- Using the pipe end preparation tool, remove the entire surface of the pipe uniformly, preferably in continuous swarf over the area identified, i.e. In excess of the insertion depth.
- A mechanical scraper could be used however; there is a considerable risk that the end preparation will not be adequate with the use of such a tool.

Note that the prepared pipe surface should not be touched by hand.

- Remove the fitting from its packing and clean the scraped area of the pipe surface and the bore of the fitting with a disposable wipe impregnated with Iso-propanol / Acetone. Ensure the prepared surfaces are completely dry before proceeding.



Note that while Iso-propanol is a suitable cleaner, its use is subject to local Health and Safety Regulations.

- Check that the pipe clamps are of the correct size for the pipes to be joined.
- Insert the pipe ends into the fitting so that they are in contact with the center stop.
- Using the pipe clamps, secure the pipes so that they cannot move during the fusion cycle. Check that the pipe ends and the fitting are correctly aligned.
- Check that there is sufficient fuel for the generator to finish the joint. Start the generator and check that it is functioning correctly.
- Switch on the control box.
- Connect the control box output leads to the fitting terminals and check that they have been fully inserted.

If required by the control box enter the fusion jointing time into the control box timer. The jointing time is indicated on the fitting. Check the correct time is shown on the control box display.

Note 1: Automatic control boxes are available which obviate the need to enter the fusion time.

Note 2: Gloves and goggles should be worn during the Fusion process.

- Press the start button on the control box and check that the heating cycle is proceeding as indicated on the display.
- On completion of the heating cycle, the melt indicators should have risen. If there is no apparent move in the melt indicators, the joint should be cut out and a fresh joint made (See note 3 below).
- If a satisfactory joint has been made, the joint is to be left in the clamps for the cooling time specified on the fitting or the automatic control box.

Note 3: If the fusion cycle terminates before completion of the countdown, check for faults as indicated by the control box warning lights and check that there is adequate fuel in the generator. DO NOT attempt a second fusion cycle within one hour of cooling of joint at Ambient Temperature of the first attempt.

1.3 RECORDS

Records of appropriate servicing and calibration shall be kept.

1.4 TRAINING



It is necessary that operators, inspection and supervisory personnel acquire the skills of electro fusion fitting fusion. The necessary training should be carried out by a qualified instructor with the objective of enabling participants to;

- Understand the principles of electro fusion fitting jointing.
- Identify pipe and appropriate fitting markings.
- Carry out pre-jointing machine and equipment checks.
- Make satisfactory electro fusion fitting joints from pipes and fittings of different sizes.
- Inspect for and identify joints of acceptable quality.

Note that some form of assessment and certification should be associated with the training. The certificate should detail the pipe and fitting size range. And the equipment used. A register of successful participants should be kept.

1.5 ELECTRO FUSION SADDLE JOINTING

- With electro fusion saddle jointing, an electrical resistance element is incorporated in the base of the saddle which, when connected to the appropriate power supply, melts and fuses the material of the fitting and the pipe together.
- The success of the technique depends on effective preparation of the jointing surfaces, in particular the removal of the oxidized surface of the pipe over the area equivalent to the area of the saddle base, and cleaning of the pipe surfaces.
- Methods of holding the tapping tee saddle during the fusion cycle are used namely, top loading and under clamping. The general parameters are similar. In some cases, if the manufacturer's procedure for holding the fitting is provided, then the same should be followed during the fusion cycle.

1.6 ELECTRO FUSION SADDLE JOINTING METHOD/ PROCEDURE

- Expose the pipe onto which the tapping tee is to be assembled, ensuring there is sufficient clear space around the pipe. In a trench, a minimum clearance of 150 mm is required.
- Clean the pipe over the general area on which the saddle is to be assembled using clean, disposable lint-free material.
- Without removing the fitting from its packaging, place it over the required position on the main. Mark the pipe surface all around and clear of the saddle base area using a felt tip pen or similar.
- Remove the surface of the pipe to a depth of 0.2 to 0.4 mm over the full area marked using a suitable tool. Remove the swarf.



- Connect the electro fusion control box input leads to the generator.

Check that the reset stop button, if fitted on the control box, is in the correct mode.

- Remove the two halves of fitting from its packing and clean the scraped area of the pipe surface and the bore of the fitting with a disposable wipe impregnated with Iso-propanol / Acetone. Ensure the prepared surfaces are completely dry before proceeding.

Note again that while Iso-propanol is a suitable cleaner, its use is subject to local Health and Safety Regulations.

- Position the fitting base onto the prepared pipe surface, and bring the lower saddle into position then gradually and evenly tighten the nuts until the upper saddle makes firm contact with the scraped pipe.
- Check that there is sufficient fuel for the generator to complete the joint. Start the generator and check that it is functioning correctly.
- Switch on the control box if applicable.
- Connect the control box output leads to the fitting terminals and check that they have been fully inserted.
- If required by the control box, enter the fusion jointing time into the control box timer. The jointing time is indicated on the fitting. Check the correct time is shown on the control box display.

Note 1: Automatic control boxes are available which obviate the need to enter the fusion time.

Note 2: Gloves and goggles should be worn during the jointing process.

- Press the start button on the control box and check that the heating cycle is proceeding as indicated on the display.
- On completion of the heating cycle, the melt indicators, where incorporated should have risen. If there is no apparent move in the melt indicators, a new saddle joint should be made. Cut the tee of the faulty joint from its base.
- If a satisfactory joint has been made, the joint is to be left in the clamps for the cooling time specified on the fitting label or by the automatic control box.

Note 3: If the fusion cycle terminates before completion of the countdown, check for faults as indicated by the control box warning lights and check that there is adequate fuel in the generator. DO NOT attempt a second fusion cycle within one hour of the first



attempt.

Note 4: The connection of the service pipe to the fitting outlet should be carried out in accordance with the procedure of the appropriate section of this Item.

Note 5: DO NOT attempt to tap the main with the integral cutter for at least 10 minutes after completion of the cooling cycle.

1.7 RECORDS

Records of appropriate servicing and calibration of Electro Fusion machines/ joints shall be kept.

1.8 TRAINING

AS PER 1.6

Note that some form of assessment and certification should be associated with the training. The certificate should detail the pipe and fitting size range and the equipment used. A register of successful participants should be kept.

1.9 STOPPING THE GAS FLOW

In the operation of a distribution system there is a periodic need to stop the gas flow for either routine or emergency maintenance. The flow may be stopped through the use of installed fittings such as valves. Where installed fittings are not available or the use of such would cause significant supply disruption, then one of the following methods may be employed.

1.10 SQUEEZE-OFF

- To control the gas flow a special tool may be used to squeeze the pipe walls together. Hydraulic jacks are used to supply the necessary force to compress the pipe walls for sizes 90 mm and above.
- It will be seen the squeeze-off equipment comprises two bars to apply pressure to the outside of the pipe. The bars are brought together, either manually or hydraulically, squeezing the pipe material together until a seal is formed where the upper and lower walls meet.
- The hydraulic machines should have a spring return for the jack and locking to prevent accidental release of pressure during operation. All squeeze-off machines should be fitted with check plate or stops to avoid over compression of the pipe.
- Where the pipe walls are compressed the polyethylene pipe will be severely deformed in the regions of maximum compression. The pipe will eventually regain its original shape after squeezing but there will be some reduction in the pressure bearing properties.
- A complete stop may not always be obtainable because of wrinkling of the inside of



the pipe. If a complete stop is required then a second squeeze can be used, with an intermediate vent to remove the gas which passes the first squeeze from say the trench area. A second squeeze-off procedure should be a minimum of three pipe diameters and right angles to the initial squeeze.

- While not essential it would be good practice to fit a reinforcing stainless steel band do not squeeze again adhesive tape around the pipe upon the completion of a squeezing operation.

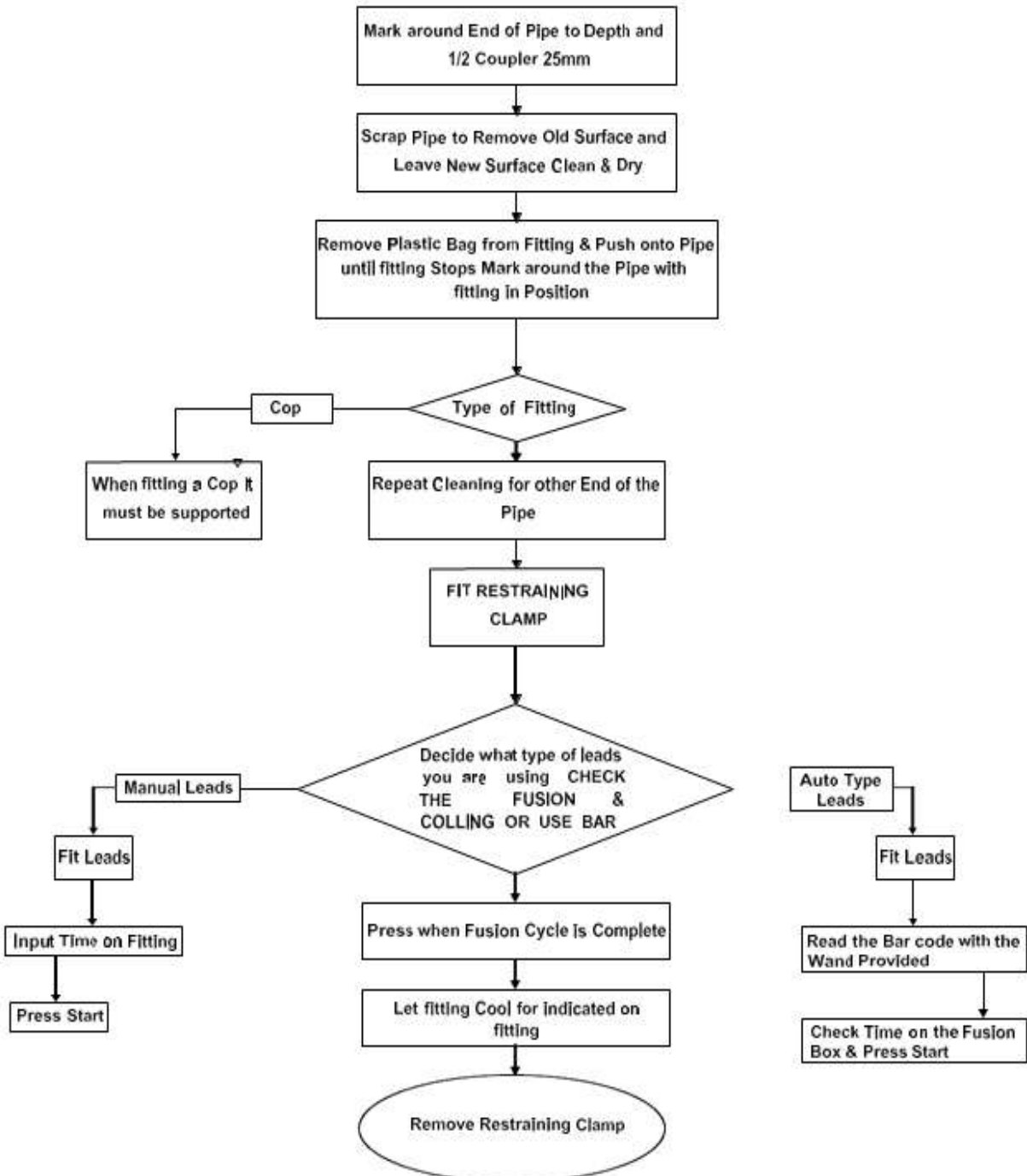
1.11 BENDING-BACK

Bending back of the pipe may be performed where the pipe has been severed damaged and stopping the gas flow is imperative. Its application is of a temporary nature, and will provide relief until a permanent repair can be affected. The section of pipe, which has been bent back, will have to be replaced because of the damage caused by the severe ness of the bend back operation. The need for any bend back operation is most likely to occur as a consequence of damage caused to a PE service pipe.

While it is not the prime function of a saddle tee, controlling the flow in a service may be achieved by opening up on an installed saddle tee and winding down the internal tapping tool to shut off the flow into the service pipe.

PTS- ELECTRO FUSION
FOR PE PIPES & FITTINGS

ANNEXURE # 1

FUSION COUPLERS FORM 20MM TO 180MM



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STANDARD SPECIFICATION - GI PIPES

VPC – SS – PE - 0005

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CONTENTS

1.0	INTRODUCTION AND SCOPE	3
2.0	DEFINITIONS	3
3.0	MATERIAL.....	3
4.0	DIMENSIONS, THICKNESS & DIMENSIONALTOLERANCES	3
5.0	END CONNECTION OF PIPE.....	3
6.0	FREEDOM FROM DEFECTS	4
7.0	GALVANIZING.....	4
9.0	MARKING	5
10.0	INSPECTION / DOCUMENTS	5
11.0	PACKAGING	6



1.0 INTRODUCTION AND SCOPE

CLIENT/ OWNER plans to augment PNG network. It supplies natural gas to domestic & commercial consumers in the GA.

This present document covers the technical specification for the procurement of GI Pipes used in high pressure natural gas transportation and distribution systems. It describes the general requirements, controls, tests, QA/QC examination and final acceptance criteria which need to be fulfilled.

This specification covers the requirements for GI pipes of heavy steel tube. Unless modified by this specification, requirements of IS 1239 (Part-I): 2004 (Latest edition) shall be valid.

2.0 DEFINITIONS

Owner	
Manufacturer	Means the Manufacturer of the GI pipe.
SS	Means the present <<Standard Specification>> and all its appendix, if any.
Third Party Inspection Agency	Means the Inspection Agency to be appointed by CLIENT.
GTS	Means the present <<General Technical Specification>> and its entire appendix, if any.

3.0 MATERIAL

The material used for the manufacturing of GI pipes confirming to IS 1239 (Part -1): 2004 (Latest edition).

4.0 DIMENSIONS, THICKNESS & DIMENSIONALTOLERANCES

The dimensions & nominal mass of tubes shall be in accordance with Table 5 subject to the tolerances permitted in CL.8.1 & 9 of IS 1239 (Part-I) : 2004 (Latest edition). Length of each pipe shall be 6 mtrs with + 6, - 0 mm tolerance. However, pipe length shall be considered 6 m. only for measurement / payment purpose.

Nominal Diameter DN	15 mm	20 mm
Grade	Heavy	Heavy
Outer Dia. (Max. / Min.)	21.8 mm / 21.0 mm	27.3 mm / 26.5 mm
Thickness (mm)	3.2	3.2
Nominal weight (Kg / m)	1.44	1.87

5.0 END CONNECTION OF PIPE



GI Pipes shall be supplied with plain end.

6.0 FREEDOM FROM DEFECTS

On visual examination the outside & inside surfaces of pipes shall be smooth & free from defects such as cracks etc.

7.0 GALVANIZING

- Pipes shall be galvanized to meet the requirement of IS: 4736 – 1986 with latest amendment.
- Zinc conforming to any grade specified in IS: 13229- 1991 with latest amendment shall be used for the purpose of galvanizing.
- Galvanizing bath: The molten metal in the galvanizing bath shall contain not less than 98.5% by mass of zinc.
- Mass of zinc coating: Minimum mass of zinc coating determined as per IS: 6745 shall be 360gms/m².
- Uniformity of galvanized coating: The galvanized coating when determined on a 100 mm long test piece in accordance with IS 2633: 1986 with latest amendment shall withstand 5 one – minute dips.
- Freedom from defect: The zinc coating on internal & external surfaces shall be uniform adhered, reasonably smooth & free from such imperfections as flux, ash & drop inclusions, bare patches, black spots, pimples, lumpiness runs, rust stains, bulky white deposits & blisters. Rejection & acceptance for these defects shall be as per Appendix - A of IS 2629: 1985 with latest amendments.
- **Samplings**
 - a) All materials of the same type in coating bath having uniform coating characteristics shall be grouped together to continue a lot. Each lot shall be tested separately for the various requirements of the specification. The number of units to be selected from each lot for this purpose shall be IS: 4711 1995 with latest amendment.
 - b) The sample selected according to Clause 6.1 & 6.2 of IS: 4736 – latest edition.
 - c) The sample found conforming to above requirements shall then be tested for mass of zinc coating in accordance with Clause 5.1 of IS: 4736 – 1986 with latest amendment.

d) Criteria for conformity: As per IS: 4736 – 1986 with latest amendments.

8.0 PRESSURE TEST

Hydrostatic pressure test shall be carried out at a pressure of 5 Mpa for the duration of at least 3 second and shall not show any leakage in the pipe. Vendor to submit the internal pressure test certificate for the same. Owner Representative or Third party Inspection Agency appointed by Owner shall witness finish goods testing as per the sample procedure specified in IS: 1239 (Part-1) – latest edition.

9.0 MARKING

Each pipe shall be embossed with CLIENT's logo, manufacturer's name or trademark, size designation, class of pipe at the interval of not more than 1 meters.

Each packing containing pipes shall carry the following embossed, stamped or written by indelible ink.

- Manufacturers name or trademark.
- Class of pipe –Heavy.
- Indian standard mark (ISI).
- Lot number / Batch no. of production.

Each pipe conforming to this standard shall also be marked with BIS standard mark.

10.0 INSPECTION / DOCUMENTS

Inspection shall be carried out as per Owner Technical Specification.

Owner Representative or Third Party Inspection Agency appointed by Owner shall carry out stage wise inspection during manufacturing / final inspection.

The manufacturer shall have a valid license to use ISI monogram for manufacturing of pipe in accordance with the requirement of IS: 1239.

Vendor shall furnish all the material test certificates, proof of approval / license from specified authority as per specified standard, if relevant, internal test / inspection reports as per Owner Tech. Spec. & specified code for 100% material, at the time of final inspection of each supply lot of material.

For any control, test or examination required under the supervision of TPIA/Owner/Owner's representative, latter shall be informed in writing one (1) week in advance by vendor about inspection date and place along with production schedule.

Even after third party inspection, Owner reserves the right to select a sample of pipes randomly from each manufacturing batch & have these independently tested. Should the



results of these tests fall outside the limits specified in Owner technical specification, then Owner reserves the right to reject all production supplied from the batch.

11.0 PACKAGING

Packing size to be mentioned to ensure uniformity in delivery conditions of the material being procured. Bidder shall submit the packaging details during QAP and also complied with at the time of delivery.



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STANDARD SPECIFICATION -GI FITTINGS

VPC-SS-PE-0006

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REV. No	DATE	Purpose	Prepared By	Checked By	Approved By



CONTENTS

1.0	SCOPE	3
2.0	DEFINATIONS	3
3.0	MATERIAL.....	3
4.0	DIMENSIONS THICKNESS & DIMENSIONAL TOLERANCES.....	3
5.0	WEIGHT	3
6.0	THREADS.....	3
7.0	FREEDOM FROM DEFECTS.....	4
8.0	GALVANIZING	4
9.0	PRESSURE TEST	4
10.0	COMPRESSION TEST	5
11.0	SAMPLING	5
12.0	MARKING.....	5
13.0	PACKAGING.....	5
14.0	INSPECTION / DOCUMENTS.....	5



1.0 SCOPE

CLIENT/OWNER plans to augment PNG network. It supplies natural gas to domestic & commercial consumers in the GA.

This present document covers the technical specification for the procurement of GI fittings used in high pressure natural gas transportation and distribution systems. It describes the general requirements, controls, tests, QA/ QC examination and final acceptance criteria which need to be fulfilled.

This specification covers the requirements for Malleable Cast Iron Fittings unless modified by this specification, requirements of IS 1879 – latest edition shall be valid.

2.0 DEFINATIONS

Owner	
Manufacturer	Means the Manufacturer of the GI fittings.
SS	Means the present <<Standard Specification>>and its appendix, if any.
Third Party Inspection Agency	Means the Inspection Agency to be appointed by CLIENT.

3.0 MATERIAL

The material used for the manufacturing of GI fittings shall conform to ISI 14329 – 1995 with latest amendments Grade BM 300.

4.0 DIMENSIONS THICKNESS & DIMENSIONAL TOLERANCES

- Dimensions of various types of fittings shall be as specified in sections 2 to 10 of IS 1879 – 1987 with latest amendments, as applicable.
- Wall thickness of fittings and tolerances on them shall be as given in Table 1.2 of S 1879 – 1987 with latest amendments,
- In case of reducing fittings, the dimensions at each outlet shall be those appropriate to the nominal size of the outlet.
- Elbows, Tees, Sockets and caps shall be of reinforced type.

5.0 WEIGHT

Weights of various types of fittings shall be as specified in sections 2 to 10 of S 1879 – 1987 with latest amendments, as applicable.

6.0 THREADS

- Threads shall be NPT type and conforming to ASME B1.20.1.
- Outlets of fittings shall be threaded to dimensions & the tolerances as specified in ASME B1.20.1.
- All internal & external threads shall be tapered.
- For checking conformity of threads gauging practice in accordance with ASME B1.20.1 shall be followed.



- Chamfering: The outlet of fittings shall have chamfer.

7.0 FREEDOM FROM DEFECTS

On visual examination, the outside & inside surfaces of fittings shall be smooth & free from any defects such as cracks, injurious flaws, fine sand depth etc.

8.0 GALVANIZING

- Fittings shall be galvanized to meet the requirement of IS: 4759-1996 with latest amendments.
- Zinc conforming to any grade specified in IS: 13229-1991 with latest amendments shall be used for the purpose of galvanizing.
- Galvanizing bath: The molten metal in the galvanizing bath shall contain not less than 98.5% by mass of zinc.
- Coating requirements: Mass of coating shall be 610 - 700gms/m².
- Freedom from defect: The zinc coating shall be uniform adhered, reasonably smooth & free from such imperfections as flux, ash bare patches, black spots, pimples, lumpiness runs, rust stains, bulky white deposits & blisters.
- Samplings
 - a. All materials of the same type in coating bath having uniform coating characteristics shall be grouped together to continue a lot. Each lot shall be tested separately for the various requirements of the specification. The number of units to be selected from each lot for this purpose shall be given in Table 2 of IS 4759 – latest edition.
 - b. The sample selected according to Column 1 & 2 of Table 2, IS: 4759 – latest edition shall be tested for visual requirements as per Clause 6.2 of IS: 4759 – latest edition
 - c. The sample found conforming to above requirements shall then be tested for mass of zinc coating in accordance with Clause 9.2 of IS: 4759 – latest edition.
 - d. Criteria for conformity: As per Clause 8.3 of IS: 4759-latest edition.
 - e. Test procedure shall be as per Clause 9 of IS: 4759-latest edition.

9.0 PRESSURE TEST

Vendor shall carry out pneumatic pressure test as per Clause 11.1b of 1879 – 1987 with latest amendments on each & every fittings. Vendor to submit the Internal Quality control certificate for the same. Owner shall witness pneumatic testing as per the sampling procedure specified in 1879 – 1987 with latest amendments.



10.0 COMPRESSION TEST

This test shall be conducted to judge the malleability of the pipe fittings & shall be carried out as per Clause 12 of 1879 – 1987 with latest amendments.

11.0 SAMPLING

Owner Representative of Third Party Inspection Agency appointed by Owner shall witness the tests as per clause 14 of 1879 – 1987 with latest amendments. However, vendor to perform 100% inspection of visual, dimensional & pressure test. Vendor shall furnish Internal test certificates at the time of final inspection to the Owner.

12.0 MARKING

Each fitting shall be embossed with CLIENT's logo, manufacturer's name or trademark and the size designation.

Each packing containing fittings shall carry the following embossed, stamped or written by indelible ink.

- Manufacturer's name or trademark.
- Designation of fittings.
- Lot number.

Each fitting conforming to this standard shall also be marked with BIS standard mark.

13.0 PACKAGING

Packing size to be mentioned to ensure uniformity in delivery conditions of the material being procured. Packing size shall be approved by owner / owner's representative before packing the material. The vendor shall submit the packaging details during QAP and also comply with at the time of delivery.

14.0 INSPECTION / DOCUMENTS

- Inspection shall be carried out as per Owner Technical Specification.
- Owner Representative or Third Party Inspection Agency appointed by Owner shall carry out stage wise inspection during manufacturing / final inspection.
- Vendor shall furnish all the material test certificates, proof of approval / license from specified authority as per specified standard, if relevant, internal test / Inspection reports as per Owner Tech Spec. & specified code for 100% material, at the time of final inspection of each supply lot of material.



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STANDARD SPECIFICATION - COPPER FITTINGS

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REV. No	DATE	Purpose	Prepared By	Checked By	Approved By



CONTENTS

1.0	SCOPE	3
2.0	MATERIAL	3
3.0	DIMENSIONAL TOLERANCES.....	3
4.0	MANUFACTURE	3
5.0	FREEDOM FROM DEFECTS	3
6.0	HYDROSTATIC TEST	4
7.0	DRIFT EXPANDING TEST	4
8.0	CARBON FILM TEST	4
9.0	CARBON CONTENT TEST	4
10.0	MARKING	4
11.0	PACKAGING	4
12.0	INSPECTION/ DOCUMENTS	4



1.0 SCOPE

This specification covers the requirements for 12 mm OD X 0.6 mm wall thickness Copper tube, Half Hard. Unless modified by this specification, requirement of BS EN 1057 (latest), Half Hard, shall be valid, with the recommended changes in physical properties to suit wrinkle free bend ability.

2.0 MATERIAL

The material used for the manufacturer of Copper tube shall confirm to BS EN 1057(latest), Grade Cu - DHP or CW024A.

- **Mechanical Properties:**

- a. Ultimate Tensile Strength–250N/sq.mm(min)

- b. Elongation – 30% (min)

- c. Hardness - 75 to 100 on HV scale.

- **Chemical Properties:**

In Each heat one no. of the copper tube will be tested for chemical properties to confirm to non-arsenical Cu - DHP / CW024A as per BS EN 1057 to have the following chemical composition:

Copper Percentage including silver : Min 99.9%

Phosphorus Percentage : 0.015 to 0.040%

3.0 DIMENSIONAL TOLERANCES

The mean outside Diameter of the tube shall not vary from the specified outside diameter by more than the amount of tolerances specified in table 4 of BS EN 1057. The tolerance on the wall thickness shall be as specified in table 5 of BS EN 1057.

The length of the tube shall be 3 m. Allowable tolerance shall be (-0, +0.5 mm).

4.0 MANUFACTURE

The tubes shall be solid drawn by the process of melting, extrusion and thereafter Bright annealing. The ends shall be cut clean & square with the axis of the tube in no case shall tubes be redrawn from old or used tubes.

5.0 FREEDOM FROM DEFECTS

- The tubes shall be free from internal & external fins, flaws, skin defects, blow holes etc. or other irregularities which might restrict the free flow of fluid and shall be so designed that resistance to the flow of fluid through the tubes is minimized.
- All tubes will be supplied 100% Eddy Current tested as per ASTM E243 and BS EN 1057. Eddy Current testing is a computer aided test, wherein the tube passes through a probe & an electromagnetic field is created around the peripheral of the tube to detect



any flaw or blow hole which may not be visible to the naked eye. The manufacturer must have in-house Eddy Current testing facilities to supply to Client. Client reserves the right to witness the Eddy Current facility at the manufacturer's factory premises.

6.0 HYDROSTATIC TEST

Hydrostatic test shall be carried out minimum 35 bar pressure for a period of 10 second as per EN 1057 (latest).

7.0 DRIFT EXPANDING TEST

Drift expanding test shall be carried out as per EN 1057. The O.D. of the tube end shall be expanded by 30% using a conical mandrel (at angle 45°) with no wrinkles, cracks, break or any form of defect should occur on the tube during & after the test.

8.0 CARBON FILM TEST

Copper tubes to be tested for carbon film test & the manufacturer will certify that the tubes meet the requirement of clause 8.5 of BS EN 1057.

9.0 CARBON CONTENT TEST

Copper tubes to be tested for carbon content test to ensure a carbon level to avoid the formation of carbon film during installation. Max. Carbon level shall be permitted as per clause 6.5 of BS EN1057.

10.0 MARKING

Each tube shall be permanently marked every meter with Client's Logo, manufactures name & size and specification of the tube.

Each packing containing tubes shall carry the following, stamped or written in indelible ink.

- Manufacturers name or trademark
- Designation of tubes (OD x wall thk)
- Lot number.
- No. of the standard (EN1057)

11.0 PACKAGING

Packing size to be mentioned to ensure uniformity in delivery conditions of the material being procured. Packing size shall be approved by owner / owner's representative before packing the material. The vendor shall submit the packaging details during QAP and also complied with at the time of delivery.

12.0 INSPECTION/ DOCUMENTS

- Inspection shall be carried out as per Client Technical Specifications, relevant codes/standard and Inspection Plan/ QAP. Vendor to prepare detailed QAP and submit the same for approval of Client / Client's Authorized Representative.
- Client representative or third party inspection agency appointed by Client shall carry out



stage wise inspection during manufacturing/ final inspection.

- Vendor shall furnish all the material test certificates, proof of approval/ license from specified authority as per specified standard, if relevant, internal test/ inspection reports as per Client Technical Specification and specified code for 100% material, at the time of final inspection of each supply lot of material.
- Even after third party inspection, Client reserves the right to select a sample of tube randomly from each manufacturing batch and have these independently tested. Should the results of these tests fall outside the limits specified in Client Technical specification, then Client reserves the rights to reject all production supplied from the batch.
- For any control test or examination required under the supervision of TPIA/owner/owner's representative, latter shall be informed in writing one (1) week in advance by vendor about inspection date & place along with production schedule.



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STANDARD SPECIFICATION - COPPER TUBE

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REV	DATE	Purpose	Prepared By	Checked By	Approved By



CONTENTS

1.0	SCOPE	3
2.0	MATERIAL	3
3.0	DIMENSIONAL TOLERANCES.....	3
4.0	MANUFACTURE	3
5.0	FREEDOM FROM DEFECTS	3
6.0	HYDROSTATIC TEST	4
7.0	DRIFT EXPANDING TEST	4
8.0	CARBON FILM TEST	4
9.0	CARBON CONTENT TEST	4
10.0	MARKING	4
11.0	PACKAGING	4
12.0	INSPECTION/ DOCUMENTS	4



1.0 SCOPE

This specification covers the requirements for 12 mm OD X 0.6 mm wall thickness Copper tube, Half Hard. Unless modified by this specification, requirement of BS EN 1057 (latest), Half Hard, shall be valid, with the recommended changes in physical properties to suit wrinkle free bend ability.

2.0 MATERIAL

The material used for the manufacturer of Copper tube shall confirm to BS EN 1057(latest), Grade Cu - DHP or CW024A.

- **Mechanical Properties:**

- a. Ultimate Tensile Strength–250N/ sq.mm(min)

- b. Elongation – 30% (min)

- c. Hardness - 75 to 100 on HV scale.

- **Chemical Properties:**

In Each heat one no. of the copper tube will be tested for chemical properties to confirm to non-arsenical Cu - DHP / CW024A as per BS EN 1057 to have the following chemical composition:

Copper Percentage including silver : Min 99.9%

Phosphorus Percentage : 0.015 to 0.040%

3.0 DIMENSIONAL TOLERANCES

The mean outside Diameter of the tube shall not vary from the specified outside diameter by more than the amount of tolerances specified in table 4 of BS EN 1057. The tolerance on the wall thickness shall be as specified in table 5 of BS EN 1057.

The length of the tube shall be 3 m. Allowable tolerance shall be (-0, +0.5 mm).

4.0 MANUFACTURE

The tubes shall be solid drawn by the process of melting, extrusion and thereafter Bright annealing. The ends shall be cut clean & square with the axis of the tube in no case shall tubes be redrawn from old or used tubes.

5.0 FREEDOM FROM DEFECTS

- The tubes shall be free from internal & external fins, flaws, skin defects, blow holes etc. or other irregularities which might restrict the free flow of fluid and shall be so designed that resistance to the flow of fluid through the tubes is minimized.
- All tubes will be supplied 100% Eddy Current tested as per ASTM E243 and BS EN 1057. Eddy Current testing is a computer aided test, wherein the tube passes through a probe & an electromagnetic field is created around the peripheral of the tube to detect



any flaw or blow hole which may not be visible to the naked eye. The manufacturer must have in-house Eddy Current testing facilities to supply to CLIENT. CLIENT reserves the right to witness the Eddy Current facility at the manufacturer's factory premises.

6.0 HYDROSTATIC TEST

Hydrostatic test shall be carried out minimum 35 bar pressure for a period of 10 second as per EN 1057 (latest).

7.0 DRIFT EXPANDING TEST

Drift expanding test shall be carried out as per EN 1057. The O.D. of the tube end shall be expanded by 30% using a conical mandrel (at angle 45°) with no wrinkles, cracks, break or any form of defect should occur on the tube during & after the test.

8.0 CARBON FILM TEST

Copper tubes to be tested for carbon film test & the manufacturer will certify that the tubes meet the requirement of clause 8.5 of BS EN 1057.

9.0 CARBON CONTENT TEST

Copper tubes to be tested for carbon content test to ensure a carbon level to avoid the formation of carbon film during installation. Max. Carbon level shall be permitted as per clause 6.5 of BS EN1057.

10.0 MARKING

Each tube shall be permanently marked every meter with CLIENT's Logo, manufactures name & size and specification of the tube.

Each packing containing tubes shall carry the following, stamped or written in indelible ink.

- Manufacturers name or trademark
- Designation of tubes (OD x wall thk)
- Lot number.
- No. of the standard (EN1057)

11.0 PACKAGING

Packing size to be mentioned to ensure uniformity in delivery conditions of the material being procured. Packing size shall be approved by owner / owner's representative before packing the material. The vendor shall submit the packaging details during QAP and also complied with at the time of delivery.

12.0 INSPECTION/ DOCUMENTS

- Inspection shall be carried out as per CLIENT Technical Specifications, relevant codes/standard and Inspection Plan/ QAP. Vendor to prepare detailed QAP and submit the same for approval of CLIENT / CLIENT's Authorized Representative.
- CLIENT representative or third party inspection agency appointed by CLIENT shall carry



out stage wise inspection during manufacturing/ final inspection.

- Vendor shall furnish all the material test certificates, proof of approval/ license from specified authority as per specified standard, if relevant, internal test/ inspection reports as per CLIENT Technical Specification and specified code for 100% material, at the time of final inspection of each supply lot of material.
- Even after third party inspection, CLIENT reserves the right to select a sample of tube randomly from each manufacturing batch and have these independently tested. Should the results of these tests fall outside the limits specified in CLIENT Technical specification, then CLIENT reserves the rights to reject all production supplied from the batch.
- For any control test or examination required under the supervision of TPIA/owner/owner's representative, latter shall be informed in writing one (1) week in advance by vendor about inspection date & place along with production schedule.



ENERGISING QUALITY

VCS PROJECT CONSULTANTS PVT. LTD.

STANDARD SPECIFICATION - BRASS FITTINGS

VPC-SS-PE-0009

00	18.06.18	ISSUED AS STANDARD	BS	MVK	AD
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CONTENTS

1.0	SCOPE	3
2.0	MATERIAL.....	3
3.0	DIMENSIONAL TOLERANCES	3
4.0	END CONNECTION.....	3
5.0	CHEMICAL PROPERTIES.....	3
6.0	CARBON IN BORE	4
7.0	RESISTANCE TO DEZINCIFICATION	4
8.0	STRESS CORROSION RESISTANCE TEST	4
9.0	FREEDOM FROM DEFECT	4
10.0	HYDROSTATIC PRESSURE TEST	4
11.0	PNEUMATIC PRESSURE TEST.....	4
12.0	MARKING.....	4
13.0	PACKAGING	4
14.0	INSPECTION/ DOCUMENTS	4



1.0 SCOPE

This specification covers the requirements for Brass Capillary fittings (End feed fittings). Unless modified by this specification, requirement of BS 864 / EN 1254 Part 1 shall be valid.

2.0 MATERIAL

- The material used for the manufacturer of Brass Capillary Fittings shall conform to EN 1254-1 (latest), Half Hard.
- Material used for the solder should conform to BS EN 29453 and should be lead free. Solder material shall be generally melting within the temperature range 180 ° C to 250 °C.
- Threading on the Brass fittings shall be done as per BS21.

3.0 DIMENSIONAL TOLERANCES

Dimensions tolerances of various types of brass capillary fittings (End feed fittings). shall be as per EN 1254 Part 1.

The tolerances at the end shall be as per EN 1254 Part I in nominal diameter which is as follows (Ref. table 2)

Diameter	Tolerance on the mean diameter with respect to the nominal diameter		Resulting Diametrical difference	
	Outside Dia. of Male end (mm)	Inside Dia of socket (mm)	Max (mm)	Min (mm)
12 mm	+0.04 -0.05	+ 0.15 +0.06	0.20	0.02

The minimum wall thickness of a fitting shall be in accordance as given below (Ref Table 3 of EN 1254 Part 1)

Nominal Dia mm D
12

Minimum Wall thickness (mm) Brass
1.1

4.0 END CONNECTION

End connection of the fitting must be capable of end feeding to the NPT x 12 mm. Internal solder ring type fitting is not acceptable.

5.0 CHEMICAL PROPERTIES

Chemical composition of Brass shall be as mentioned in EN 1254 PART I. Dezincification-resistant brass material CuZn36Pb2As or CW602N.

Cu 61.0-63.0 %
Pb 01.7-02.8 %
As 0.02 -0.15%
Remaining is zinc.



6.0 CARBON IN BORE

The internal surface of brass capillary fittings for soldering or brazing shall not contain any detrimental film nor present a carbon level high enough to allow the formation of such a film during installation. The maximum total carbon level on internal surfaces shall not exceed 1.0 mg/dm^2 when tested in accordance with the specification. This test shall be carried out as per clause no. 5.4 of EN 1254 -1.

7.0 RESISTANCE TO DEZINCIFICATION

The fittings shall be manufactured from alloys containing more than 10% Zinc. So fittings shall be required to be resistant to dezincification. It shall be carried out as per Cl. 5.5 of EN 1254 -1.

8.0 STRESS CORROSION RESISTANCE TEST

A stress corrosion resistance is to be carried out as per method defined in ISO 6957 using test solution of pH9.5 but without pickling.

9.0 FREEDOM FROM DEFECT

The fittings shall be free from internal fins, blow holes, skin defects etc. or other irregularities which might restrict the free flow of fluid, and shall be designed that resistance to the flow of fluid through the fittings is minimized.

10.0 HYDROSTATIC PRESSURE TEST

All fittings shall be leak tightness tested at 1.5×25 bars for a period of 15 minutes and no leakage is permitted. This test shall be performed on each size of the fittings.

11.0 PNEUMATIC PRESSURE TEST

All fittings shall be leak tested at 6 bars for a period of 10 seconds and no leakage is permitted.

12.0 MARKING

Each fittings shall be embossed with CLIENT' s logo, manufacturers name and trade mark BS 864 / EN 1254 Part- I and designation of fittings.

Each packing containing fittings shall carry the following stamped or written in indelible ink.

13.0 PACKAGING

Packing size to be mentioned to ensure uniformity in delivery conditions of the material being procured. Bidder shall submit the packaging details during QAP and also complied with at the time of delivery.

14.0 INSPECTION/ DOCUMENTS

- Inspection shall be carried out as per design codes/standards, CLIENT Technical Specification and Inspection Plan/ Vendor's detailed QAP duly approved by



owner/owner's representative.

- CLIENT representative or third party inspection agency appointed by CLIENT shall carry out random inspection during manufacturing/ final inspection.
- Vendor shall furnish all the material test certificates, proof of approval/ license from specified authority as per specified standard, if relevant, internal test/ inspection reports as per CLIENT Technical Specification, at the time of final inspection of each supply lot of material.
- Even after third party inspection, CLIENT reserves the right to select a sample of tube randomly from each manufacturing batch and have these independently tested. If the results of these tests fall outside the limits specified in CLIENT Technical specification, then CLIENT reserves the rights to reject all production supplied from the batch.
- Vendor shall prepare and submit the detail drawings of required brass fitting for approval by CLIENT/VCSQSPL before starting production.
- For any control test or examination required under the supervision of TPIA/owner/owner's representative, latter shall be informed in writing one (1) week in advance by vender about inspection date & place along with production schedule.



ENERGISING QUALITY

VCS PROJECT CONSULTANTS PVT. LTD.

STANDARD SPECIFICATION FOR STEEL REINFORCED RUBBER HOSE

VPC-SS-PE-0010

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CONTENTS

1.0	SCOPE	3
2.0	SPECIFICATION FOR POWDER COATING	3
3.0	MATERIAL	3
4.0	DIMENSIONS & TOLERANCES	3
5.0	FEATURES	4
6.0	MARKING	5
7.0	PACKAGING.....	5
8.0	INSPECTION/ DOCUMENTS.....	5



1.0 SCOPE

Owner/ Client plans to augment PNG network. It supplies natural gas to domestic & commercial consumers in the GA.

This present document covers the technical specification for the procurement of steel reinforced rubber hose, Type 4 used in distribution systems. It describes the general requirements, controls, tests, QA/QC examination and final acceptance criteria which need to be fulfilled.

This specification covers the requirements for steel reinforced rubber hose unless modified by this specification, requirements of IS: 9573 shall be valid.

2.0 SPECIFICATION FOR POWDER COATING

Owner

Manufacturer

Means the Manufacturer of the Steel Reinforced Rubber Hose.

PTS

Means the present <<Particular Technical Specification>> and its appendix, if any.

Third Party Inspection Agency

Means the Inspection Agency to be appointed by Client.

Type 4

Wire Reinforced hose for domestic / commercial installations

3.0 MATERIAL

- Lining: - It shall be nitrile – butadiene rubber (NBR) or chloroprene rubber (CR) compound. It shall be smooth in bore, uniform in thickness and free from air blisters, porosity and splits.
- Reinforcement material: - It shall have wire reinforcement in braided form in between the lining & cover.
- Cover:- It shall be manufactured out of synthetic rubber compound resistant to abrasion, weather and natural gas. The cover color shall be YELLOW.
- The whole shall be consolidated by wrapping or any other suitable method and uniformly vulcanized to give good adhesion between reinforcement plies and the rubber lining of the cover.

4.0 DIMENSIONS & TOLERANCES

- Bore size



Nominal base (mm)	Minimum base diameter(mm)	Minimum bend radius(mm)
8mm	7.9	95

The Nominal bore size of the hose shall be accordance to table # 1 of IS 9573: 1998 shall be as given above table. It shall be tested/ checked as method defined in IS 4143.

- The Minimum thickness so lining & cover shall be 2 mm & 1 mm respectively.
- Length of hose shall be as defined in M.R. & the tolerances on length shall be permitted $\pm 1\%$.

5.0 FEATURES

- **Mechanical properties**

Tensile Strength (Lining & Cover) at break - 10 MPa (minimum)

Elongation (Lining & Cover) in at break (%) - 200 & 250 respectively (minimum)

- **Resistance of Lining to n-pentane**

The n-pentane absorbed and the n-pentane extractable matter as determined Clause no. 5.4.3.2 of IS 9573: 1998 shall not exceed 10% & 5% respectively to the initial mass of lining.

- **Adhesion**

The minimum adhesion between rubber lining & reinforcement, between layers of reinforcement and between reinforcement & cover shall be 2KN/m.

- **Low temperature flexibility**

Flexible hose is conditioned at - 40 ° C for at least 5 hrs. and then bent at 180° around a mandrel with a diameter 12 times the nominal bore diameter of the hose, no cracks or breaks shall be shown.

- **Flexibility of Hose**

The hose shall be capable of being bent empty to the radius 95 mm without flattening and suffering structural damages.

- **Ozone resistance**

It shall be carried out as per clause no. 5.5.of IS 9573: 1978

- **Hydro static test**

All hoses shall be leak tightness tested at 2 MPa for a period of 1 minutes and no leakage is permitted. This test shall be performed on each size of the hoses as per clause no. 5.5.5.1 of IS 9573: 1978.

- **Bursting pressure**



It shall be carried out as per Clause 5.5.2 of IS 9573. The minimum burst pressure shall be 5 Mpa.

- **Grip strength test**

The hose shall comply to the requirement of Clause no. 5.5.7 of IS 9573.

- **Burning behavior**

The burning test shall be carried out on hose as per clause no. 5.5.8 of IS9573. The hose at least shall not burn till 45second.

6.0 MARKING

Each hose shall be indelibly marked as follows:

- Manufacturer's name or trade mark., if any
- Nominal bore
- Batch no. / Lot no.
- Month and year of manufacturer
- Type of hose i.e. Type 4
- BIS marking

7.0 PACKAGING

Packing size to be mentioned to ensure uniformity in delivery conditions of the material being procured. Bidder shall submit the packaging details during offer and also complied with at the time of delivery.

8.0 INSPECTION/ DOCUMENTS

- Inspection shall be carried out as per design codes/standards, Client Technical Specification and Inspection Plan/ Vendor's detailed QAP duly approved by owner/owner's representative.
- For all tests purposes, the minimum time between vulcanization & testing shall be 16h.
- Client representative or third party inspection agency appointed by Client shall carry out random inspection during manufacturing/ final inspection.
- Vendor shall furnish all the material test certificates, proof of approval/ license from



specified authority as per specified standard, if relevant, internal test/ inspection reports as per Client Technical Specification, at the time of final inspection of each supply lot of material.

- Even after third party inspection, Client reserves the right to select a sample of hose randomly from each manufacturing batch and have these independently tested. If the results of these tests fall outside the limits specified in Client Technical specification, then Client reserves the rights to reject all production supplied from the batch.
- Vendor shall prepare and submit the detail drawings of required steel reinforced rubber hose for approval by Client /VCSQSPL before starting production.
- For any control test or examination required under the supervision of TPIA/owner/owner's representative, latter shall be informed in writing one (1) week in advance by vender about inspection date & place along with production schedule.



ENERGISING QUALITY

VCS PROJECT CONSULTANTS PVT. LTD.

STANDARD SPECIFICATION FOR PURE POLYESTER POWDER COATING

VPC –SS-PE-0011

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REV	DATE	Purpose	Prepared By	Checked By	Approved By



CONTENTS

1.0	SCOPE	3
2.0	SPECIFICATION FOR POWDER COATING	3
3.0	TESTING	3
4.0	MARKING.....	3
5.0	INSPECTION/ DOCUMENTS.....	4



1.0 SCOPE

This Specification specifies the requirements for powder coating (Pure Polyester) of GI Pipes & fitting suitable to use for carrying Natural Gas directly expose to sunlight.

2.0 SPECIFICATION FOR POWDER COATING

Powder Material	:	Pure Polyester.
Application	:	Electrostatic Spraying (40 — 90 KV Manual/ Automatic)
Backing Schedule	:	180 ⁰ C to 200 ⁰ C for 10 mm (Metal Temperature)
Coating Thickness	:	50-60Microns

3.0 TESTING

Film Type	:	Glossy/Satin 86
Gloss60 ⁰	:	95%
Cross Hatch Adhesion (ASTM D-5870)	:	GT = 0/100
Cylindrical bending Test (ASTM D -522) 5mm Rod dia	:	Passes
Enrichsen cupping (min)	:	8 Passes
Pencil Hardness(mm)	:	2H
Scratch Resistance (Kg. Mm)	:	3
Impact Resistance Kg. Min(ASTM D- 2794)	:	Direct 150 Indirect 150
Salt Spray Resistance (ASTM B-117)	:	1000 Hrs (min)
Porosity (DIN 53161)	:	Passes
Humidity Resistance	:	1000 Hrs(min)

4.0 MARKING

Each fitting shall be embossed with manufacture's name or trademark and the size designation. Each packing containing fittings shall carry the following stamped or written by indelible ink.

- Manufacturers name or trademark.
- Designation of fitting.
- Lot number.



Each fitting conforming to this standard shall also be marked with BIS standard mark.

5.0 INSPECTION/ DOCUMENTS

- Inspection shall be carried out as per OWNER Technical Specification.
- OWNER representative or Third Party Inspection Agency appointed by OWNER shall carry out stage wise inspection during manufacturing/final inspection.
- Vendor shall furnish all the material test certificates, proof of approval/ license from specified authority as per specified standard, if relevant, internal test inspection reports as per OWNER Tech Spec. &- specified code for 100% material, at the time of final inspection of each supply lot of material.
- Even after third party inspection, OWNER/ OWNER REPRESENTATIVE reserves the rights to select a sample of fittings randomly from each manufacturing batch & have these independently tested. Should the results of these tests fall outside the limits specified in OWNER technical specification, then OWNER/ OWNER REPRESENTATIVE Reserves the rights to reject all production supplied from the batch. (ASTM D- 2247)

Weathering : 60-70% Gloss retention after 1000Hrs.
(sun test with water
immersion, Xenon
150K.lux)

Colour : Light colour as approved by OWNER/CONSULTANT



ENERGISING QUALITY

VCS PROJECT CONSULTANTS PVT. LTD.

STANDARD SPECIFICATION – FORGED FITTINGS (WROUGHT STEEL FITTINGS) FOR USE AT PRESSURE UP TO 100 MBAR (G)

VPC-SS-PE-0012

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REV	DATE	Purpose	Prepared By	Checked By	Approved By



CONTENTS

1.0	SCOPE	3
2.0	SPECIFICATION FOR POWDER COATING	3
3.0	MATERIAL	3
4.0	DIMENSIONS & TOLERANCES	3
5.0	THREADS	3
6.0	FREEDOM FROM DEFECTS	4
7.0	GALVANIZING.....	4
8.0	PRESSURE TEST.....	4
9.0	COMPRESSION TEST	5
10.0	SAMPLING	5
11.0	MARKING	5
12.0	PACKAGING	5
13.0	INSPECTION/ DOCUMENTS	5



1.0 SCOPE

Owner/ Client plans to augment PNG network. It supplies natural gas to domestic & commercial consumers in the GA.

This specification covers the requirements for Wrought Steel Fittings for Natural Gas for use at pressures up to 100 mbar (g). Unless modified by this specification, all the requirements of IS 1239 Part 2: 1992 and the latest editions of the standards mentioned herein this specification, including all revisions, shall apply.

2.0 SPECIFICATION FOR POWDER COATING

Owner

Manufacturer

Means the Manufacturer of the Steel Reinforced Rubber Hose.

SS

Means the present <<Standard Specification>> and its appendix, if any.

Third Party Inspection Agency

Means the Inspection Agency to be appointed by Client.

3.0 MATERIAL

The material used for the manufacturing of wrought steel fittings shall confirm to IS 1387: 1967 generally, and IS 1239 Part 2: 1992

4.0 DIMENSIONS & TOLERANCES

- Dimensions of various types of fittings shall be as specified in the table 1 to 31 of IS 1239 Part 2: 1992.
- Wall thickness on fittings & tolerances on them shall be as given in table 1 to 31 of IS 1239 Part 2: 1992.
- In case of reducing fittings, the dimensions at each outlet shall be those appropriate to the nominal size of the outlet.

5.0 THREADS

- Outlet of fittings shall be threaded to dimensions & the tolerances as specified in IS 554: 1999.
- All internal & external threads shall be tapered.
- After threading, the pipe body may be hot dip galvanized as per normal practice followed by cold galvanizing (spraying) of the threaded portions. The threaded portions shall be protected using end caps, etc.
- For checking conformity of threads gauging practice in accordance with IS 8999: 2003 shall be followed.



- Chamfering: The outlet of fittings shall have chamfer. The chamfer shall have an included angle of $90^\circ \pm 50$ for internal threads & $70^\circ \pm 100$ for external threads.

6.0 FREEDOM FROM DEFECTS

On visual examination the outside & inside surfaces of fittings shall be smooth & free from defects such as cracks, injurious flows, fine sand depth, etc. Other workmanship shall be as per Clause 14 of IS 1239 Part 2: 1992.

7.0 GALVANIZING

- Fittings shall be galvanized to meet the requirements of IS 4759: 1996.
- Zinc conforming to any grade specified in IS 209: 1992 or IS 13229: 1991 shall be used for the purpose of galvanizing.
- **Galvanized Bath:** The molten metal in the galvanizing bath shall contain not less than 98.5% by mass of zinc.
- **Coating requirements:** Mass of coating shall be 610 gms/ m². In case of pipe nipples (manufactured in accordance with the requirements of IS 1239 Part 1: 2004), the mass of coating of 400 gms/m² shall also be acceptable.
- **Freedom from defects:** The zinc coating shall be uniformly adhered, reasonably smooth & free from such imperfections as flux, ash bare patches, black spots, pimples, lumpiness runs, rust strains, bulky white deposits & blisters; otherwise the pipes shall be liable for rejection.
- **Sampling Plan for galvanizing**
 - a) All materials of the same type in a coating bath having uniform coating characteristics shall be grouped together to constitute a lot. Each lot shall be tested separately for the various requirements of the specification. The number of units to be selected from each lot for this purpose shall be as given in Table 2 of IS 4759: 1996.
 - b) The sample selected according to Column 1 & 2 of Table 2, IS 4759: 1996 shall be tested for visual requirements as per Para 8 of IS 4759: 1996. Vendor shall have appropriate correspondence between galvanizing lot number and pipe manufacturing lot number for identification / traceability.
 - c) The sample found conforming to above requirements shall then be tested for mass of zinc coating in accordance with Clause 9.2 of IS 4759: 1996.
 - d) Criteria for conformity: As per Clause 8.3 of IS 4759: 1996.
 - e) Test procedure shall be as per Clause 9 of IS 4759: 1996. All galvanizing test results shall be included in the Manufacturer's Test Certificate.

8.0 PRESSURE TEST

Pneumatic pressure test shall be carried out on each & every fittings as per procedure given in IS 1239 Part 2: 1992.



9.0 COMPRESSION TEST

As per IS 1239 Part 2: 1992.

10.0 SAMPLING

Owner Representative of Third Party Inspection Agency appointed by Owner shall witness the tests as per procedure for sampling plan given in IS 4711: 1974. However, vendor to perform 100% inspection of visual, dimensional & pressure test. Vendor shall furnish Internal test certificates at the time of final inspection to the Owner.

11.0 MARKING

Each fitting shall be embossed with Client's logo, manufacturer's name or trademark and the size designation.

Each packing containing fittings shall carry the following embossed, stamped or written by indelible ink.

- Manufacturer's name or trade mark.
- Designation of fittings.
- Lot number.

Each fitting conforming to this standard shall also be marked with BIS standard mark.

12.0 PACKAGING

Packing size to be mentioned to ensure uniformity in delivery conditions of the material being procured. Packing size shall be approved by owner / owner's representative before packing the material. The vendor shall submit the packaging details during QAP and also complied with at the time of delivery.

13.0 INSPECTION/ DOCUMENTS

- Inspection shall be carried out as per Owner Technical Specification.
- Owner Representative or Third Party Inspection Agency appointed by Owner shall carry out stage wise inspection during manufacturing / final inspection.
- Vendor shall furnish all the material test certificates, proof of approval / license from specified authority as per specified standard, if relevant, internal test / Inspection reports as per Owner Tech Spec. & specified code for 100% material, at the time of final inspection of each supply lot of material.
- Even after third party inspection, Owner reserves the rights to select a sample of fittings randomly from each manufacturing batch & have these independently tested. Should the results of these tests fall outside the limits specified in Owner technical specification, then Owner reserves the rights to reject all production supplied from the batch.



ENERGISING QUALITY

VCS PROJECT CONSULTANTS PVT. LTD.

STANDARD SPECIFICATION – WARNING MAT

VPC –SS-PE-0013

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CONTENTS

1.0 SCOPE 3

2.0 DEFINATIONS 3

3.0 REFERENCE CODE.....3

4.0 FEATURES 3

5.0 QUALITY ASSURANCE (QA) 4

6.0 DEFECT LIABILITY 4

7.0 APPENDIX - I 4



1.0 SCOPE

CLIENT/ OWNER plans to augment the PNG Network. It supplies natural gas to domestic & commercial consumers in the GA.

The present document covers the technical specifications for the procurement of Warning Mat. Warning mats shall be laid in the ground above the gas main line in order to indicate their presence.

2.0 DEFINATIONS

Manufacturer	Means the Manufacturer of the Steel Reinforced Rubber Hose.
SS	Means the present <<Standard Specification>> and its appendix, if any.
Third Party Inspection Agency	Means the Inspection Agency to be appointed by Client.

3.0 REFERENCE CODE

IS 10889	High Density Polyethylene Films
ASTM D - 638	Standard test method for tensile properties of plastics.

4.0 FEATURES

• Material

Raw material of the warning mat shall be Virgin material.

The material grade of Warning Mat shall be HDPE with warning sticker / stamp.

- Mechanical properties
- Tensile strength at break (Machine direction) - 300 Kgf /cm²(minimum)
- Elongation in machine & Transverse direction (%) - 300 (minimum)

• Colour

The Mat shall be of bright golden yellow colour. This colour must not take any appreciable alteration in the course of time.

• Dimensions

Warning Mat shall have following dimensions:

Width 300 mm ± 5 mm

Thickness 1 mm (Minimum)

Negative tolerance on thickness is not allowed.

• Marking

- Marking on the Mat shall be approved by owner. The warning Mat shall be provided with Chainage marking and the warning mat must be engraved with "Caution: High pressure gas pipeline below" in both English and Hindi along with Client's Logo at a frequency of every meter.
- Vendor shall submit proposed Artwork to be marked on the Mat for the approval from Owner / Owner's representative.



- **Tests**

- a. Colour- Fast test

Test specimen 100 mm to 150 mm wide shall be immersed in a 20% solution of ammonium sulphide at 15 to 20 °C temperature for 15 days. The colour fastness shall be evaluated by comparing the test specimen with a sample specimen. The comparison shall be made by placing the two specimens on a white back ground in day light, but without exposing them directly to sun light. Test shall be accepted satisfactory, if the colour of the strip remains intact.

- b. Other tests shall be carried out as per relevant national / international standard enclosed in QAP.

- **Packing**

The warning mat shall be delivered in rolls of 50meters. Packing size to be mentioned to ensure uniformity in delivery conditions of the materials being procured. Bidder shall submit the packing details during offer and also complied with at the time of delivery.

5.0 QUALITY ASSURANCE (QA)

Manufacturer shall prepare detailed QAP and submit for the approval from Owner / Owner's representative.

6.0 DEFECT LIABILITY

Defect liability period shall be as per the commercial volume I of II

7.0 APPENDIX - I

Vendor to submit the following Data along with BID.

SR.NO.	DESCRIPTION	UNIT	DATA	REMARKS
01.	Average gravimetric Thickness	mm		
02.	Tensile strength at Break (in machine direction)	Kg / cm ²		
03.	Tensile strength at Break (in Transverse direction)	Kg / cm ²		
04.	Elongation at Break (in Transverse direction)	%		
05.	Elongation at Break (in Transverse direction)	%		
06.	Color bleeding	-		
07.	Dimensional stability	% change		

	SS- MEDIUM DENSITY POLYETHYLENE BALL VALVES	VPC-SS-PE-28

SS- MEDIUM DENSITY POLYETHYLENE BALL VALVE

0	25.04.17	ISSUED FOR TENDER	GS	AD	GSJ
Rev	Date	Description	Author	Checked	Approved

Rev. 0



SS- MEDIUM DENSITY POLYETHYLENE BALL VALVES

VPC-SS-PE-28

TABLE OF CONTENTS

1. SCOPE
2. APPLICABLE CODES, SPECIFICATIONS AND STANDARDS
3. ABBREVIATION AND TERMINOLOGY
4. TECHNICAL REQUIREMENT
5. MATERIAL
6. DESIGN
7. DIMENSIONS AND TOLERANCE
8. DOCUMENT REQUIREMENT
9. QUALITY ASSURANCE PLAN
10. MARKING
11. PACKAGING

	SS- MEDIUM DENSITY POLYETHYLENE BALL VALVES	VPC-SS-PE-28

1.0 **SCOPE:**

This technical specification along with datasheet specifies the minimum requirements for design, selection, manufacture, inspection, testing and supply of MDPE Ball Valves and its component made from extruded or injected moulded polyethylene (PE).

This specification elaborates the requirement of MDPE Ball Valve for natural gas distribution systems at operating pressure and operating temperature 4 barg and 25°C respectively.

This specification is limited to valves with a nominal diameter (de/do) up to and including 180 mm.

Material of grade shall be PE 80 & SDR 11.

2.0 **APPLICABLE CODES, SPECIFICATIONS AND STANDARDS:**

EN 1555-1: Plastics piping systems for the supply of gaseous fuels- Polyethylene (PE) - part 1: General

EN 1555-2 / ISO 4437-2 / IS-14885: Plastics piping systems for the supply of gaseous fuels- Polyethylene (PE)

EN 1555-3: Plastics piping systems for the supply of gaseous fuels- Polyethylene (PE) - part 3: Fittings

EN 1555-4: Plastics piping systems for the supply of gaseous fuels- Polyethylene (PE) - part 4: Valves

EN 1555-5: Plastics piping systems for the supply of gaseous fuels- Polyethylene (PE) - part 5: Fitness for purpose of the system

EN 1555-7: Plastics piping systems for the supply of gaseous fuels- Polyethylene (PE) - part 7: Guidance for assessment of conformity

ISO TR 13950:1997 or latest edition: Plastics pipes and fittings - Automatic recognition systems for Electro fusions

ISO/IEC 16390:1999 or latest edition: Information technology – Automatic identification and data capture techniques – Bar code symbology specification- Interleaved 2 of 5

ISO 12176-4: Plastics pipes and fittings - Equipment for fusion jointing polyethylene system - part 4: Traceability coding

ISO 17778: Plastics piping systems- Fittings, valves and ancillaries - Determination of gaseous flow rate/pressure drop relationships.

EN ISO 1133, Plastics — Determination of the melt mass-flow rate (MFR) and the melt volume-flow rate (MVR) of thermoplastics

ISO 3126: Plastics piping systems -- Plastics piping systems — Plastics piping components — Measurement and determination of dimensions



SS- MEDIUM DENSITY POLYETHYLENE BALL VALVES

VPC-SS-PE-28

PNGRB and other referrals in the above applicable codes.

3.0 **ABBREVIATIONS & TERMINOLOGY:**

d_n / d_o	: Nominal Outside Diameter
e_n	: Nominal Wall Thickness
SDR	: Standard Dimension Ratio = d_n / e_n
LTHS	: Long Term Hydrostatic Strength (at 20°C for 50yrs)
LCL	: Lower Confidence Limit – Stress value (MPa) of mean LTHS
MRS	: Minimum Required Strength – min. value (in MPa) for LTHS of material
C	: Design Co-efficient – As per ISO: 12162 Table-2
σ_s	: Design Stress (= MRS/C)
MFR	: Melt Mass Flow rate – Value related to viscosity of the molten material at a specified temp. and rate of shear. (expressed in g/10min.)
D_f	: De-rating Co-efficient (Refer Table A.1, Annex A – EN 1555-5)
MOP	: Maximum Operating Pressure = $(20 \times MRS) / \{(SDR-1) \times C \times D_f\}$
EF	: Electrofusion

4.0 **TECHNICAL REQUIREMENT:**

- 4.1 Design of valve shall be as per European Standards EN 1555-4 and the complementary particular requirement.
- 4.2 Valves shall be leak proof and it is intended to be use in gas distribution networks made of PE pipes and accessories.
- 4.3 The valves are laid and to be welded by means of electrofusion method.
- 4.4 The internal and external surfaces of valves shall be smooth, clean and free from scoring, cavities or other surface defects to an extent that would prevent conformity to EN 1555-4.
- 4.5 No component of valve shall show any damage, scratches, pitting, bubbles, blisters, inclusions or crack.
- 4.6 Mechanical characteristics of assembled valves:
- Valve shall have mechanical characteristics conforming to the requirements given in Table-1 of standard EN 1555-4.
 - Unless otherwise specified by the applicable test method, the test pieces shall be conditioned at (23 ± 2) °C before testing.
 - Testing of valve shall be in accordance with the test methods as specified in Table-1 of standard EN 1555-4 using the indicated parameters.
 - Hydrostatic test pressure and minimum test period shall be as per Table-2 of EN 1555-4.

Rev. 0

	SS- MEDIUM DENSITY POLYETHYLENE BALL VALVES	VPC-SS-PE-28

4.7 Physical characteristics of assembled valves:

- a) Valve shall have physical characteristics conforming to the requirements given in Table-3 of standard EN 1555-4.
- b) Thermal stability test shall be done at 200 deg. C by means of differential scanning calorimetry (DSC), considering oxygen induction time (OIT) ≥ 20 min.
- c) Melt mass flow rate shall be calculated at 190 deg. C by applying 5 Kg of load on test specimen. It shall be expressed in g/ 10min.
- d) Unless otherwise specified by the applicable test method, the test pieces shall be conditioned at (23 ± 2) °C before testing.
- e) Testing of valve shall be in accordance with the test methods as specified in Table-3 of standard EN 1555-4 using the indicated parameters.

4.8 Performance requirements:

When valves are assembled to each other or to components conforming to other parts of EN 1555, the joints shall conform to EN 1555-5.

4.9 Allowable pressure drop shall be as per the standard ISO 17778.

4.10 Color of valve shall be black.

5.0 **MATERIAL:**

5.1 The PE compound from which the valve body with electrofusion socket is made shall conform to EN 1555-1.

5.2 The PE compound of the valve shall be made only from virgin material conforming to EN 1555-1. PE compound shall be cadmium free pigment compound.

5.3 All parts of the valve in contact with the gas stream shall be resistant to the gas, its condensates and other occurring substances such as dust.

5.4 The PE valves bodies made from below listed material are forbidden:

- a) Use of recycled materials
- b) Mixture of different materials
- c) Addition of complementary materials

5.5 The material and constituent elements used in marking of valve (including elastomers, greases and any metallic part, if used) shall be resistant to the external and internal corrosion and shall have life expectancy under following conditions at least equal to the PE pipes with which they are intended to be used.

- a) During storage
- b) Under the effect of the gas conveyed
- c) With respect to the services environment and operating conditions

	SS- MEDIUM DENSITY POLYETHYLENE BALL VALVES	VPC-SS-PE-28

- 5.6 The seals shall be homogeneous without any inner cracks, inclusion or impurities. It can not contain any component that can alter the properties of the materials they are in contact with.
- The nitrile rubber ring shall comply with standard EN 682.
 - Other seals shall comply with the relevant standard and be suitable for gas service.

5.7 Operating key or extension spindle shall be made of PVC and non-corrosive.

6.0 **DESIGN**

- 6.1 Valve will be designed for a maximum operating pressure (MOP) equal to 10 barg.
- 6.2 The wall thickness of the PE valve body shall be equal or greater than the minimum wall thickness of the corresponding SDR 11 series pipes.
- 6.3 Valve shall be bi-directional.
- 6.4 Specified End to End dimension in the Data-Sheet is minimum requirement.
- 6.5 The design of valve shall be such that, when assembling the valve into the pipe or other components, the electrical coil and/ or seals or any other ancillary parts are not displaced.
- 6.6 Valve ends shall have extended pipes at both plain ends. Pressure rating and thickness of extended pipes shall be compatible with the pipe in the network.
- 6.7 Valve ends shall be welded to pipes or fittings by means of electrofusion jointing using coupler.
- 6.8 Electrofusion socket shall have sufficient fusion compatibility to the pipe to which it is fused to meet the requirement of standard EN 1555-4 and EN1555-5.
- 6.9 PE valves bodies and their PE electrofusion socket / ends shall have a pressure rating of at least that of the pipe to which they are assembled.
- 6.10 Valve body and valve ends shall not be bolted and screwed and shall also be designed that it cannot be dismantled.
- 6.11 Operating Cap/ Head of valve shall be "non-blow out" type. Size of operating cap shall be 50 mm square socket and 40 mm height as per EN 1555-4.
- 6.12 The running torque of valve shall be as per standard EN 1555-4. Valve shall be designed in such a way that it cannot be easily operated by hand.
- 6.13 Operating Key or Extension spindle shall be provided for valve operation as per client requirement. Operating key or extended spindle shall be compatible with operating cap.
- 6.14 The valve should be equipped with a base plate. In order to achieve this, the valve body will be designed with a flat base or with an attached base plate or an integrated one.
- 6.15 The operating mechanism and the stop wedges will be protected against water intrusion.
- 6.16 The valve body is completely sealed except a passage for the spindle mechanism.

7.0 **DIMENSIONS & TOLERANCE:**

Rev. 0

	SS- MEDIUM DENSITY POLYETHYLENE BALL VALVES	VPC-SS-PE-28

- 7.1 The dimensions will be in conformity with the standard EN 1555-3 and EN 1555-4.
- 7.2 Dimensions shall be measured in accordance with ISO 3126 at $(23 \pm 2) ^\circ\text{C}$, after being conditioned for at least 4 hrs. The measurement shall not be made less than 24 hrs after manufacture.
- 7.3 Each valve shall be characterized by its dimensions and associated end connections.
- 7.4 Technical data given by the manufacture shall include at least following information:
- a) the dimensional characteristics, by working drawings
 - b) the assembly instruction
- 7.5 The dimensions of electrofusion socket shall conform to EN 1555-3, Table-1.
- 7.6 Pressure rating or thickness of ends shall confirm to interconnecting pipes specification.
- 7.7 Tolerance for operating cap of valve shall be $(50+0.5)$ mm square for socket and (40 ± 2) mm for height.

8.0 **DOCUMENT REQUIREMENT:**

8.1 **TO BE SUBMITTED ALONG WITH BID**

All relevant documents like detailed technical catalogue, technical deviations list (if any) along with quoted price.

8.2 **TECHNICAL FILE**

The manufactures of the valves-shall deliver for each type of valve a technical file which includes:

- a) Raw material used.
- b) Drawings, dimensions and tolerances, including for the accessories.
- c) Application range (temperature and pressure limits).
- d) Running torque and initiating torque.
- e) Pressure drop and flow diagram.
- f) Test results and Data proving the conformity of the valve in accordance with EN1555-4 and EN1555-7.
- g) The pipe elements used during valves testing.
- h) The assembly pipes/valves realized during testing shall be in conformity with the manufactures instructions and the extreme installation conditions.
- i) For the test assembly due consideration should be taken regarding the fabrication tolerances and the variation of the outside ambient temperature.

9.0 **QUALITY ASSURANCE PLAN:**

	SS- MEDIUM DENSITY POLYETHYLENE BALL VALVES	VPC-SS-PE-28

The Quality Assurance Plan (QAP). Inspection shall be carried out as per **Annexure –II** and the vendor is to submit the plan accordingly. Vendor to submit their own QAP along with offer based on indicative QAP enclosed in this tender for approval to the Owner / Owner's representative.

10.0 **MARKING:**

Following information shall be embossed upto height of 0.15 mm onto the valve and also in the form of bar code:

- a) Owner's name as Client.
- b) Manufacturer's name and/or trademark
- c) Material and Designation
- d) Design application series
- e) Nominal diameter
- f) Internal fluid gas
- g) Direction of flow
- h) Traceability code (valve and component) as per standard ISO 12176-4.
- i) Number of the system standard. This information can be printed/formed directly on the valve or on a label associated with the valve or on an individual bag
- j) Production period, year and month

The marking shall stay legible during normal manipulation, storage and installation.

The marking shall not adversely influence the performance of the valve and prevent the nonconformity of the valve.

11.0 **PACKAGING:**

The valve and its accessories shall be packaged individually in plastic bags in order to prevent them from deterioration. The valves ends shall be protected with external caps.

The cartons and/or individual bags shall bear at least one label with the manufacturer's name, type and dimensions of the part number, number of units in the box and, any special storage conditions and storage time limits.

	SS - ISOLATION VALVE	1007/03-CD-MC-SP-001

SUPPLY OF ISOLATION AND APPLIANCE VALVES

SS - ISOLATION VALVE

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	SS - ISOLATION VALVE	1007/03-CD-MC-SP-001

TABLE OF CONTENTS

<u>Sr. No.</u>	<u>Description</u>	<u>Page No.</u>
1.0	INTENT OF SPECIFICATION.....	3
2.0	SCOPE OF WORKS.....	3
3.0	DEFINITIONS	3
4.0	MATERIAL SPECIFICATION FOR ISOLATION VALVES.....	3
5.0	DATA SHEET OF ISOLATION VALVE	5

	SS - ISOLATION VALVE	1007/03-CD-MC-SP-001

1.0 INTENT OF SPECIFICATION

The intent of this specification is to establish minimum requirements to manufacture and supply of Isolation Ball Valves used for supply of natural gas to domestic & commercial connections.

2.0 SCOPE OF WORKS

The scope of the tenderer will include manufacture/ supply, inspection/ testing/ marking/ packaging/ handling and despatch of Isolation Ball Valves, as indicated in the Material Requisition & Schedule of Rates, meeting all the requirements as laid down in manufacturing standard EN331 (latest edition).

- 2.1. All codes and standard for manufacture, testing, inspection etc. shall be of latest edition.
- 2.2. Owner/ Owner's Representative reserves the right to delete or order additional quantities during execution of order, based on unit rates and other terms & conditions in the original order.

3.0 DEFINITIONS

Manufacturer SS	Means the Manufacturer of the isolation ball valves Means the present <<Standard Specification>> and all its appendix, if any.
Third Party Inspection Agency	Means the Inspection Agency to be appointed by Client.

4.0 MATERIAL SPECIFICATION FOR ISOLATION VALVES

Please Refer Data Sheet

4.1.1. Markings

Markings shall be provided & shall include:

- i) Manufacturer's name or trade mark, Model designation.
- ii) Rate working pressure in Barg.
- iii) Embossing on valves shall be "**EN 331**" only.

4.1.2. Packaging

Packing size to be mentioned to ensure uniformity in delivery conditions of the material being procured. Packing size shall be approved by owner / owner's representative before packing the material. Bidder shall submit the packaging details during offer and also complied with at the time of delivery.

	SS - ISOLATION VALVE	1007/03-CD-MC-SP-001

4.1.3. Gas Tightness

Valves shall be leak tightness tested in closed position and shall not leak to atmosphere in open and closed position when subjected progressively to internal air pressure of first 0.006 barg and then to at least 1.5 times the maximum operating pressure (MOP) of the valve. This test shall be performed as per EN331 (latest edition).

4.1.4. Temperature resistance test

This test shall be carried out as per EN331 (latest edition).

4.1.5. Mechanical Strength

- i) The body of the valves shall be capable of withstanding, without deformation or leakage, a min. torque as per EN331 (latest edition) as applied to a pipe being connected to the valve.
- ii) Valve shall be capable of withstanding, without deformation or leakage, a min. bending moment as per EN331 (latest edition) as applied to a pipe being connected to the valve.
- iii) The valves shall be capable of withstanding impact without breakage or leakage as per EN331 (latest edition).
- iv) Vendor shall submit Model Number along with catalogues in English language along with un-priced bids.
- v) Maximum turning torque to operate the valve as per EN331 (latest edition).

	SS - ISOLATION VALVE	1007/03-CD-MC-SP-001

5.0 DATA SHEET OF ISOLATION VALVE

S.NO	DESCRIPTION	DATA	
1.00	PROCESS DATA		
1.01	Fluid	Natural Gas	
2.00	Operating condition		
2.01	Pressure	4 bar (g)	
2.02	Temperature (°C)	0 - 45	
3.00	Design condition		
3.01	Pressure	6 bar (g)	
3.02	Temperature (°C)	-5 to 60	
4.00	VALVE DATA		
4.01	Size	1/2" , 3/4" & 1"	1 1/2" & 2"
4.02	Type	Isolation Ball Valve, Full Bore with NPT (Confirming to ANSI B1.20.1) Female Threaded Ends (both inlet & outlet) for natural gas application with operating knob and locking arrangement, sealing wire and lead seal (without Key). Valve full open/close position shall be at 90°. The material is required for Domestic Natural Gas Service.	
4.03	Pressure Rating	*	
4.04	End connection	End connection should be NPT Female (conforming to ANSI B1.20.1).	
4.05	Body material	Total body shall be of Forged Brass (ASTM B 283, Alloy UNSC37700) with hard Nickel / Chrome Plated. UTS – Min. 345 Mpa & Elongation 25 %	
4.06	Ball material	Hard Chrome / Nickel Plated (*), Forged Brass (ASTM B 283, Alloy UNSC37700) with Teflon Seat. UTS – Min. 345 Mpa & Elongation 25 %	
4.07	Stem	*	
4.08	Seat & seal	*	
4.09	Fire safe	*	
4.10	Anti blow out	*	
4.11	Antistatic	*	
4.12	Extension stem	NA	
4.13	Operator	Knob and locking arrangement with Butterfly type Handle	Knob and locking arrangement with Lever type Handle
5.00	PAINTING		
5.01	Surface preparation	*	
5.02	Primer	*	
5.03	Finish	*	
5.04	Insulation	*	
6.00	TEST		
6.01	Hydrostatic Shell Test		
	Test Pressure	7.8 bar(g)	
	Test Medium	*	
6.02	Hydrostatic Seat Test		
	Test Pressure	*	
	Test medium	*	



SS - ISOLATION VALVE

1007/03-CD-MC-SP-001

6.03	Functional / Pneumatic Test	
	Test Pressure	7.8 bar(g)
	Test medium	Air
6.04	Tensile Strength Test	As per EN331 (latest edition)
6.05	Bending Test	As per EN331 (latest edition)
6.06	Torque Test	As per EN331 (latest edition)
6.07	Turning Torque Test	As per EN331 (latest edition)
6.08	Antistatic Test	*
6.09	Fire Test	*
6.10	Visual and dimensional examination	As per QAP
Note	Unless otherwise stated all tests will be witnessed by the purchaser	
7.00	QUALITY CONTROL	
7.01	Material certificates	EN-10204, 3.2 Certificate
7.02	All testing certificates	*
8.00	NICKEL-CHROME PLATING	
8.01	Body, Ball etc.	* (Note-3)

NOTE:

1. All Tests shall be carried out as per EN-331 (Latest Edition).
2. Data / Information as marked “ * ” shall be provided by Vendor / Manufacturer for review and approval by Client / PMC.
3. Nickel-Chrome Plating thickness shall be 10 micron $\pm$ 2 micron on valve body and ball.

	SS - APPLIANCE VALVE	1007/03-CD-MC-SP-002

SUPPLY OF ISOLATION AND APPLIANCE VALVES

SS - APPLIANCE VALVE

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	SS - APPLIANCE VALVE	1007/03-CD-MC-SP-002

TABLE OF CONTENTS

<u>Sr.No.</u>	<u>Description</u>	<u>Page No.</u>
1.0	INTENT OF SPECIFICATION	3
2.0	SCOPE OF WORKS	3
3.0	DEFINITIONS	3
4.0	MATERIAL SPECIFICATION	3
5.0	DATA SHEET	5

	SS - APPLIANCE VALVE	1007/03-CD-MC-SP-002

1.0 INTENT OF SPECIFICATION

The intent of this specification is to establish minimum requirements to manufacture and supply of Appliance Ball Valves used for supply of domestic natural gas.

2.0 SCOPE OF WORKS

- 2.1. The scope of the tenderer will include manufacture/ supply, inspection/ testing/ marking/ packaging/ handling and despatch of Appliance Ball Valves, as indicated in the Material Requisition & Schedule of Rates, meeting all the requirements as laid down in manufacturing standard EN331 (latest edition).
- 2.2. All codes and standard for manufacture, testing, inspection etc. shall be of latest edition.
- 2.3. Owner/ Owner's Representative reserves the right to delete or order additional quantities during execution of order, based on unit rates and other terms & conditions in the original order.

3.0 DEFINITIONS

Manufacturer PTS	Means the Manufacturer of the Appliance Ball Valves Means the present <<Standard Specification>> and all its appendix, if any.
Third Party Inspection Agency	Means the Inspection Agency to be appointed by Client.

4.0 MATERIAL SPECIFICATION

Please refer Data sheet.

4.1.1. Markings

Markings shall be provided & shall include:

- i) Manufacturer's name or trade mark Model designation
- ii) Rate working pressure in Bar.
- iii) Embossing on valves shall be "EN 331" only.

4.1.2. Packaging

Packing size to be mentioned to ensure uniformity in delivery conditions of the material being procured. Packing size shall be approved by owner / owner's representative before packing the material. Bidder shall submit the packaging details during offer and also complied with at the time of delivery.

	SS - APPLIANCE VALVE	1007/03-CD-MC-SP-002

4.1.3. Gas Tightness

Valves shall be leak tightness tested in closed position and shall not leak to atmosphere in open and closed position when subjected progressively to internal air pressure of first 0.006 barg and then to at least 1.5 times the maximum operating pressure (MOP) of the valve. This test shall be performed as per EN331 (latest edition).

4.1.4. Temperature resistance test

This test shall be carried out as per EN331 (latest edition).

4.1.5. Mechanical Strength

- i) The body of the valves shall be capable of withstanding, without deformation or leakage, a min. torque as per EN331 (latest edition) as applied to a pipe being connected to the valve.
- ii) Valve shall be capable of withstanding, without deformation or leakage, a min. bending moment as per EN331 (latest edition) as applied to a pipe being connected to the valve.
- iii) The valves shall be capable of withstanding impact without breakage or leakage as per EN331 (latest edition).
- iv) Vendor shall submit Model Number along with catalogues in English language along with un-priced bids.
- v) Maximum turning torque to operate the valve as per EN331 (latest edition).

	SS - APPLIANCE VALVE	1007/03-CD-MC-SP-002

5.0 DATA SHEET OF APPLIANCE VALVE

S.NO	DESCRIPTION	DATA
1.00	PROCESS DATA	
1.01	Fluid	Natural Gas
2.00	Operating condition	
2.01	pressure	4 bar (g)
2.02	Temperature (°C)	0 - 45
3.00	Design condition	
3.01	pressure	6 bar (g)
3.02	Temperature (°C)	-5 to 60
4.00	VALVE DATA	
4.01	Size	1/4"
4.02	Type	Appliance Ball Valve, Full Bore with NPT (Confirming to ANSI B1.20.1) Female Threaded End as an inlet and the outlet shall be having Ni/Cr plated brass or stainless steel nozzle (Serrated to suit 1/4" rubber tubing / hose connection and with a metallic operating knob for full open/close at 90° position. The material is required for Domestic Natural Gas Service.
4.03	Pressure Rating	*
4.04	End connection	End connection at the inlet should be NPT Female (conforming to ANSI B1.20.1) and the outlet shall be having Ni/Cr plated brass or stainless steel nozzle
4.05	Body material	Total body including the nozzle shall be of Forged Brass (ASTM B 283, Alloy UNSC37700) with hard Nickel / Chrome Plated. UTS – Min. 345 Mpa & Elongation 25 %
4.06	Ball material	Hard Chrome / Nickel Plated (*), Forged Brass (ASTM B 283, Alloy UNSC37700) with Teflon Seat. UTS – Min. 345 Mpa & Elongation 25 %
4.07	Stem	*
4.08	Seat & seal	*
4.09	Fire safe	*
4.10	Anti blow out	*
4.11	Antistatic	*
4.12	Extension stem	NA
4.13	Operator	Knob with Butterfly type Handle and without locking arrangement
5.00	PAINTING	
5.01	Surface preparation	*
5.02	Primer	*
5.03	Finish	*
5.04	Insulation	*
6.00	TEST	
6.01	Hydrostatic Shell Test	
	Test Pressure	7.8 bar(g)
	Test Medium	*
6.02	Hydrostatic Seat Test	*
	Test Pressure	*
	Test medium	*

	SS - APPLIANCE VALVE	1007/03-CD-MC-SP-002

6.03	Functional / Pneumatic Test	
	Test Pressure	7.8 bar(g)
	Test Medium	Air
6.04	Tensile Strength Test	As per EN331 (latest edition)
6.05	Bending Test	As per EN331 (latest edition)
6.06	Torque Test	As per EN331 (latest edition)
6.07	Turning Torque Test	As per EN331 (latest edition)
6.08	Antistatic Test	*
6.09	Fire Test	*
6.10	Visual and dimensional examination	As per QAP
Note	Unless otherwise stated all tests will be witnessed by the purchaser	
7.00	QUALITY CONTROL	
7.01	Material certificates	EN-10204, 3.2 Certificate
7.02	All testing certificates	*
8.00	NICKEL-CHROME PLATING	
8.01	Body, Ball etc.	* (Note-3)

- NOTE:**
1. All Tests shall be carried out as per EN-331 as per EN331 (latest edition).
 2. Data / Information as marked “ * “ shall be provided by Vendor / Manufacturer for review and approval by Client / PMC.
 3. Nickel-Chrome Plating thickness shall be 10 micron $\pm$ 2 micron on valve body and ball.

	SS – PLB HDPE DUCT	VPC-SS-PE-0024

SS – PLB HDPE DUCT

0	03.03.2017	ISSUED FOR APPROVAL	GS	AD	GSJ
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TABLE OF CONTENTS

1.0 INTRODUCTION	3
2.0 SCOPE	3
3.0 REFERENCE DOCUMENTS	3
4.0 PLB HDPE DUCT SPECIFICATIONS	4
5.0 INSPECTION AND ACCEPTANCE TESTS:	5
6.0 IDENTIFICATION MARKINGS	7
7.0 INSTRUCTION OF TENDERER	8
8.0 TYPE APPROVAL AND ACCEPTANCE TEST:	8
9.0 PACKAGE AND DELIVERY	9
10.0 QUALITY ASSURANCE PLAN	9



SS – PLB HDPE DUCT

VPC-SS-PE-0024

1.0 INTRODUCTION

An Optical Fibre (OFC) system for the Telecommunication requirements has been most suitable for City Gas Distribution pipeline project.

For operation and maintenance of the OFC network, it is desired to purchase double layered permanently lubricated (PLB) HDPE duct for use as underground Optical Fibre Cable conduits. The HDPE duct shall be either laid in a trench at a depth of 1.65 meters or shall be laid through HDD (Horizontal direction drilling) and Optical Fibre cable shall be installed using blowing techniques.

2.0 SCOPE

Objective of this specification is to establish minimum requirements to manufacture and supply of HDPE pipes used for laying OFC. This specification covers the minimum generic requirement of permanently self-lubricated high Density Polyethylene ducts (PLB HDPE ducts) for use as underground conduits for optical fibre cables, suitable for installation of OFC by blowing technique.

The scope of the tender will include manufacture/ supply, Inspection / testing / marking / packing / handling and despatch of HDPE pipes as per following specification: per the specification/ requirements given in this document.

Material Grade	50/42, PLB duct as per TEC specifications No. GR/CDS-08/02 Nov 04 or Latest

However Optical Fibre Cable shall be laid in a permanently lubricated HDPE pipe using blowing technique.

All codes and standards for manufacture, testing, inspection etc. shall be of latest edition.

3.0 REFERENCE DOCUMENTS

Unless otherwise specified, this document requires to the latest standards of the following:

TEC/GR/TX/CDS-008/03/MAR-11	Permanently lubricated HDPE telecom Ducts for use as underground optical fibre cable conduits
IS 2530	Method for test for Polyethylene Molding Material and Polyethylene compounds
IS 4984	High Density Polyethylene Pipes for water supply
IS 7328	High Density Polyethylene materials for molding and extrusion
IS 9938	Recommended colours for PVC insulation for LF wires and cables
IS 12235 (Part – 9)	Methods of test for un-plasticized PVC pipes for potable water supplies – Impact strength at 0°C
IS 14151 (Part – 1)	Polyethylene pipes for sprinkler irrigation systems (Part – I Pipes)
ASTMD 1693	Test method for environmental stress cracking of ethylene plastics.



4.0 PLB HDPE DUCT SPECIFICATIONS

The PLB HDPE duct shall consist of two concentric layers, the outer layer being HDPE, co-extruded with an inner layer of solid permanent lubricant, to reduce the internal coefficient of Friction (ICF). The lubricant shall be of a solid layer of uniform thickness so formulated to provide a permanent, low friction boundary layer between the inner surface of the duct and Optical Fibre cable. The lubricant layer shall be clearly visible in cross section, concentric with the outer layer.

Alternatively, the duct can be of a homogenous construction (without a separate inner layer) meeting all the requirements of this specification.

The PLB HDPE Ducts shall be supplied in coil form, suitable for shipping and handling purposes.

4.1 Construction

Outer Layer

The base HDPE resin used for the outer layer of the PLB HDPE duct shall conform to any designation of IS – 7328 or to any equivalent standard meeting the following requirements, when tested as per IS – 2530. However, the manufacturers shall furnish the designation for the HDPE resin as permanently IS – 7328 as applicable.

Density	0.940 to 0.958g/cc at 27°C, when tested as per IS: 2530 or IS: 7328
Melt Flow Rate	0.2 to 1.1 g/10 minute at 190°C & 5 kg load, when tested as per IS: 2530

Inner Layer

The inner lubrication material shall be of friction reducing, polymeric material which shall be integral with HDPE layer. The lubricant materials shall have no toxic or dermatic hazards for safe handling. In the finished PLB HDPE duct, the co-extruded layer of solid permanent lubricant shall be integral part with HDPE and shall be white in colour and clearly visible in cross-section of duct.

The density of inner layer material shall be white in colour & clearly visible in cross-section of duct. The density of inner layer material shall be between 0.940 and 0.958g/cc at 27°C.

The inner layer of solid permanent lubricant shall be continuous all through and shall not come out during storage, usage and throughout the life of the duct.

4.2 Raw Material

The raw material (s) used for the duct shall meet the following requirements:

- The anti-oxidants used shall be physically harmless.
- None of the additives shall be used separately or together in quantities as to impair long term physical and chemical properties of the duct.



SS – PLB HDPE DUCT

VPC-SS-PE-0024

- Single pass rework material of the same composition produced from the manufacturer's own production shall be used and it shall not exceed 10% in any case.
- The raw material used for extrusion shall be dried the moisture content to less than 0.1%.
- Suitable UV stabilizers shall be used for manufacturer of the duct to protect against ultra violet degradation, when stored in open for a minimum period of 8 months.
- The raw material used in the manufacturer of the duct shall be such that the service life of the duct can be expected to be more than 50 years including the life of permanent lubricant.

5.0 INSPECTION AND ACCEPTANCE TESTS:

Bidder shall submit Quality Assurance Plan (QAP) immediately after receipt of order for client's approval. The test and inspection shall be carried out as per the QAP in accordance with the codes and standards outlined in the specification. Following test shall be conducted as a minimum as per the codes and standards indicated in this document in the manufacturers premises. Test results must comply with specifications as per TEC GR Nos. TEC/GR/TX/CDS-008/03/MAR-11, including all the other requirements, which are necessary

Client reserves the right to carry out inspection at vendor place, as per approved QAP, By Client representative or representative of the any third party agency nominated by Client. Notice for inspection shall be given to Engineer-in-charge at least one week in advance.

5.1 Visual Inspection

The ducts shall be checked visually for ensuring good workmanship that the ducts shall be free from blisters, shirks hole, flaking, chips, scratches, roughness, break and other defects. the ducts shall be smooth, clean, round. The ends shall be cleanly cut and shall be square with axis of the duct.

The colour of the duct shall be green and uniform throughout. Each duct shall contain 4 approximately equi-spaced continuous longitudinal stripes of width 3-mm minimum in white colour. These stripes shall be co-extruded during manufacturing. The material of the stripes shall be same as that of base compound for the duct.

In the case of two-layer construction the inner layer (Soil Lubricant) shall be white in colour.

The colours of the duct, stripe and inner layer (in the case of two-layer construction) shall be identifiable under normal lighting conditions and generally conform to IS-9938.

5.2 Dimension of Ducts

Please refer Technical data sheet

5.3 Tensile Strength and Elongation

Test shall be carried out as per ASTM F 2160 (using type IV specimens of ASTM D 638)

**5.4 Reversion Test**

The test shall be carried out as per IS-4984. For this purpose, a duct length of 200 mm shall be placed horizontally in an air-oven or a suitable liquid bath on a support at $110 \pm 2^{\circ}\text{C}$ for 60 ± 1 minutes so that the dimensional change in duct section are not impeded. After cooling to room temperature, the dimensional change of the duct section shall be measured in the longitudinal direction and the deviation from the initial length shall be calculated and stated in percentage. The dimensions shall not change by more than 3% in the longitudinal direction.

5.5 Environmental Stress Crack Resistance Test

The specimen cut from the PLB HDPE ducts shall meet the environmental stress cracking as described in ASTM D-1693.

5.6 Impact Strength Test

The test has to be carried as per IS-12235 (Part – 9). A sample duct 150 mm in length shall be placed on heavy rigid block whose faces are at an angle of 120° . A striker with a hemispherical nose of 13 mm radius and loaded to a total weight of 10 kg shall be allowed to fall freely in a suitable vertical guide through a height of 1.5 m before striking the duct. The line of fall of the striker shall coincide with the diameter of the duct. The duct shall not crack or split.

5.7 Crush Resistance Test

Samples of duct of $150 \text{ mm} \pm 2 \text{ mm}$ in length shall be subjected to a dead load of not less than 50 kg for one minute and shall be allowed to recover for 5 minutes. The deflection with load on and after recovery period shall not exceed 10% and 2% respectively.

5.8 Mandrel Test

A 150-mm long mandrel of diameter, 3 mm less than the internal diameter of the duct shall be passed through a 5-meter length of duct, freely throughout the length, when the duct is bent to a radius of 5 meters.

5.9 Ovality Test

Ovality is the difference between maximum outside diameter and the minimum outside diameter at the same cross-section of the duct, at 300 mm away from the end.

5.10 Coil Set Test:

The PLB HDPE duct shall unroll of the drums without snaking or waving having zero coil set. Thus, the duct shall lay straight into the trench without re-coiling. For this purpose, when a minimum length of 50 meters' duct taken from the coil and laid on the ground, it shall be straight without any bends or kinks and without deformation, except 5 meters from each end.

5.11 Oxidation Induction Test:

The induction time in oxygen when tested with a copper pan as per method specified in Annexure-I of Latest TEC GR and, shall not be less than 30 minutes.

**5.12 Hydraulic Characteristics:**

The duct shall be tested for internal pressure creep rupture test as per IS-4984. For this purpose, a sample length of 10 times the outside diameter of the duct shall be taken. At the end of the test, the sample shall not show signs of localised swelling or leakage and shall not burst during the test duration. The test showing failure within a distance equivalent to the length of end cap from the end shall be disregarded and the test repeated.

5.13 Internal Co-efficient of Friction:

The internal Co-efficient of Friction when tested as permanently method, shall not exceed 0.06 when tested with respect to Nylon jacketed unarmoured Optical Fibre Cable i.e., 48 F Fibre as required.

5.14 Optical Fibre Cable Blowing Test:

For this test an Optical Fibre Cable of a diameter nearest to the diameter indicated in this specification, relevant to the size of duct under test shall be installed by blowing of the cable in a length of 1 km of the duct. The duct shall be laid with bends in the horizontal and vertical planes and a raise in the middle. The 1 km section shall include two couplings at suitable locations.

The OFC shall then be blown out. It shall be inspected for any visual damage. The OFC shall then be blown in again.

It shall be possible to blow in the Optical Fibre Cable through the 1 km duct, each time in not more than 30 minutes. There shall be no visible damage to OFC. The test will be conducted on two samples out of the five submitted for Type Approval.

6.0 IDENTIFICATION MARKINGS

The duct shall be prominently marked with indelible ink, with the following information at intervals every meter to enable identification of the pipe. The size of ink markings shall be distinct, clearly and easily visible.

- Client Name
- Client Logo
- Manufacturer's Name
- Name of the duct with size
- Designation of the Pipe
- Date of manufacturing
- Sequential length marking at every meter.

Marking shall be done in continuous length of pipe as per TEC .In addition to the above the pipe shall be marked as "Client" in continuous lengths at interval of 1 m.



SS – PLB HDPE DUCT

VPC-SS-PE-0024

7.0 INSTRUCTION OF TENDERER

7.1 Length of Pipe:

Length of the Pipes and their supply will be as per following: -

DN 50mm- 500 ± 100 mtr.

7.2 Protection:

The ends shall be protected by proper end caps to prevent from shocks and ingress of the foreign body.

7.3 Documents to be submitted

- The successful bidder shall submit following for approval of Purchaser/ Consultant after placement of order
- The quality Assurance Plan (QAP & Sampling Plan)
- Material Test report as per TEC
- Performance Requirements (TEC)
- Type Test (as per TEC)

7.4 Bidder shall submit following documents at the time of bidding,

- a) BIS Certification
- b) List of current orders in hand for similar items with full details such as specification, name of purchaser etc.
- c) Details of the largest supply executed
- d) Name and address of proposed test laboratories along with their credentials / past records for carrying out all required tests.

8.0 TYPE APPROVAL AND ACCEPTANCE TEST:

All the tests mentioned in this document shall be carried out on the 5 standard lengths of ducts and the samples must pass these tests before according the type approval. The supplier shall furnish 5 standard length for carrying out these tests for according type approval. Bulk manufacturer and supply shall start only after issue of type approval. The type approval certificate shall clearly be indicated the type/ grade/ source of high-density polyethylene raw material, the size of the duct and the construction of the duct i.e., Two layer of Homogenous.

8.1 Acceptance Test

The acceptance tests shall be carried out on samples from the lot for Dimensional and Visual requirements. The requirements for Tensile Strength & Elongation, Reversion Test, Environmental Stress Crack resistance, Impact Strength, Crush resistance, Oxidation Induction Test, Hydraulic Characteristics and internal Coefficient of Friction shall be carried out.

**9.0 PACKAGE AND DELIVERY**

The store shall be supplied in coils of suitable size for delivery in such a manner that they arrive at their distribution in a safe and undamaged condition and will permit the loading, unloading and handing the stores using standard moving equipment. The minimum inner bending diameter of technical coiled duct shall be 25 times the outer diameter of the cut. The material used for packaging wrapping sealing, moisture, resistant, corrosion prevents etc. as per applicable shall be of recognized brands and shall conform to best standards for packaging. The packing shall protect the material from impact vibration rough handling rain, dust, damp, insects, rodents etc., Each packing should have packing slip and test dispatch clearance documents.

10.0 QUALITY ASSURANCE PLAN

1. Vendor shall submit the details for Quality Assurance Plan followed by them, beginning with raw materials, fabricated components, assemblies, etc., to finished product (As Applicable).
2. The Owner reserves the right to inspect and test duct at all stages of production and testing. The inspection and testing shall include but not be limited to materials, subassemblies, prototypes, produced units, guaranteed, performance specifications etc.
3. For factory inspection and testing, vendor shall arrange all the requirement e.g., quality assurance personnel spaces, test gear etc., for successful carrying out of the job by the Owner's respectively at vendor's cost at the vendor's/ Manufacturer 's works
4. Vendor shall invite the Owner, at least 30 days in advance, of the date on which material shall be ready for inspection and testing. All relevant documents and manuals approved engineering drawings, etc. shall be provided to the Owner well in advance of the start of inspection and Testing.
5. Owner shall, after completion of inspection and testing to their satisfactory, issues factory acceptance certificate to release duct for shipment. No Duct shall be shipped under any circumstances unless a factory acceptance certificate has been issued for it, unless agreed otherwise by Owner.
6. The observation and test results obtained during various tests conducted shall be complied and documented to produce test reports by vendor. The test reports shall be given for each equipment / items and system as a whole.



**STANDARD SPECIFICATION
FOR
MDPE LINE PIPE**

Total Sheets 09

DOCUMENT NO	VPC	SS	PL	0025

**STANDARD SPECIFICATION
FOR
MEDIUM DENSITY POLYETHYLENE (MDPE)
LINE PIPE**

0	10.10.2017	ISSUED AS STANDARD SPECIFICATION	MD	SM	AD
Rev.	DATE	DESCRIPTION	PREP	CHK	APPR

TABLE OF CONTENTS

1.0	DEFINITIONS	3
2.0	TERMINOLOGY	3
3.0	DESIGN CODES/ STANDARDS REFERENCES.....	3
4.0	RAW MATERIAL GRADE AND PROPERTIES	4
5.0	APPROVED MANUFACTURER FOR RAW MATERIAL (PE-80).....	5
6.0	PIPE SIZE/ DIMENSION	5
7.0	TOLERANCE.....	6
8.0	COLOR.....	6
9.0	MARKING.....	6
10.0	QUALITY ASSURANCE PLAN (QAP).....	7
11.0	TYPE TEST CERTIFICATE.....	7
12.0	FINISH / DEFECT LIABILITY	7
13.0	FIRST LOT / FIRST CONSIGNMENT LIABILITY	7
14.0	SUPPLY, PACKAGING, HANDLING TRANSPORTATION AND STORAGE OF PE-80 PIPES	7
15.0	DOCUMENTS TO BE SUBMITTED ALONG WITH BID.....	7
	REFERENCES: AMENDMENTS TO THE CLAUSES OF IS-14885:2001	7



STANDARD SPECIFICATION FOR SUPPLY OF MDPE PIPES

Document No.

VPC-SS-PL-0025

Rev

1

Page 2 of 9

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1.0 DEFINITIONS

Where used in this document, the following terms shall have the meanings indicated below, unless clearly indicated by the context to this order

OWNER	:	
CONSULTANT	:	VCS Quality Services Private Limited (VCSQSPL) the party to act for and on behalf of OWNER for the PMC Services.
MANUFACTURER	:	The party, which manufactures and supplies equipment and services to the OWNER or to CONTRACTOR
MR	:	Material Requisition.

2.0 TERMINOLOGY

- Maximum Allowable Operating Pressure (MAOP): The maximum effective pressure of gas in a piping system, expressed in bars, which is allowed in continuous use. It takes in account physical & mechanical characteristics of the components of piping system.

The equation for MAOP = $20 \times \text{MRS}/C \times (\text{S D R} - 1)$

- Minimum Required Strength (MRS) — Minimum value in MPa, for long-term hydrostatic strength (LTHS) of the material.
- Nominal Outside Diameter (d_n): A convenient round number (in millimetres) for reference purposes which is common to all components in all thermoplastic systems, except for flanges and components which are designated by thread size.
- Out of roundness (Ovality): The absolute out of roundness is the difference between the measured maximum outside diameter and the measured minimum outside diameter in the cross - section of pipe.
- Nominal Wall Thickness(e_n): The wall thickness in millimetre
Corresponding to minimum wall thickness at any point around circumference of the pipe
- Resin: A material (solid or semi-solid) which has a high molecular weight and is a product of polymerization.
- Melt Flow Rate (MFR): is a value relating to the viscosity of the molten material at a specified temperature and a rate of shear.
- Standard Dimension Ratio (SDR). The ratio of nominal outside diameter of a pipe to its nominal thickness.

For any other terminology, IS-14885-2001 (latest) and/ or other applicable National International codes/Standard can be referred.

3.0 DESIGN CODES/ STANDARDS REFERENCES

The following National & international codes/ standards/ references (Latest edition) shall be applicable for PE-80 material as well as Polyethylene pipe.

ISO-14885	Polyethylene pipes for supply of Gaseous Fuels
ISO-4437	Buried Polyethylene pipe for supply of Gaseous fuels – metric Series- Specification
IS-2530	Methods of test for PE moulding materials and PE compound

	STANDARD SPECIFICATION FOR SUPPLY OF MDPE PIPES	Document No.	Rev
		VPC-SS-PL-0025	1
		Page 3 of 9	

- ISO-11830 Plastic: Methods for determining the density of non-cellular plastic
- ISO-1872-28 Plastic: polyethylene (PE) moulding and extrusion material.
- ISO-527 Plastics: Determination of tensile properties.
- ISO-1133 Plastics - determination of the melt-mass flow rate (MFR) and melt volume flow rate (MVR) of thermoplastic.
- EN 1555-7 Gaseous fuels supply polyethylene (PE)

4.0 RAW MATERIAL GRADE AND PROPERTIES

- Raw material grade classification shall conform to Cl.4.2.1 of IS-14885: 2001.
- The raw material of polyethylene pipes shall be PE-80.
- The properties of PE-80 shall conform to the table 2 of IS-14885: 2001.
- Other materials /additives such as, anti-oxidant, UV stabilizer, pigment dispersion etc. shall conform to IS-14885: 2001.
- Raw material of polyethylene pipes shall be of virgin quality. PE compound shall be Cadmium free pigment compound.
- Anti-oxidant & UV stabilised used in PE resin shall not exceed 0.3 and 0.5 % by mass of Finished resin respectively.
- Raw material supplier to supply the certificate for percentage use of U.V. stabilizer in the raw materials (PE compound).

➤ Properties of PE-80

Property	Unit	Test Method	PE-80
Conventional Density	Kg/m3	IS-7328: 1992	≥ 928.4 at 23°C ≥ 930.0 at 27°C
Tensile Yield strength	MPa	IS-14885: 2001	15, minimum
Elongation at break	%	IS-14885: 2001	350, minimum
Melt-mass Flow Rate	g /10 min.	IS-2530: 1963 IS-14885: 2001	+/- 20% of value nominated by compound producer@ 190°C/ 5.0kg (load)
Thermal stability	Minute	Annexure-D of IS-14885-2001	≥ 20@ 200°C

Oxidation Induction time	Minute	IS-14885: 2001	≥ 20
Volatile Matter Content	(mg/kg)	IS-14885: 2001	≤ 350
Pigment Dispersion		IS-14885: 2001	≤ 3
Resistance to gas constituents	h	IS-14885: 2001	$\geq 20 @ 80^{\circ}\text{C}$

The above requirements are also same for the final product.

- PE compound quality evaluation shall be as per IS-14885: 2001.

5.0 APPROVED MANUFACTURER FOR RAW MATERIAL (PE-80)

- INEOS
- BOREALIS
- TOTAL PETROCHEMICALS
- DOW
- BASELL
- BOROUGE

6.0 PIPE SIZE/ DIMENSION

- Wall Thickness

SL. NO.	NOMINAL DIA.	MINIMUM WALL THICKNESS,(e) mm	SDR	OVALITY
1	20	3.0	11	IS-14885: 2001
2	32	3.0	11	IS-14885: 2001
3	63	5.8	11	IS-14885: 2001
4	125	11.4	11	IS-14885: 2001

- Length of Pipes

The required minimum length of straight pipes and coils / reels shall be as Follows:

Nominal Diameter (mm)	Packing Length (m)	Straight Length (m)
20	200,Roll	-
32	150,Roll	-

	STANDARD SPECIFICATION FOR SUPPLY OF MDPE PIPES	Document No.	Rev
		VPC-SS-PL-0025	1
		Page 5 of 9 Digitally signed by RAMAKANT TIWARI	

63	100,Roll	-
125	50,Roll	-

- Method of Measurement

The method of measurement of outside diameter, wall thickness, length, ovality etc. of pipe shall conform to IS-14885: 2001 or equivalent code/standards.

7.0 TOLERANCE

- ❖ Tolerances for Random Length of Pipes

- Tolerances for each rolled pipes - 0/+0.5m
- Tolerances for each straight pipes - 0/+0.05m

- ❖ Tolerances on Nominal wall thickness at any points of pipe shall be in accordance with IS-14885: 2001 or equivalent codes / standards.

8.0 COLOR

The pipe shall be of YELLOW colour, when the pipe shall be manufactured from PE-80 grade of raw material.

9.0 MARKING

- ❖ Owner's name as Client to be marked on each pipe.
 - All pipes shall be permanently and legibly marked along their length with a legend, which shall be impressed to a depth of not more than 0.15 mm.
 - Marking details shall be formed in such a way that marking does not initiate cracks or other type of failure and in such a way that with normal storage weathering and processing and permissible method of installation use legibility shall be maintained for the pipe
- ❖ The embossing for yellow pipe shall have black base. Height of character shall be uniform and at least as given below:
 - a) 3 mm for pipe less than 90 mm nominal size.
 - b) 5 mm for pipe greater than 90 mm nominal size.
- ❖ Legend shall be repeated at intervals of 1 m and shall consist of following Information's:
 - a) Manufacturer's identity name or trade name,
 - b) Material and designation
 - c) Batch no. or lot no
 - d) Internal fluid
 - e) SDR
 - f) Reference of standard

10.0 QUALITY ASSURANCE PLAN (QAP)

Vendor to submit their own QAP along with offer based on indicative QAP enclosed in this tender. However, the same QAP shall be submitted for approval to the Owner/ Owner's representative.

11.0 TYPE TEST CERTIFICATE

Vendor to submit Type Test Certificates as per IS-14885: 2001 along with the offer.

12.0 FINISH / DEFECT LIABILITY

The internal and external surfaces of the pipes shall generally be smooth, clean and free from cavities and other surface defects, which may affect pipe performance. The pipe ends shall be cut cleanly and square to the axis of the pipe and shall be within the tolerances of ends. Defect liability period shall be 24 months from last date of delivery of pipes.

13.0 FIRST LOT / FIRST CONSIGNMENT LIABILITY

Vendor shall supply 1st Lot / 1st Consignment from their Warehouse / Store subject to following tests of at least one sample from that lot / consignment duly witnessed by Client / PMC's Representative:

- Hydrostatic Strength at 80°C for at least 165 hr. as per Cl. 8.1, IS-14885.
- Elongation at break 350 percent (Min.), as per Cl. 8.7, IS-14885.

14.0 SUPPLY, PACKAGING, HANDLING TRANSPORTATION AND STORAGE OF PE-80 PIPES

Packaging shall be done in Hessian cloth (Jute) with polyethylene sheet wrapped around the pipe to avoid direct sunlight and facilitate out-door storage. Packing size to be mentioned to ensure uniformity in delivery conditions of the pipe being procured Bidder shall submit the packaging details during offer and also complied with at the time of delivery. Manufacturer shall make an arrangement for unloading of pipes at Owner's premises.

15.0 DOCUMENTS TO BE SUBMITTED ALONG WITH BID

All Relevant Documents like BIS Certification, Catalogue Etc. to be Submitted Along With the Bid.

REFERENCES: AMENDMENTS TO THE CLAUSES OF IS-14885:2001

1. TERMINOLOGY

1.1 Lot of Batch of Compound

By lot of batch of compound is meant a homogeneous quantity of PE compound of same origin of particular brand.

The lot must be registered under a single identification number (lot No.) which leaves no doubt as to the origin, identity & date of manufacture of the compound.

2. MATERIAL

2.1 Polyethylene Compound

Polyethylene compound used in manufacture of pipes shall not contain following:-

Recycled Materials

Mixture of different material

	STANDARD SPECIFICATION FOR SUPPLY OF MDPE PIPES	Document No.	Rev
		VPC-SS-PL-0025	1
		Page 7 of 9 Digitally signed by RAMAKANT TIWARI Date: 2025.10.13 18:20:32 IST	

3. Other Materials

Addition of complementary materials and I or mixture of different materials by the pipe manufacturer is forbidden.

4. PERFORMANCE REQUIREMENTS

4.1 THERMAL STABILITY TO OXIDATION

The Maximum admissible decrease in the oxidation induction time measured on a pipe sample compared to that measured on the raw material shall not exceed 20% of the latter.

5. SAMPLING, FREQUENCY OF TEST AND CRITERIA FOR CONFORMITY

5.1 Acceptance Tests

5.1.1 LOT

All pipes of the same size, same pressure rating and also manufactured essentially under similar conditions of manufacture i.e. made in a continuous process by the same extrusion machine and from the same Lot of batch of compound shall constitute a lot.

6. ANNEXURE – K, (CLAUSE – 11 OF IS-14885): SUPPLY, PACKAGING, HANDLING AND TRANSPORTATION OF POLYETHYLENE PIPES FOR GAS TRANSMISSION

K.1 SUPPLY

Prior to execution of the order, the manufacturer must submit to the company the seals which it intends to use for all the types of pipes ordered. The seals shall preferably be made of PE or material which does not adulterate polyethylene. Metal and PVC seals are not permitted. The seals must be able to withstand storage terms as guaranteed in Clause K6: STORING (of MDPE Pipe) of this Annexure-K and also to withstand handling during installation. They must not be brittle or sharp and the materials, shapes and dimensions thereof must be such that they cannot fully penetrate inside the pipes. They are of the internal plug type for all pipes supplied in straight lengths, and or pipes rolled in coils or on reels, the seals may be caps.

All seals are fitted with valve to prevent pressurization or depressurization of the pipes, depending on climatologically temperature cycles. In theory, they are placed on the pipes immediately after completion of the manufacturing tests, but before storage of the pipes. In the event of acceptance, the pipe plugs are removed and replaced by the supplier. The seals cannot be recycled after the pipes have been installed. Their removal on site should not require the use of special tools.

PE can be delivered in straight length or coils, transported and stored. Care should be taken to maintain the coil diameter at or above the specified minimum to prevent deformation. Coiled pipe should be contained on a dispensing reel. The pipe should be wrapped with non-transparent PE films of 100 mm gauge to protect from ultra violet rays.

K.2 HANDLING

PE pipe is relatively light and flexible however, it is susceptible to damage from sharp objects and stones. It should not be dragged, dropped or subjected to rough handling during loading or unloading, transport, storage or actual installation.

K.3 TRANSPORTATION

	STANDARD SPECIFICATION FOR SUPPLY OF MDPE PIPES	Document No.	Rev
		VPC-SS-PL-0025	1
		Page 8 of 9 Digitally signed by RAMAKANT TIWARI	

When being transported, care should be taken to ensure pipes are not restrained in such a manner as to cause damage to them. Sharp sections bearing against the pipes should be avoided so as to minimize the chance of indentation or scoring of the pipe wall.

Pipes with end treatment should be stacked or supported in such a way that the ends are free from loading. Pipe ends, particularly ends cut for jointing, should be given special attention at all times to ensure they are free from damage.

K.4 STORAGE

Pipes should be stored in such a manner as to prevent damage from elevated temperatures, direct sunlight and contact with chemicals.



STANDARD SPECIFICATION FOR SUPPLY OF MDPE PIPES

Document No.

VPC-SS-PL-0025

Rev

1

Page 9 of 9 Digitally signed by RAMAKANT
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Date: 2025.10.13 18:20:32 IST



**SS-MEDIUM DENSITY
POLYETHYLENE FITTINGS**

VPC-SS-PE-0026

**STANDARD SPECIFICATION FOR MEDIUM DENSITY
POLYETHYLENE FITTINGS**

0	26.11.2018	ISSUED AS STANDARD	PK	MD	AD
Rev.	Date	Description	Author	Checked	Approved



SS-MEDIUM DENSITY POLYETHYLENE FITTINGS

VPC-SS-PE-0026

TABLE OF CONTENTS

1. SCOPE
2. APPLICABLE CODES, SPECIFICATIONS AND STANDARDS
3. ABBREVIATIONS AND TERMINOLOGY
4. TECHNICAL REQUIREMENTS
5. MATERIALS
6. DESIGN
7. DIMENSIONS AND TOLERANCES
8. DOCUMENT REQUIREMENT
9. QUALITY ASSURANCE PLAN
10. MARKING
11. PACKAGING

	SS-MEDIUM DENSITY POLYETHYLENE FITTINGS	VPC-SS-PE-0026

1.0 **SCOPE**

This specification along with applicable codes and standards describes the minimum requirements for design, selection, manufacture, inspection/ testing and supply of "MDPE FITTINGS".

This specification elaborates the requirements for Electrofusion fittings in the nominal size range 16 mm to 180 mm made from PE compound used with PE pipes for supply of natural gas and to be used at operating pressure 4.0 bar(g) & operating temperature 25°C.

The material grades shall be PE80 and SDR 11.

2.0 **APPLICABLE CODES, SPECIFICATIONS AND STANDARDS**

EN 1555-1: Plastics piping systems for the supply of gaseous fuels- Polyethylene (PE) - part 1: General

EN 1555-2 / ISO 4437-2 / IS-14885: Plastics piping systems for the supply of gaseous fuels- Polyethylene (PE)

EN 1555-3: Plastics piping systems for the supply of gaseous fuels- Polyethylene (PE) - part 3: Fittings

EN 1555-5, Plastics piping systems for the supply of gaseous fuels -Polyethylene (PE)- Part 5: Fitness for purpose of the system

EN 1555-7: Plastics piping systems for the supply of gaseous fuels- Polyethylene (PE) - part 7: Guidance for assessment of conformity

EN 1716, Plastics piping systems — Polyethylene (PE) tapping tees — Test method for impact resistance of an assembled tapping tee

ISO TR 13950:1997 or latest edition: Plastics pipes and fittings - Automatic recognition systems for Electro fusions

ISO/IEC 16390:1999 or latest edition: Information technology – Automatic identification and data capture techniques – Bar code symbology specification- Interleaved 2 of 5

EN ISO 17778, Plastics piping systems — Fittings, valves and ancillaries' — Determination of gaseous flow rate/pressure drop relationships

EN ISO 1133, Plastics — Determination of the melt mass-flow rate (MFR) and the melt volume-flow rate (MVR) of thermoplastics

EN ISO 3126, Plastics piping systems — Plastics piping components — Measurement and determination of dimensions

ISO 228-1, Pipe threads where pressure-tight joints are not made on the threads — Part 1: Dimensions, tolerances and designation

	SS-MEDIUM DENSITY POLYETHYLENE FITTINGS	VPC-SS-PE-0026

PNGRB and other referrals in the above applicable codes.

3.0 **ABBREVIATIONS & TERMINOLOGY**

d_n / d_o	: Nominal Outside Diameter
e_n	: Nominal Wall Thickness
SDR	: Standard Dimension Ratio = d_n / e_n
LTHS	: Long Term Hydrostatic Strength (at 20°C for 50yrs)
LCL	: Lower Confidence Limit – Stress value (MPa) of mean LTHS
MRS	: Minimum Required Strength – min. value (in MPa) for LTHS of material
C	: Design Co-efficient – As per ISO: 12162 Table-2
σ_s	: Design Stress (= MRS/C)
MFR	: Melt Mass Flow rate – Value related to viscosity of the molten material at a specified temp. and rate of shear. (expressed in g/10min.)
D_r	: De-rating Co-efficient (Refer Table A.1, Annex A – EN 1555-5)
MOP	: Maximum Operating Pressure = $(20 \times MRS) / \{(SDR-1) \times C \times D_r\}$
EF	: Electrofusion

4.0 **TECHNICAL REQUIREMENTS**

- 4.1 The design of fittings shall be as per European Standards EN 1555-3 and the complementary particular requirement.
- 4.2 The fittings are intended to be use in gas distribution networks made of PE and Steel/GI pipes.
- 4.3 No component of the fitting shall show any signs of damage, scratches, pitting, bubbles, blisters, inclusions or cracks to an extent that would prevent conformity of the fittings to the requirements of this standard.
- 4.4 Color of the PE parts of fittings shall be black as per PNGRB.
- 4.5 Allowable pressure drop shall be as per the standard ISO 17778.
- 4.6 Any melt exudation shall not cause wire movement in electrofusion fittings such that it leads to short-circuiting, when jointed in accordance with the manufacturer's instructions. There shall be no excessive creasing of the internal surfaces of the adjoining pipes.
- 4.7 Fittings joints shall conform to EN 1555-5 and shall be leak proof.
- 4.8 **Electrical characteristics**

	SS-MEDIUM DENSITY POLYETHYLENE FITTINGS	VPC-SS-PE-0026

- a) For voltages greater than 25 V, direct human contact with energized parts shall not be possible when the fitting is in the fusion cycle during assembly in accordance with the instructions of the manufacturers of the fittings and of the assembly equipment, as applicable.
- b) The manufacturer shall state the tolerance on the electrical resistance of the fitting at 23 °C. The resistance shall not exceed the following value: [nom. value $\pm$ 10 %] + 0.1 Ω .
Note: 0.1 Ω is the assumed value of the contact resistance.
The operating voltage of the fittings shall remain 40 +_ 0.5 V.
- c) The surface finish of the terminal pins shall allow a minimum contact resistance in order to satisfy the resistance tolerance requirements. Electrofusion terminal connections shall be as per Annex A of EN 1555-3.

4.9 Mechanical characteristics

- a) Fittings shall have mechanical characteristics conforming to the requirements given in Table 4 of standard EN 1555-3.
- a) The technical descriptions of the manufacturer shall include the following information:
 - a) field of application:
 - pipe and fitting temperature limits;
 - pipe series or SDRs;
 - ovality;
 - b) assembly instructions;
 - c) fusion instructions:
 - fusion parameters with limits;
 - d) data for saddles and tapping tees:
 - the means of attachment (tools and/or under clamp);
 - Need to maintain the under clamp in position in order to ensure the performances of the assembly.
- b) Unless otherwise specified by the applicable test method, the test pieces shall be conditioned at (23 $\pm$ 2) °C before testing.
- c) Testing of fitting shall be in accordance with the test methods as specified in Table 4 of standard EN 1555-3 using the indicated parameters.
- d) Hydrostatic test pressure and minimum test period shall be as per Table-5 of EN 1555-3.

4.10 Physical characteristics

- a) Fittings shall have physical characteristics conforming to the requirements given in Table 7 of standard EN 1555-3.
- b) Thermal stability test shall be done at 200 deg. C by means of differential scanning calorimetry (DSC), considering oxygen induction time (OIT) $\geq$ 20 min.

	SS-MEDIUM DENSITY POLYETHYLENE FITTINGS	VPC-SS-PE-0026

- c) Melt mass flow rate shall be calculated at 190 deg. C by applying 5 Kg of load on test specimen. It shall be expressed in g/ 10min.
- d) Unless otherwise specified by the applicable test method, the test pieces shall be conditioned at (23 ± 2) °C before testing.
- e) Testing of fitting shall be in accordance with the test methods as specified in Table 7 of standard EN 1555-3 using the indicated parameters.

4.11 Performance requirements

When fittings are assembled to each other or to components conforming to other parts of EN 1555, the joints shall conform to EN 1555-5.

In case of wall thickness design different from that according to Table-2 of EN 1555-3, fittings and associated joints shall additionally meet the performance requirement listed in Table-6, EN 1555-3.

4.12 Electro Fusion Fitting Jointing

- a) For Electro Fusion fitting jointing an electrical resistance element is incorporated in the socket of fitting which when connected to an appropriate power supply, melts and fuses the materials of the pipe and fitting together.
- b) The effectiveness of this technique depends on attention to the preparation of the jointing surfaces, in particular the removal of the oxidized surface of the pipe over the socket depth and ensuring the jointing surface are clean. If ovality causes gap between concentrically located pipe and the fitting to exceed 1% of the pipe OD after re-rounding to ensure correct welding. If the gap still exceeds 1% of the pipe OD after re-rounding then a check should be made of the pipe OD dimensions to determine if it meets specification.
- c) The maximum gap between eccentrically located pipe and fitting i.e. pipe touching fitting at one point must not exceed 2% of the pipe OD.
- d) Sometimes coiled pipes may be too oval to fit into couplers, or the end of the pipe may make the alignment of the ends impossible. In such circumstances the use of a mechanical pipe straightener or rounding tool is necessary.

4.13 Electro-Fusion Saddle Jointing

- a) For Electro Fusion fitting jointing an electrical resistance element is incorporated in the socket of fitting which when connected to an appropriate power supply, melts and fuses the materials of the pipe and fitting together.
- b) The effectiveness of this technique depends on attention to the preparation of the jointing surfaces, in particular the removal of the oxidized surface of the pipe over the socket depth and ensuring the jointing surface are clean.

	SS-MEDIUM DENSITY POLYETHYLENE FITTINGS	VPC-SS-PE-0026

- c) Method of holding the tapping tee saddle during the fusion cycle are used namely top loading and under clamping space around the pipe. In a trench a minimum clearance of 150 mm is required.

4.14 Conditioning Period

Refer below table (Table-1 of ISO 11413) for minimum conditioning required for joints.

Nominal wall thickness, e_n Mm	Minimum conditioning period H
$e_n < 3$	1
$3 \leq e_n < 8$	3
$8 \leq e_n < 16$	6
$16 \leq e_n < 32$	10
$32 \leq e_n$	16

5.0 MATERIALS

- 5.1 The PE compound from which the fittings with electrofusion socket are made shall conform to EN 1555-1.
- 5.2 The PE compound of the fittings shall be made only from virgin material conforming to EN 1555-1. PE compound shall be cadmium free pigment compound.
- 5.3 All parts of the fittings in contact with the gas stream shall be resistant to the gas, its condensates and other occurring substances such as dust.
- 5.4 The PE fittings made from below listed material are forbidden:
- Use of recycled materials
 - Mixture of different materials
 - Addition of complementary materials
- 5.5 The material and constituent elements used in marking of fittings (including elastomers, greases and any metallic part, if used) shall be resistant to the external and internal corrosion and shall have life expectancy under following conditions at least equal to the PE pipes with which they are intended to be used.
- During storage
 - Under the effect of the gas conveyed
 - With respect to the services environment and operating conditions
 - Fittings material in contact with the PE pipe shall not adversely affect pipe performance or initiate stress cracking.
- 5.6 All metal parts susceptible to corrosion shall be adequately protected.

	SS-MEDIUM DENSITY POLYETHYLENE FITTINGS	VPC-SS-PE-0026

- 5.7 When dissimilar metallic materials are used which can be in contact with moisture, steps shall be taken to avoid the possibility of galvanic corrosion.
- 5.8 Greases or lubricants shall not exude onto fusion areas, and shall not affect the long-term performance of fitting materials. Other materials conforming to 4.2.1 of EN 1555-3 may be used provided that it is proven that the fittings conform to this standard.

6.0 **DESIGN**

Fittings shall be designed for system operation at the pressures given in below table.

Material	M.R.S. MPa	LCL (200C, 50Yrs 97.5%) MPa	Maximum Allowable Operating Pressure	Operating Voltage
PE 80	8.0	10.00 < LCL < 11.19	7.0 bar	40 +_ 0.5V

Fittings shall be free from cracks, voids, blisters, distortion, dent or other defects.

Fittings shall be capable of being fusion jointed to pipes using control boxes. The fittings shall exhibit the strengths and fusion compatibility with pipes of respective sizes.

Each fitting shall be bar coded which shall conform to ISO/TR 13950:1997 & ISO/IEC 16390:1999 or latest edition's and shall have a permanent fusion indicator.

Heating coil design shall be such that it should not be damaged during assembly leading to short circuit of heating coil.

Electrofusion Jointing:

PE pipes, fittings and valves intended to be used for jointing by electrofusion shall be prepared and assembled in accordance with ISO 11413. The conditions for the preparation of the joints are given in clause 4.2.3 of EN 1555-5 for the assessment of fitness for purpose of electrofusion joints.

For joints with electrofusion saddle fittings, the electrofusion saddle fitting shall be fused to the pipe, while it is pneumatically pressurized to the allowable maximum operating pressure. The pipe shall be cut immediately after the manufacturer prescribed cooling time has elapsed.

These joints with electrofusion saddle fitting should be prepared taking into consideration national safety regulations.

For straight equal electrofusion socket fittings (couplers) test joints on selected diameters out of the product range shall be prepared with a gap of $0.05d_n$ between the pipe end and the maximum theoretical depth of penetration of the fitting, where for diameters greater than 225 mm the adjoining pipes shall be arranged to provide the maximum angular deflection possible for the fitting, limited to 1.5° .

	SS-MEDIUM DENSITY POLYETHYLENE FITTINGS	VPC-SS-PE-0026

6.1 Electrofusion Socket Fittings

Electrofusion Socket Fittings shall incorporate a method of controlling pipe penetration within each socket. The inner cold zone of each socket shall not be less than $(0.1 d + 5)$ mm for sizes upto 125 mm & $0.1 d$ for sizes greater than 125 mm.

Depth of penetration (L1) and Fusion zone length (L2) shall be as per figure-1 & Table-1 (Clause 7.1) of SS.

- a) Elbow/Bends: Both ends of Elbow/Bends shall be electrofusion type with integral stop.
- b) Coupler: Both ends of coupler shall be electrofusion type with integral stop.
- c) Reducer: Reducer ends shall be electrofusion type with integral stop.
- d) Cap: Caps shall be electrofusion end type for leak proof termination of line.
- e) Equal Tee: Main/Header ends of tee shall be electrofusion type. Branch end shall be plain.

6.2 Tapping Tees & Saddles

Tapping Tees and Saddle shall be Wrap Around type for branch connection for ensuring proper alignment and better fusion process.

The tapping tees shall provide a means of cutting through the pressurized main pipe and allowing the gas flow into the outlet pipe. Internal cutter shall be of SS material.

Branch End shall be plain.

Dimensions H, H1, H2 and L shown in figure 2 of SS shall be as per manufacturer standard.

6.3 Transition Fittings

Transition fitting shall be seal tight, pull out resistant and have greater tensile value than that of PE part.

Ends for transition fittings other than electrofusion shall be as per below requirement:

Table – A1

Transition	Size	PE End	Steel / GI End Connection	Min. Length (mm) End to End	Min. Req'd. Steel Length for BE
PE to SS	20mm x 1/2"	EF	Threaded End	80	-
PE to GI	32mm x 3/4"	EF	Threaded End	80	-
PE to CS	32mm x 1"	EF	Threaded End	80	-
PE to CS	63mm x 2"	Plain End	Bevel End	470	400
PE to CS	125mm x 4"	Plain End	Bevel End	570	480
PE to CS	180mm x 6"	Plain End	Bevel End	590	485

6.3.1 PE Pipes to Bevel Ends

	SS-MEDIUM DENSITY POLYETHYLENE FITTINGS	VPC-SS-PE-0026

To make connection between steel pipe and MDPE pipe, specially fabricated transition pieces consisting of Steel and MDPE pipes should conform to the following requirements:

- a) MDPE pipe with one end plain should conform to the specification (EN 1555-2 / ISO 4437-2 / IS-14885/ SDR 11).
- b) MDPE end shall be compatible (thickness/ nominal size) to the interconnecting PE pipes of the network.
- c) Steel end (CS/SS) shall be compatible (grade of material/ thickness/ nominal size) to the interconnecting steel pipes of the network.
- d) Steel end of the fitting should be beveled for welding. Angle of bevel should be $30^\circ + 5^\circ$.
- e) Steel and MDPE pipes should be so jointed in the factory so as to have a monolithic joint which is leak free and should be mechanically as strong as or stronger than the PE Pipe.
- f) Minimum required length of steel for transition fitting is specified in Table A1. Vendor to provide adequate length so that the PE part of the fitting / pipe will not get effected during welding at site.
- g) Joint between metallic and non-metallic part of transition fitting shall be leak-proof.

6.3.2 PE Pipes to Threaded Ends

- a) Transition fitting for jointing of MDPE Pipes conforming to specification SDR 11, IS: 14855/ ISO: 4437/ EN1555-2.
- b) The transition fittings shall be electrofusion type for PE connection, NPT Female threading conforming to ANSI B 1.20.1.
- c) Steel end (CS/SS) / GI shall be compatible (grade of material/ thickness/ nominal size) to the interconnecting pipes of the network.
- d) Joint between metallic and non-metallic part of transition fitting shall be leak-proof.

7.0 DIMENSIONS AND TOLERANCES

Dimensions shall be measured in accordance with EN ISO 3126 at $(23 \pm 2)^\circ\text{C}$, after being conditioned for atleast 4 h. The measurement shall not be made less than 24 h after manufacture.

7.1 For Electro Fusion Socket Fittings

For electrofusion sockets (see Figure 1) having a nominal diameter given in Table-1, the socket diameter and lengths shall be given by the manufacturer and shall conform to Table 1 with the following conditions:

- a) $L_3 \geq 5 \text{ mm}$;
- b) $D_2 \geq d_n - 2e_{\min}$

Where,

$e_{\min}$ is the minimum wall thickness specified for the corresponding pipe conforming to EN 1555-2;

D_1 is the mean inside diameter in the fusion zone measured in a plane parallel to the plane of the mouth at a distance of $L_3 + 0.5L_2$ from that face;

	SS-MEDIUM DENSITY POLYETHYLENE FITTINGS	VPC-SS-PE-0026

D_2 is the bore, which is the minimum diameter of the flow channel through the body of the fitting;

L_1 is the depth of penetration of the pipe or male end of a spigot fitting. In case of a coupling without stop, it is not greater than half the total length of the fitting;

L_2 is the heated length within a socket as declared by the manufacturer to be the nominal length of the fusion zone;

L_3 is the distance between the mouth of the fitting and the start of the fusion zone as declared by the manufacturer to be the nominal unheated entrance length of the fitting.

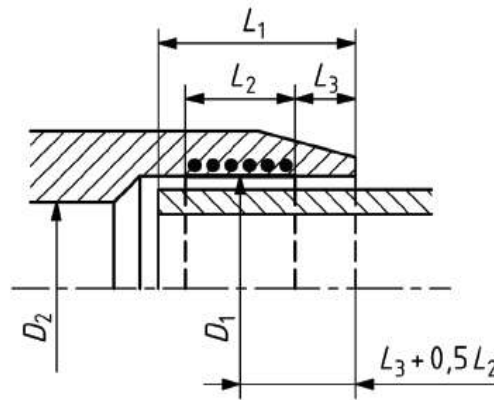


Figure 1 — Dimensions of electrofusion socket fittings

The mean inside diameter of the fitting in the middle of the fusion zone (see L_1 in Figure 1) shall be not less than d_n .

Table - 1

Nominal Diameter d_n (mm)	Depth of Penetration L_1 , min.			Fusion Zone L_2 , min.
	Intensity Regulation	Voltage Regulation	L_1 , max.	
16	20	25	41	10
20	20	25	41	10
25	20	25	41	10
32	20	25	44	10
40	20	25	49	10
50	20	28	55	10
63	23	31	63	11
75	25	35	70	12
90	20	25	41	10
110	32	53	82	15
125	35	58	87	16
140	38	62	92	18
160	42	68	98	20
180	46	74	105	21

	SS-MEDIUM DENSITY POLYETHYLENE FITTINGS	VPC-SS-PE-0026

The manufacturer shall declare the actual minimum and maximum values of D_1 to allow the end-user to determine their suitability for clamping and joint assembly and fitness for purpose testing in accordance with EN 1555-5.

In the case of a fitting having sockets of differing nominal diameters, each one shall conform to the requirements for the nominal diameter of the corresponding component.

7.1.1 Wall Thicknesses

In order to prevent stress concentrations, any changes in wall thickness of the fitting body shall be gradual.

- a) The wall thickness of the body of the fitting at any point, E , shall be greater than or equal to $e_{\min}$ for the corresponding pipe at any part of the fitting located at a distance beyond a maximum of $2L_1/3$ from all entrance faces if the fitting and the corresponding pipe are made from a polyethylene having the same MRS.

If the fitting is produced from a polyethylene having an MRS that is different from that of the corresponding pipe, the relationship between the wall thickness of the fitting, E , and the pipe, $e_{\min}$, shall be in accordance with Table 2.

Table 2 — Relation between fitting and pipe wall thicknesses

Pipe and fitting material		Relation between fitting wall thickness, E , and pipe wall thickness, e_n
Pipe	Fitting	
PE 80	PE 100	$E \geq 0,8e_n$
PE 100	PE 80	$E \geq e_n/0,8$

- b) In the case of a wall thickness design different from that according to a), fittings and associated fusion joints shall additionally meet the performance requirement given in Table 6 of EN 1555-3.
- c) When a fitting leaves the site of the manufacturer, the out-of-roundness of the bore of a fitting at any point shall not exceed $0.015d_n$.
- d) The dimensional characteristics appropriate to each manufacturer such as the overall dimensions or mounting dimensions shall be specified in a technical file.



SS-MEDIUM DENSITY POLYETHYLENE FITTINGS

VPC-SS-PE-0026

7.2 For Electro Fusion Saddle Tapping Fittings

Outlets from tapping tees and branch saddles shall have an electrofusion socket conforming to Clause 7.1 of SS.

The manufacturer shall specify the overall dimensions of the fitting in a technical file. These dimensions shall include the maximum height of the saddle, H , and for tapping tees the height of the service pipe, H_1 or H_2 (see Figure 2).

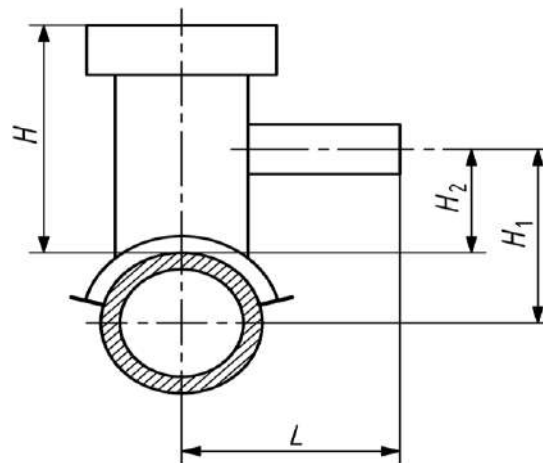


Figure 2 — Dimensions of electrofusion saddle fittings

Where,

- H height of the saddle, which comprises the distance from the top of the main pipe to the top of the tapping tee or saddle
- H_1 height of service pipe, which comprises the distance from the axis of the main pipe to the axis of the service pipe
- H_2 height of service pipe, which comprises the distance from the top of the main pipe to the axis of the service pipe
- L width of the tapping tee, which comprises the distance between the axis of the pipe and the plane of the mouth of the service tee

7.3 Dimensional Stability:

Couplers (including all forms of socket fittings):

All coupler dimensions shall conform to their specified value when the fitting has been stored for a period of 12 months at a temperature of $30 \pm 2^\circ\text{C}$.

Tapping Tees and Branch Saddle:

All tapping tee and branch saddle dimensions shall conform to their specified agreed values when the fitting has been stored for a period of 12 months at a temperature of $30 \pm 2^\circ\text{C}$.

8.0 DOCUMENT REQUIREMENT:

	SS-MEDIUM DENSITY POLYETHYLENE FITTINGS	VPC-SS-PE-0026

8.1 To Be Submitted Along with Bid

All relevant documents like detailed technical catalogue, technical deviations list (if any) along with quoted price.

8.2 Technical File:

The manufacturer of the fittings shall make availability of a technical file (generally confidential) with all relevant data to prove the conformity of the fittings to this specification. It shall include all results of the type testing and shall conform to the specification relevant technical brochure (e.g. ISO 12093 for electro fusion fittings).

The technical description of the manufacturer shall include the following information:

- a) Field of appliance (pipe and fitting temperature limits SDR's and out of roundness).
- b) Assembly instructions.
- c) Fusion instruction (fusion parameters with limits).
- d) For saddles and tapping tee
 - 1. The means of attachment (tools and/ or under clamp).
 - 2. The need to maintain the under clamp in position in order to ensure the performances of the assembly.

For electrofusion fitting, the format of the technical brochure shall conform to ISO DIS 12093.

In the event of modification of the fusion parameters, the manufacturer shall ensure that the joint conforms to this standard.

9.0 QUALITY ASSURANCE PLAN

The Quality Assurance Plan (QAP). Inspection shall be carried out as per **Annexure – I** and the vendor is to submit the plan accordingly. Vendor to submit their own QAP along with offer based on indicative QAP enclosed in this tender for approval to the Owner / Owner's representative.

	SS-MEDIUM DENSITY POLYETHYLENE FITTINGS	VPC-SS-PE-0026

10.0 **MARKING:**

Following information shall be embossed upto height of 0.15 mm onto the fitting and also in the form of bar code:

- a) Owner name as Client.
- b) Manufacturer's name and/or trademark
- c) Material and Designation
- d) Design application series
- e) The size of the fitting in mm
- f) Fusion time in seconds
- g) Cooling time in minutes
- h) Fusion parameters in BAR code
- i) Traceability code (fittings) as per standard ISO 12176-4.
- j) Number of the system standard. This information can be printed/formed directly on the fitting or on a label associated with the fitting or on an individual bag
- k) Production period, year and month

The marking shall stay legible during normal manipulation, storage and installation.

The marking shall not adversely influence the performance of the fitting and prevent the nonconformity of the fitting.

11.0 **PACKAGING:**

The fittings shall be packaged in bulk or individually protected where necessary in order to prevent deterioration. Whenever possible, they shall be placed in airtight plastic bags in card board boxes or cartons.

The cartons and/or individual bags shall bear at least one label with the manufacturer's name, date of manufacturer, type and dimensions of the part, number of units in the box, and any special storage conditions and storage.



ENERGISING QUALITY

**STANDARD SPECIFICATION
FOR HEALTH, SAFETY AND
ENVIRONMENT**

**DOC No: VPC-SS-PL-0021
Rev No : 00**



ENERGISING QUALITY

VCS PROJECT CONSULTANTS PVT. LTD.

**STANDARD SPECIFICATION
FOR
HEALTH, SAFETY & ENVIRONMENT**

VPC – SS – PL - 0021

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Contents

1.	SCOPE	3
2.	APPLICABLE SYSTEMS AND PROCEDURES	3
3.	REFERENCES	4
4.	RESPONSIBILITY & ORGANISATION	4
5.	GENERAL REQUIREMENT	4
6.	TRAINING	5
7.	TOOL BOX TALKS	5
8.	INCIDENT/ACCIDENT AND NEAR-MISS REPORTING, INVESTIGATION AND FOLLOW UP	5
9.	HAZARD IDENTIFICATION AND RISK ASSESSMENT SYSTEM (HIRA)	6
10.	SITE HSE INSPECTION/AUDIT	6
11.	FIRST AID FACILITY	7
12.	FITNESS TO WORK	8
13.	PERSONNEL PROTECTIVE EQUIPMENTS	9
14.	EQUIPMENT LIST AND INSPECTION CERTIFICATE	11
15.	HSE REQUIREMENTS AT SITE	11



1. SCOPE

This specification establishes the Health, safety and Environment (HSE) aspects to be complied with by the contractor during construction at site.

2. APPLICABLE SYSTEMS AND PROCEDURES

The reference standard for setting Quality, Health, Safety and Environment Systems and procedures will be as linked below –

- Guidelines issued by PNGRB.
- ISO 9001 – 2008 - For Quality System.
- ISO 14001 – 2004 - For Environmental Management System
- (OSHAS) 18001-2007 -For occupational health and safety management Systems.

The Occupational Health & Safety Assurance Standard (OHSAS) 18001-2007 gives requirements for an occupational health and safety (OH&S) management system. It enables an organization to control its OH&S risks and improve its performance. It provides a basis for an organization to specify its OH&S performance criteria and design the management system.

OHSAS 18001 is compatible with the ISO 9001 (Quality) and ISO 14001 (Environmental) management systems standards. This facilitates integration of quality, environmental and occupational health and safety management systems by an organization.

Organization structure of the proposed CGD project includes a position for developing, installing and maintaining (with assistance by a specialist entity) Quality Assurance (QA) and Health, Safety and Environment (HSE) systems in line with ISO 9001-2008, OHSAS 18001-2007 and ISO 14001- 2004 Standards.

Documented Standard Operating Procedures (SOP) will be prepared by the Owner/Owner's representative for CGD entity for QA and HSE, for application across the organization. Development of the SOPs and implementation of the same at construction sites, control rooms, regional and corporate offices will be followed by an internal audit to verify conformance.

The CGD Network operating entity will thereafter regularly monitor, through periodic internal and mandatory external audits, effective implementation of the SOPs at the construction sites, control rooms regional and corporate offices as per systems and procedures.



3. REFERENCES

This document should be read in conjunction with following.

- General Condition of Contract (GCC)
- Special Condition of Contract (SCC)
- Job Specifications
- Relevant IS codes, OSHAS standard
- Reporting Formats

4. RESPONSIBILITY & ORGANISATION

Health, Safety and Environment activities at site shall be under Contractor's scope. Contractor shall be responsible for implementation of HSE provisions. The nominated or designated safety engineer/ officer shall assist and perform day to day HSE work as per his advice.

5. GENERAL REQUIREMENT

- 5.1.** The contractor should follow HSE policy of owner as applicable to construction site.
- 5.2.** The contractor shall ensure that HSE requirements are clearly understood & faithfully implemented at all level, at each site.
- 5.3.** The contractor shall organize safety awareness programs regularly.
- 5.4.** The contractor shall ensure his participation in every HSE meeting called by owner/owner representative.
- 5.5.** The contractor shall conduct daily tool box talk.
- 5.6.** Contractor shall ensure that their safety supervisor must always be present at site.
- 5.7.** Contractor shall take sufficient care in moving his plants, equipment's and materials from one place to another place so that they do not cause any damage to any person or the property of the owner or any third party.
- 5.8.** Working after sunset is strictly prohibited.
- 5.9.** Hygiene requirement must be met on site by providing fresh drinking water at each site
- 5.10.** The contractor shall submit Monthly HSE reports (Form attached in ANNEXURES).



5.11. The contractor shall provide one four wheeler at site during working hour to meet any contingency.

5.12. The contractor shall adhere consistently to all provisions of HSE .In case of non- compliance or continuous failure the owner/ owner representative may impose stoppage of work for the serious HSE violation. All works shall be carried out in presence of Owner/Owner's Representative only.

6. TRAINING

The Contractor duties shall include conducting HSE training for all activities and personnel involved.

The Contractor shall ensure that their Personnel have been given the necessary HSE and work-related skills training in compliance with regulatory requirements prior to engaging the personnel for the work.

7. TOOL BOX TALKS

Contractor's Site Supervisor for specific work location shall conduct a tool box at the commencement of work on daily basis. If different team is working in different area, separate tool box talk covering location and hazard involved shall be carried out.

Each toolbox meeting shall cover the following agenda:

- Discuss safety issues of previous day
- Brief description of activities planned for the day & associated hazard
- Information & resources required to put controls in place
- Location specific hazard and instructions.
- Requirements Open

It is the responsibility of supervisor to convey PPE requirement to all workers and ensure compliance of the same and shall be checked during tool box talk before embarking on work.

Tool box talk report shall be prepared and kept at site within one hour of talk and it must be signed by all attendee to ensure participation of all in the talk. Tool box report shall be submitted to CONSULTANT/ OWNER

8. INCIDENT/ACCIDENT AND NEAR-MISS REPORTING, INVESTIGATION AND FOLLOW UP

8.1. Incident/Accident and Near-Misreporting

All incidents/accidents must be reported immediately. A report should be prepared by the Supervisor and submitted to the Site Manager within 12 hours of the occurrence and shall serve as a source for education of employee to prevent reoccurrence of similar



incident/accident.

Contractor shall submit the Initial report of all Accidents/Incidents within 12 hrs.to Owner / Consultant and detail report within 24 hrs. For serious incidents and near misses, with the potential for fatality, serious injury or significant environmental or material damage, Contractor shall notify Owner/Consultant without delay and within twenty four (24) hours.

8.2. Incident/Accident Investigation

All incidents/accidents must be reviewed and analyzed to establish root causes and type of injury, trends and practices.

Investigation shall begin promptly after the occurrence of the incidents/accidents. The completed incidents/accidents investigation report shall be submitted to the Contractor Site Manager within 7 days of the occurrence. A copy shall be submitted to Owner/Consultant.

8.3. Follow-up

All incidents/accidents, including investigation results and recommendations, shall be discussed in the Site HSE meeting and shall be brought to the notice of employees in toolbox meetings.

Key Risks Identification and Management Risks

Working at height is a critical activity. Following hazards are associated with Working at height:

- Person Fall from height
- Material falling From height
- Slips, trips and falls
- Concealed utilities (i.e. electric cable Telephone cable, water line, Drainage line}
- Electric shock

9. HAZARD IDENTIFICATION AND RISK ASSESSMENT SYSTEM (HIRA)

The Contractor shall prepare and implement comprehensive HIRA as part of the HSE Management Plan prior to Commencement of the work or services and during the execution of the work also.

10. SITE HSE INSPECTION/AUDIT

All Site HSE checklists/Inspection reports shall incorporate a follow-up procedure to ensure that any recorded HSE violations have been promptly attended to in a satisfactory manner.

The Site HSE Inspections/Audit shall be planned by the Contractor.



11. FIRST AID FACILITY

The contractor shall provide the first aid box at all the sites. The content of the first aid box shall include the following items:

- Twenty-four small sterilized dressings.
- Twelve medium size sterilized dressings.
- Twelve large size sterilized dressings.
- Twelve large size sterilized burn dressings.
- Twelve (15 gin) packets of sterilized cottonwood.
- One (200 ml) bottle of certified solution (1 per cent) or a suitable antiseptic solution.
- One (200 ml) bottle of mercurochrome (2 per cent) solution in water. (viii) One (200 ml) bottle of salt-volatile having the dose and mode of administration indicated on the label.
- One pair of scissors
- One roll of adhesive plaster (6 cm x 1in).
- Two rolls of adhesive plaster (2 cm. x 1in).
- Twelve pieces of sterilized eye pads in separate sealed packets.
- One polythene wash bottle (500 cc) for washing eyes.
- Twelve roller bandages 10 cm wide.
- Twelve roller bandages 5 cowhide.
- Six triangular bandages.
- One tourniquet.
- A supply of suitable splints.
- Two packets of safety pins.
- Kidney tray.
- One copy of first-aid leaflet issued by the Directorate General of Factory Advice Service and Labor Institutes, Government of India, Bombay.

All the content shall be kept in clearly marked and easy to remove cartons stored in such a manner that there is no rattling or spilling over even when the container is being moved. Whenever applicable the cartons shall bear instructions for use, dosage etc.



12. FITNESS TO WORK

The objective of Medical Assessment for Fitness to Work (FTW) is to assess health of employees in relation to their specific jobs such as working at height, to ensure they could perform required task without risk to health and safety.

The Contractors workers (as per the above category) shall under go through FTW prior to start work at site. It will be the responsibility of the Contractor to ensure compliance to this requirement.

12.1. Medical Examination requirement for working at height

Below specific requirements are must for Medical examination of Contractors employees working at height:

- History of Epilepsy.
- Blood Pressure.
- ECG+ any History of any Seizures.
- Vision Check.
- Blood Sugar (fasting &PP).
- And other general tests.
- Physical Examination- to confirm the person is physically fit.
- Blood Group (One time Test).
- General check about fear of Heights.

12.2. Other Requirements:

- Contractor to ensure that persons involved in working at height are trained, certified and having Valid I Card.
- Carry out tool box talk before starting of the work.
- Carry out site specific risk assessment and identify risk control measures for specific site work. (Ref doc).
- Ensure that persons are physically & mentally fit for working at height.
- Ensure that equipment shall be used as per approved standard for working at height.
- Ensure that equipment shall have facility of emergency rescue operation.
- Ensure person involved in working at height are trained in emergency rescue



operation.

- Ensure that all equipment and safety devices used are inspected, certified by competent authority & valid & suitable for use.
- Quality conformance shall be carried out prior to start of work for working at height equipment's.
- Life cycle of equipment shall be checked
- In case of any part of equipment is found damaged or defective, it will be destroyed. "Working at height equipment's shall never being repaired". The Records, showing reasons for all the defective and damaged material shall be available and shall be stored separately at Contractor's yards.
- Ensure that Personnel Protective Equipment are inspected & in good condition
- Ensure that equipment used is within Safe working load mentioned on equipment.
- Ensure all tools are secured or kept in Tool kit / bag and there are no loose objects or tools.

13. PERSONNEL PROTECTIVE EQUIPMENTS

The contractors shall provide sufficient numbers of following personnel protective equipment's (PPE's) to workmen and supervisors/engineers to use them properly at work site.

Following five numbers of Personnel protective equipment's are identified as MANDATORY for all.

- Safety Helmet
- Coverall
- Safety shoes/footwear
- Safety Glasses
- Hand Gloves (as per job requirement) Other PPEs shall be as per job requirement like Work at height- Full body harness (PETZL or equivalent make), Life line, Safety Net Arc Welding – Welding face shield Grinding – Grinding face shield Height work – Full Body harness (above 2 meters) Contractor to ensure proper use and selection of protective clothing / equipment for specialized jobs.

PPE's to be used shall be as per following Specification:

IS : 2925 – 1984 : Industrial Safety Helmets.

IS : 4770 – 1968 : Rubber gloves for electrical purposes



IS : 6994 – 1973 (Part – I)	: Industrial Safety Gloves (Leather& Cotton)
IS : 1989 – 1986 (Part – I &	: Leather safety boots and shoes
IS : 3738 – 1975	: Rubber knee boots
IS : 5557 – 1969	: Industrial and Safety rubber knee boots
IS : 6519 – 1971	: Code of practice for selection, care and repair of Safety footwear
IS : 11226 – 1985	: Leather Safety footwear having direct molding sole
IS : 5983 – 1978	: Eye protectors
IS : 9167 – 1979	: Ear protectors.
IS : 3521 – 1983	: Industrial Safety belts and harness



Technical Standard for working at height equipment's shall be as per following standard:

Quality Standards

Sr. No.	Name of equipment's	EN Standard
1	Energy absorbers	365
2	Slings	566
3	Retractable type fall arresters	360
4	Guide Type fall arresters on a rigid	353-1
5	Connectors	362
6	Dynamic mountaineering rope	892
7	Descended device	341
8	Anchor device Type-A/B	795
9	Fall arrester harness	361
10	Sit harness	813
11	Lanyards	354
12	Pulleys	12278
13	Fall arrester system	363
14	Work positioning belt	358

14. EQUIPMENT LIST AND INSPECTION CERTIFICATE

Equipment list must be made available and must be certified for safety as per the requirement of Factory Act. Tools and Tackles should be calibrated from the approved agency only.

List of Tools and Tackles

Item	Inspection/Calibration Date
Full body harness	Once in six Month
Rope Grab fall arrestor	Once in six Month
First Aid Box	Once in Month
Fire Extinguisher (10 Kg.)	Once in a Year
Extension board(without cable Joint with Socket) with Circuit Breaker	Monthly
Nylon tie line for tools	Once in a day

15. HSE REQUIREMENTS AT SITE

Contractor may conduct survey to assess the requirement of GI riser for high rise building.

For Work at Height: Contractor shall provide PETZL or equivalent system/metallic



scaffolding as a working platform and full body harness with self-locking arrangement. Full body harness with self-locking arrangement shall be used for ascending/descending/work rest.

PETZL system or equivalent system/metallic scaffold should comply with relevant IS/EN/BS standard.

Only certified trained plumber undergone practical training on work at height shall be deployed.

15.1. Any working at height related activities has to be carried out with Permit system.

Work at Height

Working at Height is performing work at height where workers can fall 1.8m or more from where they stand or sit to perform work. This includes gaining access to working at height if there is a risk of falling 1.8m or more.

Examples of Working at Height are:

- Working on temporary platform more than 1.8m high
- Working on top of vehicles/tankers or building more than 1.8 m high Risk of Working at Height
- Fall from height
- Falling objects

Safety net, fall arrest system and two lanyard full body harness when working at height While working at height, all loose tools shall be kept inside a container and good housekeeping shall be maintained.

All Working at Height shall comply with Working at Height Procedures Safety Net System.

"Safety net systems" Safety net systems and their use shall comply with the following provisions.

Safety nets shall be installed as close as practicable under the walking/working surface on which workers are working, but in no case more than 30 feet (9.1 m) below such level. When nets are used on bridges or similar kind, the potential fall area from the walking/working surface to the net shall be un obstructed.

Vertical distance from working level to horizontal plan of net	Minimum required horizontal distance of outer edge of net from the edge of the working surface
Up to 5 feet	8 feet
More than 5 feet up to 10 feet	10 feet.
More than 10 feet	13 feet



- Safety nets shall be installed with sufficient clearance under them to prevent contact with the surface or structures below when subjected to an impact force.
- Safety nets and safety net installations shall be drop-tested at the jobsite after initial installation and before being used as a fall protection system, whenever relocated, after major repair, and at 6-month intervals if left in one place. If drop test not possible designated competent person shall certify that the net and net installation is in compliance with the requirement by preparing a certification record prior to the net being used as a fall protection system. The certification record must include an identification.
- Determined that the identified net and net installation were in compliance and the signature of the person making the determination and certification. The most recent certification record for each net and net installation shall be available at the jobsite for inspection.
- Defective nets shall not be used. Safety nets shall be inspected at least once a week for wear, damage, and other deterioration. Defective components shall be removed from service. Safety nets shall also be inspected after any occurrence which could affect the integrity of the safety net system.
- Materials, scrap pieces, equipment, and tools which have fallen into the safety net shall be removed as soon as possible from the net and at least before the next work shift.
- The maximum size of each safety net mesh opening shall not exceed 36 square inches (230 cm) nor be longer than 6 inches (15 cm) on any side, and the opening, measured center-to-center of mesh ropes or webbing, shall not be longer than 6 inches (15 cm). All mesh crossings shall be secured to prevent enlargement of the mesh opening.
- Each safety net (or section of it) shall have a border rope for webbing with a minimum breaking strength of 5,000 pounds (22.2kN).
- Connections between safety net panels shall be as strong as integral net components and shall be spaced not more than 6 inches (15 cm) apart.

15.6.1 Lifeline

- Horizontal or vertical life line shall be used while working on suspended platform or similar type of platform or working at thereof/edge
- Horizontal/Vertical lifelines shall be designed, installed, and used, under the supervision of a qualified person, as part of a complete personal fall arrest system, which maintains safety factor of at least two.



- Lanyards and vertical life line shall have a minimum breaking strength of 5,000 pounds (22.2kN).
- When vertical lifelines are used, each worker shall be attached to a separate lifeline.

15.6.2 Full Body Harness

- Ensure that the full body harness must be inspected prior to use.
- Ensure that full body harness must be worn by the workmen while working at height.
- Full body harness lanyard must be anchored with a strong member.
- While climbing up or climbing down, one of the hooks of lanyard must be locked alternatively all the time.

15.6.3 Working Platform

Every working platform more than 1.8 mtr. High from which a person is likely to fall shall be of steel plates/planks/cage and shall be:

- Closely boarded, planked or plated.
- At least 700 mm wide if the platform is used as a footing only and not for the deposit/ keeping of materials.
- At least 900 mm wide if the platform is used for the deposit of materials.
- At least 1100 mm wide if the platform is used for the support of higher platform.
- Two metal/planks shall not have 25 mm gap between them the distance between two consecutive transoms or other supports on which a platform rests shall be fixed with due regards to the anticipated load and the nature of platform flooring. As a general rule such transoms shall not be placed more than 1.0 mtr. apart.

15.6.4 Scaffold

Scaffold Inspector (Project Field Officer)

This is the competent individual who shall inspect scaffolding prior to each use and perform full inspections as per the Inspection procedure. He will accept the Scaffold after ensuring the followings;

- The scaffold erected complies with legislation.
- The permissible loads per deck and the working distance between the

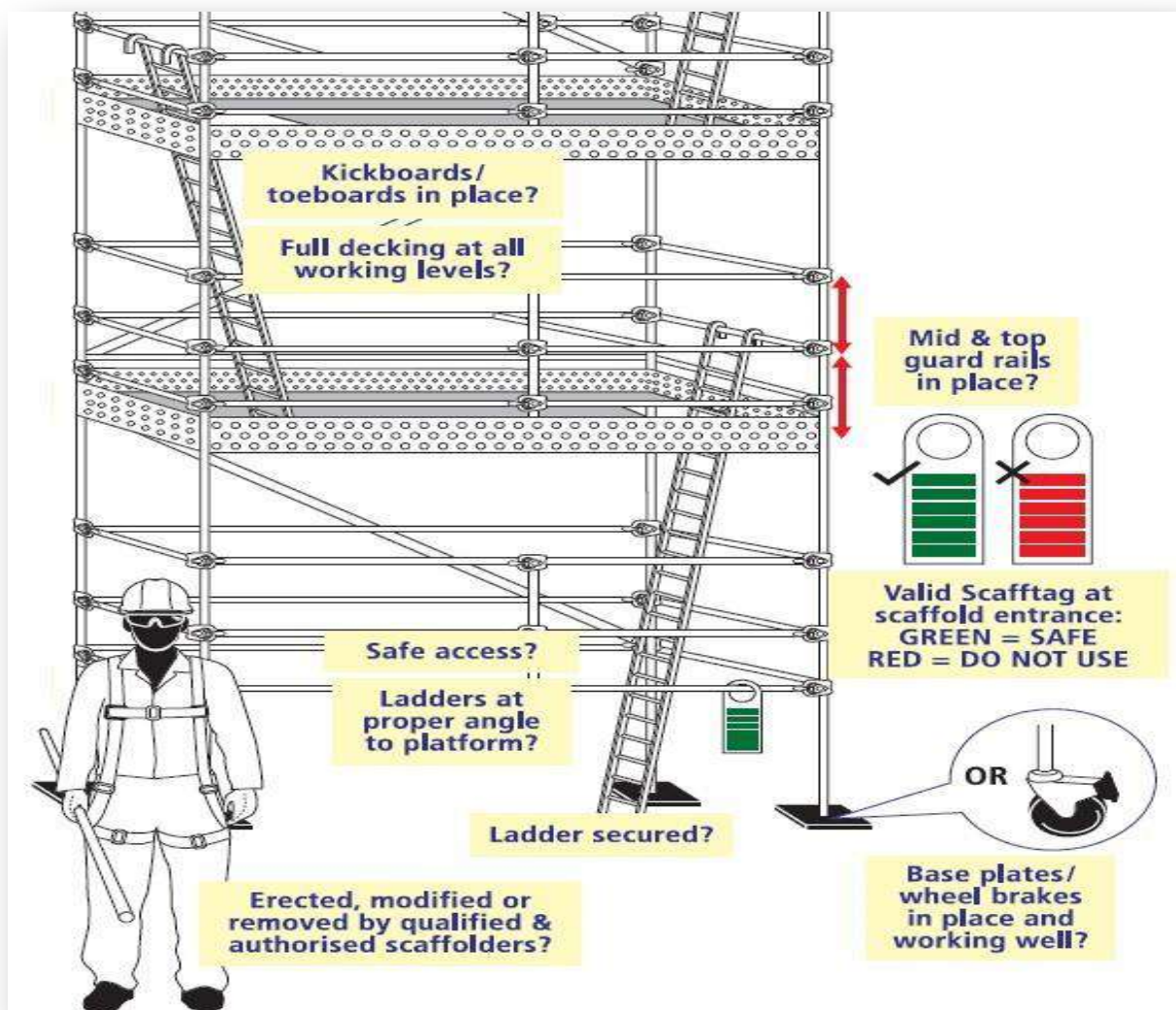


scaffold and the work surface are examined.

- Materials used for the scaffold are in a proper condition and in throughout the time it is in place.
- Existence and proper installation of collective protective equipment and means of access.
- Clear display of details of permissible loads on the scaffold.
- Acceptance is carried out prior to the scaffold being made available for the first time and is repeated after any alterations.
- Inspection is repeated at the frequency of 7 days. Issues scaffold tag (Green Tag) before its first use.

Scaffold Contractor

This refers to the company involved in the installation (erection, dismantling and alteration) and/or design of the scaffolding on behalf of CONTRACTOR.





- The erection contractor shall ensure that the scaffolding is erected in compliance with the OHSAS/IS standards. Worksite specifications and considerations shall be incorporated into any such plan.
- Ensure availability of competent staff and certified material all the time.
- Scaffolding may be erected, dismantled or altered only under the supervision of a competent individual who has received adequate specific training for the intended operations, specifically including the following:
 - Understanding the erection, dismantling and alteration plans for the scaffolding
 - Ensure PPEs and Safety at work during erection ,dismantling and alteration of the scaffolding.
 - Measures designed to prevent the risk of falling person's and objects.
 - Safety measures applicable in the event of a change in weather conditions.
 - Permissible structural load criteria.
 - Any other risk that may be entailed by erection, dismantling and alteration operations.
- Scaffold material: Safe handling, and storage.

Scaffold User

- The User shall ensure that acceptance of the scaffold has been properly carried out; green Tag is issued and provide notification of any alterations. Work from tagged scaffolds only. Comply with special conditions/additional controls noted on the access tag.
- It shall observe all restrictions on use (particularly permissible loads). Its requirements should be taken into consideration in the specifications during erection.
- Use scaffolds only for their intended purpose.
- Do not use unstable objects or makeshift devices to increase the working height of the scaffolds.
- Use portable ladders as a means of increasing the working height only after the competent person has determined that the stability of the structure has not been compromised, and adequate fall protection is in place.



- Do not straddles, stand on, or work outside of the guardrail.
- Use designed access means to descend or ascend a scaffold (stairs, attached ladder, or specially designed end frames). Do not use cross bracing or side rail
- Keep only the tools and materials on the platform that are necessary to perform the task. Control all slipping and tripping hazards by removing or securing the tools/materials.
- Do not modify or remove a scaffold system/component or status tag.
- Notify supervision immediately if a scaffold is damaged, weakened, or otherwise deficient.
- Scaffold users/ Scaffold erectors shall use IS and EN standard double lanyard safety harness with absorbent.

Inspection Points

To ensure the integrity and proper installation of scaffolding, a certain number of points shall be inspected. Inspection of these points ensures a basic level of safety. Following fundamental inspection points are as follows:

- Environment and location
- Supports and soleplates
- Structure and posts
- Decks
- Scaffold Capacity Standards
- Working levels
- Access
- Signs and signage

Mobile Scaffolding

- Mobile scaffolds are identical in design to fixed scaffolds, except that their tubular structure is lighter and in terms of support, the wheels do not offer the same load-bearing area as footplates on fixed scaffolds.
- Erection is simple and shall be carried out using personal protective equipment. Lastly, during erection, dismantling and use, the brakes shall also be applied. Care should be taken to ensure that mobile scaffolds are installed on flat surfaces.



- Mobile scaffolds are highly practical for short jobs at relatively low heights.
- Acceptance is carried out after erection has been completed.
- They are moved as the work being carried out progresses. No fresh acceptance is required after each move, but the workstation shall be verified (working distance, brakes applied)
- A freestanding scaffold shall be considered safe when the total height is equal to or less than four times the minimum or least base dimension.
- Rules for use
 - Do not extend the base to increase the height.
 - Brace each frame level as per the manufacturer's instructions.
 - Do not raise work surfaces by placing decks on rails or midribs.
 - Do not climb on the guardrails or other structural components.
 - Observe the manufacturer's guidelines governing the installation of brackets, material hoists etc.
- Stay clear of power lines and observe safety distances. (If any)

Scaffold safety

The following safety tips are as guidelines in avoiding job-site situations that could prove dangerous to scaffold workmen.

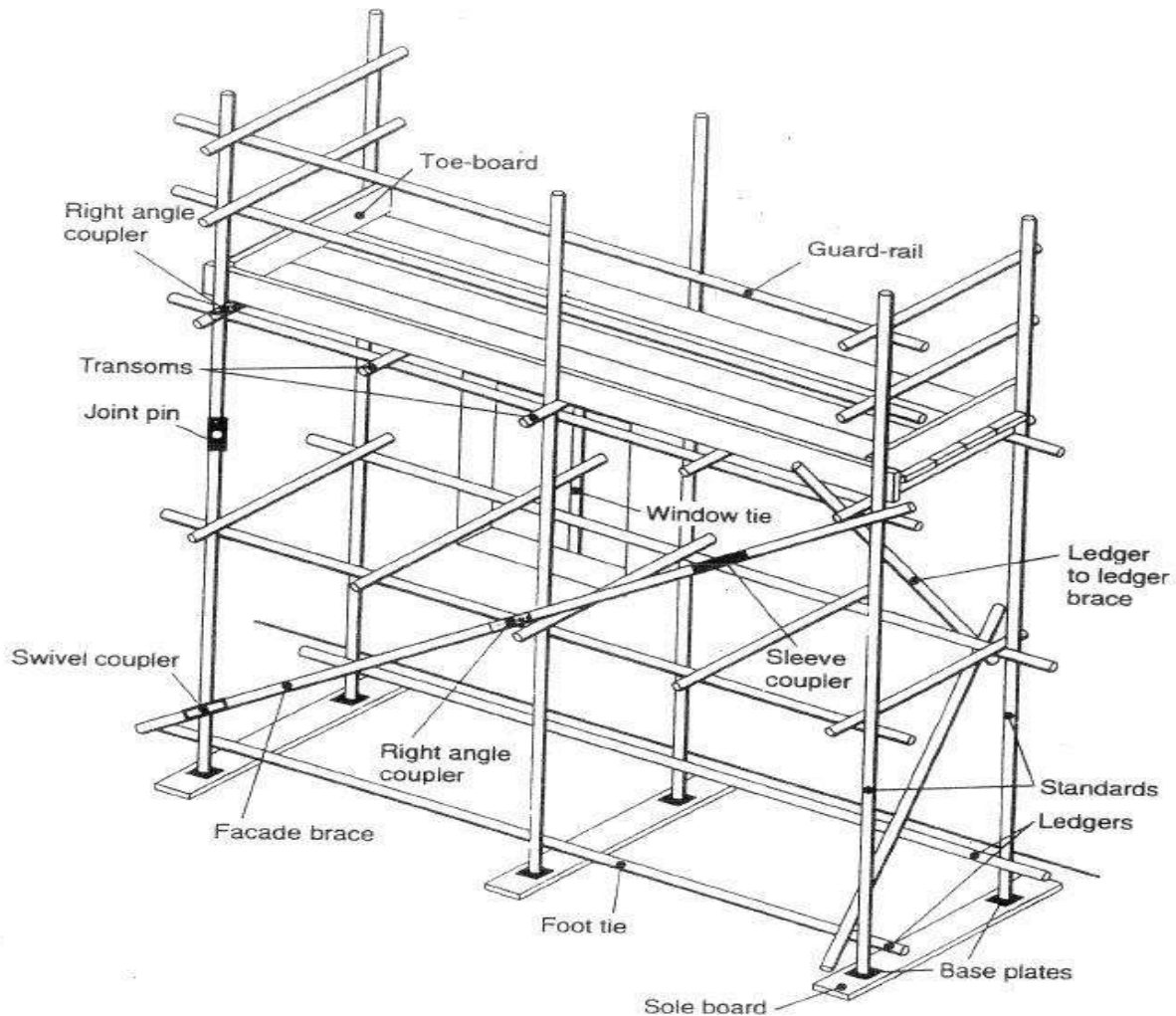
- The Scaffold to the Building: Scaffolding should be tied to the structure using heavy wire or tie-in devices. The first vertical tie should be at the maximum height of 4 times the narrowest base dimension. Additional ties are not to exceed 26 feet vertically. Maximum horizontal distance between ties is not to exceed 30feet.
- Don't Overload Scaffolding: Follow the safe load capacities as given by the scaffold manufacturer. There's a limit even to what steel can support. A4-to-1-safety factor must be figured on scaffolding.
- Use Metal Catwalks, Platforms; where available. If wood plank is used, it must be scaffold grade or better. Inspect thoroughly before every job to make sure it is free from breaks, knots, and cracks or warp age. Decking should be full width.
- All working platform must be constructed with the specific requirement of job.
- If the working platform is not permanent then safety belt must be used.
- There shall be firm foundation for all scaffoldings. All scaffolding shall be made of sound material.



- Scaffolding material shall be inspected and used, only if found in good condition.
- Provide metal base plate is used under all upright or standard scaffoldings. Correct type of couplers shall be used for all connections.
- Plumb and level scaffoldings as erection proceeds, so that braces will fit without forcing.
- Fasten all braces securely.
- Working platforms shall be provided with guards. This should consist of top rail, mid rail, and toe board. The toe board shall be of minimum height 100 mm, while the mid rail and top rail shall be at heights of 600 mm and 1200 mm respectively.
- Do not use ladders or makeshift devices on top of scaffoldings to increase the height.
- Shall be placed at least 75 deg. to the floor.
- Fall arrestor to be used where ever applicable.
- The following safety tips are as guidelines in avoiding job-site situations that could prove dangerous to scaffold workmen.
- Don't Ride Moving Scaffold; and remember scaffold units are limited in height to 4* times
- Their narrowest base dimension (unless base is widened by outriggers or more end frames; or tied into building.) Always keep casters locked. (except tore-spot)
- Don't Climb Braces: Use the steps provided on most steel scaffolds to climb up to or down from work levels. Use scaffold climbing ladders where required.
- Protect Working Levels: Use overhead canopies to protect workers on lower work levels when work is being done overhead. Rope off un safe areas underneath scaffold or provide wire mesh around work area.
- Use Double Guard Rails; and toe board so exposed side sat platform heights of 1.8 meter or more.



Illustration of a Sample Independent Scaffold



15.6.5 Ladders

- Fall protection is not needed when climbing up or down ladders less than 20 feet/6.1 meters, using 3 points of contacts.
- Portable ladders, steps and trestles should only be used for light duties of short duration. Otherwise, properly constructed means of access should be provided.
- Aluminum ladders can generate sparks when struck against rusty iron, so it must be used in Hazardous Areas with special care.
- Aluminum ladders must not be used in areas where they might be splashed with acids or alkalis ; e.g. Utilities Area



- Ladders with metal reinforced, Damaged or rotten stiles, Missed footing on ladder rungs must not be used.
- Over-reaching and over-balancing is not allowed.
- Every time before use, the user will carry out inspection of ladder.
- If the work to be done necessitates the use of both hands, a safety belt must be used.
- Tools and materials must not be hand carried by persons ascending or descending ladders. Where applicable light tools should be carried in pockets, tool belts or shoulder bags, provided they do not impair movement and are held securely.
- Rungs, stiles, or treads to be checked for bending, twisting or signs of abuse or undue wear.
- Feet to be fitted with various types of bases and in good order. Synthetic non-slip, wooden or metal.
- Non-slip stair treads mats of stepladders, should be fitted and in good condition.
- In case of moving ladders fitted with wheels, Hinges and locking devices to be secure and in good working order.
- All portable ladders must be in good condition as per the site norms.
- Ladder shall extend 3' to 4' above the point of Landing and topmost 3 rungs shall not be used.
- Ladder is checked visually for defects before every use.
- Ladders shall not be used in a horizontal position as runways or scaffoldings.
- Ladders shall not be placed in front of a door that opens toward the ladder unless the door is locked, blocked or guarded.

15.6.6 User Ladder Safety Checklist

The following check list specifies the main points to remember when using ladders:

- Do not erect:
- On sloping ground
- On top of movable objects
- In high wind
- In front of a door which may be opened
- Against a slippery or unstable surface



- At a shallow angle, or use horizontally as a plank or bridge
- Leaning to outside

15.6.7 Donor

- Drop things from ladder.
- Straddle from the ladder to a nearby foothold..
- Allow more than one person up a ladder at time.
- Use a ladder which is too short.
- Use a makeshift or 'home-made' ladder.
- Over-reach (generally always keep hips within the stiles).
- Slide down ladder.
- No ladder should be used if it has: A missing, loose or defective rung or tread.
- A defective stile side member.
- A defective rope or associated fitting (rope operated extension ladders).
- Any sign of warping.
- Missing fastenings or rivets, guide or latching hooks.
- Always Return ladders to store as soon as they are finished with.
- Inspect a ladder immediately after any fall or overload.

15.6.8 Activities Allowed on Ladder

- A ladder is considered to be suitable for access of personnel to an elevated area only. No significant works may be carried out from a ladder. In particular, activities such as those below may not be carried out on ladder:
- Carrying tools (other than those which might clip onto a tool belt) up to an elevated level.
- Activities involving heavy manual labour.
- Activities requiring reaching or stretching such that the body is no longer centered over the ladder.
- For these types of jobs, a work platform such as a scaffold is required. The safe working position from a ladder is to have both thighs and hips within the styles.

**15.6.9** Color code and inspection

- Color code of the year shall be painted on one style only and equal to one rung spacing.

15.2. Roof work

- All roof-work operations should be pre-planned and properly supervised.
- Roof work should only be undertaken by workers who are physically and psychologically fit and have the necessary knowledge and experience for such work.
- Work on roofs shouldn't be carried on in weather condition that threaten the safety of workers.
- Crawling boards, walkways and roof ladders should be securely fastened to a firm structure.
- Roofing brackets should fit the slope of the roof and be securely supported. Where it is necessary for a person to kneel or crouch near the edge of the roof, necessary precautions should be taken.
- On a large roof where work have to be carried out at or near the edge, a simple barrier consisting of crossed scaffold tubes supporting a tubing guardrail may be provided.
- All covers for openings in roofs should be of substantial construction and be secured imposition.
- Roofs with a pitch of more than 10 should be treated as sloping.
- When work is being carried out on sloping roofs, sufficient and suitable crawling boards or roof ladders should be provided and firmly secured imposition.
- During extensive work on the roof, strong barriers or guardrails and toe-boards should be provided to stop a person from falling off thereof.
- Where workers are required to work on or near roofs or other places covered with fragile material, through which they are liable to fall, they should be provided with suitable roof ladders or crawling boards strong enough and
- When spanning across the supports for the roof covering to support those workers.
- A minimum of two boards should be provided so that it is not necessary for a person to stand on a fragile roof to move a board or a ladder, or for any other reason.

15.3. Electrical Safety

- Only authorized electrical engineer / electricians are permitted to do the electrical work.



- Do not use extension cords or electric hand tools with exposed wires.
- To switch-off electrical supply in case of an emergency must be enabled at all times.
- All temporary electrical installations carried out on the site must be in accordance with the local regulations and specifications.
- The installations must be inspected regularly by a competent person (e.g. electrical engineer/supervisor) to ensure that they are in safe condition and working faultlessly.
- Each electrical power tools and electrical equipment must be under protection of earth leakage/residual current protective device(ELCB/RCCB).
- Portable power tools used on site must have protective insulation ("double insulation").
- All electrical machines, tools and appliances must be inspected by a competent person (e.g. electrician) to ensure that all equipment's are in safe condition and working faultlessly. To confirm that the inspection was conducted the equipment must be labeled or marked clearly and registered. The documentation must be submitted to TE for records.
- Assume that all circuits are live until they have been thoroughly checked and proven dead. Never work on a live circuit.
- When using electrical equipment in an environment with electrical conductivity (e.g. in confined spaces like case pipes, containers, towers) the voltage used may at maximum be 24 Volt AC. (fed from a safety low voltage transformer)
- Never use a fuse heavier than the capacity of the circuit. Also never attempt to bridge abuse.
- Never tamper with any electrical wiring or apparatus.
- Do the cable laying as per standard specifications and requirement; do not lay down power cables adjacent to secondary cables of welding machine.
- Assess overhead power line hazard and keep safe distance from it.
- All electrical equipment's, motors, transformers, welding machines, etc. to be provided with earth connections.

15.4. Power & Hand Tool Operation

- All portable tools are to be connected through control bus with ELCB.
- All contractors should ensure proper Earthing of all electrical equipment's used by



them. Suitable earthing pits must be made if required.

- Examine electric cable for defects before use.
- Do not ever insert free ends of wires into sockets and hold them in place with matchsticks / other means. Always use industrial three pin plugs.
- Check the RPM rating of grinding wheels. The RPM rating must be greater than or same to that of the driver. Wheel guard should be used in proper position before grinding. Also proper PPEs must be ensured (goggles & hand gloves).
- Do not tie electric cords to metal rods or nails.
- No cable should run under the ground. It must run overhead at a 2 m height to avoid pinch point and creating trip hazard
- All tools and Tackles must be examined daily before commencing work and record to be maintained.
- Defective tools are to return to store.
- All electrical tools must be inspected at regular intervals by an authorized electrical person and record to be maintained.
- The weight, size & type of tool should be selected to suit the job carried out.
- The handles of tools should be intact and properly tightened. Split handles should be replaced. To avoid slippage, grease and oil should be wiped off.
- Insulated and non-conducting tools shall be tested for electrical resistance.
- Wrenches should not be pushed but pulled. Chisels struck by others should be held by tongs and not by hands.
- Chipping should always be done away from self.
- Hand tools should not be allowed to lie down on benches, scaffoldings etc. from where they can fall. They should be properly stored.

15.5. Welding

The metal frames and cases of mains-powered welding rectifiers, transformers and voltage regulators and of engine driven welding machines must be positively earthed locally throughout the work.

- Welding leads and return leads must be protected against physical damage.
- Insulated electrode holders and cable lugs / protectors must be used.
- The return lead must be attached to the work place as close as reasonably practicable to the welding point.
- If mains power is used, the work piece must be positively earthed using a well-



protected earth wire connected at both ends by bolted lugs or secure screw clamps.

- Bolted joints in pipelines and structures must not be relied upon to provide adequate electrical continuity for welding currents.
- Electric arc welding should not be carried out on equipment suspended from a crane because of the risk of damage to lifting wires from uncontrolled stray currents.
- Welders must not wear metal rings, bracelets or necklaces during the work as induced currents from the welding equipment might heat these.
- Dry, non-conductive gloves should be worn.
- The welder must always disconnect the electrode holder from the supply before attempting to replace an electrode.
- The welder should not lean against an earthed conductor whilst manipulating live electrodes.
- Welders working with electrodes fed from different phases of a three-phase supply should not work in close proximity to one another.
- Ensure that welding machine is in order and approved by site engineer.
- Ensure that welding cables are in order.
- Remove all combustible material from welding area to avoid fire.
- Place a fire extinguisher nearby welding premises.
- Ensure welding holder, cable and its lugs in good condition and use only industrial power socket and plugs (3 Pin) to avoid electricity risk.
- Make sure that welding machine is provided with ON/OFF switch and is earthed/grounding.
- Do not over load electrical appliances and cable, shocked pined.

15.6. Gas Cutting

- Gas cylinders must be secured in the vertical position to prevent them being knocked or pulled over.
- Long lengths of hose should be avoided, but;-
- Cylinders must be kept far enough away from the welding or cutting operations to prevent contact with sparks, flames and metals platter.



- Cylinders must be placed where they are unlikely to be damaged by stray electric currents or falling objects.
- Cylinders must not be taken into confined spaces.
- The torch must always be lit from a lighter provided for the purpose. There should be no attempt to light it from hot metal.
- Check the cylinder and its valve or leakage and move out any leaking cylinder immediately.
- Ensure that flash back arresters are installed with torch and NRV (Non return valve) on the gas cylinders side.
- Ensure cylinder is far away from fall of sparks and hot metal.
- Check the regulator and torches that they are inspected prior to every use.
- Check for leaks around regulators, hoses/fittings & nozzle with soap solution.
- Check the entire hose length if it is cracked or worn out cut that length of hose or replace the hose.
- Check that flash back arrester used for the purpose is of approved make/specification only.
- Place a fire extinguisher nearby welding premises.

15.6.1. Gas Cylinders

The handling of gas cylinders must comply with local legislation and TE's regulations as per particulars given below:

- Gas cylinders must be stored protected from excessive heat, fire, dangerous corrosion, mechanical damage or access by unauthorized.
- Gas cylinders must not be stored together with flammable materials.
- Gas cylinders must be secured to prevent them from falling over.
- Gas cylinders must be capped and operated upright.
- Use cylinder trolley / cage for the transportation of gas cylinders at site.
- Never use oil or grease on the regulator of a cylinder valve.
- Store gas cylinders in ventilated area.
- Don't keep LPG cylinder in confine/below ground area.
- Gas stores must not be set up in critical areas such as stairways, corridors,



emergency routes, garages or passages for person's or vehicles.

- Never transport by rolling them on the ground or use them as rollers or supports.
- Never attempt to repair cylinder.
- Leaking regulators, cylinder valves, hose pipes or other equipment should be taken out of service.

15.7. Grinding Operation

- Grinding wheels should be stored in dry place.
- After expiry date, grinding wheel must be condemned, broken in to pieces.
- Power supply cable of adequate current carrying capacity shall be used and it should be in good workable condition without abrasions, cuts or puncture in outer insulation.
- Socket pin provided at supply end and On/off switch in working condition.
- Proper earthing of the body in case of metallic body.
- Wheel guard properly fitted imposition.
- Machine body without any damage like cricket.
- Moving part (wheel) must be properly fixed to the machine with the help of spanner.
- Grinding wheel must be of suitable size as per the speed of grinding machine.
- Grinding wheel without manufacturer's stickers having size, speed and expiry date must be condemned.
- Don't use portable grinding machine as bench grinder.
- Don't fit over size wheel than recommended size by machine/wheel manufacturer.
- Don't grind small, unstable object without fixing it in the vice.
- Don't over press the grinding wheel against the job for fast removal of metal.
- Put OFF the main switch, while machine is not in use (tea breakneck.).
- Don't chip off grinding/cutting wheel for achieving fast cutting rate.

PPEs:

- Use of helmet, face shield or safety goggles (where face shield is not possible.) and hand gloves.



15.8. Use of Power Tools and Cables

- All electrical equipment and tools used by the contractors and their employees shall be properly checked by contractor's supervisor before use.
- All power tools must have proper guard at all-time.
- Leads /cables must be placed so that they do not create a tripping hazard.

15.9. Pressure / Leak Testing

Hydrostatic and Pneumatic Test

Access to the test area shall be limited to essential personnel only. before the test commences compliance is required with the following points:

- Persons supervising pressure or leak tests must have sufficient knowledge and experience of testing to fully understand the hazards of the activity and the precaution, which must be taken.
- Effective communication, including formal procedures, must be established between sites whenever the test envelope extends beyond one site, for example, pipelines.
- The area shall be cordoned off (using tape, shields or barriers, etc.) at an adequate distance from the equipment to be tested, as specified on the Permit to Work
- Warning signs shall be posted at access ways, at other strategic positions, and on the equipment to be tested (including the doors of test workshops or other designated areas.
- Pressuring equipment shall be provided with suitably calibrated pressure control/regulator devices
- Pressuring equipment shall not be left unattended at any time during the test.
- Pressuring equipment shall be isolated from the equipment under test and where practicable disconnected, when the test pressure has been reached.
- Care must be taken to ensure that materials of construction have the required ductility at the test temperature to prevent brittle fracture.
- A safety valve should be fitted to the equipment/system being tested, set to relieve at a pressure that will prevent over pressurization.
- Sufficient venting / draining points shall be provided in order to prevent trapping of pressurizing medium behind non-return valves, check valves, between isolation



valves, or within dead legs of the pressure envelope.

- The equipment/plant to be pressure tested must be subjected to thorough examination prior to testing. It may be necessary to 100% inspect all welds using visual, radio graphic or other NDT techniques.
- The gas supply must be isolated when test pressure has been achieved.
- The pressure envelope must contain sufficient vents, to a safe location.
- De-pressurization after pneumatic testing must be gradual.

15.10. Barricades and Warning Signs

- Area where work is being carried out above man height or below 1' ground depth must be barricaded. Linked barrier with link chains must be provided by the contractor for cordoning the area at ground level, during GI work.
- Follow the instruction of all types of warning signs like "NO SMOKING" "NOENTRY" "DANGER" "Work at height", "Inconvenience to member of public regretted/work in progress", "
- Name of the Contractor and contact details"

15.11. Basic Safety Rules For The Construction Site

- The construction site shall be considered a restricted area and unauthorized entry into the site is strictly prohibited. Anyone found trespassing should be asked to leave the site immediately.
- All persons of CLIENT/Consultant/Contractor shall be responsible for their own safety in plant or work sites.
- Nobody authorized to touch any valve, switch, or interfere with plant/site activities.
- Children below 18 years are not allowed inside plant / worksite.
- Never walk on the pipes, equipment, structure etc.
- Always use stairs, handrails & walkover platforms.
- Never carry sharp or pointed tools in pockets.
- Alcoholic beverages will not be consumed, brought into, or manufactured on the work sites or inside the plant.
- Drugs/intoxicant substances will not be used, brought into, or manufacture don't he site or plant.



- Cigarette, beedi smoking is not allowed except in the designated smoking booths.
- Firearms, explosives, knives or other types of weapons will not be allowed on the site.
- Gambling or any other form of betting games is prohibited.
- Discrimination on the basis of race, sex or national origin is prohibited.
- Horseplay, Fight, Practical jokes, Aggressive or abnormal behavior is prohibited.
- Individuals under the influence of alcohol or drugs will not be permitted entry to the site.
- Safety helmet, safety shoes, ear plug or ear muff, hand gloves, safety goggles, safety harness & clothing for body protection are mandatory in the plant or work site.
- Use other personal protective equipment as displayed in plan/site.
- It is strictly not allowed to use non-intrinsically safe equipment or instruments in the operational area of site.
- All vehicles for use on the site shall conform to the requirements of the Vehicle Entry Permit. Maximum Speed limit inside complex is 10km/Hr.
- In case of Emergency dial appropriate agency like Fire, Hospital, Security etc. as displayed.

Violation of the Rules and Regulations might result in removing the person(s) concerned from the premises and denying the person(s) concerned from any future access to the site. The site in-charge will judge whether permanent removal of the individual from the premises is justified depending on the seriousness of the violation(s). All Indian laws shall be complied with at all the time.

15.12. Site Emergency Preparedness and Response

The CONTRACTOR shall establish, what are the arrangements in the event of an emergency.

The CONTRACTOR shall ensure that their Personnel are familiar with the essential emergency equipment, the use of which shall be demonstrated and practiced in drills.

The CONTRACTOR shall check the emergency procedures and the location and condition of the emergency equipment.

The CONTRACTOR personnel will be instructed of the actions to take in the event of serious personal injury, gas or toxic release, fire, explosion, heavy rains, wind storms, chemical spillage, land slide, scaffolding or structure collapse, critical damage to operating equipment, etc. and other emergency situations during the induction training and other



ongoing training sessions.

These situations may demand adequate rescue and relief measure to handle such events quickly and effectively.

In an emergency, or on hearing the alarm, every supervisor shall ensure the following;

- All work is stopped at once.
- All equipment vehicles and tools are shut down (all sources of ignition).
- All men are evacuated to a pre-determined Muster point.
- A roll call is taken and every man is accounted for.
- No one is permitted to return to work until notification has been received from the CONTRACTOR representative that it is safe to do so.

15.12.1. Emergency Preparedness

The basic and essential features of any emergency Preparedness are to analyse and plan for the potential risk. This includes;

- Establishing and maintaining effective communications.
- Liaison with local emergency services and authorities.
- Action Procedure (evacuation routes and assembly points).
- Appointment of key personnel and specifying their duties and responsibility.
- Emergency Response Drills

15.12.2. Emergency Response Drills

Effectiveness and comprehensiveness of Emergency Response Plan must be tested on a regular basis. Drills which reflect the conditions induced from the more likely emergency occurrences must be conducted. CONTRACTOR should conduct such drill on periodic basis. All emergency drills, exercises and responses to actual incidents shall be fully documented and followed by a complete review and when necessary, procedure revision process.

Initiate any required procedural changes, and initiate the dissemination of any lessons learned through the Site HSE communication system.

15.13. Road Safety Norms

- For roadside working site to be barricaded..
- Only eligible driver can drive required vehicle inside site
- Speed limit norms of site must be followed
- No riding or travelling on the back of open end vehicle, fork lift or trailers should be done.

**15.14. Environment**

The CONTRACTOR shall pay due regard to the environment by preserving air, water, soil, animal and plant life from adverse effects of the CONTRACTOR's activities and minimizing any nuisance which may arise from such operations.

All waste generated by the CONTRACTOR shall be contained and disposed of in accordance with the legal requirement on waste management.

15.15. Labor Welfare & Legal Requirement

- All mandatory provisions with regard to safety as prescribed under contract Labor (Abolition & Regulation) Act 1970 and Rules made there under are applicable.
- Workmen compensation insurance and registration under ESI should be maintained.
- Time to time, all rules and regulations suggested by safety committee of site must be followed and implemented



ANNEXURES

ANNEXURE – ARELEVANT IS-CODES FOR PERSONNEL PROTECTION

IS : 2925 – 1984	:Industrial Safety Helmets
IS : 4770 – 1968	:Rubber gloves for electrical purposes
IS : 6994 – 1973	:Industrial Safety Gloves (Leather & Cotton)
(Part – I)	
IS : 1989–1986	:Leather safety boots and shoes
(Part – I & III)	
IS : 3738 – 1975	:Rubber knee boots
IS : 6519 – 1971	:Code of practice for selection, care and repair of Safety footwear
IS : 11226 – 1985	:Leather Safety footwear having direct molding sole
IS : 5983 – 1978	:Eye protectors
IS : 9167 – 1979	:Ear protectors.
IS : 3521 – 1983	:Industrial Safety belts and harness



ANNEXURE – B

FORMAT - 1.01.0 : HEALTHY, SAFETY & ENVIRONMENT (HSE) PLAN

Project : -----

Contractor:-----

Date : -----

Owner:

(To be prepared & submitted by each Construction Agency)

Activity Description	Procedure/ W.I./ Guidelines	Code of Conformance	Performing Function			Audit Function Customer Review/ Audit Requirements
			Performance	Checker	Approver	

PREPARED BY

REVIEWED BY

APPROVED BY



MONTHLY CHECKLIST CUM COMPLIANCE REPORT REGARDING HSE (1/6)

Project: _____

Contractor: _____

Date: _____

Owner: _____

Inspection By: _____

Note: write 'NC' (Not Concern) wherever any of the items are not applicable

Item	Yes	No	Remarks	Action
HOUSEKEEPING				
Waste containers provided and used				
Sanitary facilities adequate and Clean				
Passageways and Walkways Clear				
General neatness of working areas				
Proper Material Storage				
Wooden Boards properly stacked and nails removed				
Cords, leads out of walk and traffic ways				
Scraps removed from the work site				
Other				
PERSONNEL PROTECTIVE EQUIPMENT				
Goggles : Shields				
Face protection				
Hearing protection				
Safety Shoes provided				
Hand protection				
Respiratory Masks etc.				
Safety Belts				
Safety Helmets				
Other				
EXCAVATIONS / OPENINGS				
Excavation permit				
Excavated earth kept away from edge				
Dewatering pump kept away from edge				
Safe access into excavated area				
Opening properly covered or barricaded				
Excavations shored				
Excavations barricaded				
Overnight lighting provided				
Other				



MONTHLY CHECKLIST CUM COMPLIANCE REPORT REGARDING HSE (2/6)

Item	Yes	No	Remark	Action
Welding Cutting				
Valid not work permit				
Flashback arrester provided for cylinders				
Power cable not crossing the welding cable				
Adequate earthing provided				
No combustible materials kept near welding & cutting works				
Gas cylinder chained upright & kept in trolleys				
Cables and hoses not obstructing				
Screens or shields used				
Flammable materials protected				
Fire extinguisher (s) accessible				
Other				
SCAFFOLDING				
Fully decked platform				
Guard and intermediate rails in place				
Toe boards in place & tied properly				
Adequate shoring				
Adequate access				
Other				
LADDERS				
Extension side rails I m above				
Top of landing				
Properly secured at top & bottom				
Angle $\pm 70^\circ$ from horizontal				
Other				



MONTHLY CHECKLIST CUM COMPLIANCE REPORT REGARDING HSE (3/6)

Item	Yes	No	Remark	Action
HOISTS, CRANES AND DERRICKS				
Condition of cables and sheaves OK				
Condition of slings, chains, hooks and eyes OK				
Inspection and maintenance logs maintained				
Outriggers used				
Singh/ barricades provided				
Signals observed and understood				
Qualified operators				
Other				
MACHINERY, TOOLS AND EQUIPMENT				
Proper instruction				
Safety devices				
Proper cords				
Inspections and maintenance				
Other				
VEHICLE AND TRAFFIC				
Rules and regulations observed				
Inspection and maintenance				
Licensed drivers				
Others				



MONTHLY CHECKLIST CUM COMPLIANCE REPORT REGARDING HSE (4/6)

Item	Yes	No	Remark	Action
TEMPORARY FACILITIES				
Emergency instruction posted				
Fire extinguishers provided				
Fire-aid equipment				
Secured against storm damage				
General nemeses				
In accordance with electrical requirements				
Other				
Fire Prevention				
Personnel instructed				
Fire extinguishers checked				
No smoking in prohibited areas				
Hydrants clear				
Other				
ELECTRICAL				
Proper wiring & earthing				
ELCB's provided				
Ground fault circuit interrupters				
Protection against damage				
Prevention of tripping hazards				
Proper electrical cable joints				
Light poles secured				
Clear way to power distribution board				
Proper rating of fuses				



MONTHLY CHECKLIST CUM COMPLIANCE REPORT REGARDING HSE (5/6)

Item	Yes	No	Remark	Action
HANDLING AND STORAGE OF MATERIALS				
Properly stored or stacked				
Passageways clear				
Other				
FLAMMABLE GASES AND LIQUIDS				
Containers clearly identified				
Proper storage				
Fire extinguishers nearby				
Other				
WORKING AT HEIGHT				
Erection plan				
Safety nets				
Safety belts tied properly				
Illumination				
No loose material at height				
No body under working area				
All openings covered				
Other				
ENVIRONMENT				
Chemical and other Effluents properly disposed				
Cleaning liquid of pipes disposed-off properly				
Seawater used for hydrotesting disposed off as per agreed proceeding				
Lubricant Waste/ Engine oils properly disposed				
Waster from Canteen office, sanitation etc. disposed properly				
Disposal of surplus earth stripping materials, Oily rags and combustible materials done properly				
Green belt protection.				



MONTHLY CHECKLIST CUM COMPLIANCE REPORT REGARDING HSE (6/6)

Item	Yes	No	Remark	Action
HEALTH CHECK				
Hygienic conditions at labour camps OL				
Availability of First Aid facilities				
Proper sanitation at site, office and labour camps				
Arrangements of medical facility				
Measures for dealing with illness				
Availability of potable drinking waters for workmen & staff				
Provision of creches for children				
ERECTION				
Slings/ D shackle checked				
Signal Man				
Tag line for guiding the load				
Protecting the slings from sharp edges				
No loose materials at height				
Ladder & platform welding inspected				
No one under the suspended load				
Stay rope				
SWL				

.....
Signature Of Resident Engineer with Seal

Monthly Health, Safety & Environmental (HSE) Report
(To be submitted by each Contractor)

Actual work start date : _____ for the month of: _____

Project: _____ Report No : _____

Name of the Contractor: _____ Status as on: _____

Name of work: _____

Name of safety officer _____

Item	This Month	Cumulative
Total strength (Staff – Workmen)		
Number of HSE meeting organized at site		
Number of HSE awareness programs conducted at site		
Whether workmen compensation policy taken	Y/N	
Whether workmen compensation policy valid	Y/N	
Whether workmen registered under ESI Act	Y/N	
Number of Fatal Accident		
Number of Loss Time Accident (Other than Fatal)		
Other accident (non loss time)		
Total No. of accident		
Total man-hours worked		
Man-hour loss due to fire and accident		
Compensation cases raised with insurance		
Compensation cases resolved and paid to workmen		

Remark

Date: ____/____/____

Safety Officer/RCM

(Signature and Name)

To: OWNER.....
RCM/SITE-IN-CHARGE1 COPY
1 COPY

SUPPLEMENTARY ACCIDENT, INCIDENT&NEAR MISS REPORT

Project: _____ Supplementary to report No. _____

Site : _____ Date: _____

Contractor: _____

NAME OF THE INJURED.....

FATHER'S NAME.....

SUB-CONTRACTOR M/S.....

DATE & TIME OF ACCIDENT.....

LOCATION.....

BRIEF DESCRIPTION & CAUSE OF A ACCIDENT

NATURE OF INJURY / DAMAGE

COMMENTS FROM MEDICAL PRACTITIONER WHO ATTENDED THE VICITIM/INJURED

SUGGESTED IMPROVEMENT IN THE WORKING CONDITION IF ANY

LOSS OF MANHOURS AND IMPACT ON SITE WORKS

ANY OTHER COMMENT BY SAFETY OFFICER

Date: ____/____/____

SIGNATURE OF CONTRACTOR WITH SEAL

To : OWNER.....1 COPY

: RCM/SITE-IN-CHARGE.....1 COPY

ACCIDENT REPORT

(To be submitted by Contractor after every accident within 2 hours of accident)

Report No. _____ Date: _____
Name of Site: _____ CONTRACTOR _____NAME OF THE INJURED.....
FATHER'S NAME.....
SUB-CONTRACTOR M/S.....
DATE & TIME OF ACCIDENT.....
LOCATION.....

BRIEF DESCRIPTION OF ACCIDENT

CAUSE OF ACCIDENT

NATURE OF INJURY / DAMAGE

MEDICAL AID PROVIDED / ACTIONS TAKEN

INTIMATION TO LOCAL AUTHORITIES

Date : ____/____/____

SIGNATURE OF CONTRACTOR WITH SEAL

To : OWNER..... 1 COPY
: RCM/SITE-IN-CHARGE 1 COPY



ENERGISING QUALITY

VCS QUALITY SERVICES PVT. LTD.

INSPECTION AND TEST PLAN FOR PLUG VALVES VCS – ITP – PP – 2009

00	27/04/2022	<i>R. Jainivaraan</i>	<i>[Signature]</i>	<i>[Signature]</i>	<i>[Signature]</i>
Rev. No	Date	Prepared By	Checked By	Approved By	Authorized By

UNCONTROLLED COPY	:	If printed
CONTROLLED COPY	:	If in soft and signed

Digitally signed by RAMAKANT

TWAPR

Date: 2025.10.13 18:20:32 IST

**INSPECTION AND TEST PLAN
FOR
PLUG VALVE**

DOC NO: VCS-ITP-PP-2009
Rev No : 00

REVISION RECORD						
Rev.	Revision Date	Prepared by	Checked by	Approved by	Authorized by	Revision Description
00	27/04/2022	R. Srinivasan				Issued as standard ITP
		SR	MC	HK	GW	

Digitally signed by RAMAKANT

TW/AR

Date: 2025.10.13 18:20:32 IST

**INSPECTION AND TEST PLAN
FOR
PLUG VALVE**

DOC NO: VCS-ITP-PP-2009
Rev No : 00

ABBREVIATIONS:			
CE	Carbon Equivalent	NDT	Non-Destructive Testing
DCN	Dispatch Clearance Note	PO	Purchase Order
DFT	Dry Film Thickness	PQR	Procedure Qualification Record
DPT	Dye Penetrant Testing	PR	Purchase Requisition
HT	Heat Treatment	RT	Radiography Testing
IC	Inspection Certificate	TC	Test Certificate
IR	Inspection Report	TPI or TPIA	Third Party Inspection Agency
IRC	Inspection Release Certificate	UT	Ultrasonic Testing
ITP	Inspection and Test Plan	VDR	Vendor Data Requirement
MPT/MT	Magnetic Particle Testing	WPQ	Welders Performance Qualification
MTC	Material Test Certificate	WPS	Welding Procedure Specification
LEGENDS:			
H - Hold (Do not proceed without approval)			
W - Witness (Give due notice, work may proceed after scheduled date)			
P - Perform			
R - Review			
RW - Random Witness [As specified or 10% (min.1 no. of each size and type of Bulk items)]			

Digitally signed by RAMAKANT

TAMAR

Date: 2025.10.13 18:20:32 IST

1.0 SCOPE:

This Inspection and Test Plan covers the minimum testing requirements of Valves.

2.0 REFERENCE DOCUMENTS:

PO / PR / Standards referred there in / Job specifications / Approved documents.

3.0 INSPECTION AND TEST REQUIREMENTS:

SL.NO.	STAGE/ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB VENDOR	VENDOR	TPIA
1.0	Procedure						
1.1	Hydrostatic Test, NDT and Other Procedures	Documented Procedures	100%	Procedure Documents	-	H	R
1.2	WPS, PQR & WPQ	Welding Parameters & Qualification Record	100%	WPS, PQR & WPQ	-	H	W- New R- Existing

**INSPECTION AND TEST PLAN
FOR
PLUG VALVE**

DOC NO: VCS-ITP-PP-2009
Rev No : 00

SL.NO.	STAGE/ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB VENDOR	VENDOR	TPIA
2.0	Material Inspection						
2.1	Castings & Forgings (Body, Cover, Plug, Stem)	Chemical, Mechanical, Heat Treatment, NDT & Other Properties as applicable	100%	Test Certificates	H	R	W (Note-1)
2.2	Castings & Forgings (Body, Cover, Plug, Stem)	Visual & Dimension	100%	Inspection Report	H	H	-
2.3	Body, Cover and Plug Castings	Radiography Examination	As per PR / Purchase Specification	Films and report	H	R (RT-Film review)	R (RT-Film review) (Note-1)
2.4	Bars for Trim material	Chemical Analysis	Each Heat	Test Certificates& Lab Report	H	R	R
2.5	Gaskets, Gear units, Fasteners, Gland, Packings, etc.	Physical / Chemical Properties	100%	Test Certificates& Lab Report	H	R	R

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Date: 2025.10.13 18:20:32 IST

**INSPECTION AND TEST PLAN
FOR
PLUG VALVE**

DOC NO: VCS-ITP-PP-2009
Rev No : 00

SL.NO.	STAGE/ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB VENDOR	VENDOR	TPIA
2.6	Actuators as applicable	Performance, Statutory Certificates as applicable	100%	Test Certificates & Lab Report	H	H	R
3.0	In Process Inspection						
3.1	Welding	Welding Parameters as per WPS / PQR	100%	Inspection Reports	-	H	R
3.2	Machining of components	Visual / Dimension	100%	Inspection Reports	-	H	-
4.0	Final Inspection						
4.1	Hydrostatic / Pneumatic Test	Hydrostatic Test – Shell Pneumatic Test – Seat	As per PR / Purchase Specification	Test Report	-	H	RW
4.2	Visual / Dimension	Surface & Dimension Check	100%	Test Report	-	H	RW
4.3	Final Stamping	Stamping Of Accepted Valves	Stamping of Valves which are witnessed by TPIA.	Inspection Report	-	H	H

Digitally signed by RAMAKANT

TW/MS

Date: 2025.10.13 18:20:32 IST

**INSPECTION AND TEST PLAN
FOR
PLUG VALVE**

DOC NO: VCS-ITP-PP-2009
Rev No : 00

SL.NO.	STAGE/ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB VENDOR	VENDOR	TPIA
4.4	Strip Test	Component integrity, PMI of BOM	One per size per rating	Test report	H	H	H
5.0	Painting						
5.1	Painting and Colour coding as applicable	Visual / DFT Check	100%	Inspection Report	-	H	R
6.0	Documentation & IC						
6.1	Documentation & Inspection Certificate (IC)	Review of Stage Inspection Reports / Test Reports & Issue of IC	100%	Vendor TC & IC	-	H	H
7.0	Final Documentation & Submission of Reports	Compilation of IR/IRC/DCN/MTC/DRGS. /VDR	100%	Compliance Certificate (Note-1)	-	H	-

NOTES (As applicable):

1. If the certification is specified as EN 10204 Type 3.1 in Data sheet / Material Requisition, then '**W**' may be replaced with '**R**' with Material Traceability.
2. ITP shall be submitted including but not limited to the item/activity covered above. Any item/activity identified and required for the completeness shall also be covered in the ITP submitted by the manufacturers.

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Date: 2025.10.13 18:20:32 IST



VCS QUALITY SERVICES PVT. LTD.

INSPECTION AND TEST PLAN FOR SEAMLESS LINE PIPES UP TO 16"

VCS – ITP – PP – 2015

03	19/12/2021	SR	MC	HK	GW
Rev. No	Date	Prepared By	Checked By	Approved By	Authorized By

UNCONTROLLED COPY	:	If printed
CONTROLLED COPY	:	If in soft and signed

REVISION RECORD						
Rev.	Revision Date	Prepared by	Checked by	Approved by	Authorized by	Revision Description
0	14.05.2019					Issued as Standard
		BS	MV	AD	SK	
1	19.11.2019					Re-Issued as Standard
		SS	MC	AD	SK	
2	15.05.2020					Document formatting, Doc numbering updated from VPC-PL-ITP-025 to VCS-ITP-PP-2015 other detail update as marked
		SS	MC	AD	SK	
3	19.12.2021	<i>R. Jainivasan</i>				Revised as Marked
		SR	MC	HK	HK	



**INSPECTION AND TEST PLAN
FOR SEAMLESS LINE PIPES**

**DOC NO: VCS-ITP-PP-2015
Rev No : 03**

ABBREVIATIONS:			
CE	Carbon Equivalent	MTC	Material Test Certificate
HT	Heat Treatment	NDT	Non-Destructive Testing
IC	Inspection Certificate	PO	Purchase Order
IGC	Inter Granular Corrosion	PMI	Positive Material Identification
ITP	Inspection and Test Plan	TC	Test Certificate
MPT/MT	Magnetic Particle Testing	TPI or TPIA	Third Party Inspection Agency
MPS	Manufacturing Process Specification	UT	Ultrasonic Testing
MR	Material Requisition	VDR	Vendor Data Requirement
LEGENDS:			
H - Hold (Do not proceed without approval)			
W - Witness (Give due notice, work may proceed after scheduled date)			
P - Perform			
R - Review			
RW - Random Witness (As specified or 10% [min.1 no. of each size and type of Bulk item])			

1.0 SCOPE:

This Inspection and Test Plan covers the minimum testing requirements of Seamless Pipes up to 16" (Including 16")

2.0 REFERENCE DOCUMENTS:

PO/PR/ Standards referred there in/ Job specifications /Approved documents.

3.0 INSPECTION AND TEST REQUIREMENTS:

SL. NO.	STAGE/ ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB VENDOR	VENDOR	TPIA
1.0	Procedure						
1.1	MPS	Documented Procedures	100%	Procedure Documents	-	H	R
2.0	Raw Material Procurement						
2.1	Raw Material Inspection	Chemical & Mechanical Properties, Method of manufacturing, Heat Treatment Condition etc.	100%	Mill Test Certificates (EN 10204-3.2)	H	H (Note-3)	R (Note-3)



**INSPECTION AND TEST PLAN
FOR SEAMLESS LINE PIPES**

**DOC NO: VCS-ITP-PP-2015
Rev No : 03**

SL. NO.	STAGE/ ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB VENDOR	VENDOR	TPIA
3.0	In Process Inspection						
3.1	First Day Production test	All testing requirement as per PR/ MPS	As per PR/ MPS	Test Report	-	H	H
3.2	Raw material Inspection	Marking & Correlations with Test Certificates	100%	Inspection Reports	-	H	-
3.3	Heat Treatment	Heat Treatment time and temperature	100%	HT Graph / Record	-	H	R
4.0	Final Inspection						
4.1	Hydrostatic Testing	Leak & pressure Drop, Calibration of Gauges/ Recorder	100%	Inspection Report	-	H	RW (Min.5%)

SL. NO.	STAGE/ ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB VENDOR	VENDOR	TPIA
4.2	Calibration of UT system	Run with calibration pipe	1) Beginning of each shift 2) After Breakdown /Maintenance	Inspection Report	-	H	W
4.3	Pipe UT	Lamination & other defects	100%	Inspection Report	-	H	RW (Min.5%)
4.4	Pipe End UT MPT as applicable	Lamination & other defects	100%	Inspection Report	-	W	RW (Min.1%)
4.5	Final visual and dimension	1. Visual Examination 2. Dimensional Check Surface Condition, Straightness, End Finish, Bevel Angle, Root Face, Outer Dia., Thickness, Length, End Finish, Marking etc.	100%	Inspection Report	-	H	RW (Min.5%)
4.6	Lot Testing	1. Chemical Analysis 2. Tensile Tests 3. Macro & Hardness Tests 4. Impact Tests and other applicable test	As per MPS/API 5L/Spec.	Inspection Report	-	H	W

SL. NO.	STAGE/ ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB VENDOR	VENDOR	TPIA
4.7	Non-conforming product/stage	Repair / Retest /Reject	100%	Inspection Report	-	H	W
4.8	Marking/Stencilling	Pipe No, Acceptance No., Heat. No., Size, Weight, Grade, Thickness, Colour Code etc as per MPS	100%	Inspection Report	-	H	RW (Min.5%)
5.0	PAINTING						
5.1	Rust Preventive Coating & Colour Coding	Visual & Colour Coding as applicable	100%	Inspection Report	-	H	-
6.0	Documentation & IC						
6.1	Documentation & Inspection Certificate (IC)	Review of Stage Inspection Reports / Test Reports & Issue of IC	100%	Manufacturer TC & IC (Note-4)	-	H	H

SL. NO.	STAGE/ ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB VENDOR	VENDOR	TPIA
6.2	Final documents as per PR/MR	Verification & compilation of inspection & test records for submission to customer	100%	Final dossier (Note-4)	-	H	H

NOTES (As applicable):

1. ITP shall be submitted including but not limited to the item/activity covered above. Any item/activity identified and required for the completeness shall also be covered in the ITP submitted by the manufacturers.
2. Acceptance Norms for all the activities shall be as per PO/PR/STANDARDS referred there in /Job Specification /Approved Documents.
3. Raw Material shall be inspected at Mills (Sub vendors works) by TPIA appointed by Vendor.
4. Items shall be EN 10204 Type 3.2 Certified based on this ITP/MR/PR for the Pipe (Final product).



ENERGISING QUALITY

VCS QUALITY SERVICES PVT. LTD.

INSPECTION AND TEST PLAN FOR FLANGES & SPECTACLE BLINDS VCS – ITP – PP – 2003

01	19/12/2021	SR	MC	HK	GW
Rev. No	Date	Prepared By	Checked By	Approved By	Authorized By

UNCONTROLLED COPY	:	If printed
CONTROLLED COPY	:	If in soft and signed

REVISION RECORD						
Rev.	Revision Date	Prepared by	Checked by	Approved by	Authorized by	Revision Description
00	22/04/2020					
		MB	MC	AD	SK	
01	19/12/2021	R. Ganivasan				Revised as Marked
		SR	MC	HK	GW	

ABBREVIATIONS:			
CE	Carbon Equivalent	NDT	Non-Destructive Testing
DCN	Dispatch Clearance Note	PO	Purchase Order
HT	Heat Treatment	PR	Purchase Requisition
IC	Inspection Certificate	RT	Radiography Testing
IR	Inspection Report	TC	Test Certificate
IRC	Inspection Release Certificate	TPI or TPIA	Third Party Inspection Agency
ITP	Inspection and Test Plan	UT	Ultrasonic Testing
MPT/MT	Magnetic Particle Testing	VDR	Vendor Data Requirement
MTC	Material Test Certificate		
LEGENDS:			
H - Hold (Do not proceed without approval)			
W - Witness (Give due notice, work may proceed after scheduled date)			
P - Perform			
R - Review			
RW - Random Witness [As specified or 10% (min.1 no. of each size and type of Bulk items)]			

1.0 SCOPE:

This Inspection and Test Plan covers the minimum testing requirements of Flanges, Spectacle Blinds & Drip Rings.

2.0 REFERENCE DOCUMENTS:

PO / PR / Standards referred there in / Job specifications / Approved documents.

3.0 INSPECTION AND TEST REQUIREMENTS:

SL.NO.	STAGE/ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB VENDOR	VENDOR	TPIA
1.0	Procedure						
1.1	Heat Treatment, NDT and Other Procedures	Documented Procedures	100%	Procedure Documents	-	H	R
2.0	Material Inspection						
2.1.	Raw Material Inspection	Chemical, Mechanical, Properties	100%	Test Certificates	-	H	R
3.0	In Process Inspection						

SL.NO.	STAGE/ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB VENDOR	VENDOR	TPIA
3.1	Heat Treatment	Stress Relieving, Normalising, Tempering, Solution Annealing, Stabilization Heat Treatment etc. as applicable	100%	HT Chart	-	H	R
3.2	Identification of Test Samples	Product Chemical, Mechanical, Impact and Other test as applicable	One/Heat/Lot	Test Report	-	H	H
3.4	Product Analysis (As applicable)	Chemical Composition	As per PR/Purchase Specification	Test Reports	-	H	R
3.5	Destructive Testing	Mechanical, Impact and Other test as applicable	One/Heat/Lot	Test Reports	-	H	H
3.6	MPI	Surface & Internal Imperfections	As per PR/Purchase Specification	NDT Reports	-	H	R
4.0	Final Inspection						
4.1	Final Inspection	1. Visual 2 Dimensions 3. Hardness 4. Marking etc	100%	Inspection Report	-	H	W

SL.NO.	STAGE/ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB VENDOR	VENDOR	TPIA
4.2	PMI Check	Chemical	As per Spec.	Inspection Report	-	H	RW
4.3	Final Stamping	Stamping Of Accepted Flanges & Spectacle Blinds	Stamping of Valves which are witnessed by TPIA.	Inspection Report	-	H	H
5.0	Painting						
5.1	Rust Preventive Coating & Colour Coding	Visual & Colour Coding as applicable	100%	Inspection Report	-	H	-
6.0	Documentation & IC						
6.1	Documentation & Inspection Certificate (IC)	Review of Stage Inspection Reports / Test Reports & Issue of IC	100%	Vendor TC & IC	-	H	H
7.0	Final Documentation & Submission of Reports	Compilation of IR/IRC/DCN/MTC/DRGS. /VDR	100%	Compliance Certificate (Note-1)	-	H	-

NOTES (As applicable):

1. If the certification is specified as EN 10204 Type 3.1 in Datasheet / Material Requisition, then '**W**' may be replaced with '**R**' with Material Traceability.
2. ITP shall be submitted including but not limited to the item/activity covered above. Any item/activity identified and required for the completeness shall also be covered in the ITP submitted by the manufacturers.



ENERGISING QUALITY

VCS QUALITY SERVICES PVT. LTD.

INSPECTION AND TEST PLAN FOR LONG RADIUS BENDS FOR ONSHORE PIPELINES VCS –ITP –PP –2004

02	19/12/2021	<i>R. Srinivasan</i>	<i>[Signature]</i>	<i>[Signature]</i>	<i>[Signature]</i>
02	19/12/2021	SR	MC	HK	GW

Rev. No	Date	Prepared By	Checked By	Approved By	Authorized By

UNCONTROLLED COPY	:	If printed
CONTROLLED COPY	:	If in soft and signed

REVISION RECORD						
Rev.	Revision Date	Prepared by	Checked by	Approved by	Authorized by	Revision Description
00	05/06/2017					Issued as Standard ITP
		GS	ADE	AD	SK	
01	22/04/2020					Document formatting, Doc numbering updated from VCS-PL-ITP-004 to VCS-ITP-PP-2004 other detail update as marked
		MB	MC	AD	SK	
02	19/12/2021	<i>R. Ganesh</i>	<i>[Signature]</i>	<i>[Signature]</i>	<i>[Signature]</i>	Revised as Marked
		SR	MC	HK	GW	

**INSPECTION AND TEST PLAN FOR
LONG RADIUS BENDS FOR ONSHORE PIPELINES**

**DOC NO: VCS-ITP-PP-2004
Rev No : 02**

ABBREVIATIONS:			
CE	Carbon Equivalent	PR	Purchase Requisition
IC	Inspection Certificate	RT	Radiography Testing
ITP	Inspection and Test Plan	TC	Test Certificate
MPT/MT	Magnetic Particle Testing	TPI or TPIA	Third Party Inspection Agency
MTC	Material Test Certificate	UT	Ultrasonic Testing
NDT	Non-Destructive Testing	VDR	Vendor Data Requirement
PO	Purchase Order		
LEGENDS:			
H - Hold (Do not proceed without approval)			
W - Witness (Give due notice, work may proceed after scheduled date)			
P - Perform			
R - Review			
RW - Random Witness [As specified or 10% (min.1 no. of each size and type of Bulk items)]			

1.0 SCOPE:

This Inspection and Test Plan covers the minimum testing requirements of long radius Bends for onshore Pipelines.

2.0 REFERENCE DOCUMENTS:

PO / PR / Standards referred there in / Job specifications / Approved documents.

3.0 INSPECTION AND TEST REQUIREMENTS:

SL.NO.	STAGE/ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB VENDOR	VENDOR	TPIA
1.0	Procedure						
1.1	Hydro Test, NDT, Bend Manufacturing, Heat treatment and Other Procedures	Documented Procedures	100%	Procedure Documents	-	H	R
2.0	Material Inspection						
2.1	Raw Material Inspection	Chemical, mechanical properties, method of manufacturing, Heat Treatment Condition, etc	100%	Mill Test Certificates (EN 10204 Type 3.2 certificate)	H	R	R

**INSPECTION AND TEST PLAN FOR
LONG RADIUS BENDS FOR ONSHORE PIPELINES**

**DOC NO: VCS-ITP-PP-2004
Rev No : 02**

SL.NO.	STAGE/ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB VENDOR	VENDOR	TPIA
3.0	In Process Inspection						
3.1	Material Identification (In case of EN 10204 Type 3.1 certificate)	Review of Test Certificates, Markings, Visual and Dimensional inspection, identity co-relation & Transfer of identification marks	One/Heat	Material Clearance Record (3.2 certificate or check test [mechanical, chemical, impact, hardness])	-	H	H
3.2	Bend Manufacturing Procedure Qualification	Bend forming parameters, Mechanical, Impact, Micro and Hardness	100%	Test Report	-	H	H
3.3	Induction Bending (Production bends)	Bending temp Bending rate Power input As per qualified procedure of test bend	100%	Inspection Report	-	H	M

Digitally signed by RAMAKANT

TAMAR reserved

Date: 2025.10.13 18:20:32 IST

**INSPECTION AND TEST PLAN FOR
LONG RADIUS BENDS FOR ONSHORE PIPELINES**

**DOC NO: VCS-ITP-PP-2004
Rev No : 02**

SL.NO.	STAGE/ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB VENDOR	VENDOR	TPIA
3.4	Heat Treatment (If Applicable)	Time / temp record	100%	HT Graph	-	H	R
4.0	Final Inspection						
4.1	NDT-RT, UT & MPT as applicable	Defects	100%	Films/Test Reports	-	H	R
4.2	Hydrostatic Test	Soundness / Leak check	100%	Test Report	-	H	W
4.3	Final visual and dimension	Visual and Dimension	100%	Inspection Report	-	H	W
4.4	Gauging Pig Passing (95% of ID)	Verification of ID / Profile	100%	Inspection Report	-	H	W
5.0	Documentation & IC						
5.1	Documentation & Inspection Certificate (IC)	Review of Stage Inspection Reports / Test Reports & Issue of IC	100%	Vendor TC & IC	-	H	H

Digitally signed by RAMAKANT

TAMAR reserved

Date: 2025.10.13 18:20:32 IST

SL.NO.	STAGE/ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB VENDOR	VENDOR	TPIA
5.2	Final documents as applicable	Verification & compilation of inspection & test records for submission to customer	100%	Final dossier	-	H	H

NOTES (As applicable):

1. ITP shall be submitted including but not limited to the item/activity covered above. Any item/activity identified and required for the completeness shall also be covered in the ITP submitted by the manufacturers.



ENERGISING QUALITY

VCS QUALITY SERVICES PVT. LTD.

INSPECTION AND TEST PLAN FOR FORGED, SEAMLESS & WELDED FITTINGS (16" NB & BELOW) VCS – ITP – PP – 2005

01	19/12/2021	<i>R. Jainivatan</i> SR	<i>[Signature]</i> MC	<i>[Signature]</i> HK	<i>[Signature]</i> GW
Rev. No	Date	Prepared By	Checked By	Approved By	Authorized By

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CONTROLLED COPY	:	If in soft and signed

REVISION RECORD						
Rev.	Revision Date	Prepared by	Checked by	Approved by	Authorized by	Revision Description
00	22/04/2020					
		MB	MC	AD	SK	
01	19/12/2021	<i>R. Geetha</i>	<i>[Signature]</i>	<i>[Signature]</i>	<i>[Signature]</i>	Revised as Marked
		SR	MC	HK	GW	



**INSPECTION AND TEST PLAN
FOR
FORGED, SEAMLESS & WELDED FITTINGS (16" NB & BELOW)**

**DOC NO: VCS-ITP-PP-2005
Rev No : 01**

ABBREVIATIONS:			
CE	Carbon Equivalent	PMI	Positive Material Identification
DCN	Dispatch Clearance Note	PO	Purchase Order
DFT	Dry Film Thickness	PQR	Procedure Qualification Record
DPT	Dye Penetrant Testing	PR	Purchase Requisition
HT	Heat Treatment	RT	Radiography Testing
IC	Inspection Certificate	TC	Test Certificate
IR	Inspection Report	TPI or TPIA	Third Party Inspection Agency
IRC	Inspection Release Certificate	UT	Ultrasonic Testing
ITP	Inspection and Test Plan	VDR	Vendor Data Requirement
MPT/MT	Magnetic Particle Testing	WPQ	Welders Performance Qualification
MTC	Material Test Certificate	WPS	Welding Procedure Specification
NDT	Non-Destructive Testing		
LEGENDS:			
H- Hold (Do not proceed without approval)			
W- Witness (Give due notice, work may proceed after scheduled date)			
P- Perform			
R- Review			
RW- Random Witness [As specified or 10% (min. 1 no. of each size and type of Bulk item)]			



**INSPECTION AND TEST PLAN
FOR
FORGED, SEAMLESS & WELDED FITTINGS (16" NB & BELOW)**

**DOC NO: VCS-ITP-PP-2005
Rev No : 01**

1.0 SCOPE:

This Inspection and Test Plan covers the minimum testing requirements of Forged, Seamless & Welded Fittings.

2.0 REFERENCE DOCUMENTS:

PO / PR / Standards referred there in / Job specifications / Approved documents.

3.0 INSPECTION AND TEST REQUIREMENTS:

SL.NO.	STAGE/ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB VENDOR	VENDOR	TPIA
1.0	Procedure						
1.1	Heat Treatment / NDT	Documented Procedures	100%	Procedure Documents	-	H	R
1.2	WPS, PQR & WPQ	Welding Parameters & Qualification Record	100%	WPS, PQR & WPQ	-	H	W- New R- Existing
2.0	Material Inspection						
2.1	Raw Material Identification (Billets, Rounds, Pipes, Coil, Plates, etc.)	Chemical and Mechanical Properties, Size & Steel making practice etc	100%	Mill test certificate, Vendor's Inspection Report	-	H	R

**INSPECTION AND TEST PLAN
FOR
FORGED, SEAMLESS & WELDED FITTINGS (16" NB & BELOW)**

**DOC NO: VCS-ITP-PP-2005
Rev No : 01**

SL.NO.	STAGE/ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB VENDOR	VENDOR	TPIA
3.0	In Process Inspection						
3.1	Welding	Welding Parameters as per WPS / PQR	100%	Inspection Reports	-	H	-
3.2	Heat Treatment	Stress Relieving, Normalising, Tempering, Solution Annealing, Stabilization Heat Treatment etc. as applicable	100%	HT chart	-	H	R
3.3	RT For Fittings As Applicable	Weld defects	PR / Purchase Specification	RT films & Reports	-	H	R (RT film review)
3.4	Identification of Test Samples	Product Chemical, Mechanical, Impact, Hardness and other test as applicable	One/Heat/Lot	Test Reports	-	H	H

**INSPECTION AND TEST PLAN
FOR
FORGED, SEAMLESS & WELDED FITTINGS (16" NB & BELOW)**

**DOC NO: VCS-ITP-PP-2005
Rev No : 01**

SL.NO.	STAGE/ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB VENDOR	VENDOR	TPIA
3.5	Product Analysis	Chemical Composition	PR/ Purchase Specification	Test Reports	-	H	R
3.6	Destructive Testing	Mechanical, Impact, Hardness and Other test as applicable	One/Heat/Lot	Test Reports	-	H	H
3.7	MPT/LPT	Surface & Internal Imperfections	PR/ Purchase Specification	NDT Reports	-	H	R
4.0	Final Inspection						
4.1	Visual and Dimensional Inspection (VDI)	Surface finish, Dimensions, Marking etc	100%	Inspection report	-	H	RW
4.2	PMI Check	Chemical Check	As Per Spec./Code	Inspection report	-	H	RW

**INSPECTION AND TEST PLAN
FOR
FORGED, SEAMLESS & WELDED FITTINGS (16" NB & BELOW)**

**DOC NO: VCS-ITP-PP-2005
Rev No : 01**

SL.NO.	STAGE/ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB VENDOR	VENDOR	TPIA
4.3	Final Stamping	Stamping of accepted Items	100%	Inspection report	-	H	H
5.0	Painting						
5.1	Rust Preventive Coating & Colour Coding	Visual Inspection & Colour Coding	100%	Inspection report	-	H	-
6.0	Documentation & IC						
6.1	Documentation & Inspection Certificate (IC)	Review of Stage Inspection Reports / Test Reports & Issue of IC	100%	Vendor TC & IC	-	H	H
7.0	Final Documentation and Submission of Reports	Compilation of IR/IRC/DCN/MTC/DRGS. /VDR	100%	Compliance Certificate (Note-1)	-	H	-



**INSPECTION AND TEST PLAN
FOR
FORGED, SEAMLESS & WELDED FITTINGS (16" NB & BELOW)**

**DOC NO: VCS-ITP-PP-2005
Rev No : 01**

NOTES (As applicable):

1. If the certification is specified as EN 10204 Type 3.1 in Datasheet / Material Requisition, then '**W**' may be replaced with '**R**' with Material Traceability.
2. ITP shall be submitted including but not limited to the item/activity covered above. Any item/activity identified and required for the completeness shall also be covered in the ITP submitted by the manufacturers.



VCS QUALITY SERVICES PVT. LTD.

INSPECTION AND TEST PLAN FOR INSULATING JOINTS VCS – ITP – PP – 2006

02	19/12/2021	<i>R. Srinivasan</i>	<i>[Signature]</i>	<i>[Signature]</i>	<i>[Signature]</i>
Rev. No	Date	Prepared By	Checked By	Approved By	Authorized By

UNCONTROLLED COPY	: If printed
CONTROLLED COPY	: If in soft and signed

**INSPECTION AND TEST PLAN
FOR
INSULATING JOINTS**

DOC NO: VCS-ITP-PP-2006
Rev No : 02

REVISION RECORD						
Rev.	Revision Date	Prepared by	Checked by	Approved by	Authorized by	Revision Description
00	06/06/2017					Issued as Standard
		GS	ADE	AD	SK	
01	22/04/2020					Document formatting, numbering updated from VCS-SD-ITP-006 to VCS-ITP-PP-2006 .
		MB	MC	AD	SK	
02	19/12/2021	<i>Rajinikanth</i>	<i>[Signature]</i>	<i>[Signature]</i>	<i>[Signature]</i>	Revised as Marked
		SR	MC	HK	GW	

**INSPECTION AND TEST PLAN
FOR
INSULATING JOINTS**

DOC NO: VCS-ITP-PP-2006
Rev No : 02

ABBREVIATIONS:			
CE	Carbon Equivalent	PO	Purchase Order
DFT	Dry Film Thickness	PQR	Procedure Qualification Record
DPT	Dye Penetrant Testing	PR	Purchase Requisition
HT	Heat Treatment	RT	Radiography Testing
IC	Inspection Certificate	TC	Test Certificate
ITP	Inspection and Test Plan	TPI or TPIA	Third Party Inspection Agency
MPT/MT	Magnetic Particle Testing	UT	Ultrasonic Testing
MTC	Material Test Certificate	VDR	Vendor Data Requirement
NDT	Non-Destructive Testing	WPQ	Welders Performance Qualification
PMI	Positive Material Identification	WPS	Welding Procedure Specification
LEGENDS:			
H - Hold (Do not proceed without approval)			
W - Witness (Give due notice, work may proceed after scheduled date)			
P - Perform			
R - Review			
RW - Random Witness [As specified or 10% (min.1 no. of each size and type of Bulk items)]			

1.0 SCOPE:

This Inspection and Test Plan covers the minimum testing requirements of Insulating Joints.

2.0 REFERENCE DOCUMENTS:

PO / PR / Standards referred there in / Job specifications / Approved documents.

3.0 INSPECTION AND TEST REQUIREMENTS:

SL.NO.	STAGE/ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB VENDOR	VENDOR	TPIA
1.0	Procedure						
1.1	Hydrostatic Test, NDT and other procedures	Documented Procedures	100%	Procedure Documents	-	H	R
1.2	WPS/ PQR /WPQ	Documented procedures	100%	Procedure Documents	-	H	R-Existing W-New
2.0	Material Inspection						

**INSPECTION AND TEST PLAN
FOR
INSULATING JOINTS**

DOC NO: VCS-ITP-PP-2006
Rev No : 02

SL.NO.	STAGE/ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB VENDOR	VENDOR	TPIA
2.1	1) Forging 2) Pup Piece	Chemical / Mechanical Properties, NDT, HT and other requirement as per purchase specification.	100%	MTC & Inspection Record	H	W	W
2.2	Gasket, Insulating Ring, Filling Material, etc.	As per material spec./code	100%	MTC & Inspection Record	H	H	R
3.0	In Process Inspection						
3.1	Welding	Welding Parameters, NDT (as applicable)	100%	NDT Records/RT films	-	W	R
4.0	Final Inspection						
4.1	Hydro Testing, Air Leak test, Vacuum test (As applicable)	Leak Check	100%	Test Report	-	H	H

**INSPECTION AND TEST PLAN
FOR
INSULATING JOINTS**

DOC NO: VCS-ITP-PP-2006
Rev No : 02

SL.NO.	STAGE/ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB VENDOR	VENDOR	TPIA
4.2	Visual and Dimension Check	Visual and Dimension Check	100%	Inspection Report	-	H	RW
4.3	Dielectric Test	Insulating Resistance	100%	Inspection Report	-	W	W
5.0	Painting						
5.1	Final painting (as applicable)	Paint Scheme, Visual & Paint thickness check	100%	Inspection Report	-	H	R
6.0	Documentation & IC						
6.1	Stamping and review of inspection documents, issue of IC	Review of documents for compliance as per PR.	100%	IC	-	-	H

**INSPECTION AND TEST PLAN
FOR
INSULATING JOINTS**

DOC NO: VCS-ITP-PP-2006
Rev No : 02

SL.NO.	STAGE/ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB VENDOR	VENDOR	TPIA
7.0	Review of final documentation	Compilation of documents as per VDR attached with PR records for submission to customer	100%	Dossier/Completion Certificate (EN 10204 Type 3.2)	-	H	H

NOTES (As applicable):

1. Items shall be EN 10204 Type 3.2 Certified.
2. ITP shall be submitted including but not limited to the item/activity covered above. Any item/activity identified and required for the completeness shall also be covered in the ITP submitted by the manufacturers.

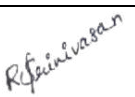


VCS QUALITY SERVICES PVT. LTD.

INSPECTION AND TEST PLAN FOR BALL VALVE VCS – ITP – PP – 2007

04	27/05/2022	SR	MC	HK	GW
Rev. No	Date	Prepared By	Checked By	Approved By	Authorized By

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CONTROLLED COPY	:	If in soft and signed

REVISION RECORD						
Rev.	Revision Date	Prepared by	Checked by	Approved by	Authorized by	Revision Description
00	16/06/2017					
		GS	ADE	AD	SK	
01	20/01/2020					Formatting update, Doc Numbering change from VCS-SD-ITP-007 to VCS-ITP-PP-2007
		AG	MC	AD	SK	
02	19/05/2020					Revised as Marked
		AG	MC	AD	SK	
03	19/12/2021					Revised as Marked
		SR	MC	HK	HK	
04	27/05/2022					Revised as Marked
		SR	MC	HK	HK	

ABBREVIATIONS:

CE	Carbon Equivalent	NDT	Non-Destructive Testing
DCN	Dispatch Clearance Note	PO	Purchase Order
DFT	Dry Film Thickness	PQR	Procedure Qualification Record
DPT	Dye Penetrant Testing	PR	Purchase Requisition
HT	Heat Treatment	RT	Radiography Testing
ITP	Inspection and Test Plan	TC	Test Certificate
IC	Inspection Certificate	TPI or TPIA	Third Party Inspection Agency
IGC	Inter Granular Corrosion	UT	Ultrasonic Testing
IR	Inspection Report	VDR	Vendor Data Requirement
IRC	Inspection Release Certificate	WPQ	Welders Performance Qualification
MPT / MT	Magnetic Particle Testing	WPS	Welding Procedure Specification
MTC	Material Test Certificate		

LEGENDS:

H - Hold (Do not proceed without approval)

W - Witness (Give due notice, work may proceed after scheduled date)

P - Perform

R - Review

RW - Random Witness [As specified or 10% (min.1 no. of each size and type of Bulk items)]

1.0 SCOPE:

This Inspection and Test Plan covers the minimum testing requirements of Ball Valves.

2.0 REFERENCE DOCUMENTS:

PO / PR / Standards referred there in / Job specifications / Approved documents.

3.0 INSPECTION AND TEST REQUIREMENTS:

SL. NO.	COMPONENT & OPERATION	CHARACTERISTICS / METHOD OF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENT & ACCEPTANCE CRITERIA	FORMAT OF RECORD	SCOPE OF INSPECTION		
						SUB VENDOR	VENDOR	TPIA
1.0	PROCEDURES							
1.1	Hydrostatic Test, NDT and Other Procedures	Documented Procedures	100%		Procedure Documents	-	H	R
1.2	WPS,PQR & WPQ	Welding Parameters & Qualification Record	100%		WPS ,PQR & WPQ	-	H	W- New R- Existing
1.3	Pre-Qualification Tests	Fire safe, Cryogenic & Other Test as applicable	As per PR/Purchase Specification		Acceptance Report	-	H	H (If new)
2.0	RAW MATERIAL							
2.1	Forging / Casting:							
	1) Body	Visual & Dimension	100%	Material & Technical Specification	Inspection Report	H	H	-
	2) End Piece							
	3) Ball	Chemical: Chemical Analysis IGC (For SS component)	All Heats	Material & Technical Specification	Vendor Test Certificate	H	R	R
	4) Seat Ring							
	5) Pup Piece (as applicable)	Mechanical: Mechanical Test	All Heats	Material & Technical Specification	Vendor Test Certificate	H	R	W (Note-1)

**INSPECTION AND TEST PLAN
FOR
BALL VALVE**

**DOC NO: VCS-ITP-PP-2007
Rev No : 04**

SL. NO.	COMPONENT & OPERATION	CHARACTERISTICS / METHOD OF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENT & ACCEPTANCE CRITERIA	FORMAT OF RECORD	SCOPE OF INSPECTION		
						SUB VENDOR	VENDOR	TPIA
		Impact Test (@ - 29°C): for CS Impact Test (@ - 45°C): for LTCS	All Heats	Material & Technical Specification / ASME B 16.34	Test Report	H	R	W (Note-1)
		Non-Destructive Examination (NDT): Radiography (100% Critical Area)	100%	Material & Technical Specification / ASME B 16.34	RT Report	H	R (RT-Film review)	R (RT-Film review)
		Non-Destructive Examination (NDT): Magnetic Particle Examination (100% exterior & accessible interior)	100%	Material & Technical Specification / ASME B 16.34	MPI Report	H	R	R
		ENP (For Ball): Visual, Thickness & Hardness	100%	25 microns (min) & 50 HRC (min)	Vendor Test Certificate	H	R	R
3.0	INCOMING / BOF ITEMS							
3.1	Stem	Chemical: Chemical Analysis	All Heats	Material & Technical Specification	Vendor Test Certificate	H	R	R
		Mechanical: Mechanical Test	All Heats	Material & Technical Specification	Vendor Test Certificate	H	R	R
3.2	Fasteners	Chemical: Chemical Analysis	All Heats	Material & Technical Specification	Vendor Test Certificate	H	R	R
		Mechanical: Mechanical Test	All Heats	Material & Technical Specification	Vendor Test Certificate	H	R	R
		Impact Test (@ - 29°C): for CS Impact Test (@ - 45°C): for LTCS	All Heats	Material & Technical Specification / ASME B 16.34	Test Report	H	R	R
3.3	Gaskets, Gear units, Gland, Packings, etc.	Physical / Chemical Properties	100%	Material & Technical Specification	Test Certificates & Lab Report	H	R	R

**INSPECTION AND TEST PLAN
FOR
BALL VALVE**

**DOC NO: VCS-ITP-PP-2007
Rev No : 04**

SL. NO.	COMPONENT & OPERATION	CHARACTERISTICS / METHOD OF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENT & ACCEPTANCE CRITERIA	FORMAT OF RECORD	SCOPE OF INSPECTION		
						SUB VENDOR	VENDOR	TPIA
4.0	MACHINED COMPONENTS							
4.1	Body, Connector, Ball & Seat Ring	Surface examination & Dimension Inspection: Visual & Measurement	100%	Manufacturer’s Drawing	Inspection Reports	100%	R	R
5.0	IN-PROCESS							
5.1	Body & Connector joint welding	Non-Destructive Examination (NDT): Magnetic Particle Examination (MPI)	100%	ASME Sec VIII - Appendix V & VI	MPI Report	100%	R	R
5.2	Valve & Pup Piece Bevel Ends joint welding	Non-Destructive Examination (NDT): Radiography (100% on weld joint)	100%	ASME B16.34	RT Report	100%	R (RT-Film review)	R (RT-Film review)
6.0	FINAL INSPECTION							
6.1	Finished Valve Assembly: Pressure Test & Final Inspection	Shell Test: Hydrostatic	100%	Testing Procedure as per Code	Test Record	-	H	RW
6.2		Seat Test: Hydrostatic				-	H	RW
6.3		Seat Test: Pneumatic				-	H	RW
6.4		Functional Test - Actuated Valve @ Atm. Pressure & Max. Diff. Pressure: Operation- Open / Close				-	H	RW
6.5		Double Block & Bleed: Hydrostatic				-	H	RW
6.6		Final Inspection: Visual, Dimension, TC Verification, Special Requirements & Marking as per sale order	100%	Approved GA Drawing (if applicable)	Test Report	-	H	RW
6.7		Anti-Static Test	100%	API 6D & Technical Specification	Test Record	-	H	RW

SL. NO.	COMPONENT & OPERATION	CHARACTERISTICS / METHOD OF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENT & ACCEPTANCE CRITERIA	FORMAT OF RECORD	SCOPE OF INSPECTION		
						SUB VENDOR	VENDOR	TPIA
6.8		Fire Safe Test	100%	API-6FA / ISO-10497	Fire safe type test report	-	H	R
6.9	Final Stamping	Stamping Of Accepted Valves	Stamping of Valves which are witnessed by VCS/TPIA	As per Tender Specification	Inspection Report	-	H	H
6.10	Strip Test	Component integrity, PMI of BOM	One per size per rating	-	Test report	H	H	H
7.0	PAINTING & PACKING	Surface examination & DFT Inspection: Visual & Measurement	100%	As per Tender Specification	Painting Record	-	H	R
8.0	DOCUMENTATION & INSPECTION CERTIFICATE(IC)	Review of Stage Inspection Reports / Test Reports & Issue of IC	100%	As per Tender Specification	Vendor TC & IC	-	H	H
9.0	FINAL DOCUMENTATION & SUBMISSION OF REPORTS	Compilation of IR/IRC/DCN/MTC/DRGS./VDR	100%	EN 10204 type 3.2/3.1 certification as specified in valve datasheet (Note-1)	Compliance Certificate	-	H	-

NOTES (As applicable):

1. If the certification is specified as EN 10204 Type 3.1 in Data sheet / Material Requisition, then 'W' may be replaced with 'R' with Material Traceability.
2. ITP shall be submitted including but not limited to the item/activity covered above. Any item/activity identified and required for the completeness shall also be covered in the ITP submitted by the manufacturers.



VCS QUALITY SERVICES PVT. LTD.

INSPECTION AND TEST PLAN FOR ASSORTED PIPES

VCS – ITP – PP – 2021

01	19/12/2021	SR	MC	HK	GW
Rev. No	Date	Prepared By	Checked By	Approved By	Authorized By

UNCONTROLLED COPY	:	If printed
CONTROLLED COPY	:	If in soft and signed

REVISION RECORD						
Rev.	Revision Date	Prepared by	Checked by	Approved by	Authorized by	Revision Description
00	22/04/2020					
		MB	MC	AD	SK	
01	19/12/2021	<i>R. Jainivason</i>	<i>[Signature]</i>	<i>[Signature]</i>	<i>[Signature]</i>	Revised as Marked
		SR	MC	HK	GW	

ABBREVIATIONS:			
CE	Carbon Equivalent	NDT	Non-Destructive Testing
HT	Heat Treatment	PO	Purchase Order
DCN	Dispatch Clearance Note	PMI	Positive Material Identification
IC	Inspection Certificate	PR	Purchase Requisition
IR	Inspection Report	TC	Test Certificate
IRC	Inspection Release Certificate	TPI or TPIA	Third Party Inspection Agency
ITP	Inspection and Test Plan	VDR	Vendor Data Requirement
MPT / MT	Magnetic Particle Testing		
LEGENDS:			
H- Hold (Do not proceed without approval)			
W- Witness (Give due notice, work may proceed after scheduled date).			
P- Perform			
R- Review			
RW - Random Witness (As specified or 10% (min.1 no. of each size and type of Bulk item))			

1. SCOPE

This Inspection and Test Plan covers the minimum testing requirements of small sizes and Assorted length Pipes.

2. REFERENCE DOCUMENTS:

PO/PR/ Standards referred there in/ Job specifications /Approved documents.

3. INSPECTION AND TEST REQUIREMENTS:

SL. NO.	STAGE/ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB VENDOR	VENDOR	TPIA
1.0	Pipe Inspection						
1.1	Pipe Inspection	Chemical & Mechanical Properties	100%	Test Certificates and marking on pipe (EN 10204 Type 3.2)	-	H	R
2.0	Final Inspection (In case of non-availability of 3.2 Certificate)						
2.1	Hydrostatic Testing	Leak Check	100%	Test Report	-	H	R
2.2	1) Visual 2) Dimension 3) Marking w.r.t MTC	Surface Condition, Straightness, End Finish, Bevel Angle, Root Face, Outer Dia., Thickness, Length, End Finish, Marking etc	100%	Inspection Report	-	H	RW

SL. NO.	STAGE/ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB VENDOR	VENDOR	TPIA
2.3	PMI Check	Chemical Check	As Per Spec.	Inspection Report	-	H	RW
2.4	Identification of Test Samples	Product Chemical, Mechanical, Impact and Other test as applicable	As Per Spec. / Code	Test Reports	-	H	H
2.5	Product Analysis	Chemical Composition	As Per Spec. / Code	Test Reports	-	H	R
2.6	Destructive Testing	Mechanical, Impact, and Other test as applicable	As Per Spec. / Code	Test Reports	-	H	H
2.7	PMI Check	Chemical Check	As Per Spec. / Code	Inspection Report	-	H	RW
2.8	Final Stamping	Stamping Of Accepted Pipes	Stamping of Pipes	Inspection Report	-	H	H

SL. NO.	STAGE/ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB VENDOR	VENDOR	TPIA
3.0	Painting						
3.1	Rust Preventive Coating & Colour Coding	Visual Inspection & Colour Coding	100%	Inspection Report	-	H	-
4.0	Documentation & IC						
4.1	Documentation & Inspection Certificate (IC)	Review of Stage Inspection Reports / Test Reports & Issue of IC	100%	Vendor TC/IR/IRC/DCN/DRGS. /VDR (Note-1)	-	H	-

NOTES (As applicable):

- Items shall be accepted based on EN 10204 type 3.2/3.1 certification as specified in material requisition.
- ITP shall be submitted including but not limited to the item/activity covered above. Any item/activity identified and required for the completeness shall also be covered in the ITP submitted by the manufacturers.



VCS PROJECTS CONSULTANTS PVT. LTD.

INSPECTION AND TEST PLAN FOR USE OF STOCK SMALL SIZES AND ASSORTED LENGTH PIPES

VCS – ITP – PP – 2025

00	04/01/2022	SR	MC	HK	GW
Rev. No	Date	Prepared By	Checked By	Approved By	Authorized By

UNCONTROLLED COPY	:	If printed
CONTROLLED COPY	:	If in soft and signed

REVISION RECORD						
Rev.	Revision Date	Prepared by	Checked by	Approved by	Authorized by	Revision Description
00	04/01/2022	R. Jain	MC	HK	GW	
		SR	MC	HK	GW	

Abbreviations:

CE	Carbon Equivalent	NPSH	Net Positive Suction Head
DFT	Dry Film Thickness	PO	Purchase Order
DPT	Dye Penetrant Testing	PESO	Petroleum Explosive Safety Organization
DHT	De-hydrogen Heat Treatment	PQR	Procedure Qualification Record
ERTL	Electronics Regional Test Laboratory	PR	Purchase Requisition
FCRI	Fluid Control Research Institute	PMI	Positive Material Identification
HT	Heat Treatment	RT	Radiography Testing
HIC	Hydrogen Induced Cracking	SSCC	Sulphide Stress Corrosion Cracking
ITP	Inspection and Test Plan	TC	Test Certificate
IP	Ingress Protection	TPI or TPIA	Third Party Inspection Agency
IHT	Intermediate Heat Treatment	UT	Ultrasonic Testing
IC	Inspection Certificate	VDR	Vendor Data Requirement
IGC	Inter Granular Corrosion	WPS	Welding Procedure Specification
MRT	Mechanical Run Test	WPQ	Welders Performance Qualification
NDT	Non-Destructive Testing	MPT / MT	Magnetic Particle Testing

1. SCOPE

This Inspection and Test Plan covers the minimum testing requirements of use of stock small sizes and assorted length pipes.

2. REFERENCE DOCUMENTS:

PO/ PR/ Standards referred there in/ Job specifications/ Approved documents.

3. INSPECTION AND TEST REQUIREMENTS:

S. No.	ACTIVITY	REFERENCE STANDARD	MIN. NO. OF TEST	PROCEDURE/ ACCEPTANCE CRITERIA	DOCUMENT TYPE	THIRD PARTY INSPECTION AGENCY
1.0	Visual Examination (For both identified & unidentified pipes)					
1.1	Pipe shall be cleaned from inside and outside.	ASTM A 106 & ASTM A 530	All Pipes	Air/ water cleaned	Inspection Report	R
2.0	Surface Defects					
2.1	Gouges/ Notches	ASTM A 106 & ASTM A 530	All Pipes	> Repair of pipe by grinding shall not reduce the wall thickness at any point to a thickness less than 90% of the nominal wall thickness. > Less than 90%-0% acceptable and shall be cut and balance pipe to be used	Inspection Report	W

S. No.	ACTIVITY	REFERENCE STANDARD	MIN. NO. OF TEST	PROCEDURE/ ACCEPTANCE CRITERIA	DOCUMENT TYPE	THIRD PARTY INSPECTION AGENCY
2.2	Grooves	-	All Pipes	0% acceptable and shall be cut and removed.	Inspection Report	W
3.0	Dent					
3.1	Dent that contains a stress concentrator such as a scratch, gouge, groove, or arc burn with scratch, groove etc.	-	All Pipes	Removed by cutting out the damaged portion of the pipe as a cylinder	Inspection Report	W
3.2	Dent affect the curvature of pipe	-	All Pipes	(i) Maximum depth of 1/4 in. (6 mm) in pipe NPS 12 (DN 300) is allowed and smaller. (ii) 2 % of the nominal pipe diameter in all pipe is allowed in size greater than NPS 12 (DN 300) Dents are removed, the damaged portion of the pipe shall be cut out as cylinder	Inspection Report	W
3.3	Dent in length	-	All Pipes	Length of the dent in any direction shall not exceed one-half the diameter pipe.	Inspection Report	R

S. No.	ACTIVITY	REFERENCE STANDARD	MIN. NO. OF TEST	PROCEDURE/ ACCEPTANCE CRITERIA	DOCUMENT TYPE	THIRD PARTY INSPECTION AGENCY
4.0	Other					
4.1	Corrosion	-	All Pipes	Wall thickness to check after removal of corrosion. Less than 90% of nominal wall thickness not acceptable nominal wall thickness.	Inspection Report	W
4.2	Pitting	-	All Pipes	Depth of pitting wall thickness to be checked. Thickness shall be more than 90% of nominal wall thickness Less than 90% shall be cut and removed.	Inspection Report	W
4.3	Wall thickness	ASTM A 106 & ASTM A 530	If the lot of pipe is known to be of uniform grade, size, and nominal thickness. 10% of the individual lengths, but not less than 10 lengths.	Measuring the thickness at quarter points on one end of each piece of pipe. The nominal wall thickness shall be considered as below the average of all the measurements taken, but in no case greater than 1.14 times the least measured thickness for all pipe smaller than NPS 20 (DN 500), and no greater than 1.11 times the least measured thickness for all pipe NPS 20 (DN 500) and larger.	Inspection Report	W

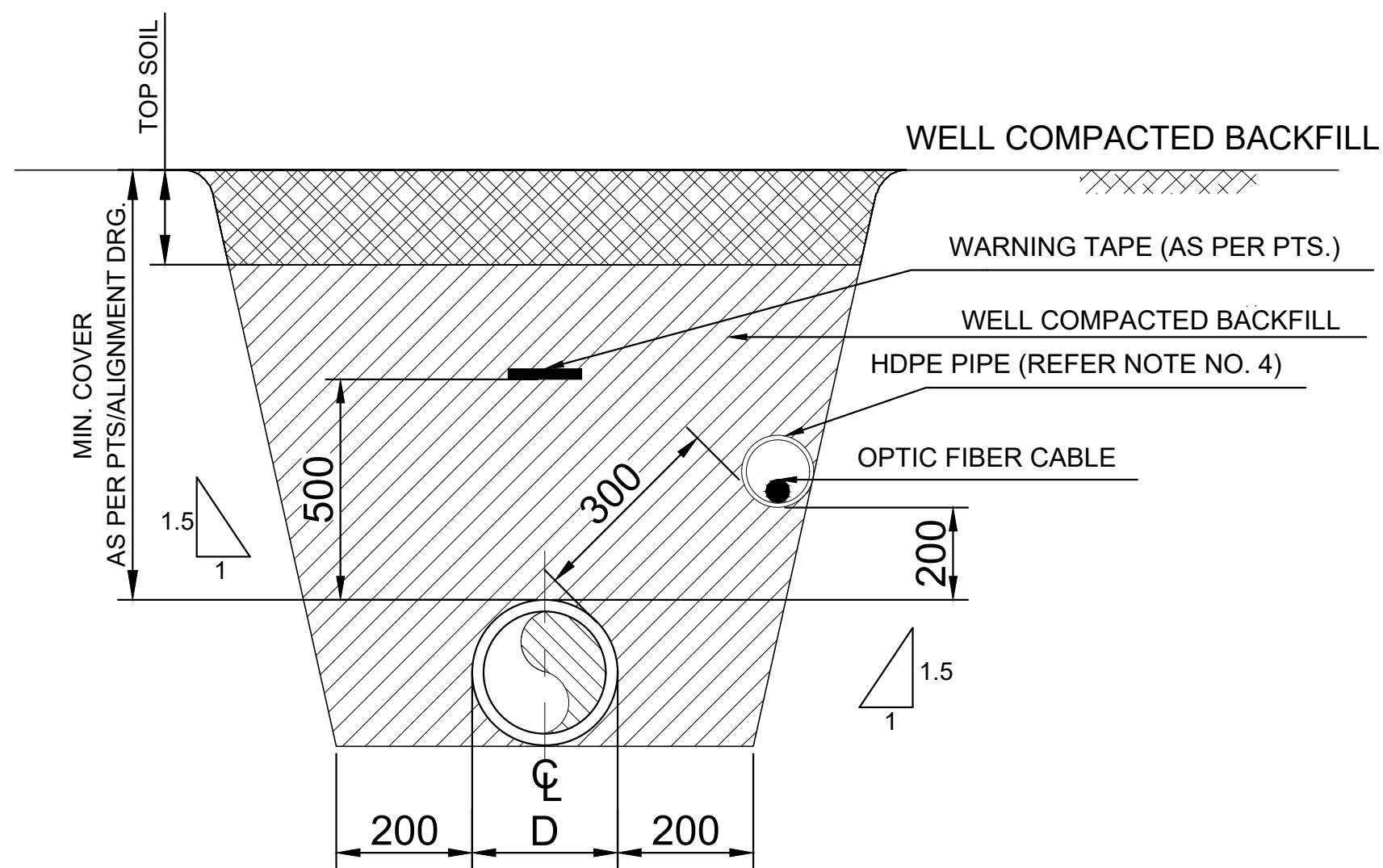
S. No.	ACTIVITY	REFERENCE STANDARD	MIN. NO. OF TEST	PROCEDURE/ ACCEPTANCE CRITERIA	DOCUMENT TYPE	THIRD PARTY INSPECTION AGENCY
			Thickness of the other lengths may be verified by applying a gauge set to the min. thickness.			

Legends: W - Witness, R – Review

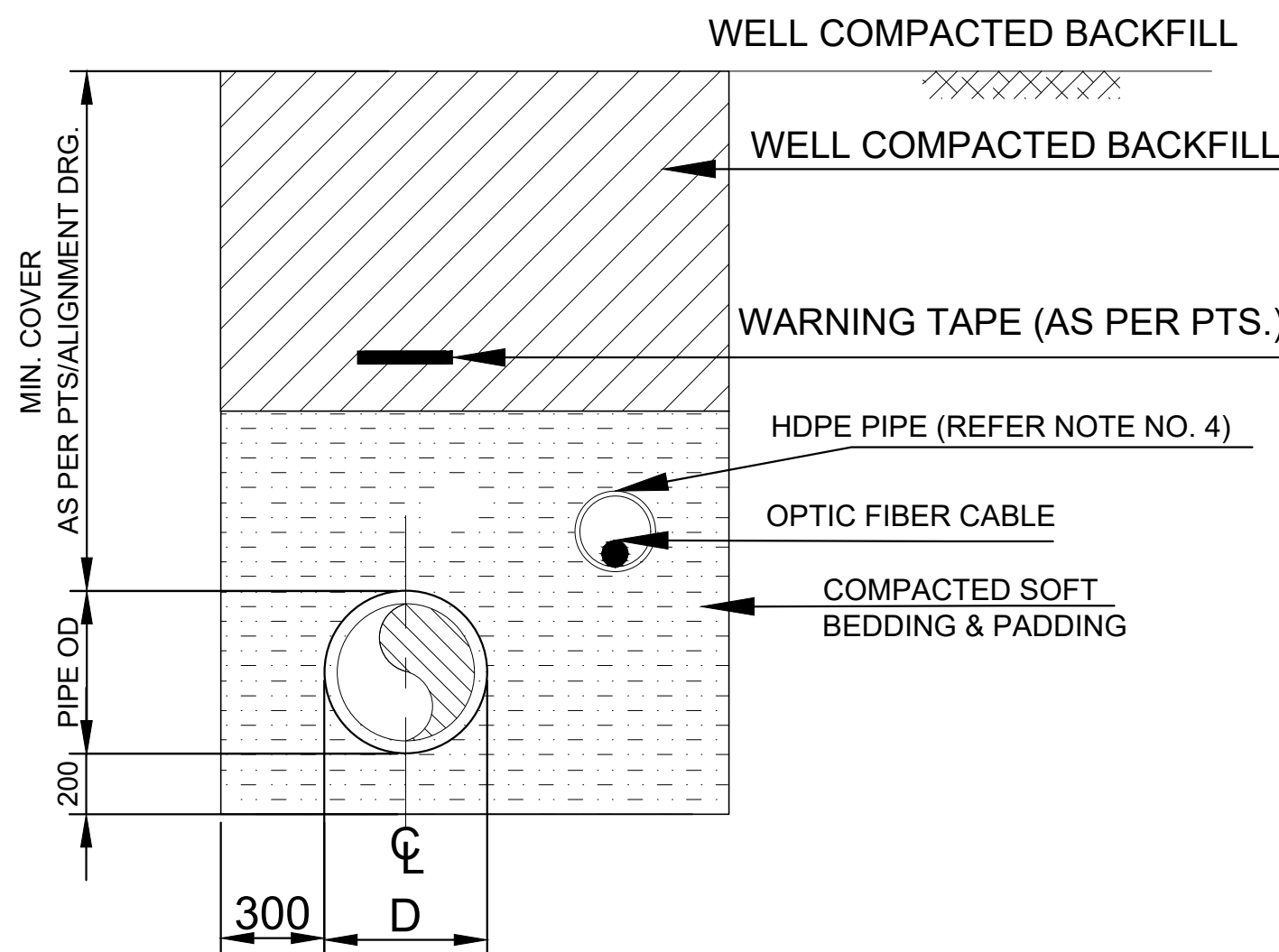
Notes:

1. Hydrotest is not required if thickness is more than 90% of nominal wall thickness. If metal loss pattern is observed having metal thickness less than 90% of nominal wall thickness, ASME B31G (modified) may be used for determination of residual strength of corroded pipe for suitability or hydrotest at site.
2. Gouges or grooves may be removed by grinding to a smooth contour, provided that the resulting wall thickness is not less than the minimum prescribed by this Code for the conditions of usage.
3. Certification requirements to comply with EN-10204, type-3.2 to be issued by TPIA appointed by manufacturer.
4. Pipe shall be retested hydrostatically either length by length in a mill type test or in the field after installation before being placed in service.

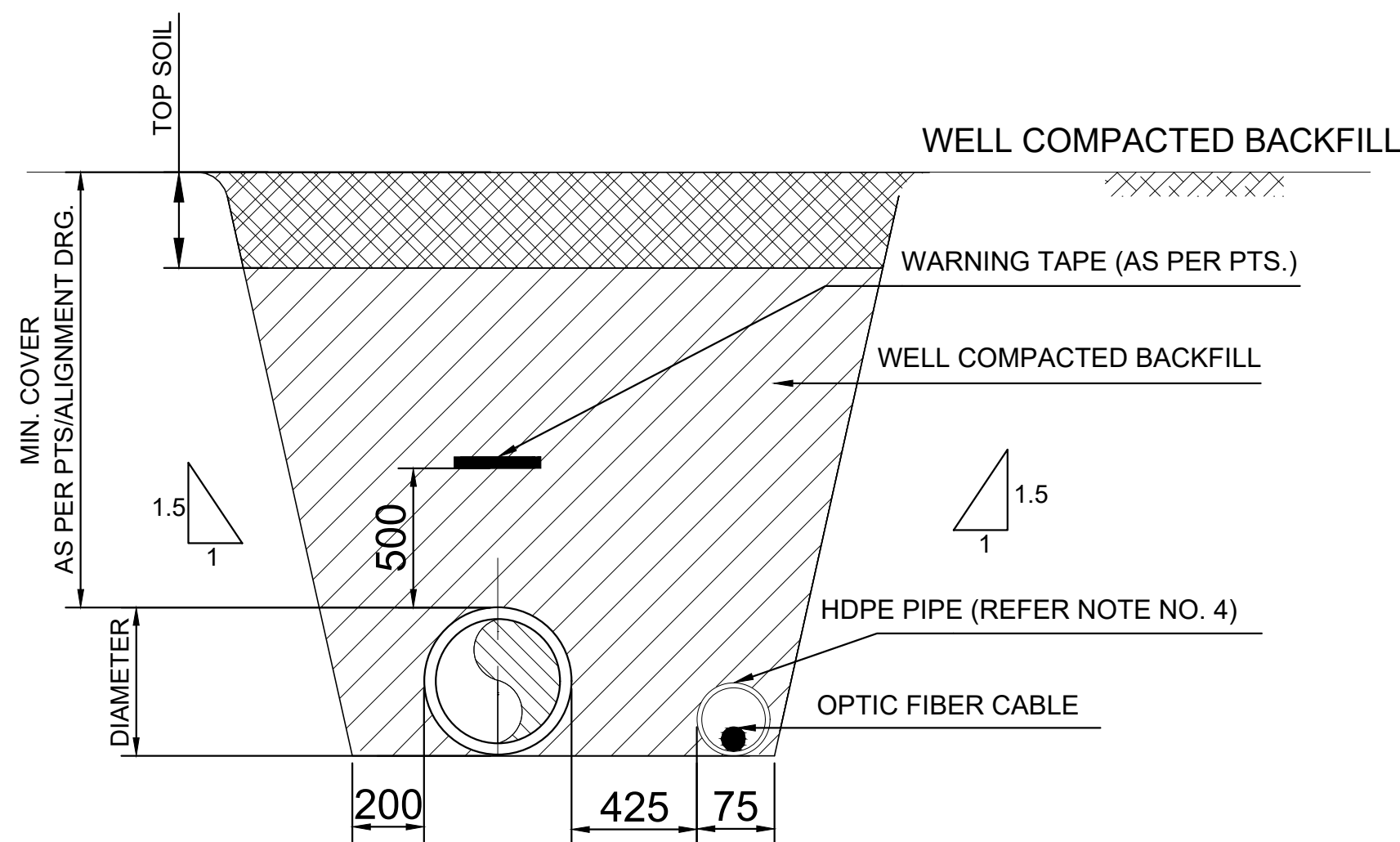
STANDARD DRAWINGS



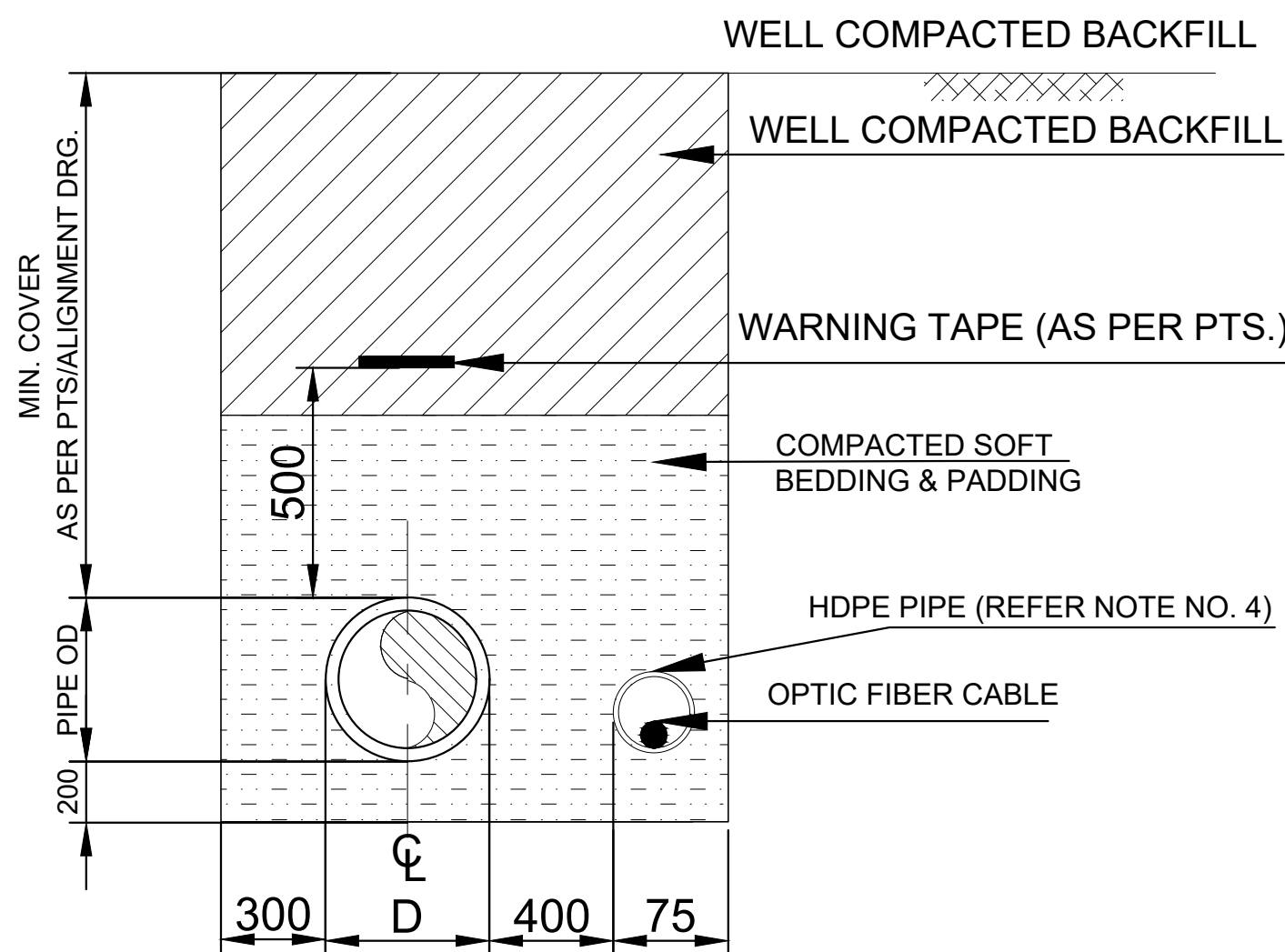
TYPICAL TRENCH DETAILS IN NORMAL SOIL
TYPE - 1



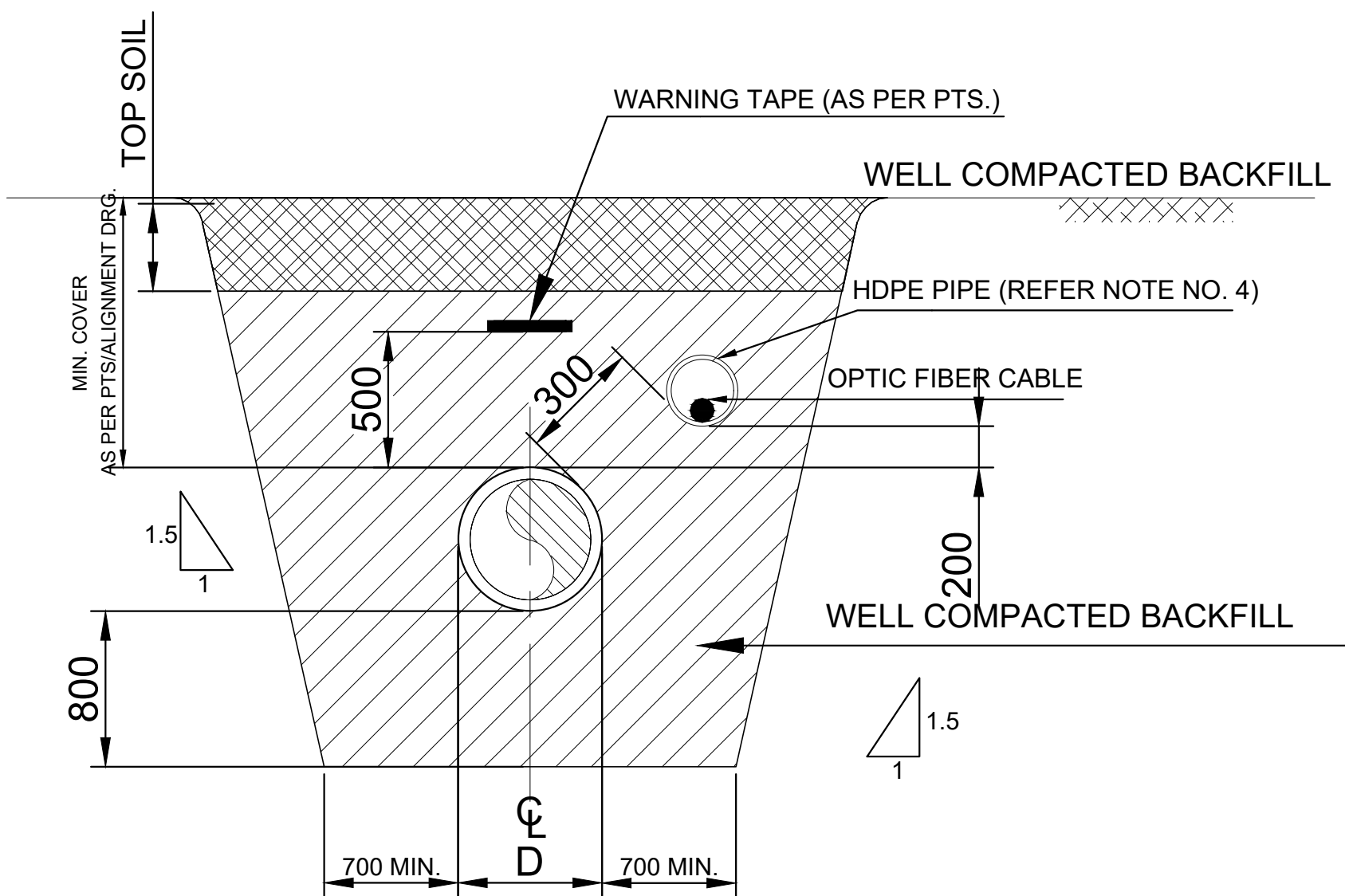
TYPICAL TRENCH DETAILS IN ROCK AREA
TYPE - 3



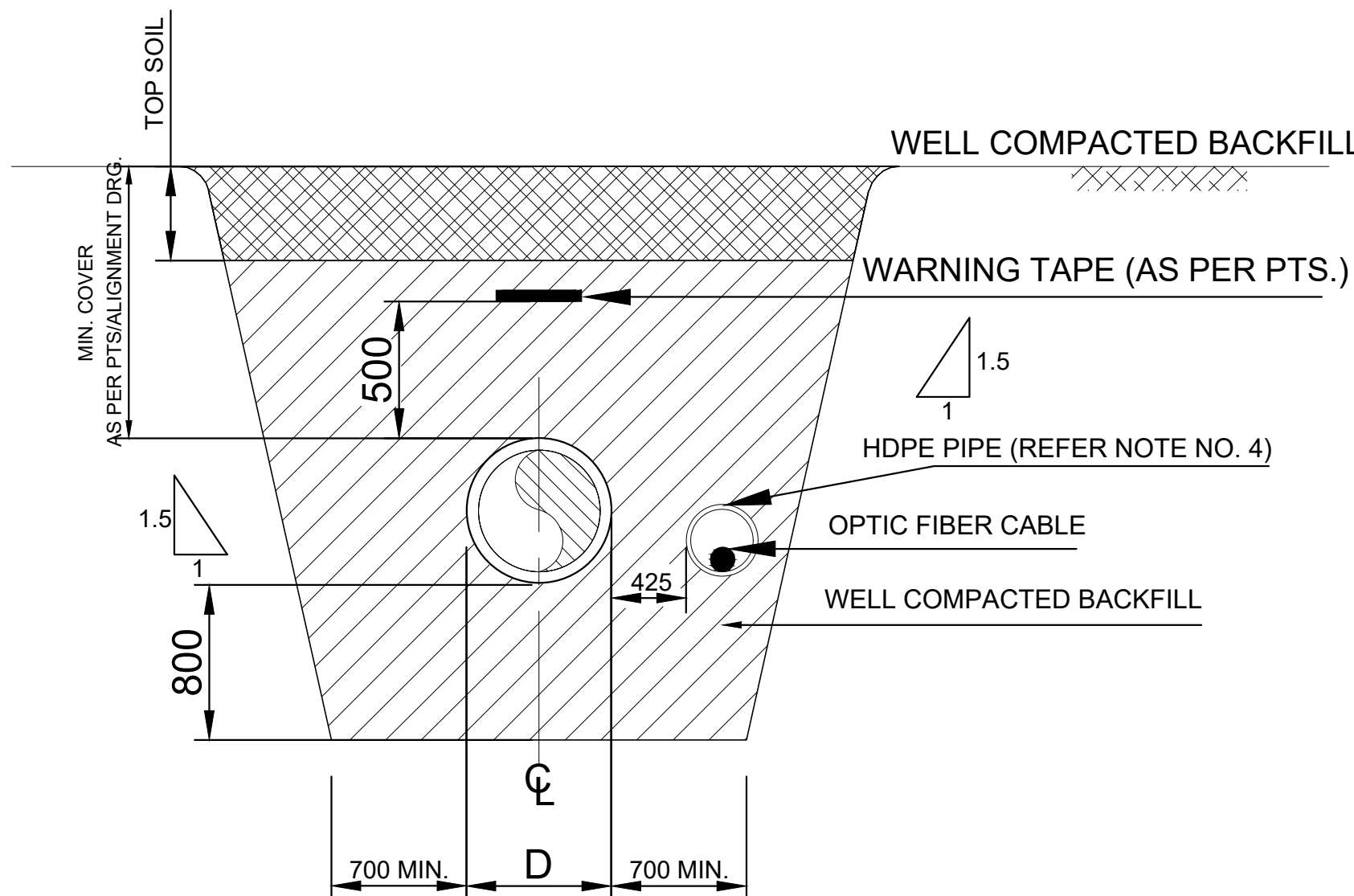
TYPICAL TRENCH DETAILS IN NORMAL SOIL
TYPE - 2



TYPICAL TRENCH DETAILS IN ROCK AREA
TYPE - 4



TYPICAL TRENCH DETAILS FOR SEISMIC FAULT (IN NORMAL SOIL) AREA
TYPE - 5



TYPICAL TRENCH DETAILS FOR SEISMIC FAULT (IN ROCK) AREA
TYPE - 6

NOTES :

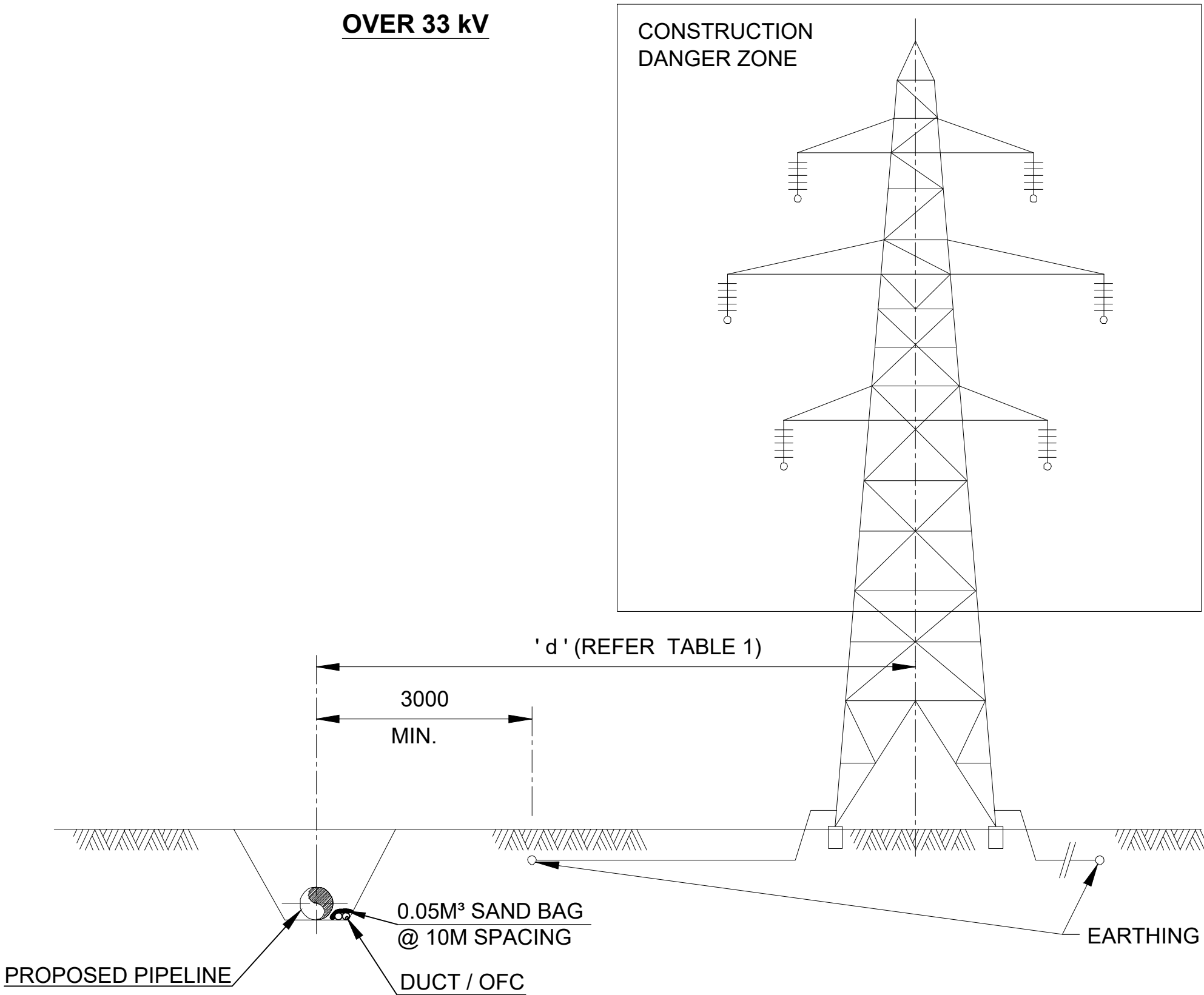
1. ALL DIMENSIONS ARE IN MM UNLESS NOTED OTHERWISE.
2. MINIMUM COVER OVER LINEPIPE SHALL BE AS PER PTS AND REQUIREMENT OF CONCERNED AUTHORITY.
3. THIS SKETCH IS INDICATIVE ONLY.
4. IF, AS PER SPECIFICATION, ARMoured OFC IS TO BE PROVIDED, IT WILL BE LAID ALONGWITH LINEPIPE AS PER THE APPROVED PROCEDURE.
5. TYPE OF TRENCHING TO BE USED SHALL BE AS PER PTS AND APPROVED PROCEDURE.
6. ALL TYPICAL CROSS SECTIONS MUST BE VIEWED LOOKING IN THE DIRECTION OF FLOW.
7. PARTICULAR TECHNICAL SPECIFICATION (PTS) INCLUDES DESIGN BASIS SCOPE OF WORK/ SOR, SPECIFICATION. IN CASE OF CONFLICT/ STRINGENT DEPTH OF COVES SHALL BE FOLLOWED.
8. PIPELINE SHALL BE LAID WITH IN ONE METER OF ROW.

00	13.02.23	ISSUED AS	STANDARD DRAWING	PSS	MC	HK
REV.	DATE	DESCRIPTION		PREP.	CHKD.	APPD.
PMC:						
 VCS QUALITY SERVICES PVT. LTD. Emerging Quality						
TITLE:						
TYPICAL TRENCH DETAILS						
SCALE:		N.T.S.	TOTAL NO. OF SHTS:		1 OF 1	
SIZE	JOB NO.		DRAWING NUMBER			REV.
A3	-----		VCS-00-PP-SD-2001			00

CROSSING OF HIGH VOLTAGE TRANSMISSION LINES

PARALLELISM TO HIGH VOLTAGE TRANSMISSION LINES

OVER 33 kV



UPTO 33 kV

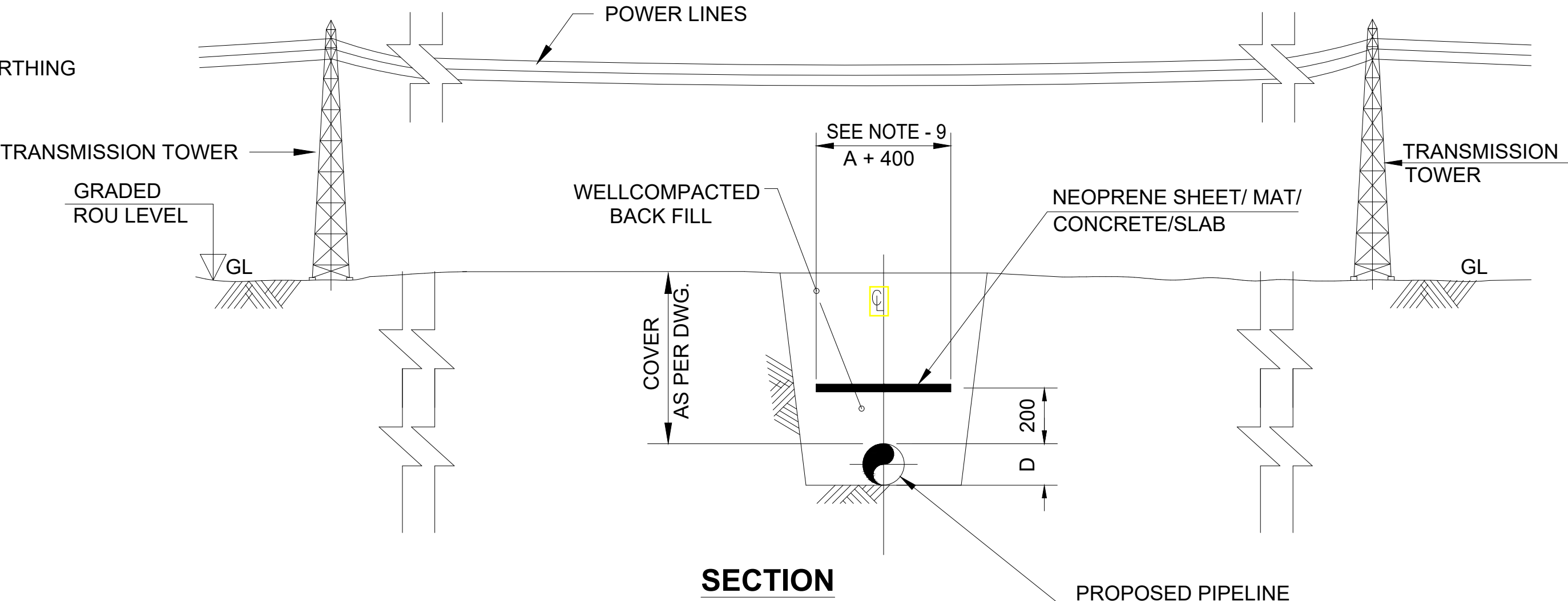
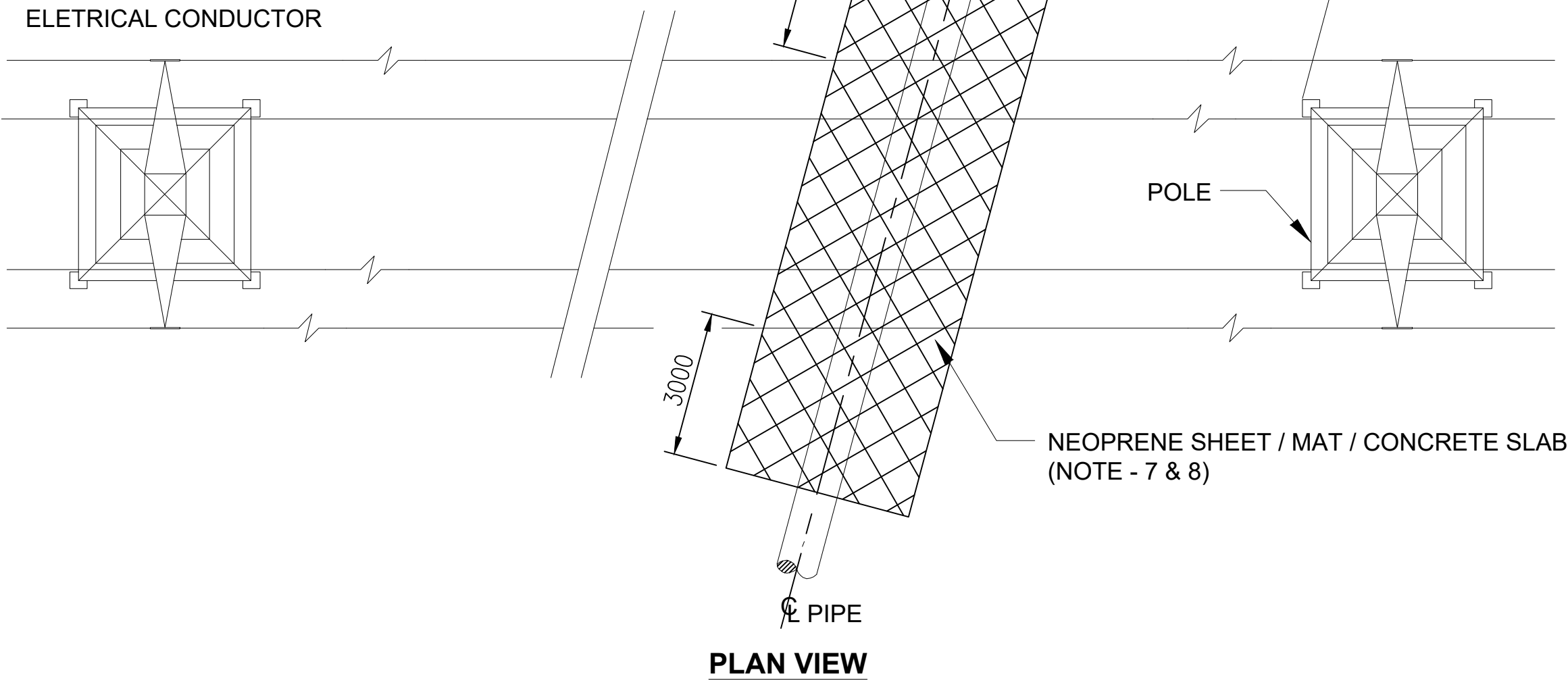
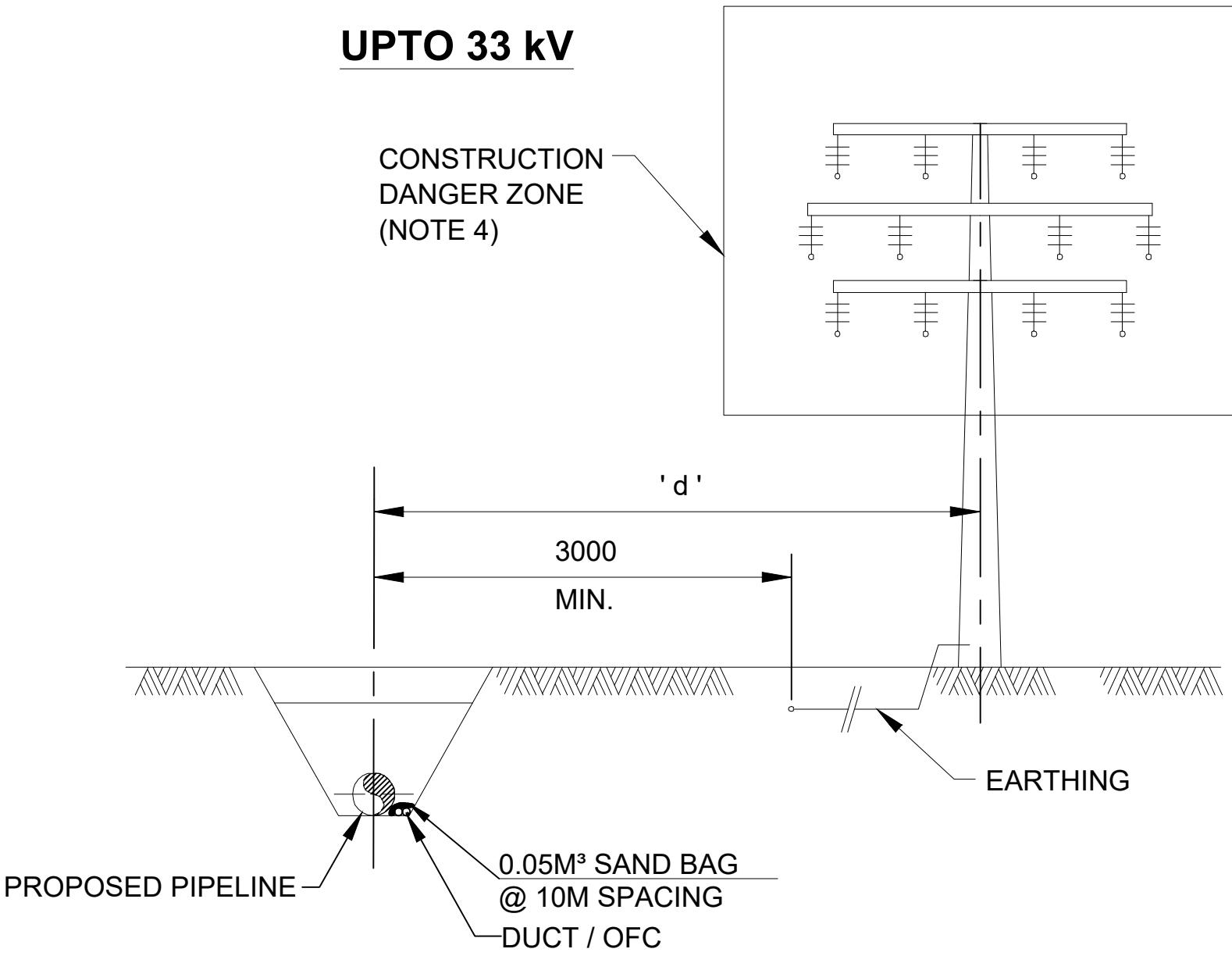


TABLE 1

MINIMUM DISTANCE FROM CENTERLINE OF PIPELINE TO POWER TRANSMISSION STRUCTURES

	PARALLELISM	CROSSING
ELETRICAL SYSTEM	ELETRICAL SYSTEM TO THE LINE AXIS ' d '	MINIMUM DISTANCE TO THE POLE ' d1 ' (NEAREST FOOTING) / EARTHING
UP TO 33 kV	5000	4000
OVER 33 kV	10000	4000

CROSSING DETAIL				
Sr.No.	CROSSING	PIPELINE ROUTE	WIDTH (M)	CONSTRUCTION METHOD

REFERENCE DRAWINGS / DOCUMENTS

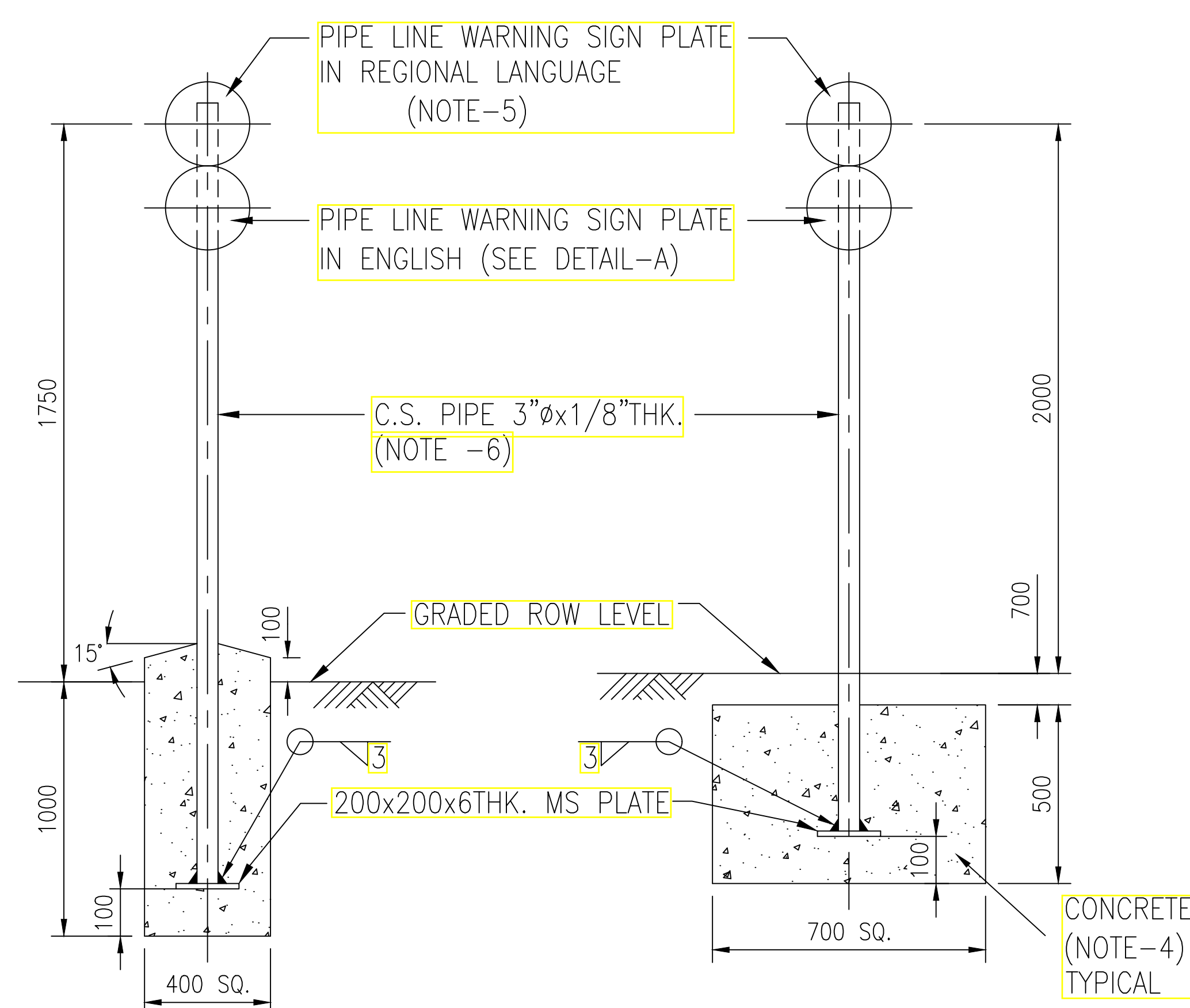
S.NO.	TITLE	NO.

NOTES:-

- ALL DIMENSIONS ARE IN MM UNLESS OTHERWISE STATED.
- IN CASE THE MINIMUM DISTANCE IS NOT MET, THE LOCAL ELECTRICAL COMPANY HAS TO BE CONTACTED FOR APPROVAL.
- STABILITY OF TIMBER POLE TO BE GUARANTEED DURING CONSTRUCTION.
- CONSIDERATION SHOULD BE GIVEN TO LIGHTNING FAULT, CURRENT PROTECTION OF PIPELINE & SAFETY OF PERSONNEL.
- IN CASE OF CROSSING OF HIGH VOLTAGE TRANSMISSION LINES, MIN. DISTANCE OF 3000 SHALL BE MAINTAINED FROM EARTHING.
- SUITABLE MEASURE SHALL BE TAKEN FOR THE PROTECTION OF THE LINE.
- CONCRETE SLAB/ NEOPRENE / MAT SHALL BE PROVIDED FOR OHL CROSSINGS FOR 33 KV AND ABOVE.
- CONCRETE SLAB SHALL BE AS PER DRAWING, C221070-00-PP-SD-2017 OR NEOPRENE SHEET SHALL BE 8MM THK.
- DIMENSION 'A' SHALL BE CALCULATED AS FOLLOWS: $A=(D1+D2+....Dn)+(n-1) \times 500$, WHERE D1,D2....Dn IS THE OUTSIDE DIAMETER (INCLUDING COATING) OF PIPELINES IN MM IN THE SAME TRENCH AND 'n' IS NO. OF PIPELINES, IN CASE OFC/DUCT IS ALSO PRESENT DIMENSION 'A' SHALL BE INCREASED BY 200MM. OFC/DUCT SHALL BE LAID AT A DISTANCE OF 200MM FROM EXTREME PIPE AS PER TRENCH SECTION DRAWING.
- FOR PIPELINE CROSSING OR LAYING PARALLEL TO H.T. LINE OF 420 KV SPECIAL PROVISION LIKE MITIGATOR SHALL BE USE AS PER CP DESIGN.

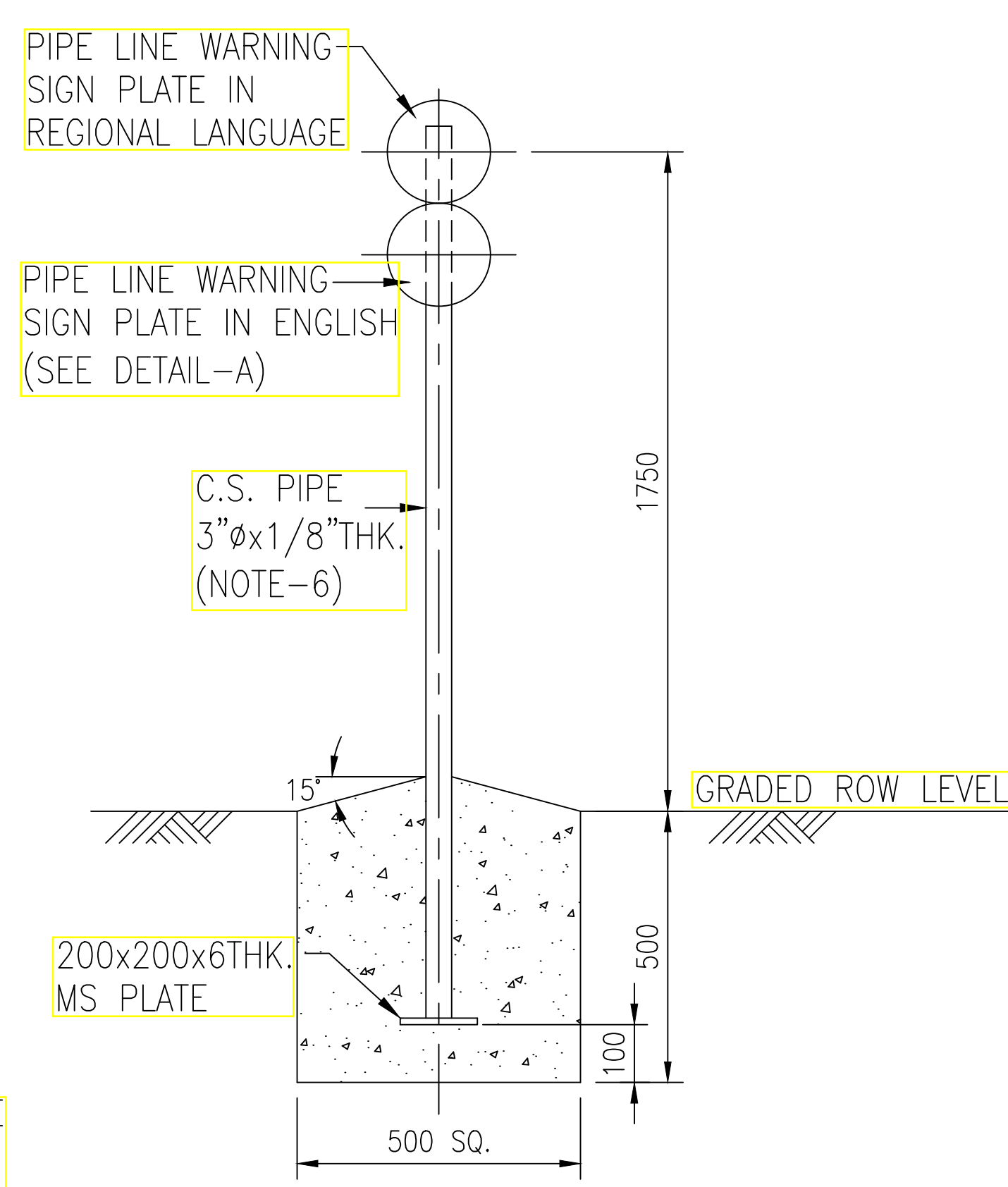
00	16.01.23	ISSUED AS STD. DRAWING	PSS	MC	HK
REV.	DATE	DESCRIPTION	PREP.	CHKD.	APPD.

PMC:  VCS QUALITY SERVICES PVT. LTD.				
TITLE: TYPICAL DRAWING FOR OVERHEAD POWER LINE CROSSING				
SCALE: N.T.S.		TOTAL NO. OF SHTS: 1 OF 1		
SIZE	JOB NO.	DRAWING NUMBER		REV.
A3	-----	VCS-00-PP-SD-2003		00

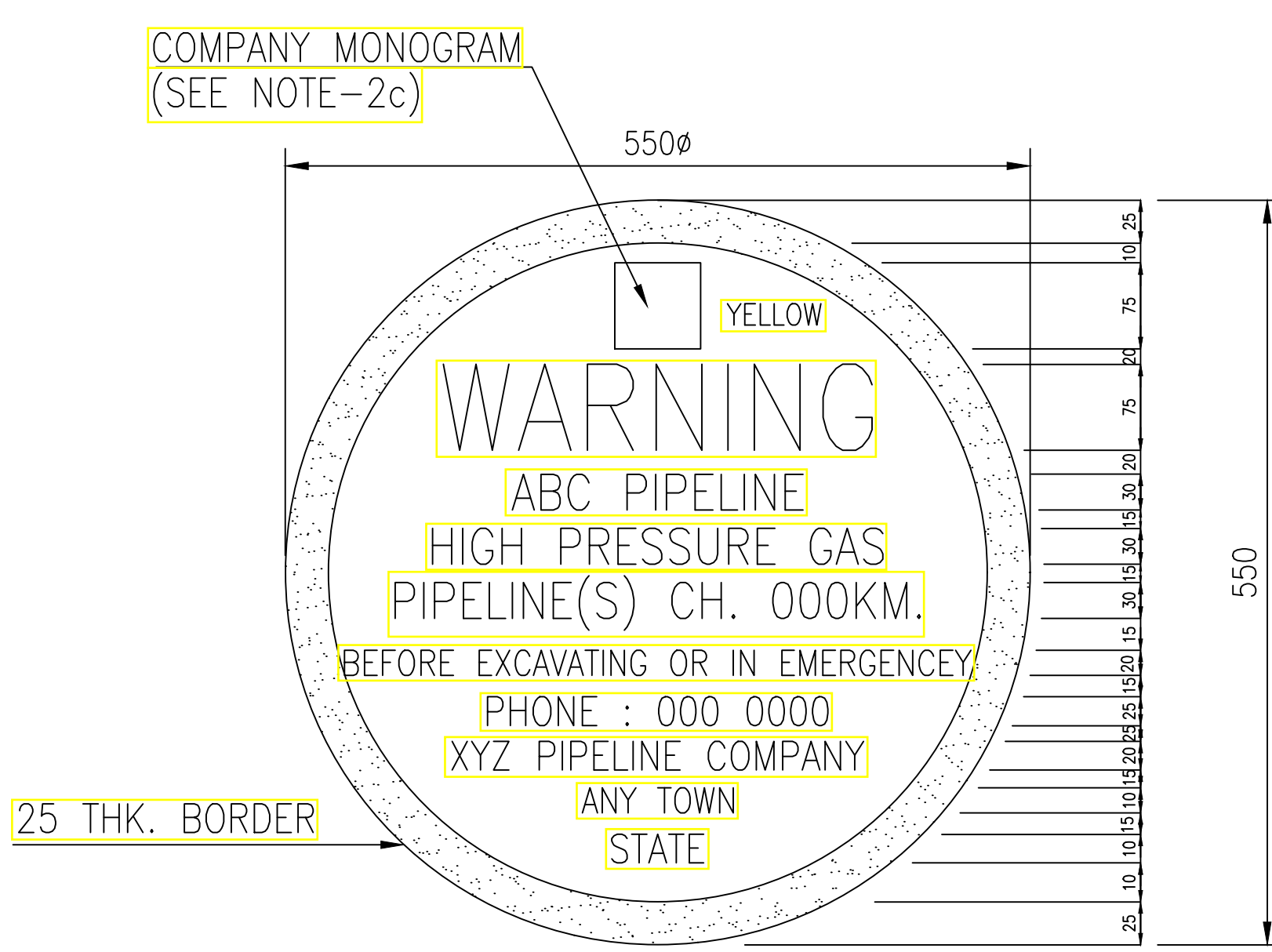


TYPE-I
FOR NORMAL SOIL

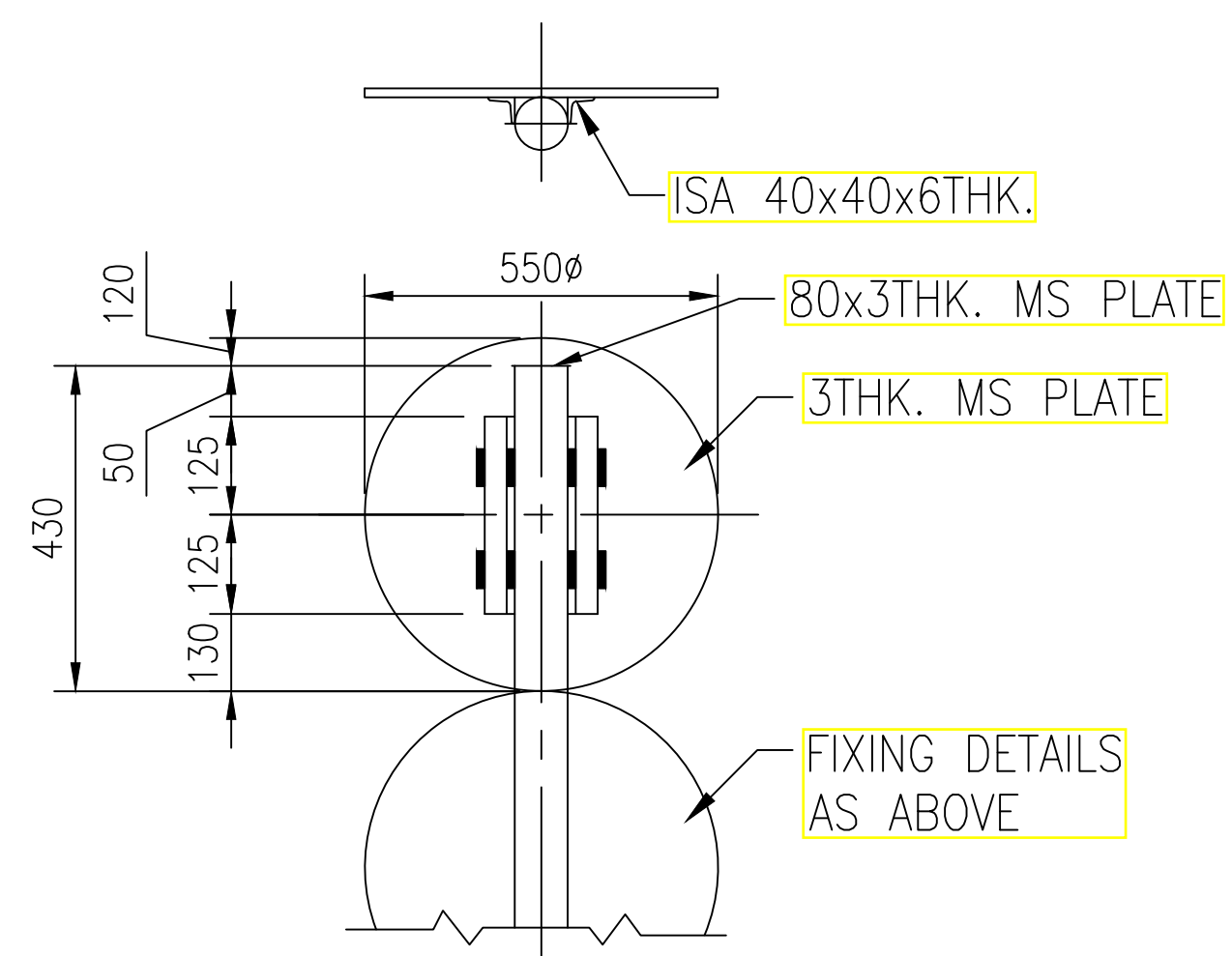
TYPE-II
FOR DRIFTING SAND AREAS
(NOTE-7)



TYPE-III
FOR ROCKY AREAS



DETAIL-A



WARNING SIGN PLATE
FIXING DETAILS

REFERENCE DRAWINGS / DOCUMENTS

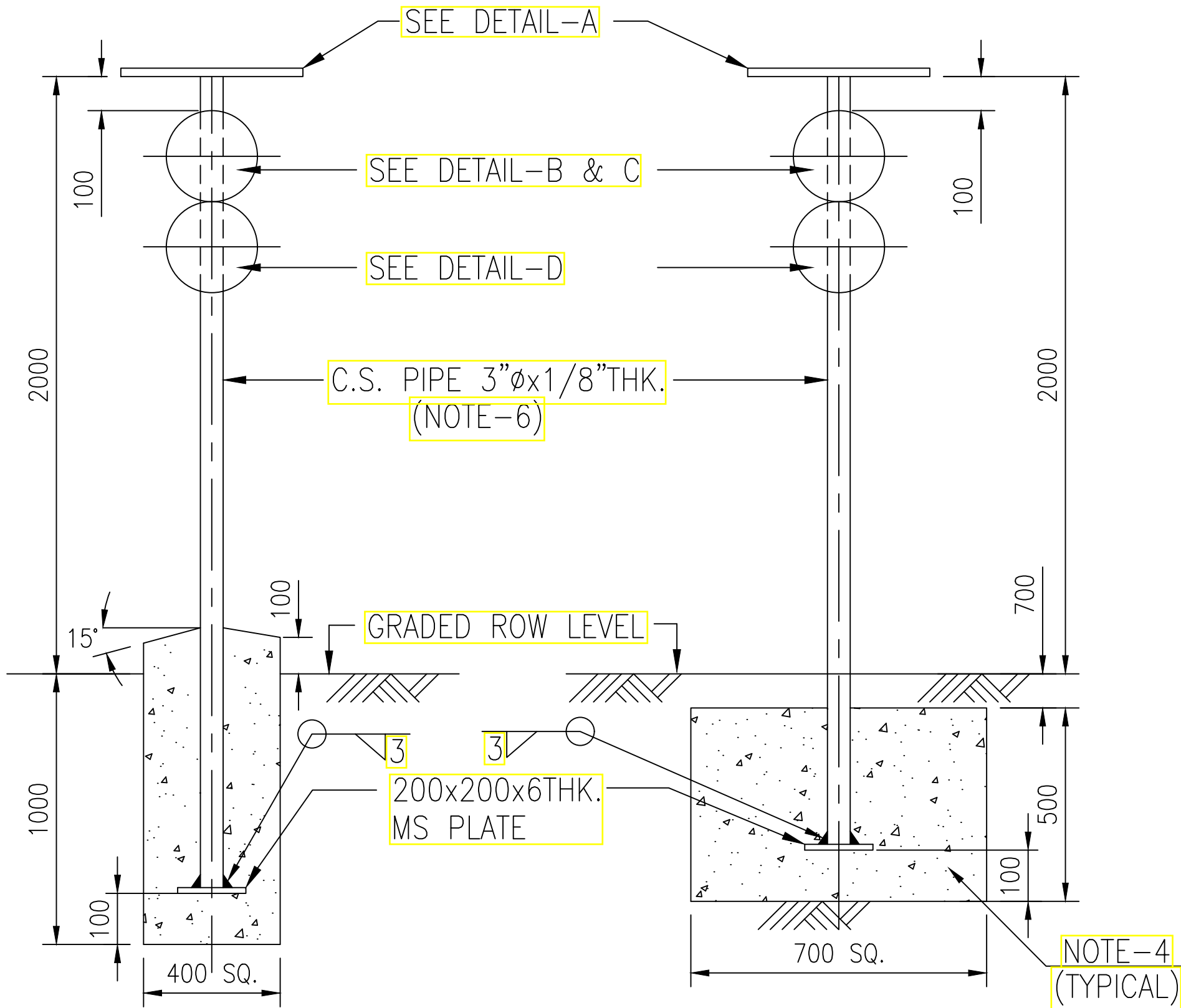
S.NO.	TITLE	NO.

- NOTES:-**
- ALL DIMENSIONS ARE IN MM UNLESS OTHERWISE STATED.
 - SCHEME OF PAINTING & COLOURING.
 - UNDERGROUND STEEL STRUCTURE (EXCEPT THAT EMBEDDED IN CONCRETE), : COAL TAR EPOXY MIN. 300 MICRON THK.
 - OVER GROUND STEEL STRUCTURE : ONE COAT OF PRIMER & TWO COATS SPECIFIED COLOUR PAINT.
 - COLOUR SCHEME FOR ABC PIPELINE CO. MONOGRAM SHALL BE AS DIRECTED BY OWNER.
 - ALL LETTERS SHALL BE PAINTED BLACK EXCEPT 'WARNING' WHICH SHALL BE PAINTED RED.
 - POST SHALL BE PAINTED WITH 250 WIDE ALTERNATE BANDS OF BLACK AND WHITE PAINT.
 - ALL OTHER ABOVEGROUND STEEL SHALL BE PAINTED YELLOW.
 - LOCATION:
 - THE PIPE LINE WARNING SIGN SHALL BE INSTALLED IN ACCORDANCE WITH CONTRACT REQUIREMENTS AND AS DIRECTED BY OWNER IT SHALL BE INSTALLED TO THE LEFT OF THE PIPE CENTER LINE, VIEWING IN THE DIRECTION OF FLOW AT 1000MM FROM PIPELINE O.D. AND THE WARNING SIGN PLATE SHALL FACE THE UTILITY BEING CROSSED.
 - THE WARNING SIGN PLATE MAY BE MOUNTED ON VENT PIPES OR KM POST WHERE EVER POSSIBLE.
 - THE FOUNDATION SHALL BE MADE OF CONCRETE M20.
 - SIGN PLATE IN REGIONAL LANGUAGE SHALL BE PREPARED BY CONTRACTOR ON SIMILAR LINES AND APPROVED BY THE OWNER.
 - THE MATERIAL FOR MARKERS SHALL BE AS FOLLOWING:
PLATE - IS2062, Gr. A
PIPE - IS - 1239
 - INTALLATION OF MARKERS ON SLOPE OF SAND DUNE SHALL BE AVOIDED. IN SUCH CASES, SAME SHALL BE INSTALLED EITHER BEFORE OR AFTER THE SAND DUNE SLOPE.

00	16.01.23	ISSUED AS STD. DRAWING	PSS	MC	HK
REV.	DATE	DESCRIPTION	PREP.	CHKD.	APPD.

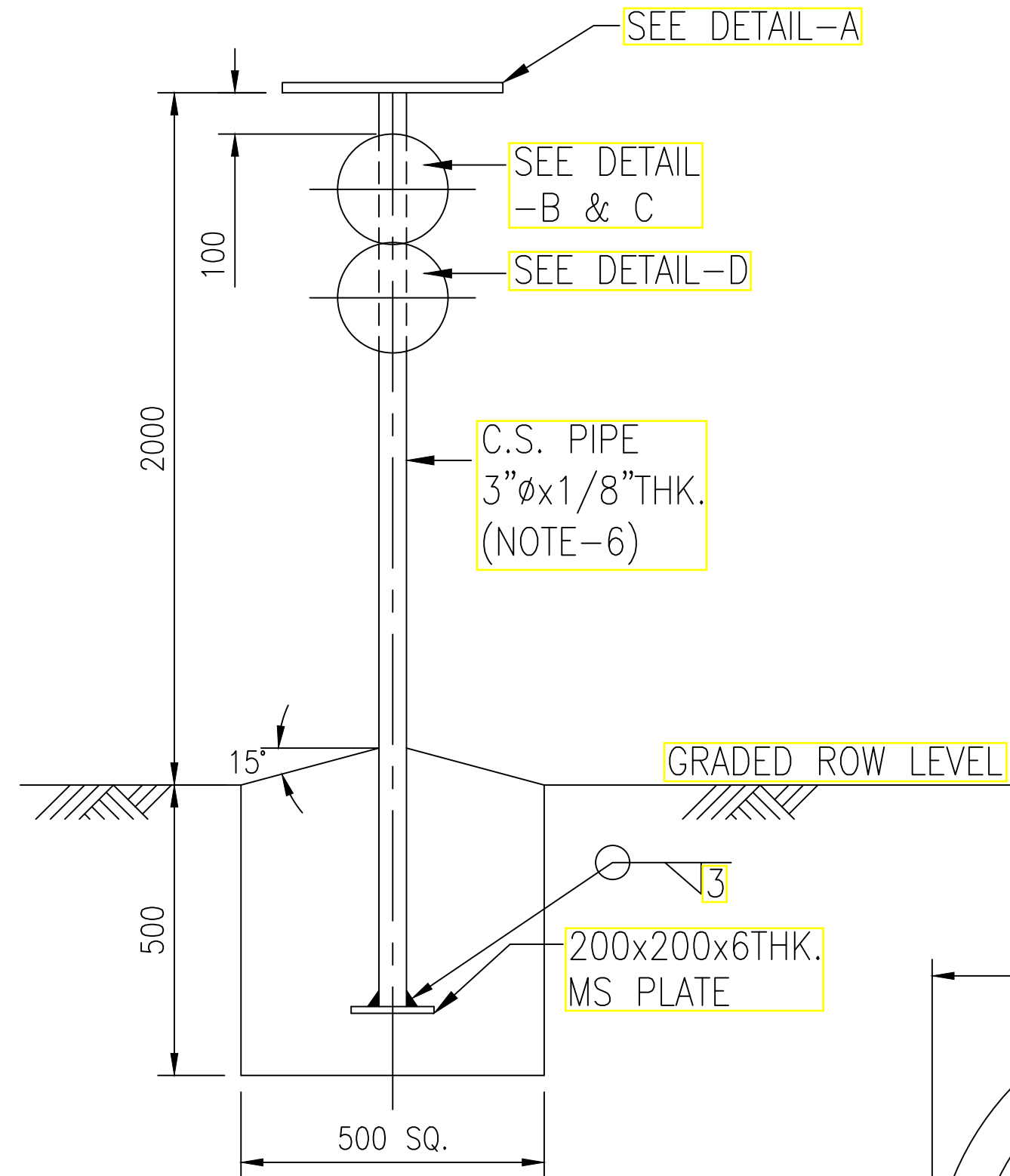
PMC:  VCS QUALITY SERVICES PVT. LTD.					
TITLE: TYPICAL DRAWING FOR PIPELINE WARNING SIGN					
SCALE: N.T.S.		TOTAL NO. OF SHTS: 1 OF 1			
SIZE	JOB NO.	DRAWING NUMBER		REV.	
A3	-----	VCS-00-PP-SD-2004		00	

CROSSING DETAIL				
Sr.No.	CROSSING	PIPELINE ROUTE	WIDTH (M)	CONSTRUCTION METHOD

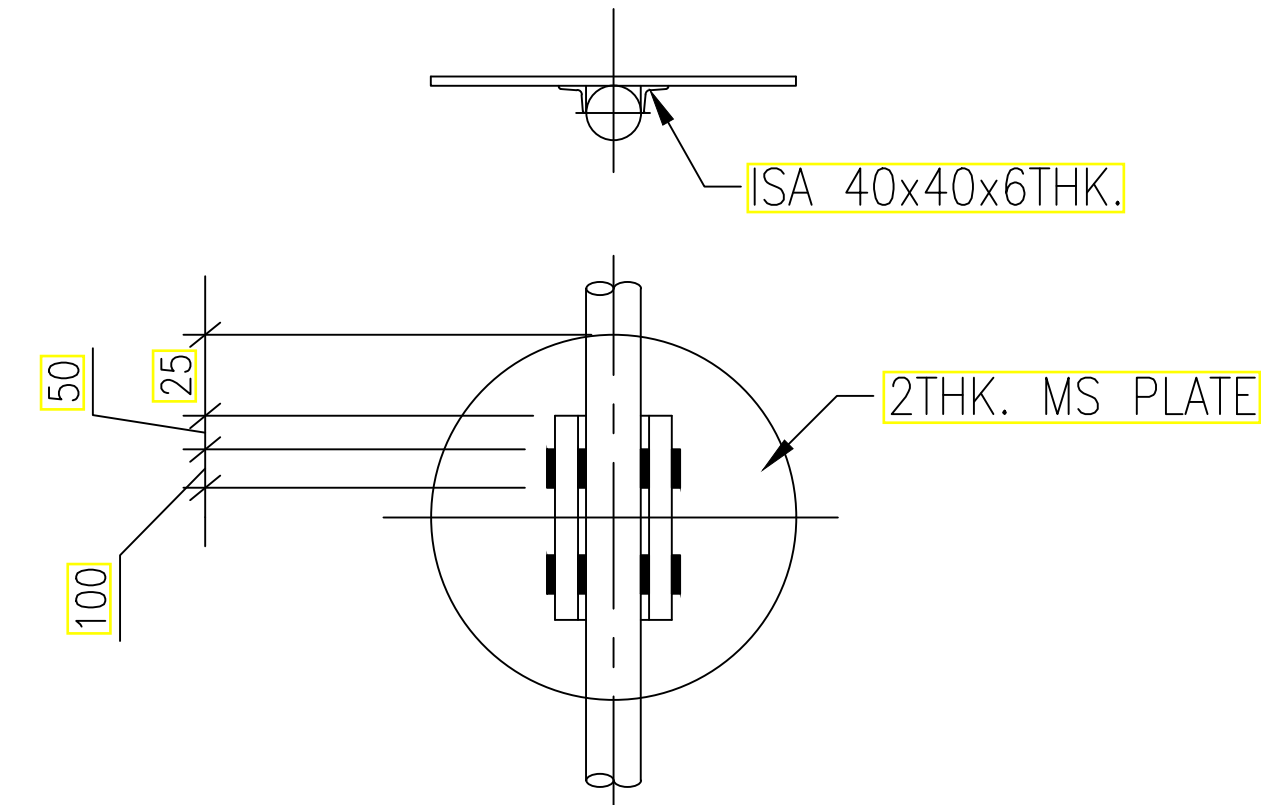


TYPE-I
FOR NORMAL SOIL

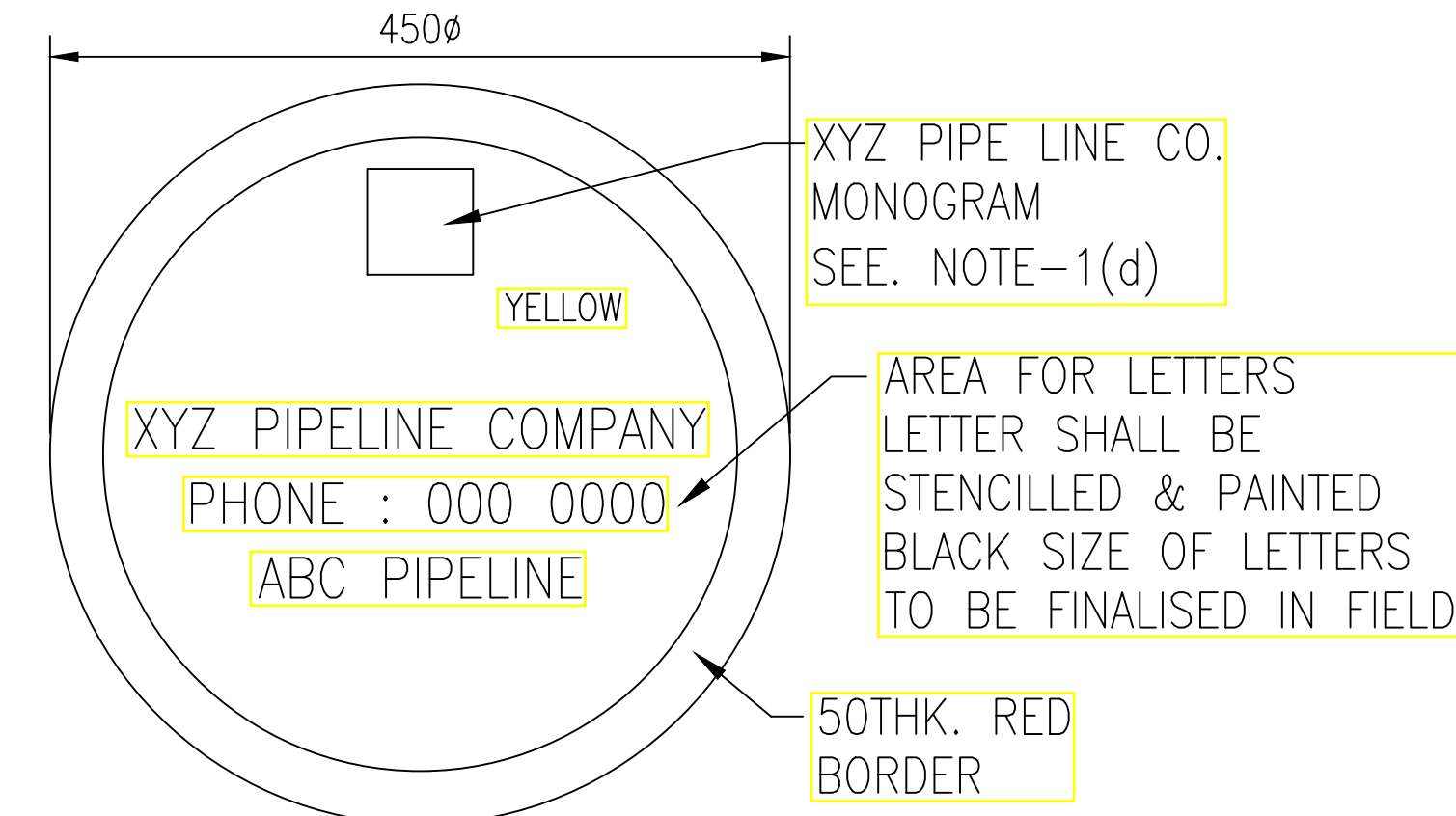
TYPE-II
FOR DRIFTING
SAND AREAS
(NOTE-7)



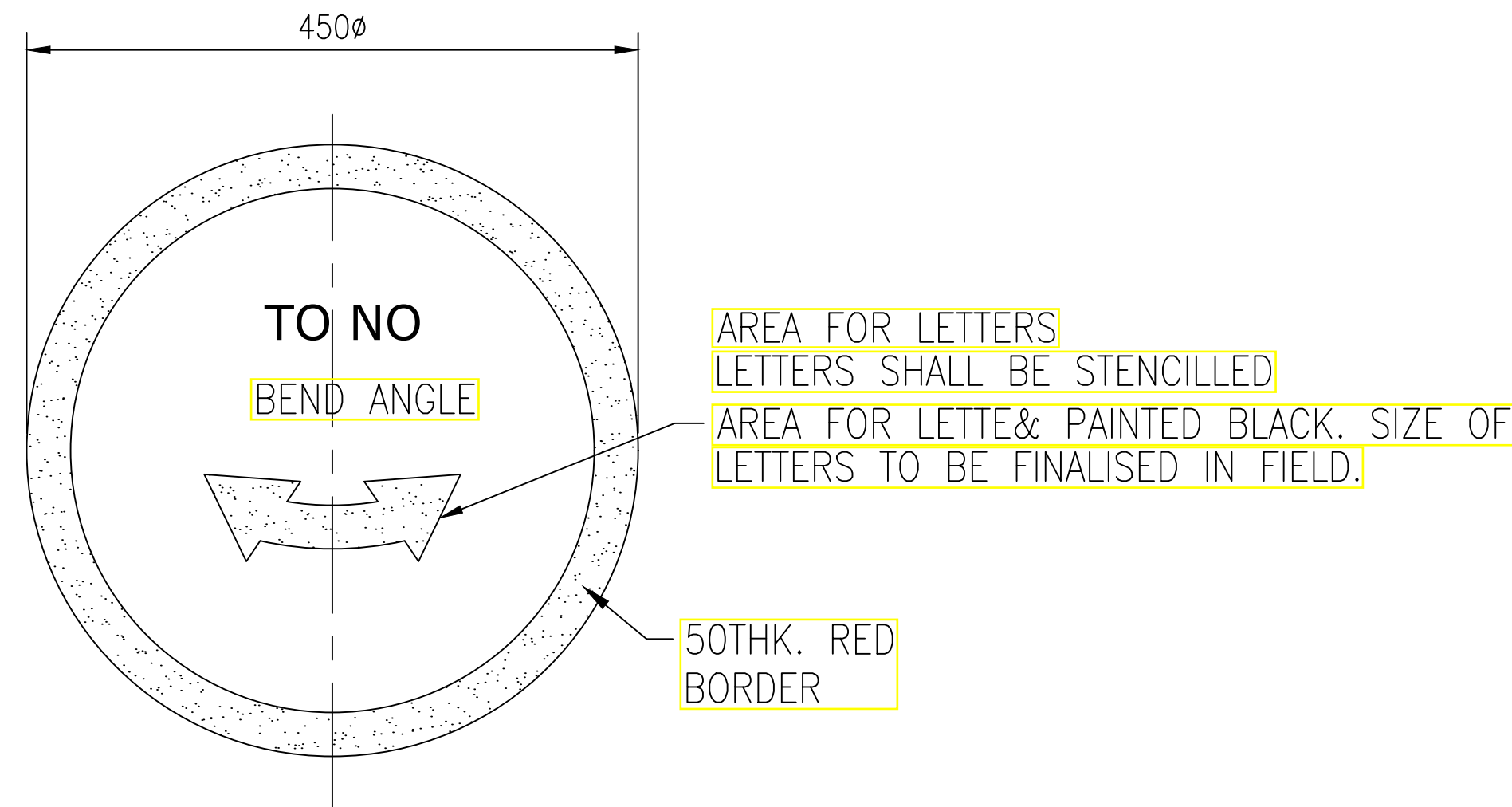
TYPE-III
FOR ROCKY AREAS



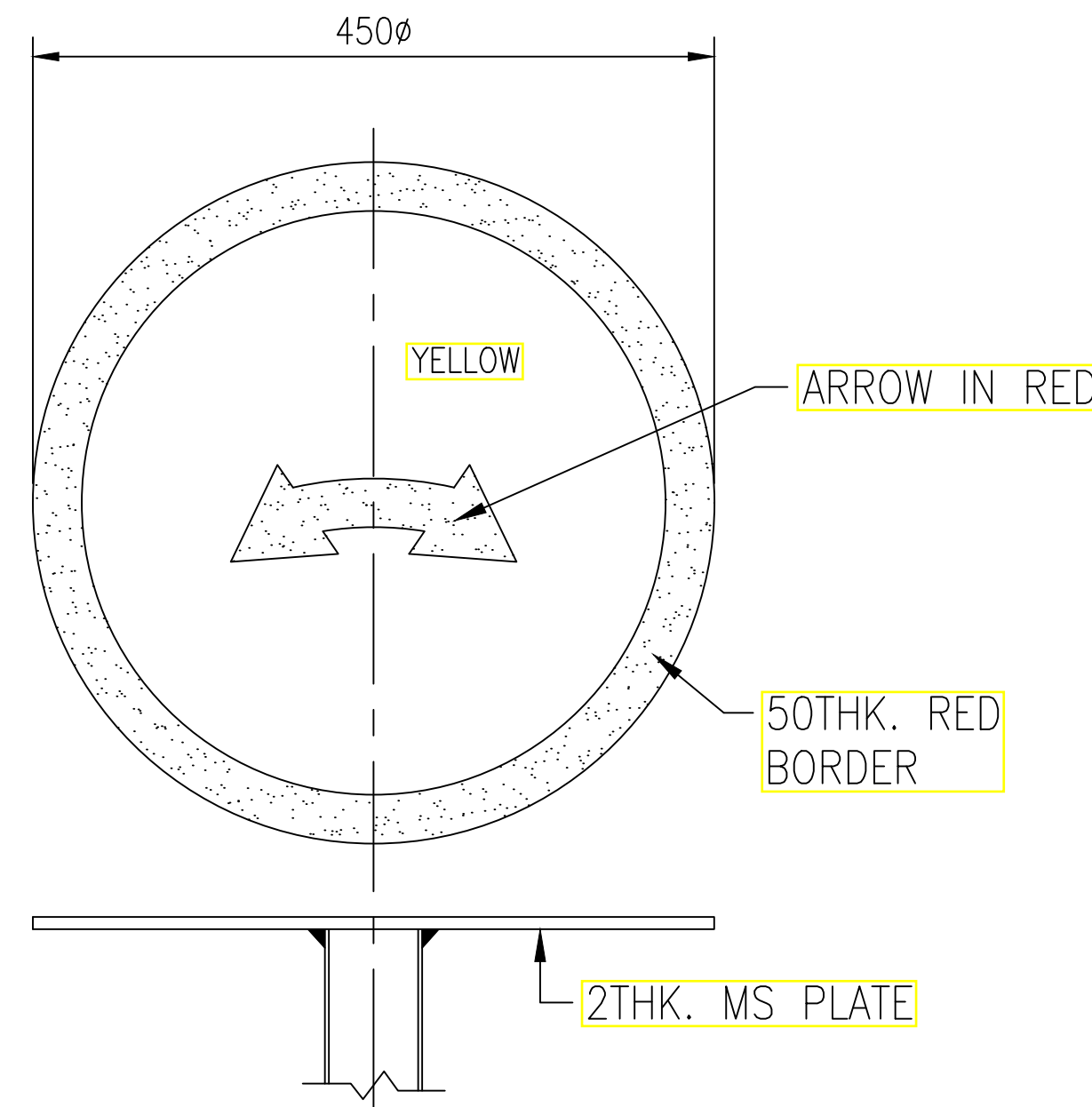
DETAIL - B



DETAIL-C



DETAIL-D



DETAIL-A

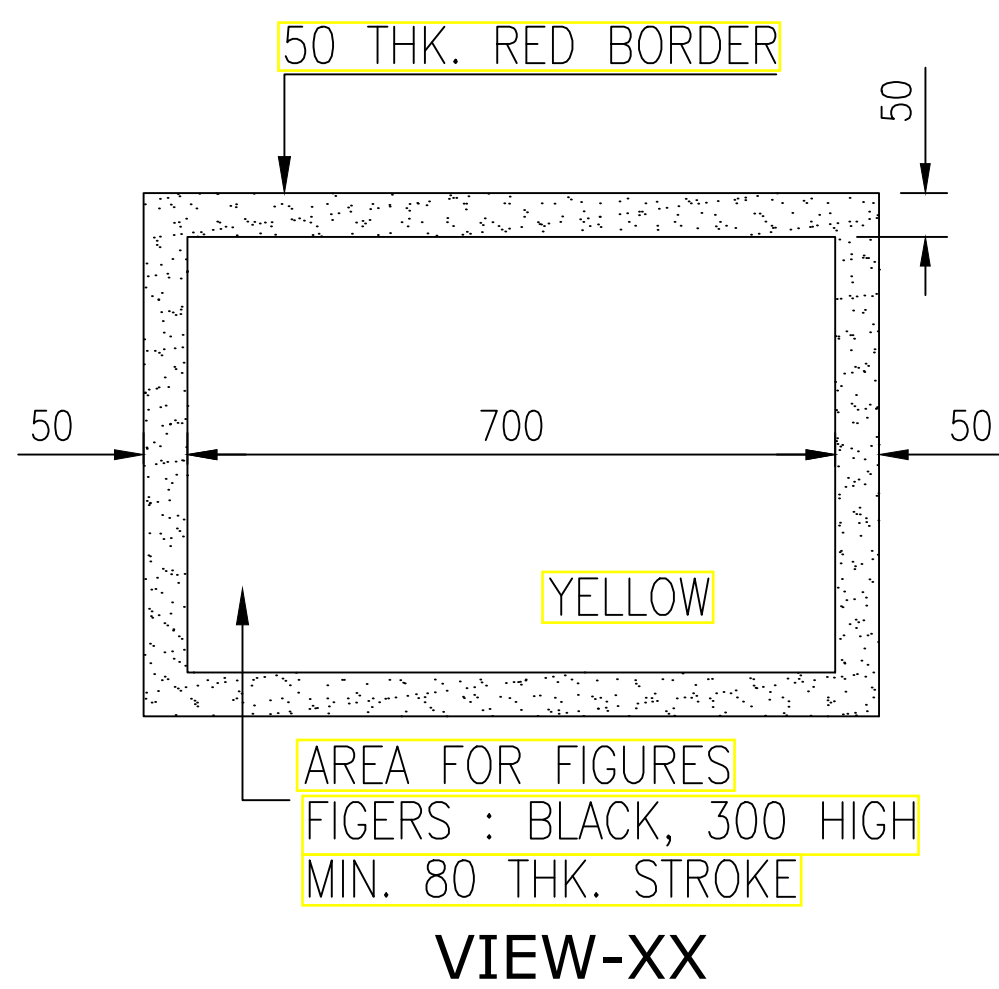
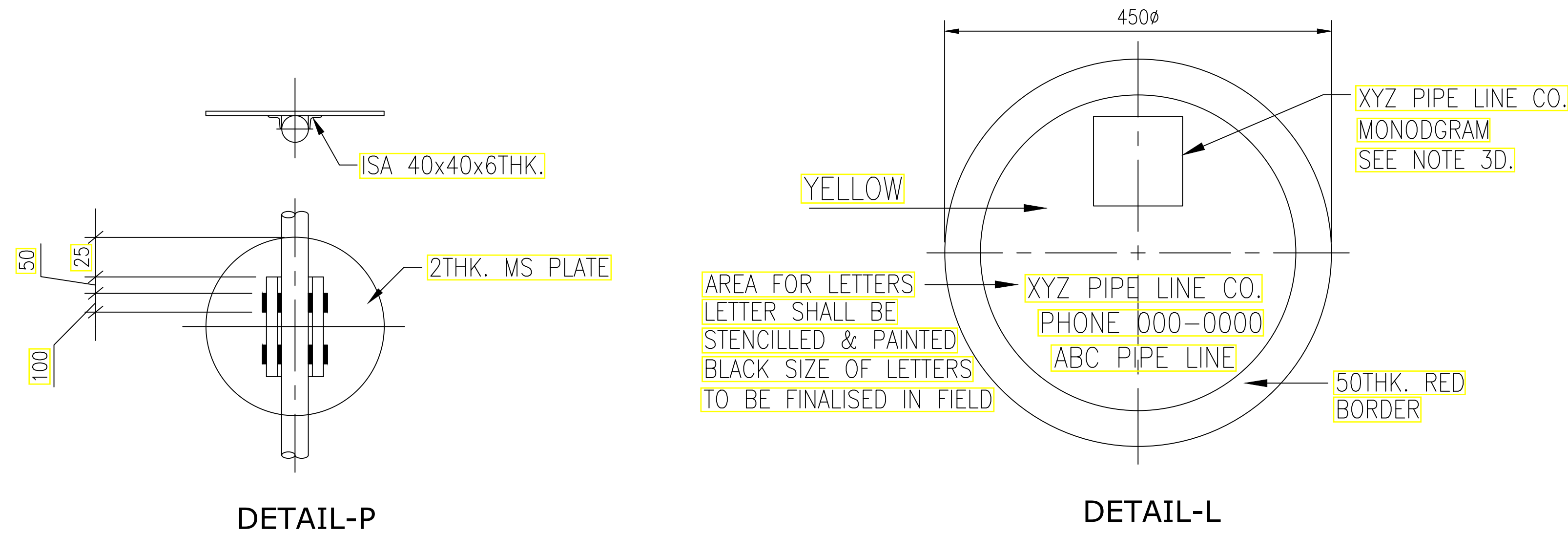
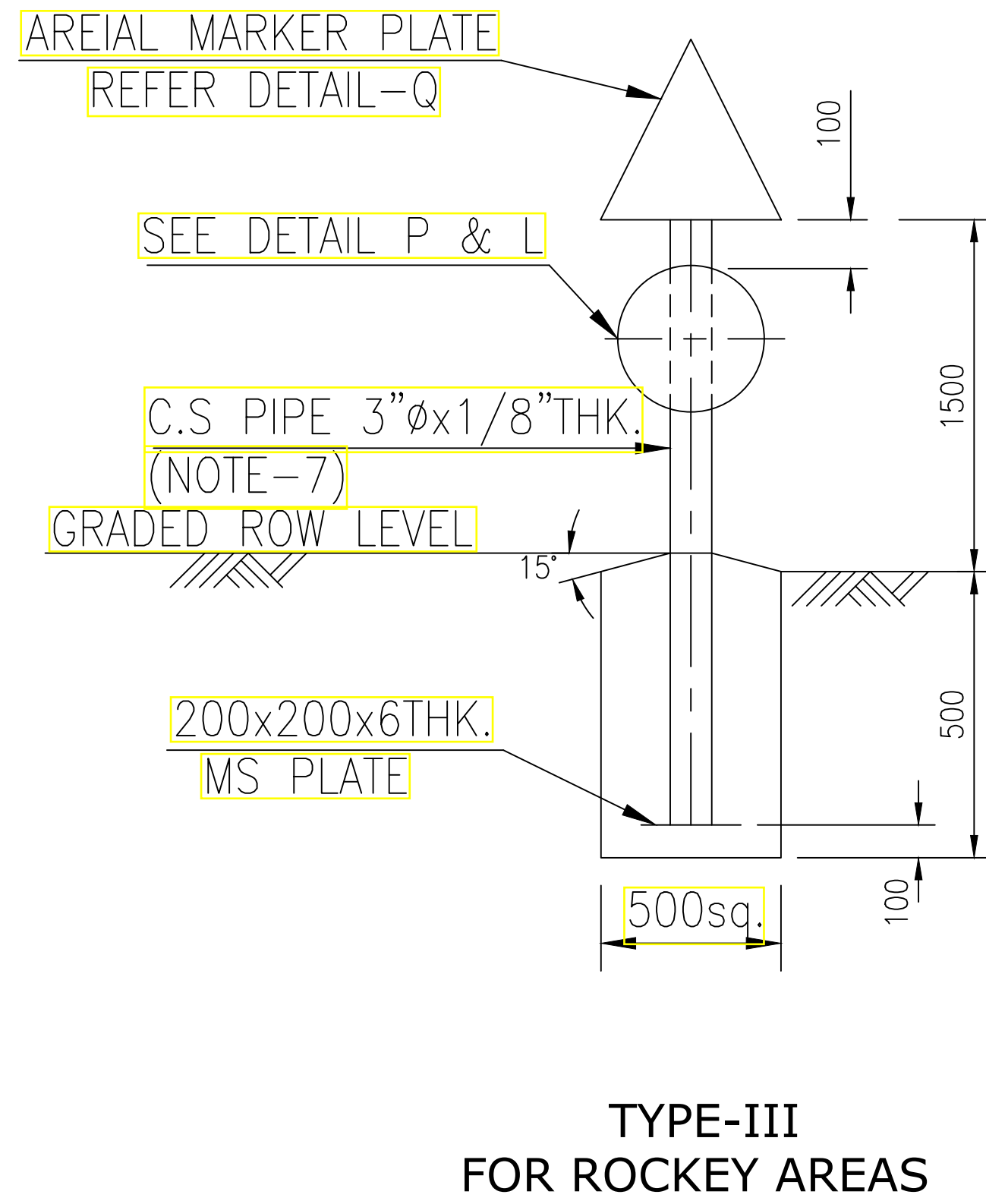
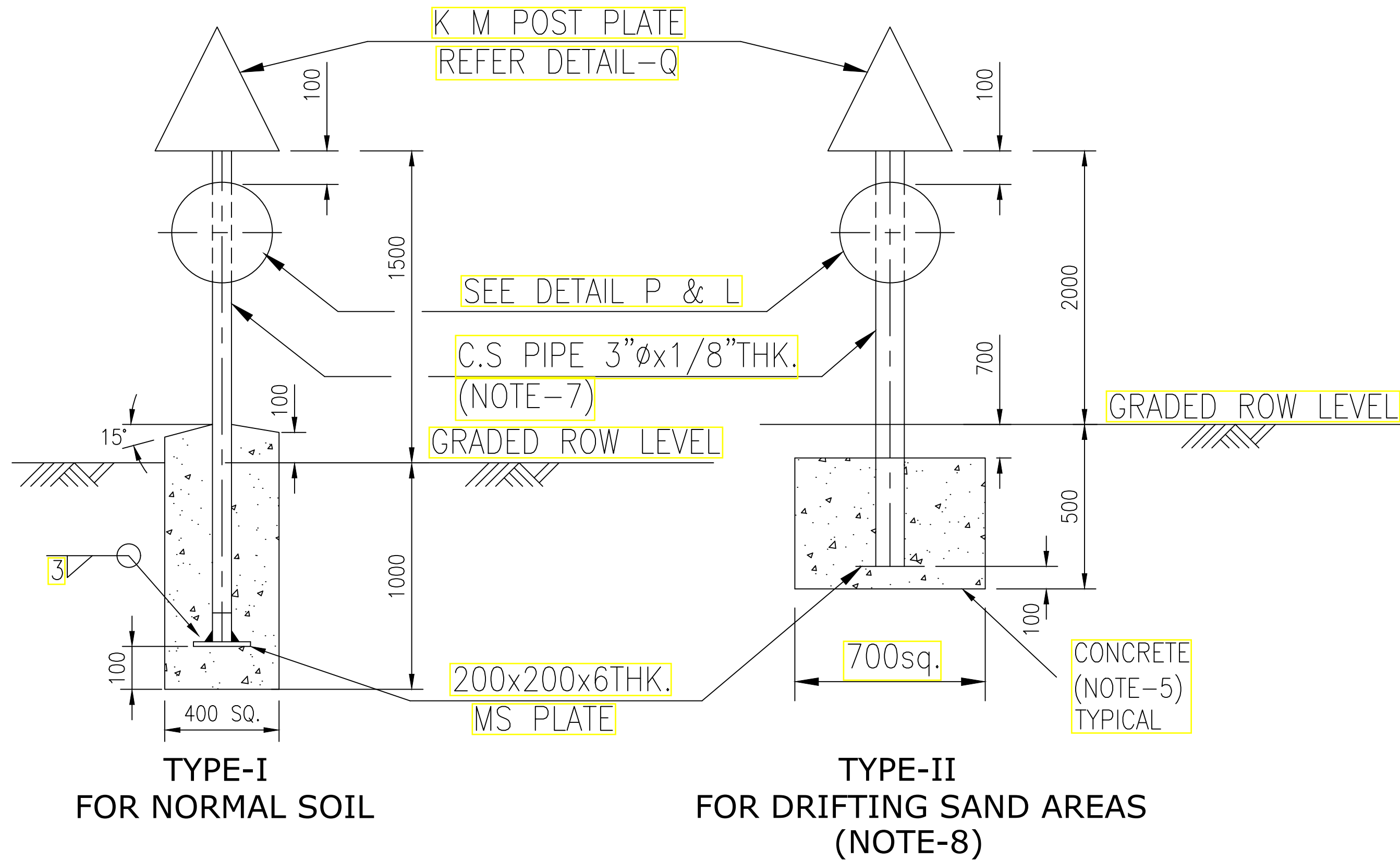
CROSSING DETAIL				
Sr.No.	CROSSING	PIPELINE ROUTE	WIDTH (M)	CONSTRUCTION METHOD

REFERENCE DRAWINGS / DOCUMENTS		
S.NO.	TITLE	NO.

- NOTES:-**
- ALL DIMENSIONS ARE IN MM UNLESS OTHERWISE STATED.
 - SCHEME OF PAINTING & COLOURING:-
 - UNDERGROUND STEEL STRUCTURE (EXCEPT THAT EMBEDDED IN CONCRETE) COAL TAR EPOXY MIN. 300 MICRON THK.
 - OVERGROUND STEEL STRUCTURE : ONE COAT OF PRIMER & TWO COATS SPECIFIED COLOUR PAINT.
 - FIGURES SHALL BE STENCILED ON BOTH SIDES OF THE POSTS IN BLACK.
 - COLOUR SCHEME FOR XYZ PIPELINE CO. MONOGRAM SHALL BE AS DIRECTED BY OWNER.
 - POST SHALL BE PAINTED WITH 250 WIDE ALTERNATE BANDS OF BLACK AND WHITE PAINT.
 - ALL OTHER ABOVEGROUND STEEL SHALL BE PAINTED YELLOW.
 - LOCATION:
 - DIRECTION MARKER SHALL BE INSTALLED AS PER SPECIFICATIONS AS DIRECTED IN APPROVED DRAWINGS AND AS DIRECTED BY OWNER.
 - OWNER NAME PLATE SHALL FACE THE PIPELINE.
 - DIRECTION MARKER SHALL BE INSTALLED 1000MM TO LEFT OF THE PIPE CENTER LINE/VIEWING TOWARDS THE DIRECTION OF FLOW AND AS INDICATED IN LOCATION SKETCH.
 - THE FOUNDATION SHALL BE MADE OF CONCRETE M20.
 - THE HEIGHT OF THE POST MAY BE VARIED TO SUIT THE FIELD REQUIREMENTS.
 - THE MATERIAL FOR MARKERS SHALL BE AS FOLLOWING:
PLATE - IS-2062, Gr. A
PIPE - IS - 1239
 - INSTALLATION OF MARKERS ON SLOPE OF SAND DUNE SHALL BE AVOIDED. IN SUCH CASES, SAME SHALL BE INSTALLED EITHER BEFORE OR AFTER THE SAND DUNE SLOPE.

REV.	DATE	DESCRIPTION	PREP.	CHKD.	APPD.
00	16.01.23	ISSUED AS STD. DRAWING	PSS	MC	HK

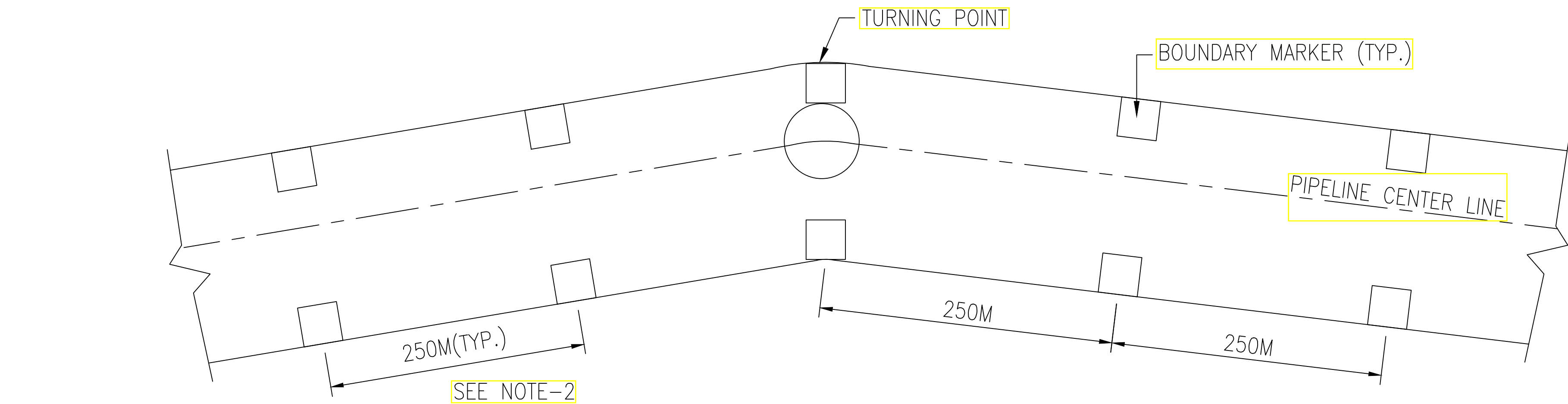
PMC:  VCS QUALITY SERVICES PVT. LTD.			
TITLE: TYPICAL DRAWING FOR DIRECTION MARKER			
SCALE:	N.T.S.	TOTAL NO. OF SHTS:	1 OF 1
SIZE	JOB NO.	DRAWING NUMBER	REV.
A3	-----	VCS-00-PP-SD-2005	00



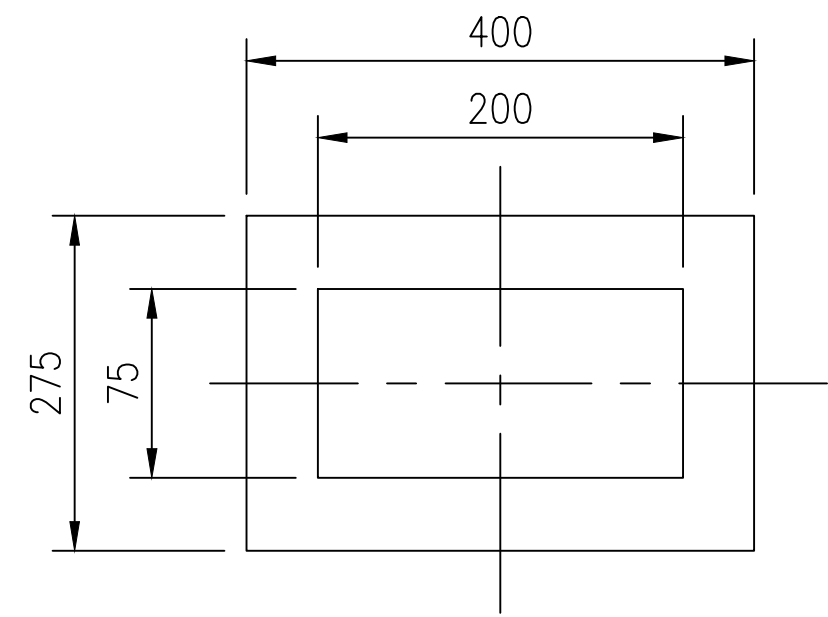
- REFERENCE DRAWINGS / DOCUMENTS**
- | S.NO. | TITLE | NO. |
|-------|-------|-----|
| | | |
| | | |
| | | |
- NOTES:-**
- ALL DIMENSIONS ARE IN MM UNLESS OTHERWISE INDICATED.
 - SCHEME OF PAINTING & COLOURING:-
 - (a) UNDERGROUND STEEL STRUCTURE (EXCEPT THAT EMBEDDED IN CONCRETE) COAL TER EPOXY MIN.300 MICRON THK.)
 - (b) OVER GROUND STEEL STRUCTURE : ONE COAT OF PRIMER & TWO COATS SPECIFIED COLOUR PAINT.
 - (c) FIGURES SHALL BE STENCILED ON BOTH SIDES OF THE POSTS IN BLACK.
 - (d) COLOUR SCHEME FOR XYZ PIPELINE CO. MONOGRAM SHALL BE AS DIRECTED BY OWNER.
 - (e) POST SHALL BE PAINTED WITH 250 WIDE ALTERNATE BANDS OF BLACK AND WHITE PAINT.
 - (f) ALL OTHER ABOVEGROUND STEEL SHALL BE PAINTED YELLOW.
 - LOCATION:
 - (a) K.M. POST SHALL BE INSTALLED AT EVERY KILOMETERS AS PER REQUIREMENTS OF CONTRACT AND AS DIRECTED BY OWNER.
 - (b) OWNER NAME PLATE SHALL FACE THE PIPELINE.
 - (c) K.M. POST SHALL BE 1000MM TO THE LEFT OF THE PIPE CENTER LINE VIEWING TOWARDS THE DIRECTION OF FLOW AND AS INDICATED IN SKETCH.
 - THE FOUNDATION SHALL BE MADE OF CONCRETE M20.
 - THE HEIGHT OF THE K.M. POST MAY BE VARIED TO SUIT FIELD REQUIREMENTS.
 - THE MATERIAL FOR MARKERS SHALL BE AS FOLLOWING:
 - PLATE - IS-2062, Gr. A
 - PIPE - IS - 1239
 - INSTALLATION OF MARKERS ON SLOPE OF SAND DUNE SHALL BE AVOIDED. IN SUCH CASES, SAME SHALL BE INSTALLED EITHER BEFORE OR AFTER THE SAND DUNE.

CROSSING DETAIL				
Sr.No.	CROSSING	PIPELINE ROUTE	WIDTH (M)	CONSTRUCTION METHOD

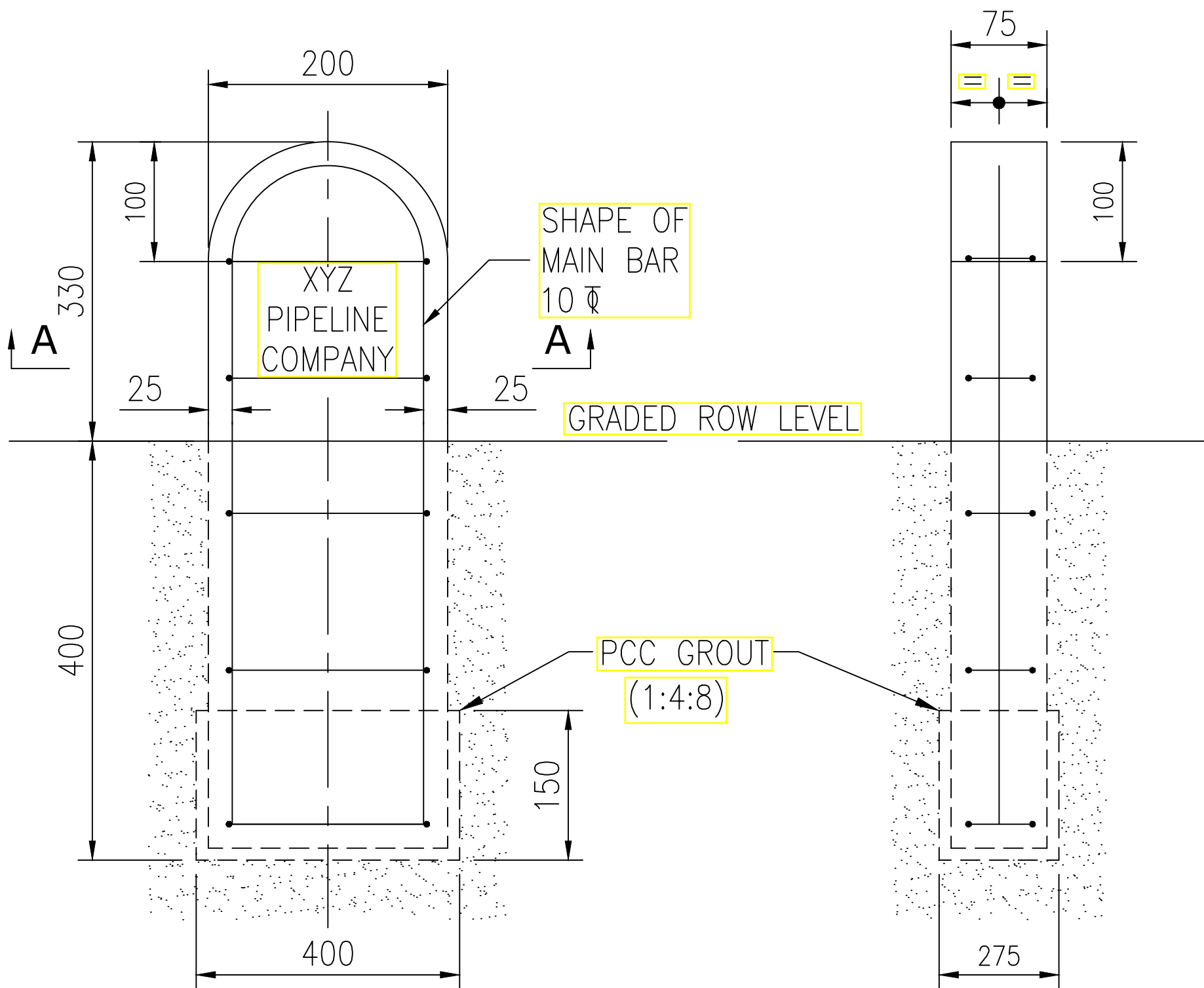
00	16.01.23	ISSUED AS STD. DRAWING	PSS	MC	HK
REV.	DATE	DESCRIPTION	PREP.	CHKD.	APPD.
PMC:  VCS QUALITY SERVICES PVT. LTD.					
TITLE: TYPICAL DRAWING FOR TYPICAL K.M. POST MARKER					
SCALE: N.T.S.		TOTAL NO. OF SHTS: 1 OF 1		A	
SIZE	JOB NO.	DRAWING NUMBER		REV.	
A3	-----	VCS-00-PP-SD-2006		00	



LOCATION PLAN OF BOUNDARY MARKER

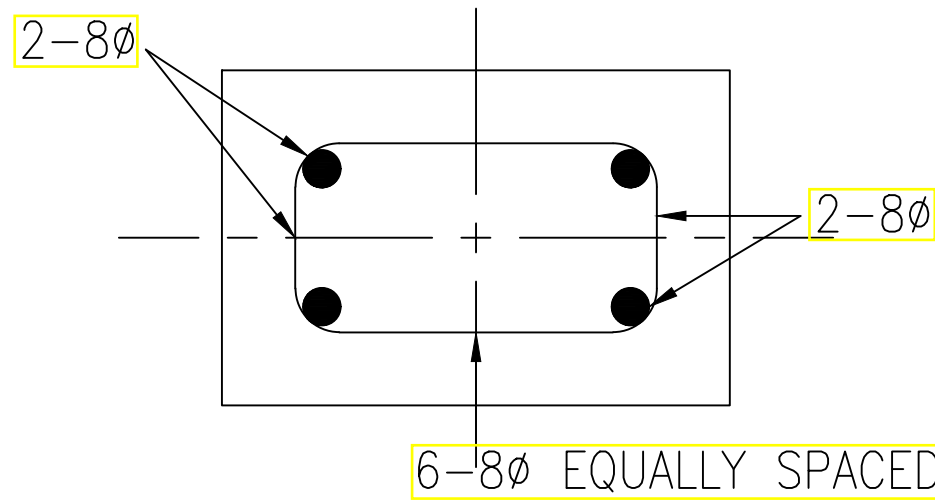


PLAN



ELEVATION

SIDE VIEW



SECTION A-A

REFERENCE DRAWINGS / DOCUMENTS

S.NO.	TITLE	NO.

NOTES:-

1. ALL DIMENSIONS ARE IN MM UNLESS OTHERWISE STATED.
2. BOUNDARY MARKERS SHALL BE INSTALLED AT THE ROW LIMITS ON EITHER SIDE AT 250M CENTERS AND ALSO AT ALL TURNING POINTS AS PER SPECIFICATIONS AND AS DIRECTED BY OWNER. BOUNDARY MARKERS SHALL PREFERABLY BE PLACED ON FIELD BUNDS/UNCULTIVABLE AREAS.
3. ALL BOUNDARY MARKERS SHALL BE PRECAST AND INSCRIPTIONS SHALL BE ENGRAVED CENTRALLY IN THE MOULD ON THE FACE.
4. LETTERS SHALL BE 60MM HIGH AND 5MM DEEP.
5. INSCRIPTIONS SHALL FACE THE PIPE LINE.
6. CONCRETE FOR BOUNDARY MARKERS SHALL BE M20.
7. ABOVE GROUND PART OF BOUNDARY MARKERS SHALL BE PAINTED YELLOW WITH MIN. THREE COATS OF COMPANY APPROVED PROOF CEMENT PAINT AS PER IS-5410. INSCRIPTIONS SHALL BE PAINTED BLACK.

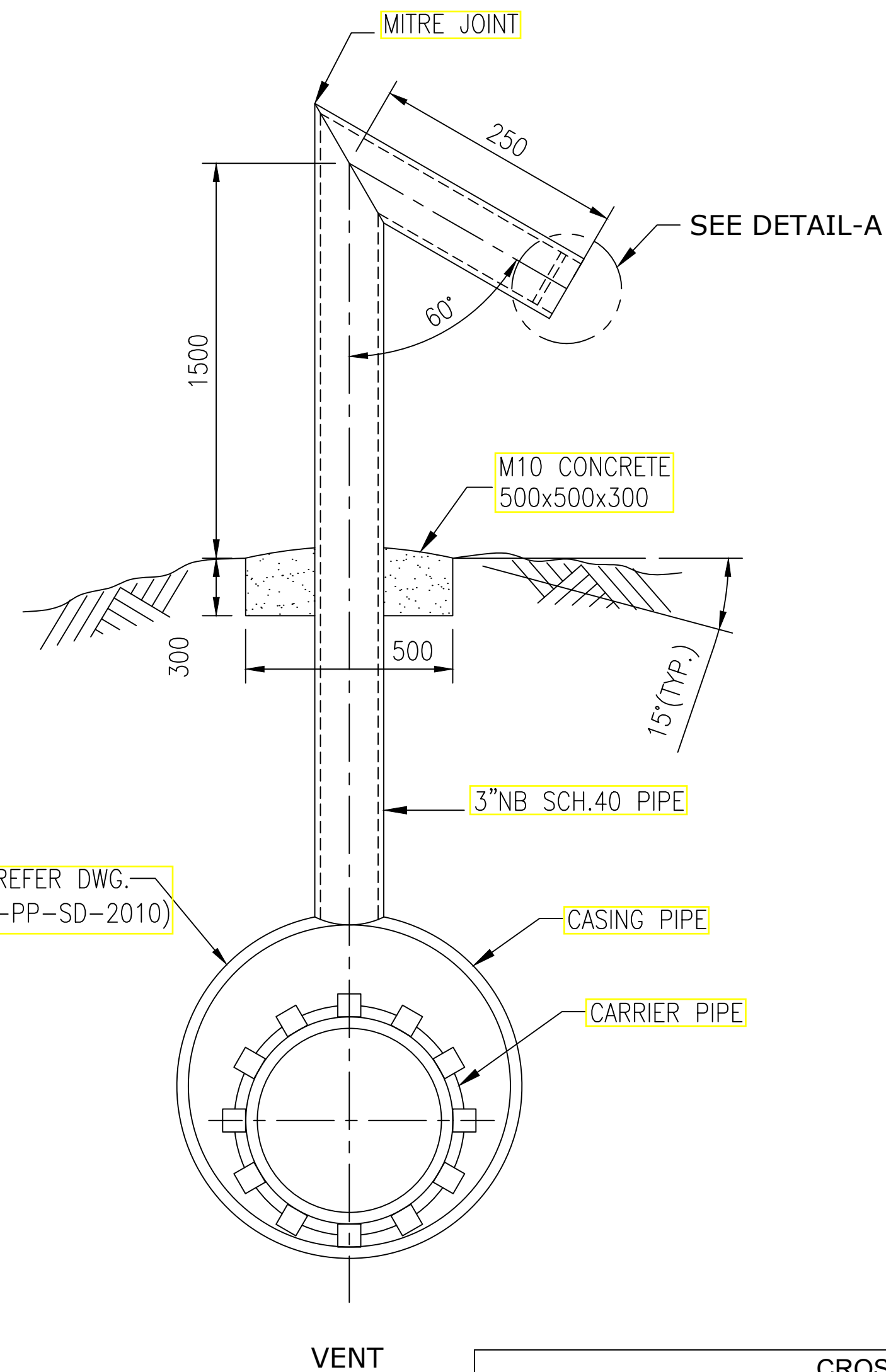
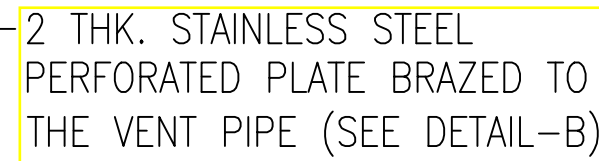
REV.	DATE	DESCRIPTION	PREP.	CHKD.	APPD.
00	16.01.23	ISSUED AS STD. DRAWING	PSS	MC	HK

PMC: **VCS QUALITY SERVICES PVT. LTD.**

TITLE: TYPICAL DRAWING FOR ROW BOUNDRY MARKER

SCALE: N.T.S. TOTAL NO. OF SHTS: 1 OF 1

SIZE	JOB NO.	DRAWING NUMBER	REV.
A3	-----	VCS-00-PP-SD-2008	00



PMC:  VCS QUALITY SERVICES PVT. LTD.			
TITLE: TYPICAL DRAWING FOR DETAIL OF CASING VENT AND DRAIN			
SCALE:		N.T.S.	TOTAL NO. OF SHTS: 1 OF 1
SIZE	JOB NO.	DRAWING NUMBER	REV.
A3	-----	VCS-00-PP-SD-2009	00

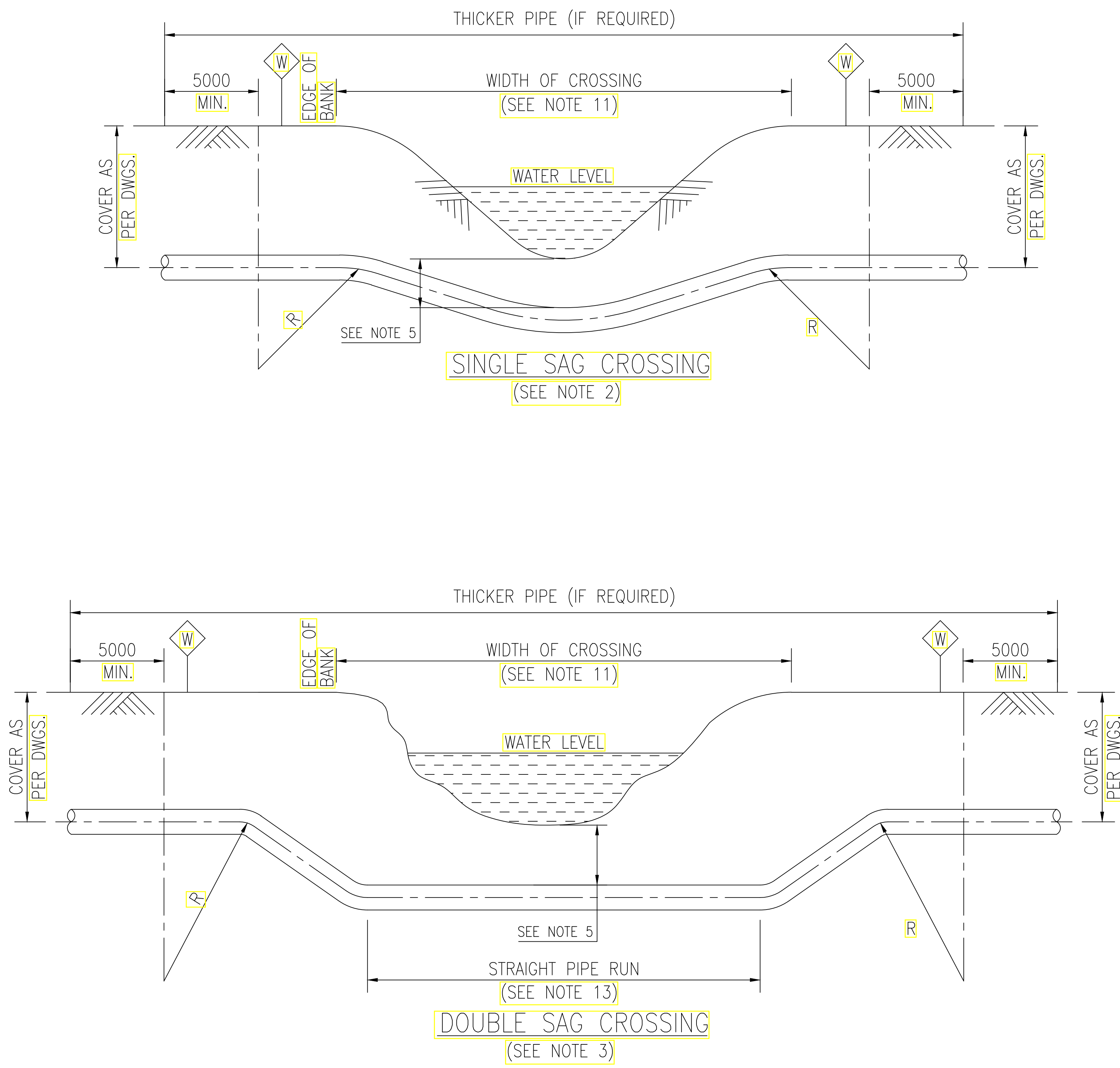
NOTES:-

1. ALL DIMENSIONS ARE IN MM UNLESS OTHERWISE STATED.
2. VENT AND DRAIN OFF TO FACE LEFT WHEN LOOKING IN DIRECTION OF CONSTRUCTION AND SHALL BE PARALLEL TO CROSSING.
3. VENT AND DRAIN OFF PIPE SHALL BE API 5L GR. B, SCH.40 OR IS-1239.
4. PORTION OF VENT AND DRAIN OFF PIPES WHICH ARE UNDER GROUND OR WHICH MAY BE UNDER WATER ARE TO COATED WITH LIQUID EPOXY OF 500 MICRON THK. OF APPROVED QUALITY ABOVE GROUND PORTION SHALL BE AS PER PAINTING SPECIFICATION.

LEGENDS:-

OFC	OPTICAL FIBRE CABLE
D	OUTSIDE DIAMETER OF PIPE

00	16.01.23	ISSUED AS STD. DRAWING	PSS	MC	HK
REV.	DATE	DESCRIPTION	PREP.	CHKD.	APPD.



REFERENCE DRAWINGS / DOCUMENTS

S.NO.	TITLE	NO.

- NOTES:-**
- ALL DIMENSIONS ARE IN mm UNLESS OTHERWISE SPECIFIED.
 - SINGLE SAG CROSSING SHALL NORMALLY BE USED WHERE THERE IS NO EVIDENCE OF EROSION OF BANKS AND SCOURING OR SHIFTING OF STREAM BOTTOM AND WHERE BED WIDTH DOES NOT PROHIBIT ITS USE.
 - DOUBLE SAG CROSSING SHALL BE USED WHERE THERE IS EVIDENCE OF EROSION OF BANKS. SCOURING OR SHIFTING OF STREAM BOTTOM.
 - IN DOUBLE SAG CROSSING, GENERALLY COLD FIELD BENDS SHALL BE USED. USE OF FACTORY MADE R=6D BEND SHALL BE MINIMIZED. R=6D BEND SHALL BE USED ONLY WITH PRIOR APPROVAL OF COMPANY.
 - UNLESS OTHERWISE SPECIFIED,THE MINIMUM COVER OVER THE PIPE MEASURED BELOW THE LOWEST BED LEVEL SHALL BE 1500MM.
 - THE TYPE AND EXTENT OF BUOYANCY CONTROL MEASURES SHALL BE AS PER SPECIFICATION AND AS DIRECTED BY COMPANY FOR INDIVIDUAL CROSSING AND SHALL BE SHOWN ON THE ALIGNMENT SHEETS.
 - THE FILL AT THE BANKS SHALL BE COMPACTED FIRMLY AND REINFORCED WITH SACKED EARTH, LEAN CONCRETE, RIP RAP OR BY OTHER MEANS AS DIRECTED BY COMPANY. ADDITIONAL BANK PROTECTION MEASURES AS PER SPECIFICATIONS SHALL BE ADOPTED WHEN THERE IS EVIDENCE OF EROSION AND SLUMPING OF BANKS OR WHEN THE BANKS ARE STEEP.
 - THE LOCATION OF CROSSING SHALL BE IN A LONG STRAIGHT STRETCH OF THE STREAM IF POSSIBLE.
 - EXACT POSITION AND ANGLE OF COLD BENDS SHALL BE DETERMINED IN FIELD.
 - AFTER INSTALLATION OF THE CROSSING, THE WATER COURSE SHALL BE RESTORED TO ITS ORIGINAL CONDITION TO THE ENTIRE SATISFACTION OF THE AUTHORITIES JURISDICTION OVER THE SAME. WHERE THE EXCAVATED MATERIAL IS UNSUITABLE , TRENCH SHALL BE BACKFILLED WITH MATERIAL APPROVED BY COMPANY.
 - WIDTH OF CROSSING SHALL BE THAT CORRESPONDING TO THE HIGHEST WATER LEVEL. THE HIGHEST WATER LEVEL SHALL BE DETERMINED BASED ON THE FOLLOWING:
I) HISTORICAL RECORDS (TO THE EXTENT AVAILABLE)
II) BANK CONDITION VIS-A-VIS EROSION, ETC.
III) EVIDENCE OF EXTINCTION OF VEGETATION ALONG BANKS.
IV) DISCUSSIONS WITH LOCAL PEOPLE.
 - THE NUMBER OF WARNING SIGNS SHALL BE:-
(a) 1 (ONE) FOR CROSSINGS LESS THAN 15 M WIDTH AT UP STREAM BANK.
(b) 2 (TWO) FOR CROSSINGS ABOVE 15 M WIDTH.
 - STRAIGHT LENGTH OF PIPE SHALL BE USED AT LEAST FOR THE ENTIRE WIDTH OF CROSSING.
 - CONTRACTOR SHALL VERIFY THE ACTUAL DIMENSIONS WITH RESPECT TO SURVEY DETAILS FOR EACH CROSSING AS AND WHEN DIRECTED BY COMPANY. CONTRACTOR SHALL PREPARE DETAILED DRAWINGS FOR INDIVIDUAL CROSSINGS FOR COMPANY APPROVAL BEFORE COMMITMENT OF CONSTRUCTION.

00	16.01.23	ISSUED AS STD. DRAWING	PSS	MC	HK
REV.	DATE	DESCRIPTION	PREP.	CHKD.	APPD.

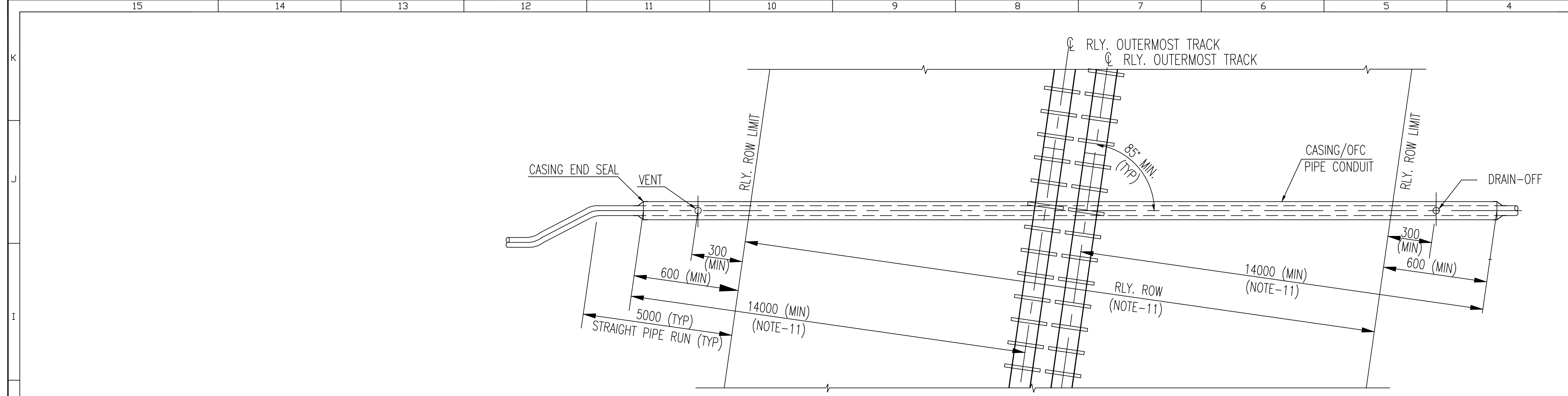
CROSSING DETAIL				
Sr.No.	CROSSING	PIPELINE ROUTE	WIDTH (M)	CONSTRUCTION METHOD

PMC:
 VCS QUALITY SERVICES PVT. LTD.

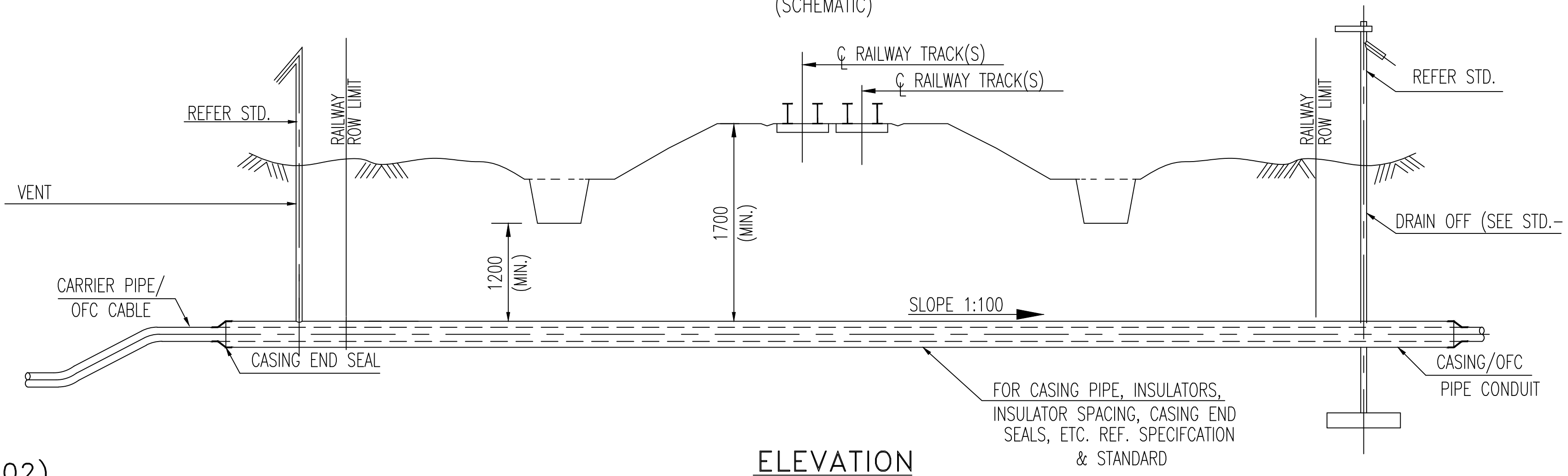
TITLE:
TYPICAL STREAM CROSSING

SCALE: N.T.S. TOTAL NO. OF SHTS: 1 OF 1

SIZE: A3 JOB NO.: ----- DRAWING NUMBER: VCS-00-PP-SD-2010 REV.: 00



PLAN
(SCHEMATIC)



ELEVATION
(SCHEMATIC)

TABLE 1 (AS PER 1102)

CARRIER PIPE O.D. IN mm (Inch)	CASING PIPE O.D. IN mm (Inch)	CASING PIPE WT IN mm	CASING PIPE MATERIAL
168.3 (6.625")	323.9 (12.75")	6.35	API 5L Gr B/ IS 1239/IS 3589 SEAMLESS/ ERW
219.1 (8.625")	355.6 (14")	6.35	
273.1 (10.75")	406.4 (16")	7.14	
323.9 (12.75")	457 (18")	7.92	
355.6 (14")	508 (20")	8.74	
406.4 (16")	559 (22")	8.74	
457 (18")	610 (24")	9.53	
508 (20")	660 (26")	10.31	
559 (22")	711 (28")	11.13	
610 (24")	762 (30")	11.91	
660 (26")	813 (32")	12.70	
711 (28")	864 (34")	14.27	
762 (30")	914 (36")	14.27	
813 (32")	965 (38")	14.27	
864 (34")	1016 (40")	15.88	
914 (36")	1067 (42")	15.88	
1016 (40")	1168 (46")	17.48	
1067 (42")	1219 (48")	17.48	

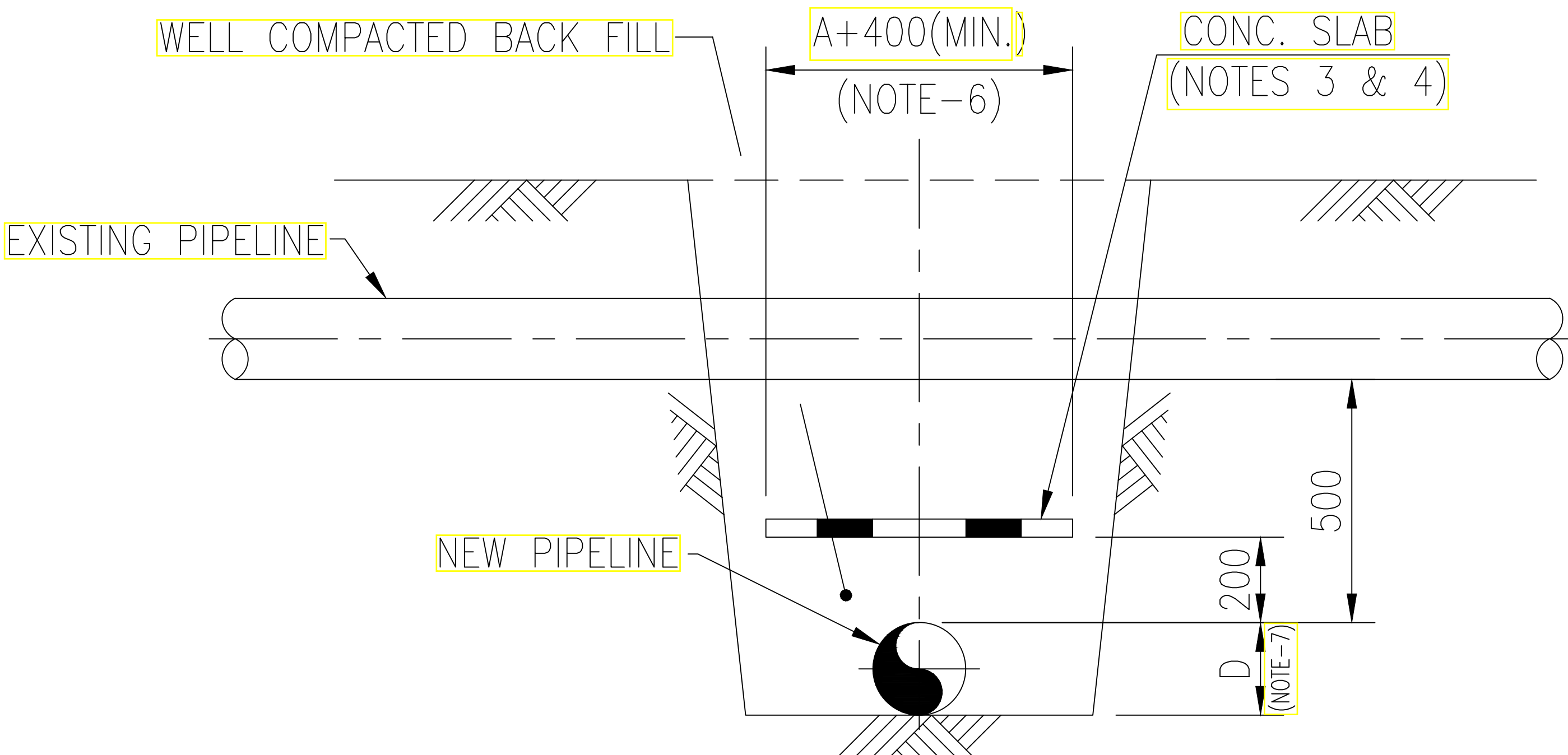
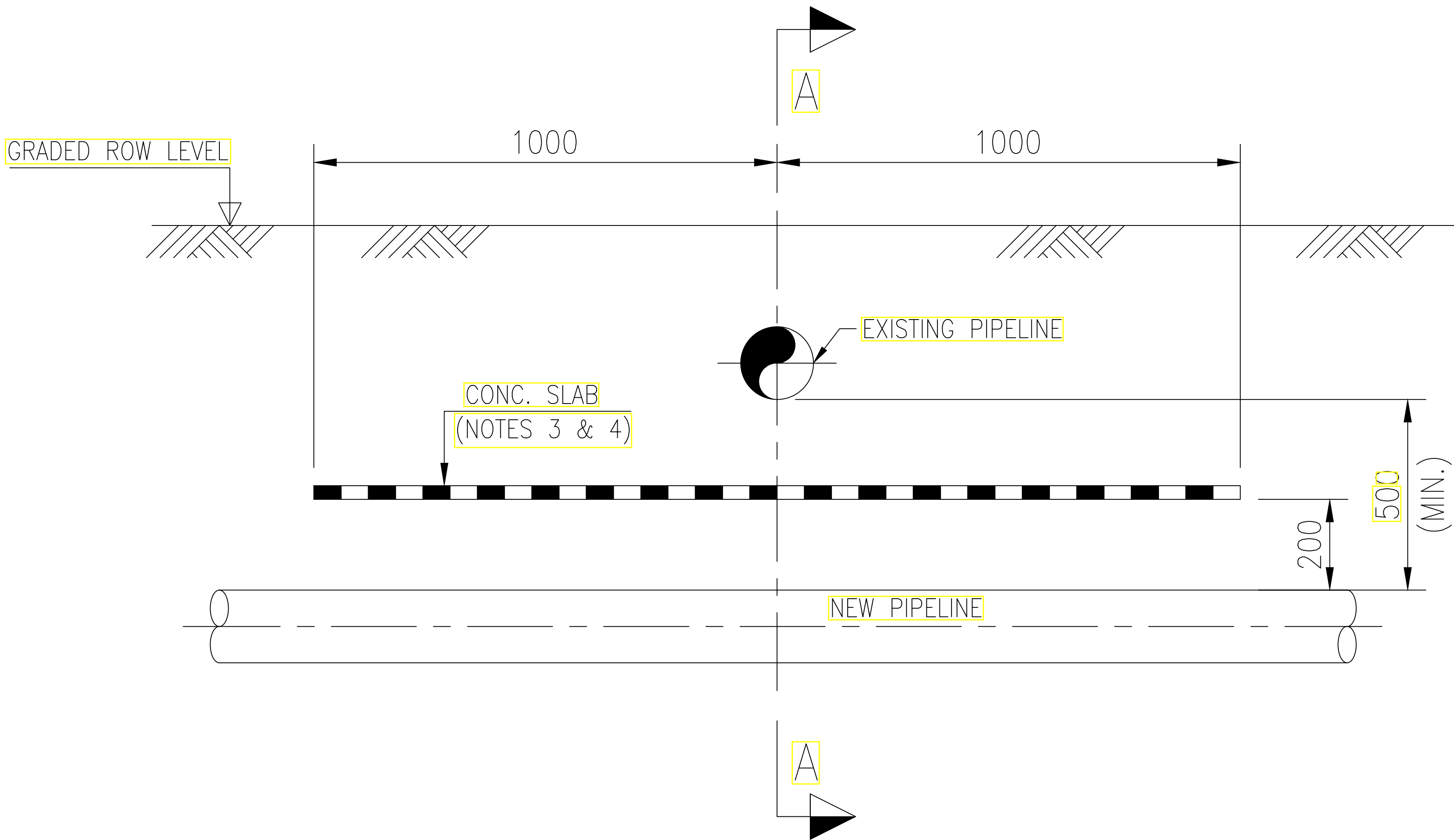
THE CASING PIPE O.D. & WALL THICKNESS SHALL GENERALLY
BE AS PER TABLE ABOVE EXCEPT WHEN SPECIFICALLY
DIRECTED BY CONCERNED RAILWAY AUTHORITIES.

REFERENCE DRAWINGS / DOCUMENTS

S.NO.	TITLE	NO.

- NOTES:-**
- ALL DIMENSIONS ARE IN mm UNLESS SPECIFIED OTHERWISE.
 - CATHODIC PROTECTION TEST LEADS TERMINAL BOX MAY BE MOUNTED ON THE VENT PIPE. FOR CP LEAD TERMINAL BOX DETAILS REFER RELEVANT STD./SPECIFICATION.
 - AT EACH CROSSING, A PIPELINE WARNING SIGN SHALL BE INSTALLED ON EITHER SIDE OF CROSSING. WARNING SIGN PLATE MAY BE MOUNTED ON THE VENT PIPE.
 - REFER API RP 1102 FOR OTHER DESIGN AND INSTALLATION REQUIREMENTS.
 - ELECTRICAL INSULATION BETWEEN CASING AND CARRIER PIPES SHALL BE CHECKED WITH SUITABLE MEGGER.
 - AFTER INSTALLATION OF CASING AND CARRIER PIPES, THE AREA SHALL BE RESTORED TO THE SATISFACTION OF THE CONCERNED AUTHORITIES/COMPANY.
 - FOR CASING PIPE DETAILS, REFER TABLE-1.
 - CONTRACTOR SHALL VERIFY THE ACTUAL DIMENSIONS WITH RESPECT TO SURVEY DETAILS FOR EACH CROSSING AND PREPARE DETAILED DRAWINGS FOR COMPANY'S / CONCERNED AUTHORITY'S APPROVAL BEFORE COMMENCEMENT OF CONSTRUCTION.
 - PIPELINE SECTION SHALL BE PRE-TESTED HYDROSTATICALLY, SEPARATELY FROM THE MAIN LINE TESTING WHEN REQUIRED BY THE AUTHORITIES CONCERNED AND/OR AS DIRECTED BY THE COMPANY.
 - ANGLE OF INTERSECTION BETWEEN PIPELINE AND RAILWAY SHALL BE AS CLOSE TO 90° AS POSSIBLE BUT IN NO CASE LESS THAN 85°.
 - CASING PIPE SHALL BE EXTENDED FOR A DISTANCE OF UPTO 14.00m FROM CENTER LINE OF OUTERMOST RAILWAY TRACK OR 0.6m BEYOND RAILWAY ROW LIMITS ON EITHER SIDE, WHICHEVER IS MORE. ROW LIMIT SHALL BE DEFINED BY THE RAILWAY AUTHORITIES .
 - JACKING / BORE THRU' TECHNIQUE SHALL BE USED FOR THE CROSSING.
 - SEPARATE C.S. CONDUIT FOR OFC SHALL BE INSTALLED AT MINIMUM DISTANCE FROM CASING FOR CARRIER PIPE. IF SPECIFIED.
 - ALL CARRIER PIPE JOINTS SHALL BE 100% RADIOGRAPHED.
 - COATING OF CASING PIPE SHALL BE AS PER REQUIREMENT OF AUTHORITIES.
 - CASING PIPE THICKNESS SHOWN IN TABLE -1 IS CONSIDERING THAT CASING PIPE IS NOT COATED & NOT CP PROTECTED.

00	16.01.23	ISSUED AS STD. DRAWING	PSS	MC	HK
REV.	DATE	DESCRIPTION	PREP.	CHKD.	APPD.
PMC:  VCS QUALITY SERVICES PVT. LTD.					
TITLE: TYPICAL DETAILS OF RAILWAY CROSSINGS					
SCALE:	N.T.S.	TOTAL NO. OF SHTS:	1 OF 1		
SIZE	JOB NO.	DRAWING NUMBER	REV.		
A3	-----	VCS-00-PP-SD-2011	00		



SECTION A-A

CROSSING DETAIL				
Sr.No.	CROSSING	PIPELINE ROUTE	WIDTH (M)	CONSTRUCTION METHOD

REFERENCE DRAWINGS / DOCUMENTS		
S.NO.	TITLE	NO.

- NOTES:-**
- ALL DIMENSIONS ARE IN MM UNLESS OTHERWISE.
 - A MODIFIED PIPELINE WARNING SIGN SHALL BE INSTALLED WHERE THE PIPELINE CROSSES AN EXISTING PIPELINE CARRYING HAZARDOUS FLUID.
 - CONCRETE SLAB SHALL BE AS PER VCS-00-PP-SD-2017.
 - CONC. SLAB NEED NOT TO BE PROVIDED BETWEEN AN EXISTING PIPELINE AND A NEW CASED PIPELINE.
 - SUITABLE CATHODIC PROTECTION BONDING SHALL BE PROVIDED BETWEEN CROSSING PIPELINES. IN SOME CASES THE NEW PIPELINE MAY REQUIRE ELECTRICAL ISOLATION. C.P. DETAILS ARE COVERED SEPARATELY.
 - DIMENSION 'A' SHALL BE CALCULATED USING FORMULA $A=(D1+D2+....Dn) + (n-1) \times 500$ WHERE D1, D2,.... Dn ARE THE DIAMETERS. OF PIPELINES IN mm IN THE SAME TRENCH AND 'n' IS NO. OF PIPELINES IN SAME TRENCH.
 - DIMENSIONS 'D' SHALL BE THE LARGEST DIAMETER OF THE PIPELINES LAID IN SAME TRENCH.
 - TRENCH DIMENSIONS SHALL BE IN ACCORDANCE WITH RELEVANT STANDARDS/SPECIFICATIONS.
 - APPROVAL OF THE CROSSING SHALL BE OBTAINED FROM CONCERNED AUTHORITIES.

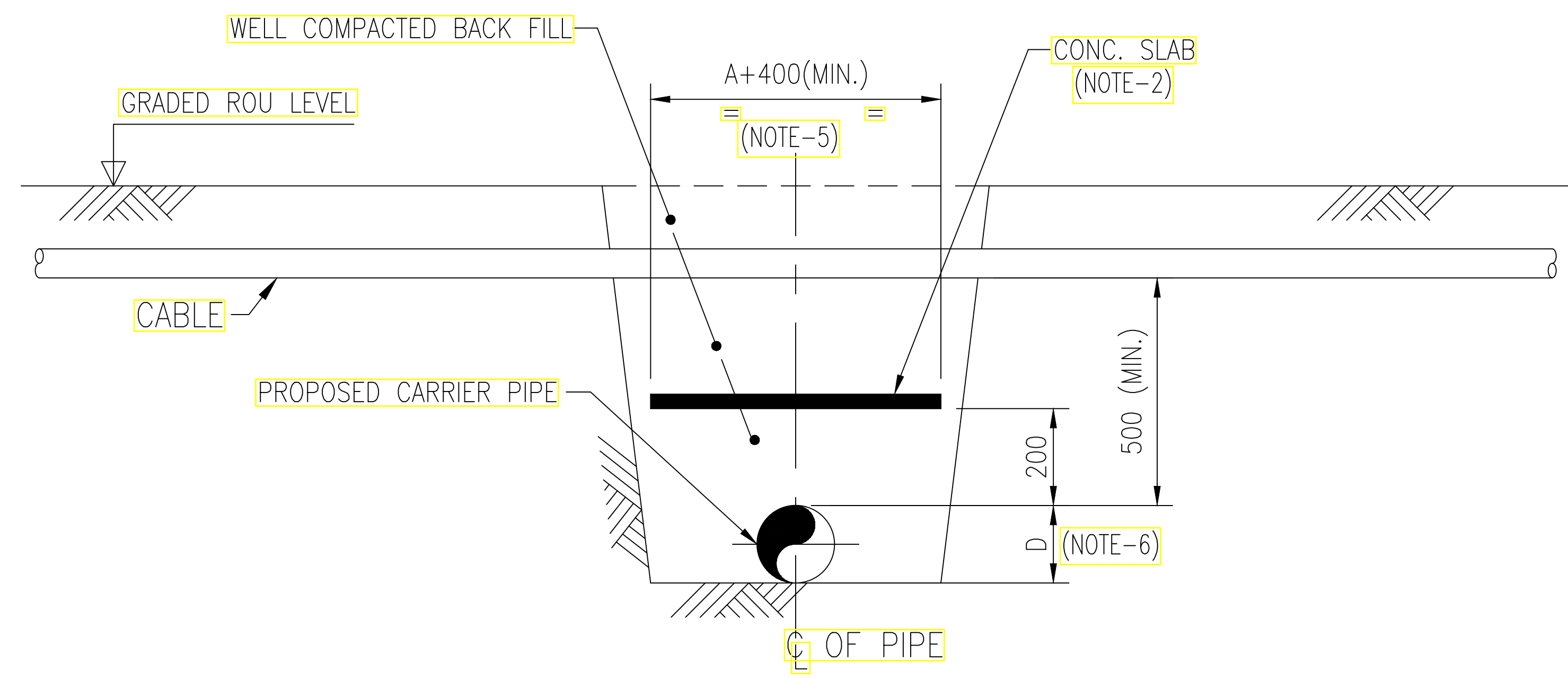
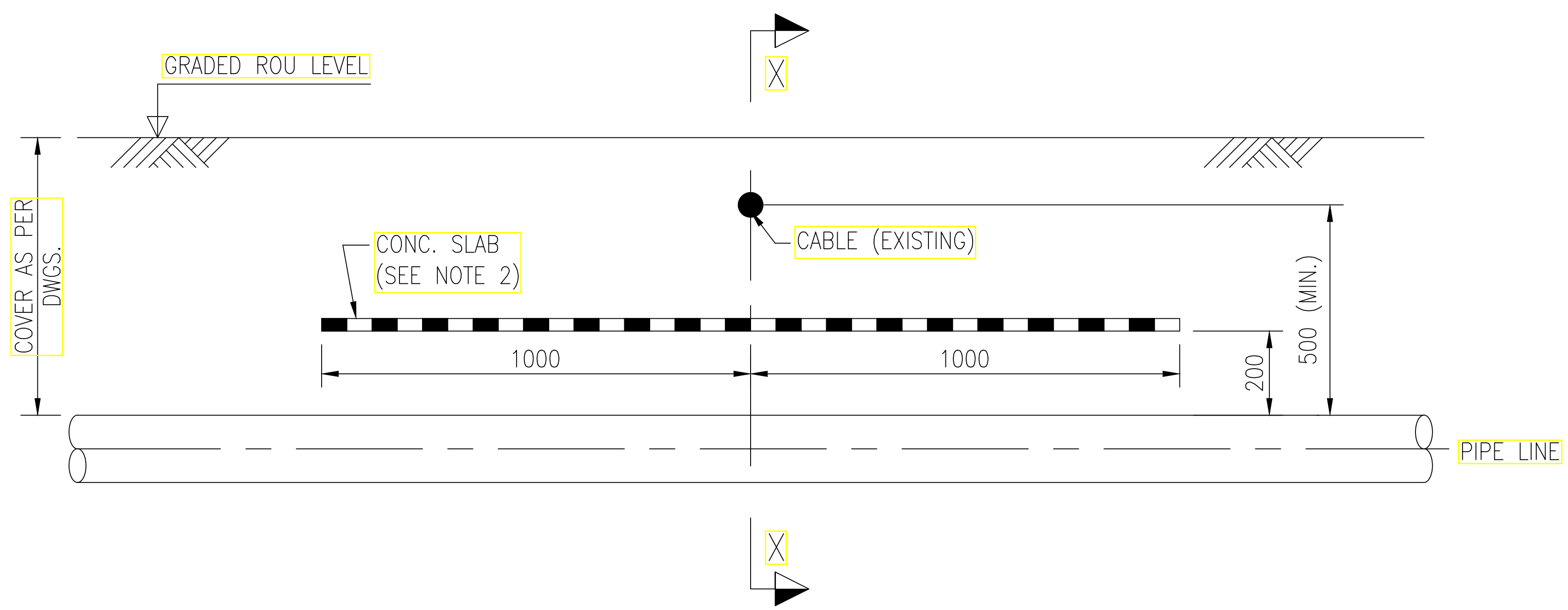
00	16.01.23	ISSUED AS STD. DRAWING	PSS	MC	HK
REV.	DATE	DESCRIPTION	PREP.	CHKD.	APPD.

PMC:
 **VCS QUALITY SERVICES PVT. LTD.**
Emerging Quality

TITLE:
TYPICAL DRAWING FOR
EXISTING UNDERGROUND PIPE CROSSING

SCALE: N.T.S. TOTAL NO. OF SHTS: 1 OF 1

SIZE: A3 JOB NO.: ----- DRAWING NUMBER: VCS-00-PP-SD-2012 REV.: 00



SECTION X-X

CROSSING DETAIL				
Sr.No.	CROSSING	PIPELINE ROUTE	WIDTH (M)	CONSTRUCTION METHOD

REFERENCE DRAWINGS / DOCUMENTS		
S.NO.	TITLE	NO.
1.	TYPICAL DRAWING FOR CONCRETE SLAB	C221070-00-PP-SD-2017

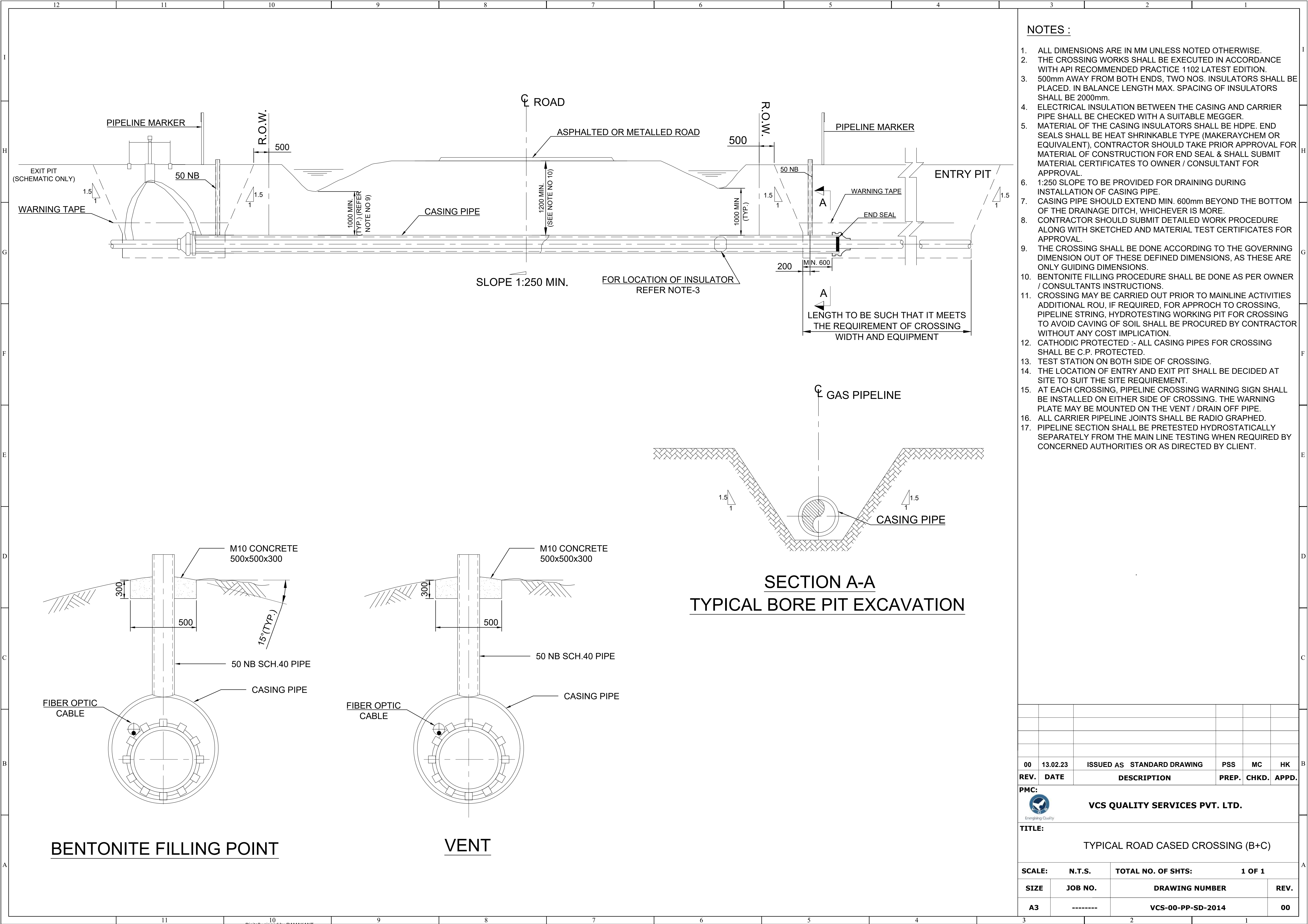
- NOTES:-**
- ALL DIMENSIONS ARE IN MM UNLESS OTHERWISE STATED.
 - REFER VCS-00-PP-SD-2017 FOR PRECAST RCC CONCRETE SLAB
 - A MODIFIED PIPELINE WARNING SIGN SHALL BE INSTALLED CLOSE TO THE CROSSING.
 - IN CASE OF ARMOURED AC CABLE, C.P. BONDING IS TO BE PROVIDED BETWEEN PIPELINE AND CABLE ARMOUR. IN CASE OF UNARMOURED CABLE, ARRANGEMENT FOR SHIELDING (BY PROVIDING CASING ON EITHER SIDE OF THE PIPELINE OR CABLE) SHALL BE CONSIDERED.
 - DIMENSION 'A' SHALL BE CALCULATED USING FORMULA $A=(D1+D2+....Dn) + (n-1) \times 500$ WHERE D1, D2,.... Dn ARE THE DIAMETERS OF PIPELINES IN mm IN THE SAME TRENCH AND 'n' IS NO. OF PIPELINES IN SAME TRENCH.
 - DIMENSIONS 'D' SHALL BE THE LARGEST DIAMETER OF THE PIPELINES LAID IN SAME TRENCH.
 - TRENCH DIMENSIONS SHALL BE IN ACCORDANCE WITH RELEVANT STANDARDS/SPECIFICATIONS.
 - APPROVAL OF THE CROSSING SHALL BE OBTAINED FROM CONCERNED AUTHORITIES.

00	16.01.23	ISSUED AS STD. DRAWING	PSS	MC	HK
REV.	DATE	DESCRIPTION	PREP.	CHKD.	APPD.

PMC:  **VCS QUALITY SERVICES PVT. LTD.**

TITLE: TYPICAL DRAWING FOR UNDERGROUND CABLE CROSSING

SCALE:	N.T.S.	TOTAL NO. OF SHTS:	1 OF 1
SIZE	JOB NO.	DRAWING NUMBER	REV.
A3	-----	VCS-00-PP-SD-2013	00



- NOTES :**
- ALL DIMENSIONS ARE IN MM UNLESS NOTED OTHERWISE.
 - THE CROSSING WORKS SHALL BE EXECUTED IN ACCORDANCE WITH API RECOMMENDED PRACTICE 1102 LATEST EDITION.
 - 500mm AWAY FROM BOTH ENDS, TWO NOS. INSULATORS SHALL BE PLACED. IN BALANCE LENGTH MAX. SPACING OF INSULATORS SHALL BE 2000mm.
 - ELECTRICAL INSULATION BETWEEN THE CASING AND CARRIER PIPE SHALL BE CHECKED WITH A SUITABLE MEGGER.
 - MATERIAL OF THE CASING INSULATORS SHALL BE HDPE. END SEALS SHALL BE HEAT SHRINKABLE TYPE (MAKERAYCHEM OR EQUIVALENT), CONTRACTOR SHOULD TAKE PRIOR APPROVAL FOR MATERIAL OF CONSTRUCTION FOR END SEAL & SHALL SUBMIT MATERIAL CERTIFICATES TO OWNER / CONSULTANT FOR APPROVAL.
 - 1:250 SLOPE TO BE PROVIDED FOR DRAINING DURING INSTALLATION OF CASING PIPE.
 - CASING PIPE SHOULD EXTEND MIN. 600mm BEYOND THE BOTTOM OF THE DRAINAGE DITCH, WHICHEVER IS MORE.
 - CONTRACTOR SHOULD SUBMIT DETAILED WORK PROCEDURE ALONG WITH SKETCHED AND MATERIAL TEST CERTIFICATES FOR APPROVAL.
 - THE CROSSING SHALL BE DONE ACCORDING TO THE GOVERNING DIMENSION OUT OF THESE DEFINED DIMENSIONS, AS THESE ARE ONLY GUIDING DIMENSIONS.
 - BENTONITE FILLING PROCEDURE SHALL BE DONE AS PER OWNER / CONSULTANTS INSTRUCTIONS.
 - CROSSING MAY BE CARRIED OUT PRIOR TO MAINLINE ACTIVITIES ADDITIONAL ROU, IF REQUIRED, FOR APPROCH TO CROSSING, PIPELINE STRING, HYDROTESTING WORKING PIT FOR CROSSING TO AVOID CAVING OF SOIL SHALL BE PROCURED BY CONTRACTOR WITHOUT ANY COST IMPLICATION.
 - CATHODIC PROTECTED :- ALL CASING PIPES FOR CROSSING SHALL BE C.P. PROTECTED.
 - TEST STATION ON BOTH SIDE OF CROSSING.
 - THE LOCATION OF ENTRY AND EXIT PIT SHALL BE DECIDED AT SITE TO SUIT THE SITE REQUIREMENT.
 - AT EACH CROSSING, PIPELINE CROSSING WARNING SIGN SHALL BE INSTALLED ON EITHER SIDE OF CROSSING. THE WARNING PLATE MAY BE MOUNTED ON THE VENT / DRAIN OFF PIPE.
 - ALL CARRIER PIPELINE JOINTS SHALL BE RADIO GRAPHED.
 - PIPELINE SECTION SHALL BE PRETESTED HYDROSTATICALLY SEPARATELY FROM THE MAIN LINE TESTING WHEN REQUIRED BY CONCERNED AUTHORITIES OR AS DIRECTED BY CLIENT.

00	13.02.23	ISSUED AS	STANDARD DRAWING	PSS	MC	HK
REV.	DATE	DESCRIPTION		PREP.	CHKD.	APPD.
PMC:						
 VCS QUALITY SERVICES PVT. LTD.						
TITLE:						
TYPICAL ROAD Cased CROSSING (B+C)						
SCALE:		N.T.S.	TOTAL NO. OF SHTS:		1 OF 1	
SIZE	JOB NO.		DRAWING NUMBER			REV.
A3	-----		VCS-00-PP-SD-2014			00

REFERENCE DRAWINGS / DOCUMENTS

S.NO.	TITLE	NO.

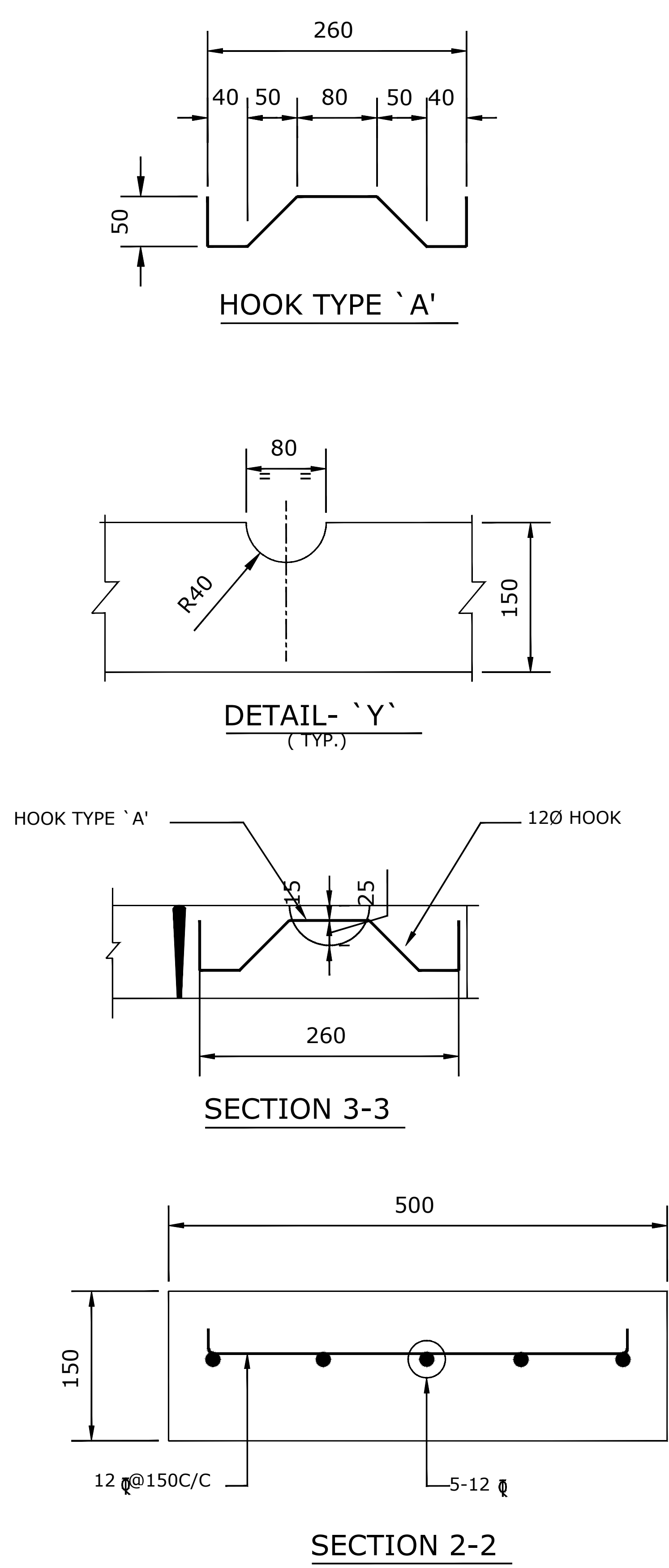
- NOTES:-**
- ALL DIMENSIONS ARE IN MILLIMETERS & LEVELS ARE IN METRES.
 - GRADE OF CONC MIX SHALL BE M-25 CONFORMING TO IS- 456.
 - REINF SHALL BE HYSD BARS OF GRADE Fe 500 CONFORMING TO IS- 1786.
 - THIS STANDARD SHALL NOT BE USED FOR VEHICULAR MOVEMENT AREAS
 - TOTAL PROTECTION LENGTH ALONG THE PROPOSED PIPELINE SHALL BE AS PER SCOPE OF CONTRACT.
 - DIMENSION "A" SHALL BE CALCULATED USING FORMULA $A=(D1+D2Dn)+(n-1) \times 500$ WHERE D1,D2, DIAMETERS OF PIPELINES IN mm AND "n" IS NO. OF PIPELINES IN THE SAME TRENCH.

00	16.01.23	ISSUED AS STD. DRAWING	PSS	MC	HK
REV.	DATE	DESCRIPTION	PREP.	CHKD.	APPD.

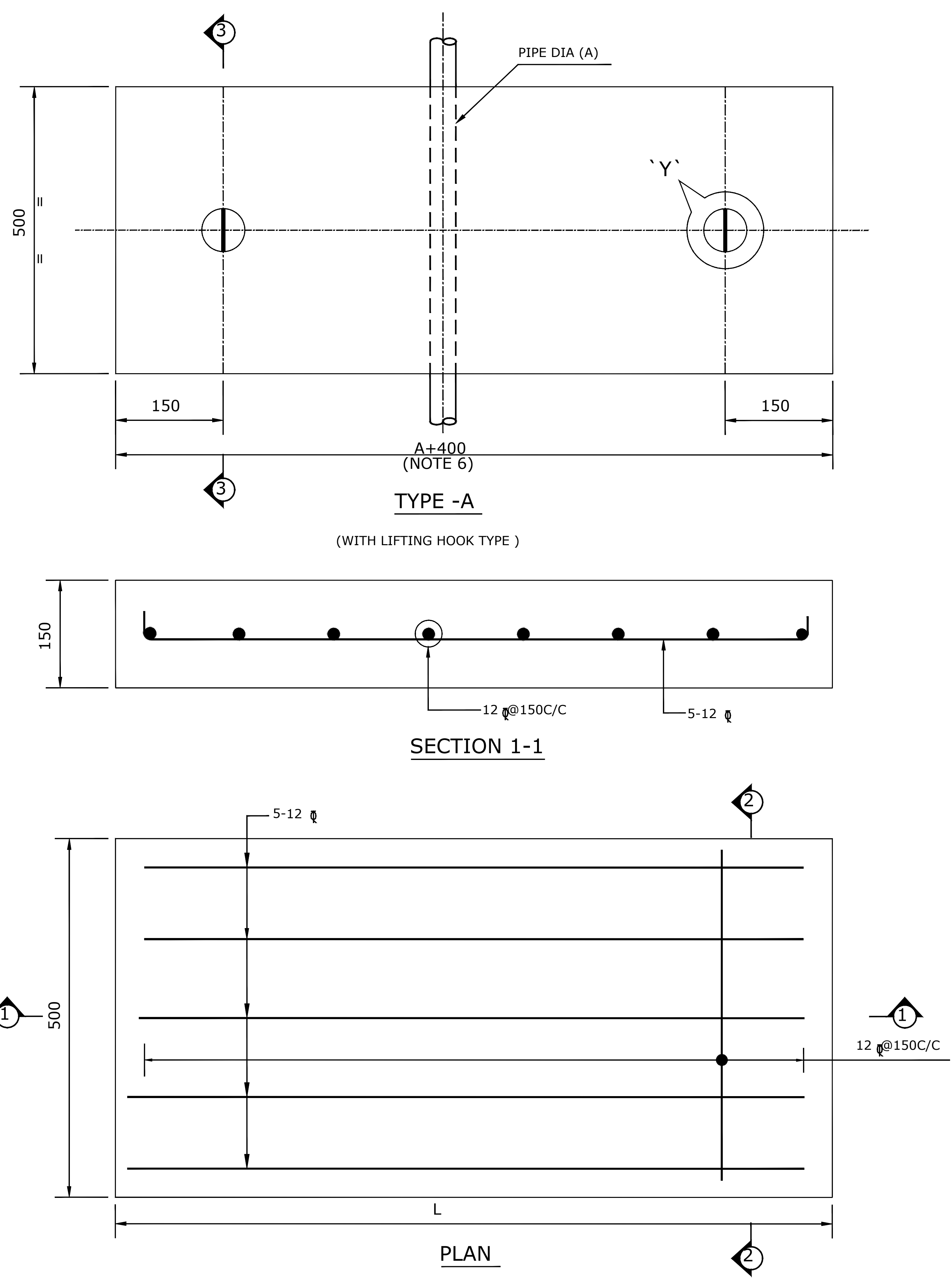
PMC:

**VCS QUALITY SERVICES PVT. LTD.**
Emerging Quality

TITLE: TYPICAL DRAWING FOR CONCRETE SLAB			
SCALE:	N.T.S.	TOTAL NO. OF SHTS:	1 OF 1
SIZE	JOB NO.	DRAWING NUMBER	REV.
A3	-----	VCS-00-PP-SD-2017	00

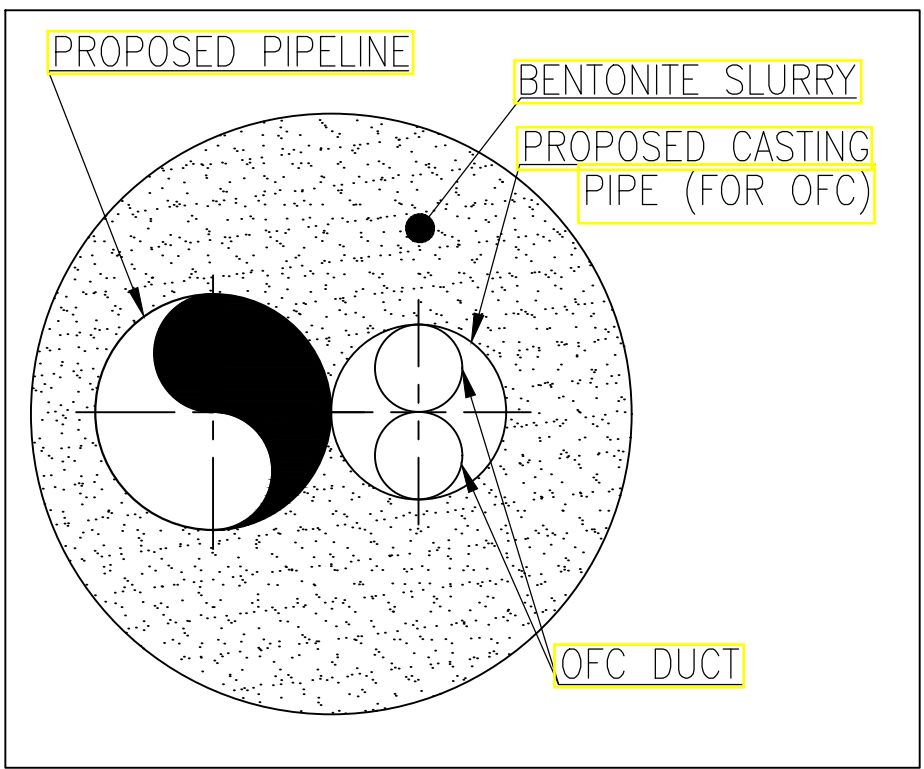
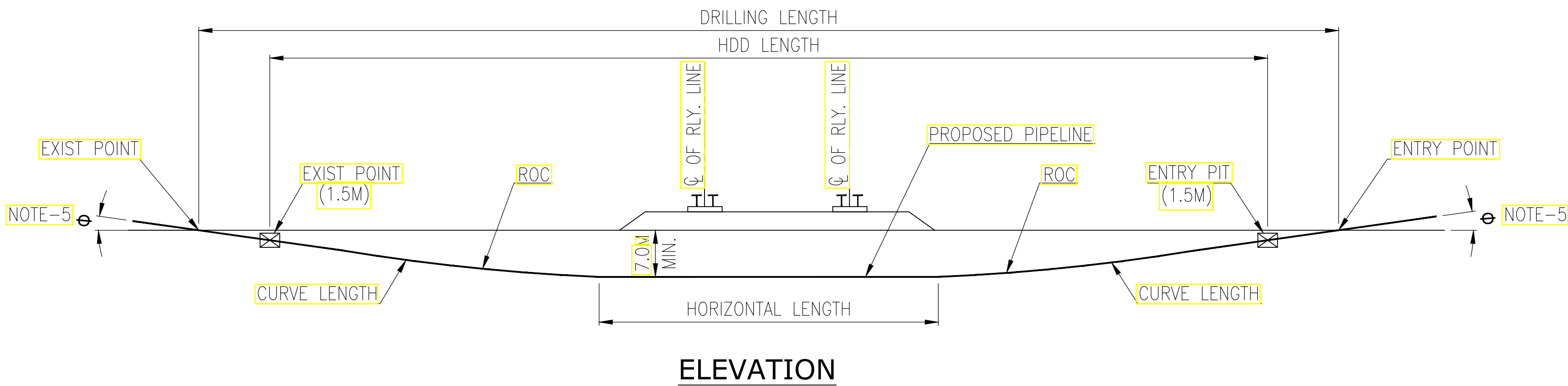
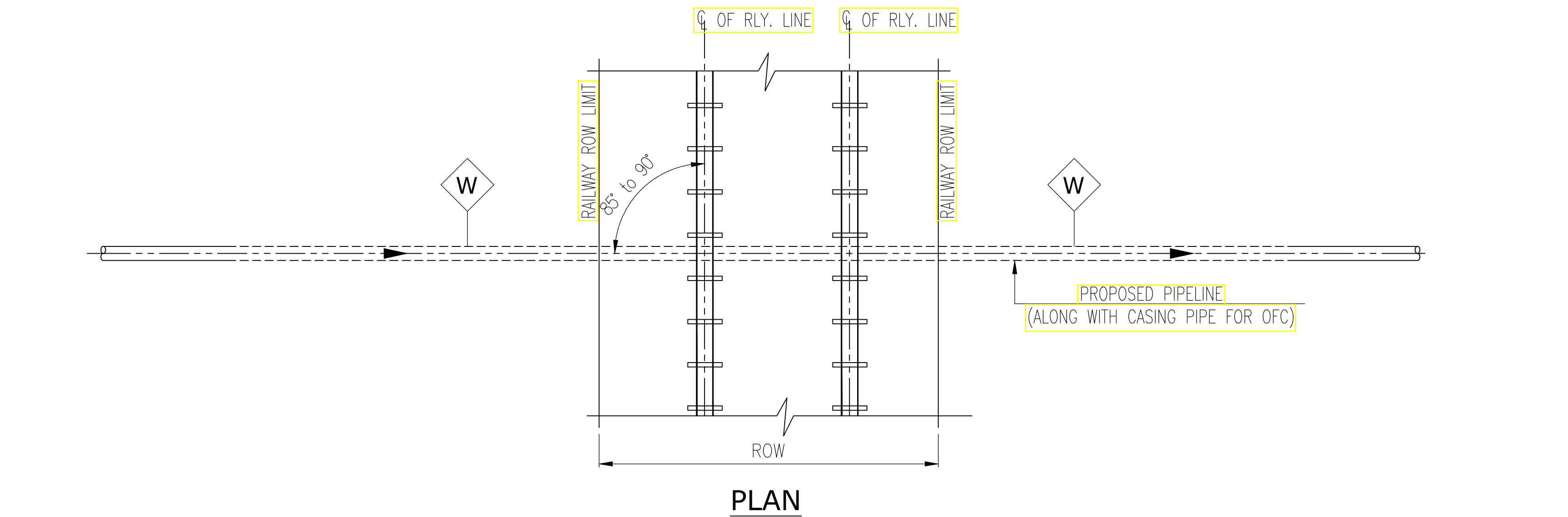


CROSSING DETAIL				
Sr.No.	CROSSING	PIPELINE ROUTE	WIDTH (M)	CONSTRUCTION METHOD



RAILWAY CROSSING DRAWING

(BY HDD - TRENCHLESS TECHNIQUE)



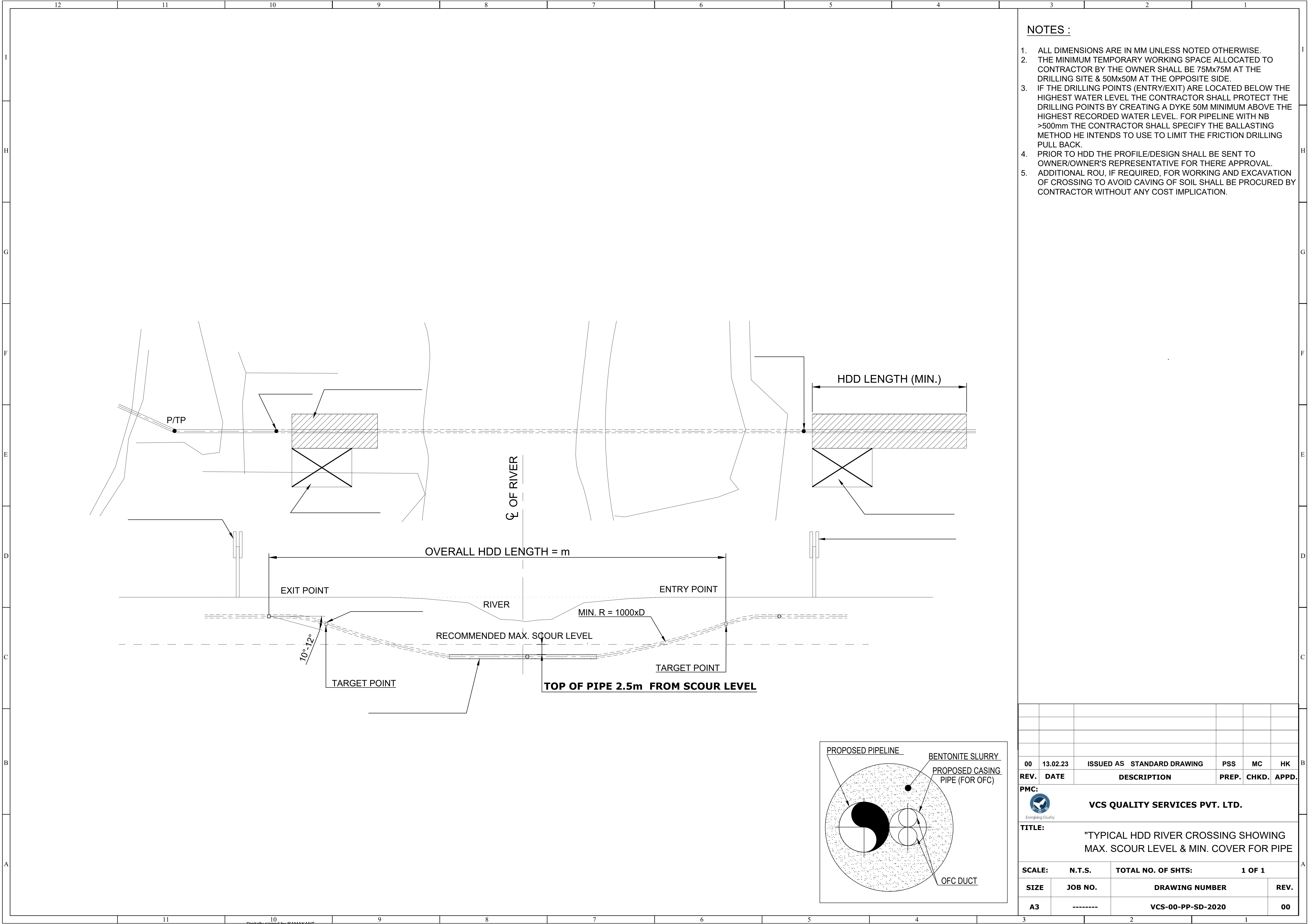
REFERENCE DRAWINGS / DOCUMENTS

S.NO.	TITLE	NO.

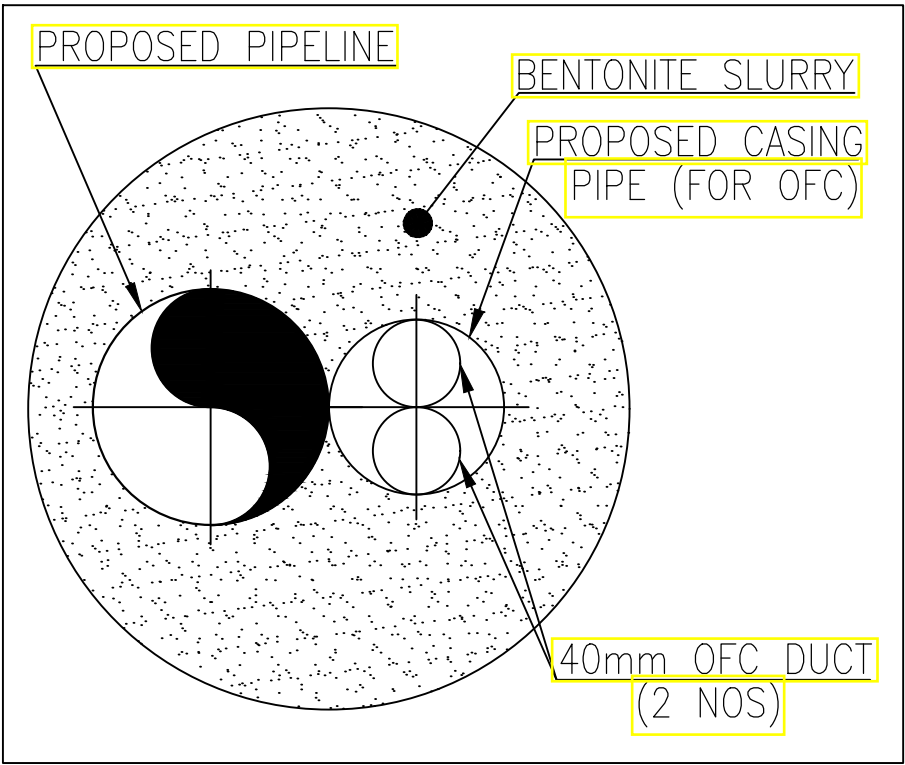
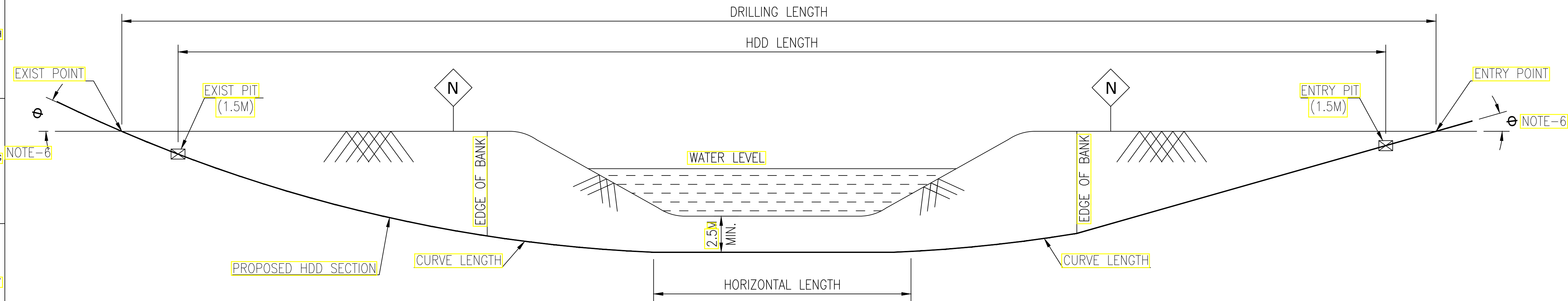
NOTES:-

- ALL DIMENSION ARE IN METERS.
- ENTRY / EXIT SIDE SHALL DEPEND ON SITE CONDITIONS.
- MINIMUM DEPTH OF COVER SHALL BE 7.0M IN RAILWAY ROW.
- HDD WITH BUNDLE PULLING.
- ENTRY & EXIST ANGLE TO BE DECIDED AS PER SITE CONDITION.
- THE NUMBER OF WARNING MARKER SHALL BE 2 NOS. FOR ALL RAILWAY CROSSING.
- REFER API RP 1102 FOR OTHER DESIGN AND INSTALLATION REQUIREMENTS.
- CONTRACTOR SHALL VERIFY THE ACTUAL DIMENSION WITH RESPECT TO SURVEY DETAIL FOR INDIVIDUAL CROSSING ENGINEER IN CHARGE APPROVAL BEFORE COMMENCEMENT OF CONSTRUCTION.
- ALL PIPELINE JOINTS SHALL BE RADIOGRAPHED.
- PIPELINE SECTION SHALL BE RADIOGRAPHED HYDROSTATICALLY SEPARATELY FROM THE MAIN LINE TESTING AS PER THE DIRECTION OF CLIENT.

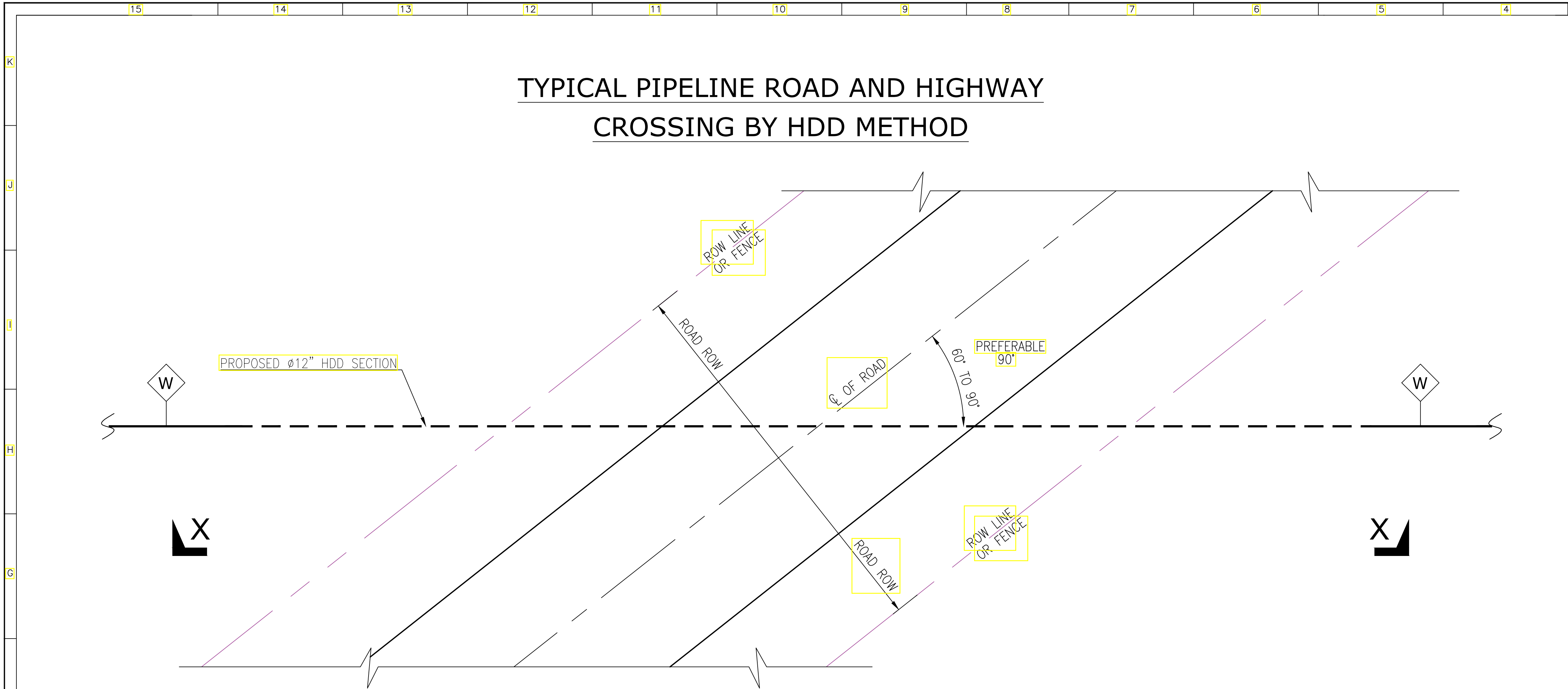
00	16.01.23	ISSUED AS STD. DRAWING	PSS	MC	HK
REV.	DATE	DESCRIPTION	PREP.	CHKD.	APPD.
PMC:					
VCS QUALITY SERVICES PVT. LTD.					
TITLE:					
TYPICAL DETAILS OF RAILWAY CROSSINGS BY HDD METHOD					
SCALE:	N.T.S.	TOTAL NO. OF SHTS:	1 OF 1		
SIZE	JOB NO.	DRAWING NUMBER	REV.		
A3	-----	VCS-00-PP-SD-2019	00		



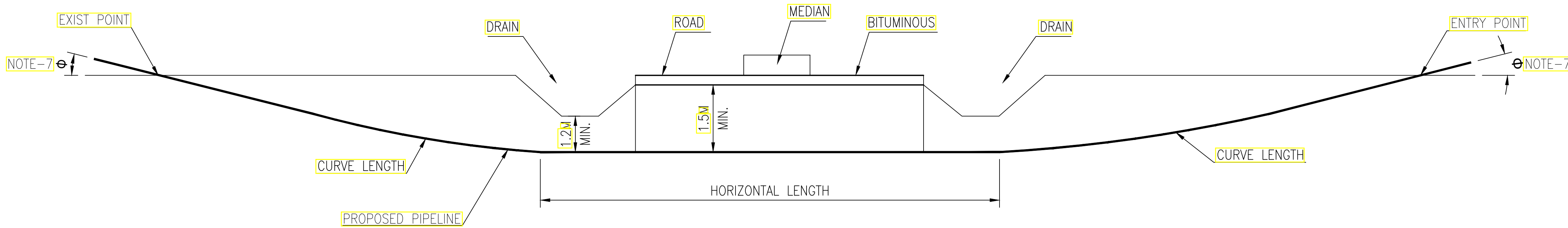
TYPICAL DETAIL FOR RIVER
CROSSING BY HDD METHOD



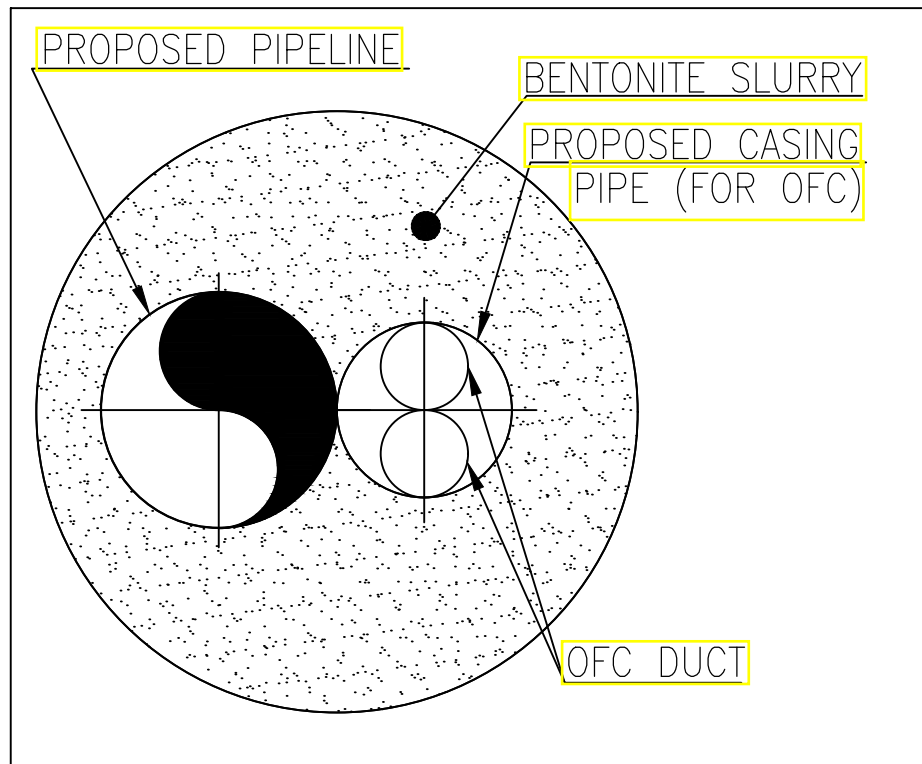
REFERENCE DRAWINGS / DOCUMENTS					
S.NO.	TITLE			NO.	
NOTES:-					
1. ALL DIMENSIONS ARE IN MM UNLESS NOTED OTHERWISE.					
2. THE MINIMUM COVER OVER SHALL BE USED ONLY WITH PRIOR APPROVAL OF COMPANY.					
(a) DEPTH OF COVER SHALL BE MINIMUM 2.5 M FROM SCOUR LEVEL					
3. THE LOCATION OF CROSSING SHALL BE IN A LONG STRAIGHT STRETCH OF THE STREAM IF POSSIBLE.					
4. WIDTH OF CROSSING SHALL BE THAT CORRESPONDING TO THE HIGHEST WATER LEVEL. THE HIGHEST WATER LEVEL SHALL BE DETERMIND BY CONTRACTOR BASED ON THE FOLLOWING.					
(a) BANK CONDITION VIS-A-VIS EROSION ETC.					
(b) EVIDENCE OF EXTIRINCTION OF VEGETATION ALONG BANKS.					
(c) DISCUSSIONS WITH LOCAL PEOPLE.					
(D) HISTORICAL RECORDS (TO THE EXEUNT AVAILABLE).					
5. THE NUMBER OF WARNING MARKER SHALL BE					
(a) 1(ONE) FOR CROSSING LESS THAN 15M WIDTH AT UPSTREAM BANK.					
(b) 2(TWO) FOR CROSSING ABOVE 15M WIDTH.					
6. ENTRY & EXIST ANGLE TO BE DECIDED AS PER SITE CONDITION.					
7. PIPELINE SECTION SHALL BE RADIOGRAPHED HYDROSTATICALLY SEPARATELY FROM THE MAIN LINE TESTING AS PER THE DIRECTION OF CLIENT.					
8. ALL PIPELINE JOINTS SHALL BE RADIOGRAPHED.					
00	16.01.23	ISSUED AS STD. DRAWING	PSS	MC	HK
REV.	DATE	DESCRIPTION	PREP.	CHKD.	APPD.
PMC:					
 VCS QUALITY SERVICES PVT. LTD.					
TITLE:					
TYPICAL DETAIL FOR RIVER CROSSING BY HDD METHOD					
SCALE:		N.T.S.	TOTAL NO. OF SHTS:		1 OF 1
SIZE	JOB NO.		DRAWING NUMBER		REV.
A3	-----		VCS-00-PP-SD-2020		00



PLAN



VIEW X-X



REFERENCE DRAWINGS / DOCUMENTS

S.NO.	TITLE	NO.

NOTES:-

1. ALL DIMENSIONS ARE IN MM UNLESS NOTED OTHERWISE.
2. ROAD HIGHWAY CROSSING SHALL BE RESTORED TO ORIGINAL CONDITION TO THE ENTIRE SATISFACTION OF OWNER AND CONCERNED AUTHORITIES HAVING JURISDICTION.
3. REFER API RP 1102 FOR OTHER DESIGN AND INSTALLATION REQUIREMENTS.
4. ANGLE OF INTERSECTION BETWEEN PIPELINE AND THE ROAD / HIGHWAY SHALL BE AS CLOSE TO 90° AS POSSIBLE.
5. CONTRACTOR SHALL VERIFY THE ACTUAL DIMENSION WITH RESPECT TO SURVEY DETAIL FOR INDIVIDUAL CROSSING ENGINEER IN CHARGE APPROVAL BEFORE COMMENCEMENT OF CONSTRUCTION.
6. ALL PIPELINE JOINTS SHALL BE RADIOGRAPHED.
7. ENTRY & EXIST ANGLE TO BE DECIDED AS PER SITE CONDITION.
9. PIPELINE SECTION SHALL BE RADIOGRAPHED HYDROSTATICALLY SEPARATELY FROM THE MAIN LINE TESTING AS PER THE DIRECTION OF CLIENT.
10. THE NUMBER OF WARNING MARKER SHALL BE 2 NOS. FOR NATIONAL HIGHWAY AND 1 NO FOR OTHER ROAD.

REV.	DATE	DESCRIPTION	PREP.	CHKD.	APPD.
00	16.01.23	ISSUED AS STD. DRAWING	PSS	MC	HK

PMC:

 **VCS QUALITY SERVICES PVT. LTD.**

TITLE:

TYPICAL DETAIL FOR PIPELINE ROAD AND HIGHWAY CROSSING BY HDD METHOD

SCALE:	N.T.S.	TOTAL NO. OF SHTS:	1 OF 1
SIZE	JOB NO.	DRAWING NUMBER	REV.
A3	-----	VCS-00-PP-SD-2021	00

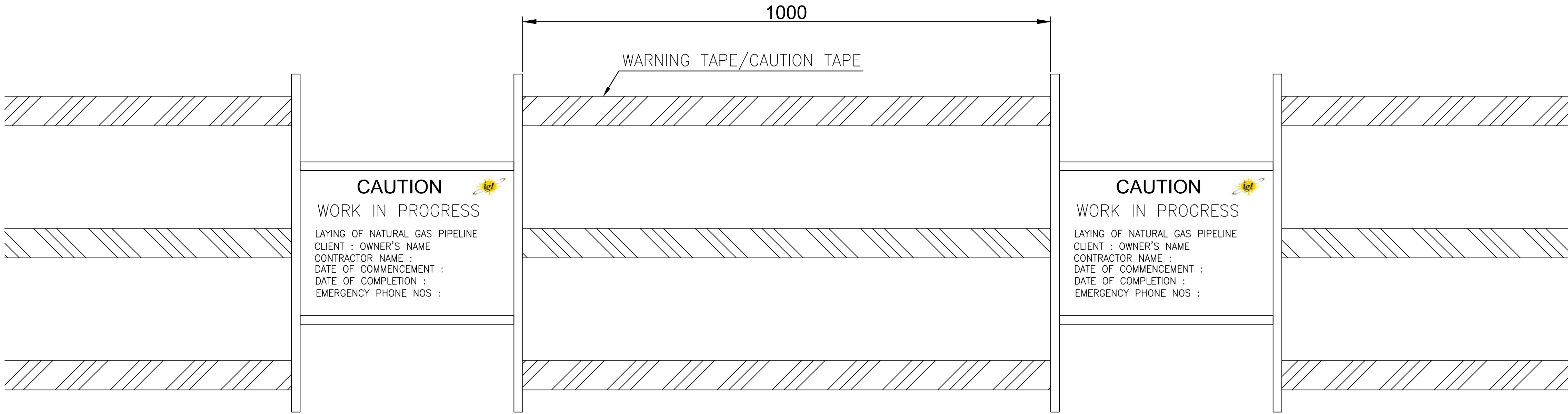
PLAN



NOTES:-

1. ALL DIMENSIONS ARE IN MM, UNLESS OTHERWISE SPECIFIED.
2. ROAD CROSSING SHALL BE RESTORED TO ORIGINAL CONDITION TO THE ENTIRE SATISFACTION OF COMPANY AND CONCERNED AUTHORITIES HAVING JURISDICTION.
3. ANGLE OF INTERSECTION BETWEEN PIPELINE AND THE ROAD/HIGHWAY SHALL BE AS CLOSE TO 90° AS POSSIBLE BUT IN NO CASE < 60°.
4. AT EACH CROSSING, PIPELINE CROSSING WARNING SIGN SHALL BE INSTALLED.
5. CONTRACTOR SHALL VERIFY THE ACTUAL DIMENSIONS WITH RESPECT TO SURVEY DETAILS OF EACH CROSSING AND PREPARE DETAILED DRAWINGS FOR INDIVIDUAL CROSSING FOR COMPANY/CONCERNED AUTHORITIES' APPROVAL BEFORE COMMENCEMENT OF CONSTRUCTION.

 PMC:  VCS QUALITY SERVICES PVT. LTD. Excellence in Quality			
TITLE: TYPICAL DETAIL FOR MINOR ROAD PIPELINE CROSSING BY OPEN CUT METHOD			
SCALE: N.T.S.		TOTAL NO. OF SHOTS: 1 OF 1	
SIZE A3	JOB NO. -----	DRAWING NUMBER VCS-00-PP-SD-2022	REV. 00

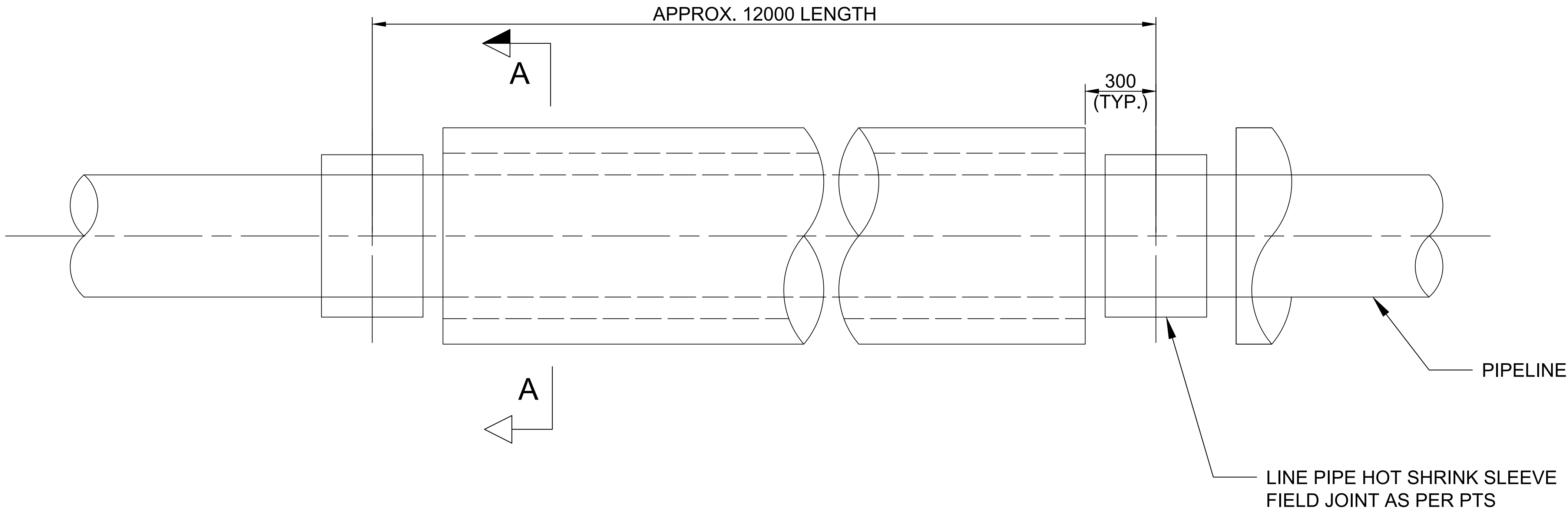


SCHEMATIC LAYOUT OF CAUTION BOARDS AND BARRICADDING

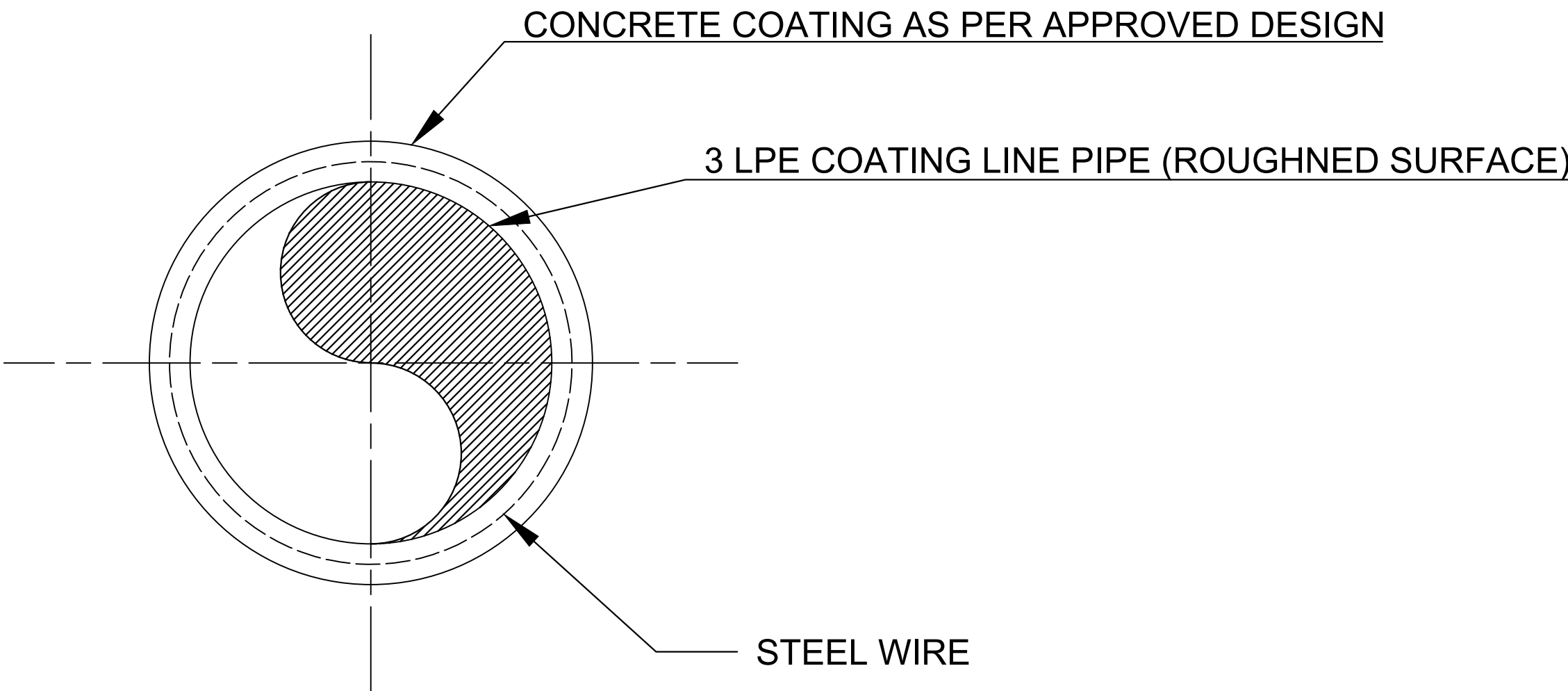
NOTES:-

1. ALL DIMENSIONS ARE IN MM UNLESS NOTED OTHERWISE.
2. TO THE CAUTION BOARDS REFER DRAWING NO. VCS-00-PP-SD-2026.

00	13.02.23	ISSUED AS	STANDARD DRAWING	PSS	MC	HK
REV.	DATE	DESCRIPTION		PREP.	CHKD.	APPD.
PMC:						
 Emerging Quality VCS QUALITY SERVICES PVT. LTD.						
TITLE:						
TYPICAL DETAIL FOR BARRICADING						
SCALE:		N.T.S.	TOTAL NO. OF SHTS:		1 OF 1	
SIZE	JOB NO.		DRAWING NUMBER			REV.
A3	-----		VCS-00-PP-SD-2023			00



DETAILS OF PIPELINE WITH CONCRETE COATING
REFER TO ALIGNMENT SHEET FOR LOCATION AND LENGTH OF CONC. COATED PIPE



SECTION A-A

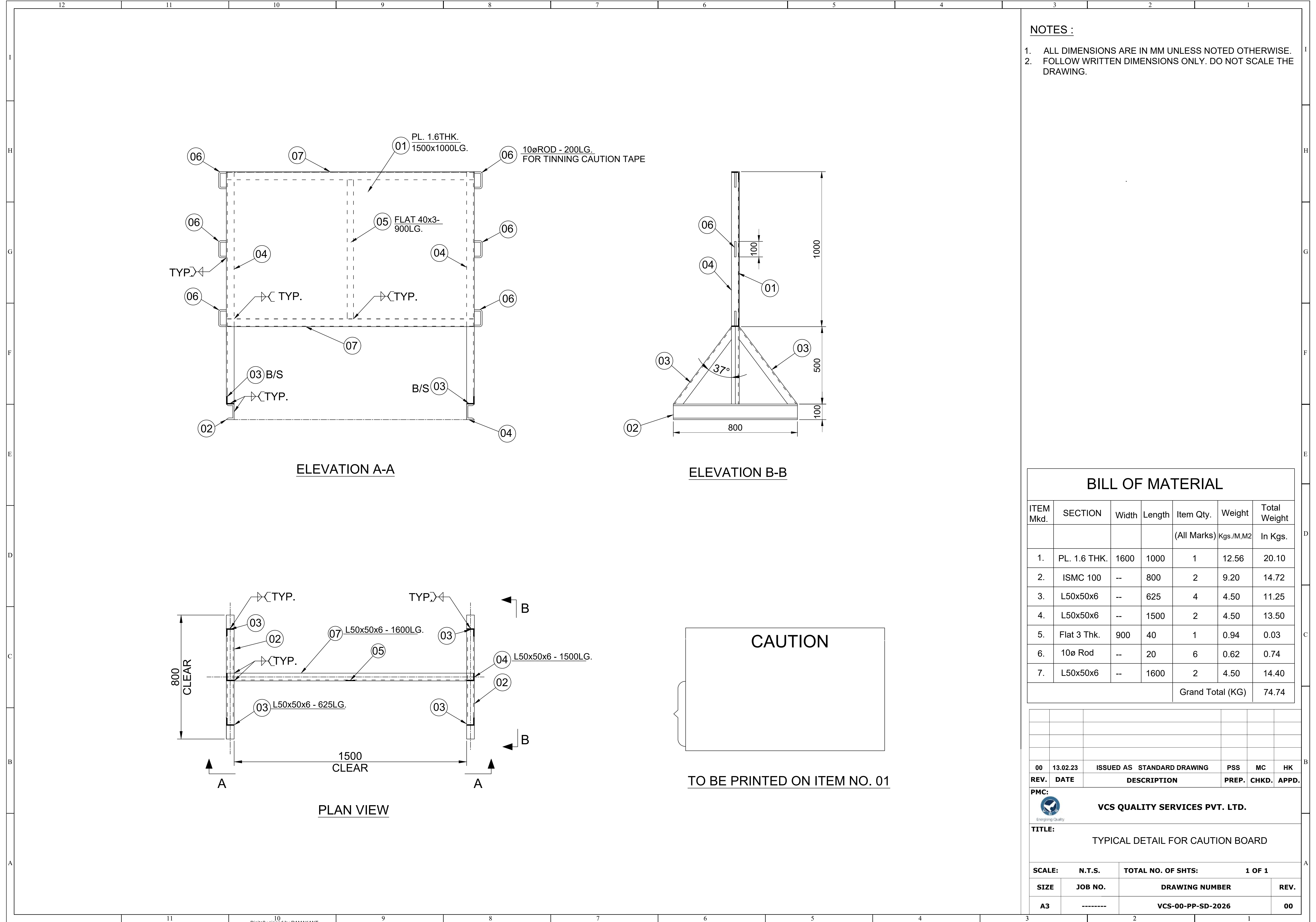
- NOTES :**
- ALL DIMENSIONS ARE IN MM UNLESS NOTED OTHERWISE.
 - REINFORCEMENT SHALL CONSIST OF WELDED STEEL WIRE FABRIC MANUFACTURED IN SLOT SHEETS OR IN ROLLS (RIBBON MESH) AND SHALL CONFORM TO ASTM A-135. WIRESH SHALL CONFORM TO ASTM A-82.
 - GALVANIZING OF STEEL WIRE SHALL BE AS PER ASTM.
 - THICKNESS OF STEEL WIRE SIZE SHALL BE 2.4mm AND SPACING OF WIRE SHALL BE 50mm x 100mm.
 - ANTIBUOYANCY CALCULATION BE SUBMITTED FOR APPROVAL.
 - MINIMUM THICKNESS OF CONCRETE COATING SHALL BE 75mm.
 - CONCRETE COATING SHALL BE M20 USED.

00	13.02.23	ISSUED AS STANDARD DRAWING	PSS	MC	HK
REV.	DATE	DESCRIPTION	PREP.	CHKD.	APPD.
PMC:					
 VCS QUALITY SERVICES PVT. LTD.					
TITLE: TYPICAL CONCRETE COATED FOR MECHANICAL PROTECTION					
SCALE: N.T.S.		TOTAL NO. OF SHTS: 1 OF 1			
SIZE	JOB NO.	DRAWING NUMBER			REV.
A3	-----	VCS-00-PP-SD-2024			00



- NOTES:**
- 1. ALL DIMENSIONS ARE IN MM UNLESS OTHERWISE SPECIFIED.
 - 2. FOLLOW WRITTEN DIMENSIONS ONLY. DO NOT SCALE THE DRAWING.

00	13.02.23	ISSUED AS STANDARD DRAWING		PSS	MC	HK
REV.	DATE	DESCRIPTION		PREP.	CHKD.	APPD.
PMC:						
		VCS QUALITY SERVICES PVT. LTD.				
TITLE:						
TYPICAL DETAIL FOR PLATE MARKER						
SCALE:		N.T.S.	TOTAL NO. OF SHTS:		1 OF 1	
SIZE	JOB NO.		DRAWING NUMBER			REV.
A3	-----		VCS-00-PP-SD-2025			00





M/s. VCS QUALITY SERVICES
PVT. LTD.

SPECTACLE BLIND FLANGE

DRAWING NO.

SD-PI-001

SHEET NO.

1 OF 1

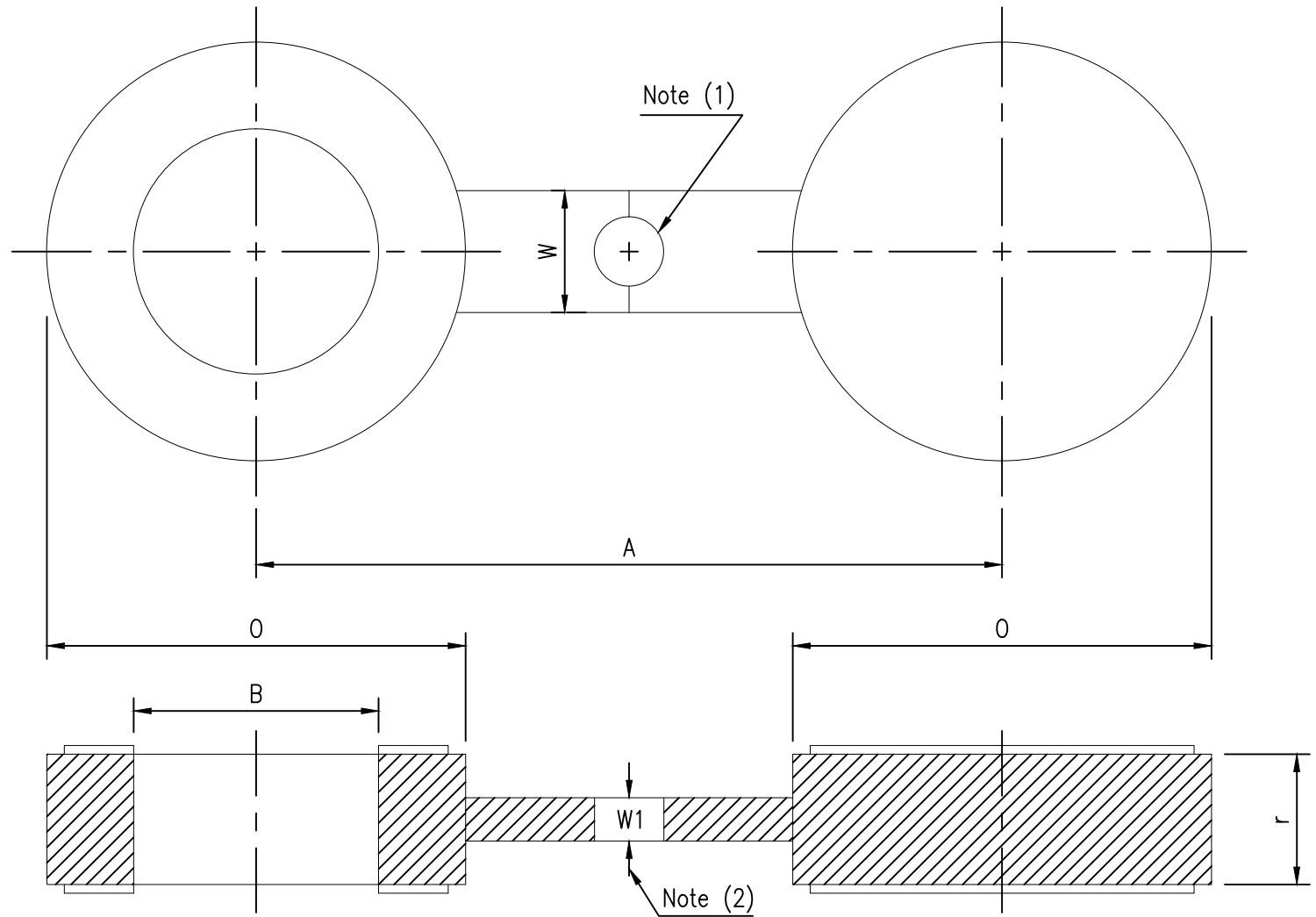


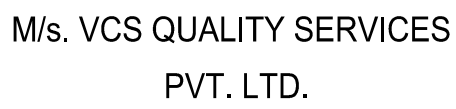
TABLE-4 DIMENSIONS OF CLASS 600 RAISED FACE FIGURE 8 BLANKS

NPS	INSIDE DIAMETER B, in.	OUTSIDE DIAMETER O, in.	CENTERLINE DIMENSION A, in.	THICKNESS r, in.	WEB WIDTH W, in.
1/2	0.62	2.00	2.62	0.25	1.50
3/4	0.82	2.50	3.25	0.25	1.50
1	1.05	2.75	3.50	0.25	2.25
1¼	1.44	3.12	3.98	0.38	2.25
1½	1.68	3.62	4.50	0.38	2.62
2	2.16	4.25	5.00	0.38	2.25
2½	2.64	5.00	5.88	0.50	2.62
3	3.26	5.75	6.62	0.50	2.62
3½	3.76	6.25	7.25	0.62	3.00
4	4.26	7.50	8.50	0.62	3.00
5	5.30	9.38	10.50	0.75	3.38
6	6.36	10.38	11.50	0.88	3.38
8	8.33	12.50	13.75	1.12	3.75
10	10.42	15.62	17.00	1.38	4.12
12	12.39	17.88	19.25	1.62	4.12
14	13.62	19.25	20.75	1.75	4.50
16	16.62	22.12	23.75	2.00	4.88
18	17.62	24.00	25.75	2.12	5.25
20	19.58	26.75	28.50	2.50	5.25
24	23.50	31.00	33.00	2.88	6.00

NOTES:

- (1) Hole size (where required due to bolt spacing) shall be the same as the flange bolt hole. and located such that it will not interfere with bolting between two flanges.
- (2) The thickness of the web (or tie bar) dimension W1 shall be 0.25 in. minimum.

0	10.05.17	ISSUED WITH TENDER	US	DK	AD
REV. NO.	DATE	SUBJECT OF REVISION	PREP	CHKD	APPD



1 OF 1

0	10.05.17	ISSUED WITH TENDER	US		DK		AD	
REV. NO.	DATE	SUBJECT OF REVISION	PREP		CHKD		APPD	



M/s. VCS QUALITY SERVICES
PVT. LTD.

CROSS GUIDE FOR BARE
PIPE SIZE 2" THRU 24"
TYPE-G4 (OFFSITE)

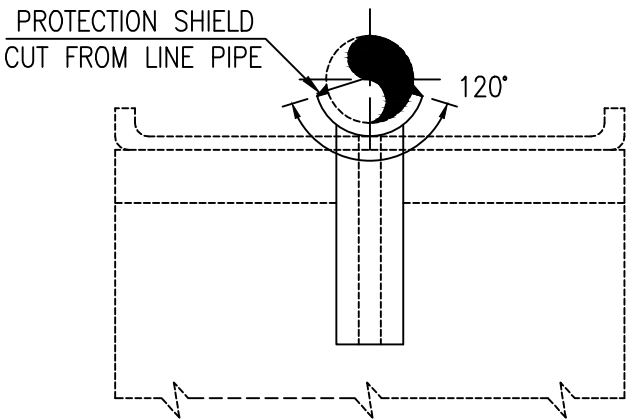
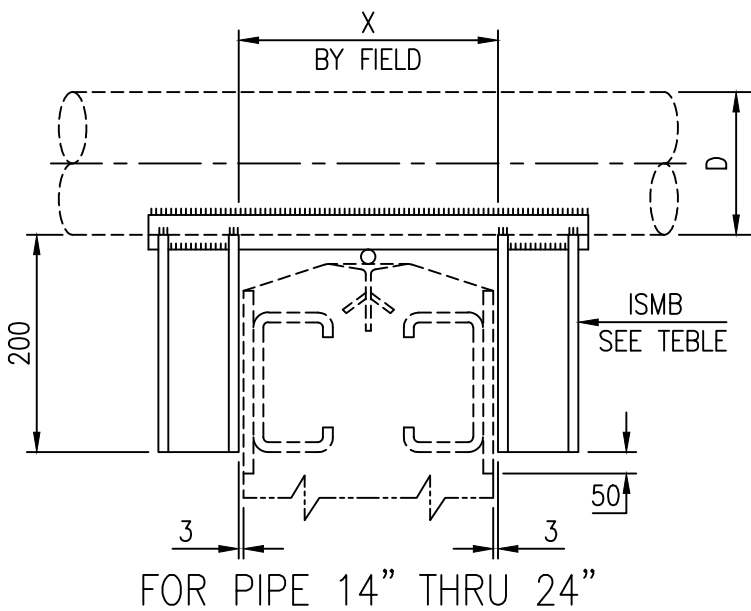
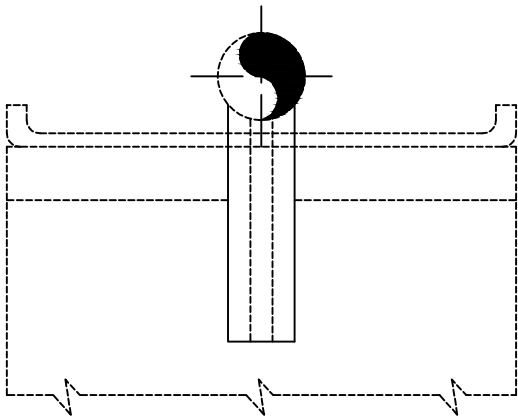
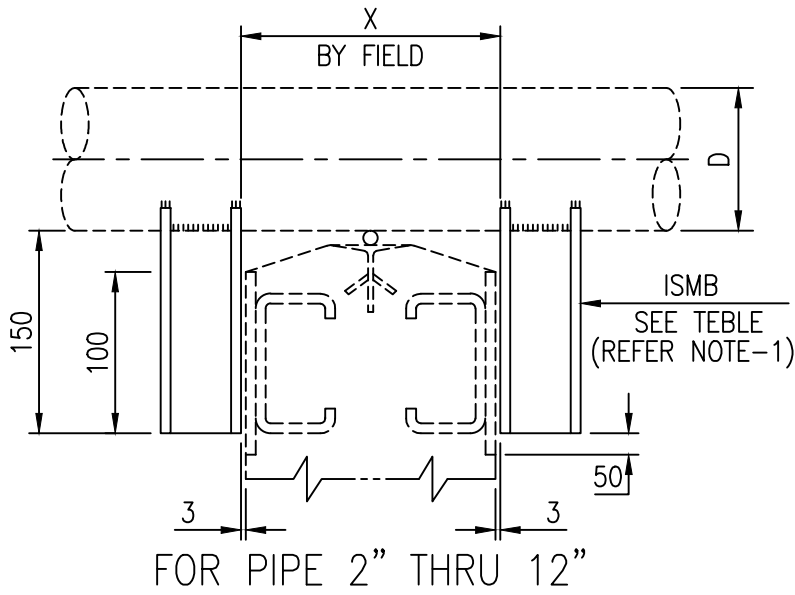
DRAWING NO.

SD-PI-003

SHEET NO.

1 OF 1

D	8	10	12	14	16	18	20	24
I BEAM	150				200		250	



G4 - D
NOM. PIPE DIA. IN INCHES
TYPE

SYMBOL

NOTE:-

- FOR SUPPORTING DETAILS FOR PIPE SIZE 2" THRU 6", REFER STD. STD.00004-PL-PI-STD-009

0	10.05.17	ISSUED WITH TENDER	US	DK	AD
REV. NO.	DATE	SUBJECT OF REVISION	PREP	CHKD	APPD



M/s. VCS QUALITY SERVICES
PVT. LTD.

CROSS GUIDE FOR BARE
PIPE SIZE 2" THRU 24"
TYPE-G3

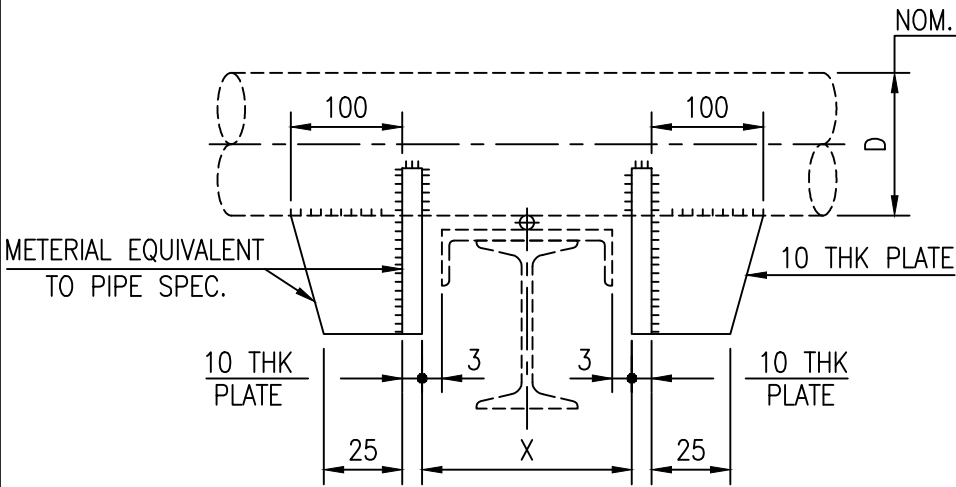
DRAWING NO.

SD-PI-004

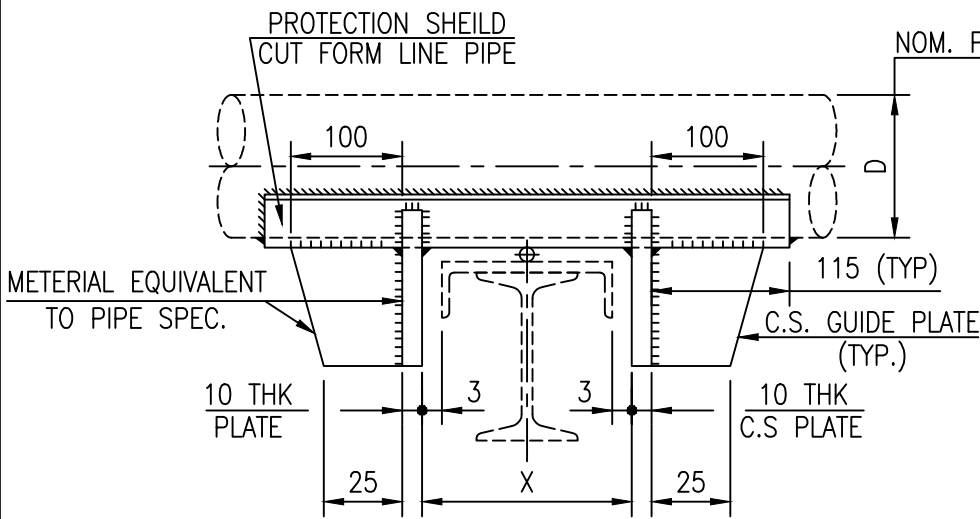
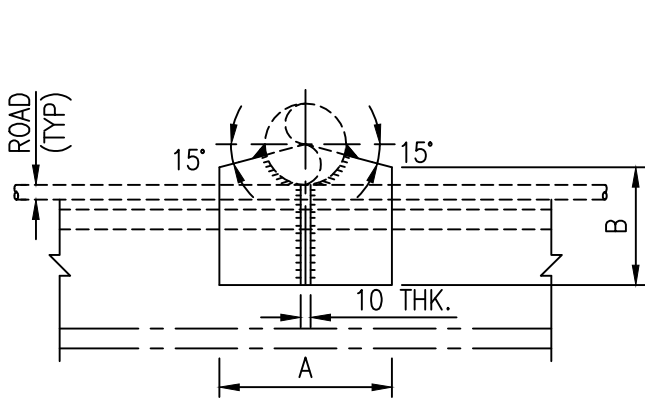
SHEET NO.

1 OF 1

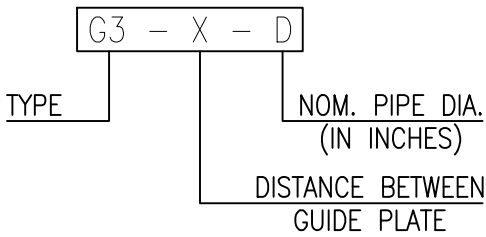
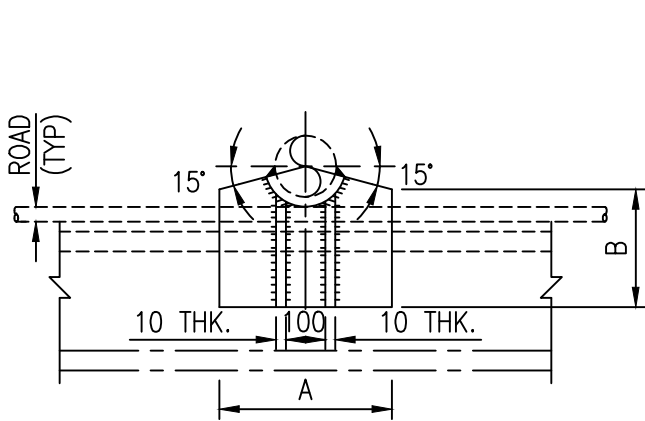
CROSS GUIDE													
D	2"	3"	4"	6"	8"	10"	12"	14"	16"	18"	20"	22"	24"
A	100	130	154	208	280	314	364	396	446	498	548	598	650
B	67	78	86	106	131	145	163	175	193	212	231	248	268



CROSS GUIDE 2" THRU 12"



CROSS GUIDE 14" THRU 24"



SYMBOL

NOTE:-

1. PROTECTION SHIELD SHALL BE CUT FROM LINE PIPE.

0	10.05.17	ISSUED WITH TENDER	US	DK	AD
REV. NO.	DATE	SUBJECT OF REVISION	PREP	CHKD	APPD



M/s. VCS QUALITY SERVICES
PVT. LTD.

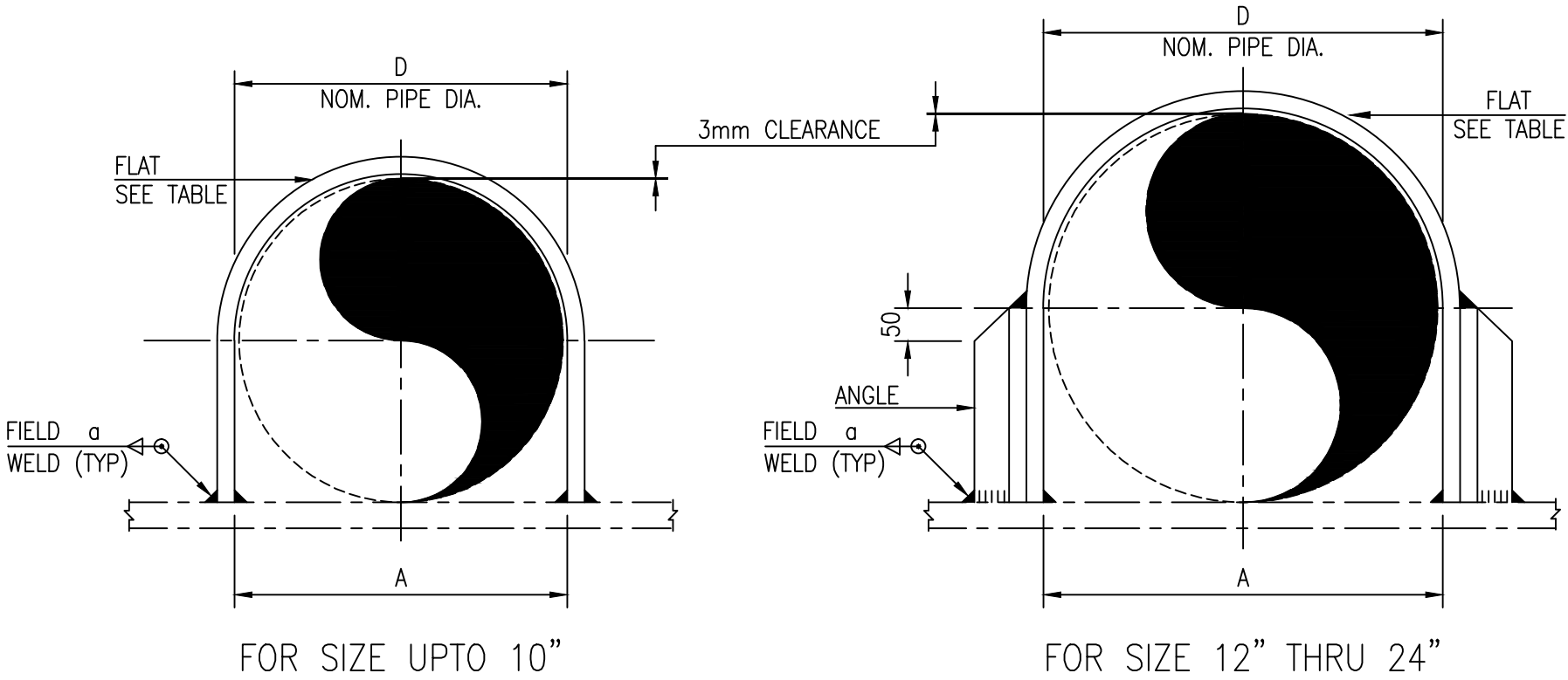
GUIDE SUPPORT FOR BARE PIPE
SIZE 1/2" THRU 24" TYPE-G1

DRAWING NO.

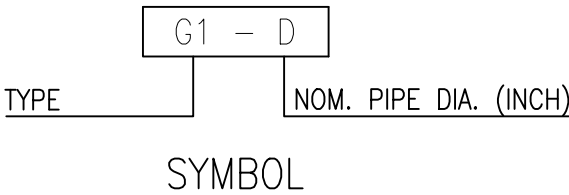
SD-PI-005

SHEET NO.

1 OF 1



D	A	α	FLAT SIZE	ANGLE SIZE
1/2"	26	6	40 x 6	-
3/4"	33			
1"	40			
1 1/4"	48			
1 1/2"	55			
2"	65			
2 1/2"	80			
3"	95	10	50 x 10	-
3 1/2"	107			
4"	120			
5"	146			
6"	174			
8"	225	10	65 x 12	75x75x10
10"	278			
12"	328	10	75 x 12	90x90x10
14"	362			
16"	412			
18"	463			
20"	515	10	75 x 12	90x90x10
24"	616			



0	10.05.17	ISSUED WITH TENDER	US	DK	AD
REV. NO.	DATE	SUBJECT OF REVISION	PREP	CHKD	APPD



M/s. VCS QUALITY SERVICES
PVT. LTD.

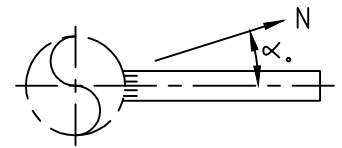
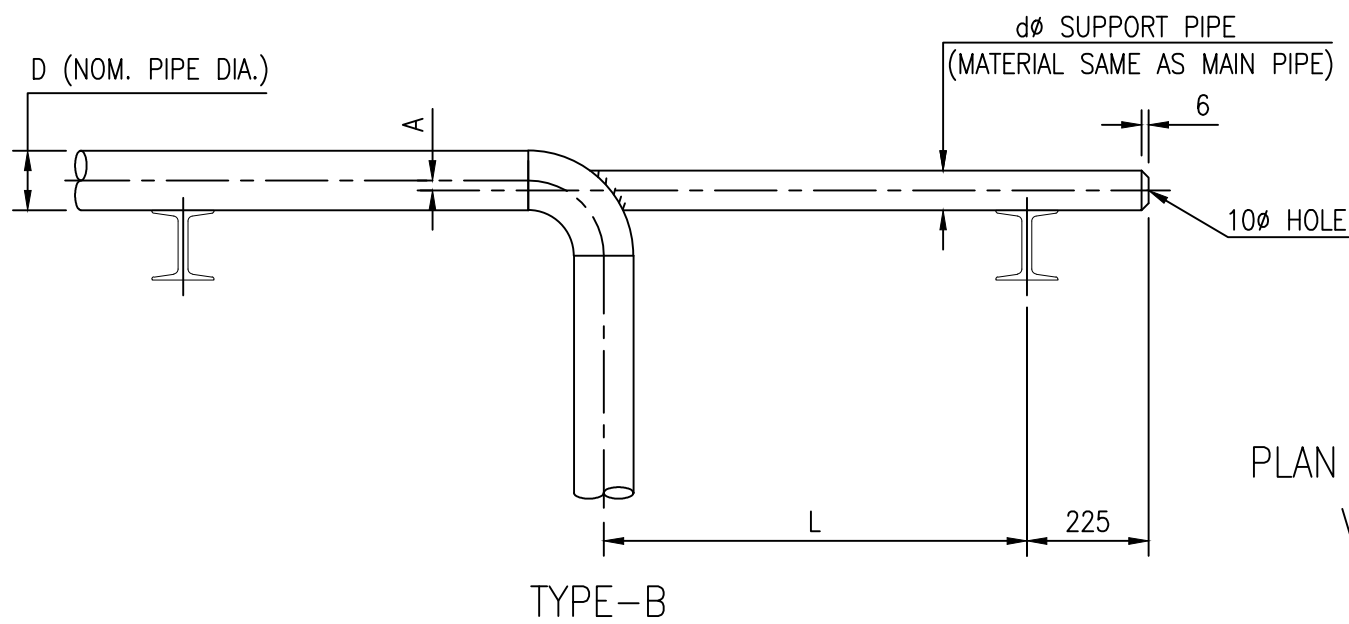
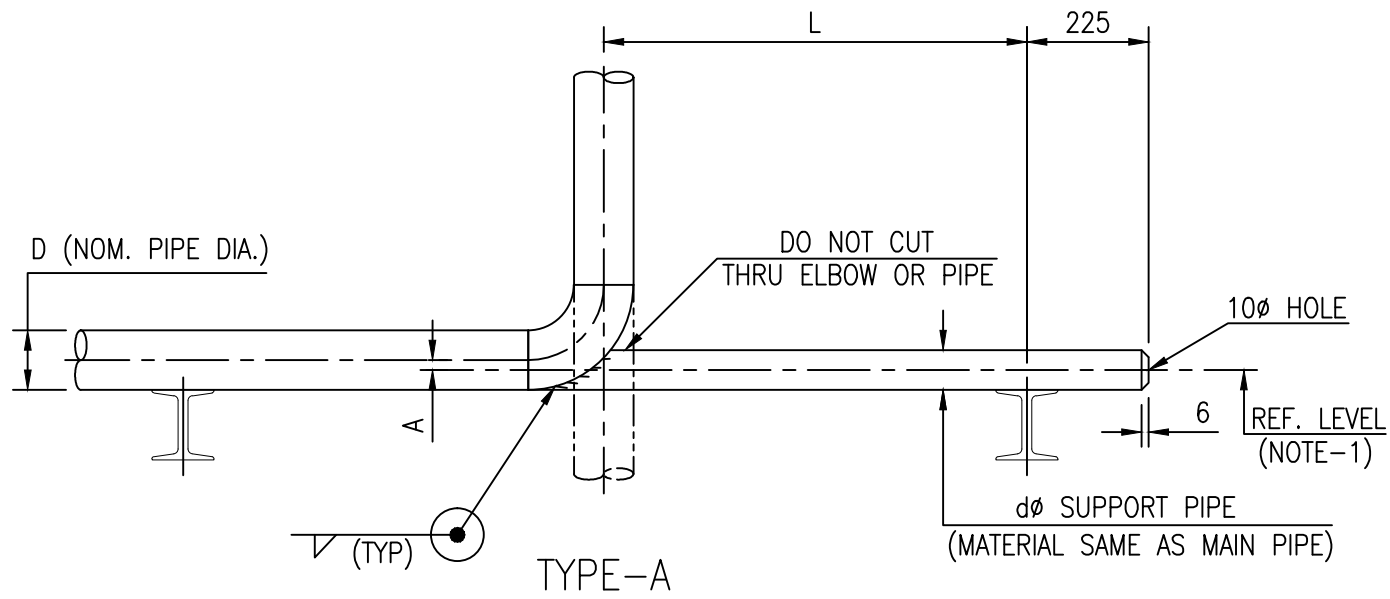
DUMMY PIPE SUPPORT FOR
BARE PIPE SIZE 2" THRU 24"
TYPE-B-39

DRAWING NO.

SD-PI-006

SHEET NO.

1 OF 1

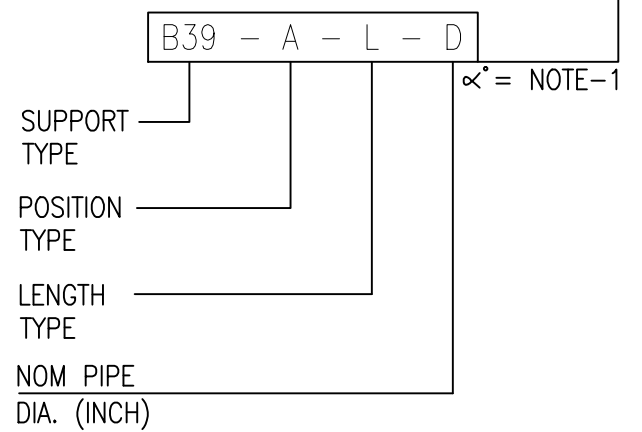


PLAN FOR SUPPORT ON
VERTICAL PIPE

FOR L, 1500 OR LESS		
D	d (NOTE 2)	A
2"	2"-SCH.40	-
3"	2"-SCH.40	15
4"	3"-SCH.40	13
6"	3"-SCH.40	40
8"	4"-SCH.40	52
10"	6"-SCH.40	52
12"	6"-SCH.40	78
14"	8"-SCH.40	68
16"	8"-SCH.40	94
18"	8"-SCH.40	119
20"	10"-SCH.40	118
24"	10"-SCH.40	168

FOR L, OVER 1500		
D	d (NOTE 2)	A
2"	2"-SCH.40	-
3"	2"-SCH.40	15
4"	3"-SCH.40	13
6"	4"-SCH.40	27
8"	6"-SCH.40	25
10"	8"-SCH.40	27
12"	8"-SCH.40	52
14"	10"-SCH.40	41
16"	10"-SCH.40	67
18"	10"-SCH.40	92
20"	12"-SCH.40	92
24"	12"-SCH.40	143

REFER LEVEL
(NOTE-1)



SYMBOL

NOTES:-

1. REF. LEVEL & α° TO BE GIVEN IN CASE SUPPORT IS WELDED TO VERTICAL PIPE.
2. IN CASE SIZE AND/OR SCH. OF SUPPORT PIPE (d) LISTED IN THE TABLE IS NOT AVAILABLE USE NEXT HIGHER SIZE AND/OR NEAREST EQUIVALENT THICKNESS AVAILABLE.

0	10.05.17	ISSUED WITH TENDER	US	DK	AD
REV. NO.	DATE	SUBJECT OF REVISION	PREP	CHKD	APPD



M/s. VCS QUALITY SERVICES
PVT. LTD.

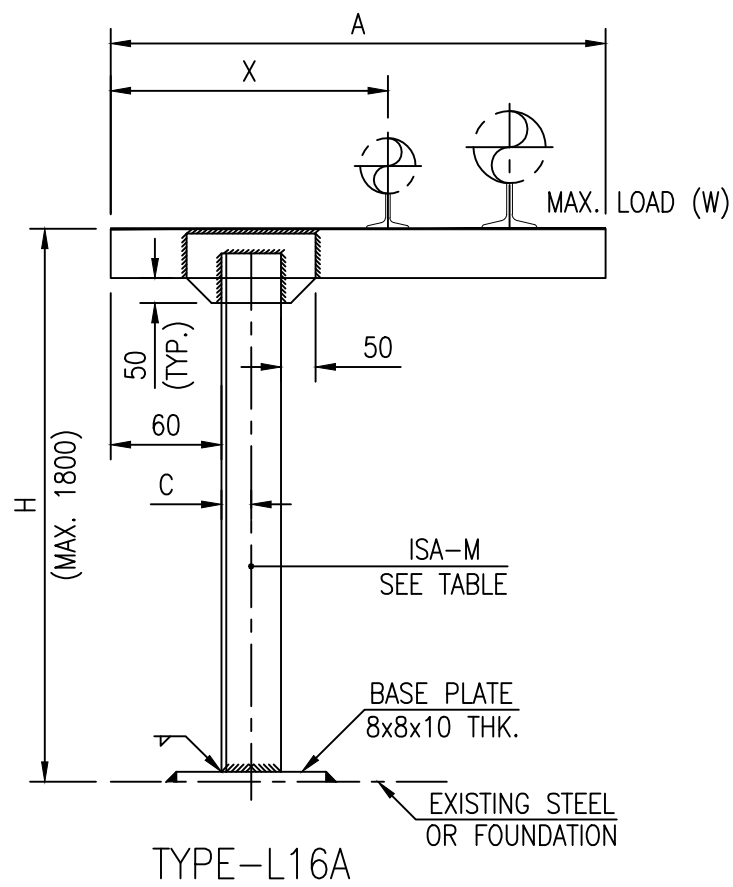
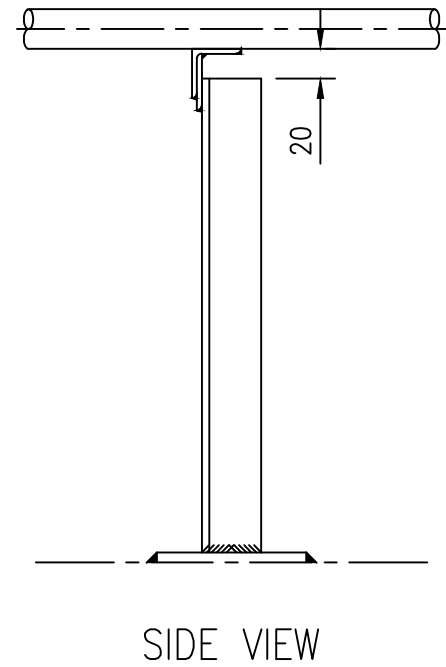
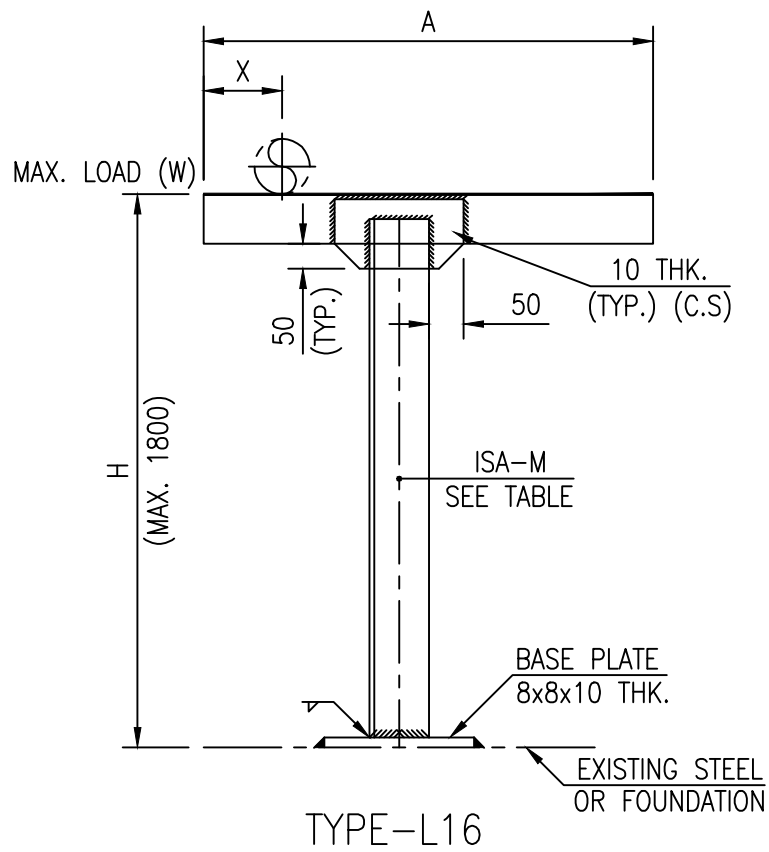
LOW SUPPORT STANCHION
TYPE-L16 AND L-16A

DRAWING NO.

SD-PI-007

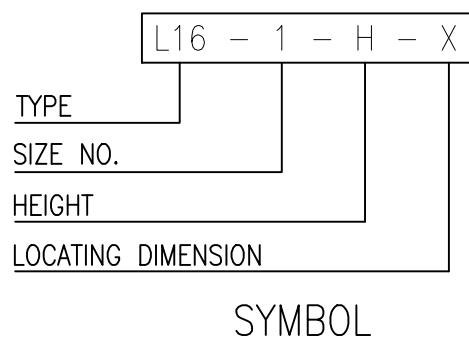
SHEET NO.

1 OF 1



NOTE:-

1. DO NOT USE FOR ANCHORING THE PIPE.



SIZE NO.	MAX. LOAD (W) Kg.	M	A	B	C
1	500	ISA 80x80x8	600	150	45
2	800	ISA 100x100x10	700	150	60
3	1500	ISA 130x130x12	800	150	80

0	10.05.17	ISSUED WITH TENDER	US		DK		AD	
REV. NO.	DATE	SUBJECT OF REVISION	PREP		CHKD		APPD	



M/s. VCS QUALITY SERVICES
PVT. LTD.

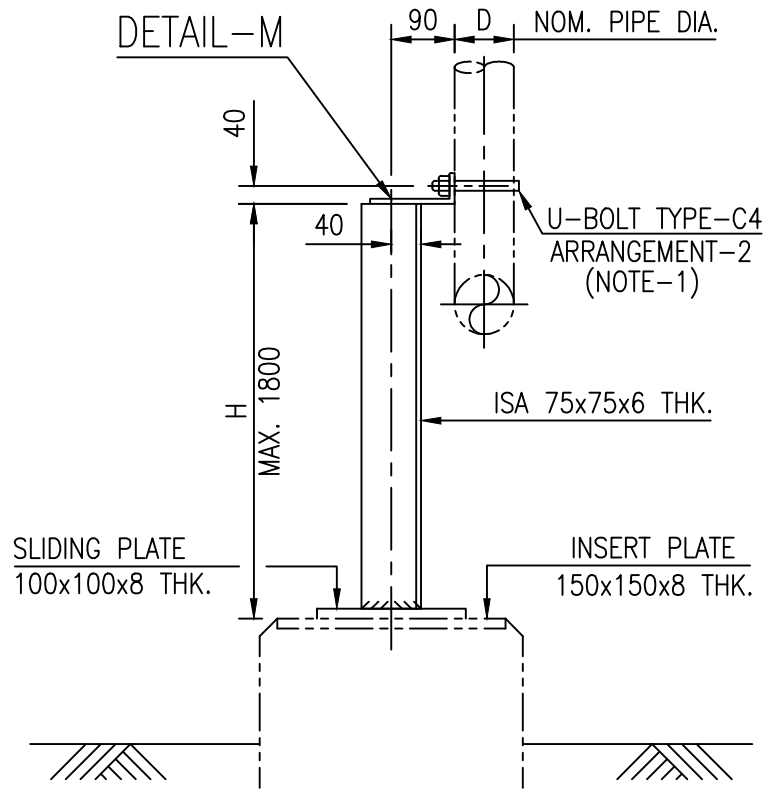
LOW SUPPORT SLIDING AND
FIXED FOR PIPE SIZE 3/4"
THRU 1 1/2" TYPE L-15

DRAWING NO.

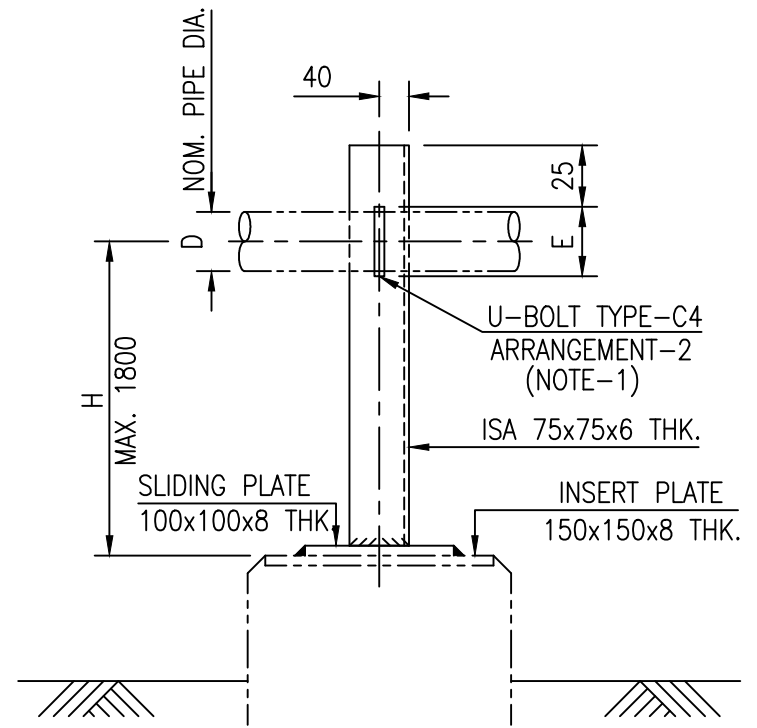
SD-PI-008

SHEET NO.

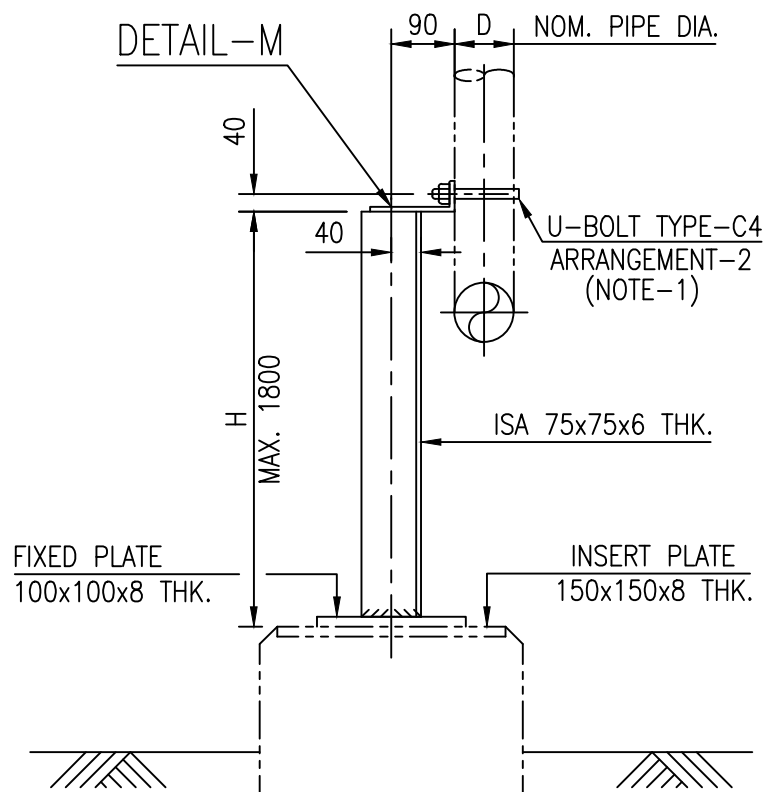
1 OF 1



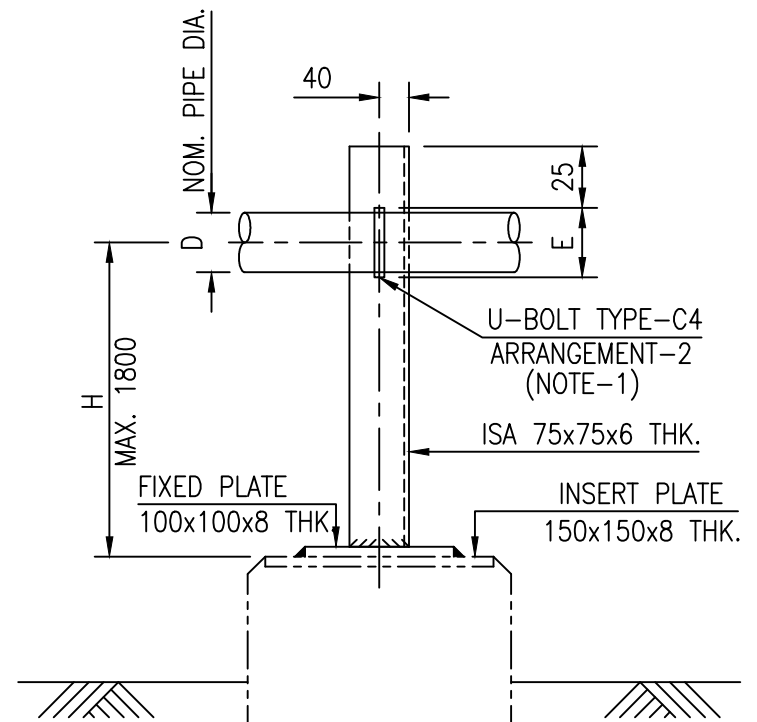
ARRANGEMENT TYPE-1
(SLIDING)



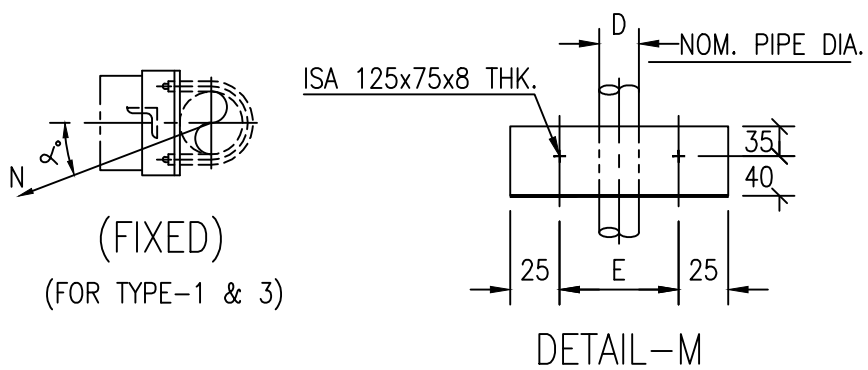
ARRANGEMENT TYPE-2
(SLIDING)



ARRANGEMENT TYPE-3
(FIXED)



ARRANGEMENT TYPE-4
(FIXED)



D	E
3/4"	36
1"	45
1 1/2"	60

$\alpha^\circ =$ (FOR TYPE 1 & 3)

TYPE
ARRANGEMENT TYPE
HEIGHT
NOM. PIPE DIA. (INCH)

L15 - 1 - H - D

SYMBOL

0	10.05.17	ISSUED WITH TENDER	US	DK	AD
REV. NO.	DATE	SUBJECT OF REVISION	PREP	CHKD	APPD



M/s. VCS QUALITY SERVICES
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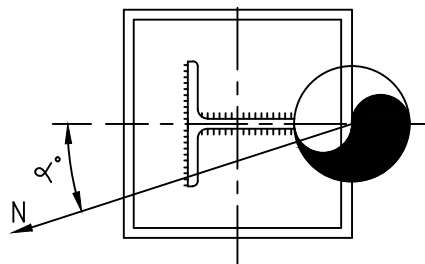
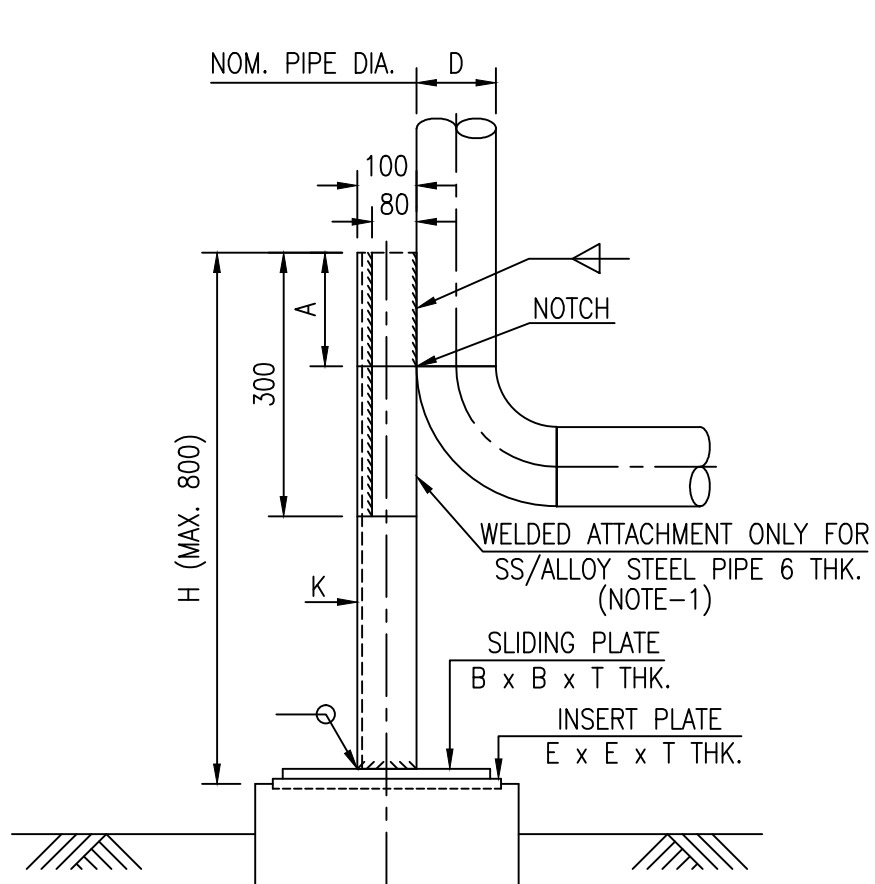
LOW SUPPORT SLIDING FOR
BARE & INSULATED PIPE
SIZE 2" THRU 24" TYPE-L6

DRAWING NO.

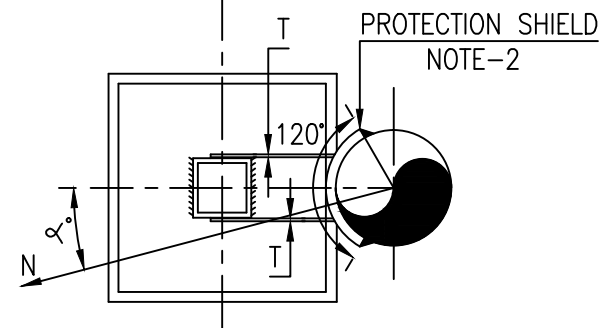
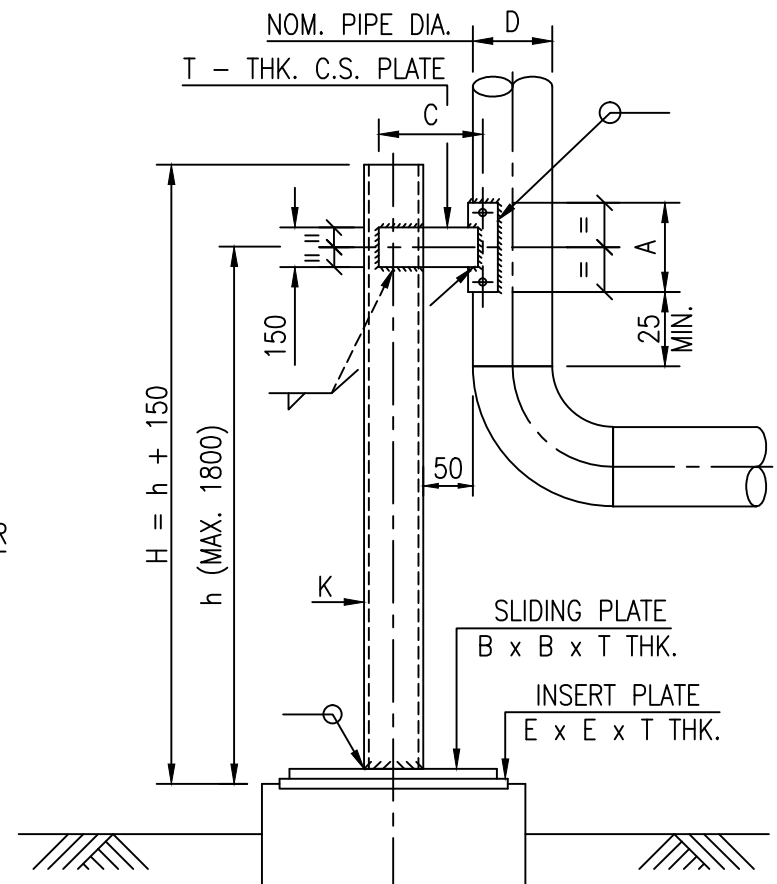
SD-PI-009

SHEET NO.

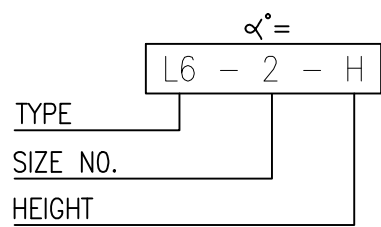
1 OF 1



FOR PIPE SIZES 2" THRU 4"



FOR PIPE SIZES 6" THRU 24"



SYMBOL

NOTES:-

1. MATERIAL FOR WELDED ATTACHMENT SHALL BE EQUIVALENT TO PIPE MATERIAL.
2. PROTECTION SHIELD IS TO BE CUT FROM LINE PIPE.

SIZE NO.	D	K	A	T	C	E	B
1	2" TO 4"	CUT FROM ISMB 200	200	10	-	250	150
2	6" TO 10"	ISMC-125 2 NOS.	200	12	150	300	200
3	12" TO 24"	ISMC-225 2 NOS.	300	12	230	400	300

FOR TEMP. UP TO 400 °C ONLY

0	10.05.17	ISSUED WITH TENDER	US	DK	AD
REV. NO.	DATE	SUBJECT OF REVISION	PREP	CHKD	APPD



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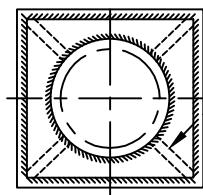
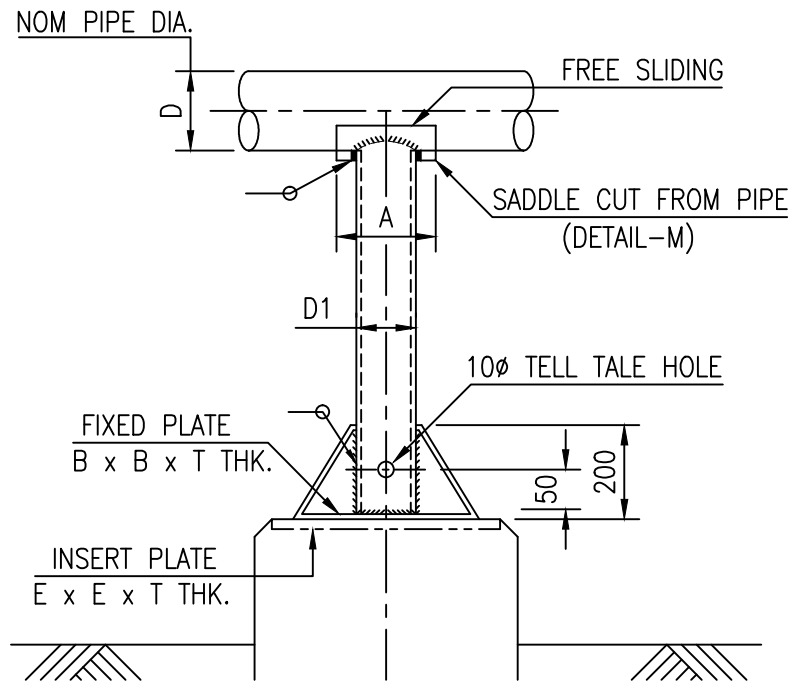
LOW SUPPORT SLIDING FOR BARE
PIPE SIZE 3/4" THRU 36"
TYPE-L5 & L5A

DRAWING NO.

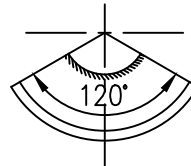
SD-PI-010

SHEET NO.

1 OF 1



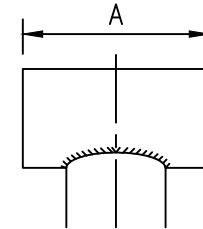
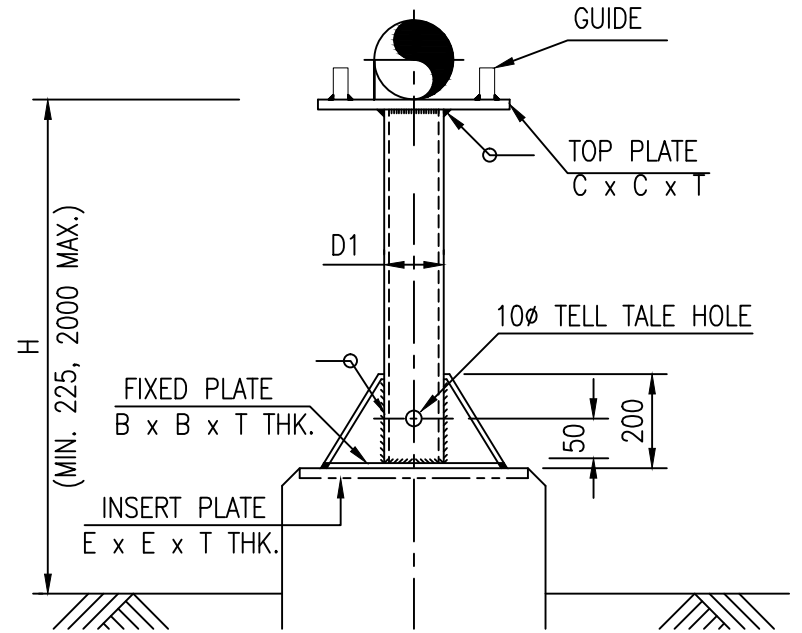
10 THK. PLATE TO BE
WELDED WHEN H EXCEEDS 1000



DETAIL-M

TYPE
SIZE NO.
HEIGHT

SYMBOL



TYPE
SIZE NO.
HEIGHT

SYMBOL

SIZE NO.	D	A	D1 (NOTE-1)	C	B	E	T
1	3/4"	2" NB x 100 Lg.	2" HEAVY IS :1239	150	150	200	12
	1"			200			
	1.1/2"	3" NB x 100 Lg.					
	2"						
2	3"	6" NB x 150 Lg.	2" HEAVY IS :1239	200	150	200	12
	4"						
3	6"	10" NB x 250 Lg.	3" HEAVY IS :1239	300	200	250	16
	8"						
4	10"	14" NB x 350 Lg.	4" HEAVY IS :1239	350	200	250	16
	12"						
5	14"	18" NB x 350 Lg.	6" HEAVY IS :1239	400	250	300	20
	16"						
6	18"	20" NB x 350 Lg.	8" SCH. 40	400	300	350	20
7	20"	24" NB x 350 Lg.	10" SCH. 40	450	350	400	20
	24"						
8	26"	30" NB x 350 Lg.	12" SCH. 40	550	400	500	20
	30"						
	36"	36" NB x 400 Lg.					

NOTES:-

- IN CASE SIZE AND/OR SCH. OF SUPPORT PIPE (D) LISTED IN THE TABLE IS NOT AVAILABLE, USE NEXT HIGHER SIZE AND/OR NEAREST EQUIVALENT THICKNESS AVAILABLE.
- MATERIAL FOR SUPPORT PIPE & PLATE SHALL BE CARBON STEEL.

0	10.05.17	ISSUED WITH TENDER	US	DK	AD
REV. NO.	DATE	SUBJECT OF REVISION	PREP	CHKD	APPD



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PVT. LTD.

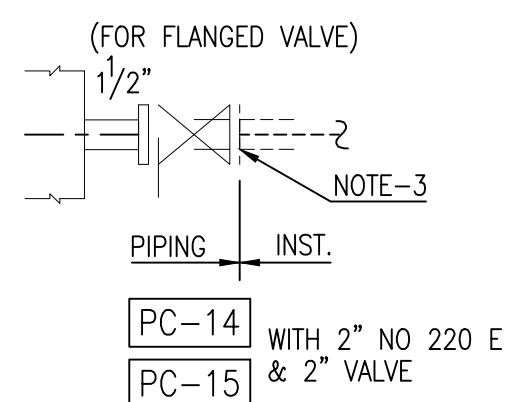
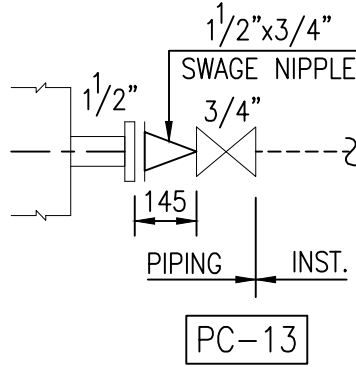
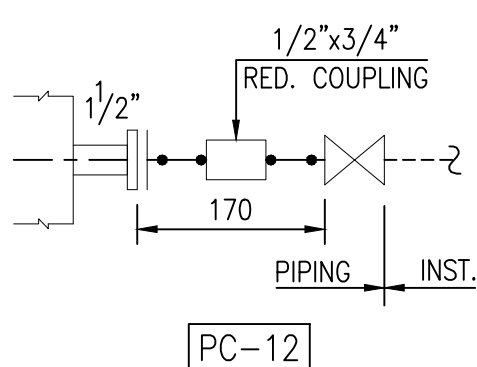
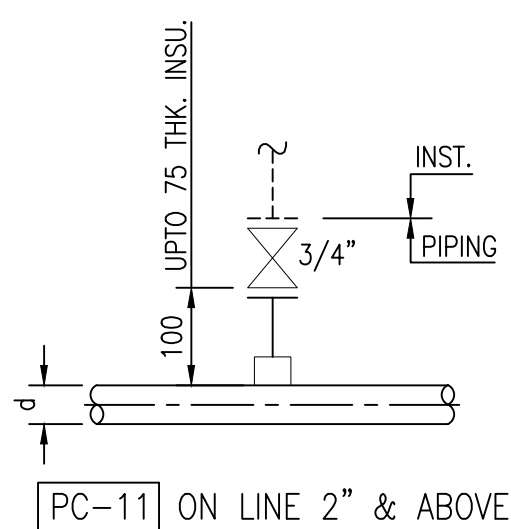
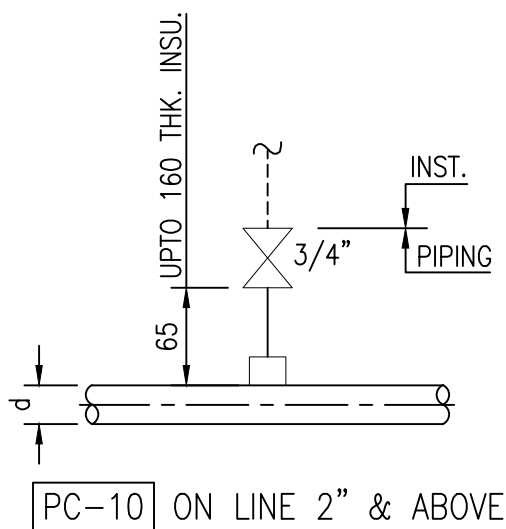
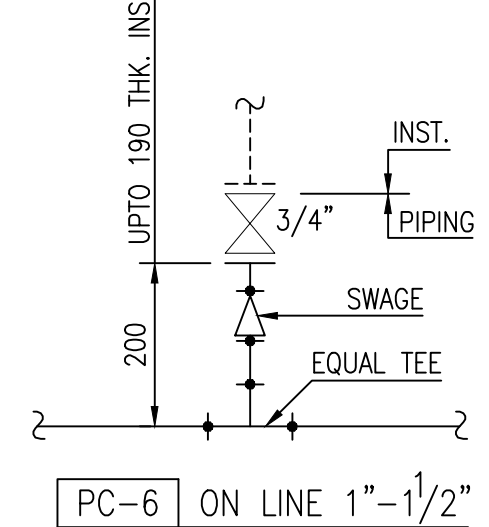
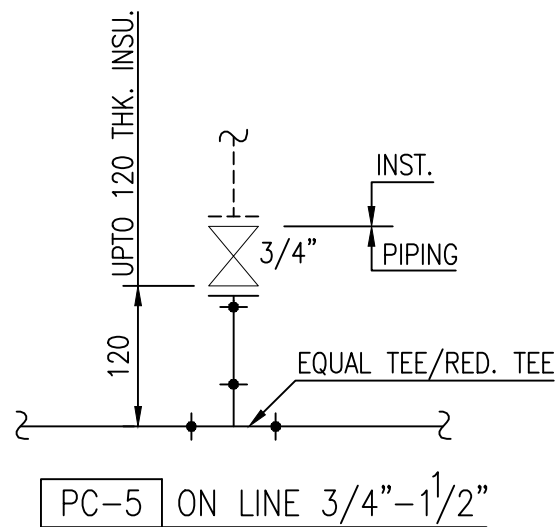
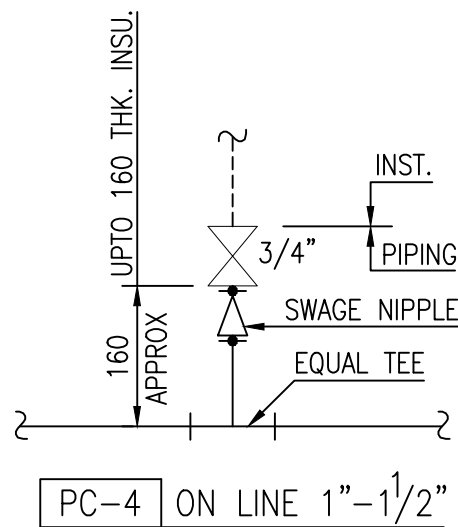
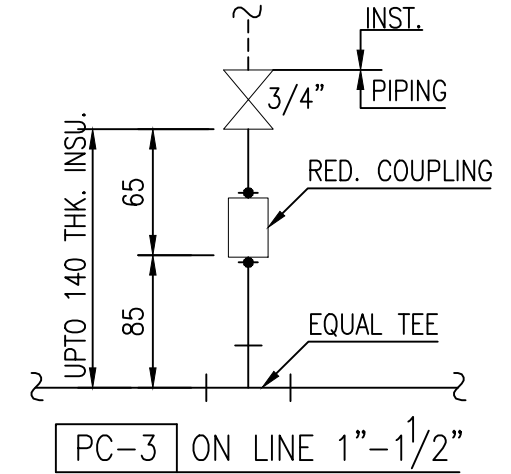
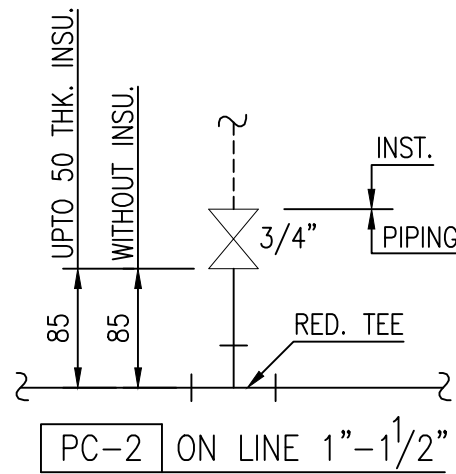
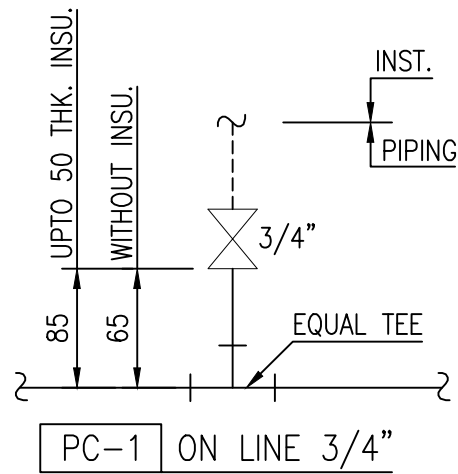
PRESSURE TAPPINGS
(PA, PG, PC, PT, PIC ETC.)

DRAWING NO.

SD-PI-011

SHEET NO.

1 OF 1



NOTES:-

1. THE INDICATED DIMENSIONS ARE MINIMUM WHICH ALSO COVER INSULATION TO THE EXTENT SHOWN ABOVE IN HIGHER THICKNESS OF INSULATION THAN INDICATED, THE DIFFERENCE SHALL BE ADDED IN THE DIMENSIONS SHOWN ABOVE ACCORDINGLY.
2. PRESSURE TAPPING SHALL BE PROVIDED WITH GATE, GLOBE OR PLUG VALVE (FLGD. SW. OR SCR'D) WITH TEE (EQ. OR RED.) HALF COUPLING (.W. OR SCR'D) OR STUB-IN AS PER PIPING SPECIFICATION.
3. IN CASE OF FLGD. VALVES BOLTING & GASKET ON BOTH SIDES OF VALVE SHALL BE IN PIPING SCOPE.
4. IN CASE OF TAPPING PROVIDED OTHER THAN INDICATED IN THIS STD FOR LAYOUT REASONS DETAILED DIMENSIONS WILL BE CALLED FOR OR CARRIED OUT.

0	10.05.17	ISSUED WITH TENDER	US	DK	AD
REV. NO.	DATE	SUBJECT OF REVISION	PREP	CHKD	APPD



M/s. VCS QUALITY SERVICES
PVT. LTD.

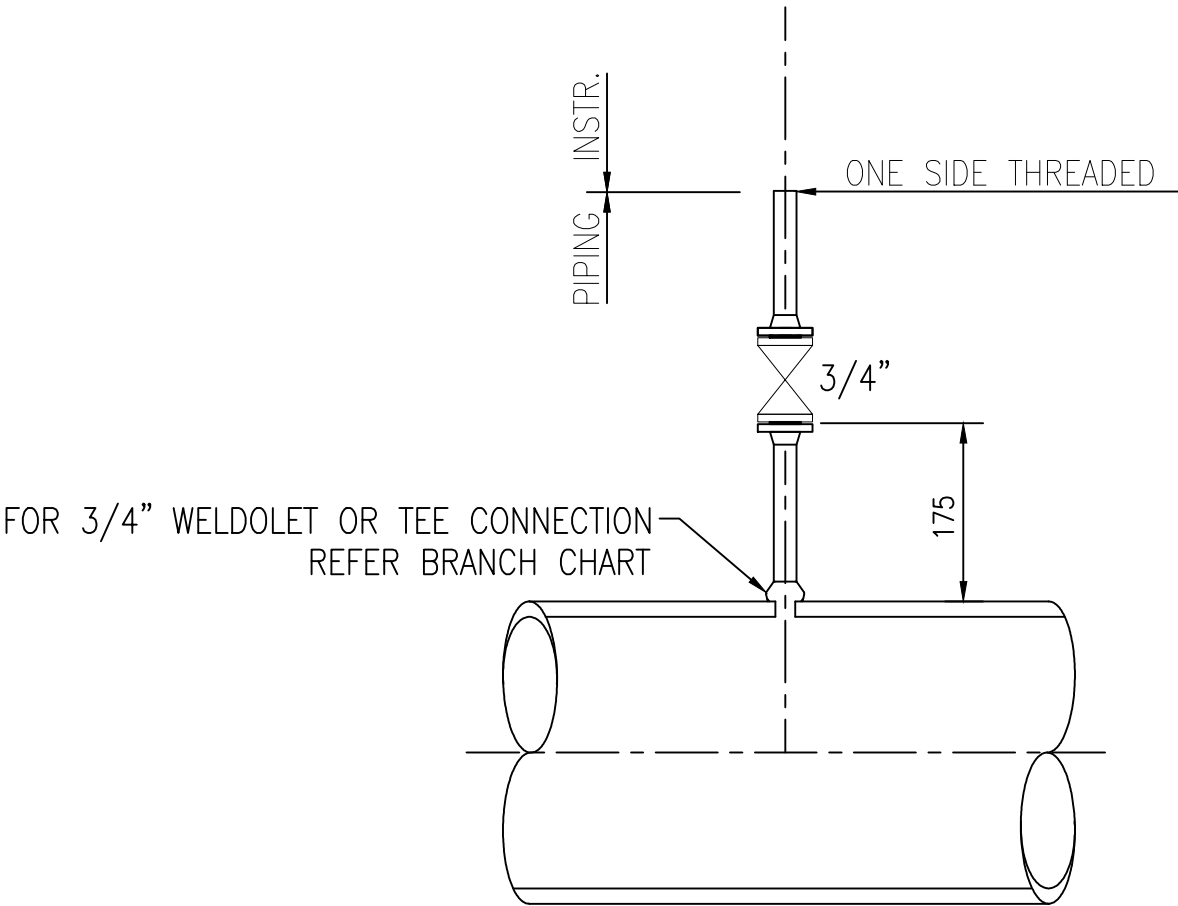
DETAIL OF PRESSURE
CONNECTIONS ABOVE GROUND
PIPE

DRAWING NO.

SD-PI-012

SHEET NO.

1 OF 1



0	10.05.17	ISSUED WITH TENDER	US		DK		AD	
REV. NO.	DATE	SUBJECT OF REVISION	PREP		CHKD		APPD	



M/s. VCS QUALITY SERVICES
PVT. LTD.

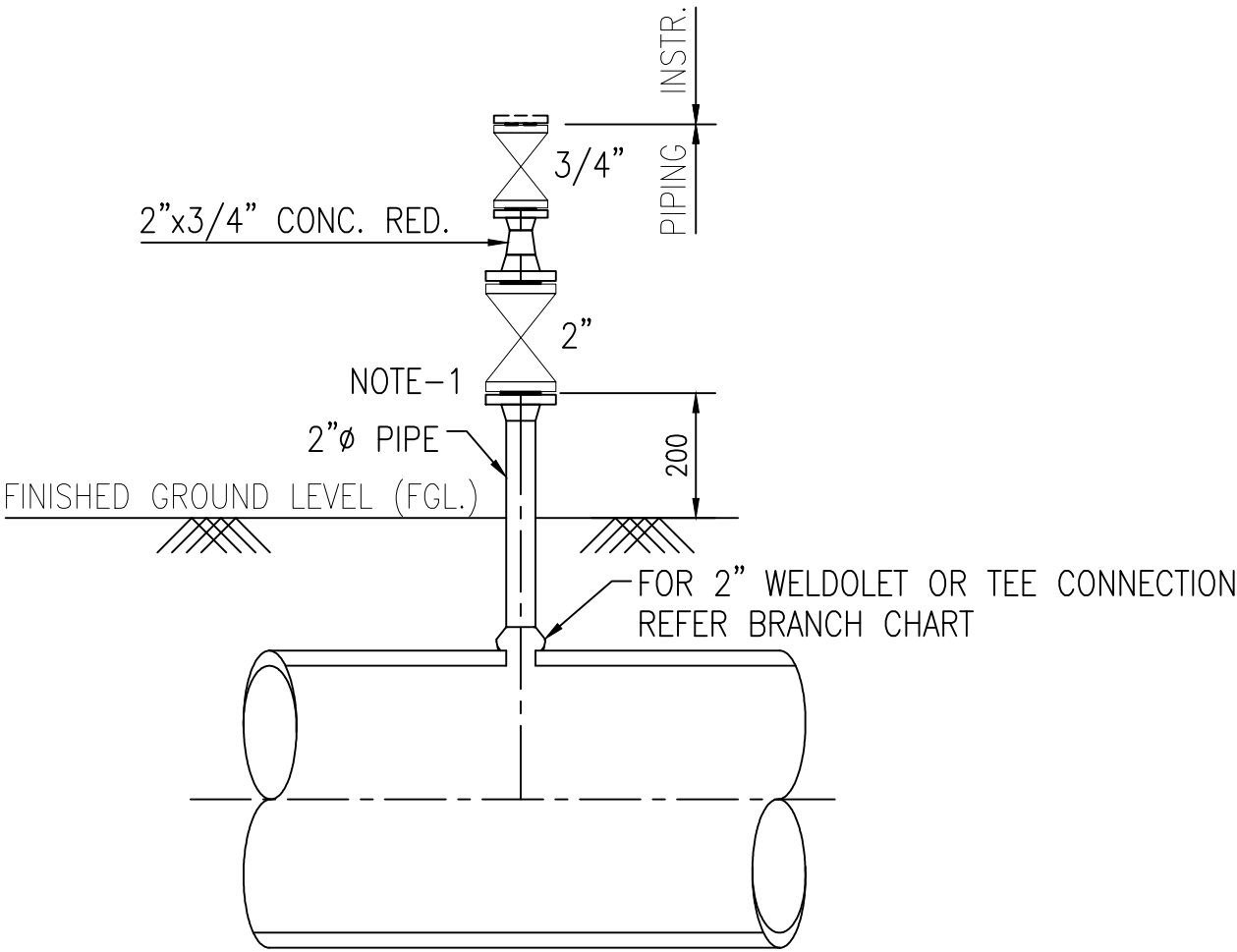
DETAIL OF PRESSURE CONNECTIONS
UNDER GROUND PIPE

DRAWING NO.

SD-PI-013

SHEET NO.

1 OF 1



NOTE:
1 INSULATION GASKET SHALL BE INSTALLED.

0	10.05.17	ISSUED WITH TENDER	US		DK		AD	
REV. NO.	DATE	SUBJECT OF REVISION	PREP		CHKD		APPD	



M/s. VCS QUALITY SERVICES
PVT. LTD.

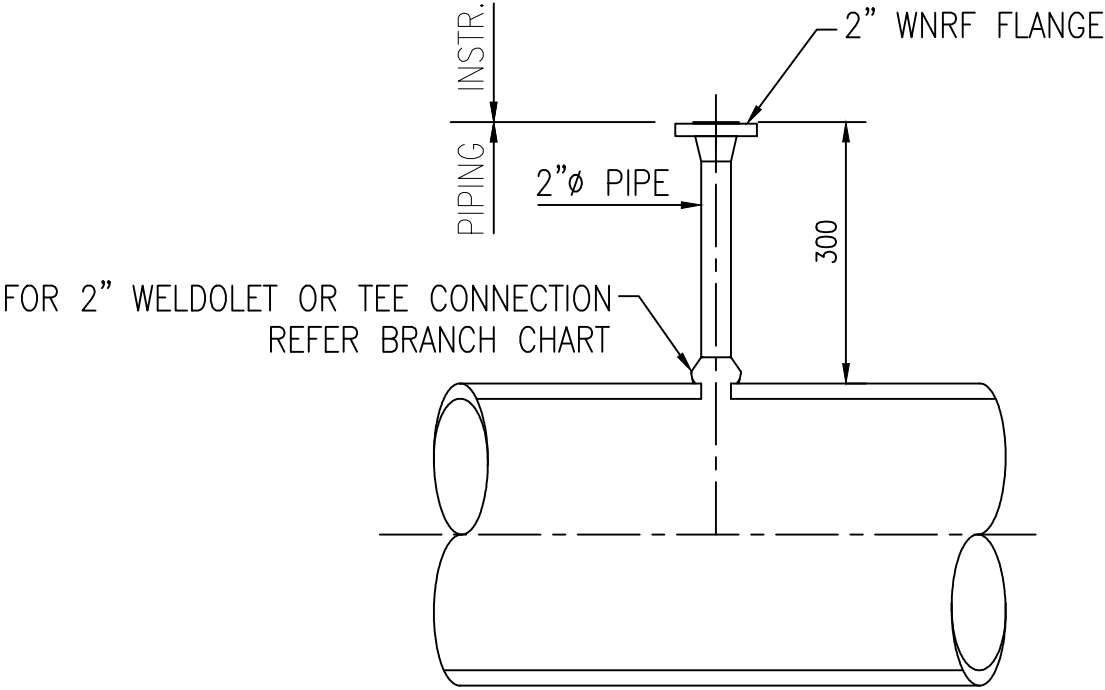
DETAIL OF TEMPERATURE CONNECTIONS
ABOVE GROUND PIPE

DRAWING NO.

SD-PI-014

SHEET NO.

1 OF 1



0	10.05.17	ISSUED WITH TENDER	US		DK		AD	
REV. NO.	DATE	SUBJECT OF REVISION	PREP		CHKD		APPD	



M/s. VCS QUALITY SERVICES
PVT. LTD.

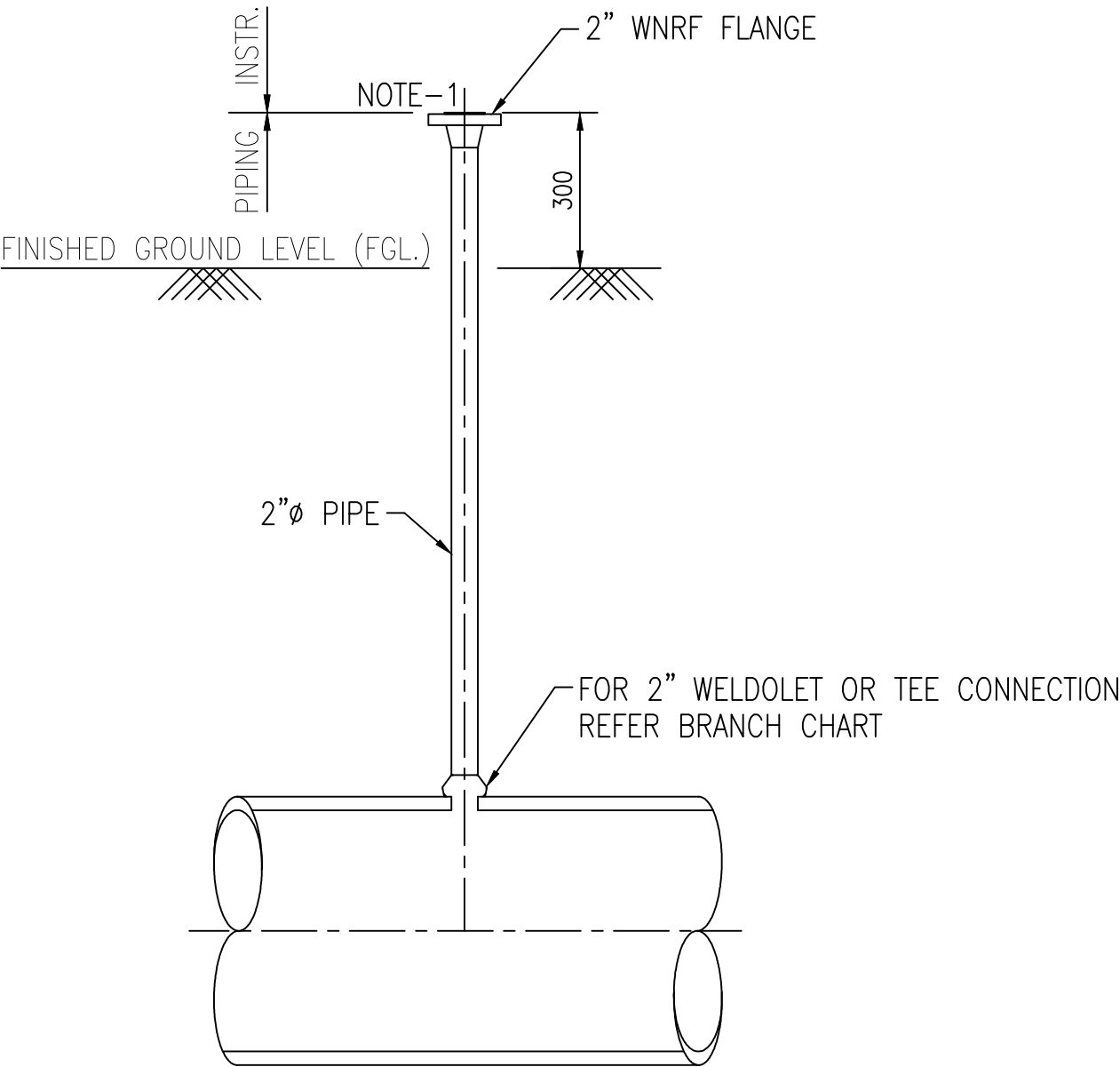
DETAIL OF TEMPERATURE
CONNECTIONS UNDER GROUND
PIPE

DRAWING NO.

SD-PI-015

SHEET NO.

1 OF 1



NOTE:
1 INSULATION GASKET SHALL BE INSTALLED.

0	10.05.17	ISSUED WITH TENDER	US		DK		AD	
REV. NO.	DATE	SUBJECT OF REVISION	PREP		CHKD		APPD	



M/s. VCS QUALITY SERVICES
PVT. LTD.

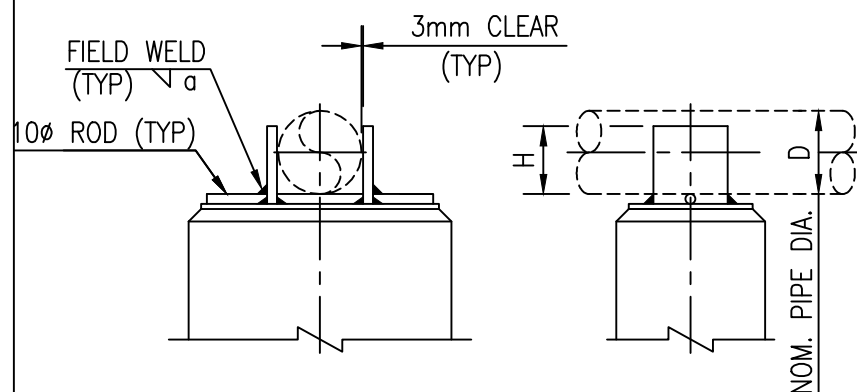
GUIDE SUPPORT FOR BARE PIPE
(SIZE 1/2" TO 24") TYPE G2

DRAWING NO.

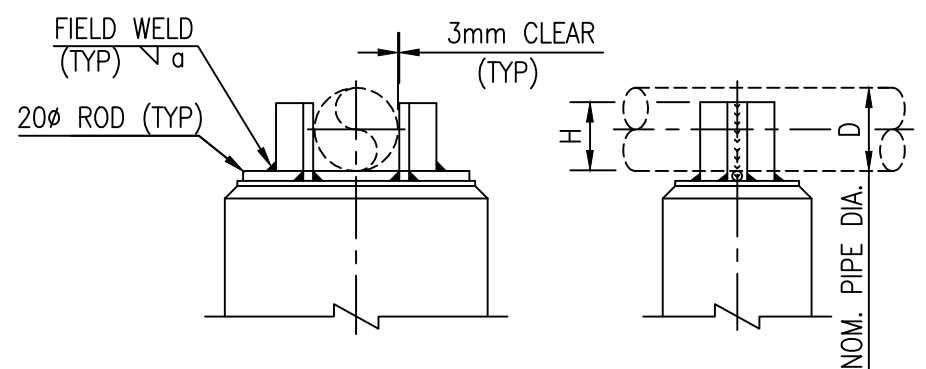
SD-PI-016

SHEET NO.

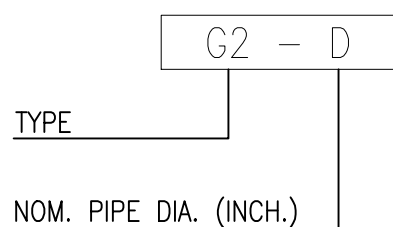
1 OF 1



FOR SIZES UPTO 4"



FOR SIZES 6" THRU 24"



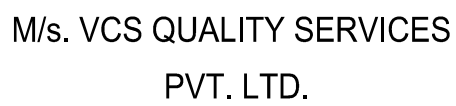
SYMBOL

D	H	a	METERIAL
2" & SMALLER	40	6	FLAT 60 x 10
3" TO 4"	70	6	FLAT 75 x 10
6" TO 8"	130	6	2 NOS. ISA 50 x 50 x 6
10" TO 18"	230	10	2 NOS. ISA 75 x 75 x 10
20" TO 24"	350	10	2 NOS. ISA 90 x 90 x 10

NOTES:-

GUIDE ANGLES SHOULD BE SUITABLY TRIMMED WHEREVER THESE OBSTRUCT ADJOINING GUIDE ANGLES.

0	10.05.17	ISSUED WITH TENDER	US		DK		AD	
REV. NO.	DATE	SUBJECT OF REVISION	PREP		CHKD		APPD	



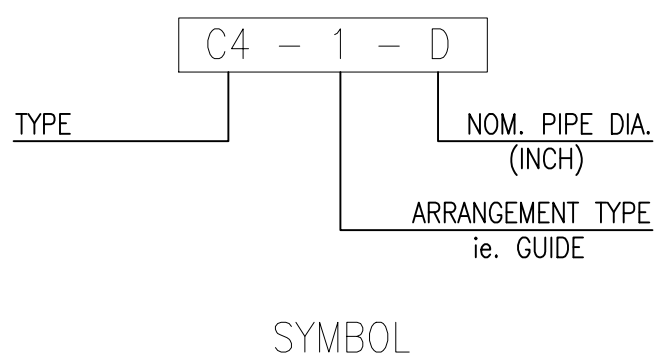
U-BOLT FOR BARE PIPE
(SIZE 1/2" TO 24")

DRAWING NO.

SD-PI-017

SHEET NO.

1 OF 1



D	O.D. (mm)	'U' CLAMP				
		L	E	S	d	F
1/2"	21	65	30	50	6	24
3/4"	27	70	36	50	6	30
1"	33	75	45	55	8	37
1 1/2"	48	90	60	55	8	52
2"	60	105	72	60	8	64
3"	89	145	106	80	12	94
4"	114	170	130	80	12	119
6"	168	240	190	100	16	173
8"	219	290	242	100	16	226
10"	273	345	296	100	16	280
12"	324	420	351	130	20	331
14"	356	450	382	130	20	362
16"	408	500	435	130	20	414
18"	457	565	490	140	24	465
20"	508	620	540	140	24	515
24"	610	720	645	140	24	620

0	10.05.17	ISSUED WITH TENDER	US		DK		AD	
REV. NO.	DATE	SUBJECT OF REVISION	PREP		CHKD		APPD	



M/s. VCS QUALITY SERVICES
PVT. LTD.

VENTS AND DRAINS
(ON LINES 2" AND ABOVE)

DRAWING NO.

SD-PI-018

SHEET NO.

1 OF 1

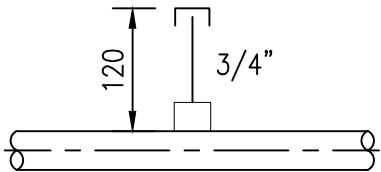
TYPE

VENT

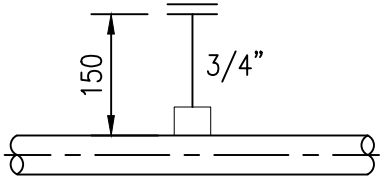
DRAIN

TYPE

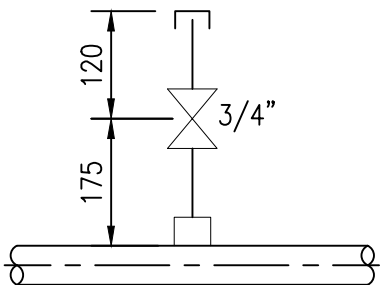
VP1
V1C



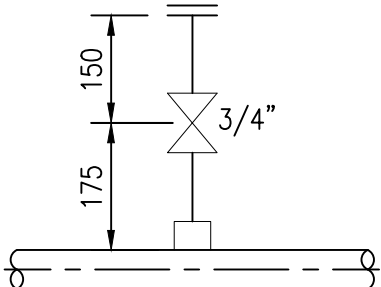
V2F



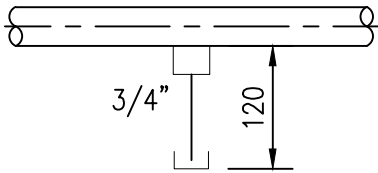
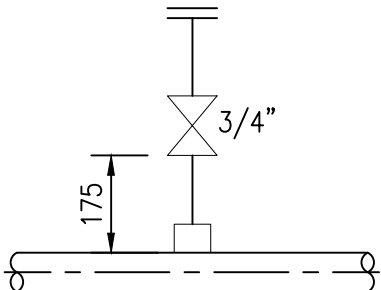
V3
V3C



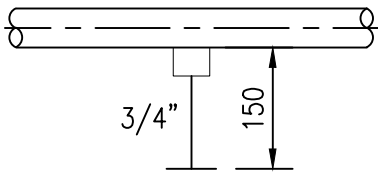
V4F



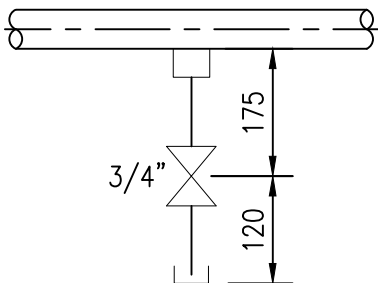
V5F



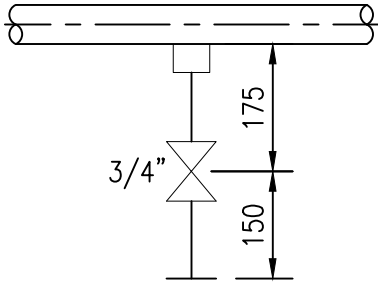
D1
D1C



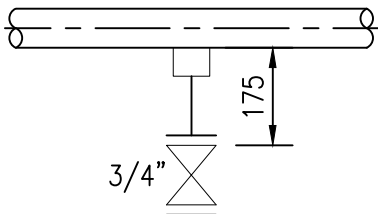
D2F



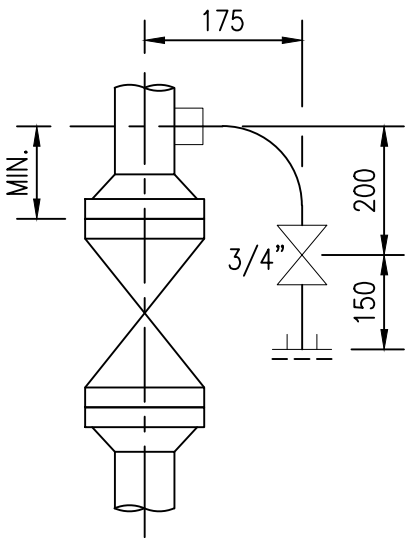
D3
D3C



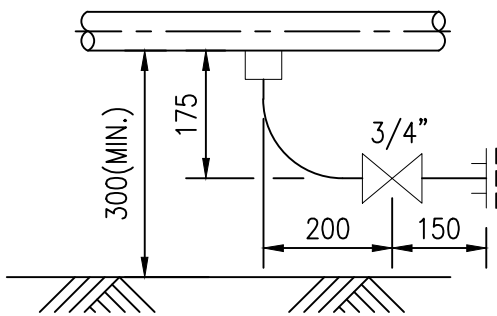
D4F



D5F



DC9
DF9



DC10
DF10

NOTES:—

1. DELETED.
2. VENTS & DRAINS SHALL BE PROVIDED WITH GATE, GLOBE OR PLUG VALVE (FLG'D.) WITH HALF COUPLING. OR STUB IN, WITH CAP OR FLANGE & BLIND FLANGE AS PER PIPING SPECIFICATIONS.
3. DELETED.
4. LEGEND : V = VENT; D = DRAIN; C = CAP; F = FLANGE; P = PLUG.

0	10.05.17	ISSUED WITH TENDER	US	DK	AD
REV. NO.	DATE	SUBJECT OF REVISION	PREP	CHKD	APPD



M/s. VCS QUALITY SERVICES
PVT. LTD.

VENTS AND DRAINS
(ON LINES 1 1/2" AND BELOW)

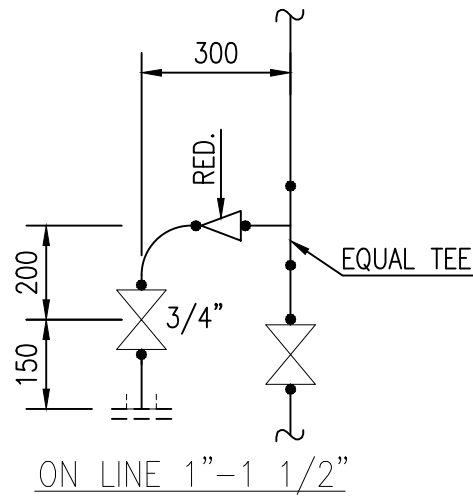
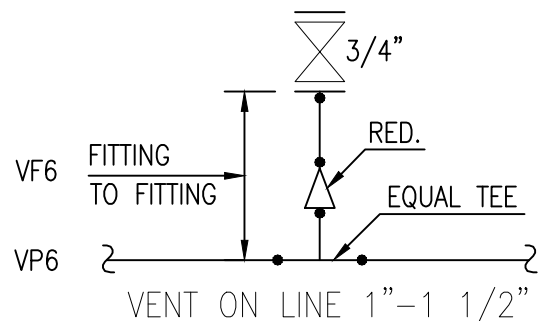
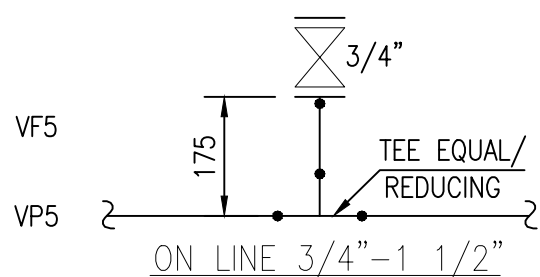
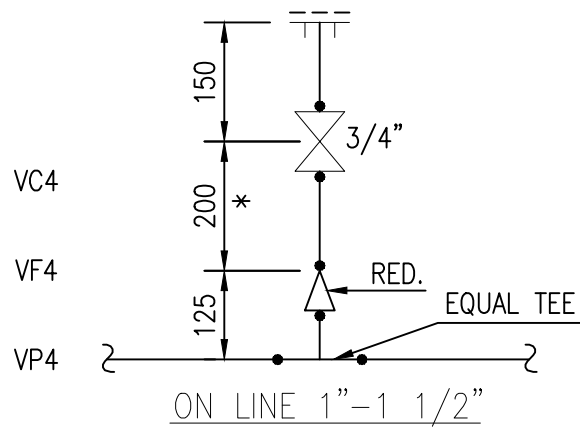
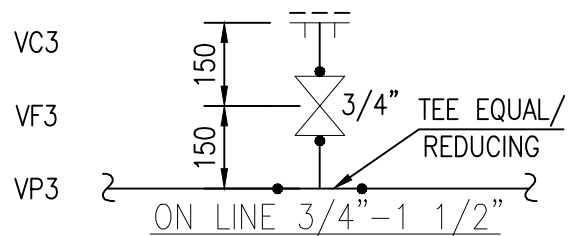
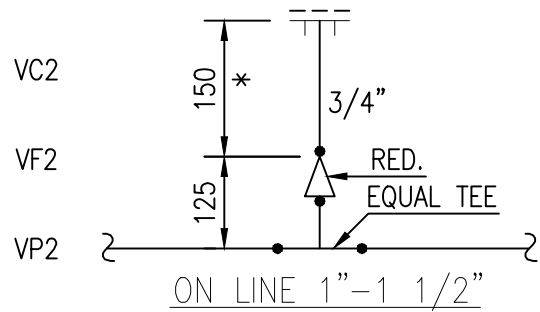
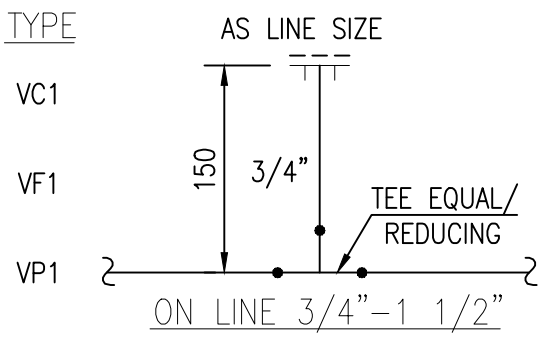
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SD-PI-019

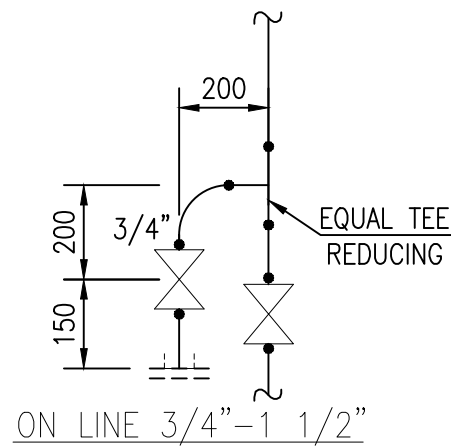
SHEET NO.

1 OF 1

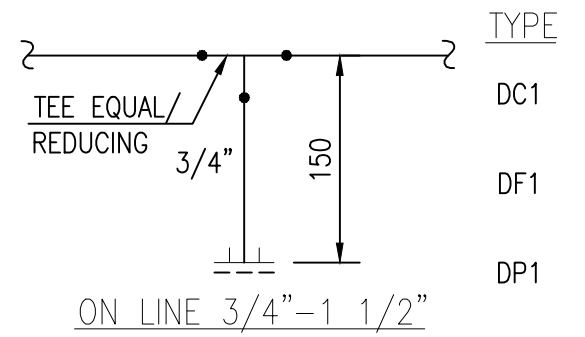
TYPE



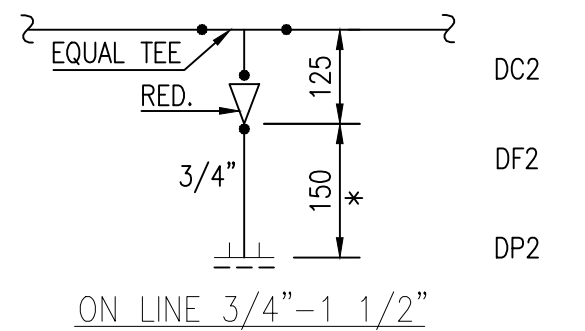
DC7
DF7
DP7



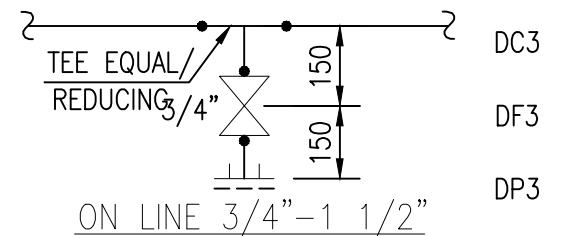
DC8
DF8
DP8



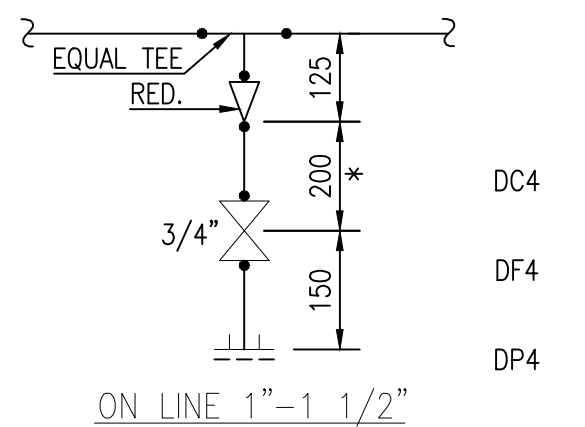
TYPE
DC1
DF1
DP1



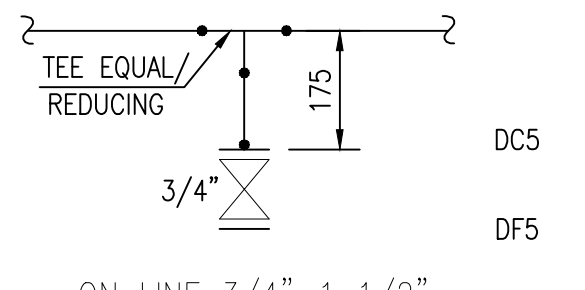
DC2
DF2
DP2



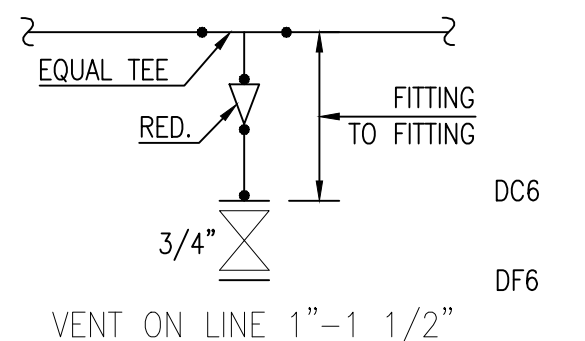
DC3
DF3
DP3



DC4
DF4
DP4



DC5
DF5



DC6
DF6

NOTES:-

- DIMENSIONS ARE VALID FOR 50mm(MAX) INSULATION THICKNESS, INCREASE DIMENSIONS AS REQUIRED, DIMENSIONS MARKED '*' ARE MAXIMUM AND MAY BE REDUCED TO SUIT.
- VENTS & DRAINS SHALL BE PROVIDED WITH GATE, GLOBE OR PLUG VALVE (FLGD.) WITH TEE (EQUAL OR REDUCING), HALF COUPLING OR STUB IN, CAP OR PLUG FLANGE AND BLIND FLANGE AS PER PIPING SPECIFICATION.
LEGEND : V = VENT; D = DRAIN; C = CAP; F = FLANGE; RED. = REDUCER, COUPLING OR SOCKET; P = PLUG.

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REV. NO.	DATE	SUBJECT OF REVISION	PREP	CHKD	APPD



M/s. VCS QUALITY SERVICES
PVT. LTD.

SYMBOLS OF PIPING
ELEMENTS ON DRAWINGS

DRAWING NO.

SD-PI-023

SHEET NO.

1 OF 4

DESCRIPTION	FLANGED	SCREWED	WELDED (NOTE-1)	SOCKET WELD
90° ELBOW				
ELBOW (TURNED UP)				
ELBOW (TURNED DOWN)				
MITERED BEND 90°				
MITERED BEND 45°				
45° ELBOW				
45° ELBOW (TURNED UP)				
45° ELBOW (TURNED DOWN)				
TEE EQUAL/UNEQUAL				
TEE (OUTLET UP)				
TEE (OUTLET DOWN)				
CROSS				
CONCENTRIC REDUCER				
ECCENTRIC REDUCER				
DEAD END				
LATERAL				
SIGHT GLASS				
UNION				
HALF COUPLING				
FULL COUPLING				
HOSE COUPLING				

0	10.05.17	ISSUED WITH TENDER	US	DK	AD
REV. NO.	DATE	SUBJECT OF REVISION	PREP	CHKD	APPD



M/s. VCS QUALITY SERVICES
PVT. LTD.

SYMBOLS OF PIPING
ELEMENTS ON DRAWINGS

DRAWING NO.

SD-PI-023

SHEET NO.

2 OF 4

DESCRIPTION	FLANGED	SCREWED	WELDED (NOTE-1)	SOCKET WELD
GATE VALVE (PLAN)				
GATE VALVE (ELEVATION)				
GLOBE VALVE (PLAN)				
GLOBE VALVE (ELEVATION)				
ANGLE VALVE (PLAN)				
ANGLE VALVE (ELEVATION)				
CHECK VALVE (PLAN OR ELEVATION)				
ANGLE STOP CHECK VALVE (PLAN)				
ANGLE STOP CHECK VALVE (ELEVATION)				
PLUG VALVE (PLAN)				
PLUG VALVE (ELEVATION)				
BALL VALVE (PLAN)				
BALL VALVE (ELEVATION)				
NEEDLE VALVE (PLAN OR ELEVATION)				
RELIEF VALVE (PLAN)				
RELIEF VALVE (ELEVATION)				
CONTROL VALVE GLOBE TYPE(PLAN)				
CONTROL VALVE GLOBE TYPE(ELEVATION)				
CONTROL VALVE BUTTERFLY TYPE(PLAN)				
CONTROL VALVE BUTTERFLY TYPE(ELEV.)				
SOLENOID OPERATED VALVE(PLAN OR ELEV.)				

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REV. NO.	DATE	SUBJECT OF REVISION	PREP	CHKD	APPD



M/s. VCS QUALITY SERVICES
PVT. LTD.

SYMBOLS OF PIPING
ELEMENTS ON DRAWINGS

DRAWING NO.

SD-PI-023

SHEET NO.

3 OF 4

DESCRIPTION	FLANGED	SCREWED	WELDED (NOTE-1)	SOCKET WELD
BUTTERFLY VALVE (PLAN OR ELEVATION)				
DIAPHRAGM VALVE (PLAN OR ELEVATION)				
3-WAY PLUG VALVE (PLAN OR ELEVATION)				
4-WAY PLUG VALVE (PLAN OR ELEVATION)				
EXPANSION JOINT				
ANGLE CONTROL VALVE				
CHAIN OPERATING VALVE				
GEAR OPERATED VALVE (BEVEL GEAR)PLAN				
GEAR OPERATED VALVE (SPUR GEAR)PLAN				
MOTOR OPERATING VALVE				
STEAM TRAP				
Y-STRAINER				

DESCRIPTION	SYMBOL	DESCRIPTION	SYMBOL
SLIP ON FLANGE		STUB - IN (WITH OR WITHOUT RENIF)	
WELDNECK FLANGE			
SCREWED FLANGE		STUB - IN (SADDLE RENIF)	
SOCKET WELD FLANGE			
SPACER		STUB - IN WITH RENIF (IN PLAN)	
SPACER BLIND			
SPECTALE FIG. 8 (BLIND)		INSULATED (LINES 12" AND BELOW)	
SPECTALE FIG. 8 (OPEN)			

0	10.05.17	ISSUED WITH TENDER	US	DK	AD
REV. NO.	DATE	SUBJECT OF REVISION	PREP	CHKD	APPD



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SYMBOLS OF PIPING
ELEMENTS ON DRAWINGS

DRAWING NO.

SD-PI-023

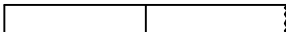
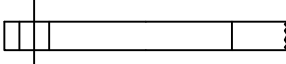
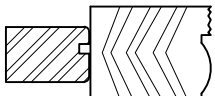
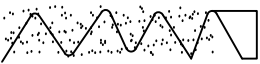
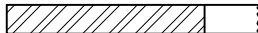
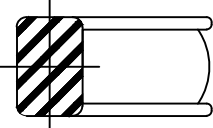
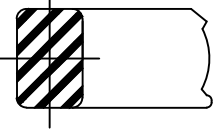
SHEET NO.

3 OF 4

DESCRIPTION	FLANGED	SCREWED	WELDED (NOTE-1)	SOCKET WELD
BUTTERFLY VALVE (PLAN OR ELEVATION)				
DIAPHRAGM VALVE (PLAN OR ELEVATION)				
3-WAY PLUG VALVE (PLAN OR ELEVATION)				
4-WAY PLUG VALVE (PLAN OR ELEVATION)				
EXPANSION JOINT				
ANGLE CONTROL VALVE				
CHAIN OPERATING VALVE				
GEAR OPERATED VALVE (BEVEL GEAR)PLAN				
GEAR OPERATED VALVE (SPUR GEAR)PLAN				
MOTOR OPERATING VALVE				
STEAM TRAP				
Y-STRAINER				

DESCRIPTION	SYMBOL	DESCRIPTION	SYMBOL
SLIP ON FLANGE		STUB - IN (WITH OR WITHOUT RENIF)	
WELDNECK FLANGE			
SCREWED FLANGE		STUB - IN (SADDLE RENIF)	
SOCKET WELD FLANGE			
SPACER		STUB - IN WITH RENIF (IN PLAN)	
SPACER BLIND			
SPECTALE FIG. 8 (BLIND)		INSULATED (LINES 12" AND BELOW)	
SPECTALE FIG. 8 (OPEN)			

0	10.05.17	ISSUED WITH TENDER	US	DK	AD
REV. NO.	DATE	SUBJECT OF REVISION	PREP	CHKD	APPD

 M/s. VCS QUALITY SERVICES PVT. LTD.		GASKET THICKNESS		DRAWING NO.					
				SD-PI-024					
				SHEET NO.		1 OF 1			
TYPICAL CROSS SECTION		DESCRIPTION		THICKNESS OF GASKET		COMPRESSED THICKNESS (NOTE -1)			
	FLAT RING FOR RAISED FACE FLANGE	COMPRESSED ASBESTOS FOR SYNTHETIC RUBBER	2.0	2.0					
	FULL FACE FOR FLAT FACE FLANGES								
	SPIRAL WOUND METAL FLAT RING GASKET, NON METALLIC FILTER, AND A STEEL SOLID RING TYPE CENTERING DEVICE- FOR RAISED FACE FLANGES.		4.4	3.0					
	FLAT METAL JACKETED GASKET, NON METALLIC FILTER COMPLETELY ENCLOSED WITHIN A FULLY ANNEALED DOUBLE METAL JACKET-FORRAISED FACE FLANGES		3.0	2.0					
	CORRUGATED METAL JACKETED GASKET, NON METALLIC FILTER, COMPLETELY ENCLOSED WITHIN A FULLY ANNEALED DOUBLE METAL CORRUGATED JACKET- FOR RAISED FACE FLANGES.		3.2	1.0					
	CORRUGATED METAL GASKET-FULLY ANNEALED CORRUGATED METAL WITH FILTER MATERIAL CEMENTED TO THE CORRUGATIONS ON BOTH FACES -FOR RAISED FACE FLANGES		3.2	1.0					
	SOLID METAL FLAT RING FOR SMALL TONGUE AND GROOVE FLANGES.		AS SPECIFIED						
	SOLID METAL FLAT RING FOR LARGE TONGUE AND GROOVE FLANGES.		AS SPECIFIED						
	SOLID METAL OCTAGONAL RING FOR R.T.J FLANGES		DIMENSIONS SHALL BE AS PER ASME B 16.20(NOTE-2)						
	SOLID METAL OVAL RING FOR R.T.J FLANGES		DIMENSIONS SHALL BE AS PER ASME B 16.20(NOTE-2)						
	FULLY ANEALED CORRUGATED METAL FOR RAISED FACE FLANGES.		3.2	1.0					
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REV. NO.	DATE	SUBJECT OF REVISION		PREP		CHKD		APPD	



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PVT. LTD.

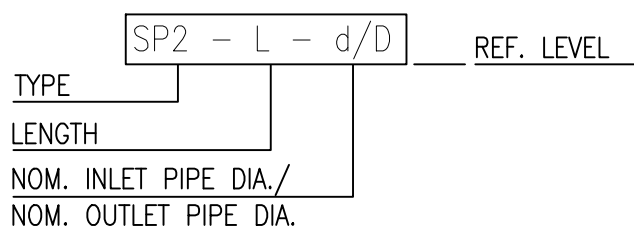
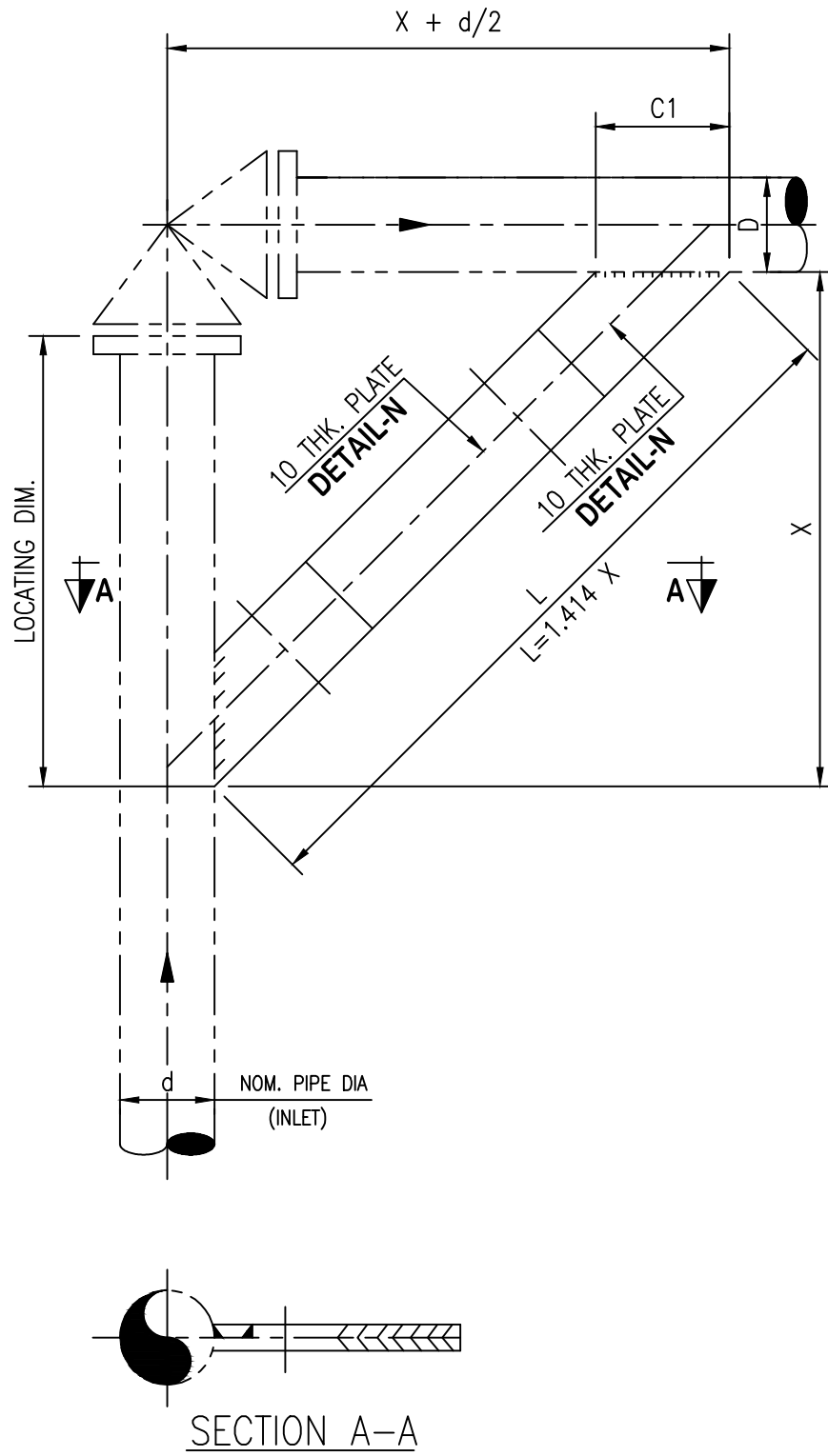
SUPPORTING ARRANGEMENT
FOR ANGLE AND RELIEF VALVES
TYPE-SP2

DRAWING NO.

SD-PI-025

SHEET NO.

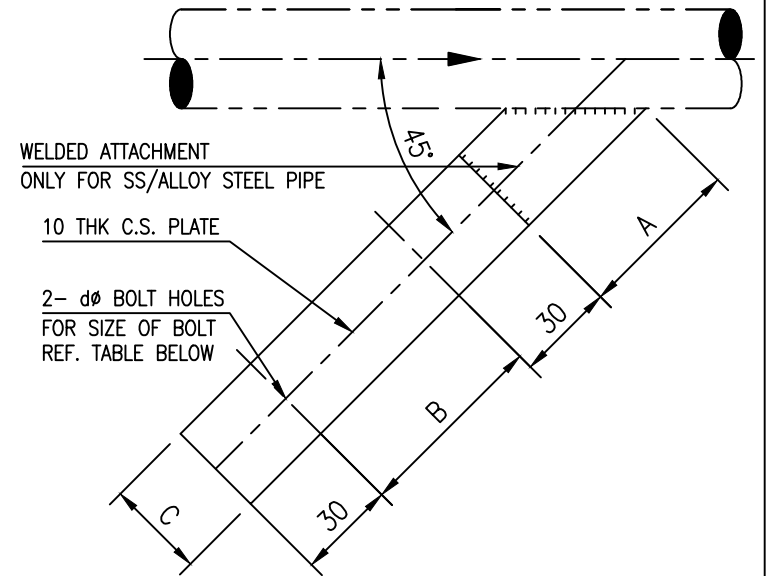
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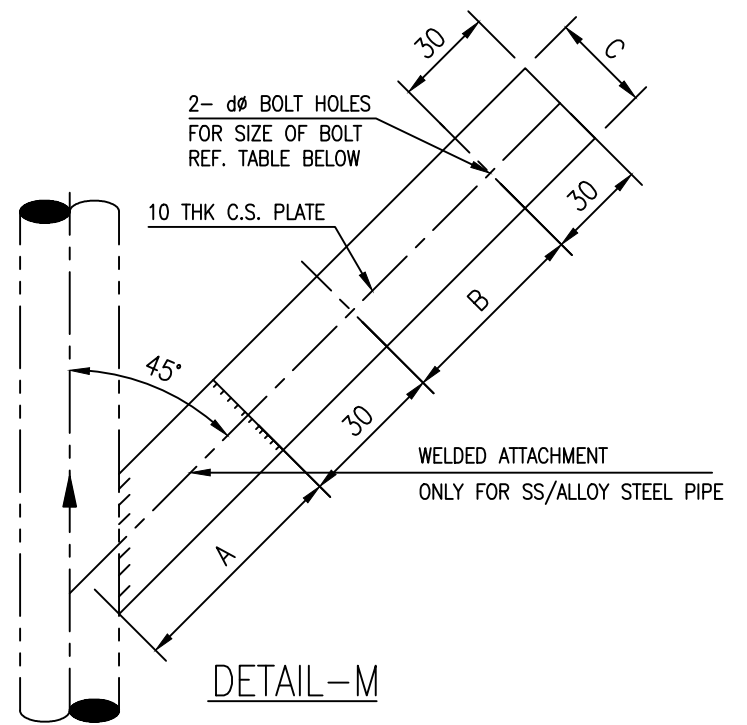
SYMBOL

D	BOLT SIZE d ϕ	A	C	B MIN.	C1	D1
1" TO 4"	M12 X 50	75	50	150	71	14
6" TO 12"	M16 X 50	100	75	200	106	18

FOR TEMP. UP TO 400 °C ONLY



DETAIL-N



DETAIL-M

NOTES:-

1. MATERIAL FOR WELDED ATTACHMENT SHALL BE EQUIVALENT TO PIPE MATERIAL.

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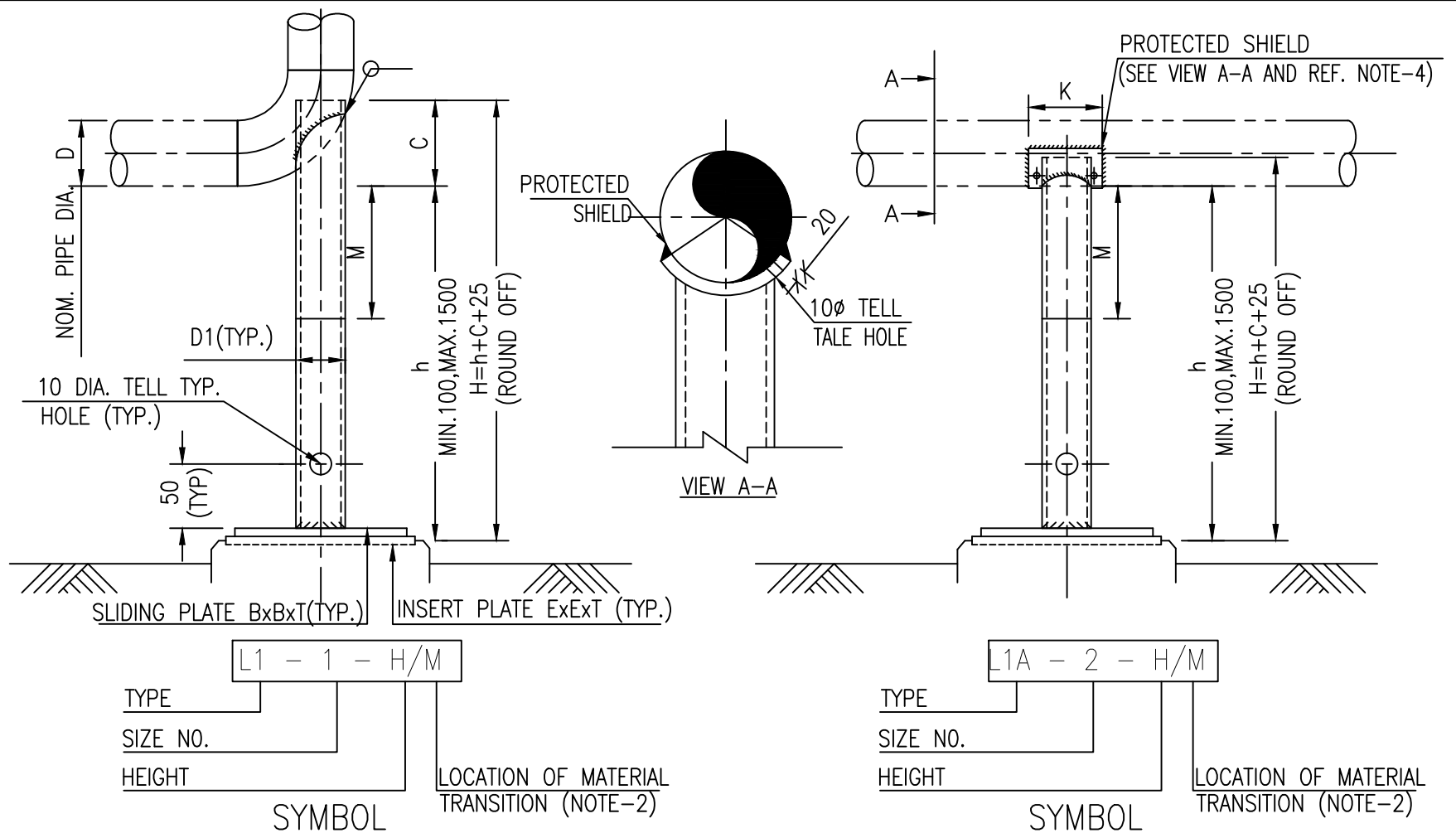
LOW SUPPORT SLIDING FOR BARE
& INSULATED PIPE SIZE 2"
THRU 36" TYPE-L1 AND L1A

DRAWING NO.

SD-PI-026

SHEET NO.

1 OF 1



SIZE NO.	D	D1 (NOTE-3)	B	T	C (NOTE-5)	E	K (NOTE-4)
1	2"	2" S40/10S	150	10	70	250	160
	3"				115		
2	4"	3" S40/10S	200	10	137	300	190
	6"				174		
3	8"	4" S40/10S	200	12	205	300	215
	10"				262		
	12"				287		
4	14"	6" S40/10S	250	12	388	350	270
	16"				418		
5	18"	8" S40/10S	300	12	454	400	320
6	20"	10" S40/10S	350	12	554	450	375
	24"				615		
7	26"	12" S40/10S	400	16	675	500	425
	30"				800		
	36"				950		

NOTES:-

- INSERT AND SLIDING PLATE MATERIAL SHALL BE CARBON STEEL WHERE DESIGN TEMP. IS $>345^{\circ}\text{C}$ WITH $h < 200\text{MM}$, SLIDING PLATE MATERIAL SHALL BE EUVALENT TO PIPE MATERIAL.
- DIMENSION "M" LOCATES THE POINT OF MATERIAL TRANSITION ON THE SUPPORT. THE STUB MATERIAL SHALL BE EQUIVALENT TO THAT OF LINE PIPE AND THE LOWER SUPPORT PIPE SHALL BE CARBON STEEL. MINIMUM VALUE OF M SHALL BE "INSULATION THICKNESS+25MM".
A. FOR CARBON STEEL(CS) LINE PIPE, THE ENTIRE SUPPORT PIPE SHALL BE CS, THAT IS $M=0$.
B. FOR ALLOY STEEL(AS) OR STAINLESS STEEL(SS) LINE -PIPE, SUPPORT PIPE SHALL CONSIST OF THE FOLLOWING-
-FOR h LESS THAN OR EQUAL TO 500MM, ENTIRE SUPPORT PIPE MATERIAL SHALL BE EQUIVALENT TIO THAT OF LINE PIPE, THAT IS $M=h$.
-FOR h GREATER THAN 500MM,SUPPORT PIPE SHALL BE COMPOSITE WITH $M=\text{INSULATION THK.}+25\text{MM}$ OR 100MM, WHICHEVER IS GREATER.
- IN CASE SIZE AND/OR SCH. OF SUPPORT PIPE (D1) LISTED IN THE TABLE IS NOT AVAILABE USE NEXT HIGHER SIZE AND/OR NEAREST HIGHER THICKNESS AVAILABLE.
- PROTECTION SHIELD (LENGTH=KMM) CUT FROM LINE-PIPE OR EQUIVALANT PLATE SHALL BE PROVIDED ON HORIZONTAL LINE AS FOLLOWS-
A. FOR 150# AND 300# CLASS PIPEING
CS AND AS LINES - 10" AND ABOVE
SS LINES - 2" AND ABOVE
B. FOR 600# AND HIGHER CLASS PIPING
CS, AS AND SS LINES - 10" AND ABOVE
- DIMENSION "C" IS TO BE MODIFIED IF OTHER THAN 1.5 D RADIUS ELBOWS ARE USED.
- IN CASE CALCULATED h EXCEEDS THE MAX. VALUE, PEDESTAL SHALL BE RAISED ACCORDINGLY.

0	10.05.17	ISSUED WITH TENDER	US	DK	AD
REV. NO.	DATE	SUBJECT OF REVISION	PREP	CHKD	APPD



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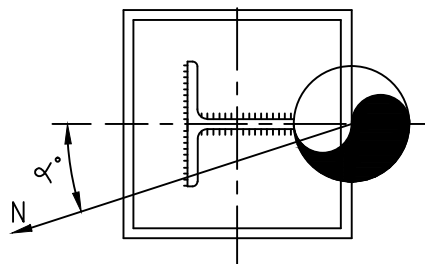
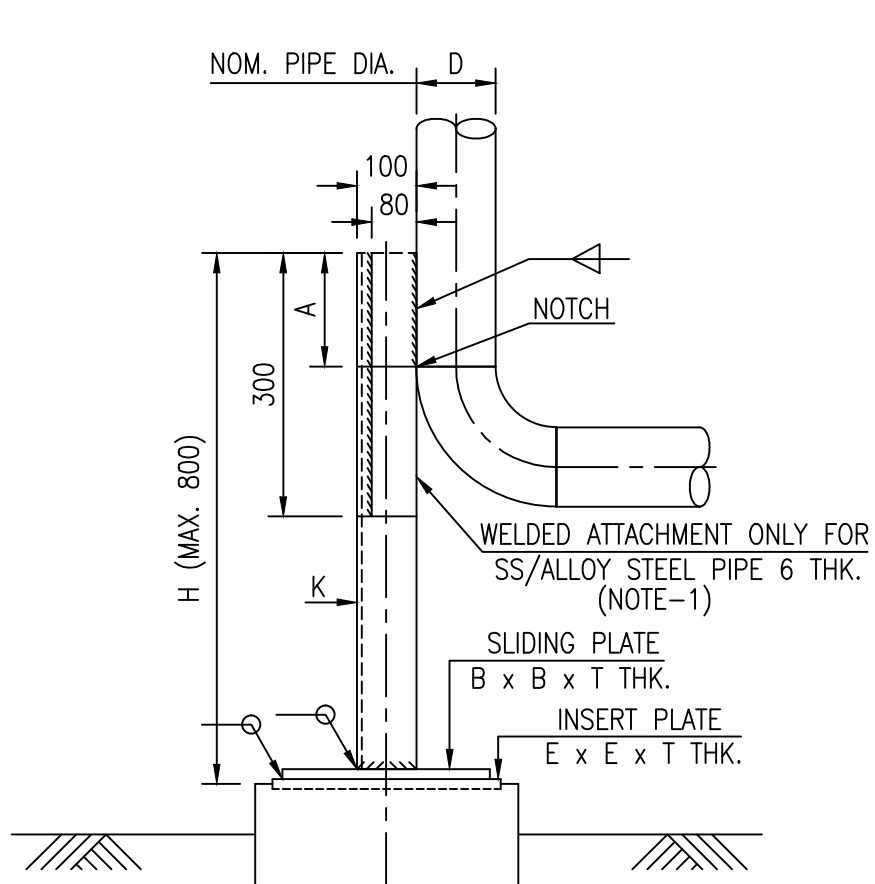
LOW SUPPORT FIXED FOR BARE
& INSULATED PIPE SIZE 2"
THRU 24"TYPE-L6

DRAWING NO.

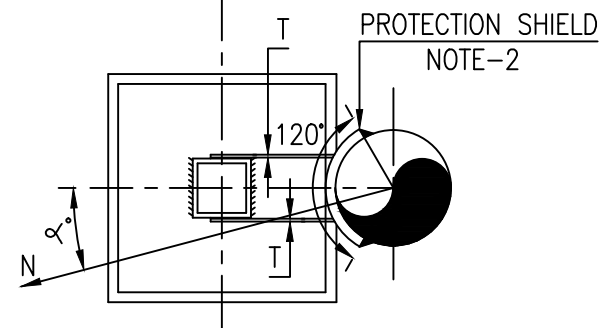
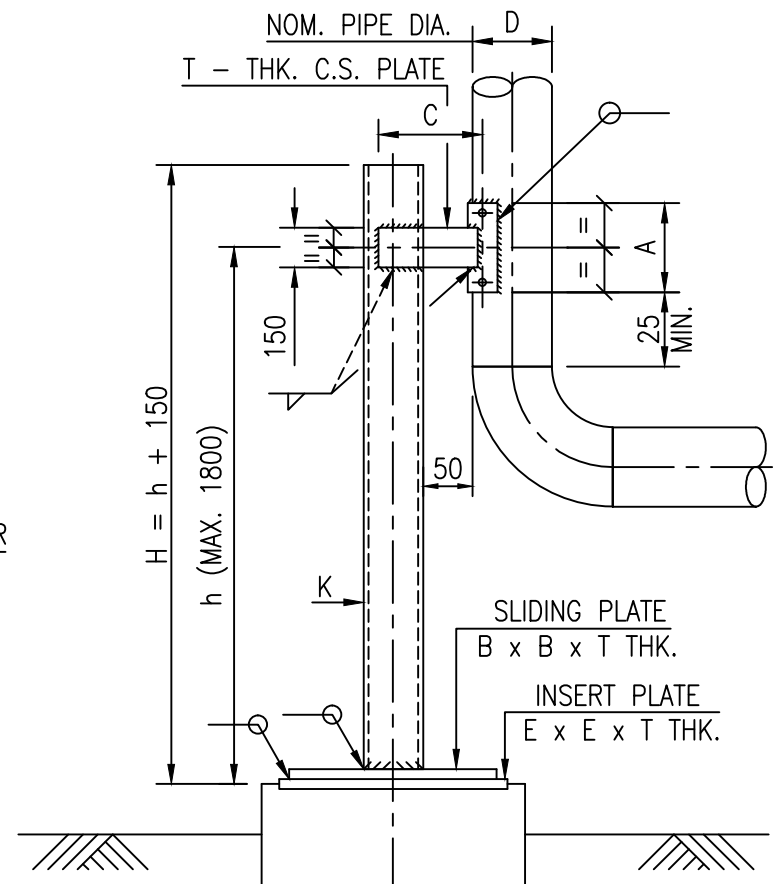
SD-PI-027

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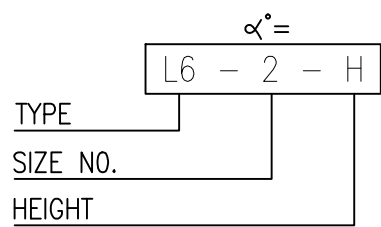
1 OF 1



FOR PIPE SIZES 2" THRU 4"



FOR PIPE SIZES 6" THRU 24"



SYMBOL

NOTES:-

1. MATERIAL FOR WELDED ATTACHMENT SHALL BE EQUIVALENT TO PIPE MATERIAL.
2. PROTECTION SHIELD IS TO BE CUT FROM LINE PIPE.

SIZE NO.	D	K	A	T	C	E	B
1	2" TO 4"	CUT FROM ISMB 200	200	10	-	250	150
2	6" TO 10"	ISMC-125 2 NOS.	200	12	150	300	200
3	12" TO 24"	ISMC-225 2 NOS.	300	12	230	400	300

FOR TEMP. UP TO 400 °C ONLY

0	10.05.17	ISSUED WITH TENDER	US	DK	AD
REV. NO.	DATE	SUBJECT OF REVISION	PREP	CHKD	APPD



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PVT. LTD.

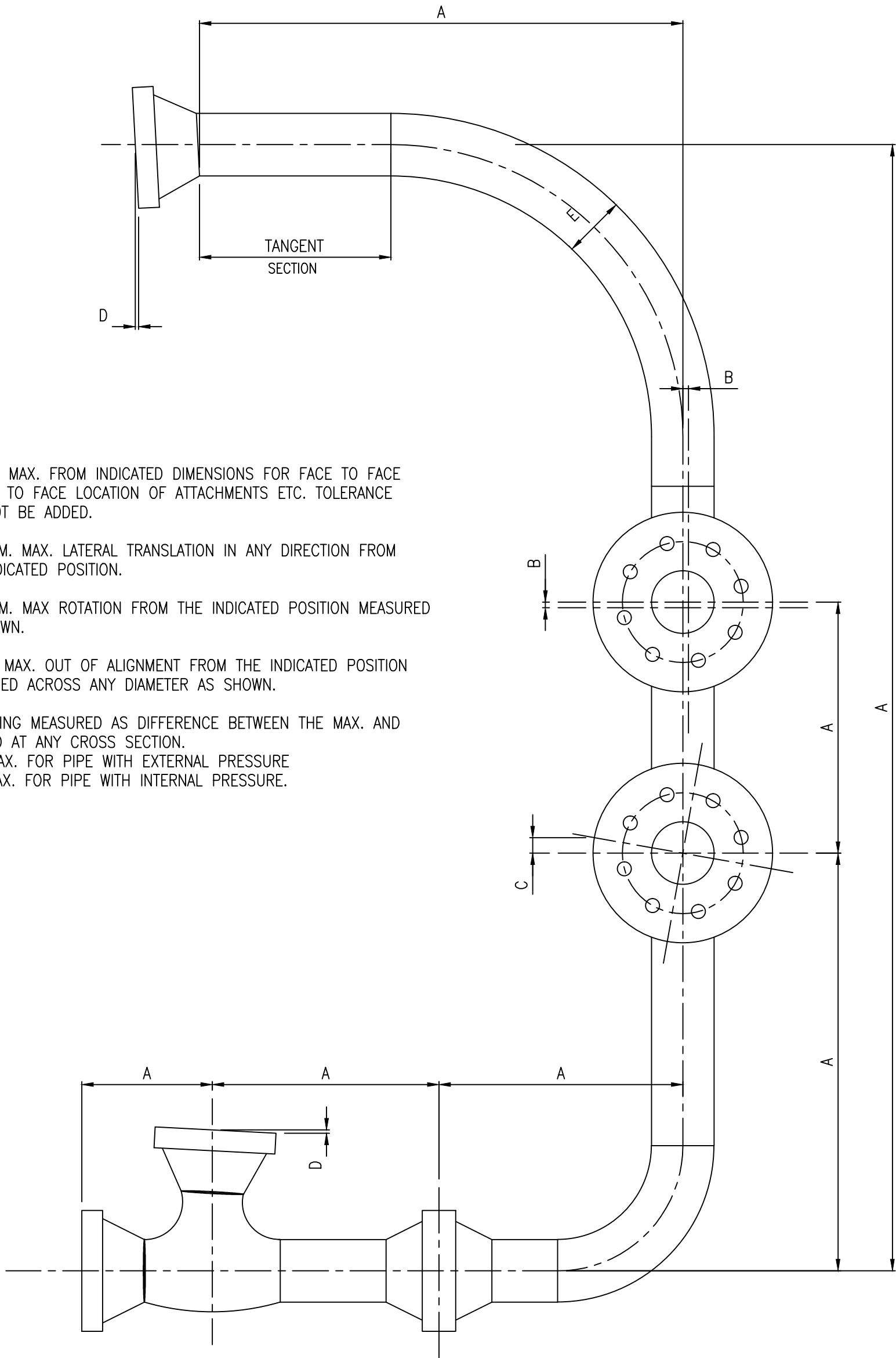
TOLERANCES
FOR FABRICATION

DRAWING NO.

SD-PI-028

SHEET NO.

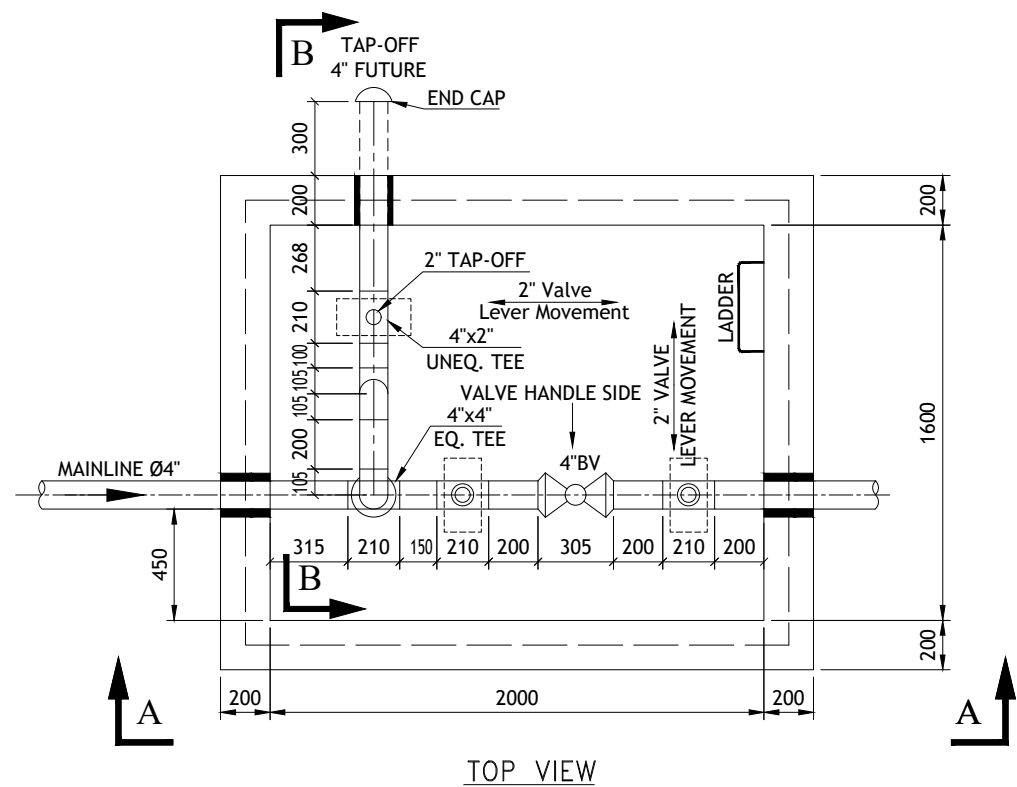
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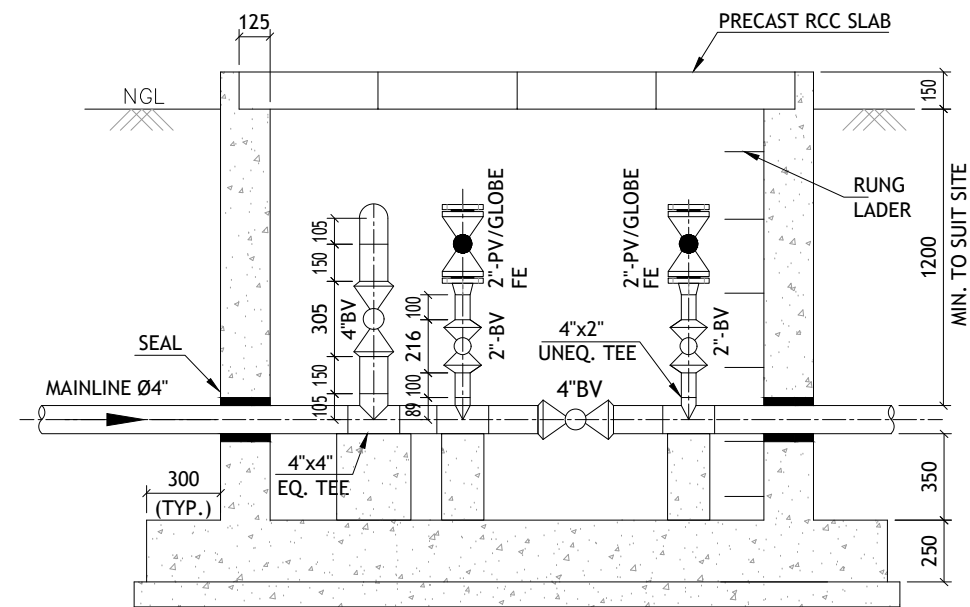
- A ± 3 MM. MAX. FROM INDICATED DIMENSIONS FOR FACE TO FACE CENTRE TO FACE LOCATION OF ATTACHMENTS ETC. TOLERANCE CAN NOT BE ADDED.
- B ± 1.5 MM. MAX. LATERAL TRANSLATION IN ANY DIRECTION FROM THE INDICATED POSITION.
- C ± 1.5 MM. MAX ROTATION FROM THE INDICATED POSITION MEASURED AS SHOWN.
- D ± 1 MM MAX. OUT OF ALIGNMENT FROM THE INDICATED POSITION MEASURED ACROSS ANY DIAMETER AS SHOWN.
- E FLATTENING MEASURED AS DIFFERENCE BETWEEN THE MAX. AND MIN. OD AT ANY CROSS SECTION.
-3% MAX. FOR PIPE WITH EXTERNAL PRESSURE
8% MAX. FOR PIPE WITH INTERNAL PRESSURE.

0	10.05.17	ISSUED FOR STANDARD	US	DK	AD
REV. NO.	DATE	SUBJECT OF REVISION	PREP	CHKD	APPD

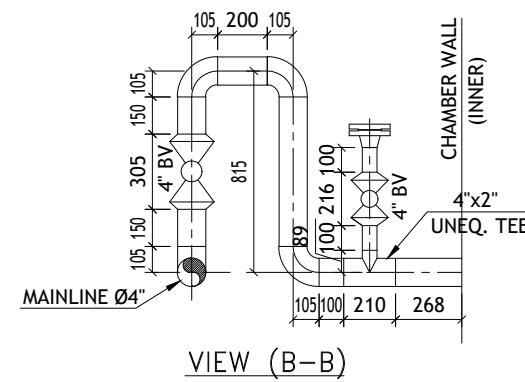
 M/s. VCS QUALITY SERVICES PVT. LTD.		ABBREVIATIONS		DRAWING NO.					
				SD-PI-029					
				SHEET NO.		1 OF 1			
M&F	MALE & FEMALE	SO	SLIP ON						
MI	MALLEABLE IRON	SOL	SOCKOLET						
MOLY OR MO	MOLYBDENUM	SP. GR	SPECIFIC GRAVITY						
MR	MATERIAL REQUISITION	SR	SHORT RADIUS						
MTO	MATERIAL TAKE OFF	SS	STAINLESS STEEL						
MS	MILD STEEL	ST	STEAM TRAP						
MSS	MANUFACTURER’S STANDARD SOCIETY	STN	STATION						
MH	MAN HLOE	STM	STEAM						
NPT	NATIONAL PIPE THREAD	STD	STANDARD						
NPSH	NET POSITIVE SUCTION HEAD	SW	SOCKET WELD						
NIP	NIPPLE	SWG	SWAGE NIPPLE / STD WIRE GAGE						
OD	OUTSIDE DIAMETER	STA	STEAM TRAP ASSEMBLY						
PC.MK	PIECE MARK	TOG	TOP OF GRATING						
PE	PLAIN END	TEMP.	TEMPERATURE						
PL	PLATE	TOL	THREDOLET						
PLTF	PLATFORM	T&C	THREADED & COUPLED						
P.S	PIPE SUPPORT	THRD	THREADED						
PSE	PLAIN SMALL END	T&G	TONGUE & GROOVE						
PRESS.	PRESSURE	TBE	THREADED BOTH ENDS						
PSI	POUNDS PER SQUARE INCH	TLE	THREADED LARGE END						
POE	PLAIN ONE END	TSE	THREADED SMALL END						
PSIG	POUNDS PER SQUARE INCH GAUGE	TOS	TOP OF STEEL						
RAD OR R	RADIUS	TOE	THREADED ONE END						
RED.	REDUCER	TYP	TYPICAL						
RF	RAISED FACE	VC	VENT CONNECTION						
R/L	RANDOM LENGTH	VERT.	VERTICAL						
REF.	REFERENCE	WP	WORKING PRESSURE, WORKING POINT						
RPM	REVOLUTIONS PER MINUTE		INVERT LEVEL OF PIPE						
RTJ	RING TYPE JOINT		BOTTOM LEVEL OF THE PIPE						
SH	SPRING HANGER		CENTRELINE ELEVATION OF PIPE						
SHT	SHEET	WN	WELD NECK						
SCH	SCHEDULE	WT	WEIGHT						
SCRD	SCREWED	WOL	WELDOLET						
S	SAMPLE CONNECTION	WLD	WELD						
SG	SIGHT GLASS	XS	EXTRA STRONG						
SC	SAMPLE COOLER	XXS	DOUBLE EXTRA STRONG						
SMLS	SEAMLESS								
NOTE:									
1. FOR ABBREVIATIONS RELATED TO CIVIL ENGINEERING/UNDERGROUND PIPING WORK, REFER CIVIL ENGINEERING STANDARD.									
0	10.05.17	ISSUED WITH TENDER		US		DK		AD	
REV. NO.	DATE	SUBJECT OF REVISION		PREP		CHKD		APPD	



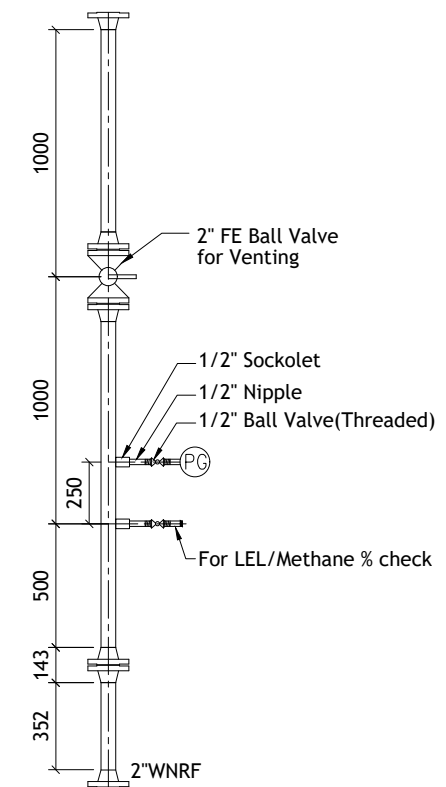
TOP VIEW



FRONT VIEW (A-A)



VIEW (B-B)



COMMON VENT PIPE FOR ALL SECTIONALIZING VALVES
(NOT TO BE FABRICATED FOR ALL SVs)

REFERENCE DRAWINGS / DOCUMENTS					
S.NO.	TITLE			NO.	

NOTES:-

- ALL DIMENSIONS ARE IN MM AND LEVELS ARE IN M UNLESS OTHERWISE MENTIONED.
- APPROVED SEALANT TO BE PROVIDED IN VALVE PIT ENTRY & EXIT OF PIPELINE TO RESTRICT WATER INTO PIT.
- COMMON VENT NOT TO BE FABRICATED FOR EACH SV. MINIMUM TWO SUCH VENTS TO BE FABRICATED FOR GAS COMMISSIONING AND THEN TO BE KEPT IN ERV FOR O&M PURPOSE.
- FIRST SECTIONALIZING VALVE OF MAINLINE TO BE PROVIDED WITH PERMANENT BY-PASS & VENT. THEREAFTER SVs MAY BE PROVIDED WITH PERMANENT BY-PASS & WITHOUT PERMANENT BY-PASS LINE ALTERNATIVELY.
- FOR VALVE CHAMBER CONSTRUCTION, REFER RESPECTIVE DRAWING FOR CIVIL WORK. CHAMBER SLEEPERS MAY BE FABRICATED AS SHOWN IN THIS DRAWING FOR EASY LIFTING DURING O&M.
- ORIENTATION OF 2" VALVES INSTALLED IN BY-PASS/TAP-OFF TO BE SUCH THAT VALVE LEVER/HANDLE MOVEMENT IS NOT RESTRICTED BY ADJACENT WALL OF A CHAMBER.
- VALVE CHAMBER PROJECTION ABOVE FGL SHALL BE 150MM-300MM SUITED AS PER SITE CONDITIONS.

LEGEND:-

	BUTT WELD BALL VALVE (B.V.)
	FLANGED BALL VALVE
	BUTT WELD GLOBE VALVE (G.V.)
	FLANGED GLOBE VALVE
	THREAD END BALL VALVE

REV.	DATE	DESCRIPTION	PREP.	CHKD.	APPD.
0	02.05.2023	ISSUED AS STANDARD	AK	MN	HK

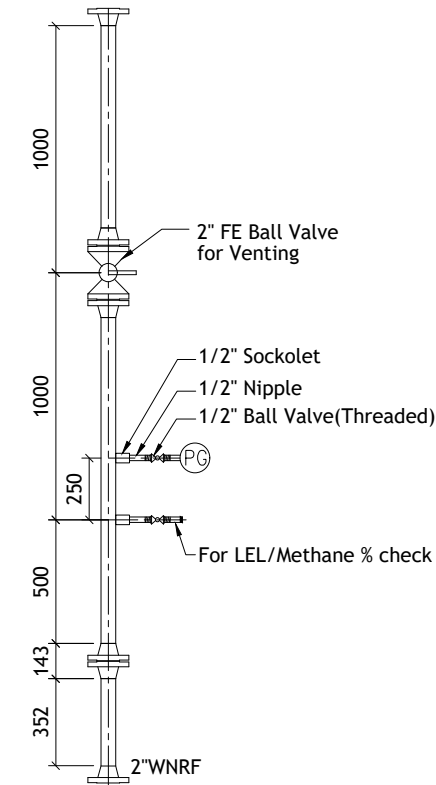
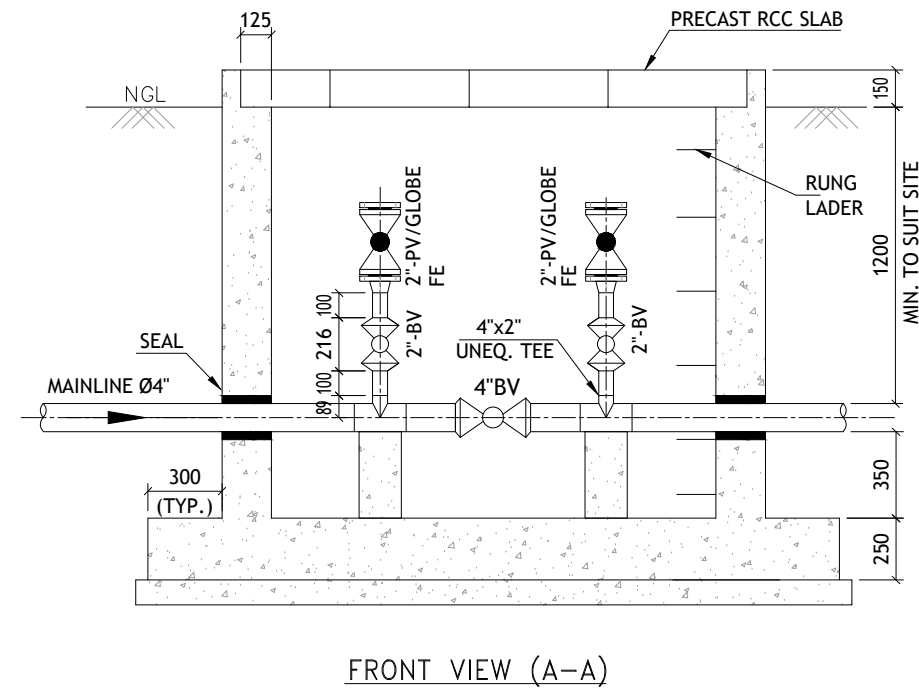
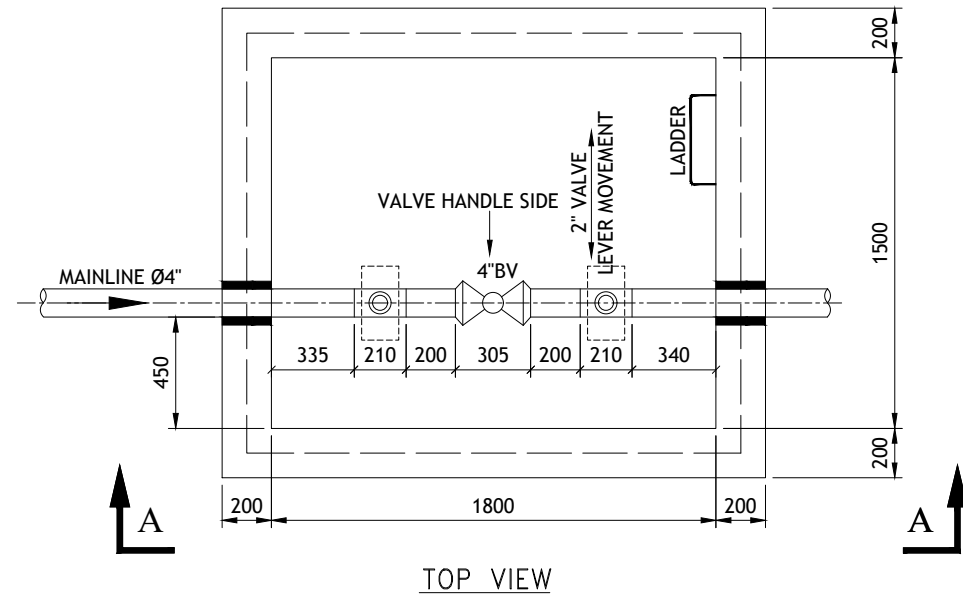
PMC

VCS QUALITY SERVICES PVT. LTD.

TITLE GENERAL ARRANGEMENT DRAWING FOR SECTIONALISING VALVE OF 4" SIZE WITH 4" FUTURE TAP-OFF & WITH FLEXIBLE BY-PASS PROVISION AND VENT (TYPE-4MV-1)

SIZE	JOB NO.	DRAWING NUMBER	SHEET	REV.
A3	XXXX	VPC-STD-PP-2025	1 OF 5	0

Digitally signed by RAMAKANT
TIWARI
Date: 2025.10.13 18:20:32 IST



COMMON VENT PIPE FOR ALL SECTIONALIZING VALVES
(NOT TO BE FABRICATED FOR ALL SVs)

REFERENCE DRAWINGS / DOCUMENTS

S.NO.	TITLE	NO.

NOTES:-

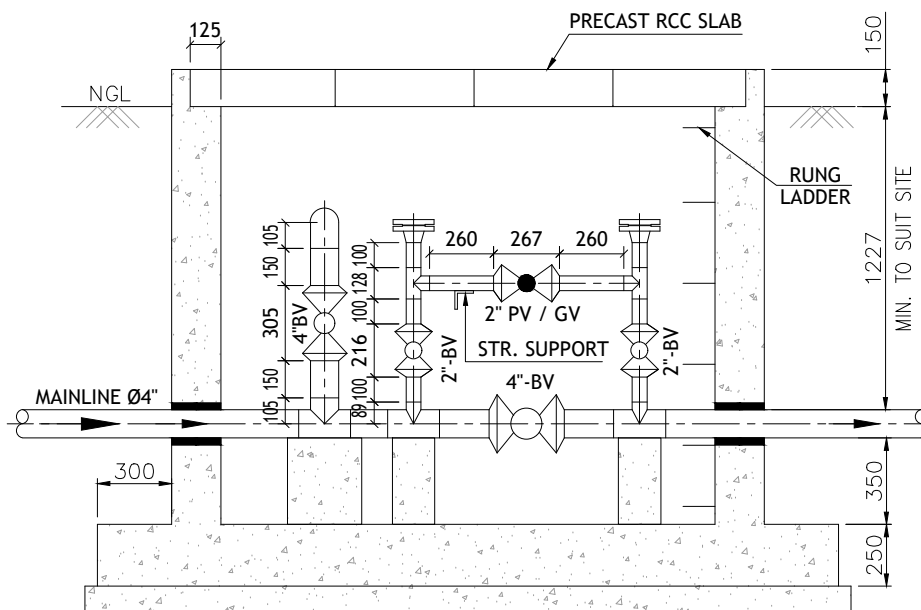
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6. ORIENTATION OF 2" VALVES INSTALLED IN BY-PASS/TAP-OFF TO BE SUCH THAT VALVE LEVER/HANDLE MOVEMENT IS NOT RESTRICTED BY ADJACENT WALL OF A CHAMBER.
7. VALVE CHAMBER PROJECTION ABOVE FGL SHALL BE 150MM-300MM SUITED AS PER SITE CONDITIONS.

LEGEND:-

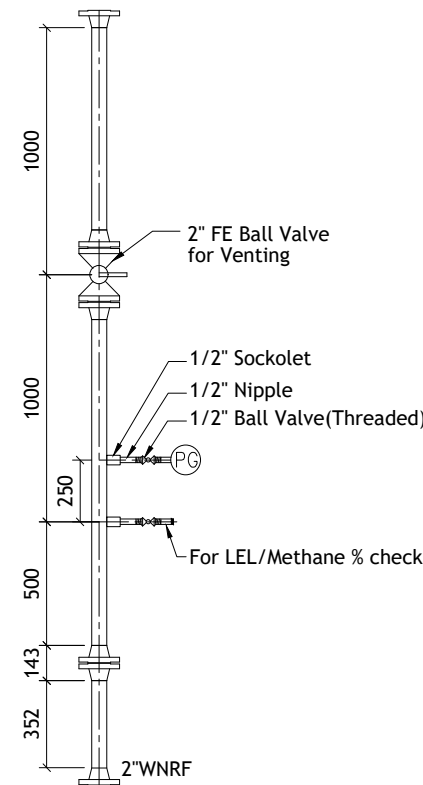
	BUTT WELD BALL VALVE (B.V.)
	FLANGED BALL VALVE
	BUTT WELD GLOBE VALVE (G.V.)
	FLANGED GLOBE VALVE
	THREAD END BALL VALVE

REV.	DATE	DESCRIPTION	PREP.	CHKD.	APPD.

PMC					
VCS QUALITY SERVICES PVT. LTD.					
TITLE GENERAL ARRANGEMENT DRAWING FOR SECTIONALISING VALVE OF 4" SIZE WITH FLEXIBLE BY-PASS PROVISION AND VENT (TYPE-4MV-2)					
SIZE	JOB NO.	DRAWING NUMBER	SHEET	REV.	
A3	XXXX	VPC-STD-PP-2025	2 OF 5	0	



FRONT VIEW (A-A)



COMMON VENT PIPE FOR ALL SECTIONALIZING VALVES
(NOT TO BE FABRICATED FOR ALL SVs)

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7. VALVE CHAMBER PROJECTION ABOVE FGL SHALL BE 150MM-300MM SUITED AS PER SITE CONDITIONS.

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	FLANGED BALL VALVE
	BUTT WELD GLOBE VALVE (G.V.)
	FLANGED GLOBE VALVE
	THREAD END BALL VALVE

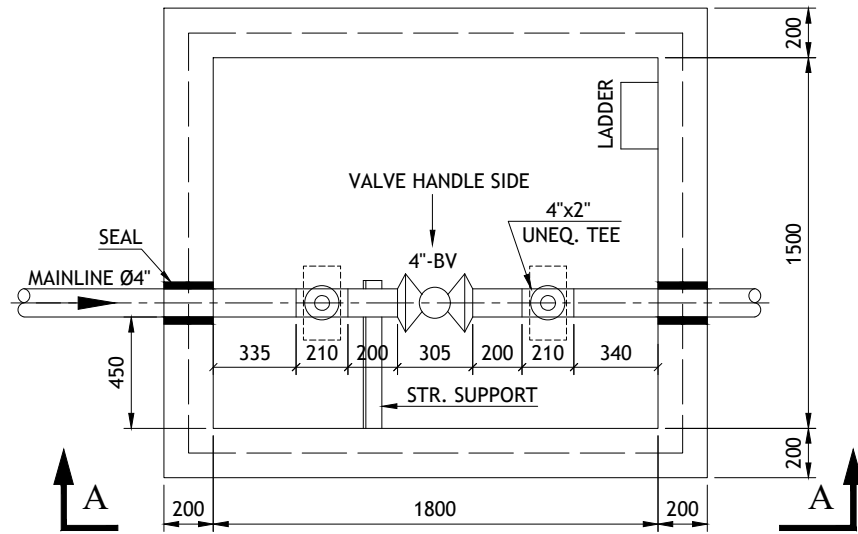
0	02.05.2023	ISSUED AS STANDARD	AK	MN	HK
REV.	DATE	DESCRIPTION	PREP.	CHKD.	APPD.



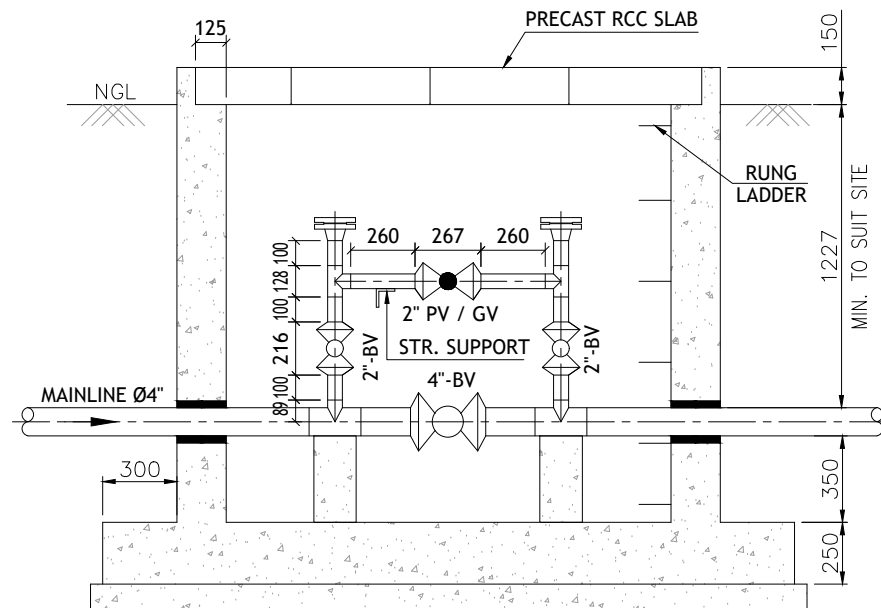
VCS QUALITY SERVICES PVT. LTD.

TITLE	GENERAL ARRANGEMENT DRAWING FOR SECTIONALISING VALVE OF 4" SIZE WITH 4" FUTURE TAP-OFF & WITH PERMANENT BY-PASS LINE AND VENT (TYPE-4MV-3)

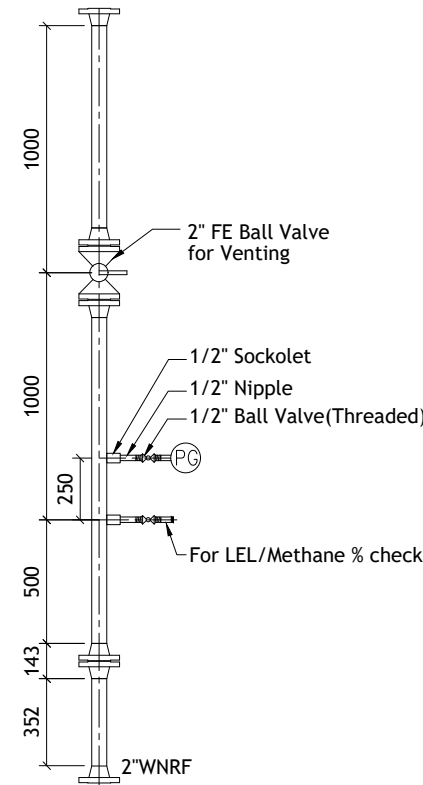
SIZE	JOB NO.	DRAWING NUMBER	SHEET	REV.
A3	XXXX	VPC-STD-PP-2025	3 OF 5	0



TOP VIEW



FRONT VIEW (A-A)



COMMON VENT PIPE FOR ALL SECTIONALIZING VALVES
(NOT TO BE FABRICATED FOR ALL SVs)

REFERENCE DRAWINGS / DOCUMENTS

S.NO.	TITLE	NO.

NOTES:-

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LEGEND:-

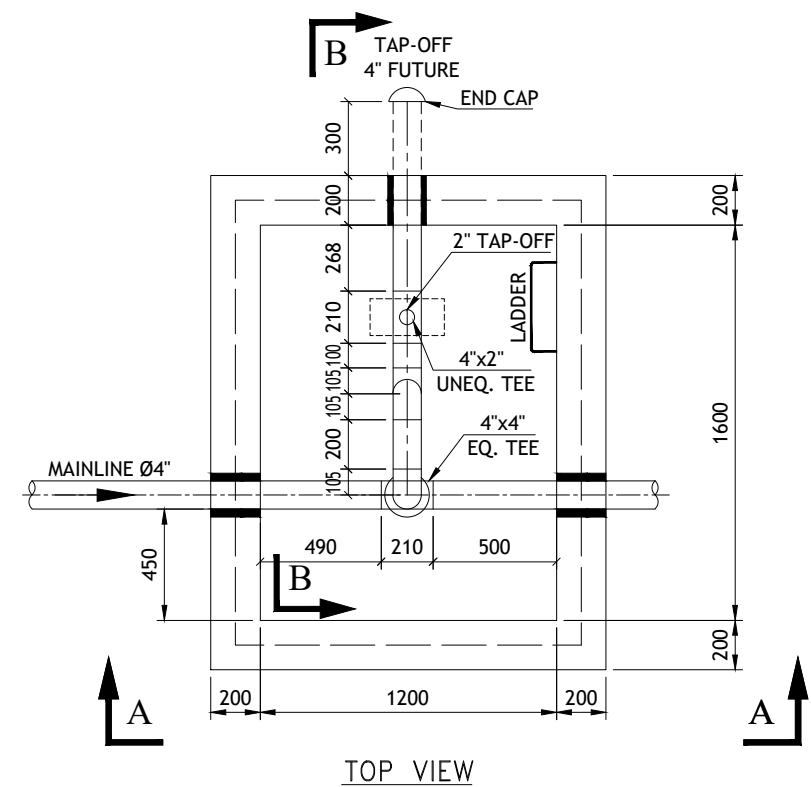
- BUTT WELD BALL VALVE (B.V.)
- FLANGED BALL VALVE
- BUTT WELD GLOBE VALVE (G.V.)
- FLANGED GLOBE VALVE
- THREAD END BALL VALVE

REV.	DATE	DESCRIPTION	PREP.	CHKD.	APPD.
0	02.05.2023	ISSUED AS STANDARD	AK	MN	HK

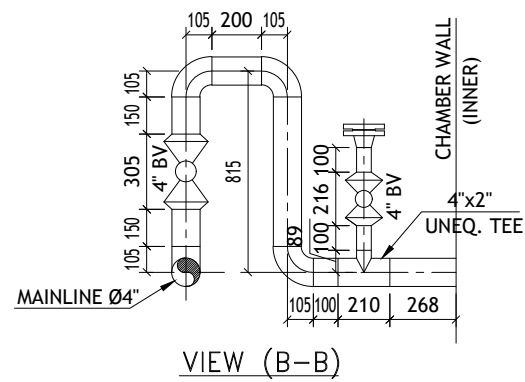
PMC	VCS QUALITY SERVICES PVT. LTD.

TITLE	GENERAL ARRANGEMENT DRAWING FOR SECTIONALISING VALVE OF 4" SIZE WITH PERMANENT BY-PASS LINE AND VENT (TYPE-4MV-4)

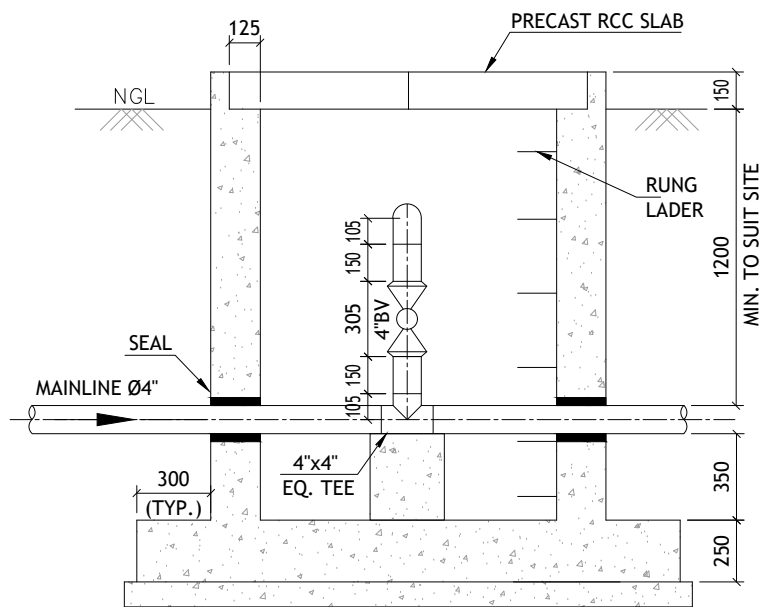
SIZE	JOB NO.	DRAWING NUMBER	SHEET	REV.
A3	XXXX	VPC-STD-PP-2025	4 OF 5	0



TOP VIEW



VIEW (B-B)



FRONT VIEW (A-A)

REFERENCE DRAWINGS / DOCUMENTS					
S.NO.	TITLE				NO.

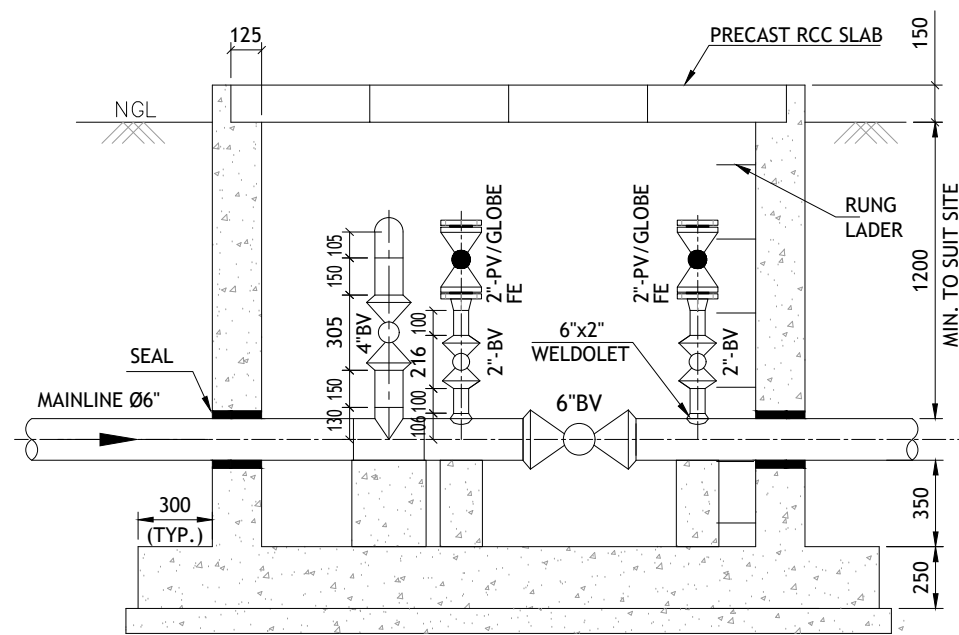
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LEGEND:-

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	FLANGED BALL VALVE
	BUTT WELD GLOBE VALVE (G.V.)
	FLANGED GLOBE VALVE
	THREAD END BALL VALVE

0	02.05.2023	ISSUED AS STANDARD	AK	MN	HK
REV.	DATE	DESCRIPTION	PREP.	CHKD.	APPD.
PMC VCS QUALITY SERVICES PVT. LTD.					
TITLE GENERAL ARRANGEMENT DRAWING FOR 4" SIZE WITH 4" FUTURE TAP-OFF					
SIZE	JOB NO.	DRAWING NUMBER	SHEET	REV.	
A3	XXXX	VPC-STD-PP-2025	5 OF 5	0	



105 200 105

150 105

30.5 4" BV

840

89

100 216 100

4" BV

105 100 210 241

130

MAINLINE Ø6"

CHAMBER WALL (INNER)

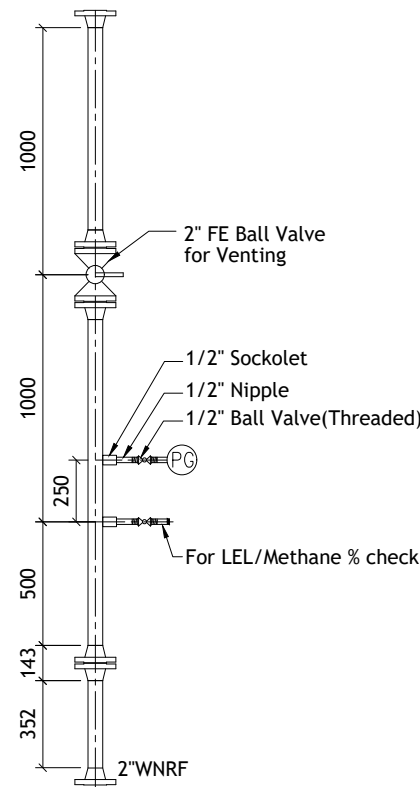
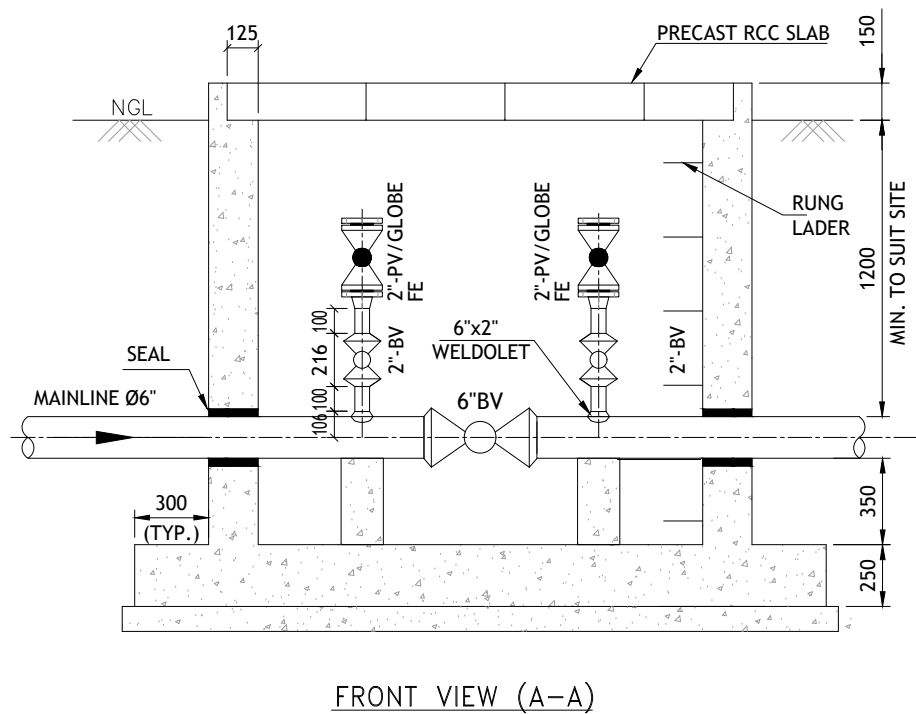
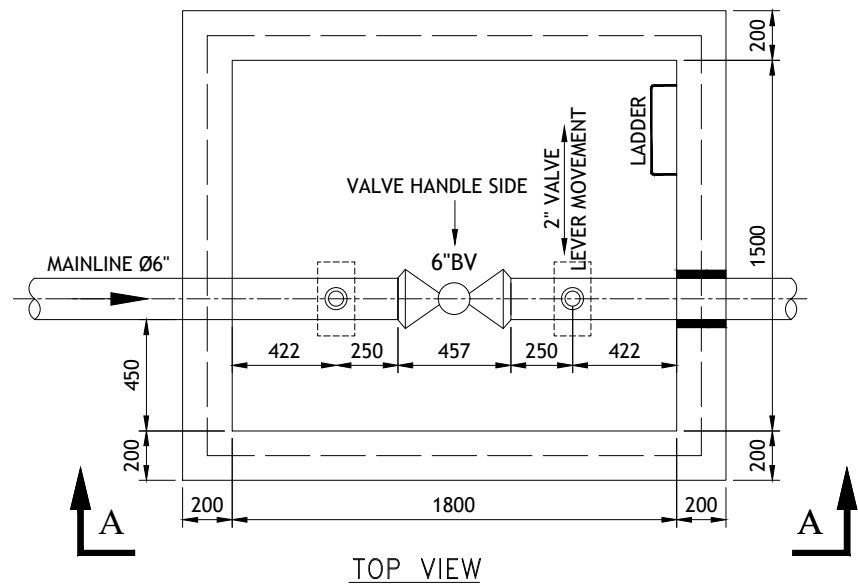
4" x 2" UNEQ. TEE

VIEW (B-B)

Diagram illustrating the components and dimensions of a 2-inch vent line assembly:

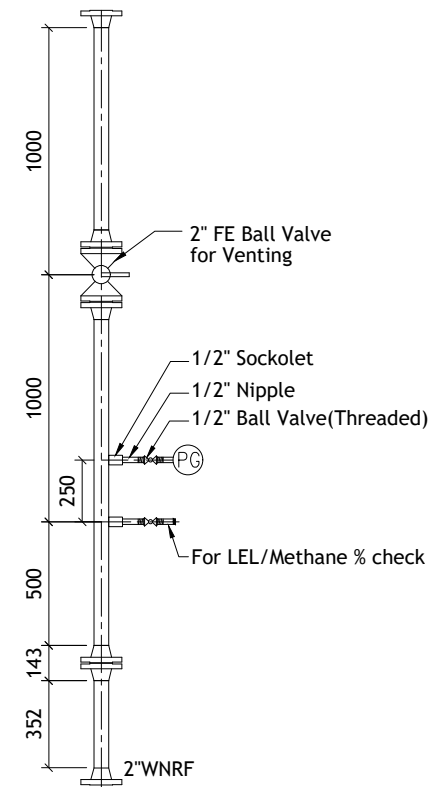
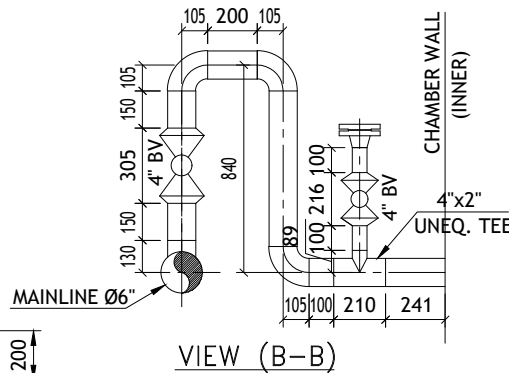
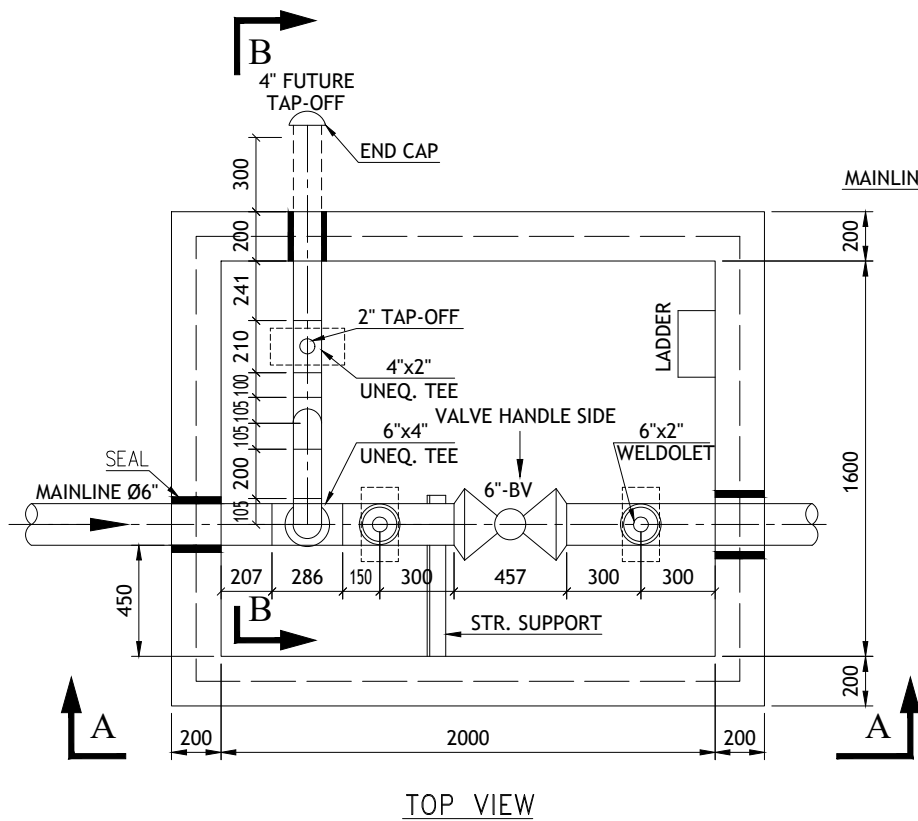
- 2" FE Ball Valve for Venting
- 1000 (Dimension)
- 1000 (Dimension)
- 1/2" Sockolet
- 1/2" Nipple
- 1/2" Ball Valve (Threaded)
- PG (Pressure Gauge)
- 250 (Dimension)
- 500 (Dimension)
- For LEL/Methane % check
- 143 (Dimension)
- 352 (Dimension)
- 2" WNRF

SIZE	JOB NO.	DRAWING NUMBER	SHEET	REV.
A3	XXXX	VPC-STD-PP-2026	1 OF 5	0

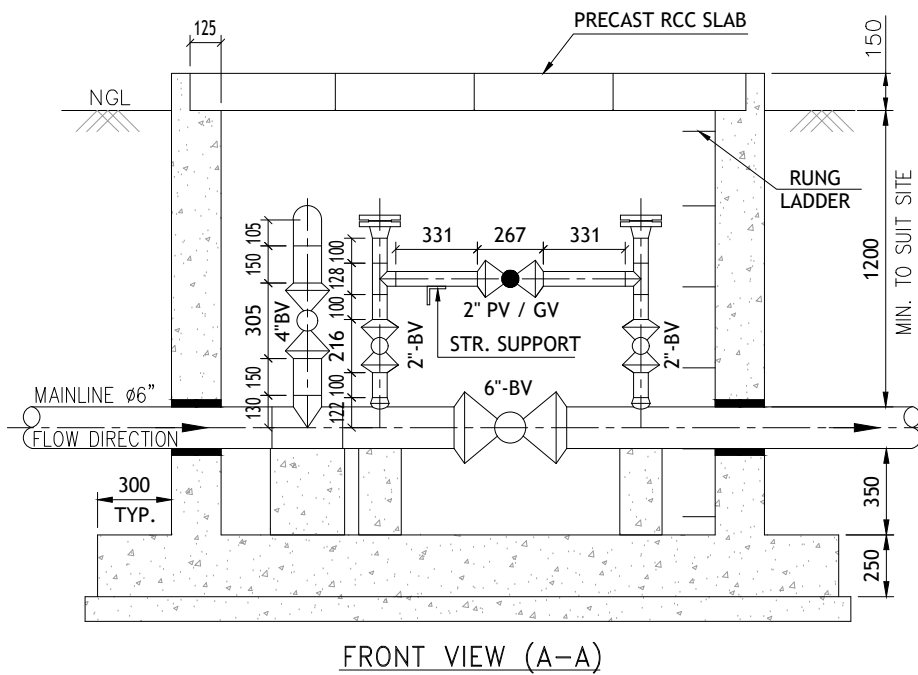


COMMON VENT PIPE FOR ALL SECTIONALIZING VALVES
(NOT TO BE FABRICATED FOR ALL SVs)

REFERENCE DRAWINGS / DOCUMENTS					
S.NO.	TITLE			NO.	
</					



COMMON VENT PIPE FOR ALL SECTIONALIZING VALVES
(NOT TO BE FABRICATED FOR ALL SVs)



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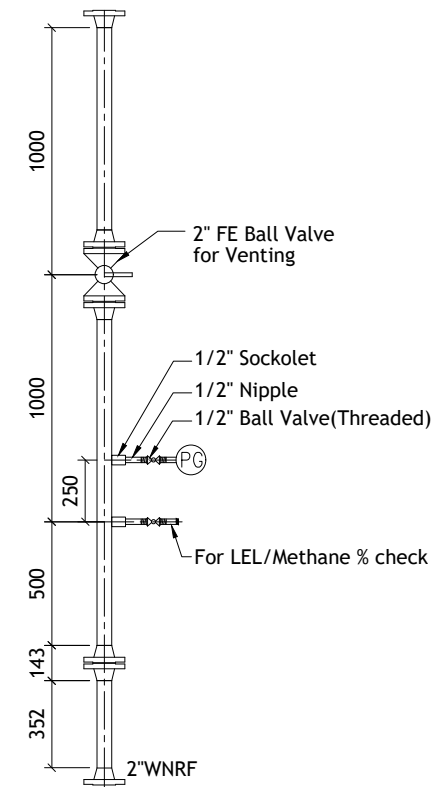
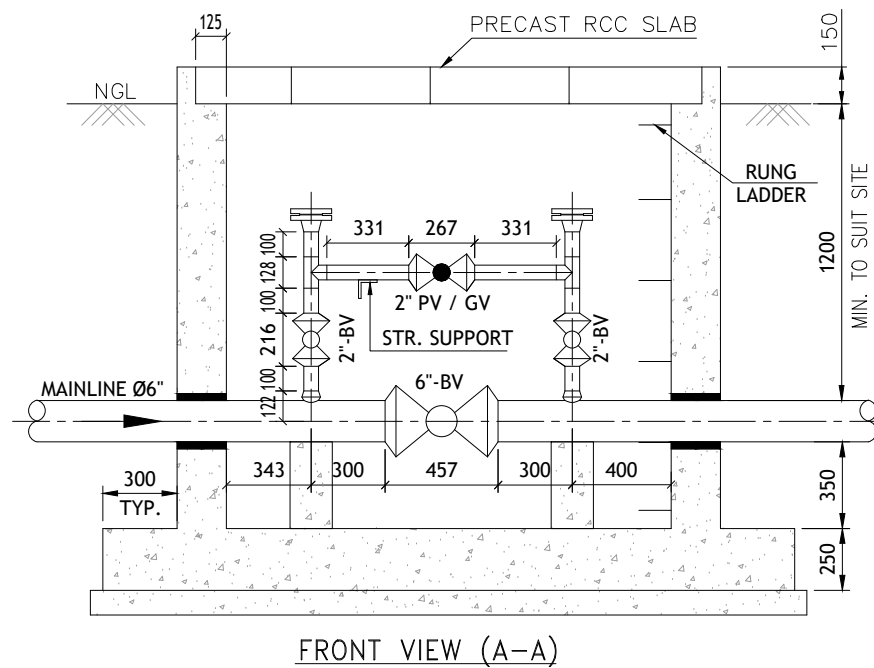
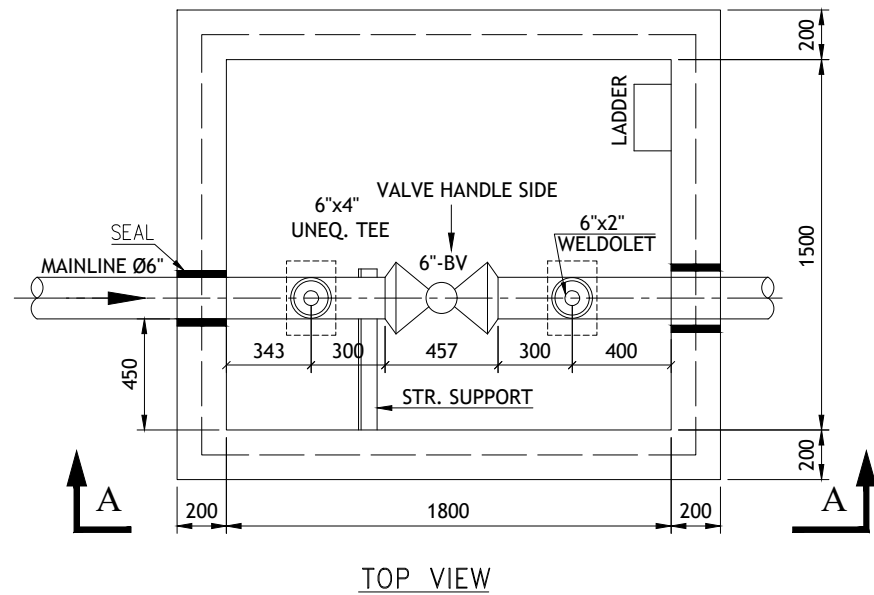
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	FLANGED BALL VALVE
	BUTT WELD GLOBE VALVE (G.V.)
	FLANGED GLOBE VALVE
	THREAD END BALL VALVE

REV.	DATE	DESCRIPTION	PREP.	CHKD.	APPD.

PMC VCS QUALITY SERVICES PVT. LTD.					
TITLE GENERAL ARRANGEMENT DRAWING FOR SECTIONALISING VALVE OF 6" SIZE WITH 4" FUTURE TAP-OFF & WITH PERMANENT BY-PASS LINE AND VENT (TYPE-6MV-3)					
SIZE	JOB NO.	DRAWING NUMBER	SHEET	REV.	
A3	XXXX	VPC-STD-PP-2026	3 OF 5	0	



COMMON VENT PIPE FOR ALL SECTIONALIZING VALVES
(NOT TO BE FABRICATED FOR ALL SVs)

REFERENCE DRAWINGS / DOCUMENTS

S.NO.	TITLE	NO.

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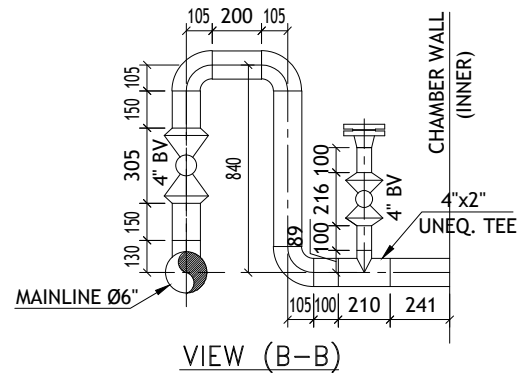
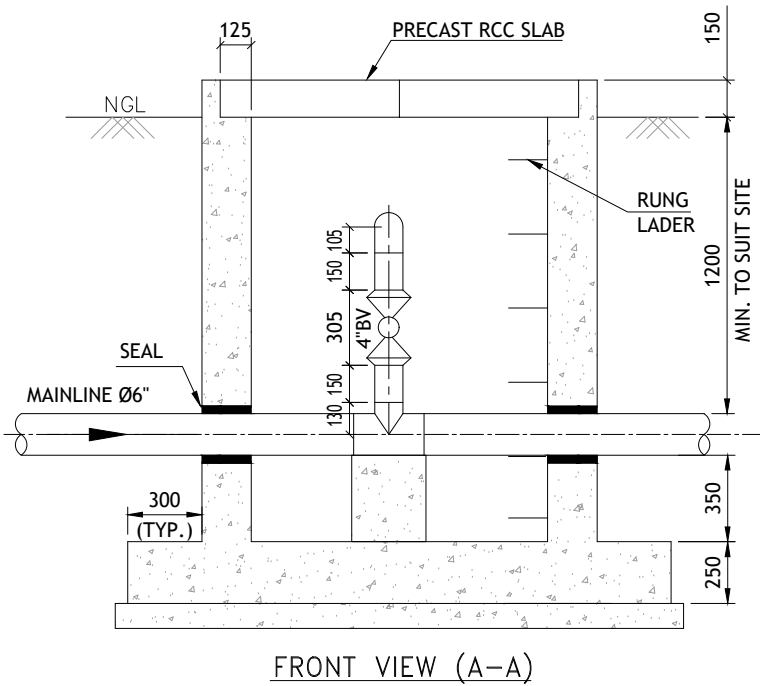
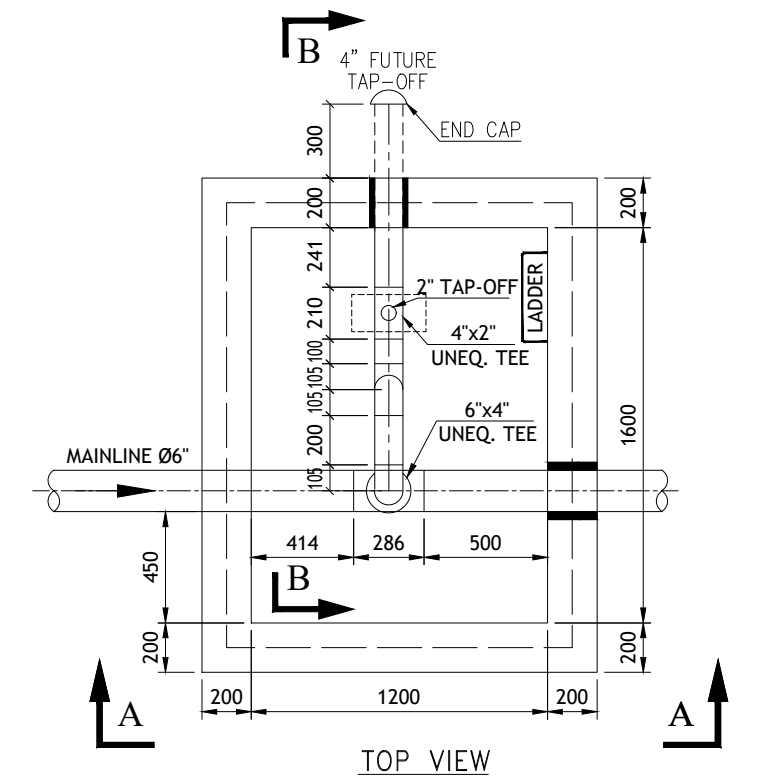
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REV.	DATE	DESCRIPTION	PREP.	CHKD.	APPD.

PMC 					
VCS QUALITY SERVICES PVT. LTD.					
TITLE GENERAL ARRANGEMENT DRAWING FOR SECTIONALISING VALVE OF 6" SIZE WITH PERMANENT BY-PASS LINE AND VENT (TYPE-6MV-4)					
SIZE	JOB NO.	DRAWING NUMBER	SHEET	REV.	
A3	XXXX	VPC-STD-PP-2026	4 OF 5	0	



REFERENCE DRAWINGS / DOCUMENTS

S.NO.	TITLE	NO.

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BUTT WELD GLOBE VALVE (G.V.)

FLANGED GLOBE VALVE

THREAD END BALL VALVE

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REV.	DATE	DESCRIPTION	PREP.	CHKD.	APPD.
PMC					
VCS QUALITY SERVICES PVT. LTD.					
TITLE					
GENERAL ARRANGEMENT DRAWING FOR 6" SIZE WITH 4" FUTURE TAP-OFF					
SIZE	JOB NO.	DRAWING NUMBER	SHEET	REV.	
A3	XXXX	VPC-STD-PP-2026	5 OF 5	0	



LIST OF RECOMMENDED VENDORS FOR BOUGHT OUT ITEMS

**TOTAL
SHEETS**

61

DOCUMENT NO

VCS-00-00-VL-0001

LIST OF RECOMMENDED VENDORS FOR BOUGHT OUT ITEMS

14

30.06.2025

Issued as Standard

Ramveer Singh

Safdar Ali

Rachna Shukla

REV

DATE

DESCRIPTION

PREP

CHK

APPR

TABLE OF CONTENT

1	
A.	MECHANICAL & PIPELINE 7
1.0	CARBON STEEL PIPES..... 7
1.1	PIPE CARBON STEEL TO INDIAN STANDARDS 7
1.2	PIPE & TUBULARS TO A.P.I. STANDARDS 8
1.3	PIPE/TUBE CS (SEAMLESS) TO ASTM STANDARDS 9
1.4	PIPE CARBON STEEL (WELDED) TO ASTM STANDARDS 9
2.0	VALVES 10
2.1	GLOBE VALVES 10
2.2	CHECK VALVES..... 11
2.3	PLUG VALVES 11
2.4	BALL VALVES..... 12
3.0	TEE 12
3.1	FLOW TEE 12
3.2	SPLIT TEE 13
4.0	FLANGES 13
5.0	FITTINGS 14
6.0	PIG LAUNCHERS/ RECEIVERS/ PIG SIGNALERS..... 14
7.0	LONG RADIUS BENDS..... 15
8.0	CLEAN AGENT SYSTEM..... 16
9.0	INSULATING JOINTS 16
10.0	GASKETS..... 16
11.0	FASTENERS 16
12.0	WELDING ELECTRODES FOR PIPELINE/PIPING WORK 17
13.0	STRAINERS 17
14.0	COLD APPLIED TAPES..... 17
15.0	HEAT SHRINKABLE SLEEVE/ FIBREGLAS REINFORCED SLEEVE ... 17
16.0	STUD BOLTS WITH NUTS..... 18
17.0	WARNING MAT..... 18



18.0	HDPE PIPES/DUCT.....	18
19.0	DRY GAS FILTER & FILTER SEPERATOR.....	18
20.0	FILTER ELEMENT.....	19
21.0	NDT AGENCY.....	19
22.0	Cold Applied Tapes.....	20
23.0	PUR Coating.....	20
24.0	Casing End Closure.....	20
25.0	Casing Insulators.....	20
26.0	FIRE FIGHTING EQUIPMENT.....	20
26.1	FIRE EXTINGUISHERS.....	20
26.2	FIRE HYDRANTS, MONITORS, DELUGE VALVE, NOZZLES.....	21
26.3	RRL Hose.....	21
26.4	HOSES.....	21
B.	CIVIL AND STRUCTURAL	22
C.	ELECTRICAL.....	28
1.0	AIR CONDITIONER.....	28
2.0	BATTERIES (LEAD ACID).....	28
3.0	BATTERIES (NICKEL CADMIUM).....	29
4.0	BATTERY CHARGER/DC-DC CONVERTER.....	29
5.0	CABLE – FIRE ALARM & COMMUNICATION CABLES.....	29
6.0	CABLE – HT(XLPE).....	29
7.0	CABLE – LT / MV POWER AND CONTROL.....	30
8.0	CABLE – GLAND.....	30
9.0	CABLE – LUGS & TERMINAL BLOCKS.....	31
10.0	CABLE – TRAY.....	31
11.0	CABLE TERMINATION AND JOINTING KIT.....	31
12.0	CEILING/EXHAUST/PEDESTAL FANS & CIRCULATORS.....	31
13.0	CONTRACTORS – AC POWER.....	32
14.0	CONTROL TRANSFORMER.....	32
15.0	GAS GENERATOR/DIESEL GENERATOR SET.....	32
16.0	FLAME PROOF LDB’S/ JB’S/CONTROL STATION/ SWITCHES.....	33
17.0	HIGH MAST.....	33



18.0	HIGH VOLTAGE PCC/ MCC PANELS	34
19.0	INDICATING LAMPS.....	34
20.0	INDICATING METERS.....	34
21.0	LIGHTING FIXTURES	35
22.0	LIGHTING FIXTURES – FLAMEPROOF.....	35
23.0	MINIATURE CIRCUIT BREAKERS (MCBS) AND LIGHTING DB	35
24.0	MOULDED CASE CIRCUIT BREAKER (MCCBS)	36
25.0	PROTECTION RELAYS.....	36
26.0	LOW/MEDIUM VOLTAGE POWER CONTROL CENTER (PCC)/ MCC/ PDB/ MLDB/ LDB.....	37
27.0	PUSH BUTTONS.....	37
28.0	SWITCHES-CONTROL.....	38
29.0	SWITCHES – 5/15A PIANO/ PLATE, SWITCH SOCKET	38
30.0	SWITCH SOCKET OUTLETS (INDUSTRIAL)	38
31.0	SOLAR POWER SYSTEM MODULES.....	38
32.0	SOLAR PCU/CHARGE CONTROLLER	39
33.0	TERMINALS BLOCKS.....	39
34.0	DISTRIBUTION TRANSFORMERS.....	39
35.0	UPS SYSTEM AND INVERTER.....	40
36.0	GI-OCTAGONAL POLE	40
37.0	ELECTRICAL MOTORS	40
38.0	ELECTRICAL PROCESS HEATER	41
39.0	CATHODIC PROTECTION AGENCIES/CONTRACTOR/ VENDERS ...	41
40.0	BACKUP AGENCY FOR INTERFERENCE SURVEY & MITIGATION....	41
41.0	PERMANENT REFERENCE CELL.....	42
42.0	CP CABLES.....	42
43.0	CP SACRIFICIAL ANODES.....	42
44.0	CP PORTABLE /PERMANENT REFERENCE CELL.....	43
45.0	CPTR (AC OPERATED).....	43
46.0	PIN BRAZING / THERMITWELD	43
47.0	CP SURGE DIVERTER/SPARK GAP ARRESTOR (EX-D).....	43



48.0	CP SOLID STATE POLARISATION CELL.	43
49.0	PETROLEUM COKE BREEZE:	44
50.0	CP ANODE (MMO TYPE):	44
51.0	HEAT SHRINK CAP FOR CP ANODE	44
52.0	ER- PROBE (EXTERNAL CORROSION) ER- PROBE & CORROSION COUPON ASSEMBLY	44
53.0	HEAT SHRINK CAP FOR ANODE TO CABLE JOINT	44
54.0	MMO WIRE ANODES (WITH FACTORY PRE-PACKED COKE BREEZE)	45
55.0	MMO WIRE ANODES (WITHOUT FACTORY PRE-PACKED COKE BREEZE)	45
56.0	MMO TUBULAR/ STRIP/ RIBBON ANODES.....	45
D.	INSTRUMENTATION	46
1.0	PRESSURE GAUGES	46
2.0	TEMPERATURE GAUGES	46
3.0	TEMPERATURE ELEMENTS INCLUDING SKIN TYPE	47
4.0	POSITIVE DISPLACEMENT FLOW METERS	47
5.0	TURBINE FLOW METER	48
6.0	ELECTRONIC VOLUME CORRECTOR	48
7.0	ORIFICES (METER RUN, FLOW CONDITIONER, ORIFICE PLATE AND ASSEMBLY)	48
8.0	ULTRASONIC FLOW METERS	48
9.0	MASS FLOW METERS	48
10.0	FIELD INSTRUMENTS (P, DP, F, L, T)	49
11.0	LEVEL GAUGES/ LEVEL INSTRUMENTS	49
12.0	PRESSURE REGULATOR AND SLAM SHUT VALVE	49
13.0	PRESSURE SAFETY VALVES	50
14.0	CONTROL PANEL & ACCESSORIES	50
15.0	JUNCTION BOXES AND CABLES GLANDS	51
16.0	CONTROL AND SIGNAL CABLES	51
17.0	GAS DETECTION SYSTEM	52
18.0	MOV ACTUATOR:	52



19.0	PNEUMATIC ACTUATOR (SOLENOID OPERATED ON-OFF TYPE) ...	52
20.0	SOLENOID VALVES	52
21.0	ELECTRO – HYDRAULIC ACTUATOR.....	53
22.0	GAS OVER OIL ACTUATOR.....	53
23.0	OFC.....	53
24.0	FLOW CONTROL VALVES	54
25.0	FLOW COMPUTERS.....	54
26.0	INDICATORS & CONTROLLERS	54
27.0	BARRIERS	54
28.0	GAS CHROMATOGRAPH	54
29.0	I/P CONVERTERS	55
30.0	SS FITTINGS, INSTRUMENT VALVES & MANIFOLDS.....	55
30.1	FOR CNG WORK:	55
30.2	EXCEPT CNG WORK:	55
31.0	SS TUBES.....	55
31.1	FOR CNG WORK:	56
31.2	EXCEPT CNG WORK:	56
E.	SHOP & FIELD PAINTING	57
1.0	INDIAN VENDORS	57
2.0	FOREIGN VENDORS FOR OVERSEAS PRODUCTS	57
F.	FOR PE & LMC WORK (GI/CU)	59
1.0	MDPE FITTINGS & MDPE VALVES	59
2.0	GI PIPE.....	59
3.0	CASTING GI FITTINGS	59
4.0	FORGED GI FITTING (FOR HIGH RISE SEGMENT).....	60
5.0	COPPER TUBES & FITTINGS.....	60
6.0	BRASS FITTINGS	Error! Bookmark not defined.
7.0	BRASS VALVES	60
8.0	BRASS FITTINGS	60
9.0	STEEL RE-INFORCED RUBBER HOSE (TYPE-4).....	60
10.0	CORRUGATED FLEXIBLE METAL HOSES (ANACONDA).....	61

A. MECHANICAL & PIPELINE

1.0 CARBON STEEL PIPES

1.1 PIPE CARBON STEEL TO INDIAN STANDARDS

- a. A.S.T. Pipes Pvt. Ltd. (AST Group)
- b. Advance Steel Tube Ltd.
- c. Apl Apollo Tubes Ltd. (Er. Bihar Tubes Ltd.
- d. Asian Mills Pvt. Ltd.
- e. Asrani Tubes Limited
- f. Dadu Pipes (P) Ltd.
- g. Essar Steel Limited(Er Hazira Pipes Mill)
- h. Gaurang Products Pvt Ltd. (Ast Group)
- i. Goodluck Steel Tubes Ltd.
- j. Hi-Tech Pipes Limited
- k. Indus Tube Limited
- l. Jindal Industries Ltd
- m. Jindal Pipes Ltd.
- n. Jindal Saw Ltd (Kosi Works)
- o. Jotindra Steel & Tube Ltd
- p. Lalit Pipes And Pipes Ltd.
- q. Maharashtra Seamless Ltd.
- r. Man Industries (India) Ltd. – Pithampur
- s. Man Industries (India) Ltd. Anjar
- t. Mukat Tanks & Vessels Ltd.
- u. Nezone Tubes Limited
- v. North Eastern Tubes Limited
- w. Pratibha Industries Limited
- x. Pratibha Pipes & Structural Ltd.
- y. Psl Ltd (Chennai)
- z. Psl Ltd (V1, V2 & NC)
- aa. Rama Steel Tubes Ltd.
- bb. Ratnamani Metals And Tubes Ltd.
- cc. Ravindra Tubes Limited



- dd. Samshi Pipe Industries Limited
- ee. Surya Roshni Ltd.
- ff. Swastik Pipes Ltd.
- gg. Utkarsh Tubes & Pipes Ltd. (Formly Bmw)
- hh. Welspun Corp. Limited (Dahej)
- ii. Zenith Birla (India) Limited

1.2 PIPE & TUBULARS TO A.P.I. STANDARDS

- a. Arcelormittal Tubular Products Roman Sa, Romania
- b. Bhel (Trichy), India
- c. Dalmine Spa (Enquiry To Tenaris), Uae
- d. Eewkorea Co. Ltd (Germany), Korea
- e. Eew Korea Co. Ltd. (Korea), Korea
- f. Eisenbau Kramer Gmbh, Germany
- g. Hyundai Rb Co. Ltd. South Korea
- h. Ilva Lamiere E Tubi Srl (Enq To Ilva Spa, Italy)
- i. Inox Tech. Spa, Italy
- j. ISMT Ltd. Ahmedngr, India
- k. TATA Steel, India
- l. PSL
- m. Jindal Pipes Ltd., India
- n. Jindal Saw Ltd. (Kosi Works), India
- o. Jindal Saw Ltd. (Nashik Works), India
- p. Lalit Pipes And Pipes Ltd. India
- q. Maharashtra Seamless Ltd., India
- r. Man Industries (I) Ltd. (Pithampur), India
- s. Mukat Tanks & Vessels Ltd., India
- t. Pratibha Industries Limited, India
- u. Ratnamani Metals And Tubes Ltd., India
- v. Siderca S.A.I.C (Enquiry Totenaris), Uae
- w. Sumitomo Metal Ind. Ltd., India
- x. Surya Roshni Ltd., India
- y. Swastik Pipes Ltd, India
- z. Tata Steel Uk Limited (Formerly C702)
- aa. Tubos De Acero De Mexico Sa (Enq. Tenaris), Uae



- bb. Tubos Reunidos Sa Spain
- cc. Umran Steel Pipe Inc (Turkey), Turkey
- dd. Valcovny Trub Chomutov, Czech Republic
- ee. Vallourec And Mannesmann Tubes, France
- ff. Welspun Corp Limited (Dahej), India

1.3 PIPE/TUBE CS (SEAMLESS) TO ASTM STANDARDS

- a. Arcelormittal Tubular Products Roman Sa, Romania
- b. Bhel (Trichy), India
- c. Changshu Seamless Steel Tube Co. Ltd., China
- d. Dalmine Spa (Enquiry To Tenaris, Uae
- e. Heavy Metals & Tubes Limited (Mehsana), India
- f. Ismt Ltd. Ahmednagr, India
- g. Ismt Ltd. Baramati India
- h. Jfe Steel Corporation, Uae
- i. Jindal Sdaw Ltd (Nashik Works) India
- j. Klt Automotive And Tubular Products Ltd., India
- k. Mahalaxmi Seamless Limited, India
- l. Maharashtra Seamless Ltd, India
- m. Products Tubulares S.A.U, Spain
- n. Ratnadeep Metal Tubes Ltd., India
- o. Staineest Tubes Pvt Ltd., India
- p. Sumitomo Metal Ind. Ltd., India
- q. Tubos Reunidos Sa Spain
- r. Valcovny Trub Chomutov, Czech Republic
- s. Vallourec Andmannesmann Tubes France
- t. Yangzhou Chengde Steel Pipe Co. Ltd Dubai (UAE)
- u. Jindal SAW Ltd Kosi Kalan Mathura

1.4 PIPE CARBON STEEL (WELDED) TO ASTM STANDARDS

- a. Eew Korea Co. Ltd. (Germany), Korea
- b. Eew Korea Co. Ltd. (Korea), Korea
- c. Eisenbau Kramer Gmbh, Germany
- d. Hyundai Rb Co. Ltd., South Korea
- e. Inox Tech. Spa, Italy
- f. Jindal Saw Ltd (Kosi Works), India



- g. Lalit Pipes and Pipes Ltd., India
- h. Man Industries (I) Ltd.(Pithampur), India
- i. Man Industries (India) Ltd. Anjar, India
- j. Mukat Tanks & Vessels Ltd., India
- k. Ratnamani Metals And Tubes Ltd., India
- l. Sumitomo Metal India Ltd., India
- m. Tata Steel Uk Limited

2.0 VALVES

2.1 GLOBE VALVES

- a. BDK (New Delhi)
- b. Datre Corpn (Calcutta)
- c. KSB Pumps (New Delhi)
- d. L&T (New Delhi)
- e. Neco Schuber & Salzer Ltd. (New Delhi)
- f. Niton Valve (Mumbai)
- g. Ornate Valves (Mumbai)
- h. Panchavati Valves (Mumbai)
- i. AV Valves Ltd.
- j. BHEL (Trichy), India
- k. Econo Valves Pvt Ltd, India
- l. Fouress Engg (I) Ltd (Aurangabad)
- m. Guru Industrial Valves Pvt Ltd
- n. Leader Valves Ltd, India
- o. NSSL Ltd. (Neco Schubert & Salzerltd)
- p. Oswal Industries Ltd, India
- q. Petrochemical Engineering Enterprises, India
- r. Sakhi Engineers Pvt Ltd
- s. Shalimar Valves Pvt Ltd
- t. Steel Strong Valves India Pvt Ltd, India
- u. Petro Valves Pvt. Limited, Ahmedabad
- v. Hawa Engineers Limited, Ahmedabad (Non API)
- w. G M Engineering PVT LTD (Non API)

**2.2 CHECK VALVES**

- a. Advance Valves Pvt. Ltd., Noida
- b. Aksons & Mechanical Enterprises, Mumbai
- c. Larsen & Toubro Limited (Audco India Limited, Chennai)
- d. AV valves Ltd., Agra
- e. BDK engineering India Ltd., Hubli
- f. BHEL, OFE&OE Group, New Delhi
- g. Datre Coroportion Limited, Calcutta
- h. Leader Valves Ltd., Jalandhar
- i. Neco schubert & Salzer Ltd., New Delhi
- j. Niton Valves Industries (P) Ltd., Mumbai
- k. Precision Engg. Co., Mumbai
- l. Econo Valves Pvt Ltd, India
- m. Fouress Engg (I) Ltd (Aurangabad)
- n. KSB Pumps Ltd (Coimbatore), India
- o. NSSL Ltd. (Neco Schubert & Salzer Ltd)
- p. Oswal Industries Ltd, India
- q. Panchvati Valves & Flanges Pvt Ltd, India
- r. Petrochemical Engineering Enterprises, India
- s. Sakhi Engineers Pvt Ltd
- t. Shalimar Valves Pvt Ltd
- u. Steel Strong Valves India Pvt Ltd, India
- v. Shiv Shakti Engineering Works (Approved up to 06 inch)
- x. Hawa Engineers Limited, Ahmedabad
- y. G M Engineering PVT LTD (Non API)

2.3 PLUG VALVES

- a. Breda Energia Sesto Industria Spa, Italy
- b. Fisher Sanmar Ltd., Chennai
- c. Larsen & Toubro Ltd., New Delhi
- d. Nordstrom Valves, USA
- e. Serck Audco Valves, UK
- f. Sumitomo Corporation India Pvt. Ltd., New Delhi
- g. Z Corporation, Korea
- h. Hawa Valves (India) Pvt. Ltd., Mumbai



- i. Steel Strong Valves India Pvt. Ltd., Navi Mumbai
- j. Econo Valves
- k. Flow-Serve PTE (Mfr. SERCK), India

2.4 BALL VALVES

- a. Hawa Valves (India) Pvt. Ltd, Navi Mumbai
- b. Larsen & Toubro, Delhi
- c. Microfinish Valves Pvt. Ltd., Noida
- d. Oswal Industries Ltd., Gandhi nagar
- e. Virgo Engineers Ltd., Delhi
- f. Boteli Valve Group Co. Ltd., China
- g. Cameron (Malaysia) SDN BHD, Malaysia
- h. Dafram S.P.A., Italy
- i. Fangyuan Valve Group Co. Ltd., China
- j. Franz Schuck GmbH, Germany
- k. O.M.S. Saleri (Italy)
- l. Pibi Viesse S.P.A (Italy)
- m. Nuovo Pignone (Italy)
- n. Perar S.P.A (Italy)
- o. Pietro Fiorentini (Italy)
- p. Cooper Cameron Valv Italy SRL-FRM, Italy
- q. Petrol Valves SRL
- r. Tormene Gas Technology S.P.A (VALVITALIA)
- s. Petro Valves Pvt. Limited, Ahmedabad
- t. Shiv Shakti Engineering Works (Approved up to 08 inch)
- u. Hawa Engineers Limited, Ahmedabad
- v. G M Engineering PVT LTD.

3.0 TEE

3.1 FLOW TEE

- a. Coprosider SPA, Italy
- b. GEA Energy System India Limited, Chennai
- c. Multitex Filtration
- d. Pipeline Engineering, UK
- e. Scomark Engg. Limited (U.K.)
- f. Skeltonhall Limited, England(U.K.)



- g. Technospecial SPA, Italy
- h. Tectubi SPA, Italy
- i. RMA Germany
- j. Pipefit Engineers Pvt. Ltd.
- k. Vee Kay Vikram & Co.

3.2 SPLIT TEE

- a. IPSCO, Canda
- b. TD Willamsons, USA
- c. Plant-Tech Power Technical Services Pvt Ltd
- d. Teemans, UK
- e. Vee Kay Vikram & CO.

4.0 FLANGES

- a. Aditya Forge Ltd., Vadodara
- b. Amforge Industries Ltd., Mumbai
- c. CD Engineering Co., Ghaziabad
- d. Echjay Forgings Pvt. Ltd. (Bombay), Mumbai
- e. Echjay Industries Ltd., Rajkot
- f. Forge & Forge Pvt. Ltd., Rajkot
- g. Golden Iron & Steel Works, New Delhi
- h. JK Forgings, New Delhi
- i. Metal Forgings Pvt. Ltd., Mumbai
- j. Perfect Marketings Pvt. Ltd., New Delhi
- k. Sky Forge, Faridabad
- l. S&G, Faridabad
- m. Chaudhry Hammer Works Ltd, India
- n. JAV Forgings (P) Ltd, India
- o. Kunj Forgings Pvt Ltd, India
- p. MS Fittings
- q. R.N. Gupta & Co. Ltd, India
- r. R.P. Engineering Pvt Ltd, India
- s. Sanghvi Forgings & Engineering Ltd
- t. Shri Ganesh Forgings Ltd., India
- u. Uma Shankar Khandelwal & Co., India
- v. Sawan Engineers, Baroda



- w. Stewarts & Lloyds of India Ltd., Kolkata
- x. Engineering Services Enterprises
- y. Pipefit Engineers Pvt. Ltd.
- z. Jindal Forging
- aa. Vivial Forges
- bb. N J Engineers (Up to 12 Inch Class 600 Only)

5.0 FITTINGS

- a. Commercial Supplying Agency, Mumbai
- b. Dee Development Engineers Ltd.
- c. Eby Industries, Mumbai
- d. Flash Forge Pvt. Ltd., Vishakhapatnam
- e. Gujarat Infra Pipes Pvt. Ltd., Vadodara
- f. M.S. Fittings Mfg. Co. Pvt. Ltd., Kolkata
- g. Stewarts & Lloyds of India Ltd., Kolkata
- h. Teekay Tubes Pvt. Ltd., Mumbai
- i. Pipe Fit, Baroda
- j. Sky Forge, Faridabad
- k. S&G, Faridabad
- l. Sawan Engineers, Baroda
- m. Eby Fasteners, India
- n. Leader Valves Ltd, India
- o. R.N. Gupta & Co. Ltd, India
- p. Exten Engg Pvt Ltd
- q. Sivananda Pipe & Fittings Ltd
- r. Jindal Forging
- s. Vivial Forges
- t. PK Tubes Rajasthan
- u. CSA Fitting
- v. Gujarat Infrapipes pvt ltd, Vadodara
- w. KS Pipes Fitting Pvt Ltd, Palwal
- x. Tube Bend, Kolkata

6.0 PIG LAUNCHERS/ RECEIVERS/ PIG SIGNALERS

- a. Bassi Luigi Fittings B.V., Holland



- b. BRAUN STAHL PIPE TEC, GERMANY
- c. FORAIN, ITALY
- d. Fluidel SRL, ITALY
- e. RMA Maschinen- und, GERMANY
- f. Siirtec Nigi, Itlay
- g. SCHUCK ARMATUREN, GERMANY
- h. T.D. Williamson Inc., USA
- i. Tectubi SPA, Italy
- j. Taylor Forge Engineering System INC, USA
- k. Tormene Americana S.A. (Argentina)
- l. Tormene Gas Technology S.p.A., Italy
- m. PIPELINE ENGINEERING, UNITED KINGDOM
- n. Krohne, Oil & Gas BV, Drive Houston,
- o. Multitex Filtration Engrs. Ltd, New Delhi
- p. BGR ENERGY SYSTEMS LIMITED New Delhi
- q. Glapwell Contracting Services Ltd. UK
- r. FULGOSI GIOVANNI S.n.c di Corrado & C, ITALY
- s. VEEKAY VIKRAM & CO, GUJRAT
- t. GBM S.R.L, ITALY
- u. Cardew Ltd., Alexeander
- v. Forain S.R.L.
- w. GD Engineering, India
- x. Pipeline Engineering, UK
- y. Siirtec Nigi SPA
- z. Control Plus
- aa. Oswal Infrastructure

7.0 LONG RADIUS BENDS

- a. Jindal Saw Ltd. (Kosi Works), India
- b. PSL Limited (Gandhidham – Mfrg), India
- c. BHEL, Trichy, Tamilnadu
- d. Welspun, Gujarat
- e. Sawan
- f. Gujarat Infra
- g. P K Tubes



- h. DEE Development
- i. Pipefit Engineers Pvt. Ltd.

8.0 CLEAN AGENT SYSTEM

- a. ADN Fire Safety Pvt Ltd (Vashi East, Thane)
- b. Chetan Corporation (Ahmedabad)
- c. Chetan Engineers (Ahmedabad)
- d. Mx Systems International Pvt. Ltd. (Mumbai)
- e. New Fire Engineers (P) Ltd (Sil Vassa)
- f. Nitin Fire Protection Industries Ltd (New Bombay)
- g. Nohmi Bosai (India) Private Limited
- h. Tyco Fire & Security India Pvt. Ltd (Bangalore)
- i. Vimal Fire Controls Pvt Ltd (Vadodara)

9.0 INSULATING JOINTS

- a. IGP Engineers
- b. V K Vikram
- c. Advance Electronics
- d. Nupros INC

10.0 GASKETS

- a. IGP Engineers (P) Ltd., Madras
- b. Madras Industrial Products, Madras
- c. Dikson & Company, Bombay
- d. Banco Products (P) Ltd., Vadodara
- e. Goodrich Gaskets Pvt Ltd
- f. Starflex Sealing India Pvt Ltd, India
- g. Teekay Meta Flex Pvt Ltd
- h. UNIKLINGER Ltd
- i. HEM Engg. Corp.
- j. Unique Industrial Packing Pvt. Ltd.

11.0 FASTENERS

- a. Nireka Engg. Co. (P) Ltd., Calcutta
- b. Precision Taps & Dies, Bombay
- c. AEP Company, Vithal Udyoug Nagar
- d. Fix Fit Fasteners, Calcutta



- e. Precision Engg. Industries, Baroda
- f. Echjay Forgings Pvt. Ltd., Bombay
- g. Capital Industries, Bombay
- h. Boltmaster India Pvt Ltd, India
- i. Deepak Fasteners Limited, India
- j. Fasteners & Allied Products Pvt Ltd, India
- k. Hardwin Fasteners Pvt Ltd, India
- l. J.J. Industries, India
- m. Multi Fasteners Pvt Ltd, India
- n. Nexo Industries, India
- o. Pacific Forging & Fasteners Pvt Ltd, India
- p. Pioneer Nuts & Bolts Pvt Ltd, India
- q. Precision Auto Engineers, India
- r. President Engineering Works, India
- s. Sandeep Engineering Works, India
- t. Syndicate Engineering Industries, India

12.0 WELDING ELECTRODES FOR PIPELINE/PIPING WORK

- a. For Mainline – Lincoln/ Bohler make
- b. For Terminal – For root pass –Lincoln/ Bohler make
For other passes – Lincoln, D&H or equivalent makeLincon

13.0 STRAINERS

- a. Bombay Chemical Equipments
- b. Gujarat Auto filed
- c. Multitex Filtration Engineering Limited
- d. Grand Prix Engineering Limited

14.0 COLD APPLIED TAPES

- a. Denso GmbH
- b. Raychem

15.0 HEAT SHRINKABLE SLEEVE/ FIBREGLAS REINFORCED SLEEVE

- a. Covalence - Seal For Life India Pvt. Ltd. (Formerly Covalence Raychem- Berry Plastics Corporation)
- b. Canussa-CPS
- c. Rigil Techno India(Distributor for M/s CYG Changtong New Material Co Ltd,China)



- d. M/s Shri Narayan Impac-India LLP

16.0 STUD BOLTS WITH NUTS

- a. Multi Thread Fasteners, Baroda
- b. Darukhanwala
- c. Precision Engineers, Baroda
- d. Unbrako
- e. TVC

17.0 WARNING MAT

- a. Sparco Multiplast Pvt. Ltd., Ahmedabad
- b. Singhal Industries , Ahemdabad
- c. Puja Packing, Mumbai
- d. Bina Enterprises, Mumbai
- e. Shree Vijay Wire & Cable Industries

18.0 HDPE PIPES/DUCT

- a. Climax Synthetics (P) Ltd., Vadodra
- b. Indian Poly Pipes, Calcutta
- c. Jain Irrigation Systems Ltd., Jalgaon
- d. Kirti Industries (India) Ltd., Indore
- e. Ori Plast Limited, Calcutta
- f. Phoel Industries Limited, Delhi
- g. Sangir Plastics (P) Ltd., Mumbai
- h. Veekay Plast,Jaipur
- i. Kisan Irrigation
- j. Dutron Polymers Ltd.
- k. Manikya Plastichem (P) Ltd
- l. Himalyan Pipe Industries
- m. NorthEast Polypipes LLP
- n. Mukand Poly Products (for Duct)

19.0 DRY GAS FILTER & FILTER SEPERATOR

- a. Grand Prix Fab (Pvt.) Ltd. (New Delhi)
- b. Perry Equipment, USA
- c. Faudi Filter, Germany



- d. Forain S.r.l., Italy
- e. ABB, Faridabad
- f. Burgess Manning, USA
- g. Multitex Filtration Engineers India
- h. Triveni Plenty Engg. Ltd. (New Delhi)
- i. Siirtec International Contractor S.P.A (Italy)
- j. Flashpoint, Pune india
- k. Filtration Engineers (I) Pvt Ltd, India
- l. Gujarat Otofilt, India
- m. Tormene Gas Technology
- n. Ultrafilter (India) Pvt Ltd, India
- o. Ravi Techno Systems Pvt Ltd, India
- p. Siirtec Nigi S.P.A
- q. Filtan Filter Anlagenbau GmbH
- r. Fairley Arlon BV
- s. PECO Facet
- t. EPE Epenstenner GMBH
- u. Filtrex srl
- v. Petromar Engineered Soln
- w. Plenty Filter
- x. Eurofiltec
- y. PTI Technologies Inc
- z. R S Instrumentation and Services

20.0 FILTER ELEMENT

- a. Peco – Facet
- b. Velcon
- c. Pall – Filterite
- d. Burgess Manning

21.0 NDT AGENCY

- a. NDT Services, Ahmedabad
- b. GEECY Industrial Services Pvt. Ltd., Mumbai
- c. Corrosion Control Services, Mumbai
- d. Perfect Metal Testing & Inspection Agency, Calcutta
- e. Inter Ocean Shipping Co., New Delhi



- f. RTD, Mumbai
- g. Sievert, Mumbai
- h. X-Tech, Vizag
- i. Industrial X Ray and Allied Radiographers (I) Pvt. Ltd.
- j. Inspection Technology
- k. IXAR
- l. Aditya NDT Services
- m. Riya NDT Engineers
- n. Star NDT Engineers
- o. Technical testing & Inspection Services
- p. PD Engineering Inspection Services

22.0 Cold Applied Tapes

- a. Denso GmbH
- b. Polyken (Berry Plastics Corporation)

22.1 End Seal Tape-PVC

- a. MAASH Industries

23.0 PUR Coating

- a. Powercrete (Berry Plastics Corporation)

24.0 Casing End Closure

- a. Raci, Italy
- b. Raychem RPG Limited

25.0 Casing Insulators

- a. Raci, Italy
- b. Raychem RPG Limited
- c. VeekayVikram

26.0 FIRE FIGHTING EQUIPMENT**26.1 FIRE EXTINGUISHERS**

- a. Avon Services (Production & Agencies) Pvt. Ltd., Bombay
- b. Kooverji Devshi & Co., Bombay



- c. Reliable (Fire Protection) India Ltd., Bombay
- d. Zenith Fire Services, Bombay
- e. Safex Fire Services, Bombay
- f. Brij Basi Hi
- g. tech Udyog
- h. Bharat Engg Works, India
- i. Gunnebo India Ltd
- j. Nitin Fire Protection Industries Ltd, India
- k. Supremex Equipments, India
- l. Vimal Fire Controls Pvt Ltd., India

26.2 FIRE HYDRANTS, MONITORS, DELUGE VALVE, NOZZLES

- a. Zenith
- b. Minimax
- c. Newage
- d. HD Fire
- e. Vijay Fire
- f. Asco Strumech Pvt Ltd, India
- g. Brij Basi Hi
- h. tech Udyog
- i. Gunnebo India Ltd
- j. Nitin Fire Protection Pvt Ltd
- k. Shah Bhogilal Jethamal & Brothers
- l. Venus Pumps & Engineering Works

26.3 RRL Hose

- a. Jayshree
- b. Newage

26.4 HOSES

- a. Ashit Sales Corporation, Bombay
- b. Royal India Corporation, Bombay
- c. Gayatri Industrial Corporation
- d. Simplex Rubber Products Ltd., Ahmedabad
- e. Zaverchand Marketing Pvt. Ltd., Baroda
- f. Presidency Rubber Mill, Calcutta
- g. The Cosmopolite, Calcutta



- h. Simplex Rubber Products, Thane

NOTE:

- 1) For procuring bought out items from vendors other than those listed above, the same may be acceptable subject to the following: -
 - a) The vendor/ supplier of bought out item(s) is a manufacturer/ supplier of said item(s) for intended services and the sizes being offered is in their regular manufacturing supply range.
 - b) The vendor / supplier should not be in the Holiday list of CLIENT / VCS / other PSU.
 - c) Should have supplied at least one single random length (i.e. 5.5 meters to 6.5 meters) for item assorted pipes / tubes and for other items, which are to be supplied in quantity on number-basis (other than assorted pipes / tubes) minimum 01 (One) number of same or higher in terms of size and rating as required for intended services. The bidder should enclose documentary evidences i.e. PO copies, Inspection Certificate etc. for the above, along with their bids.
- 2) For any other item(s) for which the vendor list is not provided, bidders can supply those item(s) from vendors/ suppliers who have earlier supplied same item(s) for the intended services in earlier projects and the item(s) offered is in their regular manufacturing/ supply range. The bidder is not required to enclose documentary evidences (PO copies, Inspection Certificate etc.) along with their offer, however in case of successful bidder, these documents shall require to be submitted by them within 30 days from date of Placement of Order for approval to CLIENT / VCS.
- 3) The details of vendors indicated in this list are based on the information available with VCS, Contractor shall verify capabilities of each vendor for producing the required quantity with. PMC does not guarantee any responsibility on the performance of the vendor. It is the contractor's responsibility to verify the correct status of vendor and quality control of each parties and also to expedite the material in time.

B. CIVIL AND STRUCTURAL

Sr. No.	Items/ Name of Products	Make/ Brands/ Manufactures
1.	Reinforcement Steel	TATA, SAIL, RINL, JSW.
2.	Cement	Ambuja, ACC, JK, Grasim, Ultratech, Birla, L&T, Cement Corporation of India
3.	Structural Steel	TATA, SAIL, RINL, IISCO, ESSAR
4.	Structural Steel Tubes ISI Marked	TATA, JINDAL, SURYA
5.	Mineral wool for thermal insulation of ceilings (Under deck insulation)	Rock wool (india) Ltd. Minwool Rock Fibres Ltd., Lloyd Insulation.
6.	Synthetic Enamel Paint (1st quality only)	ICI Paint (Dulux), Asian Paint (Apolite), Berger Paints (Luxol). Goodlass Nerolac Paints (Nerolac), Jenson & Nicholson Paints Ltd (Borolac)



ENERGISING QUALITY

LIST OF RECOMMENDED VENDORS FOR BOUGHT OUT ITEMS

DOC NO: VCS-00-00-VL-0001
Rev No : 14

7.	G.I SHEET	ESSAR, JSW, SAIL
8.	Sheeting Screw	Corroshield, Buildex,
9.	Chemical for Antitermite treatment	DE- NOCIL Bombay, Pest Control of India, Trishul
10.	Factory made Panelled Door shutter	Century; Godrej ; M/s Hindustan Housing factory Ltd., New Delhi ; M/s Delhi Construction Eqp, Sadar Bazar, Delhi ; M/s Joinery manufacturing Co., Calcutta;
11.	PVC Panel Door (Solid Core)	Rajshri Plastiwood Limited, Sintex, Hindopan, Marino
12.	Pressed steel door frames/ cupboard and window frames (manufacturers)	M/s SAIL, M/s TATA
13.	Pressed steel door frames/ cupboard and window frames (fabricators)	M/s Loyal safe works Mayapuri, N/Delhi M/s Multiwyn Industrial Corpn Calcutta M/s Metal Window Corpn N/Delhi M/s Chhabra Steel Udyog, 260 Sadar Bazar, Meerut Cantt. M/s Delite safe works, Rani Jhansi Road, N/Delhi
14.	Steel Windows, Ventilators (as per IS- 1038 of 1983) & frames pressed steel door/window	M/S Multiwyn Industrial Corpn, Calcutta ; M/S Metal Window Corp, N/ Delhi ; M/S Chhabra Steel Udyog 260, Sadar Bazar, Meerut Cantt ; Agent steel MFG Pvt Ltd, Ahmedabad ; Godrej ;
15.	AI Section for AI Door/ Window/ Partitions	Hindalco, Ajit India, Jindal
16.	AluminumI Door/ Window/ Glazing Fabricated and Anodized	M/s Alumilite Pvt Ltd, M/s Ajit India Pvt Ltd, M/s Ramniklal S Raste Agra, Argent Industries, M/s Aluminium Tech Industries, I-2249 DSIDC Narela, Delhi, M/s VR Associates, GH-14/242 Paschim Vihar, Delhi
17.	Aluminium door and windows Fittings	M/s Elite Enterprises C/6 Shalimar Hardware 133, Jarg Mahal, Dhobitalao Mumbai 400002. M/s Mohan Metal Industries 178/2-A, Bhole Nath Nagar, Shahadara, Delhi 110032. Mepro, Argent New Delhi, Classic, New Delhi. Jindal, Argent New Delhi, Golden Industries Pvt. Ltd. ECIE
18.	Aluminium Grill	Alu Grill, Arihant Aluminium Corporation, Decogrille
19.	Door Closer	Everite, Golden, Gandhi,
20.	Floor Spring	Prabhat, Everite
21.	Plywood for general purpose (IS-303)	National Plywood Inds Pvt Ltd, S Fancy lane, 8th floor, Calcutta-700001, Merino Plywood, Archid Ply, Ply, Swastik, Universal, Century, Greenply, National.
22.	Pre laminated Particle board	Kitply, Bhutan board, Ecoboard, Novapan, Archid ply, Merinova, Merino



ENERGISING QUALITY

LIST OF RECOMMENDED VENDORS FOR BOUGHT OUT ITEMS

DOC NO: VCS-00-00-VL-0001
Rev No : 14

23.	Laminated Sheets	Formica, Merino Lam, Greenlam, National, Century
24.	Modular Partitions	Godrej, Blowplast
25.	False Ceiling (Mineral Fibre Board)	Armstrong, Daiken, Luxalon, Llyods, Gypboard, Trac, Aerolite
26.	Aluminium False Ceiling	Lloyds, Armstrong, Luxlon, Trac
27.	Flooring Tiles (Mosaic / Terrazzo / PCC) (1st quality only)	Kajaria Ceramics, NITCO, Royal Tiles, Gem Tiles, Hindustan Tiles, M/S National Tiles & Industries, Ultra Tiles
28.	Glazed Ceramic Tiles, Non-Skid (Floor/Wall), (1st quality only)	Kajaria, Somany, NITCO. Murudeshwar Ceramic Ltd (Navin Diamond tile), Johnson (Marbonite),
29.	Vitrified/ Designer Vitrified Tiles (1st quality only)	Asian, Marbonite (Johnson), Kerrogres (Kajaria), NITCO, Orient
30.	PVC Tiles/Flooring (IS 3461) (1st quality only)	Marblex Tiles, Krishna Tiles, Polyfin, Armstrong, Wonder floor.
31.	False Flooring	Godrej or equivalent
32.	Glass Mosaic Tiles (1st quality only)	Paladio, Coral, Accura, Bisazza, Italia, Mridul.
33.	Designer Paver Tiles/ Interlocking tiles ISI marked/ Grass-jointed Tiles. (1st quality only)	Pavit, Ultra, Hindustan, Eurocon, Vyara, National Tiles, Gem, Unistone, Konkrete, Unitile
34.	Wall care Putty for Base preparation (1st quality only)	Birla Wall care putty, Berger, Jenson & Nicholson, JK White
35.	White Cement (1st quality only)	Birla, JK
36.	Cement based Paints (1st quality only)	Super Snowcem, Duracem, Super Acrocem.
37.	Dry Distemper / Oil bound Distemper (1st quality only)	Goodlass Nerolac Paint, Shalimar Paint, Jenson & Nicholson, Asian Paint, Berger. ICI Dulux
38.	Acrylic Washable Distemper (1st quality only)	Asian, Berger, ICI Dulux, Jenson & Nicholson, Nerolac, Shalimar, Garware & Goodlass
39.	Plastic Emulsion Paint (1st quality only)	Asian, Berger, ICI, Nerolac, Jenson & Nicholson, Shalimar, Garware & Goodlass
40.	Exterior Acrylic Emulsion (1st quality only)	ICI (Weathercoat), Excel (Nerolac), Apex (Asian), Berger, Jenson & Nicholson, Shalimar, Garware & Goodlass
41.	Polymer based Paint	STP, CICO
42.	Textured Paint / Wall Tile (1st quality only)	Unitile, Heritage, Spectrum, Iokos, Acropaints, Asian



ENERGISING QUALITY

LIST OF RECOMMENDED VENDORS FOR BOUGHT OUT ITEMS

DOC NO: VCS-00-00-VL-0001
Rev No : 14

43.	Flexible board for Expansion joint	STP or equivalent
44.	Grout	Shrinkomp, Fosroc, Fairmate
45.	Integral water proofing compound	STP, Pidilite, Fosroc, CICO, Sika.
46.	Concrete Admixture	Pidilite, Fosroc, CICO, Sika.
47.	Water proofing for cementations surface IS-2645	Acrocrete & Acrocote, CICO, Fosroc, STP
48.	Bituminous Product	M/s Faridabad Spinning & Woolen Mills Pvt Ltd, 837, SP Mukherjee Marg Delhi, M/s STP Ltd (Formerly Shalimar Tar Products) M/s Bitufelt Pvt Ltd 123/377 Fazalm Ganj Kanpur 208012, Texas, Texas India Ltd, Multiplas
49.	Hardeners	Ironite, Ferrok, Hardonate
50.	Construction Chemicals	Choksey, CICO, Forsroc, Sika
51.	Stainless Steel Cladding	Jindal
52.	Punch Tape Concertina Coil	Global Technocrat, S.G. Engineers Delhi
53.	Stainless Steel Railing	Jindal
54.	FRP/ HDPE Garbage Bins	Sintex, Swift, Nutech, Sheetal
55.	Sanitary ware	Neycer Kermag (standard), Hindustan Sanitary Ware (Ist quality), Parryware (superfine), Cera (Ist quality), Classica (Ist / standard)
56.	WC seat cover ISI Marked	Parryware, Neycer Kermag (standard), Hindustan Sanitary Ware (Ist quality), Cera (Ist quality), Classica (Ist / standard)
57.	PVC Flushing Cistern IS: 774-1984 (ISI Certified)	Parryware, Hindustan Sanitary Wares, Cera.
58.	Faucets & Taps, Stop Valves & Pillar Taps, Surgical basin mixer, Shower rose etc.	Gem, Parko, Parryware, HSW, Jaquar
59.	Kitchen Stainless Steel Sink	Diamond, Nirali, Neel Kanth, Jayna
60.	Looking Mirror	Saint Gobain, Modi Float, Triveni Float Glass, Crown, Atul.
61.	Readymade Bathroom Cabinets	Commander Gratings (I) Pvt Ltd, Gratolite Cabinet, A- 4 Sector Viii Noida-202701, Alpina, Cera.
62.	Float Valve	Leader, Bombay Metal & Alloy Co, Bombay superflow.
63.	SGSW Pipes (IS-651) ISI Marked	Perfect Agra, Devraj Ind Gaziabad, Buran, RK, Prince,

**LIST OF RECOMMENDED VENDORS FOR
BOUGHT OUT ITEMS****DOC NO: VCS-00-00-VL-0001**
Rev No : 14

64.	CI (Centrifugally Cast) Pipes for sewage disposal ISI marked	NICCO, SRIF, A-1 Singhal Casting Co Agra, Jindal Saw, Kesoram, NECO
65.	PVC rain water/sewage pipes (IS-4985)	Reliance, Finolex, Supreme, Kisan, Prince, Hindustan Plastic & machine corporation, Polypack industries (P) Ltd.
66.	HDPE Water storage tanks (Rotational Moulded)	Sintex, Swift, Nutech, Sheetal
67.	Cast Iron Pipes and Fittings	Hindustan Engineering Products Company Calcutta, S.L.C., Standard approved manufacturers of any other brand of fittings having ISI marking, RIF, BIS
68.	RCC Pipes	Indian Hume Pipe Company, Delhi / Allahabad / Chandigarh / Lucknow; Hindustan Pressure Pipes, Kolhapur; Dhere Concrete Products, Pune or any other approved manufacturer conforming B.I.S. Standard
69.	Brass Fittings	Leader Engineering Works, Jalandhar; L & K Mathura; Luster Sanitary, Jalandhar; Annapurna Metal Works, Calcutta; Neta Metal Works, Jalandhar
70.	C.P. Fittings	Ego Metal Works, Ballabhgarh; Jaquar Industries, Delhi; Soma Plumbing Fixtures Limited, Calcutta; Gem Sanitary Appliances Pvt. Ltd., Delhi; Essco Sanitations, Delhi.
71.	Stone Ware (Salt-Glazed) Pipes	Hind Ceramics Limited, Orissa; Ceramic Industries Limited, Sambalpur; Shrikamakshi Agencies, Madras; Binary Udyog Pvt. Limited, Howrah; Tirumati Moulds Limited, Nagpur.
72.	Asbestos Cement Pipes and Fittings	Ganga Asbestos Limited, U.P.; Hyderabad Asbestos Cement Products Limited; J.K. Super Pipe Industries, Nanded; Konark Cement and Asbestos Limited, Orissa; Maharashtra Asbestos Limited, Bombay.

List of Recommended Vender/Suppliers of Major Bought-Out Items: Unless otherwise specifically mentioned in the Schedule of Items, Contractor has to use materials as listed below, of only these brand names/Company's names, which are mentioned in the RECOMMENDED list for structural items thereon.

Sl. No.	Items/Name of Products	Makes/Brands/Manufactures
1	Structural Steel	SAIL / TATA / RINL / IISCO / ESSAR / ISPAT
2	Structural Steel Tubes ISI Marked	TATA / JINDAL / SURYA / SWASTIK
3	Synthetic Enamel Paint 1st Quality only	ICI Paint (Deluxe), Asian Paint (Apolite), Shalimar Paint (Superlac), Goodlass, Nerolac Paint (Nerolac), Berger Paints

Any materials not fully specified in these specifications and which may be offered for use in the works shall be subject to approval of Engineer, without which it shall not be used anywhere in the construction works.



ENERGISING QUALITY

LIST OF RECOMMENDED VENDORS FOR BOUGHT OUT ITEMS

DOC NO: VCS-00-00-VL-0001
Rev No : 14

C. ELECTRICAL

LIST OF SUPPLIERS OF MAJOR BOUGHT-OUT ITEMS

1.0 AIR CONDITIONER

- a. Blue Star
- b. O General.
- c. Daikin.
- d. Carrier
- e. Hitachi.
- f. LG.
- g. Lloyds
- h. Mitsubishi
- i. Panasonic
- j. Sharp
- k. Samsung.
- l. Blue star.
- m. Haier.
- n. Voltas.
- o. Videocon.

2.0 BATTERIES (LEAD ACID)

- a. Amco Batteries Ltd.
- b. Exide Industries Ltd.
- c. HBL Power System Ltd.
- d. Amara Raja Batteries Ltd.
- e. Su-Kam Power Systems Ltd.
- f. Base Corporation Ltd.
- g. Okaya Power Ltd.
- h. Southern Batteries Pvt Ltd.
- i. True Power International Ltd.
- j. Evolute Solutions Pvt Ltd.
- k. Greenvision Technologies Pvt Ltd.
- l. Artheon Electronics Ltd.

**3.0 BATTERIES (NICKEL CADMIUM)**

- a. Amco Saft Batteries Ltd.
- b. HBL Power Systems Ltd.

4.0 BATTERY CHARGER/DC-DC CONVERTER

- a. Amara Raja Power System(P)Ltd.
- b. BCH.
- c. Chhabi Electricals Pvt. Ltd..
- d. Caldyne Automatics Limited.
- e. HBL Nife Power Systems Ltd..
- f. Universal Instrument Mfg. Co Pvt Ltd.
- g. Hitachi HI-REL Power Electronics P. Ltd
- h. Mass-Tech Controls Pvt Ltd
- i. Dubas Engineering Pvt Ltd
- j. Chloride Power Systems & Solutions Ltd
- k. Synergee
- l. Enertech
- m. Vertiv

5.0 CABLE – FIRE ALARM & COMMUNICATION CABLES

- a. Cords Cable Industries Ltd.
- b. CMI.
- c. Delton cables Ltd.
- d. ELKAY Telcelinks.
- e. KEI Industries Ltd.
- f. Elkay Telcelinks

6.0 CABLE – HT(XLPE)

- a. Universal Cable Ltd.
- b. KEI Industries Ltd.
- c. Industrial Cables.
- d. NICCO Corporation Ltd.
- e. Uniflex.



- f. Polycab.
- g. Torrent cables Ltd.

7.0 CABLE – LT / MV POWER AND CONTROL

- a. Cords Cable Industries Ltd.
- b. Universal Cable Ltd.
- c. KEI Industries Ltd.
- d. Havells.
- e. Delton.
- f. Elkay Telelinks.
- g. Evershine Electricals.
- h. Ecko.
- i. Ravin.
- j. Rallison.
- k. Suyog.
- l. Netco.
- m. Uniflex.
- n. Paramount.
- o. Gloster.
- p. Associated cables Pvt Ltd.
- q. CMI.
- r. Gemscab.
- s. Industrial cables.
- t. NICCO.
- u. Polycab.
- v. Torrent.

8.0 CABLE – GLAND

- a. Baliga.
- b. Comet.
- c. Flexpro.
- d. Flameproof.
- e. FCG.
- f. Electro Werke.



- g. Dowels.
- h. CCI.
- i. Sudhir Switchgear
- j. Keyson Techno Equipments,
- k. RAY Flameproof Pvt Ltd

9.0 CABLE – LUGS & TERMINAL BLOCKS

- a. Dowels.
- b. Jainson.
- c. Sharma Electrical
- d. Punitam
- e. Yamuna Powers
- f. Rapid Manufacturer
- g. Varun Controls.

10.0 CABLE – TRAY

- a. Ercon Composites.
- b. Yamuna Power & Infrastructure Ltd.
- c. MEM
- d. Bharti
- e. Profab.
- f. Ratan.
- g. Slotco.

11.0 CABLE TERMINATION AND JOINTING KIT

- a. CCI.
- b. Raychem.
- c. M-Seal.

12.0 CEILING/EXHAUST/PEDESTAL FANS & CIRCULATORS

- a. Bajaj Electricals Ltd.
- b. Crompton Greaves Ltd.
- c. Khaitan Electricals Ltd.
- d. Havell's.



- e. Philips
- f. Usha
- g. Orient

13.0 CONTRACTORS – AC POWER

- a. Andrew Yule.
- b. ABB.
- c. BHEL.
- d. C&S.
- e. Havell's.
- f. L&T.
- g. Schneider.
- h. Siemens Ltd.
- i. Telemecanique.
- j. GE India Industrial

14.0 CONTROL TRANSFORMER

- a. AE.
- b. Indushree.
- c. Intra Vidyut.
- d. Kalpa Electricals.
- e. Transpower Industries Ltd.
- f. Siemens.

15.0 GAS GENERATOR/DIESEL GENERATOR SET

- a. Sterling and Wilson.
- b. Jackson Limited.
- c. Sudhir Gensets.
- d. Power Engineering (India) Pvt Ltd.
- e. Prasha Technologies Limited.
- f. Kumar Generator house.
- g. Ashok Leyland Ltd.
- h. Powerica Limited.



- i. Supernova Engineers Limited.
- j. Bhaskar Power Products (P) Ltd.
- k. Caterpillar India (P) Ltd.
- l. Cummins India Ltd.
- m. Escorts Ltd.
- n. Greaves Cotton Ltd.
- o. Kirloskar Ltd.
- p. Mahindra & Mahindra Ltd.
- q. Honda.
- r. Perkins.
- s. Eicher.
- t. Tata Motors.
- u. Ashok Leyland.

16.0 FLAME PROOF LDB'S/ JB'S/CONTROL STATION/ SWITCHES

- a. FCG.
- b. Sudhir switchgears.
- c. Prompt Engineering Works
- d. Flame Proof equipments pvt. Ltd.
- e. Baliga Lighting Equipments Pvt. Ltd.
- f. Flexpro Electricals Pvt. Ltd.
- g. Exprotecta, Beroda.
- h. FFLP Control Gears.
- i. Sterling.
- j. Kaysons Techno Equipment
- k. Bajaj
- l. Phoenix Contact
- m. RAY Flameproof Pvt Ltd

17.0 HIGH MAST

- a. Bajaj Electricals Limited.
- b. Crompton Greaves Limited.
- c. Philips India Limited.
- d. Surya Roshani.



- e. Transrail

18.0 HIGH VOLTAGE PCC/ MCC PANELS

- a. BHEL.
- b. Control and Switchgear.
- c. Siemens.
- d. Tricolite Electrical Industries.
- e. Schneider.
- f. CGL.
- g. L&T.
- h. ABB.

19.0 INDICATING LAMPS

- a. Alstom Ltd.
- b. BCH.
- c. L&T Ltd.
- d. Siemens Ltd.
- e. Vaishno Electricals.
- f. Tecknik
- g. ABB

20.0 INDICATING METERS

- a. L&T
- b. ABB.
- c. AMCO.
- d. AE
- e. Alstom Ltd. (EE).
- f. Conzerv/Schneider
- g. Elecon Measurement Pvt. Ltd.
- h. HPL Electric & Power Pvt. Ltd.
- i. MECO Instruments Ltd.
- j. Minilec.
- k. Rishabh Instruments Pvt. Ltd.



- l. Trinity energy system.
- m. Kaycee.
- n. Salzer.
- o. Trinity
- p. Secure Meters Limited

21.0 LIGHTING FIXTURES

- a. GE Lighting Pvt. Ltd.
- b. Bajaj Electricals Ltd.
- c. Crompton Greaves Ltd.
- d. Philips India Ltd.
- e. Havells
- f. Wipro
- g. Osram
- h. Siska
- i. Halonix
- j. Surya
- k. Polycab
- l. Kawlity Photonix

22.0 LIGHTING FIXTURES – FLAMEPROOF

- a. Bajaj Electricals Ltd.
- b. Baliga Lighting Equipment Pvt. Ltd.
- c. Crompton Greaves Ltd.
- d. CEAG Flameproof Controlgear Pvt. Ltd.
- e. Flexpro Electricals Pvt. Ltd.
- f. Philips India Ltd.
- g. Sudhir Switchgears Pvt. Ltd.
- h. FCG.

23.0 MINIATURE CIRCUIT BREAKERS (MCBS) AND LIGHTING DB

- a. ABB.
- b. Hagger.
- c. Havell's India Ltd.
- d. Indo Asian Fusegear Ltd.



- e. Legrand.
- f. MDS Switchgear Ltd.
- g. Schneider.
- h. Siemens Ltd..
- i. HPL.
- j. L & T
- k. Siemens

24.0 MOULDED CASE CIRCUIT BREAKER (MCCBS)

- l. ABB.
- m. Andrew Yule.
- n. Larsen & Toubro.
- o. Schneider.
- p. Siemens.
- q. Control and Switchgear.
- r. Indo Asian,
- s. Hager.
- t. Merlin Gerin.
- u. Havell's India Ltd
- v. General Electric

25.0 PROTECTION RELAYS

- a. BCH.
- b. L&T Ltd.
- c. Siemens Ltd.
- d. Tele-mechanique & Controls (India) Ltd.
- e. Eaton
- f. Alsthom
- g. ABB
- h. Ashida
- i. Novatek Electronics
- j. Cantronics
- k. Control & Switchgear
- l. Frick Electronics
- m. Indian Technologies



- n. Rao Electromechanical
- o. Kudam Corporation

26.0 LOW/MEDIUM VOLTAGE POWER CONTROL CENTER (PCC)/ MCC/ PDB/ MLDB/ LDB

- a. ABB.
- b. BCH.
- c. BHEL.
- d. C & S.
- e. Elecmech Switchgear & Instrumentation.
- f. KMG ATOZ.
- g. L&T.
- h. Pyrotech Electronics Pvt. Ltd.
- i. Risha Control Engineers Pvt. Ltd.
- j. UDKAM PROCESS EQUIPMENT INDIA PVT. LTD
- k. Tricolite Electrical Industries.
- l. Unilec Engineers Ltd.
- m. Vidyut Control India Pvt. Ltd.
- n. Control and Schematic.
- o. Zenith Engineering.
- p. Schneider Electric,
- q. AEG,
- r. HAVELL'S,
- s. MDS
- t. Synergy System
- u. Expert Engineers
- v. R K Engineering & Infrastructure

27.0 PUSH BUTTONS

- a. BCH.
- b. Alstom Ltd.
- c. L&T.
- d. Siemens Ltd.
- e. Tele-Menchanique & Controls (India) Ltd.
- f. Vaishno Electricals.

28.0 SWITCHES-CONTROL

- a. BCH.
- b. Easum Reyrolle Relays & Devices Ltd.
- c. Alstom.
- d. Kaycee Industries Ltd..
- e. L&T.
- f. Siemens Ltd.

29.0 SWITCHES – 5/15A PIANO/ PLATE, SWITCH SOCKET

- a. Anchor Electronics & Electricals Pvt. Ltd.
- b. Kingal Electricals Pvt. Ltd.
- c. North-West Switchgear Ltd.
- d. Schneider
- e. Havells
- f. Cona
- g. Orient
- h. Panasonic

30.0 SWITCH SOCKET OUTLETS (INDUSTRIAL)

- a. Alstom Ltd.
- b. Best & Crompton Engineering Ltd.
- c. BCH.
- d. Crompton Greaves Ltd.
- e. Essen Engineering Company Pvt. Ltd.

31.0 SOLAR POWER SYSTEM MODULES

- a. Tata Power Solar Systems Ltd
- b. REIL,
- c. CEIL,
- d. HBL Power.
- e. Vikram Solar.
- f. Waaree Solar.
- g. Solar Semiconductor.
- h. Sonali.



- i. Mundra Solar
- j. Vikram Solar
- k. Bharat Electronics Limited
- l. Waaree
- m. Lumipex
- n. Independent Qualitative Accessories
- o. Statcon Energy
- p. Volks Energy
- q. Green Engineering

32.0 SOLAR PCU/CHARGE CONTROLLER

- a. Statcon Energy
- b. Enertech UPS Pvt Ltd
- c. Consul Nowatt
- d. OPS India
- e. Schneider
- f. Delta Electronics
- g. ABB Ltd
- h. KACO
- i. SMA
- j. HBP Power
- k. Universal Instrument

33.0 TERMINALS BLOCKS

- a. Connectwell.
- b. Controls & Switchgear Co. Ltd.
- c. Elmex Controls Pvt. Ltd.
- d. Essen Engineering Co. Pvt. Ltd.
- e. Phoenix Contact

34.0 DISTRIBUTION TRANSFORMERS

- a. ABB.
- b. Andrew Yule.
- c. Areva.
- d. BHEL.



- e. Bharat Bijlee
- f. Crompton Greaves.
- g. EMCO Ltd.
- h. Intra Vidyut.
- i. Indushree.
- j. Indcoil
- k. Kirloskar.
- l. Skippers Electricals.
- m. Transformers & Rectifiers (I) Ltd.
- n. Voltamp.

35.0 UPS SYSTEM AND INVERTER

- a. DB Power.
- b. Keltron.
- c. Hi-Rel/HITACHI.
- d. Dubas.
- e. Toshiba Corporation.
- f. Fuzi Electric Co Ltd.
- g. Emerson.
- h. Synergy System.
- i. Eaton.
- j. Enertech

36.0 GI-OCTAGONAL POLE

- a. Bajaj.
- b. Transrail.
- c. Wipro.
- d. K.L. Industries.

37.0 ELECTRICAL MOTORS

- a. Siemens.
- b. Crompton Greaves.
- c. Kirloskar.
- d. BHEL.
- e. Bharat Bijlee.
- f. Hindustan motors.



- g. Alstom.
- h. Texmo.
- i. GE India.
- j. National Motors.
- k. ABB.

38.0 ELECTRICAL PROCESS HEATER

- a. Escorts Limited, Faridabad, Haryana.
- b. Spherehot / Kanti Lal Chuni Lal & Sons Appliances Pvt Ltd.Surat.
- c. Kerone, Bhayander(E), Thane – 401105.
- d. Excel Heaters, Andheri (West), Mumbai - 400 053, India.
- e. Nirmal Industrial Controls Pvt. Ltd., Mulund(W), Mumbai - 400 080.

39.0 CATHODIC PROTECTION AGENCIES/CONTRACTOR/ VENDERS

- a. CALTECH Engineering Service.
- b. Universal Corrosion Prevention India.
- c. Cathodic Technology Limited.
- d. Cathodic Control Company Pvt. Ltd.
- e. CORRTECH International Pvt Ltd.
- f. MITCORR Cathodic Protection Pvt Ltd.
- g. Underground Pipeline & NDTs Pvt. Ltd.
- h. JG Corrosion Solution.
- i. Mercury Cathodic Protection Service.
- j. UNDTs Corrosion Service.
- k. SARK EPC Projects Pvt. Ltd.

40.0 BACKUP AGENCY FOR INTERFERENCE SURVEY & MITIGATION

- a. PLE Germany
- b. Vendor Velde
- c. Nippon Japan
- d. SSS India CIPL / interference survey.
- e. Balslev Denmark, .
- f. SSS Germany
- g. Jef Techno Slutions Pvt. Ltd.
- h. SARK EPC Projects Pvt. Ltd.

41.0 PERMANENT REFERENCE CELL

- a. PERMACELL/ HARCO (USA)
- b. CORRTECH (ZULU), INDIA
- c. TINKER RASOR, USA
- d. SILVION, UK

42.0 CP CABLES

- a. Brooks Cables.
- b. Nicco Corporation Ltd.
- c. CCI Ltd.
- d. Delton Cables Ltd.
- e. KEI Industries.
- f. Torrent Cables.
- g. Universal cables.
- h. Victor Cables.
- i. Associated Flexible & Wires Pvt Ltd.
- j. Asain Cables (RPG Cables).
- k. Fort Gloster (Gloster Cables Ltd).
- l. Finolex Cable.
- m. Rediant Cables.
- n. NETCO Cables Pvt Ltd.
- o. Havells Ltd.

43.0 CP SACRIFICIAL ANODES

- a. Scientific Metals Engineers Pvt. Ltd., Karaikudi
- b. PSL Holding Pvt. Ltd., Mumbai.
- c. Cathodic Controls, Bangalore.
- d. BHEL, Bhopal.
- e. Nippon Corrosion, Japan.
- f. AFIC, KSA.
- g. Platt Bros. and Company, USA
- h. Wilson Walton International.
- i. Impalloy International.



- j. Corrpro International.
- k. HOCKWAY, UK
- l. NAKABOHTEC, Japan .
- m. Cortech International
- n. Titanor Component
- o. Shakti Metals, Ahmedabad
- p. Shaktianodes Private Limited, Ahmedabad

44.0 CP PORTABLE /PERMANENT REFERENCE CELL

- a. M/S PERMACELL/HARCO, USA
- b. M/S BORIN MANUFACTURER, USA
- c. M/S M.C.MILLER, USA
- d. M/S TINKER RASOR

45.0 CPTR (AC OPERATED)

- a. Canara Electric
- b. CATHODIC CONTROL COMPANY PVT LTD.
- c. Kriston Systems

46.0 PIN BRAZING / THERMITWELD

- a. SAFETRACK, SWEDEN
- b. CadWeld
- c. BAC, UK
- d. ERICO, USA
- e. THERMOWELD, USA
- f. ERICO, EUROPE

47.0 CP SURGE DIVERTER/SPARK GAP ARRESTOR (EX-D)

- a. Dhen,
- b. OBO
- c. Corrpro system
- d. Sohne
- e. Dairyland

48.0 CP SOLID STATE POLARISATION CELL.

- a. Dairyland
- b. Metricorr
- c. Rustol



- d. Dhen
- e. Kriston Systems

49.0 PETROLEUM COKE BREEZE:

- a. M/S LORESCO, USA
- b. M/S ASBURY, USA
- c. M/S GOA CARBON, GOA
- d. M/S INDIA CARBON, CALCUTTA
- e. M/S PETROCARBON & CHEMICAL COMPANY, HALDIA

50.0 CP ANODE (MMO TYPE):

- a. Corrttech
- b. Scientific Metal Engineers Karaikudi
- c. Titanor Component Ltd., Goa, India.
- d. Denora Permelic S.P.A (Italy).
- e. Oronzio De Nora S.A. Ingano Switzerland
- f. CER Anode Technologies International USA
- g. ACTEL, UK
- h. ELTECH System Corporation, Texas
- i. MAGNETO-CHEMIE, Netherlands
- j. MATCOR (USA)

51.0 HEAT SHRINK CAP FOR CP ANODE

- a. MATCOR (USA) To Cable Joint
- b. Seal For Life

**52.0 ER- PROBE (EXTERNAL CORROSION) ER- PROBE & CORROSION
COUPON ASSEMBLY**

- a. Rose Corrosion Services UK
- b. Metal Samples, USA.
- c. Roharbak Cosasco USA
- d. Caproco UK
- e. Emetricorr, Denmark

53.0 HEAT SHRINK CAP FOR ANODE TO CABLE JOINT

- a. Raychem, USA
- b. Matcor (USA)

54.0 MMO WIRE ANODES (WITH FACTORY PRE-PACKED COKE BREEZE)

- a. Matcor (USA)
- b. Covalence (USA)
- c. Berry Plastics (USA) – (Seal for Life Industries)

55.0 MMO WIRE ANODES (WITHOUT FACTORY PRE-PACKED COKE BREEZE)

- a. GROUPPO DENORA, GOA, INDIA
- b. CERANODE TECHNOLOGIES, USA
- c. TELPRO, USA

56.0 MMO TUBULAR/ STRIP/ RIBBON ANODES

- a. GROUPPO DENORA, GOA, INDIA
- b. ORANZIO DE NORA, ITALY
- c. MAGNETOCHEMIE, HOLLAND
- d. ACTEL LTD., U.K.
- e. ELTECH SYSTEMS CORPORATION, USA
- f. CERANODE TECHNOLOGIES, USA
- g. MATCOR (USA)

Note: -

For any other brought out item(s) for which the vendor list is not provided in the tender , bidders can supply those item(s) from vendors/ suppliers who have earlier supplied similar item(s) for the intended services in earlier Oil and Gas projects and the item(s) offered is in their regular manufacturing/ supply range.

- 1) The vendor/supplier should not be in the Holiday list of OWNER/ CONSULTANT/other PSU
- 2) The bidder is not required to enclose documentary evidences (PO copies, Inspection & Completion with satisfactory working certificates etc.) along with their offer, however in case of successful bidder, these documents shall required to be submitted by them within 30 days from date of Placement of Order for approval to OWNER / CONSULTANT.

D. INSTRUMENTATION

LIST OF RECOMMENDED VENDER/SUPPLIERS OF MAJOR BOUGHT- OUT ITEMS

1.0 PRESSURE GAUGES

- a. AN Instruments Pvt Ltd
- b. Badotherm Process Instruments B.V.
- c. Baumer Bourdon Haenni S.A.S
- d. British Rototherm Co Ltd
- e. Budenberg Gauge Co Ltd
- f. Dresser Inc
- g. Forbes Marshall (Hyd) Pvt Ltd
- h. General Instrument Consortium
- i. H. Guru Instruments (South India) Pvt Ltd
- j. Manometer (India) Pvt Ltd
- k. Nagano Keiki Seisakusho Ltd
- l. Hirlekar Precision, India
- m. Waaree Instruments Ltd
- n. Walchandnagar Industries Ltd (Tiwac Divn)
- o. Wika Alexander Wiegand & Co GmbH
- p. Wika Instruments India Pvt Ltd
- q. Ashcroft India Pvt Ltd.
- r. ITEC Measures Pvt Ltd

2.0 TEMPERATURE GAUGES

- a. AN Instruments Pvt Ltd.
- b. Badotherm Process Instruments B.V.
- c. Bourdon Haenni S.A.
- d. Dresser Inc.
- e. General Instruments Consortium
- f. H. Guru Instruments (South India) Pvt Ltd



- g. Nagano Keiki Seisakusho Ltd
- h. Solartron ISA
- i. Walchandnagar Industries Ltd (Tiwac Divn)
- j. Wika Alexander Wiegand & Co GmbH
- k. Wika Instruments India Pvt Ltd
- l. Pyro Electric, Goa
- m. Ashcroft India Pvt Ltd.
- n. ITEC Measures Pvt Ltd

3.0 TEMPERATURE ELEMENTS INCLUDING SKIN TYPE

- a. ABB Automation Ltd
- b. Altop Industries Ltd
- c. Bourdon Haenni S.A.
- d. Detriv Instrumentation & Electronics Ltd
- e. General Instruments Consortium
- f. Japan Thermowell Co Ltd
- g. Tecnomatic S.P.A
- h. Tempsen Instrument India Ltd
- i. Thermo Electric Co. Inc.
- j. Thermo-Couple Products Co
- k. Thermo-Electra B.V.
- l. Wika Alexander Wiegand & Co GmbH
- m. Altop Industries Ltd., Baroda
- n. Nagman Sensors (Pvt.) Ltd.
- o. Pyro Electric, Goa
- p. ITEC Measures Pvt Ltd

4.0 POSITIVE DISPLACEMENT FLOW METERS

- a. RMG (Germany)
- b. Elster Instromet
- c. Romet
- d. Dresser
- e. Itron
- f. FMG
- g. Common



- h. Metreg
- i. Raychem RPG
- j. Vemmtec

5.0 TURBINE FLOW METER

- a. Daniel
- b. Elster Instromet
- c. Itron
- d. RMG
- e. Rockwin

6.0 ELECTRONIC VOLUME CORRECTOR

- a. Elgas
- b. Itron
- c. Plum
- d. Pietro Fiorentini

7.0 ORIFICES (METER RUN, FLOW CONDITIONER, ORIFICE PLATE AND ASSEMBLY)

- a. Emerson
- b. FMC, USA
- c. Pietro Fiorentini S.P.A (Italy)
- d. Canalta Controls, Canada

8.0 ULTRASONIC FLOW METERS

- a. Daniel (USA)
- b. RMG (Germany)
- c. Instromet International (Belgium)
- d. Sick Maihak, Germany
- e. FMC, Germany

9.0 MASS FLOW METERS

- a. Daniel Measurement & Control Asia Pacific
- b. Endress + Hauser Instruments International



- c. FMC Measurements Solutions
- d. Heinrichs Messtechnik GMBH
- e. Rheonik MessGerate GMBH

10.0 FIELD INSTRUMENTS (P, DP, F, L, T)

- a. ABB Ltd
- b. Honeywell
- c. Fuji Electric Instruments Co Ltd
- d. Yokogawa
- e. Invensys India Pvt.Ltd

11.0 LEVEL GAUGES/ LEVEL INSTRUMENTS

- a. Bliss Anand
- b. Chemtrols
- c. V-Automat
- d. Levcon
- e. Nivo Controls
- f. Sbeletro Mechanicals
- g. TRAC

12.0 PRESSURE REGULATOR AND SLAM SHUT VALVE

- a. Pietro Fiorentini S.P.A. (Italy)
- b. Emerson
- c. RMG-Regel Messtechnik (Germany)
- d. Mokveld Valves BV (Netherlands)
- e. Schlumberger (USA)
- f. Gorter Controls B V (Netherlands)
- g. Instromet International NV
- h. Nirmal Industrial Controls Pvt Ltd. (up to 6" size only)
- i. ESME Valves Ltd
- j. Kaye & Macdonald Inc.



- k. Nuovo Pignone S.P.A (Italy) (GE Oil Co.)
- l. Richards Industries (Formerly Treloar)
- m. Samson AG Mess-und Regeltechnik
- n. Tormene Gas Technology
- o. Dresser Inc, USA (upto 8" size, 300# class only)

13.0 PRESSURE SAFETY VALVES

- a. Keystone Valves (India) Pvt. Ltd.
- b. Larson & Toubro Ltd.
- c. Lesser GmbH & Co KG
- d. Mekaster Engg Ltd..
- e. Tyco Sanmar Ltd. (New Delhi)
- f. Anderson Greenwood Crosby
- g. BHEL (Trichy)
- h. Curtiss Wright Flow Control Corporation
- i. Dresser Inc.
- j. Fukui Seisakusho Co. Ltd
- k. Nakakita Seisakusho Co Ltd
- l. Nuovo Pignone S.P.A (Italy) (GE Oil co)
- m. Parcol S.P.A
- n. Safety Systems UK Ltd
- o. Tai Milano S.P.A
- p. Weir Valves & Controls France
- q. Bliss Anand Pvt Ltd.

14.0 CONTROL PANEL & ACCESSORIES

- a. Keltron Controls Ltd., Kerala
- b. Elechmec Corporation Ltd., Mumbai
- c. Industrial Controls & Appliances Pvt. Ltd.,
- d. Alstom System Ltd., Noida
- e. Emerson Process Management (I) Pvt. Ltd.
- f. ABB Instruments Ltd., New Delhi
- g. Larsen & Toubro Ltd.
- h. Control & Automation, New Delhi
- i. GE Fanuc Systems Pvt. Ltd., New Delhi
- j. Rockwell Automation (I) Ltd., Ghaziabad



- k. Honeywell Automation Ltd.
- l. Rittal
- m. Pyrotech Elcronics Pvt Ltd.
- n. Positronics Pvt Ltd.
- o. Electronics Corporation of India Ltd.
- p. Phoenix Contact (I) Pvt. Ltd

15.0 JUNCTION BOXES AND CABLES GLANDS

- a. Ex-Protecta
- b. Flameproof Control Gears
- c. Baliga
- d. Flexpro Electricals
- e. RAY Flameproof Pvt Ltd (Flameproof Weatherproof)

16.0 CONTROL AND SIGNAL CABLES

- a. Associated Cables
- b. Brook
- c. Associated Flexibles & Wires (Pvt) Ltd
- d. Universal Cables Ltd, India
- e. Delton Cables Ltd, India
- f. KEI Industries Ltd INDIA
- g. CMI Limited
- h. Cords Cable Industries Ltd, India
- i. Elkay Telelinks (P) Ltd., India
- j. Udey Pyrocables Pvt Ltd, India
- k. Goyolene Fibres (I) Pvt Ltd, India
- l. Netco Cable Industries Pvt Ltd, India
- m. Nicco Corporation Ltd, India
- n. Paramount Communications Ltd, India
- o. Polycab Wires Pvt Ltd, India
- p. Radiant Cables Pvt Ltd, India
- q. Reliance Engineers Ltd., India
- r. Suyog Electricals Ltd, India
- s. Thermo Cables Ltd

**17.0 GAS DETECTION SYSTEM**

- a. Crowcon Detection Instruments Ltd
- b. Detection Instruments (I) Pvt Ltd
- c. Detector Electronics Corporation
- d. Drager Safety AG & Co. KGAA
- e. General Monitors Ireland Ltd
- f. Mine Safety Appliances Company
- g. MSA – Mines Safety Appliances(India) Ltd
- h. Industrial Scientific Oldham France S.A.
- i. Riken Keiki Co Ltd
- j. Simrad Optronics Icare
- k. Honeywell Analytics
- l. Net Safety Monitoring Inc.
- m. Simtronics SAS
- n. Pollution Protection Systems Mumbai Pvt Ltd

18.0 MOV ACTUATOR:

- a. Rotork- UK, USA & INDIA
- b. Limitorque
- c. Auma- India
- d. Biffi- Italy

19.0 PNEUMATIC ACTUATOR (SOLENOID OPERATED ON-OFF TYPE)

- a. Metso Automation
- b. Tyco
- c. Samson Controls
- d. L&T
- e. Emerson
- f. Fisher
- g. Masoneilan Process Control
- h. Instrumentation Limited (IL)-Palghat
- i. Micro Finish
- j. Rotex

20.0 SOLENOID VALVES



- a. Avcon
- b. Festo

21.0 ELECTRO – HYDRAULIC ACTUATOR

- a. Avcon Rotork controls (Deutschland Gmbh)
- b. Biffi Italia Srl
- c. Ledeen (Italy)
- d. Virgo Valves and Controls Ltd.-India
- e. Limittorque
- f. Reineke
- g. Voith
- h. Bettis
- i. Rotork- UK, USA & INDIA
- j. Rotex
- k. Schuck Group

22.0 GAS OVER OIL ACTUATOR

- a. Biffi Italia Srl,
- b. Ledeen(Italy)
- c. Virgo Valves & Control Ltd.-India,
- d. Voith,
- e. Bettis,
- f. Rotork-UK, USA, India,
- g. Rotex,
- h. Schuck Group,
- i. Valve Italia.

23.0 OFC

Manufacture/ Procurement, Testing and supply of suitable OFC Joint closures including all necessary accessories of any of the following make:

- a. Raychem
- b. 3M
- c. Siemens
- d. Any other make from the approved vendor list of client with supporting paper.

**24.0 FLOW CONTROL VALVES**

- a. Fouress Engg. (New Delhi)
- b. Fisher Xomox (New Delhi)
- c. MIL Control Ltd. (Noida)
- d. KOSO India Pvt Ltd
- e. Samson Control (Thane)
- f. Dresser Valves India Pvt Ltd.
- g. Fisher Controls
- h. Valvitalia Italy
- i. CCI Valve technology
- j. Flowserve Pvt Ltd.
- k. Metso Singapore Pvt Ltd.
- l. Instrumentation Ltd Palghat
- m. Dresser Inc. USA

25.0 FLOW COMPUTERS

- a. Emerson
- b. Instromet International (Belgium)
- c. FMC Measurement Solutions (UK)
- d. RMG (Germany)
- e. OMNI Flow Computers Inc.
- f. Thermo Fisher, USA

26.0 INDICATORS & CONTROLLERS

- a. Yokogawa
- b. Eurotherm Chessel
- c. Honeywell
- d. Emerson

27.0 BARRIERS

- a. MTL
- b. STHAL
- c. P&F
- d. Phoenix Contact (I) Pvt. Ltd.

28.0 GAS CHROMATOGRAPH

- a. ABB



- b. Emerson
- c. Instromet International, NV
- d. RMG Regal+Messtechnik GmbH
- e. Yokogawa

29.0 I/P CONVERTERS

- a. ABB
- b. Emerson
- c. IMI Watson Smith Ltd.
- d. Moore Controls Ltd
- e. Shreyas Instruments Pvt Ltd, India
- f. Thermo Brandt Instruments

30.0 SS FITTINGS, INSTRUMENT VALVES & MANIFOLDS**30.1 FOR CNG WORK:**

- a. DK-LOK
- b. Swagelok Co.
- c. Parker
- d. Dawsons Tech Components LLP
- e. ASTEC Valves & Fittings Pvt Ltd
- f. Thomas & Brian Mfg. Pvt. Ltd

30.2 EXCEPT CNG WORK:

- a. Swagelok Co.
- b. Parker
- c. Aura INC.
- d. HOKE
- e. Excelsior Engineering works
- f. Swastik Engineering works India
- g. Comfit and valves pvt ltd
- h. Arya craft and engineering Pvt Ltd
- i. DK lok
- j. ASTEC Valves & Fittings Pvt Ltd
- k. Dawsons Tech Components LLP

31.0 SS TUBES



ENERGISING QUALITY

LIST OF RECOMMENDED VENDORS FOR BOUGHT OUT ITEMS

DOC NO: VCS-00-00-VL-0001
Rev No : 14

31.1 FOR CNG WORK:

- a. Swagelok Co.
- b. Parker
- c. Sandvik
- d. Jindal Saw
- e. Tubacex Tubes and Pipes Private Ltd
- f. Krystal Global Engineering Ltd.

31.2 EXCEPT CNG WORK:

- a. Swagelok Co.
- b. Parker
- c. Sandvik
- d. Heavy metal and tube limited
- e. Nuclear fuel complex India
- f. Scorodite
- g. Ratnamani Metals and Tubes
- h. Jindal Saw

E. SHOP & FIELD PAINTING

LIST OF RECOMMENDED VENDER/SUPPLIERS OF MAJOR BOUGHT-OUT ITEMS

1.0 INDIAN VENDORS

- a. Asian Paints (I) Ltd.
- b. Berger Paints Ltd.
- c. Goodlass Nerlolac Paints Ltd.
- d. Jenson And Nicholson Paint Ltd & chokuGu Jenson & Nicholson Ltd.
- e. Shalimar Paints Ltd.
- f. Sigma Coating, Mumabai
- g. CDC Carboline Ltd.
- h. Premier Products Ltd.
- i. Coromandel Paints & Chemicals Ltd.
- j. Anupam Enterprises
- k. Grand Polycoats
- l. Bombay Paints Ltd.
- m. Vanaprabha Esters & Glycer, Mumbai
- n. Sunil Paints and Varnishes Pvt. Ltd.
- o. Courtaulds Coating & Sealants India (Pvt.) Ltd.
- p. Mark-chem Incorporated, Mumbai (for phosphating chemicals only)
- q. VCM Polyurethane Paint (for polyurethane Paint only)

2.0 FOREIGN VENDORS FOR OVERSEAS PRODUCTS

- a. Sigma Coating, Singapore
- b. Ameron, USA
- c. Kansai Paint, Japan
- d. Hempel Paint, USA
- e. Valspar Corporation, USA
- f. Courtaulds Coating, UK.



ENERGISING QUALITY

LIST OF RECOMMENDED VENDORS FOR BOUGHT OUT ITEMS

DOC NO: VCS-00-00-VL-0001
Rev No : 14

Notes:

1. Bidder can select equipment of two different makes, selected from this VENDOR LIST and mention the same in the checklist for technical evaluation attached with the tender. The offered bid must include filled datasheet indicating make, model, size, rating of offered instrument/ equipment duly supported by sizing calculation of offered equipment (wherever applicable).
2. Vendors who have already supplied above equipment in other terminals of client, shall also be considered qualified for this tender provided the supplied equipment are commissioned and running successfully and they have not been put on holiday.
3. Equipment / Instruments of any make which is offered by one bidder and acceptable to client shall be accepted for other bidder also. After placement of order, on request of the successful bidder list of other qualified makes for a particular item (for which successful bidder wants to change the vendor) shall be provided.
4. Bidder shall take prior approval of the make / model no of the offered item and it shall be from the list given above. However additional vendors will be considered in exceptional cases, provided they have supplied for similar application to reputed gas transmission/distribution companies, in quantities at least half the numbers being supplied for this tender, and working satisfactorily for minimum 6 months. Documentary evidence substantiating above shall be submitted for taking approval.

F. FOR PE & LMC WORK (GI/CU)

1.0 MDPE PIPE

- a. Mukand Poly Products,
- b. Dewa Polymers Pvt. Ltd.

2.0 MDPE FITTINGS & MDPE VALVES

- c. Aliaxis,
- d. George Fischer,
- e. Al-Aziz,
- f. Kimplas,
- g. Banides,
- h. Agru,
- i. Friatech,
- j. Plasson

3.0 GI PIPE

- a. Swastik Pipe Ltd.
- b. Jindal Industries Ltd.
- c. Vishal Pipes Ltd.
- d. Indus Tubes Ltd
- e. Advance steel Tubes Ltd.
- f. Good Luck Tubes Ltd.
- g. Surya Roshni Limited
- h. APL Apollo Tubes Limited
- i. Jindal Pipes Limited
- j. RK Steel Manufacturing Company Private Limited
- k. PSL Tubes Limited

4.0 CASTING GI FITTINGS

- a. Sarin Industries Ltd.
- b. Jupiter Metal Industries Ltd.
- c. Jainsons Industries Ltd.
- d. Jinan Meide Casting Co. Ltd.
- e. Green Malleable Pvt. Ltd.
- f. Chandan Enterprises
- g. Unique Pipe Fitting Co

**5.0 FORGED GI FITTING (FOR HIGH RISE SEGMENT)**

- a. Jainsons Industries
- b. B.M. Meters Pvt. Ltd.

6.0 COPPER TUBES & FITTINGS

- a. Jay Banas Mehta Tubes Limited- Trade Mark "MEXFLOW"
- b. Rajco metal (Tubes & Fittings)
- c. Paras Industries
- d. MERCURE METAL & ALLOYS PVT LTD
- e. Chandan Enterprises (Fittings only)

7.0 BRASS VALVES

- a. Universal srl, Italy
- b. Tiemme Raccorderie Sede, Italy
- c. Enolgas Bonimu s.a.s., Italy
- d. Fratelli Fortis s.r.l, Italy
- e. Giacomo Climbrio, Italy
- f. Parker Hannifin S.P.A., USA
- g. Singapore Valve & Amp; Fittings Pte Limited, Singapore /Bengaluru
- h. Rubinetterie Utensilerie Bonomi (RUB), Italy
- i. Zhegiang Valogin Technology Co. Ltd., China,
- j. Ningbo Zhiqing Industrial Co. Ltd., China,
- k. Zhegiang Dunan Valve Co. Ltd.,
- l. Ningbo Huaping, China.
- m. Chandan Enterprises

8.0 Isolation & Appliance valves

- a. Chandan Enterprises

9.0 BRASS FITTINGS

- a. Chandan Enterprises
- b. Paras Industries Ltd.
- c. Chokhawala Distributors – Brass Adaptor.

10.0 STEEL RE-INFORCED RUBBER HOSE (TYPE-4)

- a. Super Seal Flexible Hose Ltd.



- b. Suraksha Products Pvt. Ltd.
- c. Vansh Industries
- d. T & L Gases

11.0 CORRUGATED FLEXIBLE METAL HOSES (ANACONDA)

- a. KPC Flex Tubes
- b. Vestas Hose Division
- c. Alpha Flexi Tubes
- d. Chandan Enterprises

Note:

1. Vendor may procure material from any of approved vendors listed.
2. For equipment/components other than the above, vendor shall submit past track record for the proposed sub-vendors and obtain written approval from Owner / Consultant before placing order.
3. In case of exigencies like long delivery periods from approved vendors, the contractor shall list down the proposed suppliers/vendors for such items and submit the same for owner review/approval along with necessary documents/PTR.
4. Non-acceptance of a particular proposed vendor due to any reasons whatsoever shall not be a cause of schedule and cost implication. If equipment is sourced from outside India, vendor shall obtain prior approval for make of equipment before placement of order.

Above mentioned vendor list is tentative and further addition/deletion may be done as per discretion of Owner/VCS.



Energising Quality

LIST OF AUTHORIZED THIRD-PARTY INSPECTION AGENCY (TPIA)

DOC. NO.- VCS-C&P-TPIA-001

SL. NO.	NAME OF TPIA
1	Det Norske Veritas (DNV)
2	Germanischer Lloyd Industrial Services GmbH
3	Bureau Veritas (India) Pvt. Ltd.
4	Moody International (India) Pvt. Ltd. (Industry Services Division)
5	SGS India Pvt. Ltd.
6	Certification Engineer International Limited (CEIL)
7	TÜV SÜD South Asia Pvt. Ltd.
8	ABS Industrial Verification (India) Pvt. Ltd.
9	Lloyd Register of Industrial Services
10	IRCLASS Systems and Solutions Private Limited
11	Tata Projects Limited
12	International Certification Services Pvt. Ltd.
13	TUV India Pvt. Ltd., Industrial Services Division
14	Intertek India Pvt. Ltd. (Industry Services Division)
15	Quality Austria Central Asia Pvt. Ltd.
16	Edlipse Engineering Global Pvt. Ltd.
17	TUV-Rheinland

Digitally signed by RAMAKANT
TIWARI
Date: 2025.10.13 18:20:32 IST

VOLUME B (CIVIL)



Energising Quality

VCS Quality Services Pvt Ltd

**STANDARD SPECIFICATION
FOR
EARTHWORK IN SITE GRADING**

VCS-SS-CS-6002

					
03	31.01.2022	NV	GDS	HK	GW
02	14.02.2020	NV	GDS	RKB	SK
01	16.10.2019	MA	MO	AD	SK
00	05.07.2017	MA	MO	AD	SK
Rev. No	Date	Prepared By	Checked By	Approved By	Authorized By

UNCONTROLLED COPY : If printed

CONTROLLED COPY : If in soft and signed



Energising Quality

**STANDARD SPECIFICATION
FOR EARTHWORK IN SITE GRADING**

**DOC NO: VCS-SS-CS-6002
Rev No : 03**

REVISION RECORD						
Rev.	Revision Date	Prepared by	Checked by	Approved by	Authorized by	Revision Description
00	05.07.2017	MA	MO	RKB	AD	Issued for use as Standard
01	16.10.2019	MA	MO	RKB	AD	
02	14.02.2020	NV	GDS	RKB	SK	New revision system updated
03	31.01.2022	NV	GDS	HK	GW	VCS QMS Integration



Energising Quality

**STANDARD SPECIFICATION
FOR EARTHWORK IN SITE GRADING**

**DOC NO: VCS-SS-CS-6002
Rev No : 03**

ABBREVIATION

m	Metre
Mm	Millimetre
IS	Indian Standard
m ²	Square metre
GPS	Global Positioning System
VCS	VCS Quality Services Pvt Ltd



CONTENTS

1.0	SCOPE	5
2.0	REFERENCES	5
3.0	GENERAL	5
4.0	MATERIAL FOR EARTHWORK	5
5.0	CUTTING TREES	6
6.0	CLEANING AND STRIPPING	6
7.0	EARTHWORK IN EXCAVATION/CUTTING	7
8.0	EARTHWORK IN FILLING.....	8
9.0	REMOVAL OF SURPLUS EARTH.....	10
10.0	EXCAVATION IN ROCK	10



1.0 SCOPE

This specification and the method of measurements described thereon are applicable for earthwork involved in Site Grading & Rock Cutting

2.0 REFERENCES

2.1 BIS CODES

IS: 2720 Part IV - Methods of tests for soils, Part-V- Grain size Analysis

IS: 2720 Part V - Methods of tests for soils, Part 5- Determination of liquid & plastic limit.

IS: 2720 Part VI - Methods of tests for soils, Part 6- Determination of shrinkage factors.

IS: 2720 Part VII - Methods of tests for soils, Part 7- Determination of water content dry density relation using light compaction.

2.2 VCS SPECIFICATIONS

VCS-SS-CS-6003 Earthwork for underground piping

VCS-SS-CS-6022 Earthwork in Foundations

NOTE: - Latest Edition of all Codes and Standards shall be followed.

3.0 GENERAL

3.1 CONTRACTOR shall maintain adequate drainage facilities at SITE at all times during the execution of work. Additional ditches, drains & such other temporary means to achieve this, over and above what is shown in the drawings, shall be provided and maintained by CONTRACTOR at his own cost.

3.2 Adequate dewatering facilities like dewatering pumps and piping etc. shall also be provided by the CONTRACTOR for this work, including dewatering during excavation etc. as required, at his own cost.

4.0 MATERIAL FOR EARTHWORK

4.1 Only soil considered suitable by the Engineer-in-charge shall be deployed for the construction and that considered unsuitable shall be disposed off, as directed by Engineer-in-charge, at his own cost and no claim for compensation will be entertained.

4.2 The CONTRACTOR shall give the samples of soil he proposes to use for filling, along with the following characteristics of the samples, to Engineer-in-charge for approval, prior to collection and use. The tests for these characteristics shall be done in a laboratory / test house as approved by Engineer-in-charge.

a. Mechanical analysis or grain size analysis as per IS: 2720 Part IV.



- b. Liquid limit as per IS: 2720 Part V.
 - c. Plastic limit as per IS: 2720 Part V.
 - d. Determination of Shrinkage limit factors as per IS: 2720 Part VI.
 - e. Determination of water content dry density relation using light compaction as per IS: 2720 Part VII.
- 4.3 The soil used for filling shall be free from boulders, lumps, tree roots, rubbish or any organic deleterious matter.
- 4.4 Soil having plasticity index less than 20 shall be used for filling purpose.
- 4.5 Soil having laboratory maximum dry density of less than 1.5 gm/cc shall not be used.
- 4.6 Care shall be taken to see that unsuitable waste material is disposed off in such a manner that there is no likelihood of its getting mixed with the material, proposed to be used, for filling.
- 4.7 The work shall be so planned and executed that the best available soil is reserved for the top portion of Embankments.

5.0 CUTTING TREES

- 5.1 All trees having girth above 30 cms, which are not marked for preservation, shall be cut down and their roots dug up to a depth of 1 metre from the existing ground level.
- 5.2 All holes or hollows produced by digging up roots shall be carefully filled with approved soil, including all leads and lifts, rammed and compacted to obtain 90% of maximum laboratory dry density of soil and levelled as directed.
- 5.3 All uprooted trees shall be stacked or disposed off as directed by Engineer-in-charge.
- 5.4 PAYMENT

This clause shall apply to item rate tenders only.

Cutting of trees above 30 cms girth shall be paid per number. The rate quoted shall include cutting, uprooting removing the trees within plant boundary as directed, including filling holes or hollows produced by removal of roots etc. as per specifications.

6.0 CLEANING AND STRIPPING

- 6.1 All the areas, including depressions, where filling or cutting is to be carried out shall be cleared and stripped completely of bushes, roots, vegetation, plantation trees, shrubs, trees up to 30 cms girth, organic and other objectionable materials. All these shall be completely uprooted and virgin soil exposed and not merely scrapped at the surface. The roots of trees of girth up to 30 cms shall be removed to a minimum depth of 1m below existing ground level and holes, hollows filled up with selected approved available soil within all leads and lifts and compacted to obtain 90% of



laboratory dry density of soil as per IS: 2720, Part VII and leveled as directed by Engineer-in-charge. All soft patches must be worked out to remove soft soil and selected approved earth must be filled back and the areas (areas coming under filling) compacted to obtain 90% of maximum laboratory dry density of soil, as per IS: 2720 Part VII. The depth of stripping shall be generally 50 to 150 mm as decided by Engineer-in-Charge.

- 6.2 Material obtained from clearing shall be stacked or disposed off as directed by Engineer-in-charge within a lead as per directions of Engineer-in-Charge.

6.3 PAYMENT

This clause shall apply to item rate tenders only.

No separate payment shall be made for clearing, stripping and disposal of materials obtained from clearing. This shall be considered as part of cutting work in areas of cutting and filling work in areas of filling and the rates quoted under the respective items of

- a. Earthwork in Excavation/ Cutting
- b. Earthwork in filling (both with available earth & earth obtained from approved borrow areas), shall be inclusive of clearing and stripping with all operations described above in clause no.6.0 in respective areas of cutting and filling.

No separate payment shall be made for clearing, stripping and disposal of materials obtained from clearing of borrow areas for earth. This shall be considered as part of filling work in area of filling and the rate quoted under the respective items.

7.0 EARTHWORK IN EXCAVATION/CUTTING

- 7.1 After clearing and stripping of areas as specified above in clause No.6.0, spot levels at intervals and pattern as decided by the Engineer-in-charge, shall be taken jointly by CONTRACTOR and Engineer-in-charge. Excavation / cutting shall commence only after the levels are signed by the contractor as a token of his acceptance.
- 7.2 Excavation/ cutting shall be carried out strictly as per the instruction of Engineer-in-charge.
- 7.3 If the contractor excavates/ cuts beyond the required level, additional quantity of earthwork shall not be paid for. The excavation taken below the specified level shall be made good by filling with approved material, to the required compaction, at Contractor's cost.
- 7.4 The final bed and sides of excavation must be levelled, dressed and compacted. In case of areas under excavation for site grading, the final surface shall be levelled, dressed and consolidated by means of sheep foot / power driven rollers to obtain maximum compaction. However, no test control is required in such areas.



- 7.5 Shoring and strutting shall be adopted only with the permission of Engineer-in-charge in writing. Such shoring and strutting shall follow the necessary specification.
- 7.6 Provisions for dewatering shall be governed by the relevant clauses.
- 7.7 Payment

This clause shall apply to item rate tenders only.

Payment for Excavation shall be on the basis of volume of excavation calculated on the basis of joint level taken as per clause 7.1 and the final finished grade levels, the volume being calculated by the Trapezoidal rule including dewatering, if required. Intermediate payment will be on the basis of volume calculated based on spot levels taken during the time of the billing. Reference is also invited to clause 7.3.

8.0 EARTHWORK IN FILLING

- 8.1 After clearing, stripping and consolidation of areas as specified in clause 6.0, spot levels at intervals and pattern as decided by Engineer-in-charge shall be taken jointly by the CONTRACTOR and Engineer-in-Charge and filling shall commence only after the levels are signed by the CONTRACTOR as a token of his acceptance. Approved fill Material shall be spread in uniform layers not exceeding 30 cms in loose depth.

The contractor has to make his own approach and access roads from the borrow area to the demarcated filling areas. While the CONTRACTOR may make use of such short cuts as may be available to him for earth movement from borrow areas to the filling areas, the OWNER does not guarantee any passage way or right of way for the CONTRACTOR'S work other than available at site. No claim shall also be admissible to the CONTRACTOR on account of his having to take longer leads or routes for earth movement, than envisaged by him, either due to any road cuttings, non-availability of routes, or any other grounds whatsoever.

In case total filling required in any area consists of soil both from borrow areas and available approved excavated material from within plant area, then joint levels, shall be taken before commencing filling with earth from borrow area.

However, earth available from borrow areas required for filling can be used only after the available earth from excavation within demarcated area has been utilized and clearance to this effect obtained from the Engineer-in-charge.

- 8.2 All clods, lumps etc, shall be broken before compaction.
- 8.3 Successive layers of filling shall not be placed until the layer below has been thoroughly compacted and tested to satisfy the requirements laid down in this specification.
- 8.4 Prior to rolling, the moisture content of material shall be brought to within plus or minus 2% of the Optimum Moisture Content as described in IS: 2720 Part VII. The moisture content shall preferably be on the wet side for potentially expansive soil.



- 8.5 After adjusting the Moisture Content as described in clause 8.4, the layers shall be thoroughly compacted by either sheep foot roller or power driven roller or vibratory roller, as approved by Engineer-in-charge, till the specified maximum laboratory dry density is obtained.
- 8.6 Each layer shall be tested in field for density and accepted by Engineer-in-charge, subject to achieving the required density, before laying the next layer. A minimum of one test per 500m² for each layer shall be conducted.
- 8.7 If the layer fails to meet the required density, it shall be reworked or the material shall be replaced and method of construction altered as directed by Engineer-in-charge to obtain the required density.
- 8.8 The filling shall be finished in conformity with the alignment, levels, cross-section and dimensions as shown in the drawing.
- Earthen embankment shall be filled 300mm more on both sides, where height is more than 1M and this extra filling shall be dressed, after compaction, in conformity with alignment, level, cross-section and dimension as shown in the drawing, to achieve proper compaction in the slope. No extra payment shall be made in this regard.
- 8.9 Extra material shall be removed and disposed off as directed by the Engineer-in-charge.
- 8.10 Tolerances
- 8.11 General site grading, including cutting and filling in depressions, shall be carried out to within up down tolerance of +5 cms of final lines, grades and slopes.

Earth Work In Filling In Open Lined/Unlined Wells

For earth work in filling in open lined/unlined wells, only locally available coarse sand shall be used, in layers of 500 mm thickness. Each layer shall be thoroughly wetted by sprinkling water, before next layer is filled up. Filling shall be done upto 1m depth below NGL as above. Layers from a depth of 1m below NGL, upto NGL, shall also comprise of locally available coarse sand and compacted with suitable Mechanical / manual means,

to obtain same level of compaction as required for filling above NGL. Filling above NGL shall be done as per CI. 8.1 to 8.10 above.

8.12 Payment

This clause shall apply to item rate tenders only.

- a. Payment for filling shall be made on cubic metre of volume calculated on the basis of cross section plotted from the levels of ground, where filling is to be carried out and the levels reached after filling is duly consolidated, volume being calculated by Trapezoidal method.



- b. In case of simultaneous cut and fill operation, wherever specified, payment shall be made on the basis of one composite rate for cutting and filling. All other details about measurement etc. remaining same as above.
- c. Payment for filling in open wells, lined or unlined, shall be made on the basis of volume calculated on the basis of average area multiplied with depth of open well
- d. No extra payment shall be made towards testing.

9.0 REMOVAL OF SURPLUS EARTH

9.1 Surplus earth and soil from excavation and general site grading shall be removed from the construction areas to the area demarcated by the Engineer-in-charge.

9.2 Payment

This clause shall apply to item rate tenders only.

Payment shall be made only for lead beyond initial lead from construction area. Rate shall include loading, transportation, dumping, stacking the surplus earth and soil in the area demarcated by the Engineer-in-charge.

Payment shall be made on cubic metre basis of the difference of measurements of the volumes of the excavation and the measurement of the filling with the excavated earth. However, the contractor's entitlement to payment shall be restricted to the actual quantity of earth removed. Quantity generated due to void in back filled volume of earth shall also be removed by the contractor at no extra cost and this disposal of earth shall not be measured and paid under any item.

10.0 EXCAVATION IN ROCK

Blasting operations for site grading shall be carried out as per specification No. VCS-SS- CS-6022.



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**STANDARD SPECIFICATION
FOR
EARTHWORK FOR UNDERGROUND PIPING**

VCS-SS-CS-6003

					
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**STANDARD SPECIFICATION
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ABBREVIATION

m	Metre
Cm	Centimetre
Mm	Millimetre
Km	Kilometre
U/G	Underground



CONTENTS

1.0	SCOPE	5
2.0	REFERENCES	5
3.0	MATERIAL	5
4.0	EARTHWORK IN EXCAVATION FOR TRENCHES / PITS FOR PIPELINES	5
5.0	BACKFILLING AND COMPACTION IN TRENCHES AND AROUND VALVE PITS, MANHOLES ETC.....	7
6.0	TRANSPORTATION OF SURPLUS EARTH.....	8
7.0	PAYMENT	9



1.0 SCOPE

This specification deals with earthwork in trenches and pits (for valves, manholes, catch pits etc.) for underground piping.

2.0 REFERENCES

BIS CODES

- IS: 783 Code of practice for laying of RCC pipes.
- IS: 1200 (Part-I) Method of measurement of building and civil engineering works.
- IS: 3764 Excavation work - code of safety.

2.2 SPECIFICATIONS

- VCS-SS-CS-6002 Earthwork in Site Grading
- VCS-SS-CS -6022 Earthwork in Foundations

NOTE: - Latest Edition of all Codes and Standards shall be followed.

3.0 MATERIAL

All workmanship and materials shall conform to the provisions of IS: 1200 (Part-1) and IS: 3764.

4.0 EARTHWORK IN EXCAVATION FOR TRENCHES / PITS FOR PIPELINES

4.1 Excavation

Plant, machinery and equipment's for excavation shall be selected and deployed to provide optimum mechanization in excavation of trenches and pits. The selection for excavation and earth movement machinery etc. shall take into account type of materials to be excavated, method of excavation, prevailing weather conditions and type of transport to be used.

The excavation of area of cut shall be so timed that the bottom level is not exposed to the deteriorating influence of the weather for longer duration.

Excavation and earth moving equipment shall be deployed such that minimum damage is caused to the natural sub-soil structure of exposed formations.

The monitoring of soil deformations, ground water levels during and possibly after construction work shall be taken into consideration.

In the event, when excavation works are carried out in the vicinity of structures of any importance, the above monitoring shall be carried out within a distance, from the edge of the excavation of 5 to 15 times the excavation depth, depending upon the subsoil conditions and the stability of the neighboring structures.



- 4.2 Trenching work shall be carried out in all classes of soil including soft rock and excluding hard rock and shall be for all depths.
- 4.3 The trench shall be cut true to the line and level as per drawings.
- 4.4 If the trench is excavated below the required level than that indicated in the drawing, the extra depth shall be filled with concrete 1:5:10 or approved equivalent materials, as directed by the Engineer-in-Charge, at no extra cost to the owner.
- 4.5 In case of pressure piping, the trench shall be excavated generally as to provide a cover of 1000 mm or dia of pipe whichever is more. In case of gravity sewers/ pipes, the trench shall be excavated to conform to invert levels as per drawings. However in certain cases, the pipes may run at shallower levels or at deeper levels depending upon drawing, site condition etc. No rebate for lesser excavations, nor extra payment due to deeper excavations, shall be admissible in those cases where pipeline laying rates are inclusive of earthwork items. The rates quoted shall be deemed to cover all works connected with trenching, whether trenches are with single pipeline or have multiple pipelines in common trenches including road cutting and making good the same.
- 4.6 The width of the trench shall be sufficient to give free working space of personnel, equipment, supports and ancillaries on each side of the pipe. The free working space shall conform to IS: 783. Generally it shall not be less than 150 mm on either side or 1/3 dia of outer diameter of the pipe, whichever is greater.
- 4.7 When pipelines are running parallel, whether the trenching shall be individual or common, shall be decided by the Engineer-in-Charge and such decision shall be final and binding on the contractor. No extra shall be payable for common excavations.
- 4.8 All earthwork involved in excavations of all types of manholes, catch pits, valve chambers, inspection chambers, chambers for instrumentation tapping etc., which are coming on the alignment of U/G piping or as defined by drawing as a part of U/G piping work, shall be paid extra under Earth work in excavation, back filling and removal of surplus earth etc. under relevant clauses of the SOR.
- 4.9 Aspects such as variations in the soil conditions and the geological structure, depth of excavation, the existence of ground water and surface water, the type and extent of excavation, the topography of site, the proximity of items such as roads, buildings and buried services, construction traffic and activities near the excavation eg. stock piling shall be taken into account when determining whether the sides of excavation should be free standing, sloping or temporary supported.

Suitable drainage and / or dewatering system like Well Point method / Bore well method etc. shall be provided to prevent or limit ingress of surface or sub surface water into excavation.

Serviceable materials intended for reuse should be used as soon as possible after excavation otherwise they should be stock piled at a location beyond 1.5m from the top edge of the excavation or beyond a distance equal to the depth of the excavation whichever is higher at a location approved by the Engineer-in-charge. If excavated serviceable material is not possible to be stacked within the limits specified above, due to some constraint, it shall be stacked away at a location approved by Engineer-in-Charge and paid separately under relevant item.



Areas used for temporary stockpiling of excavated material shall be kept clean and orderly, with excavated material kept by the side of road to avoid traffic movement. Excavated areas shall be restored to their original condition before completion of works.

types of shoring and strutting, wherever necessary, shall be adopted to with hold the face of earth or cutting in slope, as per site requirements and direction of Engineer-in-Charge. Supports shall be maintained such that the integrity of the sides of the excavation is not impaired.

- 4.10 Any obstacle encountered during excavation shall be reported immediately to the Engineer-in-Charge and shall be dealt with as instructed.
- 4.11 The contractor shall maintain all excavated trenches and pits, in a dry and trim condition.
- 4.12 Necessary barricading and protection of slopes against slips due to traffic movement shall be provided to the satisfaction of Engineer-in-Charge. Necessary warning flags and lights shall be provided to caution traffic in the areas where trenches and/ or pits are provided.
- 4.13 In case of road cutting, all road material i.e. metal etc., shall be taken out carefully and kept separately for reuse and road work shall be redone up to the original level, as it was prior to cutting the road, with the excavated road materials after laying and testing of the pipeline, within 10 days from the date of starting this work, at the cost of the contractor. The contractor shall provide suitable warning signs and barricades to prevent accidents.

Contractor shall also provide reasonable bye pass at his own cost when a road is cut for Laying pipeline. Tankage dykes cut due to laying of the pipes, shall be redone conforming to the original specifications, by the Contractor at his own cost. Secondary dykes, to take care of any eventuality during construction, shall be provided by the Contractor at his own cost.

- 4.14 Dewatering shall be done in advance of the installation of the pipe to allow adequate inspection of padding of the bottom, if required. Dewatering shall be continued throughout during installation and backfilling.

The trench shall follow the gradient of pipeline as specified in the drawing. The contractor shall keep the trench in good condition, until the pipe is laid and tested. No extra claim shall be entertained due to its caving or setting down, either before or after the pipe is laid.

In case, pipe is lowered in caved trench and backfilled before being inspected by the Engineer-in-Charge, the Contractor shall re-excavate the trench for inspection and backfill it at his own cost.

5.0 BACKFILLING AND COMPACTION IN TRENCHES AND AROUND VALVE PITS, MANHOLES ETC.

BACKFILLING



Trenches shall be back filled with suitable materials which should be compacted to the same degree or better as the surrounding soils.

- 5.1 The soil used should be selected and approved by Engineer-in-Charge. Suitable material can be extracted from available excavated material. The soil should be free from rubbish, grass, organic matter, stones, building waste and Black Cotton Soil etc. It should be free from clods and hard lumps. In case good soil is not available from excavated material for back filling, trench shall be filled back with locally available coarse sand up to 30 cm. thick above the pipe and rest of trench shall be filled back with excavated soil up to required level.'
- 5.2 The filling should commence only after approval of Engineer-in-Charge is obtained and after the structures or pipes to be buried are tested and approved. Otherwise, if required, contractor shall uncover buried portion and refill at his own cost.

Temporary excavation supports should be removed as back filling and compaction proceeds, such that unacceptable movement of the supported ground does not occur.

Voids caused by extracted supports should be filled and compacted.

- 5.3 Filling should be done in layers. Each layer should be not more than 15 cm thick when loose and should be well rammed, with necessary watering, to obtain at least 90% of maximum laboratory dry density.

Compaction trials should be carried out on each soil type to be placed in backfill, in order to confirm the type of machine and number of passes required to obtain optimum compaction for given soil moisture contents. These trials should also be used to determine the variability of the proposed fill material for different weather conditions.

- 5.4 Care must be exercised to protect cables, pipes, joints, and other features from damage due to backfilling and consolidation.
- 5.5 Filling should extend up to the level of original ground surface or as per drawing or as directed by Engineer-in-Charge. The finished surface should be properly trimmed and dressed. The adjoining area should be cleaned and no heaps of surplus earth should be left out.

6.0 TRANSPORTATION OF SURPLUS EARTH

Unserviceable materials and serviceable materials not intended for re-use shall be removed from the work site and disposed off at a location as approved by Engineer-in-charge.

The surplus earth is generated due to pipe laying, valve chambers, and manhole construction etc. Surplus earth is also generated due to voids in the back filled volume of earth. The removal of surplus earth shall include excavation, loading, transportation, dumping, stacking or spreading, as per the directions of Engineer-in-charge.



7.0 PAYMENT

This clause shall be applicable for item tender rate only.

- 7.1 Unless specifically stated in the schedule of rates, no separate payment for earthwork in excavation, backfilling, transportation, dewatering etc. shall be admissible and the payment for the same is deemed to have been included in the relevant items of the contract.
- 7.2 In case payment for earthwork is specified separately in the Schedule of Rates, the payment shall be based on the actual quantity of excavation, backfilling and transportation done, taking into consideration the slopes authorized by the Engineer-in-Charge for excavation, volume of backfilling calculated on the basis of excavation reduced by the volume of pipes.
- 7.3 In cases where hard rock excavation is involved, the matter shall be referred to Engineer-in-Charge, before proceeding with the work.



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**STANDARD SPECIFICATION
FOR
RCC PIPE CULVERTS & ERC CROSSING
VCS-SS-CS-6008**

					
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ABBREVIATION

m	Metre
mm	Millimetre
IS	Indian Standard
IRC	Instrumentation Road Crossings
ERC	Electrical Road Crossings
PVC	Poly Vinyl Chloride
RCC	Reinforcement Cement Concrete



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CONTENTS

1.0	SCOPE	5
2.0	REFERENCES	5
3.0	MATERIALS.....	5
4.0	TRANSPORTATION AND STACKING.....	5
5.0	LOWERING AND LAYING OF RCC PIPES	6
6.0	LOWERING AND LAYING OF PVC PIPES	7



1.0 SCOPE

The scope of this specification covers R.C.C pipe culverts and ERC/ IRC crossings with RCC or PVC pipes.

2.0 REFERENCES

2.1 BIS CODES

- IS: 458 : Precast Concrete Pipes (with and without reinforcement)
- IS: 783 : Code of practice for laying of RCC pipes
- IS: 4985 : Un-plasticized PVC pipes for potable water supplies

NOTE:- Latest Edition of all Codes and Standards shall be followed.

2.2 SPECIFICATIONS

- VCS-SS-CS-6002 Earthwork for Site Grading
- VCS-SS-CS-6003 Earthwork for underground piping
- VCS-SS-CS-6022 Earthwork in Foundations

3.0 MATERIALS

- 3.1 All pipes must be new and perfectly sound, free from cracks, cylindrically straight and of standard nominal diameter and length, with even texture. RCC Pipes shall be of collar type only and each pipe shall have one collar with it. PVC Pipes shall be Class-I as per IS: 4985.

For pipe culverts, class of RCC pipe shall be NP3 / NP4 or as mentioned in the drawings.

- 3.2 The Contractor shall submit manufacturer's test certificate for acceptance of RCC/PVC pipes.
- 3.3 Spun yarn for pipe joints shall be of best quality. It shall be free from dust etc.

4.0 TRANSPORTATION AND STACKING

- 4.1 The transportation of materials to the worksite and stacking shall be done in a manner to cause minimum inconvenience to the traffic and other construction work.
- 4.2 The pipe shall be protected during handling against impact, shocks and free fall to avoid cracks and damage.
- 4.3 The Contractor shall be fully responsible for the safety and security of materials transported and stacked in the field.

4.4 EARTHWORK



Refer standard VCS-SS-CS-6002, VCS-SS-CS-6022 for earthwork.

5.0 LOWERING AND LAYING OF RCC PIPES

5.1 GENERAL

The laying and jointing of RCC pipes shall confirm to IS: 783. Pipes shall be jointed by collar joints.

The trench shall be checked for proper level, grade and alignment before lowering the pipes.

5.2 LOWERING

The RCC pipe shall be lowered cautiously to prevent disturbance to the bed and sides of the trench. The heavy RCC pipes shall be lowered by means of proper tripods, chain pulley blocks or as directed by Engineer-in-charge. Great care should be taken to prevent sand etc. from entering the pipes.

5.3 LAYING

5.3.1 Laying of RCC pipes shall proceed upgrade of slopes.

5.3.2 The error of grade shall not be rectified by packing up earth underneath the pipe. If required, concrete shall be used for packing.

5.3.3 The end of RCC pipes shall be kept closed to keep dirt, mud and foreign materials out. Adequate provision shall be made to prevent floating of pipes in the event of flooding of trenches.

The body of RCC pipe, for its entire length, shall rest on an even bed in the trench and places shall be excavated to receive the collar for the purpose of jointing.

5.4 JOINTING OF RCC PIPES

5.4.1 A few skeins of spun yarn, soaked in neat cement wash shall be inserted in the groove at the end of the pipe and the two adjoining pipes butted against each other. The collar shall then be slipped over the joint covering equally both the pipes. Spun yarn soaked in neat cement wash shall be passed round the pipes and inserted in the joint by means of caulking tools from both ends of the collar. More skeins of yarn shall be added and well rammed home. The object of the yarn is to center the two ends of the pipes within the collar and to prevent the cement mortar of the joint penetrating into the pipes.

5.4.2 Cement mortar 1:2 (1 cement: 2 sand) shall be slightly moistened and must on no account be soft or sloppy and shall be carefully inserted by hand into the joint. The mortar shall then be punched and caulked into the joint and more cement mortar added until the space of the joint has been filled completely with tightly caulked mortar. The joint shall be finished off neatly outside the collar on both side at an angle 45°



- 5.4.3 Any surplus mortar projecting inside the joint is to be removed and guarded against any damage. Sack or gunny bags shall be drawn past each joint after completion.

5.5 CURING

The Cement mortar joints in RCC pipes shall be cured at least for seven days.

5.6 TESTING

All joints in culvert pipelines shall be tested to a head of 1.5 m of water above the top of the highest pipe, if required, by Engineer-in-Charge.

5.7 PAYMENT

This clause shall be applicable for item tender rate only.

Payment shall be made on running meter basis, which includes supplying, transporting, lowering, laying, jointing and curing, concreting around RCC pipes etc., all complete.

6.0 LOWERING AND LAYING OF PVC PIPES

- 6.1 Lowering and laying of PVC pipes shall be done as per IS: 4985. The jointing of the pipes shall be done by expanding one end after heating and using solvent cement.

6.2 PAYMENT

Payment shall be made on running meter basis of PVC pipes, which includes supplying, transporting, lowering, laying and jointing, concreting around PVC pipes etc., all complete.



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**STANDARD SPECIFICATION
FOR
MISC. CIVIL & STRUCTURAL WORKS FOR UNDERGROUND
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Energising Quality

**STANDARD SPECIFICATION
FOR MISC. CIVIL & STRUCTURAL WORKS FOR
UNDERGROUND SERVICES**

**DOC NO: VCS-SS-CS-6011
Rev No : 03**

ABBREVIATION

m	Metre
mm	Millimetre
cm	Centimetre
IS	Indian Standard
m ²	Square metre
U/G	Underground
CI	Cast Iron
M.S.	Mild Steel



CONTENTS

1.0	SCOPE	5
2.0	REFERENCES	5
3.0	EARTHWORK & BACKFILLING	6
4.0	PLAIN AND REINFORCED CEMENT CONCRETE	6
5.0	BRICK WORK	6
6.0	CEMENT PLASTERING.....	6
7.0	M.S. RUNGS/C.I. STEPS.....	7
8.0	CHEQUERED PLATES & STRUCTURAL STEEL WORKS	7
9.0	C.I. MANHOLE FRAME AND COVER	7
10.0	VENT PIPES	8
11.0	FUNNELS, CLEAN OUTS, PLUGS	8
12.0	BRICK BAT FILL.....	8



1.0 SCOPE

This specification covers the material and construction details for various civil works as given below:

- a. All earthworks except for Site Grading and U/G Piping.
- b. Plain and reinforced cement concrete work in catch pits clean outs manholes, pipe supports, water monitors, hydrant pedestals, Thrust block etc.
- c. Brick work for various structures such as Manholes, Catch basins, Valve Chambers, instrument tapping chambers, Flushing chambers, etc
- d. Plastering for the above structures as applicable.
- e. Manhole frames, manhole covers, ladder rungs etc. for the above structures as applicable.
- f. Miscellaneous structure steel work such as ladders, platforms, chequered plate covers, gratings etc.

The work shall include supply of various materials as per relevant standards, required for the execution of work except for those items designated as Owner's scope of supply in the special conditions of contract or elsewhere in the contract documents. Contractor shall transport from Owner's stores those materials which are a part of owner's supply.

All materials not fully specified herein and which may be used in the WORK shall be of quality approved by the Engineer-in-charge and he shall have the right to determine whether all or any of the materials offered or delivered for use in the WORK are suitable for the purpose. CONTRACTOR shall give the samples of material to the Engineer-in-charge and shall get it approved before procurement and use.

2.0 REFERENCES

2.1 BIS CODES

- IS: 5455 Cast Iron Steps for man holes
- IS: 3502 Steel Chequered Plates
- IS: 2062 Hot Rolled medium and High tensile structural steel
- IS: 1726 Cast Iron Manhole covers and frames
- IS: 1239 Specification for Steel tubes, Tubulars and Other wrought steel fittings

2.2 SPECIFICATIONS

VCS-SS-CS-6002, VCS-SS-CS-6003, VCS-SS-CS-6022 Earth work

VCS-SS-CS-6023 Plain and Reinforced Cement Concrete



VCS-SS-CS-6027 Brick Masonry

VCS-SS-CS-6043 Plastering & Pointing

3.0 EARTHWORK & BACKFILLING

3.1 Refer specification no VCS-SS-CS-002, VCS-SS-CS-003 & VCS-SS-CS-022

4.0 PLAIN AND REINFORCED CEMENT CONCRETE

4.1 Refer specification No. VCS-SS-CS-6023

5.0 BRICK WORK

Refer specification no. VCS-SS-CS-6027

6.0 CEMENT PLASTERING

6.1 MATERIALS

The specifications for cement, sand and water shall be as given in spec. No. VCS-SS-CS-6021 Cement mortar shall be of grade and thickness specified in drawing or as directed by the Engineer-in-Charge, if not specified. The surface on which plastering is to be done shall be thoroughly cleaned from dust, dirt, oil, etc. It should be washed properly and watered for 4 hours before plastering. The joints of brick work shall be raked out to a depth of at least 12mm when plastering has to be done. On cement concrete surface, the surface shall be scarified by lines with trowel when it is still green or hacked if concrete is hard as directed by Engineer-in-Charge.

6.2 Plaster shall not in any case, be thinner than specified. It shall have uniform specified thickness. Any extra thickness of plaster done by contractor will not be paid for. When smooth finishing is required the cement plaster shall be floated over with neat cement within 15 minutes of the application of the final coat.

During the process of plastering all corners shall be rounded to a radius of 25mm unless otherwise specified.

6.3 The plaster shall be protected from sun and rain by such means as the Engineer-in-Charge may approved. The plaster shall be cured for 7 days.

6.4 Construction joint shall be kept in plastering work at places approved by Engineer-in-Charge.

6.5 PAYMENT

This clause shall apply to item rate tender only.

6.5.1 Payment for plastering shall be made on basis of the area of surface plastered, measured before plastering. All Measurements shall be separately made for each face of walls.



- 6.5.2 The rate of plastering shall include cost of scaffolding, swings, cleaning the surface, raking out joints, hacking concrete surfaces, etc. needed for carrying the work and shall cover the extra labour for plastering the jambs, sills, and soffits or opening except for plastering bands, cornices and skirting up to 30 cm width.

7.0 M.S. RUNGS/C.I. STEPS

The rungs for valve pits/manholes shall be of M.S. conforming to Indian Standard and to the shape and size as shown drawings. C.I. steps for manholes if used shall be as per IS: 5455. M.S. Rungs or CI steps shall be coated with 2 coats approved bituminous paint.

Payment for steps/rungs shall be made per number and the rate shall include supply and fixing, finishing the wall etc. complete.

8.0 CHEQUERED PLATES & STRUCTURAL STEEL WORKS

Chequered plates shall be 6mm (7mm moreover chequers and shall conform to IS: 3502). Steel for chequered plate shall conform to IS: 2062 and shall be clearly rolled and free from harmful surface defects such as crack surface flaws etc. The plate shall be cut to shape and fixed to the bearing members as shown in relevant drawings and as directed by Engineer-in-Charge. The edges shall be made smooth, no burrs or gagged ends shall be left. The plates may be spliced with prior consent of the Engineer-in-Charge. But in that case care should be taken so that there is continuity in the pattern of the plates between the portions. Lifting arrangements shall be provided including lifting rods.

Grating shall be fabricated out of M.S flats, angles and rounds etc., as per drawings and as approved by Engineer-in-Charge. Steel for grating plates shall conform to IS: 2062 of general weldable quality and shall be clearly rolled and shall be free from harmful surface defects.

Payment shall be made on the basis of weight of M.S Gratings/chequered plate and supporting frame actually laid. The rate shall include supply of all necessary, steel materials cutting to size, fabricating, smoothening edge if necessary, transporting and fixing at all positions and providing lifting arrangements. Full deductions shall be made for all opening above 30mm square and the rate shall include making of opening of all sizes and supplying and painting 2 coats of anticorrosive paint over a coat of red oxide zinc chromate primer. The exposed surface of grating and frame shall be painted with two thick coats of coal tar. The rate shall include providing and laying M.S grating and frame, breaking and making good existing concrete/brick masonry surface if necessary finishing, painting etc. complete with all labour and materials. Payment shall be on number basis.

9.0 C.I. MANHOLE FRAME AND COVER

C I manhole frame and covers shall conform to IS: 1726 with size and grade as shown in drawing.



10.0 VENT PIPES

These shall be M.S. Black Steel Tube conforming to IS: 1239 Medium grade or as specified in drawing. The pipe bends shall be embedded in 1:3:6 grade cement concrete or as shown in drawing.

All pipes shall be 25mm clear of wall or column with M.S. holder bat clamp as per instructions of the Engineer-in-Charge. All holes in walls and column shall be made good by 1:2:4 grade cement concrete. All pipes and clamps shall be painted with two coats of paints of approved make.

Payment shall be made on running meter basis and the rate shall include supply of all materials, cutting, edge preparation, jointing by welding, fixing in concrete block, cutting of walls or concrete and making good the same, painting with 2 coats of anticorrosive paint necessary scaffolding etc. complete.

The rate shall also include excavation and backfilling if any.

11.0 FUNNELS, CLEAN OUTS, PLUGS

These shall be fabricated from M.S Plates, pipes chequered Plates, rounds, angles etc., to be supplied by the contractor. The fabric action shall be in accordance with the approved drawing.

Payment for these items shall be made on weight basis and rate shall include fabrication, erection, welding jointing and painting etc. all complete.

12.0 BRICK BAT FILL

- 11.1 The brick bats used as filling in valve pits shall be from common burnt clay building bricks. A sample of brickbats used shall be got approved from Engineer-in-charge.
- 11.2 The compaction of the layer of brick bats shall be proper so that brickbats are not disturbed and do not sink in the soil.
- 11.3 The payment for brick-bat fill shall be made on m2 basis as shown in drawing and the rate shall include supply, laying, compacting etc. complete with all materials & labour.



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**STANDARD SPECIFICATION
FOR
CHAIN LINK FENCING**

VCS-SS-CS-6013

					
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**STANDARD SPECIFICATION
FOR CHAIN LINK FENCING**

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ABBREVIATION

m	Metre
mm	Millimetre
IS	Indian Standard



CONTENTS

1.0 SCOPE 5

2.0 REFERENCES 5

3.0 REFERENCE OF SPECIFICATIONS / STANDARDS 5

4.0 CEMENT CONCRETE FOR FOUNDATION & SILL 5

5.0 CEMENT CONCRETE IN PRECAST POSTS/STRUTS.....6

6.0 REINFORCEMENT 6

7.0 PAYMENT 8



1.0 SCOPE

This specification specifies the requirements of chain link fence for security purposes. The height of the fence shall be approximately 2.0 m to the top of the chain link fencing at the posts and approximately 2.5 m in vertical height at the top line of barbed wire attached to the cranked tops of the posts.

2.0 REFERENCES

IS: 278	Specification for galvanized steel barbed wire for fence fabric
IS: 383	Specification for coarse and fine aggregates for concrete
IS: 456	Plain and Reinforced Concrete - Code of Practice
IS: 2721	Specification for Galvanized Steel Chain Link Fencing

NOTE: - Latest Edition of all Codes and Standards shall be followed.

3.0 REFERENCE OF SPECIFICATIONS / STANDARDS

Following standard specification shall be enclosed as part of the job specifications.

Technical Specifications - Civil and Structural Works

General Scope	VCS-SS-CS-6020

Technical Specifications - Civil and Structural Works

Material	VCS-SS-CS-6021

Technical Specifications - Civil and Structural Works

Earth work in Foundation	VCS-SS-CS-6022

Technical Specifications - Civil and Structural Works

Plain & Reinforcement Cement Concrete	VCS-SS-CS-6023

Technical Specifications - Civil and Structural Works

Structural Steel Works	VCS-SS-CS-6024

Technical Specifications - Civil and Structural Works

Earthwork in Site Grading	VCS-SS-CS-6002

Details of Chain Link Fencing	VCS-STD-CS-6002

4.0 CEMENT CONCRETE FOR FOUNDATION & SILL

Refer specification no VCS-SS-CS-6023



5.0 CEMENT CONCRETE IN PRECAST POSTS/STRUTS

(Straining posts, intermediate posts and struts)

- 5.1 Pre-Cast Cement concrete shall be of M25 grade for moderate environment exposure condition and M30 grade for severe environment exposure condition with 20mm and down size crushed stone aggregates conforming to IS: 383.
- 5.2 The work shall be carried out as per IS: 456 in all respects.
- 5.3 Necessary moulds shall be provided for casting the concrete posts and the same shall be smooth finished with 1:3 cement sand mortar as directed by the Engineer-in-Charge.

6.0 REINFORCEMENT

Refer specification No. VCS-SS-CS-6023

6.1 MATERIALS

6.1.1 CHAIN LINK FENCING

The material requirement shall conform to IS: 2721 latest edition. The chain link fencing shall be woven from 3.15 mm dia wire with mesh size of 75 sq mm. The mesh wire shall not vary from the specified dia by more than ± 0.05 mm.

6.1.2 GALVANIZED WIRES

- a. All steel wires shall be hot dipped galvanized wire and dia of the wire shall be 3.15 mm over the galvanized coating.
- b. The line wire shall be 4.0 mm dia Mild Steel.
- c. The stirrup wire for securing the line wires to the concrete intermediate posts shall be 3.15 mm diameter Mild Steel.
- d. The tying wire for securing the chain link fencing to the line wire shall be 2.50 mm diameter Mild Steel.
- e. Hair pin staples for fastening down the bottom of galvanized chain link fencing to the concrete sill shall be of 3.15 mm wire. The ends shall be bent outwards to secure anchorage.

- 6.1.3 Cleats for eye bolts shall be of uniform size and shall consist of Mild Steel angle of 75 x 50 x 6mm.

6.1.4 EYE BOLT STRAINERS

- a. The eye bolt strainer shall consist of bolts with welded eye sufficiently threaded and fitted with a nut and washer.



- b. Two-way eye bolt strainer shall have suitable ring nuts, fitted after wires have been strained on one side.
- 6.1.5 Stretcher bar shall consist of Mild Steel flats 25 mm x 4.75 mm. They shall be secured to the cleats by steel bolts.
- 6.1.6 Droppers for barbed wire shall be of Mild Steel not less than 25mm x 4.75 mm thick with 38mm x 4.85mm half round staples for fastening the barbed wire to them.
- 6.1.7 **BARBED WIRE**
- a. Barbed wire shall conform to IS: 278. The galvanized barbed wire shall be manufactured from galvanized Mild Steel wire conforming to IS: 280. The coating on the wire shall be smooth and relatively free of lumps, globes or points, wires with excessive roughness, blisters, Sal ammoniac spots shall be rejected. A galvanized steel barbed wire of Type A-1 IS: 278 shall be made from two strands of galvanized, twisted 2.5 mm steel wire with 4 points of barbs. Each barb shall have two turns tightening around both line wires making altogether four complete turns. The barbs shall be so finished that four points are set and looked at right angles to each other.
 - b. Bracing of the rows of barbed wire shall be as shown in Standard drawing.
 - c. The barbs shall have a length of not less than 13mm and not more than 18mm.
- 6.2 **ERECTION**
- 6.2.1 Straining posts shall be provided at all ends and corners of fences, at changes in direction or acute variations in level and at intervals not exceeding 60m on straight lengths of fence. Intermediate posts shall be spaced at regular intervals not exceeding 3M.
- 6.2.2 Struts shall be fitted to all straining posts behind the chain link fabric in the direction of the line of fence.
- 6.2.3 **FIXING CHAIN LINK FENCING**
- a. There shall be four evenly spaced rows of line wire. The top wire shall be doubled, making five line wires in all. The bottom wire shall be close to the ground.
 - b. Each line wire shall be strained tightly by means of eyebolt strainers or winders at each straining point.
 - c. Each line wire shall be secured to each intermediate post by a wire stirrup passed through a hole in the posts and secured to the line wire by three complete turns on each side of the post.
 - d. The chain link fencing shall be strained between each pair of straining posts and secured to each straining post by means of a Stretcher bar. One of the top line wires shall be threaded through the appropriate adjacent rows of mesh, care being taken that no meshes in the rows are bypassed by the line wire except where deviation is necessary at the straining posts. The second top line wire shall



be strained in front of the fencing. The fencing shall be attached to the top and bottom line wire by wire ties spaced 150mm apart and to the other line wires by wire ties spaced 450 mm apart.

- e. The bottom of the fencing shall be treated as follows:

Continuous concrete sill 230 mm wide x 300 mm high for full length between posts shall be cast with the top 25 mm above G.L. and 25mm below the chain link fencing. Hair pin staples shall be threaded through the bottom row of mesh at 0.75 m c/c and set in the sill to a depth of 150 mm.

6.2.4 FIXING BARBED WIRES FOR ANTICLIMBING DEVICE.

- a. Three lines of barbed wire shall be provided as shown in drawing . The wires shall be attached by eye bolts to the cranked tops of the straining posts. On concrete intermediate posts they shall be secured to cranked tops with stirrup wires. The barbed wire shall be fitted with one dropper at the centre of each bay, secured to the wires so that they cannot be bunched together

7.0 PAYMENT

This clause shall apply to item rate tenders only.

7.1 EARTHWORK

Payment for earthwork shall be made on cubic meter basis

7.2 CEMENT CONCRETE (CAST-IN-SITU AND PRE-CAST)

Payment shall be made on cubic meter basis and the rate shall include labour, materials, mixing placing, leaving pockets, fixing chain link fencing, line wires, barbed wires inserts in concrete post while casting as shown in the drawing or as per the directions of Engineer-in-Charge, keeping the concrete post in the proper position while concreting, scaffolding, all moulds, curing etc. complete including handling & transportation from pre-casting yards to place of fixing, preparation of pre-casting yards etc. but excluding cost of reinforcement.

7.3 REINFORCEMENT

Payment for reinforcement shall be made on metric ton basis including transportation of steel to site of work, straightening, cleaning, cutting, bending to required shapes and lengths, placing, binding with soft annealed wire as per drawings, specifications and instruction of Engineer-in-Charge.

7.4 CHAIN LINK FENCING

Payment for chain link fencing shall be made on running meter basis for bottom 2.0meter height of the total height including supply of chain link fencing in 1.9meter width roll, fixing in position true to line and as per drawing. The rate shall also include supplying and fixing necessary galvanized line wires, stirrup wires, tying wires, hair pin staples for fixing the fence in cons sill, etc. tensioning the line wire and fencing, all materials and labour etc. required to complete the job as per drawings and direction of Engineer-in-Charge.



7.5 BARBED WIRE FENCING

Payment for barbed wire shall be made on running meter basis. The rate shall included supply and fixing necessary droppers, straining bolts tensioning the barbed wire etc. and all materials and labour etc. required to complete the job.



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VCS Quality Services Pvt Ltd

**STANDARD SPECIFICATION
FOR
EARTHWORK IN FOUNDATIONS**

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ABBREVIATION

m	Metre
mm	Millimetre
Cm	Centimetre
m ²	Square metre
m ³	Cubic metre
CNS	Cohesive Non Swelling



CONTENTS

1.0	SCOPE	5
2.0	REFERENCES	5
3.0	CLASSIFICATION OF SOIL.....	5
4.0	BACKFILLING MATERIAL	5
5.0	SETTING OUT	6
6.0	EARTHWORK IN EXCAVATION.....	6
7.0	SHORING AND STRUTTING:	12
8.0	BACK FILLING AROUND FOUNDATIONS AND IN PLINTH.....	13
9.0	TRANSPORTATION OF SURPLUS EARTH.....	14



1.0 SCOPE

This specification deals with earth work in excavation and filling.

2.0 REFERENCES

2.1 SPECIFICATIONS

VCS-SS-CS-6002 Earthwork in Site Grading

VCS-SS-CS-6003 Earthwork for underground piping

3.0 CLASSIFICATION OF SOIL

3.1 SOFT / LOOSE / HARD / DENSE SOIL AND MUD

Generally any soil which yields to the application of pick and shovel or to phawra, rake or other, ordinary digging implement such as vegetable or organic soil, turf, gravel, sand, silt, loam, clay, peat, cobble stone, mud etc.

3.2 SOFT / DISINTEGRATED / WEATHERED ROCK (NOT REQUIRING BLASTING)

Rock or boulder which may be quarried or split with crowbar. This will also include laterite and hard conglomerate.

3.3 HARD ROCK (REQUIRING BLASTING)

Any rock or boulder for the excavation of which blasting is required.

3.4 HARD ROCK (BLASTING PROHIBITED)

Hard rock requiring blasting as described under cl. No. 3.3 above, but where blasting is prohibited for any reason(s), breaking up of rock shall be done by chiselling, wedging or by using Hydraulic Splitter and chemical substances mixed in an appropriate proportion.

4.0 BACKFILLING MATERIAL

4.1 Backfilling material shall be as approved by the Engineer-in-Charge.

4.2 Backfilling of excavation in trenches, foundations and elsewhere shall consist of one of the following materials as shown on drawing, or directed by the Engineer-in-Charge.

a. Soil

b. Selected earth from heaps or brought from borrow areas.

4.3 In case a. or b. are not available, the Engineer-in-Charge may approve use of any of the following: Stone/gravel

c. Sand



d. CNS material.

- 4.4 The material shall be free from rubbish, roots, hard lumps and any other foreign organic material

5.0 SETTING OUT

- 5.1 The Contractor shall be responsible for the true and proper setting out of the work in relation to original point's lines and levels of reference and for the correctness of the levels, dimensions and alignment of all parts of the work. If at any time during progress of the work any error appears or arises in the position of level, dimension, or alignment of part of the work, the Contractor at his own expense shall rectify such errors to the satisfaction of the Engineer-in-Charge. The checking of any line or level by the Engineer-in-Charge shall not in any way relieve the Contractor of his responsibilities.
- 5.2 The Contractor shall lay out and construct one or more permanent bench marks in some central place before the start of the work, from which all important levels for the excavations will be set.
- 5.3 These permanent bench marks shall consist of masonry pillars with top neatly plastered and levelled as per the directions of the Engineer-in-Charge. Bench marks shall be well connected with triangular grid system or any other bench mark approved by the Engineer-in-Charge.

6.0 EARTHWORK IN EXCAVATION

- 6.1 Excavation shall be carried out in any material met on the site to the lines, levels and contours shown on the detailed drawings and the Contractor shall remove all excavated materials to spoil heaps on site or transport for use in filling on the site or stack them for reuse as directed:
- 6.2 Excavated material shall not be deposited within 1.5m from the top edge of the excavation.
- 6.3 The sides of the excavation may be cut sloping, or shored and strutted to hold the face of earth as per site requirements and as directed by the Engineer-in- Charge.
- 6.4 Foundation pits/trenches shall not be excavated to the full depth unless construction is imminent. The last fifteen (15) cm depth of the excavation shall not be done until concreting work is imminent. The full depth may at the discretion of the Engineer-in-Charge be excavated and the bed covered with a fifty (50) mm (minimum) thick (or as indicated on drawing) layer of lean concrete 1:5:10 mix (1 cement: 5 coarse sand: 10 crushed stone aggregate) or as specified in schedule of rates/shown on drawing, after watering if required, and consolidating the bed.
- 6.5 If the bottom of any excavation has been left exposed by the Contractor and in the opinion of the Engineer-in-Charge, that has become badly affected by the atmosphere or by water, then the Contractor shall remove such portions of the deteriorated material as the Engineer-in-Charge may direct and shall make good with lean concrete



- 1:5:10 mix (1 Cement: 5 Coarse Sand: 10 Crushed Stone Aggregate). All expenses for such additional concrete and excavation shall be borne by the Contractor.
- 6.6 Where excavation is made in excess of the depth required, the Contractor shall, at his own expense, fill up to required level with lean concrete 1:5:10 mix (1 Cement : 5 Coarse Sand : 10 Crushed Stone aggregates) or as decided by Engineer-in-Charge.
- 6.7 The Contractor shall provide suitable drainage arrangement to prevent surface water from any source entering the foundation pits at his own cost.
- 6.8 The Contractor shall make all arrangements for dewatering during excavation and subsequent works, the accumulated water from any source (including subsoil water) in the excavated pits/trenches and keeping the excavated pits/trenches dry for subsequent works.
- 6.9 The Contractor shall make necessary arrangements for lighting, fencing and other suitable measures for protection against risk of accidents due to open excavation.
- 6.10 Where the excavation is to be carried out below the foundation level of an adjacent structure, the precaution to be taken such as under pinning, shoring and strutting etc. shall be determined by the Engineer- in-Charge. No excavation shall be done unless such precautionary measures are carried out as per directions of the Engineer-in-Charge. The payment for such precautionary measures shall, however, be made separately.
- 6.11 Loose or soft bed ground encountered in excavation at the required depth shall on the Engineers-in-Charge's instructions be excavated to a firm bed and difference made up to the required level with lean concrete 1:5:10 mix (1 Cement: 5 Coarse Sand: 10 Crushed Stone Aggregates).
- 6.12 In those cases where during excavation, side slips occur for reasons not attributable to the Contractor (e.g. side slips which take place on their own but not due to surcharge of earth kept near the edge of excavation and cracking of excavation top strata due to clay drying out leading to collapse of excavation sides), the Engineer-in-Charge shall admit payment at his discretion.
- 6.13 Any obstacle encountered during excavation shall be reported immediately to the Engineer-in-Charge and shall be dealt with as instructed by him. Removal of buried pipes or cables shall not be done without prior permission of the Engineer-in-Charge and the Contractor shall provide all measures to protect the same. Costs of such protective measures are deemed to be included in the rates for various items of excavation.
- 6.14 The Contractor shall not undertake any concreting in foundation until the excavation pit/trench is approved by the Engineer-in-Charge.
- 6.15 The specification for earth work shall also apply to excavation in rock in general.
- 6.16 In case of hard rock requiring blasting, the provisions mentioned below shall be strictly followed.



6.16.1 GENERAL

Where hard rock is met with and blasting operations are considered necessary, the Contractor shall intimate about the same to the Engineer-in-Charge, and obtain his approval in writing for resorting to blasting operation.

The Contractor shall obtain license from the district authorities for undertaking blasting work as well as for obtaining and storing the explosive as per Explosive Rules 1983, corrected up to date. He shall purchase the explosives, fuses, detonators etc. only from a licensed dealer. He shall be responsible for the safe custody and proper accounting of the explosive materials. The Engineer-in-Charge or his authorized representative shall have the access to check the Contractor's store of explosive and his accounts.

In case where explosives are required to be transported and stored at site, relevant clauses of the Explosive Rules, 1983 as amended subsequently, shall apply.

The Contractor shall be responsible for any accident to workmen, public or property, due to blasting operations.

6.16.2 PRECAUTIONS

Blasting operations shall be carried out under the careful supervision of a responsible, authorized and licensed blaster of the Contractor (referred subsequently as "blaster" only) during specified hours, as approved in writing by the Engineer-in-Charge. The blaster shall be fully conversant with the rules of blasting.

Proper precautions for safety of persons shall be taken. Red flags shall be prominently displayed around the area to be blasted and all the people on the work except those who actually light the fuses shall withdraw to a safe distance of not less than 200 meters from the blast. Precautions as per Explosive Rules 1983 with amendment shall be followed.

6.16.3 FUSES

All fuses shall be cut to the lengths required before being inserted into the holes. Joints in fuses shall be avoided. Where these are unavoidable, a semicircular niche shall be cut in one piece of fuse about 2 cm. deep from the end and the end of other piece inserted into this niche, and the two pieces then wrapped together with a string. All joints exposed to dampness shall be wrapped with rubber tape. Fuse and detonators shall be kept separated from the explosives.

6.16.4 BLASTING WITH GUN POWDER

Blasting shall normally be done with gun powder. Dynamite, gelatine or any other high explosive shall only be used in special cases with the written permission of the Engineer-in-Charge.

In case of blasting with gun powder, the position of all bore holes to be drilled shall be marked out in circles with white paint. The bore holes shall be jumped or drilled in the rock face. The depth of bore hole shall be about the same as that of the line of least



resistance and its size shall be such that the cartridges can easily pass down to the bottom. The bore holes must be dried before being charged and these shall be inspected by the Contractor's agent.

Gun powder may be used in the form of pellet blasting cartridges or as powder or granules. Cartridges are provided with tapered central hole. One end of fuse is passed through the narrow end of the hole and a sufficient length of the fuse is doubled back so that when the fuse is pulled, it is held tight in the tapered hole of the cartridge. Other cartridges are then inserted in the fuse to make up the required charge. The cartridge along with the fuse is lowered down in the bore hole, placed in position and gently filled and pressed home with dry hay or turf. The rest of the bore shall then be filled with dry clay, which shall be tamped with copper or brass rod until it becomes compact. Care shall be taken to avoid any possibility of an air space around the fuse. The safety fuses shall be taken to the required distance so as to allow the blasting to take place after the person lighting the fuse has withdrawn to a safe distance.

Where gun powder is used in the form of powder or granules it shall be introduced in the bore hole by means of funnel or copper tube. The bore holes shall be loaded with two thirds of the quantity of charge required, and safety fuse then directly introduced over the charge. Remaining one third charges shall then be introduced, and gently filled and pressed home with dry hay or turf. The rest of the bore hole shall be filled with dry clay in the same way as for cartridges, and the safety fuse taken to the required distance.

The charges shall be fired by igniting the fuse. The number of charges to be fired and the actual number of shots heard shall be compared, and the Contractor's blaster shall satisfy himself by examination that all the charges have exploded, before workmen are permitted to approach the site. The charge which has not exploded shall not be permitted to be withdrawn.

The tamping and charge shall be flooded with water and the holes marked with a red cross (X) over it. Another hole shall be jumped at a distance of about 45 cm from the old hole and fired in the usual way. This operation shall be continued, till the original and any subsequent unfired charges are exploded.

6.16.5 BLASTING WITH DYNAMITE OR ANY OTHER HIGH EXPLOSIVE

In case of blasting with dynamite or any other high explosive the position of all bore holes to be drilled shall be marked out in circle with white paint. These shall be inspected by the Contractor's blaster. Bore holes shall be of a size that the cartridge can easily pass down. After the drilling operation, the blaster shall reinspect the holes to see that the holes marked out by him have been drilled. He shall then prepare all charges necessary for the bore holes. The bore holes shall be thoroughly cleaned before a cartridge is inserted. Wooden tamping rods (not pointed but cylindrical throughout) shall be used, in charging holes. Metal rods shall never be used for tamping. One cartridge shall be first placed in the bore hole, gently pressed and not rammed down. Other cartridges shall then be added as may be required to make up the necessary



charge for the bore hole. The top most cartridges shall be connected to the detonator which shall in turn be connected to the safety fuse of required length.

The maximum of eight bore holes shall be loaded and fired on each occasion. The charges shall be fired successively and not simultaneously.

Immediately before firing a blast, due warning shall be given and the blaster shall see that all persons have retired to a place of safety. The safety fuses of the charged holes shall be ignited in the presence of the blaster, who shall see that all the fuses are properly ignited.

Careful count shall be kept by him and others of each blast as it explodes. After the blast the blaster shall inspect the work and ascertain that all the charged holes have been exploded. In case of misfired holes, he shall inspect the same after half an hour and mark red crosses (X) over the holes. During this interval of half an hour, no body shall approach the misfired holes. None of the drillers shall work near such holes, until one of the two following operations has been done by the blaster.

- a. Either the Contractor's blaster shall very carefully (when the tamping is of damp clay) extract the tamping with a wooden scraper and withdraw the fuse, primer and detonator, after which a fresh detonator, primer and fuse shall be placed in the misfired holes and fired.

OR

- b. The hole shall be cleaned for 30 cm of tamping and its direction ascertained by placing a stick in the hole. Another hole shall then be drilled 15 cm away and parallel to it. This hole shall be charged and fired. The misfired hole should also explode along with the new one

Before leaving the work, the blaster of one shift shall inform another blaster relieving him for the next shift, of any cases of misfire, and shall point out their positions denoted by red crosses and also state the action, if any, to be taken in the matter.

The Engineer-in-Charge shall also be informed by the blaster of all cases of misfire, their causes and steps taken in that connection.

6.16.6 CONTROLLED BLASTING

Whenever required by the Engineer-in-Charge, rock blasting shall be carefully controlled so that vibrations generated during the blasting do not cause damage to the buildings and installation around. Similarly, the rock pieces should not fly off and endanger the buildings and installations around. Apart from the general precautions mentioned in the preceding paragraphs, following protective measures and limits for use of explosive are suggested as guidelines. Tenderers are requested to carefully check the site conditions and submit details of the scheme they propose to adopt for controlling the blast.

Following protective measures shall be adopted while carrying out blasting operations.



The hole shall be covered with mild steel plate of minimum 12mm thickness.

Reinforcement rod meshes not less than 20mm dia. at 150mm centre in both directions shall be placed over the steel plates.

Steel plate and reinforcement shall be inspected after every blasting operation and all twists shall be removed before reuse to the satisfaction of the Engineer-in- Charge.

Sand filled bags of 6 to 8 layers shall be placed over the mesh suitably covering the whole region under blasting operation.

The thickness of covering plate and the kind of dead weight is to be duly approved by the Engineer-in-Charge.

- 6.16.7 Hard rock requiring blasting as described under cl.no. 2.3 above, but where blasting is prohibited for any reason(s) breaking up of rock can be done by using Hydraulic Splitter and chemical substances of approved manufacturer (Lifton or equivalent) mixed in an appropriate proportion. The method involves drilling holes into rock and then inserting/injecting hydraulic splitter/chemical solvents into the holes. The breaking-up of rock takes place in a controlled fashion without much noise and spark.

6.17 PAYMENT

This clause shall apply to item rate tenders only.

- 6.17.1 Payment for earth work in excavation shall be made on cubic meter (m³) basis on the measurement of volume of pit/trench of excavation with working space as per relevant Indian Standards (IS: 1200) and slopes/stepping as permitted by the Engineer-in-Charge. The rate shall include cost of all the operations of blasting with explosives & accessories, making of all arrangements for dewatering the accumulated water from any source in the excavated pit or trench, removal and disposal of surplus excavated soil within a lead of 100m from construction areas. The rate shall also include setting out and line out work required for the excavation.

- 6.17.2 The following works shall not be measured separately and allowance for the same shall be deemed to have been made in the description of main item:

- a. Setting out works, profiles, etc.;
- b. Site clearance, such as cleaning grass and vegetation;
- c. Unauthorized battering or benching of excavation;
- d. Forming (or leaving 'dead men' or 'tell-tales' in borrow pits and their removal after measurements;
- e. Forming (or leaving) steps in sides of deep excavation and their removal after measurements;
- f. Excavation for insertion of planking and strutting;



- g. Unless otherwise specified, removing slips or falls in excavations;
 - h. Baling out or pumping of water in excavation from rains;
 - i. Baling out or pumping of water in excavation from sub-soil water, and
 - j. Slings or supporting pipes, electric cables, etc, met during excavation.
- 6.17.3 Special pumping other than what is included in 6.17.2 (h and i) and well point dewatering where resorted to, shall each be measured separately, unless otherwise stated, in kilolitres of water against separate specific provision(s) made for the purpose.
- 6.17.4 The Contractor shall intimate to the Engineer-in-Charge as soon as different classification of soils are met with. The measurements of various soil classifications then shall be worked out by either of the following alternatives in the order of their decreasing importance.
- a. Joint levels shall be taken as to the levels of different soil classifications and volume worked out on the basis of levels only.
 - b. Where levels of different strata cannot be clearly marked and defined, the Contractor shall stack different soils of various classifications separately for measurement purpose and then dispose it off.
 - c. If the quantum of work involved in (b) above is extensively large & time consuming, then the total area may be divided into various zones and reasonably representative samples as in (b) above may be taken and quantities of soils of various classifications finalized for the entire zone based on the representative.

If soil of any classification other than that specified in the Schedule of Rates is met with during excavation, the decision of the Engineer-in-Charge as to the classification of soil, levels of the strata of different classifications and their location shall be binding.

In above case, the total quantity of excavation shall be computed from the measurement of the pit/trench excavated. The hard rock and soft rock shall be measured separately from the relevant stacks and each shall be reduced by fifty percent for voids, and paid under the relevant items. The balance, that is the total quantity of excavation minus the reduced (for voids) quantity of excavation for rocks shall be paid as soft/hard soil as per the direction of the Engineer-in-Charge (However, the maximum payment shall be limited to the volume of the excavated pit/trench as approved by Engineer-in-Charge).

7.0 SHORING AND STRUTTING:

- 7.1 The shoring and strutting of the sides to withhold the face of excavation pits/trenches shall be done when approved or directed by the Engineer-in-Charge.
- 7.2 The shoring shall be of close or open timbering type depending upon the site requirements and as directed by the Engineer-in-Charge whose decision shall be final and binding as to the type of shoring to be used.



7.3 The arrangement of the shoring and strutting shall be sound and safe and shall be got approved from the Engineer-in-Charge before installation. The approval shall not absolve the Contractor of his responsibilities of safety and any other requirements of the contract.

7.4 The shoring and strutting shall be kept in position till all the relevant work in the excavated area is completed and approved. It shall be dismantled and removed only after the permission to do so is obtained from the Engineer-in-Charge.

7.5 PAYMENT

This clause shall apply to item rate tenders only.

Payment for shoring and strutting by close and open timbering shall be made on square meter (m²) basis as separate items. In both the cases, the measurement shall be done on the basis of the surface area of the sides of the excavation actually shored and strutted.

The rate shall include all labour, materials, erection of the poling boards, wales, struts, ballies etc., fixing and keeping the same in position as required, dismantling and removing the same after the work is over as directed.

8.0 BACK FILLING AROUND FOUNDATIONS AND IN PLINTH

8.1 Back filling around completed foundations, structures, trenches and in plinth shall be done to the lines and levels shown on the drawings including any trimming of the surfaces, as may be necessary. This shall be done with selected and approved earth from excavation or otherwise with materials described under clause 3.2 as directed by the Engineer-in-Charge. Where sufficient suitable material is not available from the excavation, the Engineer-in-Charge may direct to import suitable earth from other sources. The filling shall be done in layers of thickness not exceeding 15 cm with watering, rolling and ramming by manual methods/mechanical compactors to grade and level as shown on drawings to obtain 90% laboratory maximum dry density.

8.2 The Contractor shall not commence filling in and around any work until it has been permitted by the Engineer-in- Charge.

8.3 Backfilling around liquid retaining structures and pipes shall be done only after approval of the Engineer-in- Charge is obtained.

8.4 PAYMENT

This clause shall apply to item rate tenders only.

Payment for backfilling with earth shall be based on volume in cubic meters (m³) of consolidated fill. This volume shall be derived from the difference between the volume of excavation and the structure or trenches as the case may be. The rate shall include cost of extracting suitable approved earth from available excavated soil from spoil heaps within a lead of 100m, placing, watering, rolling, ramming compacting in layers,



trimming and dressing finished surface and disposal of surplus material up to a lead of 100m.

However, backfilling done with materials other than earth shall be paid separately under relevant items.

9.0 TRANSPORTATION OF SURPLUS EARTH

9.1 Surplus earth and soil from excavation shall be removed from construction area to the area demarcated by the Engineer-in-Charge.

9.2 PAYMENT

This clause shall apply to item rate tenders only.

9.2.1 Payment shall be made only for the lead beyond initial 100m from construction area. Rate shall include re- excavation, loading, transportation, dumping, stacking or spreading (as per directions of the Engineer in Charge) the surplus earth and the soil in the area demarcated by the Engineer-in-Charge Payment shall be made on cubic meter (m³) basis on the difference of measurements of the volume of the excavated pits and the measurement of the back filling. Quantity generated due to voids in back filled volume of earth shall also be removed by the Contractor at no extra cost and this disposal of earth shall not be measured and paid under any item.

9.2.2 In exceptional circumstances the Engineer-in-Charge may direct the Contractor to remove surplus earth, concrete debris or any other waste material from site to the areas of disposal on the basis of truck measurement. In such cases volume of material shall be calculated on the basis of truck volume reduced by 30% for voids in case of soft/hard soils and 50% for soft/hard rock. All other provisions of disposal such as spreading, levelling, grading shall apply in this case also.



Energising Quality

VCS Quality Services Pvt Ltd

**STANDARD SPECIFICATION
FOR
STRUCTURAL STEEL WORKS**

VCS-SS-CS-6024

					
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**STANDARD SPECIFICATION
FOR STRUCTURAL STEEL WORKS**

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**STANDARD SPECIFICATION
FOR STRUCTURAL STEEL WORKS**

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Rev No : 03**

ABBREVIATION

m	Metre
mm	Millimetre
IS	Indian Standard
BIS	Bureau of Indian Standards



CONTENTS

1.0	SCOPE	5
2.0	REFERENCE	5
3.0	MATERIALS.....	6
4.0	FABRICATION DRAWINGS.....	7
5.0	FABRICATION	9
6.0	MARKING FOR IDENTIFICATION.....	18
7.0	SHOP ERECTION.....	18
8.0	INSPECTION & TESTING OF STRUCTURES	19
9.0	SHOP PAINTING	19
10.0	PACKING.....	20
11.0	TRANSPORTATION	20
12.0	SITE (FIELD) ERECTION	20
13.0	SAFETY & SECURITY DURING ERECTION	20
14.0	FIELD CONNECTIONS	21
15.0	GROUTING	21
16.0	SCHEME AND SEQUENCE OF ERECTION	22
17.0	PAYMENT	22
18.0	PAINTING AFTER ERECTION	23
	ANNEXURE-'A'	26
	ANNEXURE-'B'	28



1.0 SCOPE

This specification covers the requirements for material, storage, preparation of fabrication drawings, fabrication, assembly, tests/examinations, transportation, erection and painting of all types of bolted and/or welded structural steel works for general construction work. Fabrication of structures shall also include fabricating:

- a. Built up sections/plate girders made out of rolled section and/or plates.
- b. Compound sections made out of rolled sections.

2.0 REFERENCE

2.1 BIS CODES

IS: 800	General Construction in steel-Code of practice
IS: 816	Code of practice for use of Metal Arc welding for General construction in mild steel
IS: 819	Code of practice for Residual spot welding for light assemblies in mild steel
IS: 822	Code of practice for Inspection of welds
IS: 919 (Part-I)	ISO system of limits and fits (Bases of tolerances, deviations and fits)
IS: 919 (Part-II)	ISO system of limits and fits (Tables of tolerances, grades and limit deviation for hole and shafts)
IS: 1024	Use of welding in bridges and structures subject to dynamic loading-Code of practice
IS: 1261	Code of practice for Seam welding in mild steel
IS: 1323	Code of practice for Oxy-Acetylene welding for structural works in mild steel
IS: 1477	Code of practice for painting of ferrous metals in buildings
IS: 1852	Specification for rolling and cutting tolerance for hot rolled steel products
IS: 2074	Ready mix paint, Air draying, Red oxide Zinc Chrome, painting specification
IS: 7205	Safety code for erection of Structural steel works
IS: 7215	Tolerance for fabrication of steel structures
IS: 7307	Approval tests for welding procedures



IS: 7310	Approval tests for welders working to approved welding procedures
IS: 7318	Approval tests for welders when welding procedures approval is not required
IS: 9595	Metal Arc welding of carbon and Carbon manganese steel - Recommendations
IS: 12843	Tolerance for Erection of Steel structure and other relevant BIS Codes.
SP: 6(1)	

2.2 SPECIFICATIONS

VCS-SS-CS-6021 Materials and Specification for Shop & Field Painting

- 2.3 In case of conflict between the clauses mentioned in this specification and those in the Indian Standards, this specification shall govern. Any special provision as shown or noted on the design drawings shall govern over the provisions of this specification.

3.0 MATERIALS

3.1 GENERAL

All materials shall conform to their respective specifications given in Specification no. VCS-SS-CS-6021. The use of equivalent or alternative materials shall be permitted only in very special cases and for all such cases prior written approval of the Engineer-in-Charge shall be obtained.

3.2 RECEIPT & STORING OF MATERIALS

- 3.2.1 Each section shall be marked for identification and each lot shall be accompanied by manufacturer's quality certificate, chemical analysis and mechanical characteristics.
- 3.2.2 All sections shall be checked, sorted out and arranged by grade and quality in the store. Any instruction given by the Engineer-in-Charge in this respect shall be strictly followed.
- 3.2.3 All material shall be free from surface defects such as pitting, cracks, laminations, twists etc. Defective material shall not be used and all such rejected material shall be immediately removed from the store/site. The decision of the Engineer-in-Charge in this regard shall be final and binding.
- 3.2.4 Welding wires and electrodes (packed in their original cartons) shall be stored separately by quality and lots inside a dry and enclosed room in compliance with IS: 9595 and as per the instructions given by the Engineer-in-Charge. Electrodes shall be kept perfectly dry to ensure satisfactory operation and weld metal soundness.



- 3.2.5 Each lot of electrodes, bolts, nuts etc. shall be accompanied by manufacturer's quality/test certificates.
- 3.2.6 All bolts (including nuts & washers) shall be checked, sorted out and arranged diameter-wise by grade and quality in the store.

3.3 MATERIAL TESTS

- 3.3.1 The Contractor shall submit manufacturers' quality certificates for all the materials supplied by him. In case, quality certificates are not available or are incomplete or when material quality differs from standard specifications, such materials shall not be used in the construction. However, the Contractor shall get all appropriate tests conducted in approved test houses for such materials as directed by the Engineer-in-Charge, at no extra cost, and submit the same to Engineer-in-Charge for his approval. The Engineer-in-Charge may approve the use of such materials entirely at his discretion.
- 3.3.2 The Contractor shall ensure that all materials brought to site are duly approved by the Engineer-in-Charge. Rejected materials shall not be used and shall be removed from site forthwith. Any material of doubtful quality for which specific tests are to be carried out as per the instruction of the Engineer-in-Charge shall be separately stacked and properly identified and shall not be used. These shall be removed from site forthwith.

4.0 FABRICATION DRAWINGS

- 4.1 Fabrication and erection drawings shall be prepared by the Contractor on the basis of "Approved for Construction (AFC)" design drawings, Standards issued to the Contractor. These drawings shall be prepared by the Contractor or by an agency appointed by the Contractor and approved by the Engineer-in-Charge.
- 4.2 Fabrication and erection drawings shall be thoroughly checked, stamped "Approved for Construction" and signed by the Contractor's own responsible Engineer irrespective of the fact that such drawings are prepared by the Contractor or his approved agency, to ensure accuracy and correctness of the drawings. Unchecked and unsigned drawings shall not be used for the purpose of proceeding with the work. The Contractor shall proceed with the fabrication and erection work only after thoroughly satisfying himself in this regard.
- 4.3 All fabrication and erection drawings shall be issued for construction by the Contractor directly to his work- site. Six copies of such drawings shall simultaneously be submitted to the Engineer-in-Charge who may check/ review some or all such drawings at his sole discretion and offer his comments for incorporation in these drawings by the Contractor.

However, the Contractor shall not proceed with the fabrication of such structures whose fabrication drawings are required to be reviewed before taking up the fabrication work as noted on "Approved for Construction (AFC)" design drawings issued to the Contractor or as conveyed by the Engineer-in-Charge. The fabrication of such structures shall be done only as per the reviewed fabrication drawings.



The review of such drawings shall be restricted to the checking of the following only:

- a. Structural layout, orientation and elevation of structures/members.
- b. Sizes of members.
- c. Critical joint details.

4.4 Fabrication drawings shall be drawn to scale and shall convey the information clearly and adequately. Following information shall be furnished on such drawings:

- a. Reference to design drawing number (along with revision number) based on which fabrication drawing has been prepared.
- b. Structural layout, elevations & sections (with distinct erection marking of all members).
- c. Framing plans, member sizes, orientation and elevations.
- d. Layout and detailing of rain water pipes and gutters showing all necessary levels, connections and provisions wherever required.
- e. Detailing of shop/field joints, connections, splices, for required strength and erection.
- f. Location, type, size and dimensions of welds and bolts.
- g. Shapes and sizes of edge preparation for welding.
- h. Details of shop and field joints/welds.
- i. Bill of materials/D.O.D. Lists.
- j. Quality of structural steel, plates etc., welding electrodes, bolts, nuts and washers to be used.
- k. Erection assemblies identifying all transportable parts and sub-assemblies with special erection instructions, if required.
- l. Method of erection and special precautions to be taken during erection as required.

4.5 The Contractor shall additionally ensure accuracy of the following and shall be solely responsible for the same:

- a. Provision for erection and erection clearances.
- b. Marking of members
- c. Cut length of members
- d. Matching of joints and holes.



- e. Provision kept in the members for other interconnected members.
 - f. Bill of materials/D.O.D. Lists.
- 4.6 Connections, splices and other details where not shown on the design drawings shall be suitably designed and shown on the fabrication drawings based on good engineering practice developing full member strength. Design calculations for such connections/splices shall be submitted to the Engineer-in-Charge along with the fabrication drawings.
- 4.7 Any substitution or change in section shall be allowed only when prior written approval of the Engineer-in-Charge has been obtained. Fabrication drawings shall be updated incorporating all such substitutions/changes by the Contractor at no extra cost to the Owner.
- 4.8 In case during execution of the work, the Engineer-in-Charge on review of drawings considers any modifications/substitutions necessary to meet the design parameters/good engineering practice, these shall be brought to the notice of the Contractor who shall incorporate the same in the drawings and works without any extra cost to the owner. The Contractor will be totally responsible for the correctness of the detailed fabrication drawings and execution of the work.
- 4.9 Contractor shall incorporate all the revisions made in the design drawings during the course of execution of work in his fabrication drawings, and resubmit the drawings at no extra cost to the Owner. All fabrication shall be carried out only as per the latest AFC design drawings and corresponding fabrication drawings.
- 4.10 The Contractor shall supply two prints each of the final/as built drawings along with their transparencies to Engineer-in-Charge for reference and record. The rates quoted shall include for the same.

5.0 FABRICATION

5.1 GENERAL

- 5.1.1 Fabrication of structures shall be done strictly as per "Approved for Construction" fabrication drawings (prepared by the Contractor based on the latest design drawings) and in accordance with IS: 800, IS: 9595 & other relevant BIS Codes and BIS Hand Book SP: 6(1).
- 5.1.2 Prior to commencement of structural fabrication, undulations in the fabrication yard, if any, shall be removed and area levelled and paved by the Contractor.
- 5.1.3 Any defective material used in the work shall be replaced by the Contractor at his own expense. Necessary care and precautions shall be taken so as not to cause any damage to the structure during any such removal and replacement.
- 5.1.4 Any faulty fabrication pointed out at any stage of work by the Engineer-in-Charge, shall be made good or replaced by the Contractor at his own cost.



5.1.5 Tolerances for fabrication of steel structures shall be as per IS: 7215.

5.2 FABRICATION PROCEDURE

5.2.1 STRAIGHTENING & BENDING

5.2.1.1 All materials shall be straight and, if necessary, before being worked shall be straightened and/or flattened (unless required to be of curvilinear form) and shall be free from twists.

5.2.1.2 Bending of rolled sections and plates shall be done by cold process to shapes as shown on drawings.

5.2.2 CLEARANCES

The erection clearance for cleated ends of members shall be not greater than 2mm at each end. The erection clearance at ends of beams without web cleats and end plates shall be not more than 3mm at each end but where for practical reasons, greater clearance is necessary, suitably designed seating's approved by the Engineer-in-Charge shall be provided.

5.2.3 CUTTING

5.2.3.1 Prior to cutting, all members shall be properly marked showing the requisite cut length/width, connection provisions e.g. location and dimensions of holes, welds, cleats etc. Marking for cutting shall be done judiciously so as to avoid wastages or unnecessary joints as far as practicable. Marking shall be done by placing the members on horizontal supports/pads in order to ensure accuracy. Marking accuracy shall be limited to + 1 mm.

5.2.3.2 Cutting may be affected by shearing, cropping or sawing. Gas cutting by mechanically controlled torch shall be permitted for mild steel. Hand flame cutting may be permitted subject to the approval of the Engineer-in-Charge.

5.2.3.3 Except where the material is subsequently joined by welding, no loads shall be transmitted into metal through a gas cut surface.

5.2.3.4 Shearing, cropping and gas cutting shall be clean, square, free from any distortion & burrs, and should the Engineer-in-Charge find it necessary, the edges shall be ground afterwards, to make the same straight and uniform at no extra cost to the Owner.

5.2.4 HOLING

5.2.4.1 Holes for bolts shall not be formed by gas cutting process.

5.2.4.2 Holes through more than one thickness of material of members such as compound stanchions and girder flanges shall, where possible, be drilled after the members are assembled and tightly clamped/bolted together. Punching may be permitted before assembly, provided the thickness of metal is less than 16mm and the holes are punched 3mm less in diameter than the required size and reamed, after assembly, to the full diameter. Punching shall not be adopted for dynamically loaded structures.



- 5.2.4.3 Holes may be drilled in one operation through two or more separable parts and burrs removed from each part after drilling.
- 5.2.4.4 Holes in connecting angles and plates, other than splices, also in roof members and light framing, may be punched full size through material not over 12mm thick, except where required for close tolerance bolts or barrel bolts.
- 5.2.4.5 All matching holes for black bolts shall register with each other so that a gauge of 2mm less in diameter than the diameter of hole shall pass freely through the assembled members in the direction at right angle to such members. Finished holes shall be not more than 2mm in diameter larger than the diameter of the black bolt passing through them, unless otherwise specified by the Engineer-in-Charge.
- 5.2.4.6 Holes for turned and fitted bolts shall be drilled to a diameter equal to the nominal diameter of the shank or barrel subject to H8 tolerance specified in IS: 919. Parts to be connected with close tolerance or barrel bolts shall be firmly held together by tacking bolts or clamps and the holes drilled through all the thicknesses in one operation and subsequently reamed to size. Holes not drilled through all the thicknesses in one operation shall be drilled to a smaller size and reamed out after assembly. Where this is not possible, the parts shall be drilled and reamed separately.
- 5.2.4.7 To facilitate grouting, holes shall be provided in column bases or seating plates exceeding 300mm in width for the escape of air.
- 5.2.4.8 To avoid accumulation of water in gusseted column bases of laced, battened or box type stanchions, suitable reverse U-type holes shall be provided at the junction of base plate and column section in the vertical gussets for draining out of any water.

5.2.5 ASSEMBLY

The component parts shall be assembled and aligned in such a manner that they are neither twisted nor otherwise damaged, and shall be so prepared that the required camber, if any, is provided. Proper clamps, clips, jigs and other fasteners (bolts and welds) shall be placed in a balanced pattern to avoid any distortion in the members and to ensure their correct positioning (i.e. angles, axes, nodes etc.). Any force fitting, pulling/stretching of members to join them shall be avoided. Proper care shall be taken for welding shrinkage & distortion so as to attain the finished dimensions of the structure shown on the drawings.

5.2.6 WELDING

5.2.6.1 GENERAL

- a. All joints shall be welded unless noted otherwise on the design drawings.
- b. Welding shall be in accordance with IS: 816, IS: 819, IS: 1024, IS: 1261, IS: 1323 and IS: 9595 as appropriate.
- c. The Contractor shall make necessary arrangement for providing sufficient number of welding sets of the required capacity, all consumables, cutting and grinding



equipment with requisite accessories/ auxiliaries, equipment & materials required for carrying out various tests such as dye penetration, magnetic particle, ultrasonic etc.

- d. Adequate protection against rain, dust, snow & strong winds shall be provided to the welding personnel and the structural members during welding operation. In the absence of such a protection no welding shall be carried out.
- e. It shall be the responsibility of the Contractor to ensure that all welding is carried out in accordance with the terms of this specification and relevant BIS codes. The Contractor shall provide all the supervision to fulfill this requirement.

5.2.6.2 PREPARATION OF MEMBER FOR WELDING

- a. Edge Preparation

Edge preparation/bevelling of fusion faces for welding shall be done strictly as per the dimensions shown in the drawings. In case, the same are not indicated, edges shall be prepared (depending on the type of weld indicated in the drawing) as per the details given in IS: 9595. Bevelling of fusion faces shall be got checked and approved by the Engineer-in-Charge. The tolerances on limits of gap, root face & included angle shall be as stipulated in IS: 9595.

- b. Cleaning

Welding edges and the adjacent areas of the members (extending up to 20mm) shall be thoroughly cleaned of all oil, grease, scale and rust and made completely dry. Gaps between the members to be welded shall be kept free from all foreign matter.

- c. Preheating

Preheating of members shall be carried out as per IS: 9595 when the base metal temperature is below the requisite temperature for the welding process being used. Preheating shall be done in such a manner that the parts, on which the weld metal is being deposited, are above the specified minimum temperature for a distance of not less than 75mm on each side of the weld line. The temperature shall be measured on the face opposite to that being heated. However, when there is access to only one face, the heat source shall be removed to allow for temperature equalization (1 minute for each 25mm of plate thickness) before measuring the temperature.

- d. Grinding

- i. Column splices & butt joints of struts and compression members (depending on contact for load transmission) shall be accurately ground and close-butt over the whole section with a tolerance not exceeding 0.2mm locally at any place. In column caps & bases, the ends of shafts together with the attached gussets, angles, channels etc., shall be accurately ground so that the parts connected butt over minimum 90%



surface of contact. In case of connecting angles or channels, care shall be taken so that these are fixed with such accuracy that they are not reduced in thickness by grinding by more than 2mm.

- ii. Ends of all bearing stiffeners shall be ground to fit tightly at both top and bottom. Similarly bottom of the knife edge supports along with the top surface of column brackets shall be accurately ground to provide effective bearing with a tolerance not exceeding 0.2mm locally at any place.
- iii. Slab bases and caps shall be accurately ground over the bearing surfaces and shall have effective contact with the ends of stanchions. Bearing faces which are to be grouted direct to foundations need not be ground if such faces are true & parallel to the upper faces.

5.2.6.3 WELDING PROCESSES

Welding of various materials under this specification shall be carried out using one or more of the following processes.

- a. Manual Metal Arc Welding Process (MMAW)
- b. Submerge Arc Welding Process (SAW)
- c. Gas Metal Arc Welding Process (GMAW)
- d. Flux Cored Arc Welding Process (FCAW)

The welding procedure adopted and consumables used shall be specifically approved by the Engineer-in-Charge. A combination of different welding processes or a combination of electrodes of different classes/makes may be employed for a particular joint only after qualifying the welding procedures to be adopted and obtaining the written approval of the Engineer-in-Charge.

5.2.6.4 APPROVAL & TESTING OF WELDERS

The Contractor shall satisfy the Engineer-in-Charge that the welders are suitable for the work upon which they will be employed. For this purpose the welders shall have satisfied the relevant requirements of IS: 7318. If the welders will be working to approved welding procedures, they shall have satisfied the relevant requirements of IS: 7310.

Adequate means of identification shall be provided to enable each weld to be traced to the welder by whom it was made. The Contractor shall intimate the Engineer-in-Charge sufficiently in advance, the commencement of tests, to enable him to be present to witness the same.

5.2.6.5 APPROVAL & TESTING OF WELDING PROCEDURES

The Contractor shall carry out procedure tests in accordance with IS:7307 to demonstrate by means of a specimen weld of adequate length on steel representative of that to be used, that he can make welds with the welding procedure to be used for



the work to the complete satisfaction of the Engineer-in-Charge. The test weld shall include weld details from the actual construction and it shall be welded in a manner simulating the most unfavorable instances of fit-up, electrode condition etc., which are anticipated to occur on the particular fabrication. Where material analyses are available, the welding procedure shall be carried out on material with the highest carbon equivalent value.

After welding, but before the relevant tests given in IS: 7307 are carried out, the test weld shall be held as long as possible at room temperature, but in any case not less than 72 hours, and shall then be examined for cracking. The examination procedure shall be sufficiently rigorous to be capable of revealing significant defects in both parent metal and weld metal.

After establishing the welding method, the Contractor shall finally submit to the Engineer-in-Charge for his approval the welding procedure specification in standard format given in IS: 9595 before starting the fabrication.

5.2.6.6 SEQUENCE OF WELDING

- a. As far as practicable, all welds shall be made in a sequence that will balance the applied heat of welding while the welding progresses.
- b. The direction of the general progression in welding on a member shall be from points where the parts are relatively fixed in position with respect to each other towards points where they have a greater relative freedom of movement.
- c. All splices in each component part of a cover-plated beam or built up member shall be made before the component part is welded to other component parts of the member.
- d. Joints expected to have significant shrinkage shall be welded before joints expected to have lesser shrinkage.
- e. Welding shall be carried continuously to completion with correct number of runs.
- f. The Contractor shall choose the welding sequence after carefully studying each case such as to minimize distortion and shrinkage & submit the same to the Engineer-in-Charge for comments and approval.

5.2.6.7 WELDING TECHNIQUE

- a. After the fusion faces are carefully aligned and set with proper gaps, the root pass of butt joints shall be executed properly so as to achieve full penetration with complete fusion of the root edges.
- b. On completion of each run, all slag and spatters shall be removed and the weld and the adjacent base metal shall be cleaned by wire brushing and light chipping. Visible defects such as cracks, cavities and other deposition faults, if any, shall be removed to sound metal before depositing subsequent run of weld.



- c. All full penetration butt welds shall be completed by chipping/gouging to sound metal and then depositing a sealing run of weld metal on the back of the joints. Where butt welding is practicable from one side only, suitable backing steel strip shall be used and joint shall be arranged in such a way as to ensure that complete fusion of all the parts is readily obtained.
- d. While welding is in progress care shall be taken to avoid any kind of movement of the components, shocks, vibrations to prevent occurrence of weld cracks.
- e. Any deviation desired from the recommended welding technique and electrodes shall be adopted only after obtaining written approval of the Engineer-in-Charge.

5.2.6.8 INSPECTION & TESTING OF WELDS

The method of inspection shall be according to IS: 822 and extent of inspection and testing shall be in accordance with the relevant applicable standard or, in the absence of such a standard, as specified by the Engineer-in-Charge. Welds shall not be painted or otherwise obscured until they have been inspected, approved and accepted.

The Engineer-in-Charge or his representative shall have access to the Contractor's work at all reasonable times and the Contractor shall provide him with all facilities necessary for inspection during all stages of fabrication and erection without not limited to the following objectives.

- a. To check the conformity with the relevant standards and suitability of various welding equipments and their performance.
- b. To witness/approve the welding procedure qualification.
- c. To witness/approve the welders performance qualification.
- d. To check whether shop/field welding being executed is in conformity with the relevant specifications and codes of practice.

Inspection and testing of all fabricated structures shall be carried out by the Contractor by any, or, a combination of all the following methods as directed by the Engineer-in-Charge and no separate payment shall be made, unless otherwise mentioned, for inspection and testing of welds/fabricated structures:

A. Visual Inspection

All finished welds (i.e. 100 percent) shall be visually inspected for identification of the following types of weld defects & faults.

- a. Weld defects occurring at the surface such as blow holes, exposed porosity, unfused welds etc.
- b. Surface cracks in the weld metal or in the parent metal adjacent to it.
- c. Damages to the parent metal such as undercuts, burning, overheating etc.



- d. Profile defects such as excessive convexity or concavity, overlapping, unequal leg lengths, excessive reinforcement, incompletely filled grooves, excessive penetration beads, root grooves etc.
- e. Distortion due to welding i.e., local shrinkage, camber, bowing, twisting, rotation, wariness etc.
- f. Linear eccentric, angular and rotational misalignment of parts.
- g. Dimensional errors.

B. Mechanical Tests

The mechanical testing (such as tensile load tests, bend tests, impact tests etc.) shall be done in accordance with the relevant standards and as per the instructions of the Engineer-in-Charge.

C. Magnetic Particle/Dye Penetration/Ultrasonic Examination:

The examination shall be done at random as directed by the Engineer-in-Charge. Whenever such tests are directed, the tests shall be carried out on joints chosen by him. The tests shall be carried out by employing approved testing procedure in accordance with IS: 822.

D. Radiographic Examination

Radiographic examination shall be carried out only in special cases for random joints as directed by the Engineer-in-Charge. The Contractor shall be paid extra for such examination except for penalty radiographic tests for which the cost shall be borne by him. The Contractor shall make necessary arrangement at his own expense for providing the radiographic equipment, films and all other necessary materials required for carrying out the examination. The tests shall be carried in the presence of the Engineer-in-Charge by employing approved testing procedure in accordance with IS: 822. The Contractor shall fulfill all the statutory safety requirements while handling X-ray and Gamma-ray equipment and provide the Engineer-in-Charge all the necessary facilities at site such as dark room, film viewer etc., to enable him to examine the radiographs.

5.2.6.9 Repair of Faculty Welds

No repair of defective welds shall be carried out without proper permission of the Engineer-in-Charge and his approval for the corrective procedure.

Welds not complying with the acceptance requirements (as specified by BIS Codes & the Engineer-in-Charge), as revealed during inspection & testing of welds or erection or in-situ condition shall be corrected either by removing & replacing or as follows:

- a. Excessive convexity - Reduced to size by removal of excess weld metal.
- b. Shrinkage cracks, - Defective portions removed down to sound



cracks in parent plates	metal and re-welded.
and craters	
c. Under cutting.	- Additional weld metal deposited.
d. Improperly fitted/ misaligned parts.	- Welding cut & edges suitably prepared and parts.
e. Members distorted the by heat of welding	- Member straightened by mechanical means or careful application of limited amount of heat, temperature of such area not to exceed 650 degree Centigrade dull red heat).

In removing defective parts of a weld, gouging, chipping, oxygen cutting or grinding shall not extend into the parent metal to any substantial amount beyond the depth of weld penetration, unless cracks or other defects exist in the parent metal. The weld or parent metal shall not be undercut in chipping, grinding, gouging or oxygen cutting.

Any fabricated structure or its component which, in the opinion of Engineer-in-Charge, is defective and/or beyond any corrective action shall be removed forthwith from the site as instructed by the Engineer-in-Charge without any extra claim. The owner reserves the right to recover any compensation due to any loss arising out of such rejections.

5.2.7 BOLTING

5.2.7.1 All bolts shall be provided such that no part of the threaded portion of the bolts is within the thickness of the parts bolted together. Washers of suitable thickness shall be used under the nuts to avoid any threaded portion of the bolt being within the thickness of parts bolted together.

5.2.7.2 The threaded portion of each bolt shall project through the nut at least one thread.

5.2.7.3 Flat washers shall be circular and of suitable thickness. However, where bolt heads/nuts bear upon the bevelled surfaces, they shall be provided with square tapered washers of suitable thickness to afford a seating square with the axis of the bolt.

5.2.8 SPLICING

5.2.8.1 Splicing of built up/compound/latticed sections shall be done in such a fashion that each component of the section is joined in a staggered manner.

5.2.8.2 Where no butt weld is used for splicing, the meeting ends of two pieces of joist/channel/built up section shall be ground flush for bearing on each other and suitable flange and web splice plates shall be designed and provided for the full strength of the flange/ web of the section and welds designed accordingly.



- 5.2.8.3 Where full strength butt weld is used for splicing (after proper edge preparation of the web and flange plates) of members fabricated out of joist/ channel/ angles/ built up section, additional flange and web plates shall be provided, over and above the full strength butt welds, to have 40% strength of the flange and web.
- 5.2.8.4 Where a cover plate is used over a joist/channel section the splicing of the cover plate and channel/joist sections shall be staggered by minimum 500mm. Extra splice plate shall be used for the cover plate and joist/channel section as per clause 5.2.8.2 or 5.2.8.3.
- 5.2.8.5 Prior approval shall be obtained by the Contractor for locations of splices where not shown on design drawings. Only a single splice at approved location shall be allowed for member's up to a length of 6 to 7m. Maximum two numbers of splices shall be allowed for members exceeding this length.
- 5.2.9 MACHINING & GRINDING**
- 5.2.9.1 All slab bases and slab caps shall be accurately machined over the bearing surfaces and shall be in effective contact with the ends of column sections (shafts).
- 5.2.9.2 For slab bases and slab caps, ends of column shafts shall be accurately machined. However, for gusseted bases and caps, the column shafts shall be ground flush for effective contact with parts connected together.
- 5.2.9.3 Gusseted bases and caps shall be ground flush for effective contact with ends of column sections.
- 5.2.9.4 End of all bearing stiffeners shall be machined or ground to fit tightly at top and bottom without any air gap.
- 5.2.9.5 While machining or grinding care shall be taken so that the length or thickness of any part does not get reduced by more than 2.0mm.
- 5.2.9.6 For all machining or grinding works for gusseted base and cap plates, the clearance between the parts joined shall not exceed 0.2mm at any location.

6.0 MARKING FOR IDENTIFICATION

- 6.1 Each component shall be distinctly marked (with paint) before delivery in accordance with the marking diagrams and shall bear such other marks as will facilitate erection.
- 6.2 For small members which are delivered in bundles or crates, the required marking shall be done on small metal tags securely tied to the bundle.

7.0 SHOP ERECTION

The steel work shall be temporarily shop erected complete or as directed by the Engineer-in-Charge, so that the accuracy of fit may be checked before dispatch.



8.0 INSPECTION & TESTING OF STRUCTURES

- 8.1 The Engineer-in-Charge (or his authorized representative) shall have free access at all times to those parts of the Contractor's works which are concerned with the fabrication of the steel work and shall be provided with all reasonable facilities for satisfying himself that the fabrication is being undertaken in accordance with the provisions of these specifications & other relevant BIS Codes.
- 8.2 Should any structure or part of a structure be found not to comply with any of the provisions of this specification (or relevant BIS Codes as referred to), it shall be liable to rejection. No structure or part of the structure, once rejected shall be resubmitted for inspection, exception cases where the Engineer-in-Charge or his authorized representative considers the defect as rectifiable.
- 8.3 Defects which may appear during/after fabrication/ erection shall be made good only with the consent of the Engineer-in-Charge and procedure laid down by him.
- 8.4 All necessary gauges and templates shall be supplied free to the Engineer-in-Charge by the Contractor whenever asked for during inspection. The Engineer-in-Charge, may at his discretion, check the test results obtained at the Contractor's works by independent tests at a test house, and the cost of such tests shall be borne by the Contractor.

9.0 SHOP PAINTING

- 9.1 All components and members of steel work shall be given one shop coat of primer (conforming to relevant BIS codes) or any other primer as specified, in the tender, immediately after the surfaces have been properly prepared (i.e. degreased, de-rusted, descaled & cleaned) in accordance with IS: 1477 or IS: 800, as applicable. The primer coat shall be applied over completely dry surfaces (using brushes of good quality) in a manner so as to ensure a continuous and uniform film without "holidaying". Special care shall be taken to cover all the crevices, corners, edges etc. However, in areas which are difficult to reach by brushing, daubers/mops shall be used by dipping the same in paint and then pulling/ pushing them through the narrow spaces. The primer coat shall be air dried and shall have a minimum film thickness as per table 29 of IS: 800 after drying, as applicable.
- 9.2 Surfaces which are inaccessible after shop assembly, shall receive the full specified protective treatment before assembly (this shall not apply to the interior of sealed hollow sections).
- 9.3 Steel surfaces shall not be painted within a suitable distance of any edges to be welded if the paint specified would be harmful to welders or impair the quality of the welds.
- 9.4 Welds and adjacent parent metal shall not be painted prior to de-slagging, inspection and approval by the Engineer-in-Charge.
- 9.5 Parts to be encased in concrete shall have only coat of primer and shall not be painted after erection.



10.0 PACKING

- 10.1 All items shall be suitably packed in case these are to be dispatched from the fabrication shop to the actual site of erection so as to protect them from any damage/distortion or falling during transit. Where necessary, slender projecting parts shall be temporarily braced to avoid warping during transportation.
- 10.2 Small parts such as gussets, cleats etc., shall be securely wired on to their respective main members.
- 10.3 Bolts, nuts washers etc. shall be packed in crates.

11.0 TRANSPORTATION

Loading and transportation shall be done in compliance with transportation rules. In case, certain parts cannot be transported in the lengths stipulated on the drawings, the position details of such additional splice joints shall be got approved by the Engineer-in-Charge.

12.0 SITE (FIELD) ERECTION

12.1 PLANT & EQUIPMENT

The suitability and capacity of all plant and equipment used shall be to the complete satisfaction of the Engineer-in-Charge.

12.2 STORING & HANDLING

All steel work shall be so stored and handled at site so that the members are not subjected to excessive stresses and any damage.

12.3 SETTING OUT

Prior to setting out of the steel work, the Contractor shall get himself satisfied about the correctness of levels, alignment, location of existing concrete pedestals/columns/brackets and holding down bolts/pockets provided therein. Any minor modification in the same including chipping, cutting and making good, adjusting the anchor bolts etc., if necessary, shall be carried out by the Contractor at his own expense. The positioning and levelling of all steel work including plumbing of columns and placing of every part of the structure with accuracy shall be in accordance with the drawings and to the complete satisfaction of the Engineer-in-Charge.

12.4 TOLERANCES

Tolerances for erection of steel structures shall be as per Annexure 'A'

13.0 SAFETY & SECURITY DURING ERECTION

- 13.1 The contractor shall comply with IS: 7205 for necessary safety and adhere to safe erection practices and guard against hazardous as well as unsafe working conditions during all stages of erection.



- 13.2 During erection, the steel work shall be securely bolted or otherwise fastened and when necessary, temporarily braced/guyed to provide for all loads to be carried by the structure during erection till the completion, including those due to the wind, erection equipment & its operation etc. at no extra cost to the owner. For the purpose of guying, the Contractor shall not use other structure in the vicinity without prior written permission of the Engineer-in-Charge.
- 13.3 No permanent bolting or welding shall be done until proper alignment has been achieved.
- 13.4 Proper access, platform and safety arrangement shall be provided for working and inspection, (at no extra cost to the owner) whenever required.

14.0 FIELD CONNECTIONS

14.1 FIELD BOLTING

Field bolting shall be carried out with the same care as required for shop bolting.

14.2 FIELD WELDING

All field assembly and welding shall be executed in accordance with the requirements for shop assembly and welding. Holes for all erection bolt – where removed after final erection shall be plugged by welding. Alternatively erection bolts may be left and secured.

15.0 GROUTING

- 15.1 Prior to positioning of structural columns/girders/trusses over the concrete pedestals/columns/brackets, all laitance & loose material shall be removed by wire brushing & chipping. The bearing concrete surfaces shall be sufficiently levelled, hacked with flat chisels to make them rough, cleaned (using compressed air) and made thoroughly wet. All pockets for anchor bolts shall also be similarly cleaned and any excess water removed. Thereafter, the structural member shall be erected, aligned & plumbed maintaining the base plates/shoe plates at the levels shown in the drawings, with necessary shims/pack plates/wedges.
- 15.2 After final alignment and plumbing of the structure, the forms shall be constructed around and joints made tight to prevent leakage. Grouting (under the base plates/shoe plates including grouting of sleeves & pockets) shall be done with non-shrink grout having compressive strength (28 days) not less than 40N/sq.mm Non shrink grout shall be of free flow premix type and of approved quality and make. It shall be mixed with water in proportion as specified by the manufacturer. Ordinary 1:2 cement/sand mortar grout shall be used only for small, isolated structures e.g. operating platforms not supporting any equipment, pipe supports, cross-over's, stairs & ladders. The thickness of grout shall be as shown on the drawings but not less than 25 mm nor more than 40mm in any case.
- 15.3 The grout mixture shall be poured continuously (without any interruption till completion) by grouting pumps from one side of the base plate and spread uniformly



with flexible steel strips and rammed with rods, till the space is filled solidly and the grout mixture carried to the other side of the base plate.

- 15.4 The grout mixture shall be allowed to harden for a period as decided by the Engineer-in-Charge. At the end of this period, the shims/wedges/pack plates may be removed and anchor bolts tightened uniformly. The alignment of the structure shall now be rechecked and if found correct, the voids left by the removal of shims/wedges/pack plates (if removed) must be filled up with a similar mixture of grout. In case after checking, serious misalignment is indicated, the grout shall be removed completely and fresh grouting done after making appropriate correction of alignment.

16.0 SCHEME AND SEQUENCE OF ERECTION

The Contractor shall furnish the detailed scheme and sequence of erection to match with the project schedule and get the same approved by the Engineer-in-Charge. All necessary co-ordination and synchronization shall be done with the Civil contractor where Civil works are not included in the scope of structural contractor at no extra cost so as to match with the project schedule.

17.0 PAYMENT

This clause shall apply to Item Rate tender only.

- 17.1 Payment for structural steel works shall be made on the basis of admissible weight in metric tons (determined as described in clause 17.2 and 17.3) of the structure accepted by the Engineer-in-Charge. The rate shall include supplying (as per supply conditions given in the Tender) fabricating, erecting in position (at all levels & locations), testing/examining (excluding radiography only) of bolted and/or welded structural steel works of all types (including all built up/compound sections made out of rolled sections and/or plates) including all handling, transporting, storing, straightening if required, cutting, edge preparation, preheating, bolting and welding of joints (including sealing the joints of box sections with continuous welding), finishing edges by grinding/machining as shown, fixing in line & level with temporary staging & bracing and removal of the same after erection, grouting with no shrink/ordinary grout as specified, preparation of fabrication & erection drawings, & erection schedule and getting them reviewed, preparation and submission of as built drawings, as built drawings, preparing the surfaces for painting, surface cleaning, wire brushing, removal of mill scale, dust, rust, oil or grease and applying coat of primer or any other primer as specified after fabrication, return of surplus materials to owner's stores and material reconciliation in the case of materials supplied by the owner as per relevant contract conditions etc. all complete for all the operations mentioned in the foregoing clauses.
- 17.2 The weight for payment shall be determined from the fabrication drawings and respective bill of materials prepared by the Contractor. The bill of materials shall be checked and approved by the Engineer-in-Charge before making the payment. The Contractor shall prepare full scale template in order to supplement/verify the actual cutting dimensions where so directed by the Engineer-in-Charge. The weight shall be calculated on the basis of BIS Hand Book wherever applicable. In case sections used



are different from BIS sections, then Manufacturers' Hand Book shall be adopted. No allowance in weight shall be made for rolling tolerances.

- 17.3 Welds, bolts, nuts, washers, shims, pack plates, wedges, grout and shop painting shall not be separately measured. The quoted rate shall be deemed to include the same.
- 17.4 The rate shall include all expenses related to safety & security arrangements during erection and all plants & tools required for fabrication, transportation & erection.

18.0 PAINTING AFTER ERECTION

18.1 GENERAL

- 18.1.1 The scope of painting after erection shall be at the sole discretion of the Engineer-in-Charge and the Contractor shall obtain written instruction in this regard sufficiently prior to taking up any procurement of paint and execution of painting work after erection of steel structures.
- 18.1.2 The Contractor shall carry out the painting work in all respects with the best quality of approved materials (conforming to relevant BIS Codes or IS: 800, as applicable) and workmanship in accordance with the best engineering practice. The Contractor shall furnish characteristics of paints (to be used) indicating the suitability for the required service conditions. The paint manufacturer's instructions supplemented by Engineer-in-Charge's direction, if any, shall be followed at all times. Particular attention shall be paid to the following:
- a. Proper storage to avoid exposure & extremes of temperature.
 - b. Surface preparation prior to painting.
 - c. Mixing & thinning.
 - d. Application of paint and the recommended limit on time intervals between consecutive coats.
- 18.1.3 Painting shall not be done in frost or foggy weather, or when humidity is such as to cause condensation on the surfaces to be painted.
- 18.1.4 Surface which shall be inaccessible after site assembly shall receive the full specified protective treatment before assembly.
- 18.1.5 Primers & finish coat paints shall be from the same manufacturer in order to ensure compatibility. Painting colour code shall be as per Annexure-'B'.

18.2 RUB DOWN & PRIMER APPLICATION

The shop coated surfaces shall be rubbed down thoroughly with emery/abrasive paper to remove dust, rust, other foreign matters and degreased, if required, in accordance with IS: 1477 or IS: 800, as applicable, cleaned with warm fresh water and air dried. The portions, from where the shop coat has peeled off, shall be touched up and allowed to dry.



Primer coat as per table 29 of IS: 800 shall be applied by brushing/ spraying over the shop coat in a manner so as to ensure a continuous and uniform film throughout. Special care shall be taken to cover all the crevices, corners, edges etc. The final primer coat shall be air dried and shall have a minimum film thickness as per IS: 800 after drying, as applicable.

In case a different cleaning procedure & primer specifications are specified in the drawing/Tender, the same shall be adopted.

18.3 FINAL PAINT APPLICATION

After the primer is hard dry, the surfaces shall be dusted off and one coat of synthetic enamel paint of approved colour & shade (conforming to IS: 2932) or any other paint as per IS: 800, shall be applied by brushing/spraying so that a film free from "holidaying" is obtained. The colour & shade of first coat of paint shall be slightly lighter than the second coat in order to identify the application of each coat. The second coat of paint shall be applied after the first coat is hard dry. The minimum thickness of each film shall be as per IS: 800 after drying.

In case a different type of paint & painting procedure are specified in the drawing/tender, the same shall be adopted.

Color coding for structural steel shall be as per ANNEXURE "B".

18.4 INSPECTION & TESTING OF PAINTING WORKS

18.4.1 All painting materials including primers & thinners brought to site by the Contractor for application shall be procured directly from reputed and approved manufacturers and shall be accompanied by manufacturer's test certificates. Paint formulations without certificates shall not be accepted.

18.4.2 The Engineer-in-Charge at his discretion may call for additional tests for paint formulations. The Contractor shall arrange to have such tests performance including batch wise test of wet paints for physical & chemical analysis. All costs shall be borne by the Contractor.

18.4.3 The painting work shall be subject to inspection by the Engineer-in-Charge at all times. In particular, the stage inspection will be performed and Contractor shall offer the work for inspection and approval at every stage before proceeding with the next stage. The record of inspection shall be maintained. Stages of inspection are as follows:

- a. Surface preparation
- b. Primer application
- c. Each coat of paint

18.4.4 Any defect noticed during the various stages of inspection shall be rectified by the Contractor to the entire satisfaction of the Engineer-in-Charge before proceeding further. Irrespective of the inspection, repair and approval at intermediate stages of



work the Contractor shall be responsible for making good any defects found during final inspection/guarantee period/defect liability period, as defined in General Conditions of Contract. Dry film thickness (DFT) shall be checked and recorded after application of each coat. The thickness shall be measured at as many locations as decided by the Engineer-in-Charge. The Contractor shall provide standard thickness measuring instrument such as elkometer (with appropriate range for measuring dry film thickness of each coat) free of cost to the Engineer-in-Charge whenever asked for.

18.5 PAYMENT

This clause shall apply to Item Rate tender only.

Payment for painting of structural steel works shall be made on the basis of admissible weight in metric tons of the painted structures accepted by the Engineer-in-Charge.

The rate shall include supplying & applying two coats of synthetic enamel paint or any other paint specified in the tender of approved quality and shade over a coat of red oxide zinc chromate primer or any other primer specified in the tender over one coat of shop primer already applied to structural steel works of all types/shapes at all levels, locations & positions including storage, surface preparation, degreasing, cleaning, drying, touching up of shop primer coat, providing temporary staging, testing etc. all complete to the entire satisfaction of the Engineer-in-Charge.

**ANNEXURE-'A'****(Clause 12.4)**

Maximum Permissible Erection Tolerances

A. Columns

1. Deviation of column axes at foundation top level with respect to true axes.
 - i) In longitudinal direction $\pm 5\text{mm}$
 - ii) In lateral direction $\pm 5\text{mm}$
2. Deviation in the level of bearing surface of columns at foundation top with respect to true level $\pm 5\text{mm}$
3. Out of plumb (Verticality) of column axis from true vertical axis, as measured at top:
 - i) Up to and including 30m height $\pm H/1000$ or $\pm 25\text{mm}$
Whichever is less.
 - ii) Over 30m height $\pm H/1200$ or $\pm 35\text{mm}$
Whichever is less.
4. Deviation in straightness in longitudinal & transverse planes of column at any point along the height. $\pm H/1000$ or $\pm 10\text{mm}$
Whichever is less.
5. Difference in the erected positions of adjacent pairs of columns along length or across width of building prior to connecting trusses/beams with respect to true distance. $\pm 5\text{mm}$
6. Deviation in any bearing or seating level with respect to true level. $\pm 5\text{mm}$
7. Deviation in difference in bearing levels of a member on adjacent pair of columns both across & along the building. $\pm 5\text{mm}$

Note: 1. Tolerance specified under 3 should be read in conjunction with 4 & 5.

Note: 2. 'H' is the column height in mm.

**B. Trusses**

1.	Shift at the centre of span of top chord member with respect to the vertical plane passing through the centre of bottom chord.	$\pm 1/250$ of height of truss in mm at centre of span or $\pm 15\text{mm}$ whichever is less.
2.	Lateral shift of top chord of truss at the centre of span from the vertical plane passing through the centre of supports of the truss.	$\pm 1/1500$ of height of truss in mm or $\pm 10\text{mm}$ whichever is less.
3.	Lateral shift in location of truss from its true position.	$\pm 10\text{mm}$
4.	Lateral shift in location of purlin from true position.	$\pm 5\text{mm}$
5.	Deviation in difference of bearing levels of truss from the true level.	$\pm 1/1200$ of span of truss in mm or $\pm 20\text{mm}$ whichever is less.

C. Gantry Girders & Rails

1.	Shift in the centre line of crane rail with respect to centre line of web of gantry girder.	$\pm \left[\frac{\{\text{web thickness (mm)}\} + 2\text{mm}}{2} \right]$
2.	Shift of alignment of crane rail (in plan) with respect to true axis of crane rail at any point.	$\pm 5\text{mm}$
3.	Deviation in crane track gauge with respect to true gauge.	
i)	For track gauge up to and including 15m.	$\pm 5\text{mm}$
ii)	For track gauge more than 15m.	$\pm [5 + 0.25 (S - 15)]$ Subjected to maximum $\pm 100\text{mm}$, where S in Metres is true gauge.
4.	Deviation in the crane rail level at any point from true level.	$\pm 10\text{mm}$
5.	Difference in level between crane track rails (across the bay) at	
i)	Supports of gantry girders	15mm
ii)	Mid span of gantry girders	20mm
6.	Relative shift of crane rail surfaces (at a joining) in plan and elevation.	2mm

**ANNEXURE-'B'****(Clause 18.3)****PAINTING COLOUR CODE FOR STRUCTURAL STEEL**

1.	GANTRY GIRDER & MONORAIL	DARK GREEN
2.	GANTRY GIRDER & MONORAIL STOPPER	SIGNAL RED
3.	BUILDING STRUCTURAL STEEL COLUMNS, BRACKETS, BEAMS, BRACINGS, ROOF TRUSS, PURLINS, SIDEGIRTS, LOUVERS, STRINGERS,	DARK ADMIRALITY GREY
4.	PIPE RACK STRUCTURE & TRESTLE	DARK ADMIRALITY GREY
5.	CHEQUERED PLATE (BOTH FACES)	BLACK
6.	GRATING	BLACK
7.	LADDER	RUNGS-BLACK VERTICALS & CAGE RED
8.	HAND RAILING	
-	HANDRAIL, MIDDLE RAIL, TOE PLATE	SIGNAL RED
-	VERTICAL POST	BLACK



Energising Quality

VCS Quality Services Pvt Ltd

**STANDARD SPECIFICATION
FOR
BRICK MASONRY**

VCS-SS-CS-6027

					
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**STANDARD SPECIFICATION
FOR BRICK MASONRY**

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02	25.02.2020	NV	GDS	RKB	SK	New revision system updated
03	31.01.2022	NV	GDS	HK	GW	VCS QMS Integration



ABBREVIATION

m	Metre
mm	Millimetre
Cm	Centimetre
m ²	Square metre
m ³	Cubic Metre
Kg	Kilogram
IS	Indian Standard
MS	Mild Steel
C/C	Center to Center
RCC	Reinforced Cement Concrete
PCC	Plain Cement Concrete



CONTENTS

1.0	SCOPE	5
2.0	REFERENCES	5
3.0	MATERIALS.....	5
4.0	GENERAL REQUIREMENTS.....	5
5.0	CONSTRUCTION PROCEDURE	6
6.0	PAYMENT	10



1.0 SCOPE

THIS SPECIFICATION ESTABLISHES THE MATERIALS, DRESSING, LAYING, JOINING, CURING, WORKMANSHIP ETC. FOR BRICK MASONRY WORKS. BRICK MASONRY SHALL ALSO COMPLY WITH ALL THE REQUIREMENTS OF IS: 2212.

2.0 REFERENCES

2.1 BIS CODES

IS: 2212 Brick works-code of practice

IS: 2250 Code of practice for preparation and use of masonry works

2.2 SPECIFICATIONS

VCS-SS-CS-6021 Materials

3.0 MATERIALS

Refer specification no. VCS-SS-CS-6021: Materials

4.0 GENERAL REQUIREMENTS

4.1 CEMENT MORTAR

Cement mortar shall meet the requirements of IS: 2250 and shall be prepared by mixing cement and sand by volume. Proportion of cement and sand shall be 1:6 (1 part of cement and 6 parts of sand), or as directed by the Engineer-in-Charge/shown on the drawing, for brick masonry of one brick thickness or more, while 1:4 cement mortar (1 part of cement and 4 parts of sand) shall be used for brick masonry of half brick thickness. The sand being used for mortar shall be sieved. The mortar shall be used as soon as possible after mixing and before it has begun to set and in any case within initial setting time of cement after water is added to the dry mixture. Mortar unused for more than initial setting time of cement, shall be rejected and removed from the site of work.

4.1.1 PROPORTIONING

The unit of measurement for cement shall be a bag of cement weighing 50 kgs and this shall be taken as 0.035 cubic metre. Sand shall be measured in boxes of suitable size on the basis of its dry volume. In case of damp sand, its quantity shall be increased suitably to allow for bulkage.

4.1.2 MIXING

The mixing of mortar shall be done in a mechanical mixer operated manually or by power. The Engineer-in-Charge may, however, permit hand-mixing as a special case, taking into account the magnitude, nature and location of work. The Contractor shall take the prior permission of Engineer-in-Charge, in writing, for using hand-mixing before the commencement of work.



a. Mixing in Mechanical Mixer

Cement and sand in specified proportions, by volume, shall be thoroughly mixed dry in a mixer. Water shall then be added gradually and wet mixing continued for at-least one minute. Care shall be taken not to add more water than that which shall bring the mortar to the consistency of stiff paste. Wet mix from the mixer shall be unloaded on water-tight masonry platform, made adjacent to the mixer. Platform shall be at-least 150 mm above the levelled ground to avoid contact of surrounding earth with the mix. Size of the platform shall be such that it shall extend at-least 300mm all-round the loaded wet mix area. Wet mix, so prepared, shall be utilized within initial setting time [thirty (30) minutes either for ordinary Portland cements conforming to IS: 269 or for Portland slag cement conforming to IS: 455] after addition of water. Mixer shall be cleaned with water each time before suspending the work.

b. Hand Mixing

The measured quantity of sand shall be levelled on a clean water-tight masonry platform and cement bags emptied on top. The cement and sand shall be thoroughly mixed dry by being turned over and over, backward and forward, several times till the mixture is of uniform colour. The quantity of dry mix which can be consumed within initial setting time of cement shall then be mixed with just sufficient quantity of water to bring the mortar to the consistency of stiff paste.

5.0 CONSTRUCTION PROCEDURE

5.1 SOAKING OF BRICKS

Bricks shall be soaked in water before use for a period that is sufficient for the water to just penetrate the whole depth of bricks as well as to remove dirt, dust and sand. Proper soaking of bricks shall prevent the suction of water from the wet mortar as otherwise mortar will dry out soon and crumble before attaining any strength. The bricks shall not be too wet at the time of use as they are likely to slip on mortar bed and there will be difficulty in achieving the plumb-ness of wall as well as proper adhesion of bricks to mortar. The period of soaking shall be determined at site by a field test by immersing the bricks in water for different periods and then breaking the bricks to find the extent of water penetration. The least period that corresponds to complete soaking, will be the one, to be allowed for in the construction work.

The soaked bricks shall be removed from the tank, sufficient early, so that at the time of laying, they are skin dry. The soaked bricks shall be stacked over a clean place, wooden planks or masonry platforms to avoid earth, dirt being smeared on them.

5.2 LAYING

5.2.1 BRICK WORK (ONE OR MORE BRICK THICKNESS)



Brick work (one or more brick thickness) shall be laid in English Bond unless otherwise specified. Half or cut bricks shall not be used except when needed to complete the bond. In no case the defective bricks shall be used.

A layer of average thickness of 10mm of cement mortar shall be spread on full width over a suitable length of lower course or the concrete surface. In order to check and achieve uniformity in masonry, the thickness of bed joints shall be such that four courses and three joints taken consecutively shall measure equal to four times the actual thickness of the brick plus 30mm. Each brick with frog upward shall be properly bedded and set in position by gently tapping with handle of trowel or wooden mallet. Its inside faces shall be buttered with mortar before the next brick is laid and pressed against it. After completion of the course, all vertical joints shall be filled from top with mortar.

All brick courses shall be taken up truly plumb; if battered, the batter is to be truly maintained. All courses shall be laid truly horizontal and vertical joints shall be truly vertical. The level and verticality of work in walls shall be checked up at every one metre interval.

The masonry walls of structures shall be carried up progressively, leaving no part one metre lower than the other. If this cannot be adhered to, the brick work shall be raked back according to bond (and not left toothed) at an angle not more than 45 degrees but raking back shall not start within 60 cm of a corner. In all cases returns, buttresses, counter forts, pillars etc. shall be built up carefully course by course, and properly bonded with the main walls. The brick work shall not be raised more than fourteen (14) courses per day.

At the junction of any two walls, the bricks shall at each alternate course, be carried into each of the respective walls so as to thoroughly unite the work.

The courses at the top of plinth and sills, at the top of the wall just below the soffit of the roof slab or roof beam and at the top of the parapet, shall be laid with bricks on edge. Brick on edge course shall be so arranged as to tightly fit under the soffit of the roof beam or roof slab, restricting the mortar layer thickness up to 12mm, however, any gap between the finished brick work and soffit of roof slab/beam shall be suitably sealed with the mortar.

5.2.2 BRICK WORK (HALF BRICK THICKNESS)

For brick walls of half brick thickness, all courses shall be laid with stretchers. Wall shall be reinforced with 2 nos. - 6mm diameter mild steel reinforcement bars, placed at every fourth course. The reinforcement bars, shall be straightened and thoroughly cleaned. Half the mortar thickness for the bedding joint shall be laid first and mild steel reinforcement, one on each face of the wall, shall be embedded, keeping a side cover of 12mm mortar. Subsequently, the other half of the mortar thickness shall be laid over the reinforcement covering it fully.

The reinforcement bars shall be carried at least 150mm into the adjoining walls or RCC columns. In case the adjoining wall being of half brick thickness, the length of bars



shall be achieved by bending the bars in plan. During casting of reinforced concrete columns, 6mm dia. M.S. reinforcing bar shall be placed at every fourth course of brick masonry. At the junction of two walls, the brick shall, at each alternate course, be carried into each of the respective walls so as to thoroughly unite the work. The brick masonry work shall not be raised more than 14 courses per day.

Brick course under the soffit of beam or slab, shall be laid by restricting the mortar thickness to 12mm. However, any gap between the finished brickwork and soffit of slab/beam shall be suitably sealed with the mortar.

5.2.3 CAVITY WALLS

Brick work in cavity walls shall be included with general brickwork. It shall consist of one wall of one or more brick thickness while the other wall shall be of half brick thickness at a clear gap of 50mm. The brick work on either side of cavity shall conform to the specifications already stated under clause no. 5.2.1 and 5.2.2. At the base of the cavity wall, the walls shall be solidly constructed up to 300mm above the ground level. The cavity wall shall be terminated 300mm below the soffit of roof slab/beam and the courses over this shall be continued in solid brickwork.

Cavity should be continuous and free from obstructions. Mortar droppings shall be prevented from falling down the cavity by the use of laths or by hay hands which shall be drawn up the cavity as the work proceeds. Any mortar which may unavoidably fall on the wall-ties, shall be removed daily and temporary openings shall be provided to permit the daily removal of mortar droppings from the bottom of the cavity.

The outer and inner leaves shall be tied by means of wall ties. Ties shall be of mild steel round bars of 8mm dia. 200 mm long with hooks at both the ends. These shall be placed not more than 750mm c/c horizontally and not more than 300mm vertically, and staggered. Additional ties shall be provided near the openings. There shall at least, be 5 ties per square metre of surface area of the wall. Ties shall be given a bituminous coat before placement, to protect them from corrosion.

In order to keep the cavity dry, air slots shall be provided in the cavity walls at bottom as well as top to the extent of 50 sq.cm areas of vents to every 2.0 sq.metre area of the wall.

5.2.4 CIRCULAR BRICK WORK

The detailed specification for brick work covered under clause no. 5.2.1 & 5.2.2 shall apply, in so far as these are applicable. Bricks forming skew backs shall be dressed or cut so as to give proper radial bearing. Defects in dressing of bricks shall not be covered up by extravagant use of mortar, nor shall the use of chips etc., be permitted.

The circular brick work shall be carried up from both ends simultaneously and keyed in the centre. The bricks shall be flushed with mortar and well pressed into their positions so as to squeeze out a part of their mortar and leave the joints thin and compact. All joints shall be full of mortar and thickness of joints shall be between 5mm and 15mm.

5.3 JOINTING



Joints shall be restricted to a width of 10mm with brickwork of any classification. All bed joints shall be normal to the pressure upon them i.e. horizontal in vertical walls, radial in circular brick masonry and at right angles to the face in the battered retaining walls. The vertical joints in alternate courses shall come directly one over the other and shall be truly vertical. Care shall be taken that all the joints are full of mortar, well flushed up. In case no pointing is to be done, cement mortar shall be neatly struck as the work proceeds. The joints in faces which are to be plastered or pointed shall be squarely raked out to a depth of 12mm while the mortar is still green. The rake joints shall be brushed to remove loose particles. After the day's work, the faces of the brick work shall be cleaned on the same day with wire brush and all mortar droppings removed.

5.4 CURING

Green work shall be protected from rain or any other running water or accumulated water from any source, by suitable means. Masonry work as it progresses shall be, kept thoroughly wet by sprinkling water at regular intervals, on all faces. Curing shall be done after 24 hours of completion of day's work and shall be done for at-least 10 days after completion. Proper watering cans with spray nozzles, rubber or PVC pipes shall be used for this purpose.

5.5 STAGING / SCAFFOLDING

5.5.1 Staging/scaffolding shall be properly planned and designed by the Contractor. Use of only steel tubes is permitted for staging/scaffolding. Design of staging/scaffolding shall be submitted for approval of the Engineer-in-Charge, before commencement of work.

Single scaffolding having one set of vertical support, shall be used and other end of the horizontal scaffolding member shall rest in a hole provided in the header course. The support shall be sound and strongly clamped with the horizontal pieces over which the scaffolding planks shall be fixed. The holes left in the masonry work for supporting the scaffolding shall be filled and made good with plain cement concrete of grade 1:3:6 during plastering. Suitable access shall be provided to the working platform area. The scaffolding shall be strong enough to withstand all loads likely to come upon it and shall also meet the requirements specified in IS: 2750.

Double scaffolding shall be provided for pillars less than one metre in width or for the first class masonry or for a building having more than two storey.

The following measures shall also be considered during erection of the scaffolding/staging.

- a. Sufficient sills or underpinnings, in addition to base plates, shall be provided particularly, where scaffoldings are erected on soft grounds.
- b. Adjustable bases to compensate for uneven ground shall be used.
- c. Proper anchoring of the scaffolding/staging at reasonable intervals shall be provided in each direction with the main structure wherever available.



- d. Horizontal braces shall be provided to prevent the scaffolding from rocking.
- e. Diagonal braces shall be provided continuously from bottom to top between two adjacent rows of uprights.
- f. The scaffolding/staging shall be checked at every stage for plumb line.
- g. Wherever the scaffolding/staging is found to be out of plumb line, it shall be dismantled and re-erected afresh. Efforts shall not be made to bring it in line with a physical force.
- h. All nuts and bolts shall be properly tightened and care shall be taken that all the clamps/couplings are firmly tightened to avoid slippage.
- i. Erection work of a scaffolding/staging, under no circumstance shall be left totally to semiskilled or skilled workmen and shall be carried out under the supervision of Contractor's technically qualified civil engineer.

5.5.2 For smaller works or works in remote areas wooden ballies may be permitted for scaffolding/staging by the Engineer-in-Charge at his sole discretion. The contractor must ensure the safety and suitability of such works as described under clause 5.5.1 above.

5.6 EMBEDMENT OF FIXTURES

All fixtures, pipes, conduits, holdfasts of doors and windows etc. required to be built in walls, shall be embedded in plain cement concrete block of grade 1:3:6, at the required positions, as the work proceeds.

6.0 PAYMENT

This clause shall apply to Item Rate tender only.

6.1 GENERAL

The payment of brick masonry shall be inclusive of all labour, material, scaffolding/staging sampling and testing, soaking of bricks, laying of bricks, raking of joints, cutting of bricks, providing recesses and making rectangular or round openings, sealing the gap between brick masonry and soffit of beam/slab with and including cement mortar, curing, making of masonry platform for unloading the wet mix, embedding the fittings/fixtures including providing PCC(1:3:6) etc, all as specified for all heights and depths. Deduction for rectangular or circular openings shall be done as per relevant BIS Codes

- 6.1.1 Payment for brick masonry works of one or more brick thickness, including circular brickwork, shall be made on cubic metre basis of the work done
- 6.1.2 Payment for half brick masonry work shall be made on square metre basis on the area of works done and shall also include the cost of supplying and fixing of reinforcement bars in position



- 6.1.3 Payment for forming the cavity shall be in square metres and shall include the cost of laying of bitumen coated MS ties in position, labour required for keeping the cavity clear, providing air slots etc



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DEMOLITION AND DISMANTLING**

VCS-SS-CS-6029

					
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**STANDARD SPECIFICATION
FOR DEMOLITION AND DISMANTLING**

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Rev No : 03**

ABBREVIATION

m	Metre
mm	Millimetre
Sqm	Square Metre
Cum	Cubic Metre



CONTENTS

1.0	SCOPE	5
2.0	REFERENCES	5
3.0	GENERAL	5
4.0	SAFETY PRECAUTIONS	5
5.0	PROCEDURE	6
6.0	CLEANING & STACKING	7
7.0	DISPOSAL	7
8.0	PAYMENT	7



1.0 SCOPE

This specification covers the procedure and safety requirements for demolition and dismantling of masonry (Brick & Stone), concrete (Plain /Reinforced), structural steel (sheeted / un sheeted) works.

2.0 REFERENCES

- 2.1 Specification No. VCS-SS-CS-6002, Earth work in site grading
- 2.2 VCS-SS-CS-6003, Earth work for Underground piping
- 2.3 VCS-SS-CS-6022, Earth work in foundations

for Earth work.

3.0 GENERAL

- 3.1 Apart from this specification, the demolition and dismantling of structures (part or whole) shall be in compliance with all statutory safety regulations and any other special requirement as shown/noted on the drawings and General Conditions of Contract. Prior consent and approval of the Engineer-in-charge shall be obtained in writing before starting any dismantling works. Any restrictions imposed regarding working hours shall also be strictly followed by the Contractor.
- 3.2 All materials obtained from dismantling/demolition operations shall be the property of the Owner unless otherwise specified and shall be kept in safe custody until handed over to the Engineer-in-charge.
- 3.3 Where it becomes necessary to disconnect any existing service line(s) (such as electrical, piping etc.) during dismantling/demolishing operation and where so required by the Engineer-in-charge, suitable alternate arrangement shall be made by the Contractor to maintain the continuity and proper functioning of the affected service line(s) with the approval of the Engineer-in-charge at no extra cost to the Owner.

4.0 SAFETY PRECAUTIONS

- 4.1 The Contractor shall adhere to safe demolishing/dismantling practices at all stages of work to guard against accidents, hazardous and unsafe working procedures.
- 4.2 Necessary propping, shoring strutting and/or underpinning shall be done for the safety of all surrounding structures (whose safety is likely to be endangered) before taking up, the demolishing and dismantling work.
- 4.3 Temporary enclosures made out of GI sheets, fencings, danger lights etc. shall be provided by the Contractor and got approved by the Engineer-in-charge before start of work to prevent accidents.
- 4.4 Contractor must ensure the availability of adequate firefighting equipment / arrangements before starting actual demolishing/dismantling works. These facilities



shall be made available throughout the entire operation of demolition and dismantling of structures.

- 4.5 All equipment's, pipes, fittings and instruments, underground utilities etc. located in the vicinity shall be protected by suitable means, as decided by the Engineer-in-charge, during demolishing, dismantling operations.
- 4.6 Roads and working spaces shall be kept free of any debris/dismantled materials at the end of day's work.
- 4.7 Necessary measures shall be taken to keep the dust and noise nuisance to minimum levels.
- 4.8 Dismantled elements/components shall not be dropped from a height or thrown from a distance. Dismantling of elements fixed by screws/bolts/hooks etc. shall be done by taking out the fixtures with proper tools only. Such fixtures may be allowed to be cut by sawing or flame cutting, in the event of their being stuck-up due to corrosion etc. however the decision of Engineer-in-charge in this regard shall be final and binding, Welds shall be removed by flame cutting. Tearing or ripping of elements shall not be resorted to under any condition.

5.0 PROCEDURE

- 5.1 Entire work of demolishing & dismantling shall be meticulously planned. Prior to start of work, the Contractor shall thoroughly understand the scope and nature of the work, and then prepare and submit the proposed work execution plan of demolishing & dismantling to the Engineer-in-charge for his review. Comments if any, shall be taken care by the contractor and execution of the work shall be done based on the revised execution plan.
- 5.2 Demolition and dismantling shall be restricted to the extent shown on drawings or as directed by the Engineer-in-charge.
- 5.3 Demolition of any structure shall be carried out in the sequence reverse to that followed at the time of its construction.
- 5.4 Dismantling shall be done in a systematic manner. All elements shall be carefully removed without causing any damage.
- 5.5 Blasting in any form shall not be permitted.
- 5.6 Chipping of concrete/grout shall be done with precision by chiseling. The finished surfaces shall be made true to the requisite size and shape.
- 5.7 Pockets/holes of specified size shall be made/cut by drilling/chiseling.



6.0 CLEANING & STACKING

- 6.1 All demolished/dismantled serviceable materials such as bricks, stones, reinforcement bars, structural steel, sheeting etc. shall be separated out, cleaned and stacked in separate lots within the plant boundary as directed by the Engineer-in-charge.

7.0 DISPOSAL

All unserviceable materials shall be disposed off in spoil heaps within or outside the plant boundary as per the directions of the Engineer-in-charge. Areas required outside the plant boundary for dumping of disposed material shall be arranged by the contractor and got approved by the Engineer-in-charge.

8.0 PAYMENT

This clause shall be applicable for item tender rate only.

8.1 GENERAL

Measurement of all works shall be taken prior to start of demolishing / chipping / dismantling works.

8.2 MASONRY/CONCRETE WORKS (DEMOLITION)

- 8.2.1 Payment shall be made on the basis of actual volume in cubic meters (cu.m.) of masonry/concrete works demolished. The thickness of plaster/bitumen felt shall be included in measurements. The rate for demolishing shall include supply of labour, tools & tackles, necessary safety measures, propping, underpinning, scaffolding, handling, cutting, straightening, scraping & cleaning of reinforcement bars and other embedment's (in case of reinforced concrete works), sorting out and stacking of all serviceable materials, disposal of all unserviceable material, clearing the site, etc. all complete as specified and directed by the Engineer-in-charge.

8.3 EXCAVATION & BACKFILLING

- 8.3.1 Excavation and backfilling shall be paid separately as per relevant clauses of specification No. VCS-SS-CS-6002, VCS-SS-CS-6003, VCS-SS-CS-6022 for Earth Work.

8.4 CHIPPING OF CONCRETE WORKS

Payment shall be made on the basis of admissible area in square meters (sq.m.) of concrete surfaces chipped, pertaining to the different categories of thicknesses specified in the schedule of items.

The rate for chipping shall include supply of labour, tools and tackles, necessary safety measures, scaffolding, chiseling, handling exposing, cutting, straightening, scraping, clearing the reinforcement bars (in case of reinforced concrete works), wire brushing and washing the exposed surfaces, disposal of all unserviceable material etc. all complete as directed.

8.5 MAKING POCKETS/HOLES IN CONCRETE WORKS



Payment shall be made on the basis of number (Each) of pockets/holes of sizes up to & inclusive of 200x200x500 mm, made or cut in the concrete works.

The rate for making pockets/holes shall include supply of labour, tools & tackles, necessary safety measures, scaffolding, chiseling, drilling, handling, cutting or relocating reinforcement bars, cleaning, disposal of all unserviceable material etc. all complete as directed.

8.6 DISMANTLING OF STRUCTURAL STEEL WORKS

Payment shall be made on the basis of weight (MT) of the structure/components being dismantled. Assessment of weight shall be done as per the specifications or as per the direction of Engineer-in-charge.

The rate for dismantling shall include supply of labour, tools and tackles, equipment, consumables, necessary safety measures, scaffolding, propping, handling, unbolting, cutting (by sawing or flame cutting) of gussets/plates/bolts/hooks/welds, cleaning, sorting out and stacking of all serviceable materials, disposal of all unserviceable material, etc. all complete as specified and directed.

8.7 DISMANTLING OF ROOF & WALL SHEETING

Payment shall be made on the basis of dismantled sheeted area in square meters (sq.m.) of plan area in case of roof sheeting and area in elevation in case of side and louver sheeting.

The rate for dismantling shall include supply of labour, tools and tackles, equipments, consumables, necessary safety measures, handling, scaffolding, unbolting, cutting (by saw or flame cutting) of hook bolts, removal of ridges, gutters, flashings, transporting, stacking of all serviceable materials, disposal of all unserviceable material etc. all complete as directed.



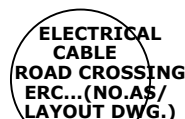
CABLE CROSSING UNDER ROAD (P.V.C. PIPES)

REV.	SIZE

03

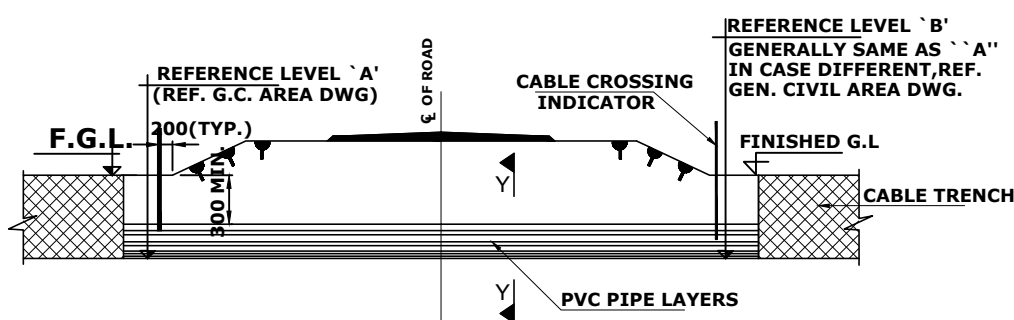
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1 OF 1

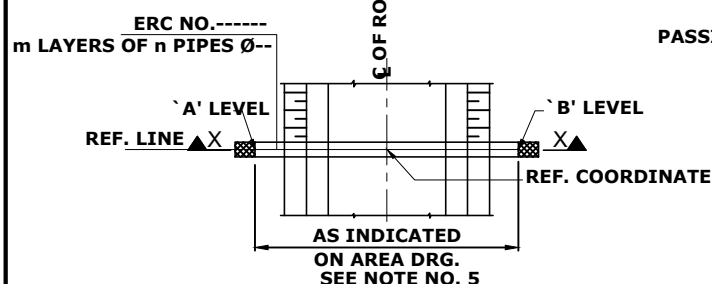


VIEW-1
(SEE NOTE-6)

DETAIL OF CABLE CROSSING INDICATOR

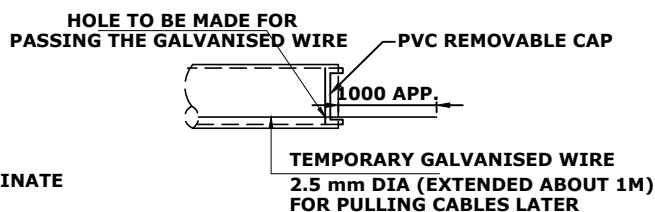


SECTION X-X
(APPLICABLE FOR ERC & IRC)



PLAN

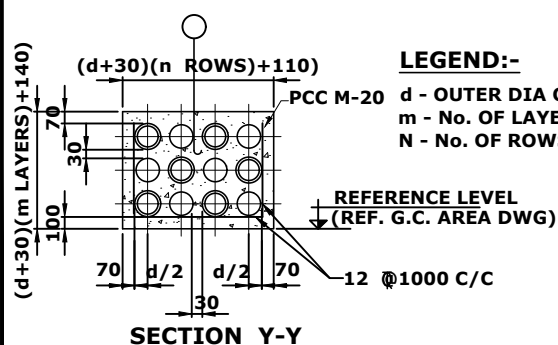
FEAR
(REPRESENTATION ON AREA DRG.)



SLEEVE END PLUGGING DETAIL

NOTES:-

1. ALL DIMENSIONS ARE IN MM. UNLESS NOTED OTHERWISE.
2. CONDUIT MATERIAL P.V.C. PIPE OF NOM. OUT SIDE PIPE DIA.Ø110, Ø160 OR Ø210 AS PER LAYOUT PLAN
3. PIPES SHALL CONFIRM TO IS: 4985 CLASS-I AND EMBEDDED IN PLAIN CEMENT CONCRETE.
4. BACK FILLING WITH ROAD MATERIAL SHALL BE DONE IN 150 MM THK. LAYER WELL WATERED AND COMPACTED AS PER ROAD SPECIFICATION.
5. INCASE CABLE CROSSING IS REQUIRED TO CROSS THE OPEN DITCHES ON EITHER SIDE THE LENGTH & THE LEVEL OF CABLE CROSSING SHALL BE DECIDED CLEARING THE SERVICE ALONG ROAD SIDE.
6. CABLE CROSSING INDICATOR MADE OF 4mm THK. MILD STEEL PLATE AS PER IS:2062, ENAMEL PAINTED IN JADE GREEN BACKGROUND ON BOTH SIDES WITH WHITE LETTERING.
7. THE SHAPE OF PVC REMOVABLE TYPE CAP AS SHOWN IS INDICATIVE.



SECTION Y-Y

03	03.02.22	RE-ISSUED AS STANDARD	MN	GDS	HK	WG
02	30.01.20	RE-ISSUED AS STANDARD	RK	GDS	RKB	SK
REV NO.	DATE	PURPOSE	PREPARED BY	CHECKED BY	APPROVED BY	AUTHORIZED BY



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STANDARD
FOR
SAFE SIGNING

STANDARD DRAWING NO.

VCS-STD-CS-6023

SHEET NO.

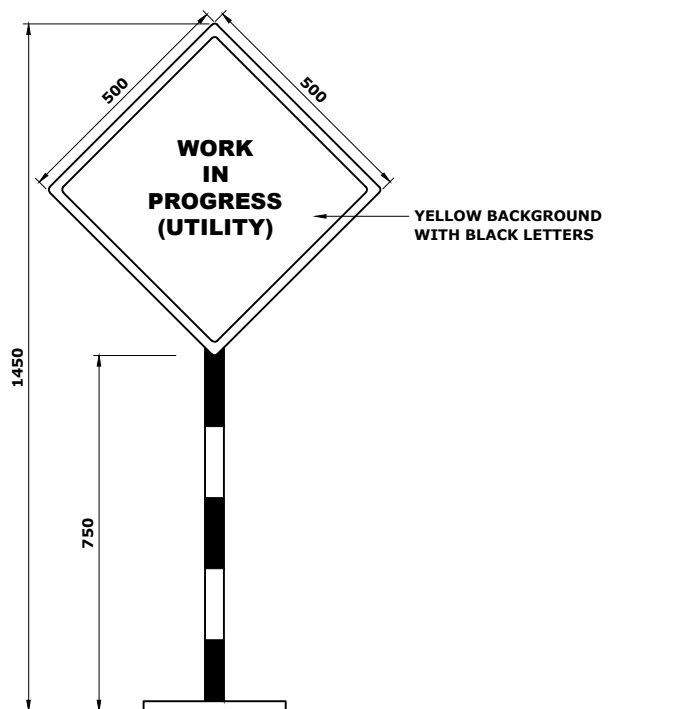
1 OF 1

REV.

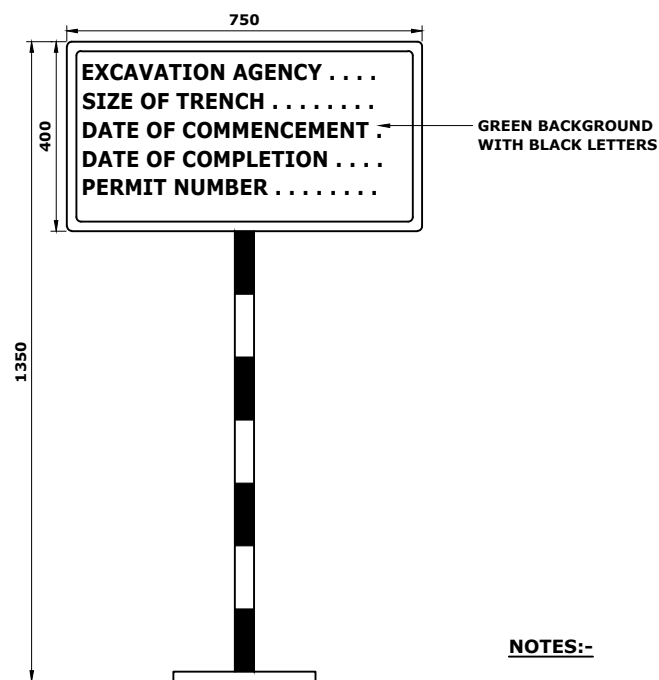
03

SIZE

A4



CAUTION BOARD



INFORMATION BOARD

NOTES:-

1 ALL DIMENSIONS ARE IN MILLIMETERS.

03	03.02.22	RE-ISSUED AS STANDARD	MN	GDS	HK	WG
02	30.01.20	RE-ISSUED AS STANDARD	RK	GDS	RKB	SK
REV NO.	DATE	PURPOSE	PREPARED BY	CHECKED BY	APPROVED BY	AUTHORIZED BY

FORMAT NO. VCS-FMT-003_00

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VALVE PIT (RCC)
TYPE-VI
FOR Ø 8" > 8" TO < 16" VALVE

STANDARD DRAWING NO.

VCS-STD-CS-6030

SHEET NO.

1 OF 1

REV.

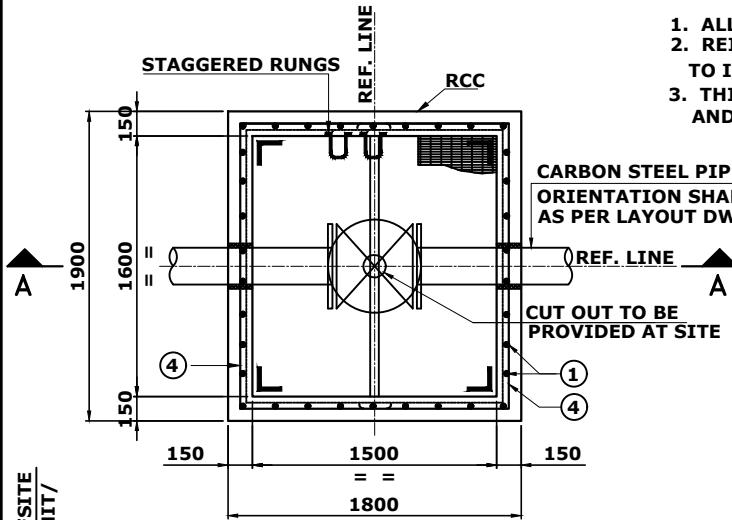
03

SIZE

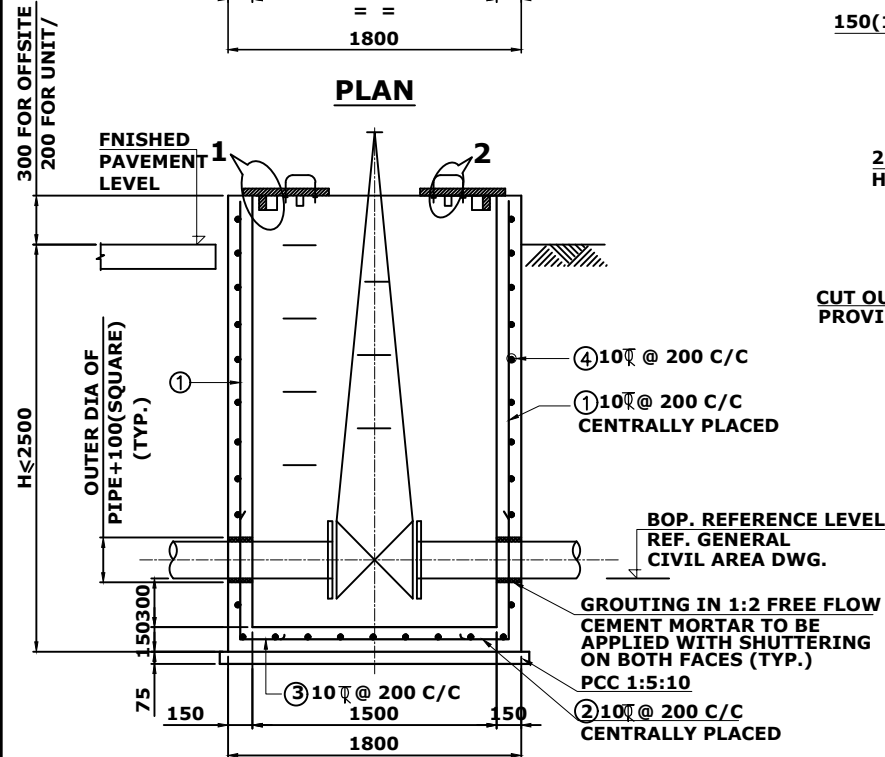
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NOTE:

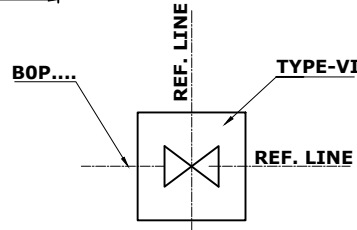
1. ALL DIMENSIONS ARE IN mm. UNLESS NOTED OTHERWISE.
2. REINFORCEMENT SHALL BE OF GRADE Fe 415 CONFORMING TO IS:1786
3. THIS STD. IS ALSO APPLICABLE FOR UNIT AREA, OFFSITE AREA AND AREA WHERE GROUND WATER TABLE IS UPTO FGL..



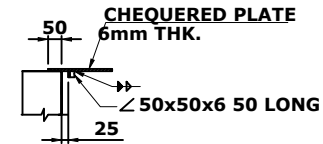
PLAN



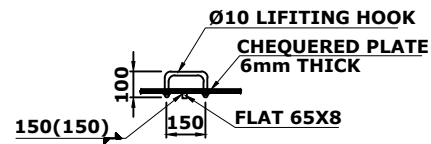
SECTION - A A



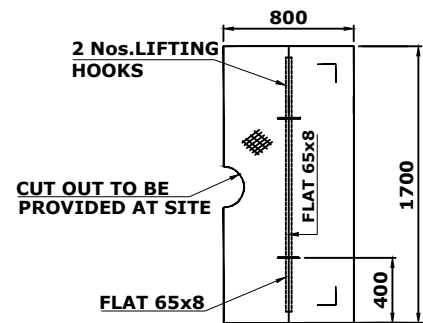
REPRESENTATION
ON AREA DRG.



DETAIL-1



DETAIL-2



PLAN

CHEQUERED PLATE
(2.NOS PER VALVE PIT)

BAR BENDING SCHEDULE

BAR MARK	DIA	BAR SHAPE
①	10	
②	10	
③	10	
④	10	

REV NO.	DATE	PURPOSE	PREPARED BY	CHECKED BY	APPROVED BY	AUTHORIZED BY
03	03.02.22	RE-ISSUED AS STANDARD	MN	GDS	HK	WG
02	30.01.20	RE-ISSUED AS STANDARD	BSS	MO	RKB	SK

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STANDARD FOR DETAIL
OF LIFTING HOOKS IN PRECAST SLABS
AND CHQD.PLATES

STANDARD DRAWING NO.

VCS-STD-CS-6045

SHEET NO.

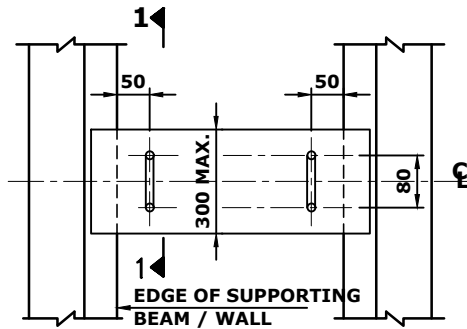
1 OF 1

REV.

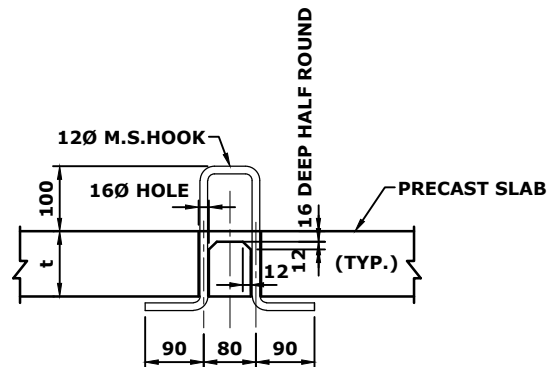
03

SIZE

A4

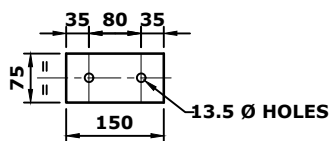


PLAN

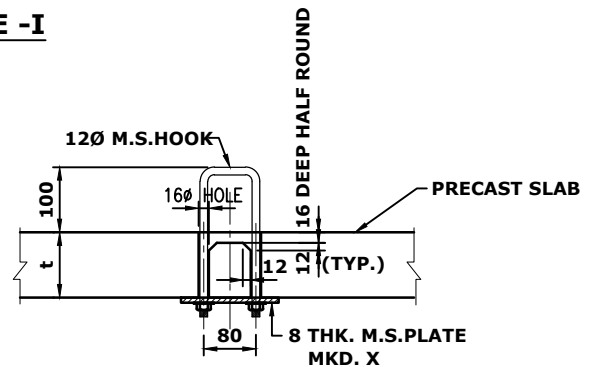


SECTION 1-1

TYPE -I

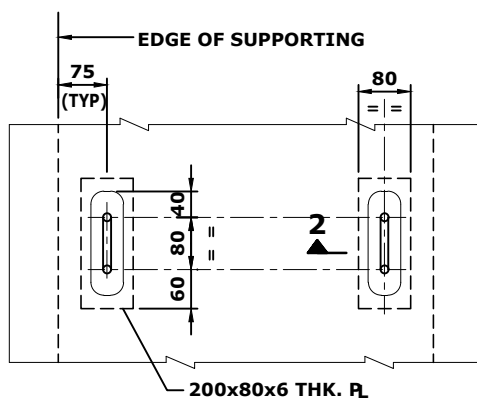


DETAIL OF M.S. PLATE MKD. X

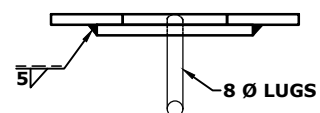


SECTION 1-1

TYPE -II



2



(OTHER DETAILS SAME AS IN TYPE-I ABOVE)

SECTION 2-2

TYPE -II
(FOR CHQD. PLATE ONLY)

NOTES:

1. ALL DIMENSIONS ARE IN mm.
2. FOR PRECAST SLABS GENERALLY LIFTING HOOK TYPE-I SHALL BE USED UNLESS TYPE-II IS SPECIFIED IN THE DRAWING.

REV NO.	DATE	PURPOSE	PREPARED BY	CHECKED BY	APPROVED BY	AUTHORIZED BY
03	03.02.22	RE-ISSUED AS STANDARD	MN	GDS	HK	WG
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STANDARD FOR DETAIL
OF R.C.C SLAB
FOR LOW COVER PIPELINE

STANDARD DRAWING NO.

VCS-STD-CS-6056

SHEET NO.

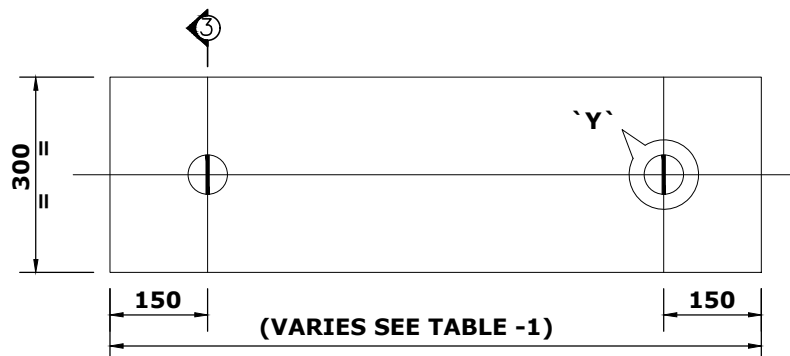
1 OF 1

REV.

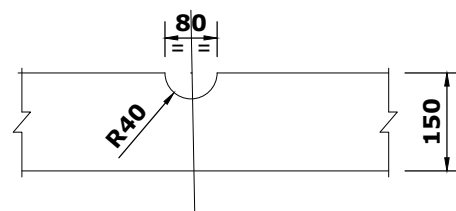
03

SIZE

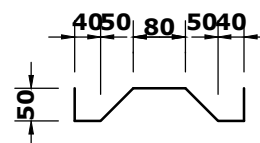
A4



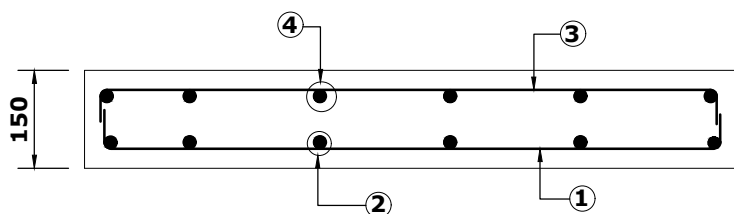
TYPE - A
(WITH LIFTING HOOK TYPE)



DETAIL- 'Y'
(TYP.)

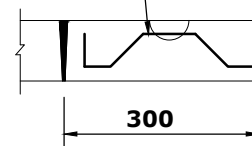


HOOK TYPE 'A'

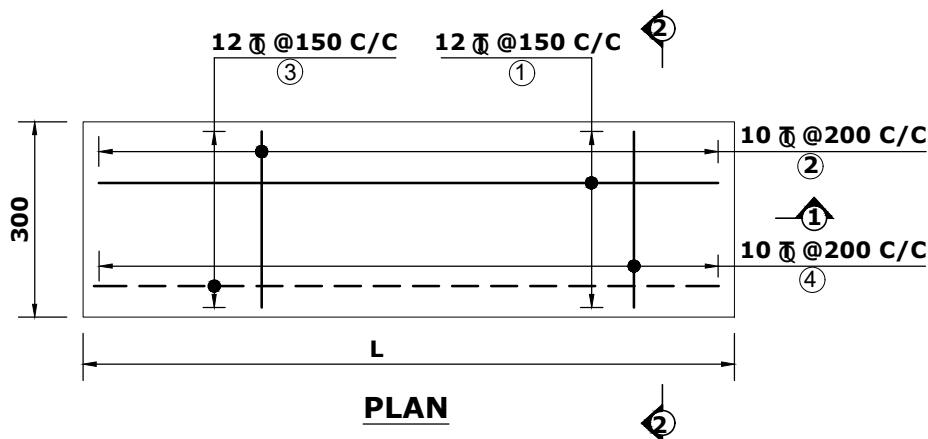


SECTION 1-1

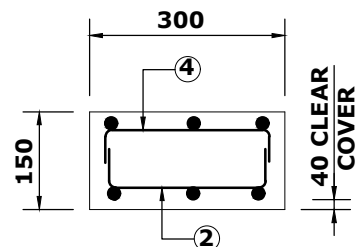
HOOK TYPE 'A'



SECTION 3-3



PLAN



SECTION 2-2

NOTES:-

1. ALL DIMENSIONS ARE IN MILLIMETERS & LEVELS ARE IN METRES.
2. GRADE OF CONC MIX SHALL BE M-25 CONFORMING TO IS- 456.
3. REINF SHALL BE HYSD BARS OF GRADE Fe 415 CONFORMING TO IS- 1786.
4. THIS STANDARD SHALL BE NOT BE USED FOR VEHICULAR MOVEMENT AREAS

TABLE - 1

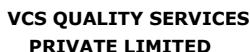
S.NO	PIPE DIA	LENGTH IN mm
1.	UP TO 16" Ø	1000
2.	18" Ø & ABOVE	D+600

REV NO.	DATE	PURPOSE	PREPARED BY	CHECKED BY	APPROVED BY	AUTHORIZED BY
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02	30.01.20	RE-ISSUED AS STANDARD	YS	GDS	RKB	SK

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STANDARD FOR DETAIL IN SERVICE PIPELINE SAFETY PROTECTION AGAINST ACCIDENTAL DAMAGE

STANDARD DRAWING NO.

REV.

SIZE

VCS-STD-CS-6057

03

A4

SHEET NO.

1 OF 2



NOTES:-

1. ALL DIMENSIONS ARE IN MILLIMETERS & LEVELS ARE IN METRES.
2. GRADE OF CONC MIX SHALL BE M-25 (MIN.) CONFORMING TO IS- 456.
3. REINF SHALL BE HYSD BARS OF GRADE Fe 415 CONFORMING TO IS- 1786.
4. THIS STANDARD SHALL BE NOT BE USED FOR VEHICULAR MOVEMENT AREAS
5. ALL INSERTS PLATES SHALL BE EPOXY PAINTED

03	03.02.22	RE-ISSUED AS STANDARD	MN	GDS	HK	WG
02	30.01.20	RE-ISSUED AS STANDARD	YS	GDS	RKB	SK
REV NO.	DATE	PURPOSE	PREPARED BY	CHECKED BY	APPROVED BY	AUTHORIZED BY



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STANDARD FOR DETAIL
IN SERVICE PIPELINE SAFETY PROTECTION
AGAINST ACCIDENTAL DAMAGE

STANDARD DRAWING NO.

VCS-STD-CS-6057

SHEET NO.

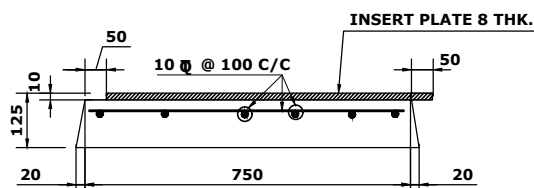
2 OF 2

REV.

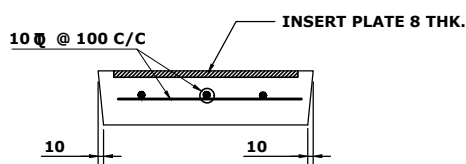
03

SIZE

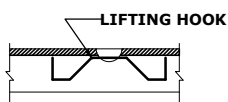
A4



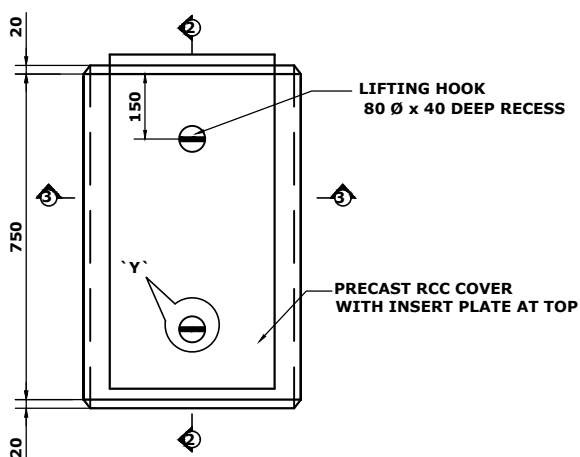
SECTION 2-2



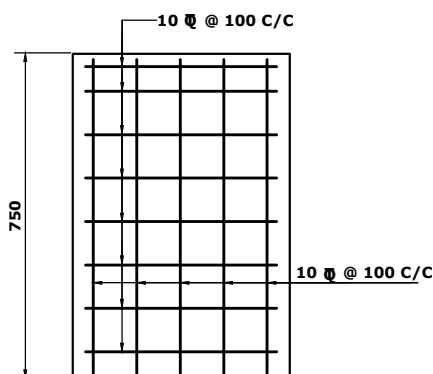
SECTION 3-3



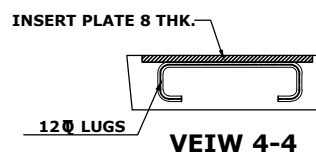
DETAIL- 'Y'
(TYP.)



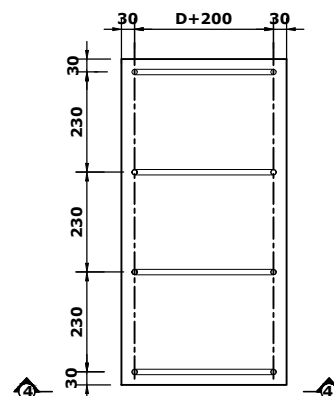
DETAIL OF PRECAST COVER



REINFORCEMENT DETAILS OF COVER SLAB



VEIW 4-4



DETAILS OF INSERT PLATE (IP-1)

NOTES:-

1. ALL DIMENSIONS ARE IN MILLIMETERS & LEVELS ARE IN METRES.
2. GRADE OF CONC MIX SHALL BE M-25 (MIN.) CONFORMING TO IS- 456.
3. REINF SHALL BE HYSD BARS OF GRADE Fe 415 (MIN.) CONFORMING TO IS- 1786.
4. THIS STANDARD SHALL BE NOT BE USED FOR VEHICULAR MOVEMENT AREAS
5. ALL INSERTS PLATES SHALL BE EPOXY PAINTED

REV NO.	DATE	PURPOSE	PREPARED BY	CHECKED BY	APPROVED BY	AUTHORIZED BY
03	03.02.22	RE-ISSUED AS STANDARD	MN	GDS	HK	WG
02	30.01.20	RE-ISSUED AS STANDARD	YS	GDS	RKB	SK

FORMAT NO. VCS-FMT-003_00

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STANDARD FOR DETAIL
OF BOLLARD

STANDARD DRAWING NO.

VCS-STD-CS-6074

SHEET NO.

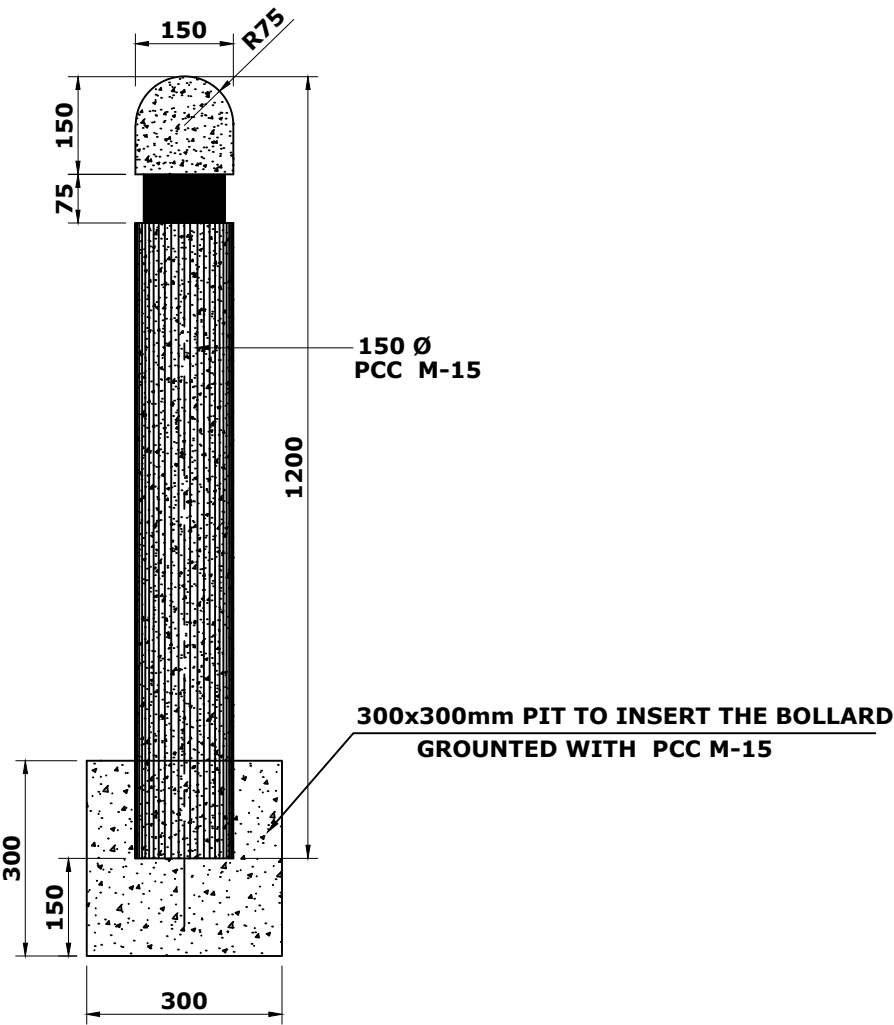
1 OF 1

REV.

03

SIZE

A4



DETAIL OF BOLLARD

REV NO.	DATE	PURPOSE	PREPARED BY	CHECKED BY	APPROVED BY	AUTHORIZED BY
03	03.02.22	RE-ISSUED AS STANDARD	MN	GDS	HK	WG
02	30.01.20	RE-ISSUED AS STANDARD	YS	GDS	RKB	SK

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VOLUME C (TCP)



**CITY GAS DISTRIBUTION PROJECT
HYDERABAD**



TCP DESIGN BASIS			Total Sheets		7
DOCUMENT NO.	C251151	00	CP	DB	4001

BHAGYANAGAR GAS LIMITED

CITY GAS DISTRIBUTION PROJECT

**TCP DESIGN BASIS
FOR
KAKINADA AND VIJAYWADA GA**

C1	24.03.2025	ISSUED FOR REVIEW	FJ	AA	AA
REV	DATE	DESCRIPTION	PREP	CHKD	APPR



CITY GAS DISTRIBUTION PROJECT

CONTENTS

1.	GENERAL	3
2.	TEMPORARY CATHODIC PROTECTION	3
3.	ADDITIONAL REQUIREMENTS:	6
4.	CODES AND STANDARDS:	7

	TEMPORARY CATHODIC PROTECTION DESIGN BASIS	Document No.	Rev
		C251151-00-CP-DB-4001	C1
		Page 2 of 7	

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CITY GAS DISTRIBUTION PROJECT

1. GENERAL

This design basis defines the design requirements for this project in addition to the applicable specifications for:-

- Temporary cathodic protection (TCP)
- Sacrificial anode cathodic protection system
- Impressed current cathodic protection system.
- NACE requirements
- OISD requirements and
- PNGRB regulations

In case of conflict the requirements mentioned in the stringent requirements mentioned in this document **or stringent** shall prevail.

2. Temporary Cathodic protection

2.1. Type	<u>Sacrificial Zinc/Magnesium anode</u>
2.2. Design life	2 Year or till commissioning of PCP whichever is later
2.3. Pipeline coating	Three Layer Polyethylene
2.4. Casing for carrier pipe	HDD is the preferred obstacle crossing method. Bare casing will be used where required.
2.5. Protective current density at 30° C	As per standard specification
2.6. Current drainage and coating resistance measurement survey	Shall be carried out
2.7. Corrosion Survey	Shall be carried out
2.8. Anode material (for sacrificial CP System)	Magnesium (1.55 V)
2.9. Minimum number of anodes (TCP)	At least 1 anode must be provided for each km of pipeline even if calculations show a lower requirement.
2.10. Polarization coupons (Factory manufactured)	Shall be provided at every 10 kms and additional coupons as required as per specification for TCP
2.11. Size of exposed area of coupon	100mm x 100 mm
2.12. No. & Location of coupons	To be decided during detail engineering subject to 1.7 above
2.13. No. of magnet devices for operation of magnetic reed switch	As per SOR/SOW
2.14. Electrical resistance probes	Shall be provided. Location to be decided during detail engineering.
2.15. Polarization cell	Solid state type shall be provided at every HT Line Crossings of 66 KV & Above.

	TEMPORARY CATHODIC PROTECTION DESIGN BASIS	Document No.	Rev
		C251151-00-CP-DB-4001	C1
		Page 3 of 7	



CITY GAS DISTRIBUTION PROJECT

2.16. Surge Diverters	Solid state type surge diverter shall be provided at every insulating joint. <i>Lightning impulse current (10/350 μs) (Iimp) 100 kA</i>
2.17. Additional tests to evaluate the coating defects	Shall be conducted after connecting to PCP system.
2.18. Test Stations	Test stations shall be provided at an average spacing of 1 km along the pipeline ROW
2.19. Test station locations	- At places where TCP anodes are installed - Both sides of cased crossings (Road or railway) - One side of the crossing if it is not cased - All insulating joints - At location of reference cells, surge diverters, polarization coupons, polarization cells, ER Probes - Both sides of canal crossings of width >50 m - Both sides of major river crossings - At EHV/ HV AC/ HV DC overhead line crossings and where these overhead lines are in parallel. - Near DC networks or grounding systems and HV DC grounding suystems - Where interference problems are suspected - At crossings of pipelines and other structures - At SV/IP/DT/RT stations - At any other location considered necessary by the owner/consultant.
2.20. Cable type	High conductivity, annealed Tinned copper conductor, 650/1100 volt grade, HMWPE insulated, aluminum backed by Mylar tape/polyester tape shielded, armoured/unarmoured and HMWPE sheathed cables shall be used.
2.21. Cable sizes	- Ref Cell 1x10mm² - Potential measurement 1x6mm² - Polarization coupon 1x6 mm² & 1x10 mm² - Current measurement 1x10mm² - Pipe bonding 25mm² - Cathode connection 35 mm² - Anode Header connection 35 mm² - Surge diverter 25 mm² - Anode connection (HT Crossing) 25 mm² - Anode connection Cased crossing 10 mm² - Anode connection TCP 06 mm²
2.22. Bonding with foreign pipelines	Will be done.

	TEMPORARY CATHODIC PROTECTION DESIGN BASIS	Document No.	Rev
		C251151-00-CP-DB-4001	C1
		Page 4 of 7	

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CITY GAS DISTRIBUTION PROJECT

NOTE:

Within 60 days of lowering each continuous segment of pipe it should be protected at a minimum -850 mV potential by Mg anodes as part of the TCP. Where soil resistivity is 150 ohm.M or more, achievement of -850 mV potential level should not be mandatory. However minimum acceptable shift of potential at such locations (where soil resistivity is 150 ohm.M or more) shall be decided by the owner/consultant, on a case to case basis.

	TEMPORARY CATHODIC PROTECTION DESIGN BASIS	Document No.	Rev
		C251151-00-CP-DB-4001	C1
		Page 5 of 7	

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CITY GAS DISTRIBUTION PROJECT

3. Additional requirements:

- a) For protection of the carrier pipe inside casing pipe, if any, zinc ribbon anode shall be used with below mentioned installation method after consultation with PMC/owner:
 - Zinc ribbon anodes to be installed for protection of carrier pipe inside the casing pipe along with Bentonite filling at the annular space between casing and carrier. Discrete Mg anode (quantity as required to achieve -850mV potential level), shall be connected to casing pipe at the cased crossings in case casing and carrier pipe is shorted (i.e become in mechanical contact with each other) and the short is not cleared after filling of Bentonite.
- b) The pipeline shall be grounded through polarization cell with Zinc galvanic anode/zinc ribbon anode or braided copper mitigator, wherever the pipeline is either crossing or running in parallel with overhead EHV/ HV transmission lines of voltage grade 66 KV and above.
- c) Current measurement test station needs to be installed at all the intermediate CP Station for measurement of the upstream and downstream pipeline current as well as coating resistance.
- d) In case anode ground bed for foreign pipeline is existing within 100m of the proposed pipeline ROW and cause interference to proposed pipeline, CP CONTRACTOR need to relocate the anode bed with the consent of the OWNER of the foreign pipeline without any extra cost to BGL.
- e) Necessary measures shall be adopted to mitigate the stray current interference due to crossings of high tension line, electrified railway track, existing pipeline in the close vicinity etc. by providing sacrificial anodes, grounding cells, diodes etc.
- f) Surge diverter across insulation joints shall be solid state type. Unprotected side of Surge diverter shall be grounded with GI Earth Electrode and resistance of Earth electrode should be maintained less than 3 Ohms.

	TEMPORARY CATHODIC PROTECTION DESIGN BASIS	Document No.	Rev
		C251151-00-CP-DB-4001	C1
		Page 6 of 7	

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CITY GAS DISTRIBUTION PROJECT

4. Codes and Standards:

1. NACE SP0169	Control Of External Corrosion On Underground Or Submerged Metallic Piping Systems
2. NACE 10A190	Measurement Techniques Related To Criteria For Cathodic Protection of Underground Or Submerged Steel Piping Systems
3. NACE SP0177-2014	Mitigation Of Alternating Current And Lightning Effects On Metallic Structures And Corrosion Control Systems
4. NACE SP0286-2007	Electrical Isolation Of Cathodically Protected Pipelines
5. NACE Pub 54276	CP Monitoring For Buried Pipelines
6. NACE SP0572	Standard Recommended Practice - Design, Installation, Operation, And Maintenance Of Impressed Current Deep Anode Beds
7. IS 8062:2006	Code Of Practice For Cathodic Protection Of Buried Pipelines/Structure For Transportation Of Oil, Natural Gas And Liquids
8. BS 7361-1:1991	Cathodic Protection. Code Of Practice For Land And Marine Applications
9. VDE 0150	Protection Against Corrosion Due To Stray Currents Of D.C. Installation
10. BIS 7098 Part I	Cross-linked Polyethylene Insulated Thermoplastic Sheathed Cables For Working Voltages Up to And Including 1100 Volts
11. IS 1554-1	PVC Insulated (Heavy Duty) Electric Cables, Part 1: For Working Voltages Up To And Including 1100 V
12. NACE Standard SP0207	Performing Close-Interval Potential Surveys and DC Surface Potential Gradient Surveys on Buried or Submerged Metallic Pipelines
13. IS 8062	Code of Practice for Cathodic Protection of Buried Pipeline/ Structure for Transportation of Natural Gas, Oil and Liquids
14. IS 1554, Part I	PVC Insulated (Heavy Duty) Electric Cables: For Working Voltages up to and Including 1100V
15. IS/ IEC: 60079	Electrical Apparatus for Explosive Gas Atmosphere
16. IS/ IEC: 60529	Classification of Degree of Protection Provided by Enclosures

	TEMPORARY CATHODIC PROTECTION DESIGN BASIS	Document No.	Rev
		C251151-00-CP-DB-4001	C1
		Page 7 of 7	

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Energising Quality

PROJECT NO. C251151



TCP SCOPE OF WORK

TOTAL SHEETS

12

DOCUMENT NO.

C251151

00

CP

SOW

4002

BHAGYANAGAR GAS LIMITED

CITY GAS DISTRIBUTION PROJECT

TCP SCOPE OF WORK

FOR

KAKINADA AND VIJAYWADA GA

C1	24-03-2025	ISSUED FOR REVIEW	FJ	AA	AA
REV	DATE	DESCRIPTION	PREP	CHKD	APPR



CITY GAS DISTRIBUTION PROJECT HYDERABAD

ABBREVIATION

PNGRB	Petroleum and Natural Gas Regulatory Board
OISD	Oil Industry Safety Directorate
CEA	Central Electricity Authority
SEA	State Electricity Authority
BS	British Standards
ICCP	Impressed Current Cathodic Protection
TCP	Temporary Cathodic Protection
MEDB	Main Electrical Distribution Board
HDD	Horizontal directional drilling
MLV	Main Line valve
CPPSM	Cathodic Protection Power Supply Module
3LPE	3-Layer Polyethylene
NACE	National Association of Corrosion Engineers
ASTM	American Society for Testing and Materials
CIPL	Close Interval Potential Logging
CPTRU	Cathodic Protection Transformer Unit
DCVG	Direct Current Voltage Gradient
IJ	Insulation Joint

 Energising Quality	TCP SCOPE OF WORK	Document No.	Rev
		C251151-00-CP-SOW-4002	C1
		Page 2 of 12	



CITY GAS DISTRIBUTION PROJECT HYDERABAD

TABLE OF CONTENTS

1.0	SCOPE OF WORK	4
2.0	SCOPE OF SUPPLY	9
3.0	QUALITY ASSURANCE, INSPECTION AND TESTING	9
4.0	TESTING & COMMISSIONING	10
5.0	DRAWINGS, STANDARD SPECIFICATION AND INSTALLATION STANDARDS	10

 Energising Quality	TCP SCOPE OF WORK	Document No.	Rev
		C251151-00-CP-SOW-4002	C1
		Page 3 of 12	



CITY GAS DISTRIBUTION PROJECT HYDERABAD

1.0 SCOPE OF WORK

Corrosion survey, design, detail engineering, fabrication, supply, installation, testing and commissioning of the temporary cathodic protection system using Mg/ Zn galvanic anodes to protect the external surface of 3LPE coated pipeline against corrosion for design life of minimum 2 years. The detailed length of the pipeline for Kakinada and Vijayawada GA as below:

Kakinada		
Stretch	Dia in inch	Length (kM)
Achampeta to Pipathapuram	6	16
Peddapuram DBS to Online	4	0.6
Pithampuram to Peddapuram	6	12
DRS & Outlets connectivity	4	1
Additional	6	1.4
Total		31
Vijayawada		
Stretch	Dia in inch	Length (kM)
JNR Sons to Y Junction (Loop)	4	1.8
Connectivity from Swathi Theater junction to JNR Sons, Andhra Engineering and Ravindra Oil	4	1.2
Gollapudi Y junction to Navabhargava Filling Station & Ravi filling Station	6	8
Connectivity to DRS (Poranki, Nidamanuru and Guntupalli Area from Existing line	4	1
Enkepadu (Ravi Kiran fillinfg Station) to Prasadampadu (Loop Line)	6	3
Total		15

 Energising Quality	TCP SCOPE OF WORK	Document No.	Rev
		C251151-00-CP-SOW-4002	C1
		Page 4 of 12	



CITY GAS DISTRIBUTION PROJECT HYDERABAD

Maintaining and keeping of PSP value as specified and monitoring at monthly basis of PSP voltage & AC voltage of the temporary cathodic protection system till the handover of the pipeline to the owner as per Annexure-A. All work shall be carried out conforming to the Scope of work, Design Basis, Data Sheets, National & International standard & as per standard specification No- **VCS-SS-EL-4018A** for Temporary Cathodic Protection system. Scope shall also include but not limited to the following for completion of jobs:-

- (i) Measurement of soil resistivity along the ROW of the main pipeline (At 500 mtr. Interval) & collection of soil & water samples along ROW at depth of 1M, 2M & 3M at every 3 km interval (Min 03 sample at each location) for its chemical & microbial analysis along the pipeline route as per specification for corrosion survey **VCS-SS-EL-4017 & NACE Standard TM0106-2006** for detection of SRB, ARB, TDS, pH, Rx, Moisture & total dissolved H₂S etc.

Collection of additional data related to cathodic protection along the ROW of pipeline related to AC, DC interference including details of all like foreign pipeline, overhead power transmission lines crossings & parallelism, power cables, river crossing, road crossing locations, railway traction (electrified/non-electrified), Substations (HVAC/HVDC), existing CP facilities (such as transformer rectifiers, anode ground beds, test facilities etc.) along with GPS coordinates. Site survey report submitted in design document shall have all these details included.

- (ii) Design, Detailed Engineering, Preparation of Design Document, Preparation of Test station schedule & Bill of Material as per the corrosion survey & Chemical analysis of Soil/Water samples for Temporary Cathodic Protection system. Catalogues, vendor drawings, installation procedures, operation and maintenance manuals etc. for all equipment/materials shall be the part of design document.
- (iii) Supply, installation, testing & commissioning of Mg (3 Kg) galvanic anodes with backfill as per the standard specification- **VCS-SS-EL-4018A**. The weight of the Mg Anode & the total nos. of anodes shall be calculated as per the corrosion survey, soil chemical analysis, total weight and current requirement of the pipeline section. However, minimum one anode shall be installed at every 1 KM with test station.
- (iv) Supply, Installation, Testing & commissioning of Test stations (Big Size & Normal Size) weatherproof (IP-55) including cement concrete foundation as per specification & enclosed drawings. Selection of TLP size will be as per the nos. of cables terminating at the station. TLP shall be sealed at both ends by means of foam sealing/solid sealing. Termination plate inside the TLP should

 Energising Quality	TCP SCOPE OF WORK	Document No.	Rev
		C251151-00-CP-SOW-4002	C1
		Page 5 of 12	



CITY GAS DISTRIBUTION PROJECT HYDERABAD

have high insulation level (FRP or higher grade) to avoid drainage of CP current due to insulation leakage. All the test-stations and junction boxes shall be provided with shrouded Allen screws to avoid vandalism. Connection scheme shall be permanently fixed inside the TLP.

- (v) Cable laying and Cable to pipe connection by Thermit welding and Pin brazing (for charged pipeline) for 35 mm², 25 mm², 10 mm², 6 mm² of 600/1100 V grade copper cables XLP insulated /PVC sheath including excavation and exposing piping, recoating with epoxy, testing etc. Colour code identification for the various CP System cables used in the system shall be included in design document.
- (vi) Contractor to note that the exact cable routing and exact cable quantities shall be decided at site based on actual site conditions. Contractor shall ensure that there is no surplus or shortage of cables at site and procure cables accordingly.
- (vii) Supply, laying of HDPE sheets (1200 mm wide, 6 mm thick) between the BGL pipeline and the other CP protected foreign pipeline at the crossing locations for providing electrical isolation.
- (viii) GI Earthing of aboveground cathodically unprotected pipeline at all locations. The earth electrode shall be per IS 3043. Earth electrode resistance shall be limited to 2Ω max.
- (ix) Supply, installation, testing & commissioning of one set of Explosion proof type solid state spark gap arrester (100 kA @ 10/350 μs) across each insulating joint provided at dispatch terminal, receiving terminal & various consumer terminals as per P&ID/specification. Surge diverter cable needs to be terminated without any joints across the IJ.
- (x) For CP at cased crossings, **Bare Casing shall be considered** as far as possible. At cased crossing, if the casing pipe is coated then it shall be protected additionally by (Independent from carrier pipe protection system) sacrificial Zn anodes installation. Carrier pipeline at cased crossings shall be protected by providing Sacrificial Ribbon anodes. The TCP contractor shall check and confirm the isolation between carrier pipe and casing after installation and before welding the section with mainline. Any re-work requires for establishing isolation shall be in the scope of pipeline Contractor without any extra time and cost to OWNER.
- (xi) Supply, installation, testing & commissioning of solid state polarization cells with Grounding through zinc anodes at HT line crossings/ running parallel (66 KV and above).

 Energising Quality	TCP SCOPE OF WORK	Document No.	Rev
		C251151-00-CP-SOW-4002	C1
		Page 6 of 12	



CITY GAS DISTRIBUTION PROJECT HYDERABAD

The rating of the cell shall depend upon anticipated fault current & ground bed resistance at the location of installation and the calculation of the same shall be furnished to VCS for review & selection of rating of the Polarisation Cell. However, the rating of polarisation cell shall not be less than 3.7 KA @ 30 Cycle & number of 20 kg net weight zinc anode shall not be less than two. If required Zn Ribbon anode/ (Dia 15mm with back fill trench)/ multi strand Cu cable encased with low resistance backfill may also be used for the grounding purpose to get lower grounding resistance as per the direction of engineer in-charge. The resistance of grounding shall be limited to 2-3 ohms max.

At any location of HT line crossing, max 4 (four) nos. zinc anodes shall be provided to limit the grounding resistance to 2-3 ohms max. Calculation for grounding resistance shall be submitted along with design document & if required, Zinc ribbon anodes of suitable length in addition to 4 (four) nos. zinc anodes shall be provided to limit the grounding resistance.

If any proposed additional line of voltage rating 66kV & above is envisaged during construction, the same shall also be considered. Contractor shall supply polarization cell along with Zn anode for the same.

- (xii) If it is observed during the monthly monitoring that the source of the AC interference is due to the power lines less than 66kV, Contractor shall provide grounding of the pipeline through SSD to mitigate AC interference on the pipeline.
- (xiii) Supply, installation, testing & commissioning of external electrical resistance Probe along the pipeline at marshy/vulnerable locations to monitor the external corrosion activity on the pipeline. Location of external ER probe shall be decided during detail engineering.
- (xiv) Cu-wire mitigator for AC Mitigation encased in low resistance backfill with corrosion inhibitors and braiding (M/s MATCOR make or equivalent) (20 Mtr wire shall be installed on each side of HT crossing, Cables running parallel etc).
- (xv) Supply, installation, testing & commissioning of Polarisation coupons (as per SOR) have one side exposed area of 100 mm x 100 mm with permanent reference cell shall be provided along the pipeline at marshy areas and at vulnerable locations to monitor the external corrosion activity on the pipeline as per enclosed standard specification. Location of external polarization coupon and no of magnetic devices for operation of magnetic switch shall be decided during detail engineering in consultation with BGL/VCS.

Care shall be taken during installation of polarization coupon so that the bare face of polarization coupon is opposite to pipe and polarization coupon shall not be installed between TLP & Pipeline.

 Energising Quality	TCP SCOPE OF WORK	Document No.	Rev
		C251151-00-CP-SOW-4002	C1
		Page 7 of 12	



CITY GAS DISTRIBUTION PROJECT HYDERABAD

The works related to collection of approximately 2-5 m of pipeline material (In pieces of 300 to 1000 mm length) for fabrication of polarization coupon is in the scope of the contractor.

- (xvi) Bonding in between pipelines running parallel or crossing as required including taking of permission from the owner of the foreign pipeline (Permission shall be taken by the Pipeline Owner and any fee required for the same shall be paid by the Owner, however contractor shall assist in all respect to get such permissions from foreign pipeline owner).
- (xvii) PSP Monitoring on monthly basis of the TCP system till commissioning of the permanent cathodic protection system including the coupon OFF PSP. Till the construction of the pipeline is in progress and or till handover of the pipeline system to the owner.
- (xviii) All civil/ structural & other miscellaneous works related to TCP system including supply of bricks, cement etc. required for completion of the system.
- (xix) Coating Integrity test of HDD section of the pipeline shall be conducted immediately after the completion of the HDD of each HDD section by separate temporary power source and anode bed. Bidder shall submit the procedure as per the NACE requirements for approval along with the design document.
- (xx) Temporary CP system shall be installed immediately of the any lowered section but not later than 15 days from the time of lowering of pipeline segments. To achieve this the TCP design document must be submitted and approved before the construction of the pipeline begins.
- (xxi) All civil work related to the CP works like Preparation of buried cable trenches, excavation, back filling, compacting, providing of brick protection by second-class bricks, spreading of fine river sand including supply of bricks, cements steel etc. The job includes repairing of all civil works damaged during installation of electrical and other facilities.
- (xxii) Supplying, laying, termination, Glanding, ferruling & testing of all the cables of TCP system, Cu- Conductor, XLPE insulated, PVC sheathed, Armd/Unrmd (1Cx6 mm², 1Cx10 mm², 1Cx25 mm², 1Cx35 mm²) as required
- (xxiii) The scope of work under this contract shall be inclusive of breaking of walls and floors, and chipping of concrete foundations necessary for the installation of equipment, materials. Minor modifications wherever required to be done in the owner free supplied equipment or devices to enable cable entry, termination, etc.

 Energising Quality	TCP SCOPE OF WORK	Document No.	Rev
		C251151-00-CP-SOW-4002	C1
		Page 8 of 12	



CITY GAS DISTRIBUTION PROJECT HYDERABAD

- (xxiv) Supply and installation of all other accessories not specifically mentioned herein but necessary for completion of job.
- (xxv) Co-ordination with other Contractors/Pipeline contractor.

Note:

- i. Connection scheme of CP system in TLP boxes shall be permanently fixed inside the test station box (TLP Box).**
- ii. For chainages refer Pipeline Schematic Route Diagram**
- iii. Hazardous area electrical equipments should be classified type (Ex-d) as per the area classification**
- iv. Vendor list of make of CP material is enclosed with the tender. All CP materials shall be as per the make mentioned in the vendor list.**

2.0 SCOPE OF SUPPLY

2.1 **Owner's scope of Supply: NIL**

2.2 **Bidder's scope of Supply:**

Supply, testing, Packing, Forwarding, Delivery, Installation and commissioning of all items required to accomplish all jobs/activities listed under clause "scope of work" are included in the scope of the contractor. **No equipment will be free issued by the owner.**

- (i) All commissioning & start up spares are in bidder's scope (Included in this package). Any commissioning & startup spare consumed during the startup & commissioning is included in the supply of this package, for which no extra payment is made.
- (ii) All The necessary permissions required for the bonding, interference mitigation (from SEB's, water works departments/ boards, railways & other pipeline owners) are in the scope of contractor and shall be obtained before taking mitigation measures.

3.0 INSPECTION AND TESTING

All the equipment supplied by the contractor shall be inspected by the approved inspection agency (TPI) at the manufacturer's works prior to dispatch. Contractor shall furnish necessary certificates, test reports etc. for Review /Approval to Owner/ Inspection agency. Contractor to get DCN prior to supply of equipment/ material from VCS. The TPI shall be from approved TPI

 Energising Quality	TCP SCOPE OF WORK	Document No.	Rev
		C251151-00-CP-SOW-4002	C1
		Page 9 of 12	



CITY GAS DISTRIBUTION PROJECT HYDERABAD

list attached with the tender. TPI shall be arranged by the CP contractor for the testing of the material/equipment at the vendor works.

The issue of DCN for any equipment or component thereof does not absolve the contractor from his contractual obligations towards subsequent satisfactory performance of the equipment at site. If any equipment be found defective, in whole or part thereof after receipt at site or during erection/commissioning and testing, the same shall be Rectified/Changed by contractor free of cost.

4.0 TESTING & COMMISSIONING

The successful tenderer shall provide adequate supervisory/ skilled personnel and all tools and tackles, testing equipment and instruments required for complete checking of installations and testing and commissioning of all equipment and accessories. The testing and commissioning of all equipment is in the scope of bidder & shall be carried out in accordance with the latest edition of relevant Indian / International Standard and NACE standards.

Any defects noticed during the testing and commissioning relating to the equipment supplied and work carried out by the Contractor, will be rectified by the contractor at his own cost. Any work not conforming to the execution drawings, specifications or codes shall be rejected forthwith and the contractor shall carry out the rectification at his own cost.

5.0 DRAWINGS, STANDARD SPECIFICATION AND INSTALLATION STANDARDS

5.1 The equipment/ materials to be supplied and their installation by the contractor shall conform to the requirements of the applicable standard specifications. Also of various material/ equipment shall also conform to the standard specification.

Construction shall be as per drawings/ specifications issued/ approved by the Owner/ Consultant during the course of execution of work.

A)	SPECIFICATION	
	Specification for TCP system	VCS-SS-EL-4018A
	Specification for Corrosion Survey	VCS-SS-EL-4017
B)	DATASHEETS & QAP	
	Quality Assurance Plan	VCS/QAP/TCP/001
C)	STANDARD DRAWINGS	
1.0	Prepacked Zinc Anode	VCS-STD-EL-4511
2.0	Prepacked Mg Anode	VCS-STD-EL-4510
3.0	Details of Test Station for TCP	VCS-STD-EL-4510
4.0	Test Station Connection Schemes	VCS-STD-EL-4514

 Energising Quality	TCP SCOPE OF WORK	Document No.	Rev
		C251151-00-CP-SOW-4002	C1
		Page 10 of 12	



CITY GAS DISTRIBUTION PROJECT HYDERABAD

5.0	Galvanic Anode Installation	VCS-STD-EL-4502
6.0	Zinc Ribbon Anode for Cased Crossings with Coated Casings	VCS-STD-EL-4506
7.0	Pipeline Grounding Through Polarisation Cell and Galvanic Anodes	VCS-STD-EL-4507
8.0	Details of Zinc Grounding Cell	VCS-STD-EL-4508
9.0	Permanent Copper – Copper Sulphate Reference Cell & Installation Details	VCS-STD-EL-4509
10.0	Details of thermit weld for cable to pipe joint	VCS-STD-EL-4504

6.0 In case of an irreconcilable conflict between Indian or other applicable standards, general conditions of contract, special conditions of contract, specifications, drawings or schedule of rates, the following shall prevail to the extent of such irreconcilable conflict in order of precedence:

1. Contract Agreement
2. Detailed Letter of Acceptance along with Statement of Agreed Variations.
3. Fax / Letter of Intent / Fax of Acceptance.
4. Schedule of Rates as enclosures to Letter of Acceptance.
5. Job / Particular Specifications.
6. Drawings
7. Technical / Material Specifications.
8. Special Conditions of Contract.
9. Instruction to Bidders
10. General Conditions of Contract.
11. Indian Standards
12. Other applicable Standards

- 6.1 It will be the contractor's responsibility to bring to the notice of engineer-in-charge any irreconcilable conflict in the contract documents before starting the work (s) or making the supply with reference which the conflict exists.
- 6.2 In the absence of any specifications covering any material, design of work (s) the same shall be performed / supplies / executed in accordance with standard engineering practice as per the instructions / directions of the engineer-in-charge, which will be binding on the contractor.
- 6.3 In case of any conflict in technical requirements among PJS, TS, SCC, SOR etc. of tender document and international / national codes / standards, more stringent requirement shall govern or as per the decision of EIC.

 Energising Quality	TCP SCOPE OF WORK	Document No.	Rev
		C251151-00-CP-SOW-4002	C1
		Page 11 of 12	



CITY GAS DISTRIBUTION PROJECT HYDERABAD

Annexure-A

Format for TCP system Commissioning

Sr No	TS No	Chainage	TS Type	Natural PSP	Instant PSP	Polarised PSP (24 Hrs.)	Anode Voltage (V)	Anode Current (mA)	AC Voltage (V)	Other Readings (If Any)	Remarks

Format for Monthly Monitoring Report of TCP system

Sr No	TS No	Chainage	TS Type	PSP (-) Voltage			Anode Voltage (V)	Anode current (mA)	AC Voltage (mV)	Other Readings (If Any)	Remarks
				Carrier		Casing (If Protected)					
				Without Bonding	Bonding						

 Energising Quality	TCP SCOPE OF WORK	Document No.	Rev
		C251151-00-CP-SOW-4002	C1
		Page 12 of 12	



ENERGISING QUALITY

VCS QUALITY SERVICES PVT. LTD.

**STANDARD SPECIFICATION
FOR
SACRIFICIAL ANODE CATHODIC PROTECTION SYSTEM FOR
PIPELINES**

VCS – SS – EL – 018A

00	06.11.2017	ISSUED AS STANDARD	MG	RD	AD	SK
Rev. No	Date	Purpose	Prepared By	Checked By	Approved By	Approved By



CONTENTS

1.0	SCOPE.....	4
2.0	LATEST CODES & STANDARDS.....	4
3.0	DESIGN	5
4.0	MATERIAL	8
5.0	INSPECTION, TESTING AND COMMISSIONING.....	15
6.0	SYSTEM MONITORING.....	17

ANNEXURE-I : TCP MATERIALS DATASHEET



ABBREVIATION

LPE	Three Layer Polyethylene
AC	Alternating Current
Ag / AgCl	Silver / Silver chloride reference electrode
CSE/Cu/CuSO ₄	Copper Sulphate Electrode
DC	Direct Current
HDD	Horizontal Directional Drilling
HT	High Tension Line
ICCP	Impressed current Cathodic Protection
MIJ	Monolithic Insulation Joint
PCP	Permanent Cathodic Protection
PSP	Pipe to Soil Potential
ROU	Right of Use
ROW	Right of Way
SV Station	Sectionalized Valve Station
TCP	Temporary Cathodic Protection
TLP	Test Lead Point



1.0 SCOPE

This specification defines the requirements of design, engineering, installation, testing and commissioning of sacrificial anode cathodic protection system (SACP) for external surface of city gas distribution buried 3LPE coated pipelines with associated high build liquid epoxy valves/fitting. The SACP system shall be used for protecting city gas distribution pipelines during the TCP construction phase.

This specification defines the basic guidelines to develop a suitable sacrificial cathodic protection system for city gas distribution pipelines.

All data required in this regard shall be taken into consideration to develop an acceptable design and for proper engineering of the system.

Compliance with this specification and/or approval of any of the contractor's documents shall in no case relieve the contractor of his contractual obligations.

2.0 LATEST CODES & STANDARDS

ISO 15589-1: 2015	Petroleum and natural gas industries-CP of pipe line transportation systems- on land pipelines
NACE SP-0169-2013	Recommended practice control of external corrosion on underground or submerged metallic piping system
IS 8062 part-2: 2006	Code of Practice for Cathodic Protection of Steel Structures, Part II: Underground Pipelines
OISD-RP-226- 2013	Natural gas transmission pipelines and city gas distribution networks
NACE SP-0286-2007	Recommended Practice- the electrical isolation of cathodically protected pipe lines
NACE SP-0200-2014	Cathodic Protection for metallic cased crossings
BS EN 50162:2004	Protection against corrosion by stray current from direct current systems
BS EN 15280:2013	Evaluation of AC corrosion likelihood of buried pipelines applicable to cathodically protected pipelines
NACE SP-0177-2014	Recommended Practice- Mitigation of AC and lighting effects on metallic structures and corrosion control systems
NACE-SP-21424-2018	Alternating Current Corrosion on Cathodically Protected Pipelines: Risk Assessment, Mitigation, and Monitoring
NACE SP0104-2014	The Use of Coupons for Cathodic Protection Monitoring Applications
NACE TM0497-2012	Measurement techniques related to criteria for cathodic protection on submerged metallic piping system
ASTM G57-2012	Field measurement of soil resistivity using Wenner four pin electrode method
ASTM B418-2016	Cast and Wrought Galvanic Zinc Anodes
ASTM B843-2018	Magnesium Alloy anodes for cathodic protection
API 1102	Recommended practice for Steel Pipelines Crossing Railroads and Highways
IS 1554 PART-1	PVC Insulated heavy duty cables
IS 3043: 2007	Code of practice for Earthing
ISO 13847:2013	Petroleum and natural gas industries — Pipeline transportation systems — Welding of pipelines



OISD RP-113-2013	Classification of area for electrical installations at hydrocarbon processing and handling facilities
OISD-RP-188-2019	Corrosion monitoring of offshore and onshore pipelines
PNGRB-G.S.R. Infra/ T4S/ P&PPPL/01 /2014	Technical Standards and Specifications including Safety Standards for Petroleum and Petroleum Products Pipelines
PESO Petroleum rules 2002	CHAPTER III: PART V- Transport by Pipelines

The equipment shall also confirm to the provisions of Indian Electricity rules and other statutory regulations currently in force in the country.

In case of any contradiction between various referred standards/ specifications /data sheet and statutory regulations the following order of priority shall govern:

- a. Statutory regulations
- b. Material datasheet
- c. Particular specification (if applicable)
- d. This specification (standard specification)
- e. Codes and standards

3.0 DESIGN

The design and engineering of the SACP system shall be carried out by the contractor as per procedures and design parameters specified below:

3.1 SYSTEM IMPLEMENTATION

- a. Corrosion survey of the ROW as per VCS tender specification
- b. Design basis of SACP system
- c. Design and engineering package of SACP (Including calculation for SACP system)
- d. Field testing and commissioning procedure
- e. As built documentation

3.2 CORROSION SURVEY

- 3.2.1 The details of corrosion survey including soil resistivity data along ROW and other data required for CP design if available with the Owner shall be included as part of project specification. However, verification of its veracity and adequacy shall be the entire responsibility of the contractor. Contractor shall also carry out soil resistivity survey at sacrificial anode ground bed locations for proper design of ground. Wenner's 4-pin method or approved equal shall be used for such measurements. Survey instruments shall have maximum AC and DC ground current rejection feature.

Soil/water samples shall be collected along the ROU for analysis. Samples shall be collected on an average at one location for every 05 km along ROU with minimum at two locations. Exact locations shall be decided at site depending on the type of soil, soil resistivity and in consultation with OWNER or his representative. At each location the soil samples shall be collected at 1 M, 2 M depth and at expected depth of pipeline if it is more than 2 m at the location.



- 3.2.2 Care shall be taken to ensure that the resistivity observations are not influenced by the presence of foreign pipelines/structures, and earth currents in the vicinity of HT lines and installations using earth return in their power system etc.

3.3 ADDITIONAL DATA TO BE COLLECTED

The following data shall be collected to generate design data for evaluation of interaction/interference possibilities due to presence of other services in ROW/in vicinity. Owner shall provide assistance for liaison work to the extent possible.

- Route and types of foreign service/pipeline in and around or crossing the right of way (including those existing and those which are likely to come up during contract execution)
- Diameter, wall thickness, pressure, soil-cover, and type of external coating, type of cathodic protection system provided, if any and year of laying/commissioning in case of foreign pipelines.
- Details of the existing cathodic protection systems protecting the services i.e., type of protection, location, rating of anode beds, test station locations and their connection schemes. Present output current and voltage readings of the CP power supply units.
- Remedial measures existing on foreign pipelines/services to prevent interaction.
- Graphical representation of existing structure/ pipe to soil potential records.
- Possibility of integration/isolation of CP systems, which may involve negotiations with owners of other services
- Information on existing and proposed DC/AC power sources and systems using earth return path such as HVDC substations/ earthing stations, fabrication yards with electric welding etc. in the vicinity of the entire pipeline route.
- Crossing and parallel running of electrified and non-electrified traction (along with information regarding operating voltage; AC/DC type etc.) as well as abandoned tracks near ROW having electrical continuity with the tracks in use.
- Crossing or parallel running of any existing or proposed 11 kV and above AC/DC overhead power lines along with details of voltage, AC/DC type etc.
- Voltage rating phases sheathing details of underground power cables running along ROW or in its vicinity.
- Any other relevant information that may be needed in designing and implementing proper protection.
- Contractor shall conduct necessary potential gradient surveys for any existing anode ground beds that may interfere with the CP system of the pipelines covered under this project.

3.4 REPORT

- On completion of all field work, a report incorporating all the results generated from surveys and details of additional data, collected shall be prepared.



- The report shall also contain detailed interpretation of:
 - Survey results and resistivity data
 - List of Foreign pipeline crossings and other DC interference prone areas
 - List of HT line ($\geq 66\text{kV}$) crossings and other AC interference prone areas
 - Various drawings prepared in connection with the above work.
 - Soil resistivity values plotted on semi-log graph sheets.

3.5 CATHODIC PROTECTION DESIGN PARAMETERS

Unless otherwise specified, following parameters shall be used for design of cathodic protection system.

Where the cathodic protection system is specified for temporary protection, those parts of sacrificial anode cathodic protection system, which will be integrated, with the permanent CP system shall be designed based on permanent CP parameters.

3.5.1 DESIGN LIFE

- TCP shall be designed for 2 years

3.5.2 PROTECTION CURRENT DENSITY

Pipelines directly buried and having three-layer polyethylene (3LPE) coating

Pipeline surrounding	Temporary CP ($\mu\text{ A/m}^2$)
Soil resistivity more than 100 ohm-m	10
Soil resistivity 10 ohm-m to 100 ohm-m	25
Soil resistivity less than 10 ohm-m	50

Pipelines laid through HDD and having three-layer polyethylene (3LPE) coating

Pipeline surrounding	Temporary CP ($\mu\text{ A/m}^2$)
Soil resistivity for HDD	50

Note:

- I. Safety factor for current density: 1.3
- II. Anode utilization factor: 0.85
- III. Pipeline Natural Potential: (-) 0.45 V w.r.t CSE
- IV. Steel Resistivity: 2.2×10^{-7} ohm-M

The above current density values for temporary CP system are applicable for CP system design life.



Actual current density to be adopted shall be decided based upon soil and other environmental conditions, current drainage survey data (where included in Contractor's scope) at HDD locations, proximity of foreign pipe lines/structures and other interference areas affecting the installation. Where considered necessary for satisfactory protection of pipeline the current density shall be suitably increased by contractor.

The pipe protection current density indicated as above shall be applicable where the temperature of the fluid transported by the pipeline/ the surface temperature of the buried portion of the pipeline does not exceed 30° C, the protection current density shall be increased suitably in consultation with the Owner/Company.

3.5.3 CATHODIC PROTECTION DESIGN CRITERIA

Cathodic protection system shall be designed to meet the following criteria:

The pipe to soil potential measurements shall be between (-) 0.95 V (ON) and (-) 1.5 V (ON) for polyethylene coated pipe lines with respect to a copper/copper sulphate reference electrode.

At locations of polarization coupons, the coupon to soil potential measurement shall be between -0.850 V (Instant OFF) to -1.18 V (Instant OFF) with respect to stable permanent copper / copper sulfate reference electrode installed close to the coupon.

A positive potential swing of 50 milli volts or more shall be considered sufficient to indicate the presence of an interaction/interference situation requiring investigation and incorporation of mitigation measures by the Contractor.

4.0 MATERIAL

The system shall include the following major equipment/sub-systems unless otherwise specified in project specifications.

- a. Sacrificial anodes (Magnesium/Zinc, as per soil resistivity)
- b. Sacrificial (Mg) anodes only at coated cased crossings
- c. Sacrificial (Mg) anodes at HDD locations
- d. Test stations
- e. Surge diverter at MIJ and zinc grounding anode at unprotected side of MIJ
- f. DC decoupling device with earthing system
- g. Interconnecting cables
- h. Cables to pipe connections
- i. Polarization coupons for measurement of "Instant OFF" potentials with permanent reference cell

All equipment shall be new and procured from approved manufacturers. Equipment offered shall be field proven. Equipment requiring specialized maintenance or operation shall be avoided as far as possible. Prototype equipment shall not be accepted.



Equipment shall conform to the relevant specifications enclosed with the tender document. All equipment including test stations shall be located in safe non-hazardous areas.

Where it is essential to install the equipment in hazardous area, such equipment shall be flame-proof type and shall meet the requirement of IS: 2148 or equivalent international Standard and shall be suitable for gas group IIB, temperature class T3 (200°C). Indigenous equipment shall be certified by CMRI or any other recognized testing body and shall be approved by the concerned statutory authority. All flameproof equipment shall carry the BIS license marking as per the requirement of statutory authorities. All imported equipment for hazardous area may be tested and certified by an independent certifying agency of country of equipment origin and shall be approved by the concerned statutory authority in India.

4.1 SACRIFICIAL ANODE GROUND BEDS

- 4.1.1 Along ROW where soil resistivity predominantly remains low, ranges from 0-10 ohm-m and pH value is within 9, zinc anodes shall be provided. Anodes of type I as per ASTM-B 418 standard shall be used for seawater, brackish water or saline electrolyte application and anode of type II as per ASTM-B 418 standard shall be used for fresh water, back fill and soil applications.
- 4.1.2 Along ROW where soil resistivity is predominantly in the range of 10 ohm-m to 30 ohm-m, low potential (1.55V) magnesium anodes, as per ASTM-B 843 shall be provided.
- 4.1.3 Along ROW where soil resistivity is predominantly in the range of 30 ohm-m to 50 ohm-m high potential (1.75V) magnesium anodes, as per ASTM-B 843 shall be provided.
- 4.1.4 At high resistivity area where resistivity is of the order of 50 ohm-m and above magnesium ribbon anodes may be provided.
- 4.1.5 In case the soil resistivity varies from 5 ohm-m to 50 ohm-m, then low potential (-1.55V_{CSE}) magnesium anode shall be used for the entire length of the pipeline.
- 4.1.6 Average separation distance between each consecutive sacrificial anode location along the pipeline route for temporary cathodic protection shall be 1 km.
- 4.1.7 The minimum weight of the sacrificial anode for temporary cathodic protection for design life of 2 years shall be min. 2.5kg net pre-packed or whichever is higher, as per detailed design calculations.
- 4.1.8 Suitability of the selected sacrificial anodes for the soil conditions with particular attention to carbonates, bicarbonates, phosphates and nitrates, shall be checked for proper operation by the Contractor.
- 4.1.9 The anodes shall be laid in proper type of back fill consisting of a 20 % bentonite, 75 % gypsum and 5 % of sodium sulfate to improve the local conductivity around the anodes, such that the effect of soil is minimum on the anode effectiveness and life.
- 4.1.10 The leads of all the anodes shall be brought up to the test station and shall be terminated individually.



- 4.1.11 The number of anodes at each ground bed shall be sufficient for providing the specified pipe protection current density taking into consideration the ground bed resistance, cable resistance, etc. The number of anodes for ground bed, spacing of ground beds based on the applicable soil resistivity, size of pipeline, type of coating for the pipeline shall be chosen from the table after necessary verification by the CP contractor.
- 4.1.12 Any deficiency in the protection system if noticed during commissioning or during monitoring shall be corrected by the CP contractor by suitably augmenting the system with additional anodes without any cost / schedule implications.
- 4.1.13 For the portion of the pipeline for which the CP system has been specified based on the permanent CP system parameters – cased crossing, HDD, HT line locations, the contractor shall ascertain the requirement of the cathodic protection current density indicated above, and the anodes installed at these locations, shall be suitable for PCP system design life.

4.2 TEST STATIONS

- 4.2.1 Test stations shall be provided along the pipeline ROW for monitoring the performance of the cathodic protection system at the following locations. Test stations shall be provided at additional locations, if required, so that distance between any two adjacent test stations does not exceed 1000 meters in inhabited areas and 2000 meters in uninhabited areas like forest/deserts.
- At the location of anode ground beds
 - At one sides of metallised road crossings
 - At all insulating joints
 - At tap-off station
 - At HT ($\geq 66\text{kV}$) AC/DC overhead line crossings and location of HT line parallelism within 50M of the pipeline.
 - At vulnerable location with drastic change in soil resistivity.
 - At both sides of major river crossings and HDD.
 - At location of DC decoupler
 - In the vicinity of DC networks or grounding system where interference problems are suspected.
 - At crossings of other pipelines/structures.
 - At both sides of cased crossings.
 - At any other locations considered vulnerable/locations where AC/DC interference is expected
 - At railway line crossings and at selected location along railway lines running parallel to the pipeline.
 - At the location of Sectionalizing Valve (SV) Station.
 - At any other locations considered necessary by owner/owner's representative



4.2.2 The types of TLP to be used shall be as follow:

- i. Type A- Potential measurement
- ii. Type B- Current measurement
- iii. Type C- At the locations of cased crossing- Bare casing
- iv. Type D- At the locations of cased crossing – coated casing
- v. Type E- At locations of foreign pipeline crossings
- vi. Type F- At MIJ locations
- vii. Type H- At HV locations and SV stations
- viii. Type A+HDD- At HDD crossing locations
- ix. Type A + PC- At locations of polarization coupon installations

4.2.3 Test stations used for sacrificial anodes shall have shunt for measurement of anode current, provision for resistance insertion to limit the anode current output and anode disconnecting link.

4.2.4 Test stations for bonding shall be provided with shunt and resistor as a means to monitor and control current flow between the pipeline and foreign pipelines or structures that may exist in common ROW-

4.2.5 Test station with current measuring facility shall be provided at interference prone areas, on both sides of major river crossings, HDD locations, near marshy areas and minimum one for every 10 km max. along the pipeline.

4.2.6 The test stations shall be installed with the face of the test station facing the pipeline. The nameplate of test stations shall carry the following minimum information

- a. Chainage in km.
- b. Test station connection scheme
- c. Distance from pipeline in meters.
- d. Direction of product flow.

4.2.7 Terminals and different schemes of wiring shall be provided as per the test station connection scheme. Minimum twenty percent spare terminals shall be provided in each test.

4.2.8 Minimum two cables shall be provided from the pipeline at any test station

4.2.9 The location of all the test stations shall be marked with their connection schemes and other relevant information on alignment sheets. A detailed test station schedule shall be prepared.

4.3 SURGE DIVERTER & GROUNDING OF PIPELINE AT UNPROTECTED SIDE OF MIJ

Explosion proof type spark gap surge diverter shall be connected across each monolithic insulating joint (MIJ) to protect it from high voltage surges.

The surge diverter shall be rated for discharging lightening current (10/350 μ s) & AC fault currents picked by the pipeline across the MIJ without causing excessive voltage build up which would damage the MIJ or cause an electric arc or flashover across the MIJ.



Surge diverters shall be directly mounted on MIJ to prevent the breakdown of MIJ which is 5 kV. The length of the surge diverter leads connecting across the MIJ shall be suitable to connect to the MIJ cleats without any joint/copper clamp.

The above ground portion of the pipeline at the unprotected side of the MIJ shall be grounded by GI plant earthing or zinc anodes of 20 kg net weight.

4.4 GROUNDING OF PIPELINE

4.4.1 AT LOCATION OF HT TRANSMISSION LINE CROSSING (≥ 66 kV)

In TCP scope at all HT crossings (66 kV and above), H-Type TLP's shall be provided, for grounding 3LPE coated pipeline through a suitably rated DC decoupler and suitably designed grounding system.

- a) DC Decoupler:** The DC Decoupler through which the pipeline shall be grounded shall be solid state type and shall be capable of blocking DC voltages ± 2 V and provide an effective and continuous conductive path to suitably design the grounding system for AC induced voltages, lightning currents, surge currents and AC fault currents.
- b) Grounding System:** The grounding system resistance shall be less than 5 ohms to meet the following requirement of AC interference mitigation:
- AC induced voltage: < 15 V RMS AC
 - AC current density: a) < 30 A/m², if DC current density exceeds 1 A/m²
b) < 100 A/m², if DC current density is less than 1 A/m²

The AC-DC current density to be measured at coupon locations and the current densities mentioned above will be time weighted average of 24 hrs.

To achieve required grounding resistance, following type of grounding system shall be designed and installed:

Soil resistivity Range (in ohm-cm)	Type of Grounding System
< 2500 ohm-cm	Minimum two (2) nos. of zinc grounding anodes, in a chemical backfill. Each zinc grounding cell shall have net weight of 20kg.
> 2500 ohm-cm	- Zinc ribbon anode of minimum dimension 12/14 mm, with trench backfilled with chemical backfill. - Copper conductor of size 16 mm ² , with factory pre-packed adequate backfill.

Note: The length of zinc ribbon anode/copper conductor shall be decided by the contractor after having performed grounding calculations.

4.4.2 AT LOCATION OF HT TRANSMISSION LINE RUNNING PARALLEL

Where transmission lines run parallel within 50 M of either side of the pipeline, the pipeline shall be grounded at a maximum interval of 1 km, at suitable locations, where AC induced voltages are the highest. The grounding shall be done through DC decoupler using grounding system to meet the AC interference criteria as specified above under Clause 4.6.1



4.5 CP AT CASED CROSSING

- 4.5.1 Casing should be avoided as far as possible. If cased crossing is unavoidable, bare casing to be provided, with selecting higher thickness allowance as per API 1102
- 4.5.2 No sacrificial anodes (ribbon anodes) shall be used inside casing & carrier annular space.

4.6 REFERENCE CELL ACCESS POINTS

- 4.6.1 Reference cell access points shall be provided at all test station locations, at insulating joint locations, where the ground is paved, for measurement of pipe to soil potentials. A perforated 2" PVC pipe of 1.5- 2-meter length so as to reach the pipeline depth filled with native soil and buried at the location shall be provided for the purpose. The length of the PVC pipe shall be adequate to reach the native soil below the paving.

4.7 CABLES

- 4.7.1 Cables shall be with annealed high conductivity stranded copper conductor, PVC insulated, 650/1100V grade, PVC sheathed conforming to IS: 1554 Part -I. The size of the copper conductor shall be:
- For anode tail cable to test station: 10 mm² unarmored
 - From test station to pipeline: 10 mm² armored
 - For bonding, DC decoupler, grounding anodes and surge diverter: 25 mm² armored
 - For reference cells and pipeline potential measurements: 6 mm² armored

CABLE LAYING

Cables shall be laid in accordance with the layout drawings to be prepared by the Contractor. No straight through joint shall be permitted. Cable route shall be carefully measured and cables cut to required length. Minimum half meter cable slack shall be provided near anodes, pipeline and test stations to account for any settling

All cables inside station/plant area shall be laid at a depth of 0.75 M Cables outside station/plant area shall be laid at a depth of minimum 1.5 M Cables shall be laid in sand under brick cover and backfilled with normal soil. For cables laid outside the station/plant area, polyethylene warning mats shall be placed at a depth of 0.9 m. from the finished grade to mark the route

PVC pipes of proper size shall be provided for all underground cables for road crossings

Cables shall be neatly arranged in trenches in such a manner that crisscrossing is avoided and final take off to equipment is facilitated.

4.8 POLARIZATION COUPON

- 4.8.1 Coupon shall have one side exposed area of 1 cm². The coupon shall be made from the material of the pipeline. Minimum one polarization coupon shall be installed every



5 kms for measurement of "Instant OFF" or polarized potential of the 3LPE coated buried pipeline, which otherwise cannot be measured in a TCP based cathodic protection system.

- 4.8.2 The location of polarization coupon TLP shall preferably be between two Types-A TLP's to check the mid-point pipeline polarization.
- 4.8.3 Cable connection of 10mm² and 6mm² shall be provided to the coupon for connecting it to the pipeline for cathodic protection and potential protection measurements respectively.
- 4.8.4 Polarization coupon TLP will not have any sacrificial anode connected.
- 4.8.5 Polarization coupon shall be provided with a permanent copper / copper sulfate reference electrode installed close to the polarization coupon.
- 4.8.6 Connection of coupon to pipeline shall be through a vacuum sealed magnetic reed switch housed inside the test station. The magnetic reed switch shall be rated to carry and break minimum 10 mA at 50 V DC.
- 4.8.7 Coupons shall be installed at bottom 1/3rd portion of the pipeline and 250 mm away from the pipe surface.
- 4.8.8 The bare area of coupon shall be placed opposite to the pipeline.
- 4.8.9 The permanent reference electrode shall be placed 150 mm from the pipeline.
- 4.8.10 Coupons shall be provided as per the requirement of NACE SP104:2014
- 4.8.11 Selection of other locations of Polarization coupons shall be decided by PMC / Engineer-In-Charge

4.9 PERMANENT REFERENCE CELLS

- 4.9.1 High purity copper-copper sulphate reference cells with proven high reliability shall be provided for stable coupon to soil potential measurement at the locations of polarization coupons.
- 4.9.2 The reference cells shall be of silver/silver chloride type in place of copper/copper sulphate cells, at marshy area locations, where water table is high and chloride ion concentration is more than 300 ppm for marshy area in saline soils high purity zinc may be considered as an alternative to silver/silver chloride.
- 4.9.3 The life of reference cells shall be minimum 10 years under burial-conditions.
- 4.9.4 The test station connection scheme inside the test station shall clearly indicate the type of reference cell (Cu CuSO₄ /Ag AgCl).

4.10 CABLE TO PIPE CONNECTIONS

- 4.10.1 All cable connections to the new pipeline shall be made by an approved exothermic process or by pin brazing. However, cable connection to charged pipelines shall be made by pin brazing. Exothermic welding shall be adopted for water pipelines. The resistance of the cable to pipe at the connection point shall not exceed 0.1 ohm.



Coating shall be repaired after connection of cable conductor to pipeline. The coating repair material shall be compatible with the original coating and shall prevent ingress of water along the cable, surface and at the interface of coating repair with the original pipe coating

5.0 INSPECTION, TESTING AND COMMISSIONING

5.1 SYSTEM TESTING AT SITE

- 5.1.1 Field tests as per the reviewed field testing and commissioning procedures prepared by the Contractor shall be carried out on the equipment/systems before these are put into service. Acceptance of the complete installation shall be contingent upon inspection and test results
- 5.1.2 Before the CP system facilities are put into operation, necessary tests shall be carried out to establish that all equipment, devices, wiring and connection have been correctly installed, connected and are in good working condition as required for the intended operation. Owner/Owner's representative may witness all tests. Intimation shall be given at least one week before commencing the tests.
- 5.1.3 All tools, equipment and instruments required for testing shall be provided by Contractor. Generally, the following minimum tests must be carried out and recorded.

a. Cables

- i. Cable No.
- ii. Voltage grade
- iii. Conductor cross section
- iv. Continuity check
- v. Voltage test
- vi. Insulation resistance values between each core & earth, between cores. All cables shall be tested by 500 V megger

b. Insulating Joint

- i. Location
- ii. Pipe to soil potential of both protected and non-protected sides of the insulating joint before and after energization of CP system

c. Surge Diverter

- i. Location/Identification number rating
- ii. Type
- iii. Explosion proof enclosure check for healthiness
- iv. Check for proper connection

d. DC Decoupler

- i. Location/Identification number
- ii. Ratings
- iii. Check for wiring



- iv. Details of grounding provided

e. Sacrificial Anode

- I. Location
- II. Type
- III. Open circuit potential

f. Permanent Reference Cell

- I. Location
- II. Type of cell
- III. Potential reading
- IV. Installed on near coupon location
- V. Distance and depth from pipeline

g. Grounding Anodes

- I. Location
- II. Type of anode
- III. Potential reading
- IV. Grounding Resistance

h. Coupon

- I. Location
- II. Exposed area of coupon
- III. Potential reading
- IV. Distance and depth from pipeline
- V. Distance of permanent reference electrode from coupon

5.2 COMMISSIONING

- 5.2.1 Natural potential of pipe to soil for the complete pipeline and casing pipeline at the locations of cased crossings shall be measured at all the test station locations, recorded prior to connecting anodes to pipe line and casing pipeline respectively.
- 5.2.2 The anode shall be connected to pipeline in the test station and the pipe to soil potential observation shall be made after allowing 48 to 72 hours for polarization.
- 5.2.3 The current output of each anode at temporary CP anode ground bed shall also be measured. In case the anode output current exceeds the rated capacity, it shall be controlled by insertion of resistance element in the anode circuit inside test station and the pipe to soil potential shall be rechecked for adequacy of protection.
- 5.2.4 At locations of polarization coupon, the coupon 'Instant OFF' potential shall be measured by switching off the reed switch.
- 5.2.5 Additional anodes shall be provided where required to achieve desired level of protection and to keep the anode output current within the rated value. In case pipe to soil potential exceeds the specified value, suitable resistance shall be inserted in the anode circuit to limit the potential.



- 5.2.6 The PSP of casing and carrier pipe shall be recorded and in case the difference in the ON PSP of casing (with anodes disconnected) and carrier pipe is less than 200 mV, the same shall be reported to the Owner/Owner's representative.
- 5.2.7 AC induced voltage measurements shall also be made on the pipeline at all TLP locations to find out continuous induction of voltage.
- 5.2.8 Potential on the protected and unprotected side of the MIJ to be recorded to confirm the integrity of MIJ.
- 5.2.9 At foreign pipeline locations, potential of both the pipelines- owners and foreign shall be recorded and the locations of foreign pipeline anode bed have to be identified to avoid any anodic interference in future. At locations of foreign pipeline crossing Zinc anodes- 20 kg can also be installed as a mitigation measure shall be sized for the design life specified for permanent CP.
- 5.2.10 Resistance of the grounding anode shall be recorded at MIJ (unprotected side) and HT line crossing (location shall be recorded it should be less than 5 ohm or as per design requirement).
- 5.2.11 After connecting all the anode ground beds to pipe line, measurement of pipe to soil potentials shall be taken at each test station to ensure conformity to protection criteria.
- 5.2.12 In case of insufficient protection as per the CP design criteria on any portion of the pipeline/ casing pipeline (at cased crossings where casing is cathodically protected) Contractor shall carry out necessary additions/modifications to the provided protection in consultation with the Owner/Owner's representative.

6.0 SYSTEM MONITORING

- 6.1** Where the CP provided is temporary, the CP system shall be monitored at all test stations once in a month for healthiness/adequacy of protection of installed TCP system. If any deficiency/interference in protection system is noticed, the same shall be rectified/augmented by providing additional anodes as required. The monitoring report shall be submitted regularly to owner for his review/information.



ANNEXURE – I **TCP MATERIALS DATASHEET**

1.1 MAGNESIUM ANODE

MAGNESIUM ANODE		
Standard	ASTM-B-843	
Composition	Weight Content (Low Potential)	Weight Content (High Potential)
Manganese	0.15 %	0.5 – 1.3%
Aluminum	5.3-6.7 % max.	0.01 % max.
Copper	0.02 % max.	0.02 % max.
Nickel	0.002% max.	0.001% max.
Iron	0.003 % max.	0.03 % max.
Zinc	2.5-3.5 %	-
Silicon	0.1% max.	0.05% max.
Other	0.30 % max. (Total)	0.30 % max. (Total)
Magnesium	Balance	
Anode Circuit Open Potential	1.55 volts (CSE)	1.75 volts (CSE)
Anode Consumption Rate	7.9 Kg/ (A. Yr) max.	7.9 Kg/ (A. Yr) max.
Anode tail cable	1C X 10 mm ² (un-armored)	
Backfill Material	Gypsum – 75% Bentonite – 20% Sodium Sulphate – 5%	
Make	As per approved vendor list	

1.2 ZINC ANODE

ZINC ANODE		
Standard	ASTM-B-418	
Composition	Weight: Type-I (Used for seawater, brackish water or saline electrolyte application)	Weight: Type-II (Used for fresh water, back fill and soil applications)
Aluminum	0.1% to 0.5% max.	0.005 % max.
Cadmium	0.025% to 0.07%	0.003 % max.
Copper	0.005 % max.	0.002 % max.
Iron	0.005 % max.	0.0014 % max.
Lead	0.006 % max.	0.003 % max.
Others	0.01% max.	-
Zinc	Balance	Balance
Anode Open Circuit Potential	(-) 1.1 Volts w.r.t CSE	(-) 1.1 Volts w.r.t CSE
Anode Consumption rate	11.24 Kg/(A. Yr) max.	11.24 Kg/ (A. Yr) max.



ZINC ANODE	
Anode tail cable	1C X 25 mm ² (armored)
Backfill Material	Gypsum –50% Bentonite – 50%
Make	As per approved vendor list

1.3 ZINC RIBBON ANODE

ZINC RIBBON ANODE	
Standard	ASTM-B-418
Dimension	12/14 mm
Length	As required
<u>Composition</u>	<u>Weight: Type-II</u> <u>(Used for fresh water, back fill and soil applications)</u>
Aluminum	0.005 % max.
Cadmium	0.003 % max.
Copper	0.002 % max.
Iron	0.0014 % max.
Lead	0.003 % max.
Others	-
Zinc	Balance
Anode Open Circuit Potential	(-) 1.1 Volts w.r.t CSE
Anode Consumption rate	11.24 Kg/ (A. Yr) max.
Anode tail cable	1C X 25 mm ² (armored)
Backfill Material	Gypsum –50% Bentonite – 50%
Remarks	Trench to be backfilled with chemical backfill
Make	As per approved vendor list

1.4 COPPER CONDUCTOR (AC MITIGATOR)

COPPER CONDUCTOR	
Diameter	38mm
Wire Size	6 AWG (16 mm ²)
Length	As required
Backfill	Special backfill with corrosion inhibitors
Fabric	Integrated woven synthetic acid resistant
Braid	Tough, porous, protective braid enhancing the abrasion and damage resistance of the fabric jacket
Make	As per approved vendor list



1.5 SURGE DIVERTER

SURGE DIVERTER	
Type	Spark gap, explosion proof Ex d IIC T6, Solid State
Lightning Impulse Current (10/350 μ s)	50 kA
Nominal Discharge Current (8/20 μ s)	100 kA
Spark Over AC Voltage (50 Hz)	≤ 1.2 kV
Power Frequency Sparkover Voltage (50 z)	≤ 0.5 kV
Power Frequency Withstand Voltage (50 z)	≤ 250 V
Degree of protection	IP-67
Make	As per approved vendor list

1.6 DC DECOUPLER/POLARIZATION CELL

DC DECOUPLER	
Type	Solid state type
Blocking DC Voltage	- 2 V DC
Leakage Current at -1.2V at 20°C	< 20 μ A
Steady state AC discharge current	45 Arms @ 50 Hz
Power fault current (40 milli sec) 2 cycle @ 50 Hz	5 kA
Power fault current (200 milli sec) 10 cycle @ 50 Hz	3.7 kA
Power fault current (600 milli sec) 30 cycle @ 50 Hz	3.7 kA
Lightning Impulse Current (10/350 μ s)	75 kA
Lightning Impulse Current (8/20 μ s)	100 kA
Max. permissible voltage DC	- 2 V
Degree of protection	IP-68
Make	As per approved vendor list



1.7 CABLES

All the cables shall be annealed high conductivity, tinned, stranded copper conductor, XLPE insulated, 1100V grade, FRLS, PVC sheathed

CABLES	
Anode Tail cable for Magnesium anodes	Conductor Size - 10 Sq mm No of Cores - Single Protection - Un armored
Potential Measurement	Conductor Size - 6 Sq mm No of Cores - Single Protection - Armored
Current Measurement cable	Conductor Size - 10 Sq mm No of Cores - Single Protection - Armored
Bonding, Surge Diverter connection Cable	Conductor Size - 25 Sq mm No of Cores - Single Protection - Armored
Make	As per approved vendor list

1.8 TEST STATION

TEST STATION	
Type	Normal Type / Big Type (to house DC Decoupler)
Dimension	As per manufacturer's detailed drawings
Terminal Plate dimension	As per manufacturer's detailed drawings
Height of the Test station from ground level	1200 mm (min.) Bakelite Sheet with 20% spares.
No. of Terminals	12 Nos. (min.) M-8 (SS)
Test station Material	Mild Steel (MS, 3 mm thick)
Protection Level	IP 55 (Weather Proof), IP - 55 Certificate shall be enclosed with MTC
Cable Entry	Bottom entry through pipe bend
Support Pipe	M.S. Pipe of 100 mm Dia (4"), SCH -40, 90° Elbow, R=5D
Length of Support Pipe	1000 mm.
Base Plate	As per manufacturer's detailed drawings
Thickness of pipe	4.5 mm.
Shutter of the test station	Hinged type with concealed lock (With castle lock key) + Two Nos. of Allen Key lock
Test station for Sacrificial anode	Shall have a shunt (0.10Ohm, 0.5 A, 50 mV) & provision for variable resistance insertion (Rating: 0-0.1 Ohm) at Mg anode locations
Name plate	As per design document (Anodized aluminum name plate, White letter with black back ground) (0.9 thick x 120 x 160mm)
Painting	The sheet steel used for fabrication of test lead point shall be thoroughly cleaned and degreased to remove mill scale, rust, grease and dirt. Fabricated structures shall be pickled and then rinsed to remove any trace of acid. The under surfaces shall be prepared by applying a coat of phosphate paint and a coat of blue/grey zinc chromate primer. The



TEST STATION	
	under surfaces shall be free from all imperfections before undertaking the finished coat. After preparation of the under surface, spray painting with two coats of final paint shall be done. The finished panel is dried in oven in dust free atmosphere. Panel finish shall be free from imperfections like pin holes, orange peels, run off paint etc.
Cable Entry Sealing	With Foam / Solid Sealing
Gas Kit	6 mm – Neoprene
PCC Details	1:5:10
RCC Details	M20
PCC over foundation base Plate	150 mm PCC over foundation
Stencil block letter marking	40 mm marking on Test station by black color, showing arrow of direction of flow, Test Station No., Chainage, "Test station connection scheme type with name of the pipeline", Distance from pipeline in meters
Make	As per approved vendor list

Note: - Variable Power Resistor shall be provided in circuit to limit PSP to -1.5 V (ON).

1.9 PIN BRAZING KIT

PIN BRAZING KIT	
Pin Brazing Pin + Ferrule	Safe track Make or Equivalent
Insulating Resin Material	Epoxy Dobo fill 60 + Hardener 758
Enclosure	Funnel

1.10 THERMIT WELD CONNECTION KIT

THERMIT WELD CONNECTION KIT	
Thermit Cartridge	M/s Erico Europa Make or Equivalent
	CA-15: For 6 to 16 Sq. mm. CA-25: For 25 sq. mm. and above
Insulating Resin Material	Epoxy Dobo fill 60 + Hardener 758
Enclosure	Funnel



Energising Quality

VCS Quality Services Pvt Ltd

STANDARD SPECIFICATION FOR CORROSION SURVEY

VCS – SS – EL - 4017

02	05.03.2022	SP	RD	AA	HK
01	16.10.2019	MG	VV	AD	SK
00	05.07.2017	MG	RD	AD	SK
Rev. No	Date	Prepared By	Checked By	Approved By	Authorized By

UNCONTROLLED COPY	:	If printed
CONTROLLED COPY	:	If in soft and signed

REVISION RECORD						
Rev.	Revision Date	Prepared by	Checked by	Approved by	Authorized by	Revision Description
00	05.07.2017	MG	RD	AD	SK	Issued for use as Standard
01	16.10.2019	MG	VV	AD	SK	New revision system updated
02	05.03.2022	SP	RD	AA	HK	New revision system updated

ABBREVIATION

ROU	Right of Use
EHC	Extra High Voltage
HV	High Voltage

CONTENTS

1.0	SCOPE	5
2.0	REFERENCE DOCUMENTS	5
3.0	DEFINITION	5
4.0	GENERAL	5
5.0	SOIL RESISTIVITY SURVEY	6
6.0	TESTS ON SOIL SAMPLES	6
7.0	ADDITIONAL DATA COLLECTION	7
8.0	REPORT	8

1.0 SCOPE

- 1.1** The Specification covers the requirements for corrosion survey including measurement of soil resistivity, chemical analysis of soil/water and collection of other cathodic protection related data along ROU of the pipelines.

2.0 REFERENCE DOCUMENTS

- 2.1** Equipment and measurement techniques shall unless otherwise specified, conform to the requirement of latest revisions of following applicable Standards:
- BIS Specifications
 - BS Specifications and codes of practice
 - NACE publications
- 2.2** The work shall be carried out in compliance with all applicable local laws and regulations.
- 2.3** In case of any contradiction between various referred Standards/Specifications/Data Sheet and statutory regulations the following order of priority shall govern:
- Statutory regulations
 - Data Sheets
 - Job Specification
 - This Specification
 - Codes and Standards.

3.0 DEFINITION

For the purpose of this document, the words and expressions listed below shall have the meanings assigned to them as follows:

OWNER / COMPANY	OWNER of the particular Project (Project Specific).
CONSULTANT	The party which is doing engineering, procurement, construction, pre-commissioning and assistance for commissioning, monitors and controls the overall project management.
BIDDER / SUPPLIER / VENDOR	The party(s) which manufactures and / or supplies material, equipment, technical documents / drawings and services to perform the duties specified by Contractor.

4.0 GENERAL

- 4.1** This Specification defines the basic guidelines for carrying out the corrosion survey. Contractor shall be responsible for providing necessary data interpretation based on corrosion survey measurements, which is intended to form a basis for design of cathodic protection system for the pipeline.

5.0 SOIL RESISTIVITY SURVEY

- 5.1** Unless otherwise specified the soil resistivity measurements shall be carried out at intervals of approximately 500 m along the ROU. Where soil resistivity is less than 100 ohm.m and two successive readings differ by more than 2:1 then additional soil resistivity readings in between the two locations shall be taken.
- 5.2** To carry out the soil resistivity measurement Wenner's 4 pin method or approved equal shall be used. The depth of resistivity measurement at each location shall be at around 1 m and at the burial depth of the pipeline accounting for the cuttings /fillings or 2 m approximately whichever is higher. At locations where multi-layer soil with large variation in resistivity/ corrosiveness is expected and /or locations specifically advised by Owner or his representative resistivity measurements at additional depth of up to 3 m (approx.) or more shall be taken. In general the resistivity of soil, which shall be surrounding the pipe, shall be measured. Hence the depth of measurement / electrode spacing may vary depending on topography and strata at the area.
- 5.3** At places where ROU has not yet been cleared, measurements shall be made right over the center line of pipeline route surveyed accounting for the cuttings /fillings also.
- 5.4** Observations shall be made enclosing the soils adjoining the trench wherever pipeline trenching has already been done.
- 5.5** The observations shall be made enclosing the soil immediately surrounding the pipeline route where ROU has been cleared but trenching has not been done.
- 5.6** All measurements shall be taken at right angles to the ROU unless otherwise asked by Owner or his representative at site.
- 5.7** At places in ROU where other pipelines are already existing care shall be taken to precisely locate such pipes line and take such precautions that observations are not adversely affected by presence of such pipelines.
- 5.8** Care shall also be taken that the observations are not influenced by presence of other earth currents in the area especially in the vicinity of EHV/HV lines and plants using earth return in their source of power etc.
- 5.9** Wherever possible / advised by Owner or his representative, depth of water table shall be determined by resistivity observations.
- 5.10** All measurements shall be made and recorded in metric units. While recording the data reference to the nearest intersecting point shall be made. To provide visual representation of variations in the resistivity along ROU, values shall be plotted on semi log graph sheets. The resistivity graph shall also indicate the resistivity at additional depths measured at various locations and depth of water table.

6.0 TESTS ON SOIL SAMPLES

- 6.1** Soil/water samples shall be collected along the ROU for analysis. Samples shall be collected on an average at one location for every 10 km along ROU with minimum at two locations. Exact locations shall be decided at site depending on the type of soil, soil

resistivity and in consultation with Owner or his representative. At each location the soil samples shall be collected at 1 m, 2 m depth and at expected depth of pipeline if it is more than 2 in at the location.

- 6.2** The collected soil/water shall be analyzed to determine presence and percentage of corrosive compounds including carbonates, bicarbonates, nitrates, chlorides, oxygen activity, moisture content and pH value.

7.0 ADDITIONAL DATA COLLECTION

- 7.1** The following data shall be collected with a view to generate design data for evaluation of cathodic protection interaction possibilities due to presence of other services in ROU and its vicinity:

- 7.2** Following information regarding foreign service/pipeline in or around the ROU (for existing and those, which are likely to come up during contract execution).

7.2.1 Types of service / pipelines and year of laying.

7.2.2 Diameter and pipeline coating in case of pipeline.

7.2.3 Parallel running / crossing.

7.2.4 Year of laying / commissioning.

7.2.5 Depth of laying.

7.2.6 Type of existing cathodic protection systems (impressed-current / sacrificial).

7.2.7 Location and type (Deep well / surface) of anode ground bed.

7.2.8 Rating of impressed current type of anode ground bed.

7.2.9 Location of existing CP power supply units and their output voltage, current, pipe to soil potential readings.

7.2.10 Location of existing test stations.

7.2.11 Remedial measures existing on foreign service/pipeline to prevent interactions.

7.2.12 Graphical representation of existing structure / pipe to soil potential records.

7.2.13 Possibility of integration/isolation of CP system of the foreign service/pipeline with that of the proposed pipeline, which may involve negotiations with owners of foreign services.

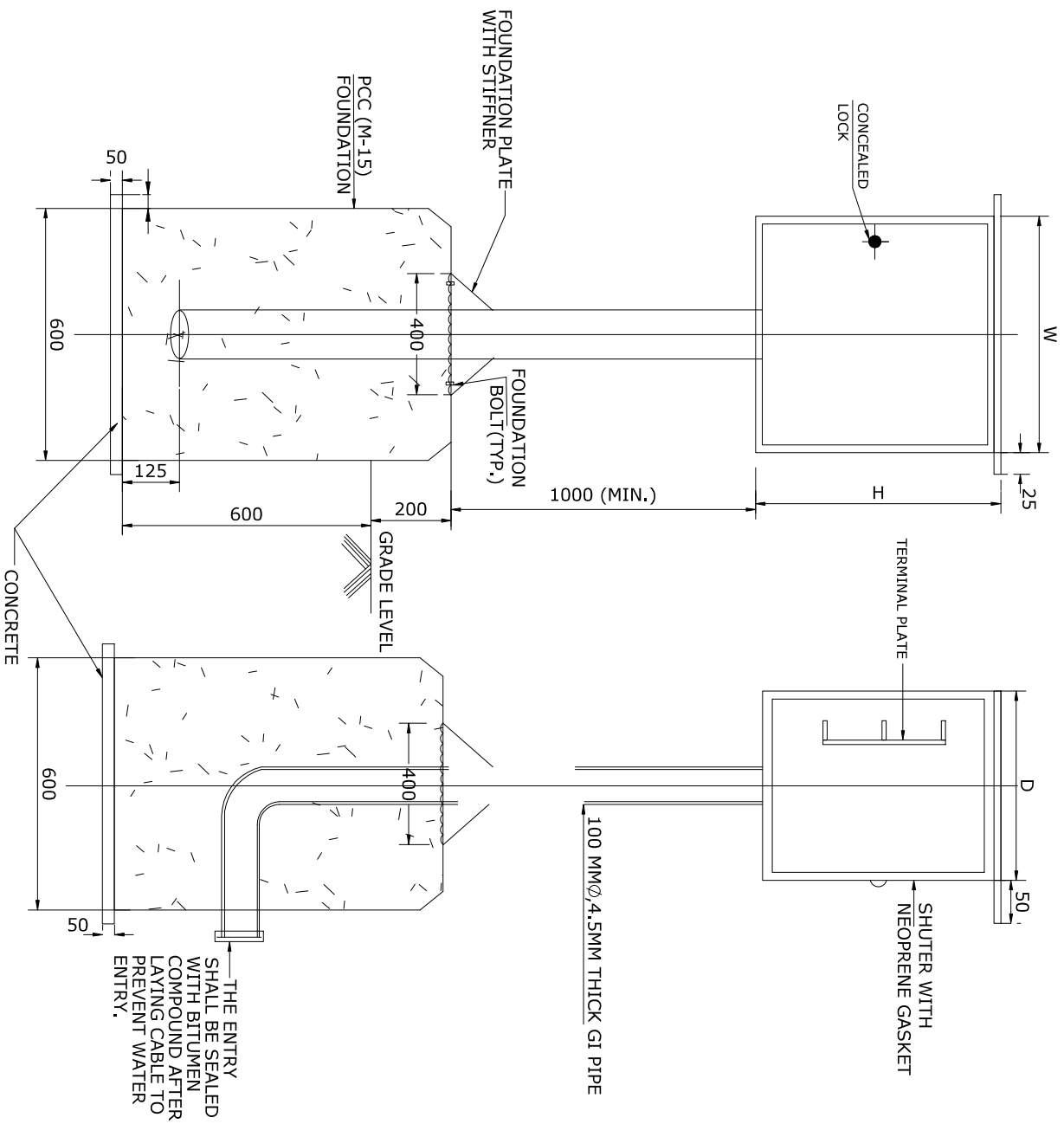
7.2.14 Where, pipeline is likely to "pass close to any existing ground bed (within 100 m approx.), anode-bed potential gradient survey shall be carried out, to verify possible interference with the CP system of the pipeline covered under this project.,

- 7.3** Voltage rating, phases and sheathing details of cables running parallel or crossing the ROU.

-
- 7.4** Existing .and proposed DC/AC power sources and systems using earth return path such as HVDC substations/ earthing stations fabrication yards with electric welding etc. in the vicinity of the entire pipeline route
- 7.5** Crossing and parallel running of electrified and non-electrified traction (along with information regarding, operating voltage, AC/DC type etc.) as well as abandoned tracks near ROU having electrical continuity with the tracks in use.
- 7.6** Crossing or parallel running of any existing or proposed EHV/HV AC/DC overhead power lines along with details of voltage, AC/DC type etc.
- 7.7** Voltage rating, phases, sheathing details of underground power cables, along ROU or in its vicinity.
- 7.8** Any-other relevant information that may be needed in designing and implementing of proper cathodic protection scheme for the proposed pipeline.

8.0 REPORT

- 8.1** On completion of all the field and laboratory work an interim report incorporating results generated from surveys, additional data collected, results of test carried out, etc., shall be submitted for comments / approval. The report shall also highlight any adverse impact on performance of sacrificial anodes due to the percentage of corrosive compounds including carbonates, bicarbonates, nitrates, chlorides present in the soil and pH value of the soil noticed during the survey. The final report incorporating comments/missing data shall be furnished for records. The report along with various drawings, graphs etc. prepared in connection with the work shall be submitted along with six prints by the Contractor.

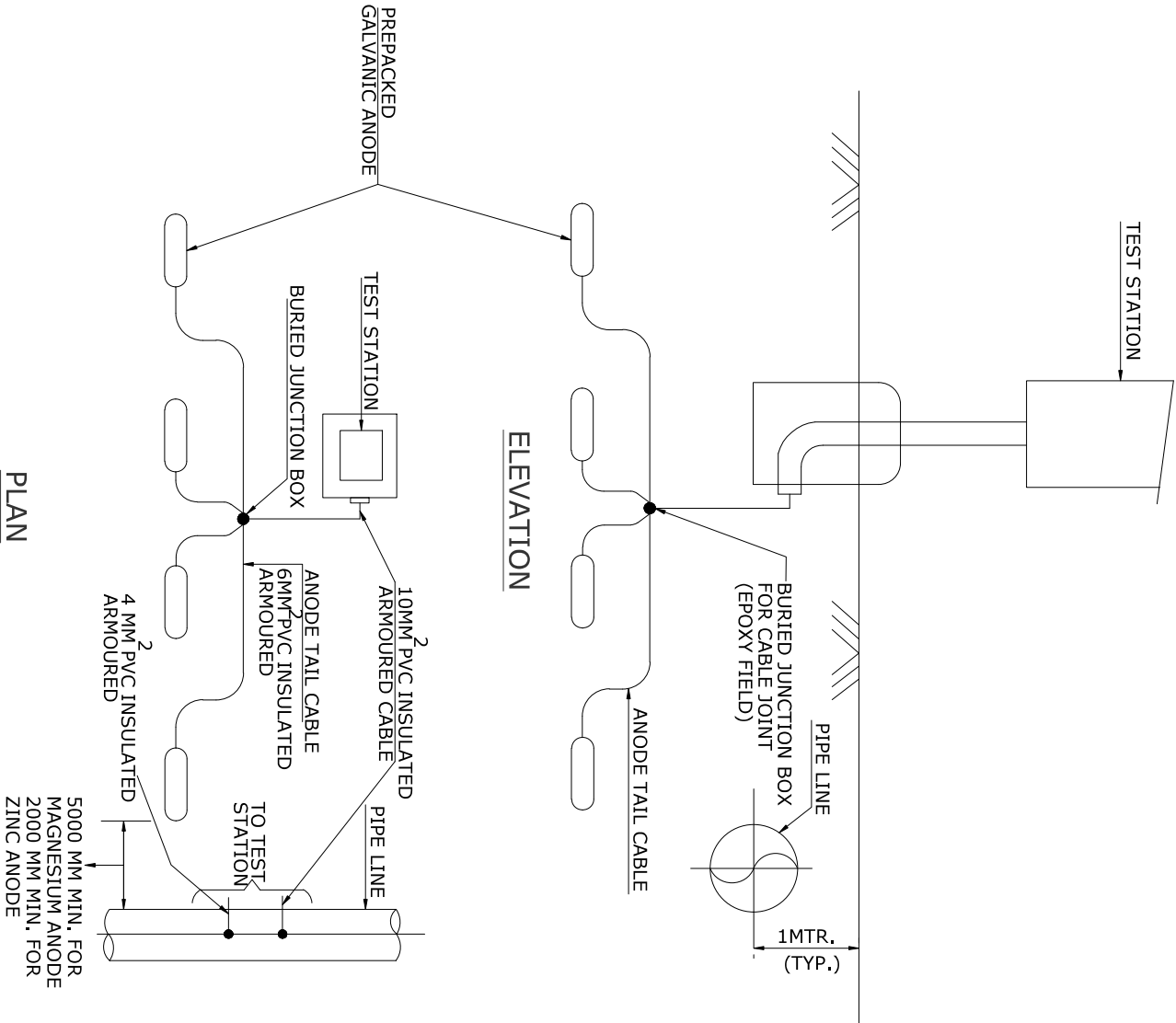


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NOTES:

1. THE SHUTTER SHALL BE HINGED TYPE WITH CONCEALED LOCK & SHALL HAVE DOOR GASKET TO MAKE THE TEST STATION WEATHER PROOF (IP:55).
2. THE INNER & OUTER SURFACE OF THE TEST STATION SHALL BE EPOXY PAINTED.
3. THE NAME PLATE SHALL BE OF ANODISED ALUMINIUM WITH BLACK BACKGROUND & WHITE LETTERS & SHALL BE FIXED TO THE INNER SIDE OF SHUTTER.
4. TEST STATION SHALL BE ERRECTED WITH THEIR SHUTTERS PARALLEL TO THE LINE OF AXIS & FACING THE PIPELINE.
5. THE CHAINAGE OF TEST STATION SHALL BE WRITTEN WITH BLACK PAINT ON THE OUTER SIDE OF THE FRONT SHUTTER.
6. HEIGHT OF THE TEST STATION SHOWN ABOVE GROUND LEVEL IS MINIMUM ONLY. THE ACTUAL HEIGHT SHALL BE DECIDED BASED ON LOCAL FLOOD LEVELS TO BE ASCERTAINED .
7. CONTRACTORS SHALL FURNISH ALL THE DIMENSIONS OF THE TEST STATION.
8. ALL DIMENSIONS ARE IN MM.

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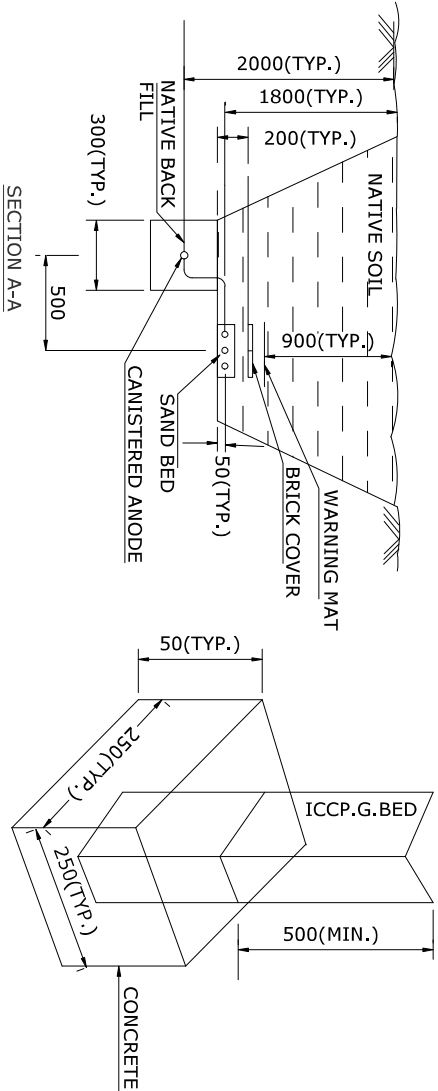
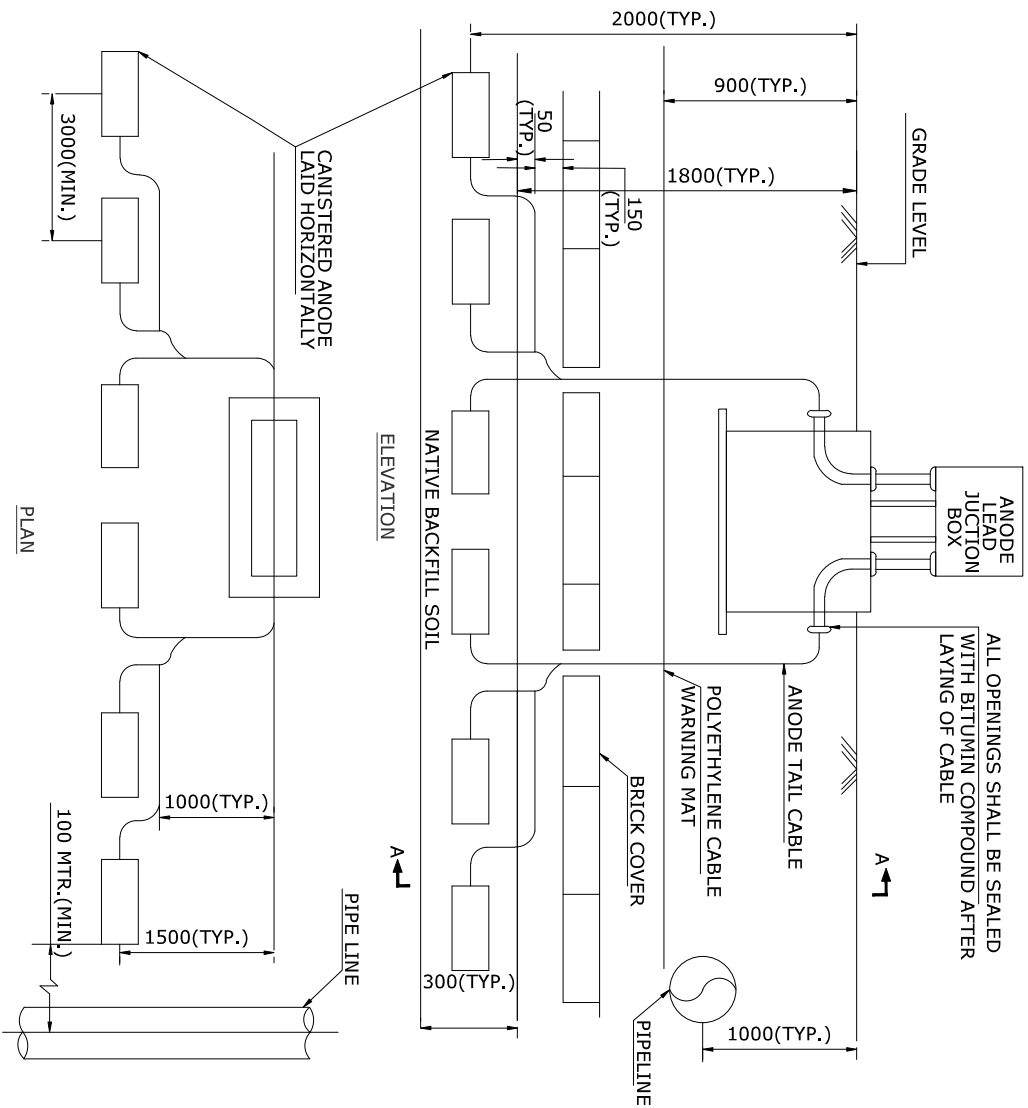
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- NOTES:**
1. THE PREPACKED GALVANIC ANODE SHALL BE INSTALLED AT A MINIMUM DEPTH, EQUAL TO BOTTOM LEVEL OF THE PIPELINE.
 2. THE ANODES ARE SHOWN HORIZONTALLY LAID. ALTERNATIVELY THE ANODES MAY BE VERTICALLY INSTALLED WITH
 3. NUMBER OF TERMINALS FOR TEST STATION FOR GALVANIC ANODES FOR PERMANENT CP SYSTEM SHALL BE DECIDED BASED ON NUMBER OF ANODES.

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NOTES:

1. THE ANODE GROUND BED SHALL BE LOCATED ELECTRICALLY REMOTE FROM THE PIPELINE WITH MINIMUM 100 MTR. AWAY FROM THE NEAREST POINT ON THE PIPELINE.
2. NO. SPLICING SHALL BE ALLOWED FOR THE CABLES.
3. CONTRACTOR SHALL FURNISH THE DIMENSIONED DRAWING SHOWING ACTUAL QUANTITY OF ANODES FOR EACH GROUND BED.
4. ALL UNARMoured CABLES SHALL BE RUN THROUGH PE SLEEVES.
5. ANODE BED MARKER SHALL BE RUN THROUGH PE SLEEVES.
6. NATIVE BACKFILL SOIL SHALL BE FREE OF ROCKS, GARBAGE, PAPERS, PLASTICS ETC.
7. ANODES MAY BE LAID VERTICALLY IN CASE OF VERTICALLY SHALLOW ANODE GROUND BED DESIGN.
8. ALL THE DIMENSIONS ARE IN MM.

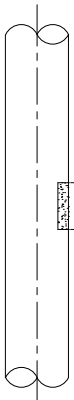
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STANDARD DRAWING NO.		REV.	SIZE
VCS-STD-EL-4504		02	A4
SHEET NO.	1 OF 1		

REMOVABLE PIPE COATING, FILE TO BRIGHT METAL AND DRY ANY MOISTURE WITH A CLOTH

75x45 mm



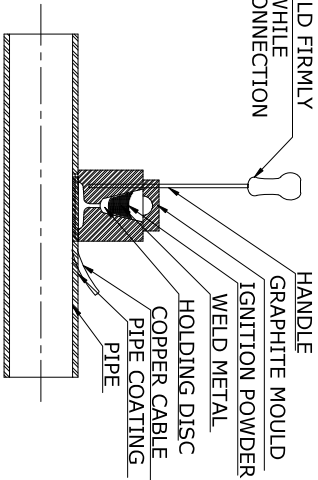
STEP-1

STRIP INSULATION FROM WIRE EQUAL TO LENGTH OF MOULD



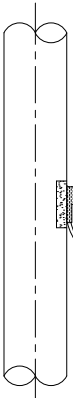
STEP-2

HOLD MOULD FIRMLY IN PLACE WHILE MAKING CONNECTION



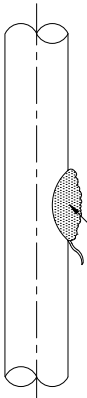
STEP-3

REMOVE SLAG WITH HAMMER/ WIRE BRUSH



STEP-4

EPOXY ENCAPSULATION INTERGARD 821(OR EQUIVALENT)

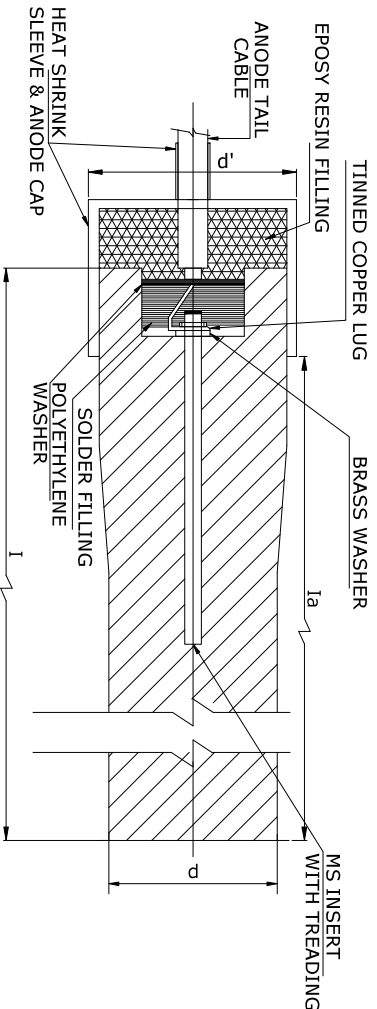
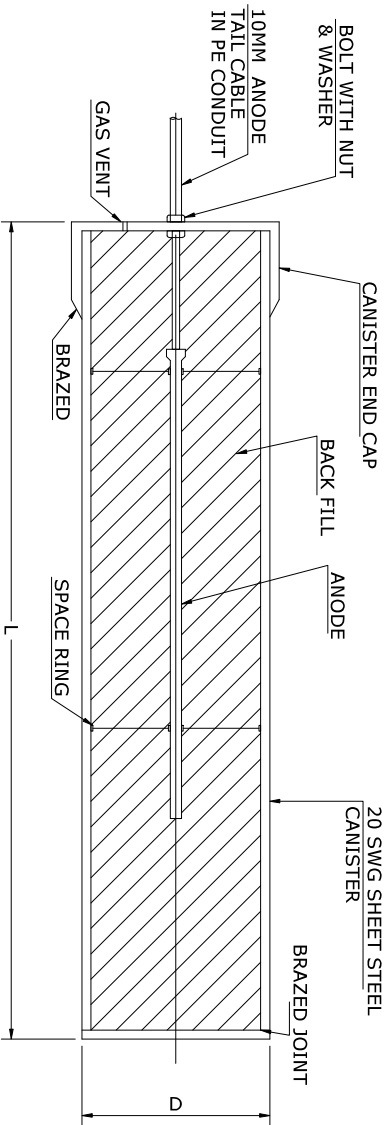


STEP-5

NOTES: GENERAL THERMITE WELDING PROCEDURE

1. REMOVABLE PIPE COATING FILE TO BRIGHT METAL AND DRY ANY MOISTURE WITH A CLOTH.
2. STRIP INSULATION FROM WIRE EQUAL TO LENGTH OF MOULD.
3. INSERT THE CONDUCTOR INTO MOULD.
4. INSERT STEEL DISC IN BOTTOM OF MOULD CAVITY INSIDE MOULD _ DUMP THE METAL INTO MOULD BEING CAREFUL NOT TO UPSET THE STEEL DISC. TAP THE BOTTOM OF THE TUBE TO LOOSEN ALL THE IGNITION POWDER AND SPREAD IT EVENLY OVER THE WELD METAL. PLACE A SMALL MOUNT OF STARTING POWDER ON THE TOP EDGE OF THE MOULD UNDER COVER OPENING FOR EASY IGNITION.
5. CLOSE COVER AND IGNITE WITH THE FLINT GUN MOVE GUN AWAY QUICKLY TO PREVENT FOULING . IF FLINT GUN SHOULD BECOME FOULED , SOAK IT IN HOUSEHOLD AMMONIA.
6. AFTER IGNITION, HOLD THE MOULD IN PLACE FOR 5 SECONDS TO ALLOW THE WELD TO SOLIDIFY, AFTER THE WELD HAS COOLED, REMOVE THE SLAG WITH A CHIPPING HAMMER OR WIRE BRUSH.
7. ENCAPSULATE THE CONNECTION AND ENTIRE PREPARED SURFACE WITH TWO PART EPOXY COMPOUND.
8. REMOVE ALL SLAGS FROM THE WELDER BEFORE MAKING THE NEXT WELD CLEAN THE COVER EVERY 6 TO 10 WELDS.
9. WET OR DAMP MOULDS WILL PRODUCE POROUS WELDS, MOULDS MUST BE DRIED OUT BEFORE ATTEMPTING TO WELD.
10. CONNECTIONS ARE TO BE PLACED A MINIMUM OF 100mm APART, UNSUCCESSFUL WELDS ARE ABANDONED AND MOVED TO ANOTHER PREPARED SURFACE NOT LESS THAN 100mm AWAY.

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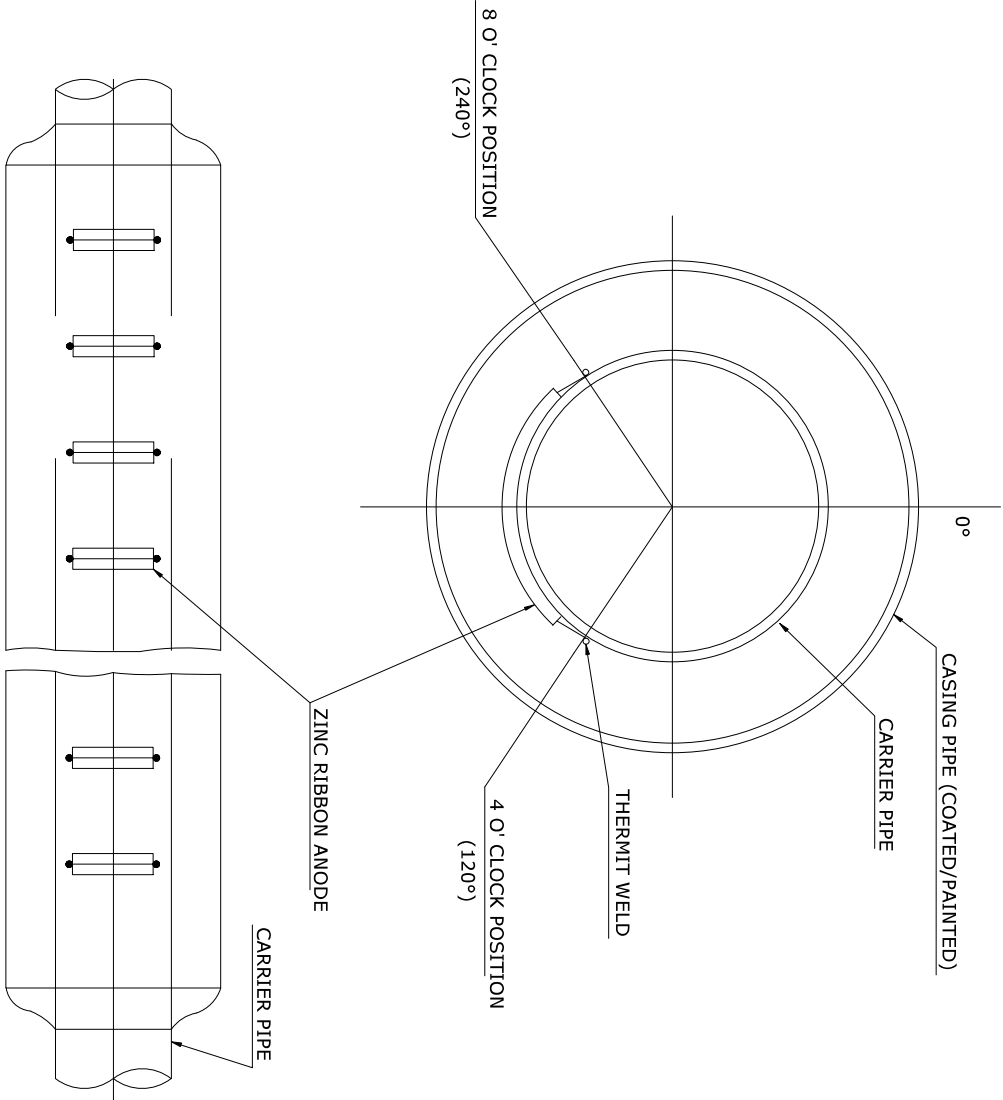
CHEMICAL COMPOSITION OF ANODE (% WEIGHT):-

CARBON	-----	: 0.7%-1.1%
MANGANESE	-----	: 1.5% max.
SILICON	-----	: 14.2%-14.75%
CHROMIUM	-----	: 3.25%-5%
MOLYBDYNUM	-----	: 0.2%max.
COPPER	-----	: 0.5% max
IRON	-----	: REMAINDER

NOTES:

1. ANODE FOR SURFACE AND DEEP GROUND BED APPLICATION SHALL BE IDENTICAL EXCEPT FOR BACK FILL PREPACKING.
2. SHEET STEEL ANODE CANISTERS SHALL BE FILLED WITH METALLURGICAL GRADE COKE BREEZE.
3. FLUID PETROLEUM COKE BREEZE BACKFILL SHALL BE PROVIDED IN THE WELL, SURROUNDING ANODES IN DEEP WELL GROUND BEDS.
4. ANODE TAIL CABLE SHALL BE 10 Sq.mm HIGH CONDUCTIVITY, STRANDED COPPER CONDUCTOR, 650V GRADE, PE INSULATED, PVC SHEATHED & UNARMoured.
5. ALL THE DIMENSIONS, NET WEIGHT & GROSS WEIGHT OF THE ANODE SHALL BE FURNISHED BY CONTRACTOR.
6. THE ACTIVE LENGTH 'la' OF ANODE SHALL BE CONSIDERED FOR CALCULATING THE SIZE / WEIGHT.

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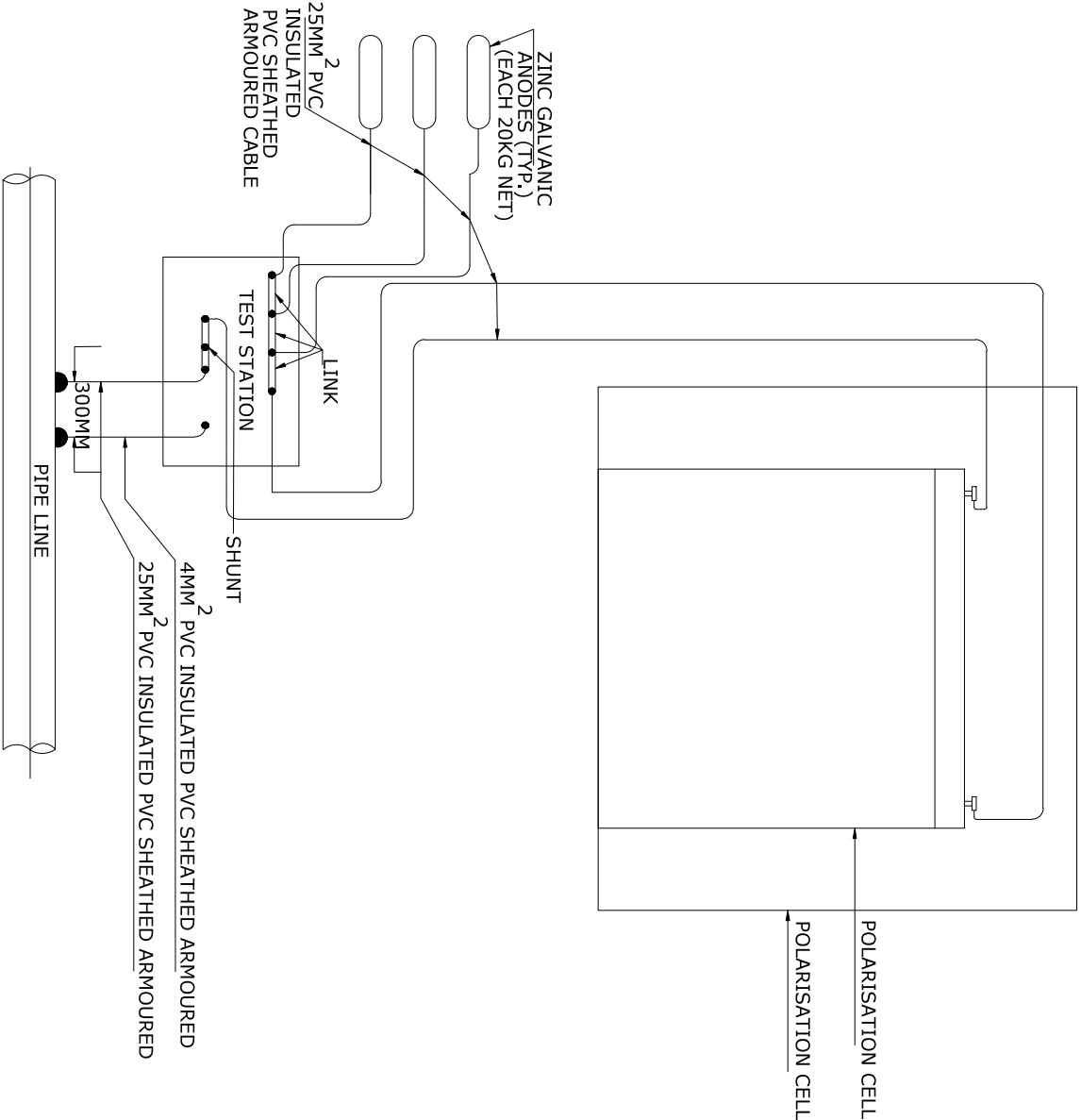
CHEMICAL COMPOSITION OF ANODE (% WEIGHT):-

A1	-----	: 0.005% max.
Cd	-----	: 0.003% max.
Cu	-----	: 0.002% max.
Fe	-----	: 0.0014% max.
Pb	-----	: 0.003%max.
Zn	-----	: REMAINDER

NOTES:

1. STEEL CORE TO BE THERMIT WELDED DIRECTLY TO CARRIER PIPE WITHIN CASINGS AT 4 & 8 'O' CLOCK POSITIONS FOR CARRIER PIPE OF LESS THAN 4 INCH DIA. ANODES MAY BE PROVIDED ALONG THE LENGTH OF THE CARRIER PIPE LINE AT THE BOTTOM LEVEL.
2. SIZE OF ANODE & SPACING BETWEEN ANODES SHALL BE DECIDED BASED ON DESIGN CRITERIA. HOWEVER MINIMUM ONE NUMBER ANODE SHALL BE PROVIDED BETWEEN TWO PIPE SPACERS/CENTRALISERS PROVIDED BETWEEN CARRIER AND CASING PIPES.
3. PIPE SPACERS/CENTRALISERS ARE NOT SHOWN.
4. ANODE COMPOSITION, DIMENSION, NET & GROSS WEIGHT PER UNIT LENGTH SHALL BE FURNISHED BY THE CONTACTOR.
5. CASING PIPE WHERE COATED AGAINST CORROSION OF EXTERNAL SURFACE SHALL BE PROTECTED BY GALVANIC ANODES INSTALLED AT BOTH THE ENDS OF THE CASING PIPE.

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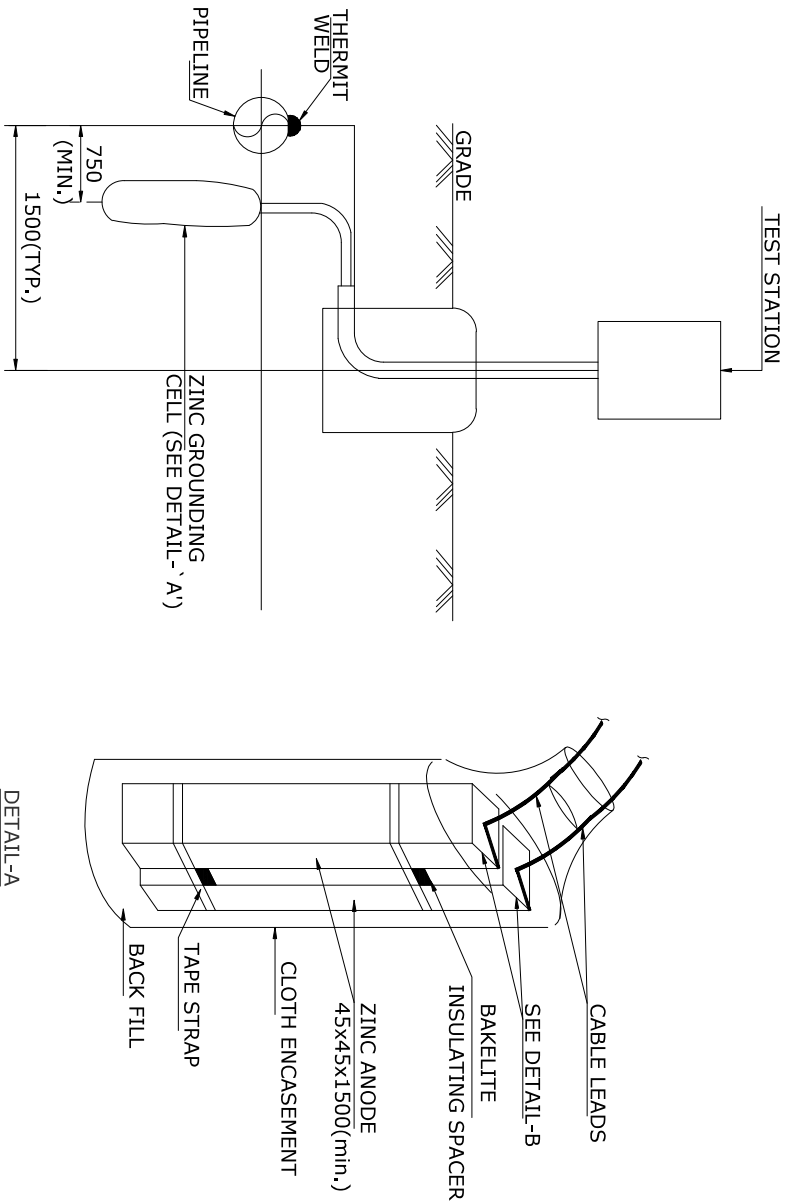


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NOTES:

1. THE POLARISATION CELL, ANODES AND ASSOCIATED CABLES, CABLE JOINT ETC. SHALL BE MINIMUM BE RATED FOR THE EXPECTED FAULT CURRENT AT THE LOCATION OF THE INSTALLATION & SIZED FOR DESIGN LIFE OF PERMANENT C.P SYSTEM.
2. THE POLARISATION CELL SHALL BE HOUSED IN A VANDALLISM PROOF HOUSING.
3. CELL SHALL HAVE GOOD VENTILATION TO ATMOSPHERE & SHALL BE PROTECTED AGAINST DIRECT SUN LIGHT & RAIN / WATER.
4. ANODE TAIL CABLES OF EACH ANODE SHALL BE TERMINATED INDIVIDUALLY IN TESTSTATION.
5. CONTACTOR SHALL FURNISH DRAWING WITH ACTUAL DIMENSIONS & RATINGS.
6. EASY ACCESS TO POLARISATION CELL SHALL BE AS PER STANDARD 7-51-0601 (PREPACKED ZINC ANODE).

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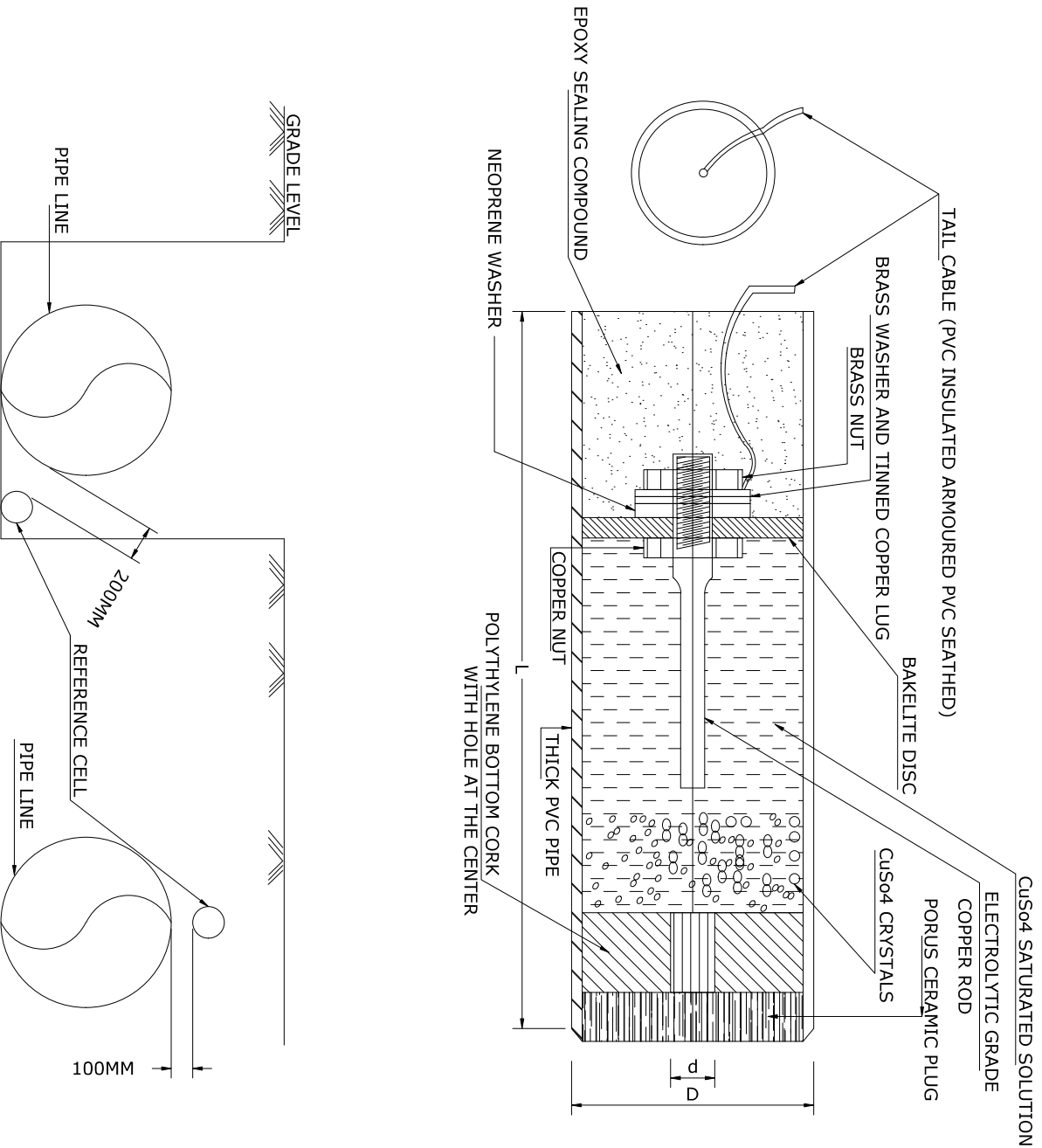


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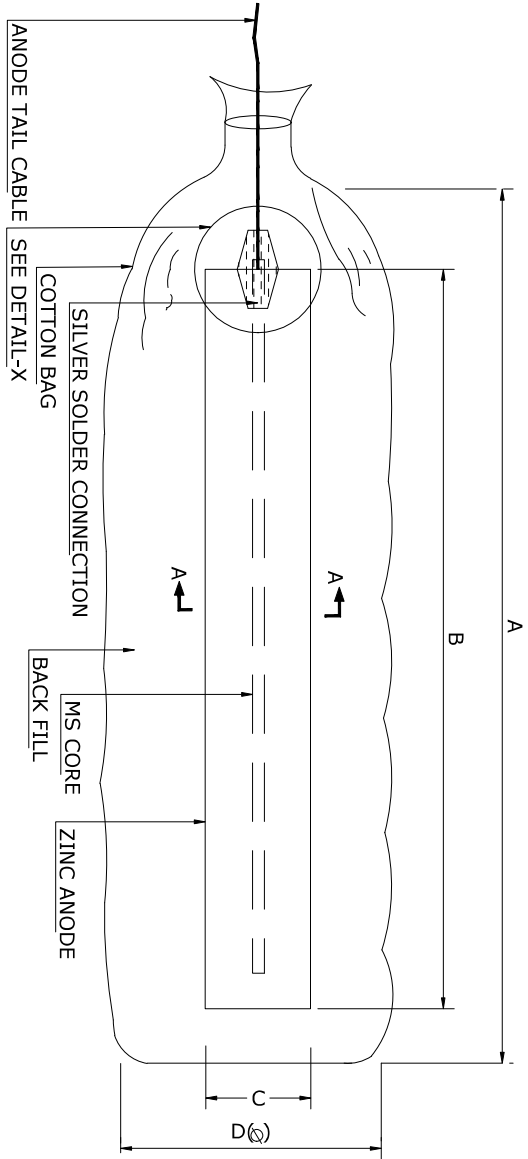
1. CONTACTOR SHALL FURNISH ANODE COMPOSITION, NET WEIGHT, GROSS WEIGHT AND ALL THE DIMENSIONS OF THE GROUNDING CELL.
2. ZINC GROUNDING CELLS SHALL BE INSTALLED VERTICALLY SUCH THAT THE TOP OF THE CELL IS APPROXIMATELY AT THE SAME ELEVATION AS PIPE CENTRE LINE.
3. NET WEIGHT OF ZINC FOR EACH PLATE OF THE GROUNDING CELL SHALL BE MINIMUM 20KG.
4. ALL CABLE LEADS FOR ZINC GROUNDING CELL SHALL BE KEPT AS SHORT & DIRECT AS POSSIBLE.
5. GROUNDING CELL CABLE LEAD SHALL BE 25 sqmm HIGH CONDUCTIVITY, STRANDED, COPPER CONDUCTOR 650V GRADE, PVC INSULATED, ARMoured & PVC SHEATHED.
6. CABLE JOINT TO ANODE CORE SHALL BE SUITABLE TO DISCHARGE MINIMUM 10 KA FAULT CURRENT.
7. ALL DIMENSIONS ARE IN MM.

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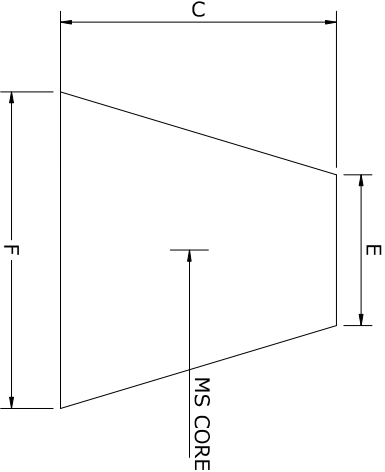
**NOTES:**

1. REFERENCE CELL SHALL BE BACK FILLED WITH CARBONACEOUS BACK FILL MATERIAL SPECIFIED.
2. FOR NEW PIPELINES REFERENCE ELECTRODE SHALL BE INSTALLED APPROXIMATELY AT THE BOTTOM LEVEL OF THE PIPE LINE, 200MM AWAY FROM SURFACE OF THE PIPELINE.
3. REFERENCE ELECTRODES MAY BE INSTALLED AT THE TOP OF THE PIPELINE, APPROXIMATELY 100MM ABOVE THE PIPELINE WHERE THE PIPELINE HAS ALREADY BEEN LAID.
4. REFERENCE CELL CABLE SHALL BE ROUTED ALONG THE BOTTOM LEVEL OF THE PIPELINE, AND 250MM APPROX. AWAY FROM THE SURFACE OF THE PIPE.
5. BACKFILLED REFERENCE ELECTRODES SHALL BE SOAKED IN 20 LTRS. OF CLEAN FRESH WATER FOR 24 HOURS IMMEDIATELY PRIOR TO INSTALLATION.
6. CONTACTOR SHALL FURNISH REFERENCE CELL DRAWING WITH ALL DIMENSIONS.

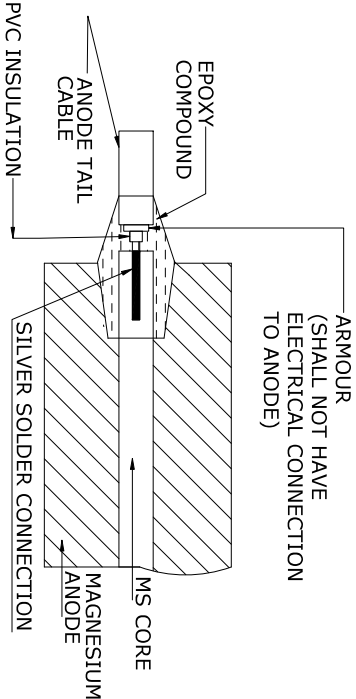
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ELEVATION



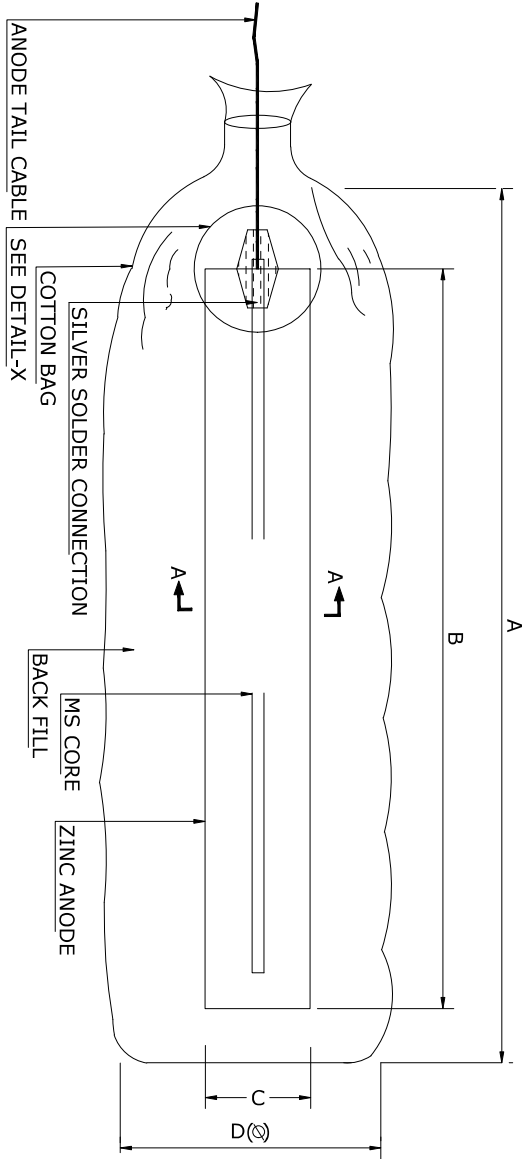
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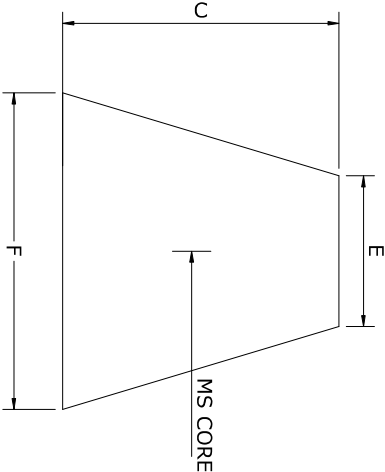
DETAIL-X

- NOTES:**
1. ANODE COMPOSITION, NET WEIGHT, GROSS WEIGHT AND DIMENSIONS SHALL BE FURNISHED BY CONTACTOR.
 2. ANODE TAIL CABLE SHALL BE HIGH CONDUCTIVITY, STRANDED, COPPER CONDUCTOR, 650V GRADE, PVC INSULATED, PVC SHEATHED & ARMoured.

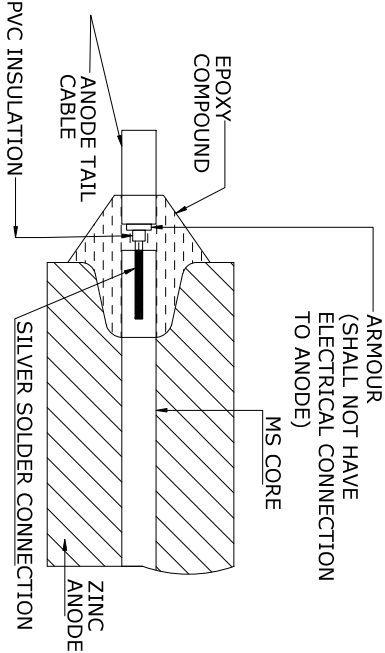
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ELEVATION



SECTION-AA

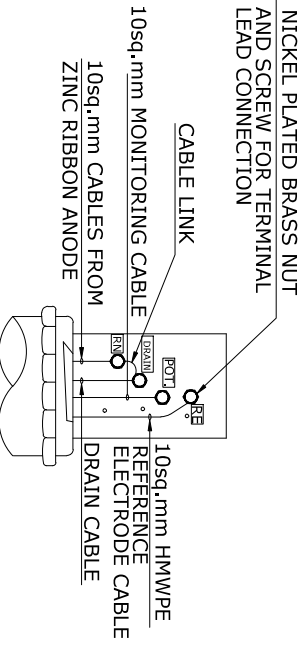
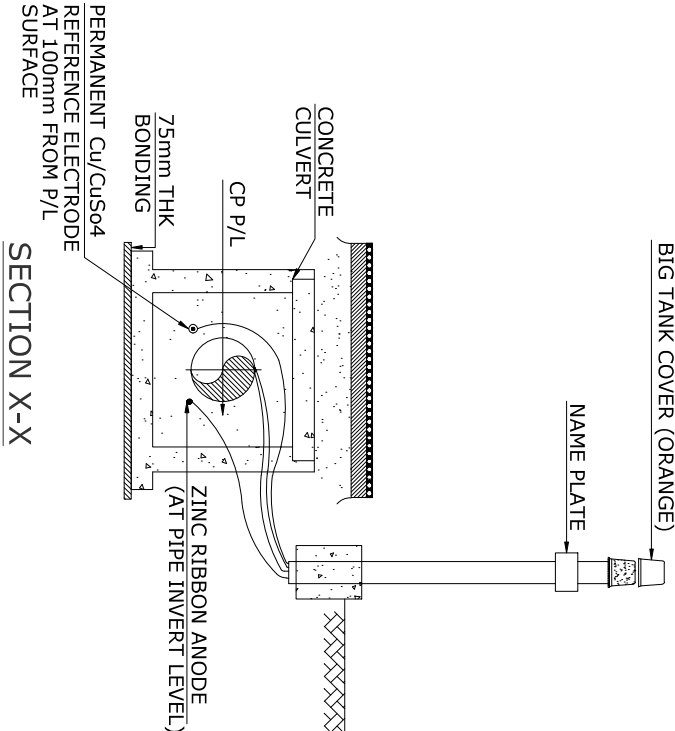
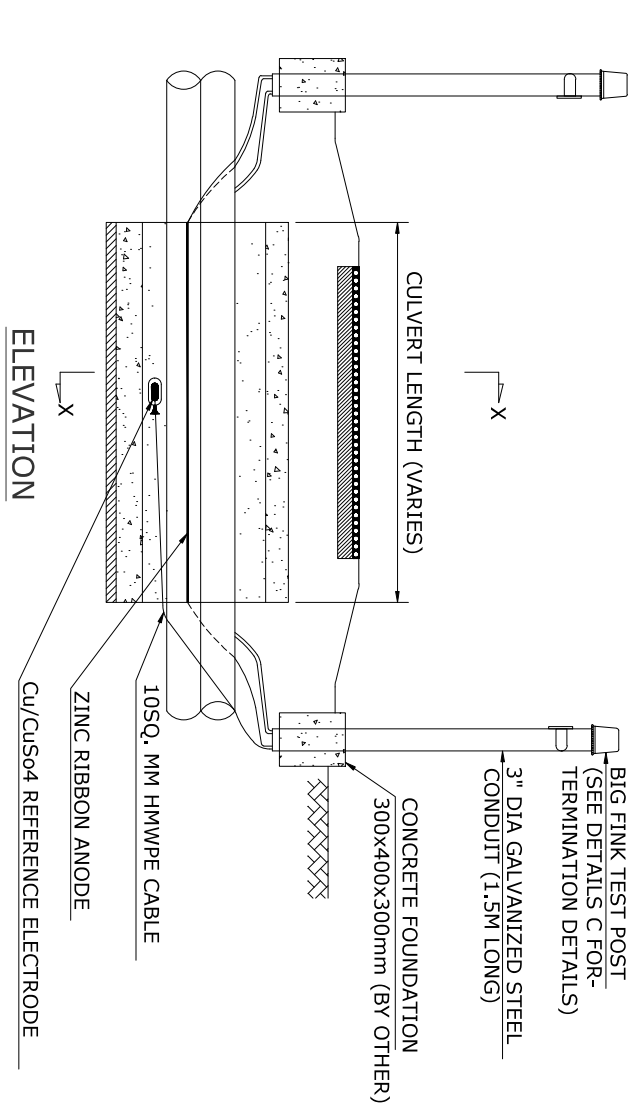


DETAIL-X

NOTES:

1. ANODE COMPOSTION, NET WEIGHT, GROSS WEIGHT AND DIMENSIONS (A,B,C,D,E & F) SHALL BE FURNISHED BY CONTRACTOR.
2. ANODE TAIL CABLE SHALL BE HIGH CONDUCTIVITY, STRANDED, COPPER CONDUCTOR, 650V GRADE, PVC SHEATHED & ARMoured.
3. ANODE TYPE-I SHALL BE USED FOR SEA WATER, BRACKISH WATER OR SALINE ELECTROLYTE AND ANODE-II SHALL BE USED FOR WATER, BACK FILLS & SOIL APPLICATION.

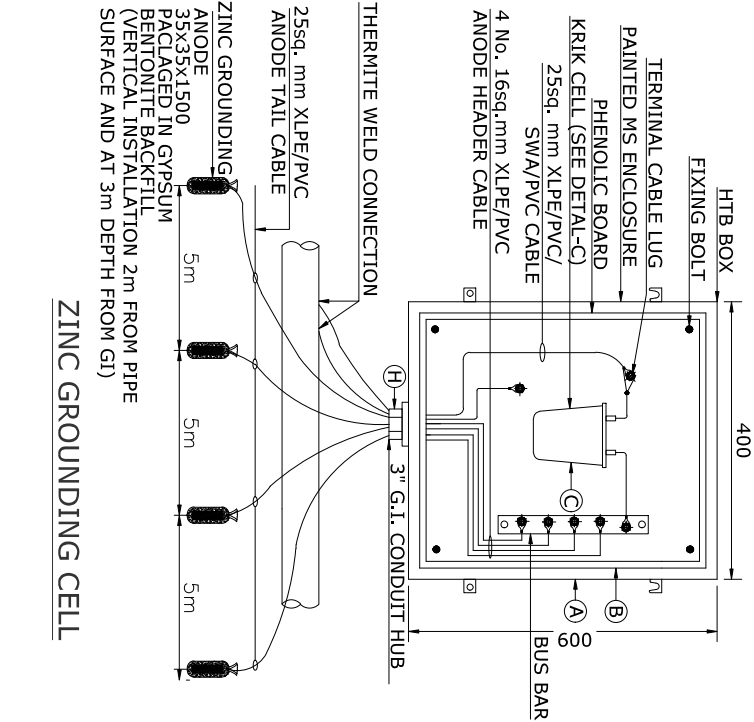
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01	19.12.19	RE-ISSUED AS STANDARD DRAWING	SY	VV	AD	SK
0	15.05.17	ISSUED AS STANDARD	SY	RD	AD	SK
REV NO.	DATE	PURPOSE	PREPARED BY	CHECKED BY	APPROVED BY	AUTHORIZED BY



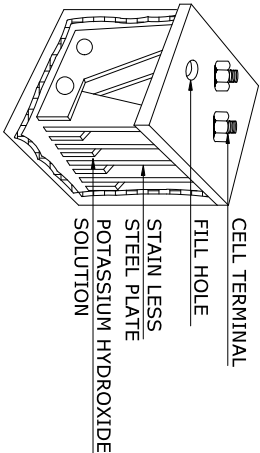
TEST POST INSTALLATION DETAILS AT ROAD CROSSING WITH CONCRETE CULVERT

- NOTES:**
1. ALL DIMENSIONS ARE IN MM UNLESS OTHERWISE SPECIFIED.
 2. ANODE RIBBONS SHALL BE INSTALLED AT ROAD CROSSING WHERE THE PIPE IS CASSED IN CONCRETE CULVERT.
 3. EACH TEST POST SHALL BE HAVE ONE MONITORING AND ONE DRAIN CABLE CONNECTED TO THE PIPE PIPE STRUCTURE.

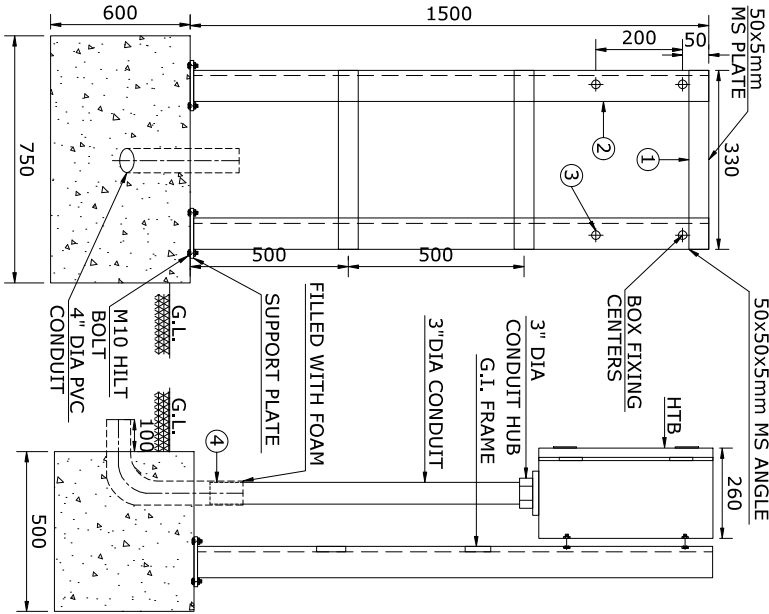
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0	15.05.17	ISSUED AS STANDARD	SY	RD	AD	SK
REV NO.	DATE	PURPOSE	PREPARED BY	CHECKED BY	APPROVED BY	AUTHORIZED BY



ZINC GROUNDING CELL



DETAIL-C
KRIK CELL (5KA RATING) DETAILS



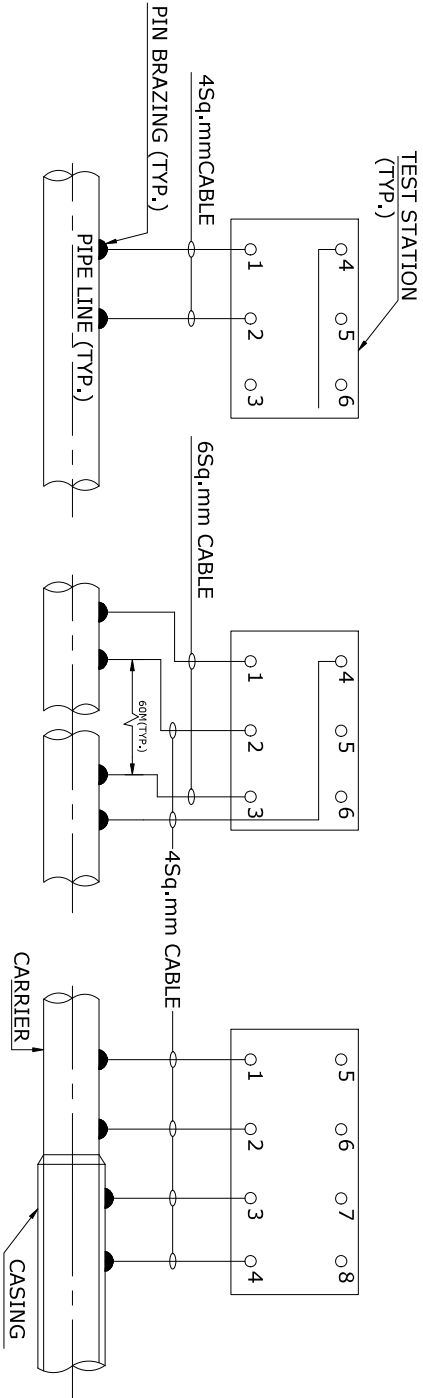
HTB MOUNTING DETAILS (BY OTHERS)

MATERIALS SCHEDULE		
ITEM NO.	DESCRIPTION	QTY.
A.	PAINTED STEEL ENCLOSURE LOCKABLE TYPE RATED FOR IP 55 PROTECTION MIN. 1.6mm THICK.	1 No.
B.	PHENOLIC BOARD-6mm THICK	1 No.
C.	TINNED CUPPER BUS BAR 25x5mm PLATE	1 No.
D.	SHUNT 10A, 100mV	2 No.
E.	VARIABLE RESISTOR 1.29 OHM 60 WATTS.	2 No.
F.	BRASS TERMINAL C/W WASHER, LOCK WASHER & NUTS	AS REQ.
G.	CRIMPED CABLE LUG	AS REQ.
H.	2" DIA G.I. CONDUIT HUB	1 No.

MOUNTING FRAME MATERIAL SCHEDULE (BY OTHERS)			
ITEM NO.	DESCRIPTION	UNIT	QTY.
1.	MS FLAT SIZE 50x5mm, LENGTH TO SUIT	NO	3
2.	MS ANGLES SIZE 50x50x5mm, OVERALL LENGTH 1500mm	NO	2
3.	FRAME AND BOX FIXING HOLES, 11mm DIAMETER AND STAINLESS STEEL SET SCREWS, NUTS AND WASHERS	NO	4
4.	CONDUIT LENGTH TO SUIT.	NO	1
5.	2" DIA PVC CONDUIT LENGTH TO SUIT.	NO	1

- NOTES:**
1. ALL DIMENSIONS ARE IN MM UNLESS OTHERWISE SPECIFIED.
 2. THE ZINC GROUNDING ANODE INSTALLATION CAN BE DONE ON ANY ONE SIDE OF THE OVERHEAD POWER LINE CROSSING TO SUIT THE DRILLING AUGERING MACHINE ACCESSIBILITY AT SITE.

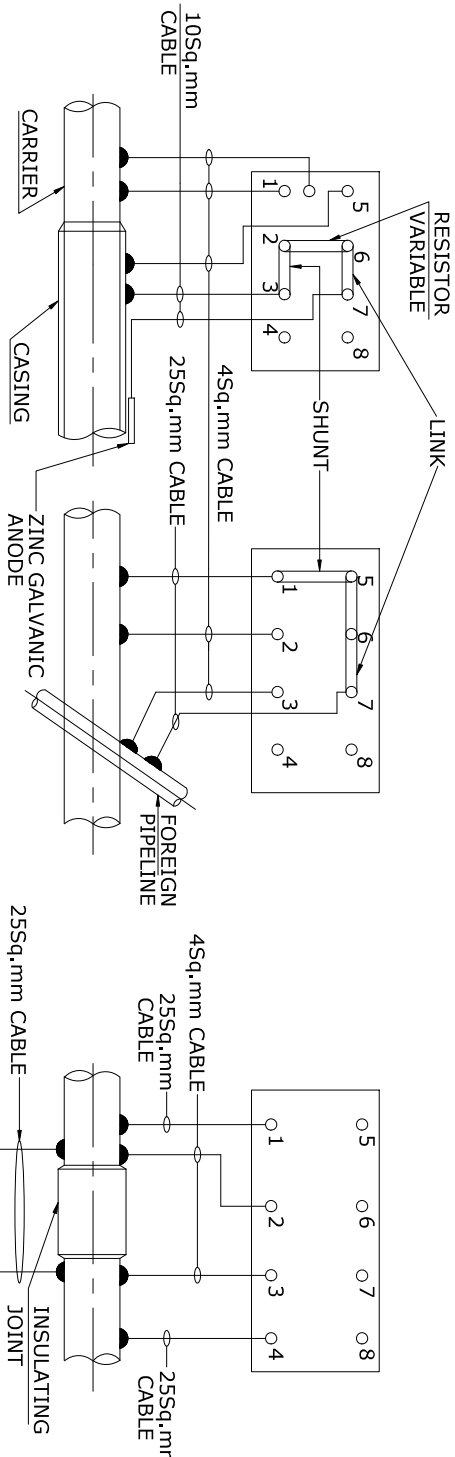
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0	15.05.17	ISSUED AS STANDARD	SY	RD	AD	SK
REV NO.	DATE	PURPOSE	PREPARED BY	CHECKED BY	APPROVED BY	AUTHORIZED BY



POTENTIAL MEASUREMENT
CONNECTION SCHEME-A

CURRENT MEASUREMENT
CONNECTION SCHEME-B

CASED CROSSING WITH
UNCOATED/UNPAINTED CASING
CONNECTION SCHEME-C

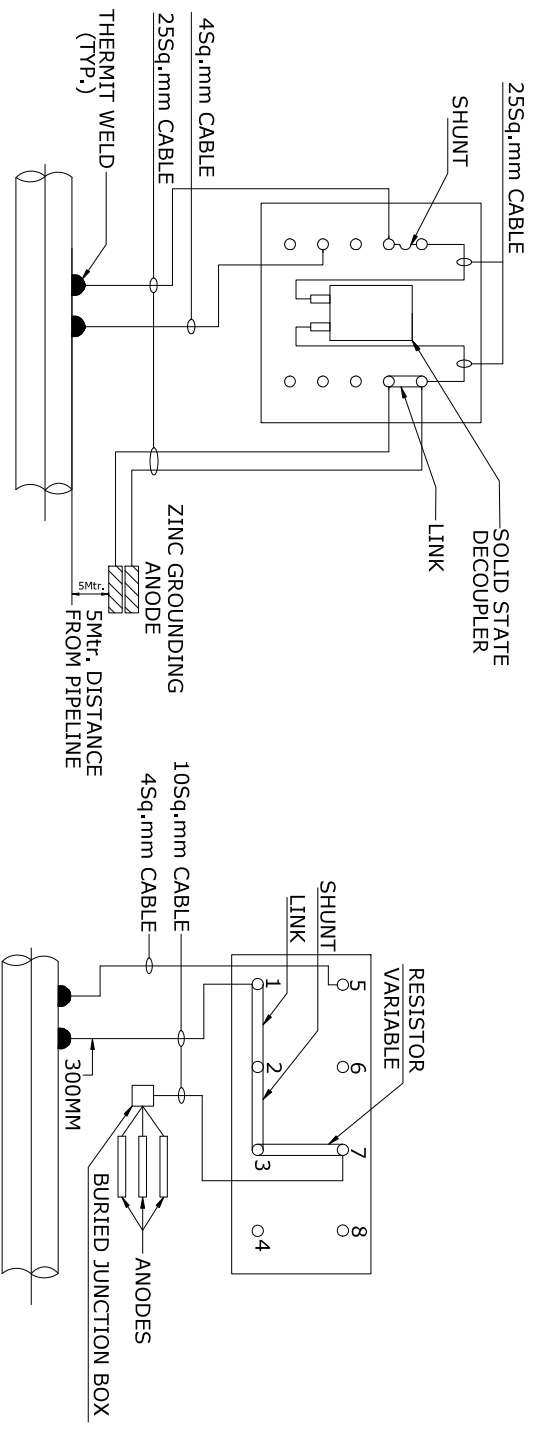
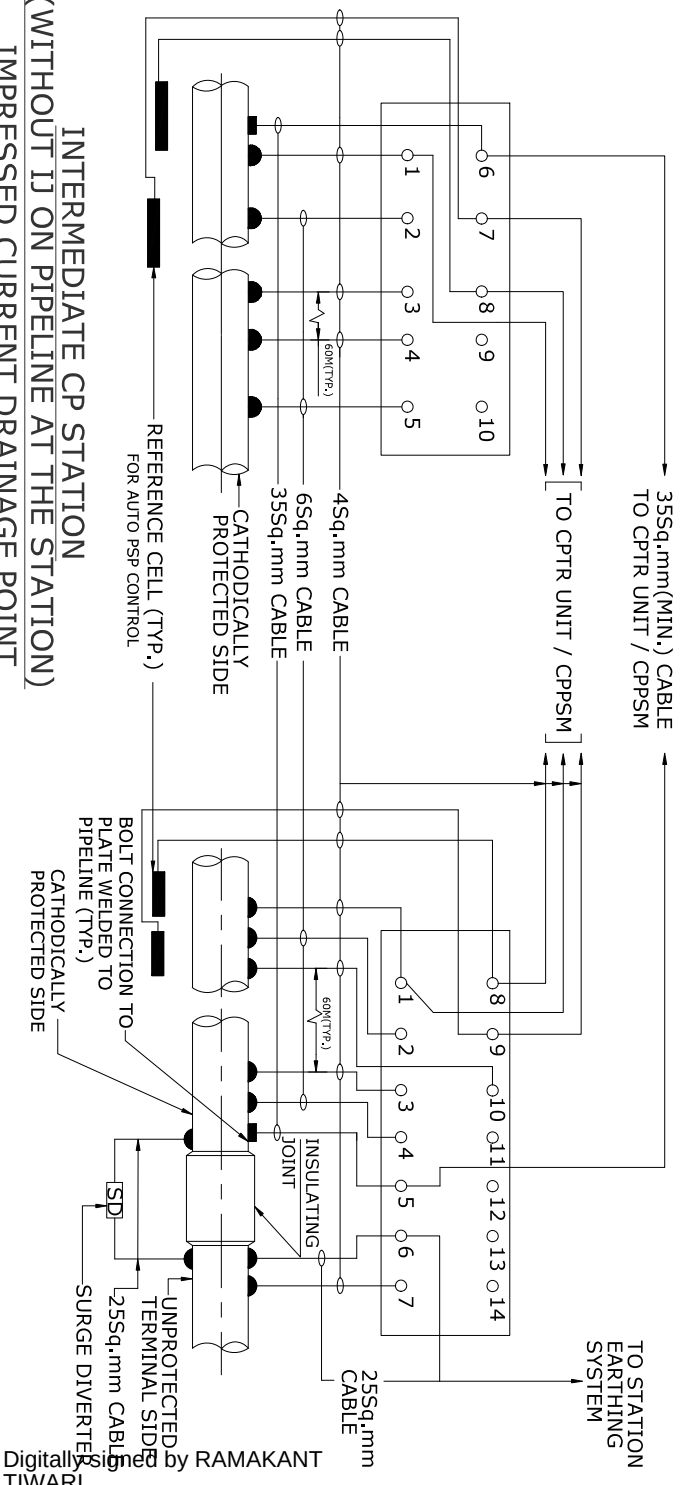


CASED CROSSING WITH
COATED/PAINTED CASING
(CONNECTION SCHEME-D)

FOREIGN PIPELINE CROSSING
(CONNECTION SCHEME-E)

INSULATING JOINT CONNECTION
(CONNECTION SCHEME-F)

02	06.05.22	RE-ISSUED AS STANDARD DRAWING	SY	RD	AA	HK
01	18.12.19	RE-ISSUED AS STANDARD DRAWING	SY	VV	AD	SK
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REV NO.	DATE	PURPOSE	PREPARED BY	CHECKED BY	APPROVED BY	AUTHORIZED BY

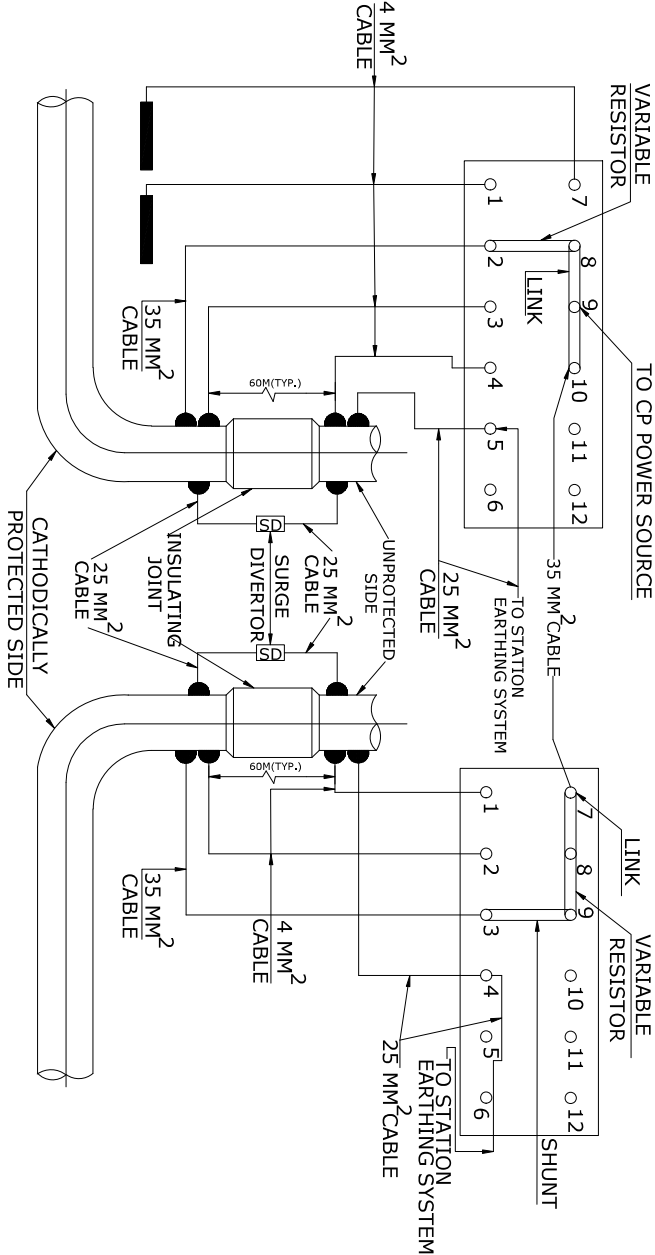


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01	18.12.19	RE-ISSUED AS STANDARD DRAWING	SY	VV	AD	SK
0	15.05.17	ISSUED AS STANDARD	SY	RD	AD	SK
REV NO.	DATE	PURPOSE	PREPARED BY	CHECKED BY	APPROVED BY	AUTHORIZED BY



TEST STATION I-1

TEST STATION I-2

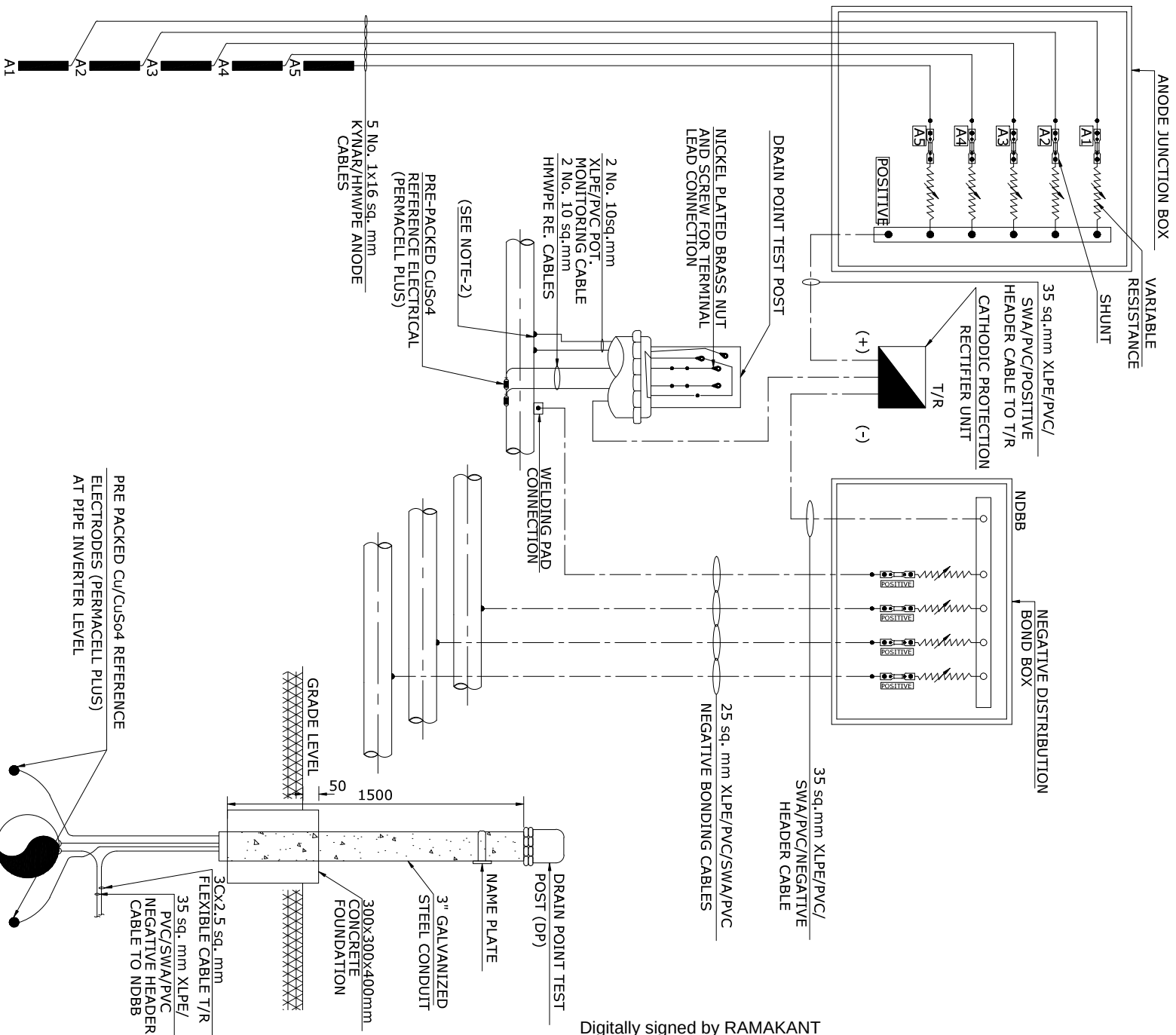


INTERMEDIATE PIGGING STATION
IMPRESSED CURRENT DRAINAGE POINT
CONNECTION SCHEME -I

NOTES:

1. NUMBER OF TERMINALS FOR TEST STATION OF DIFFERENT CONNECTION SCHEME SHALL BE AS SHOWN ON THE RESPECTIVE SCHEME DRAWING, TEST STATION FOR ANY OTHER SCHEME DRAWING. TEST STATION FOR ANY OTHER SCHEME SHALL PREFERABLY BE SIMILAR TO ANY OF THE ABOVE TYPES.
2. ELECTRICAL CONNECTIONS SHALL BE CLEANED TO BRIGHT SURFACE & TIGHTENED WITH NON-OXIDE GREASE APPLIED ON MECHANICALLY MATED SURFACE.
3. NUMBER OF TERMINALS FOR TEST STATION FOR GALVANIC ANODES FOR PERMANENT CP SYSTEM SHALL BE DECIDED BASED ON NUMBER OF ANODES.

02	06.05.22	RE-ISSUED AS STANDARD DRAWING	SY	RD	AA	HK
01	18.12.19	RE-ISSUED AS STANDARD DRAWING	SY	VV	AD	SK
0	15.05.17	ISSUED AS STANDARD	SY	RD	AD	SK
REV NO.	DATE	PURPOSE	PREPARED BY	CHECKED BY	APPROVED BY	AUTHORIZED BY



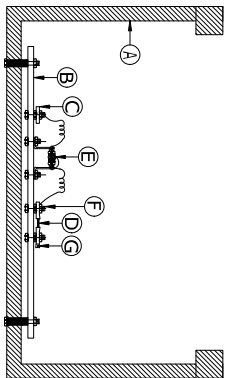
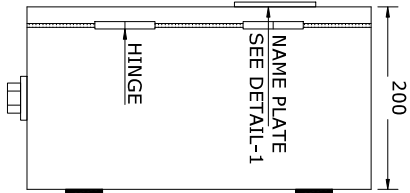
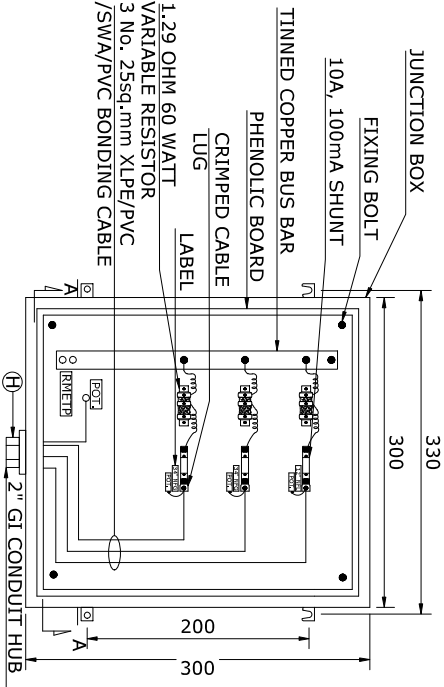
Digitally signed by RAMAKANT
TIWARI
Date: 2025.10.13 18:20:32 IST

MMO ANODES GROUNDED

NOTES:

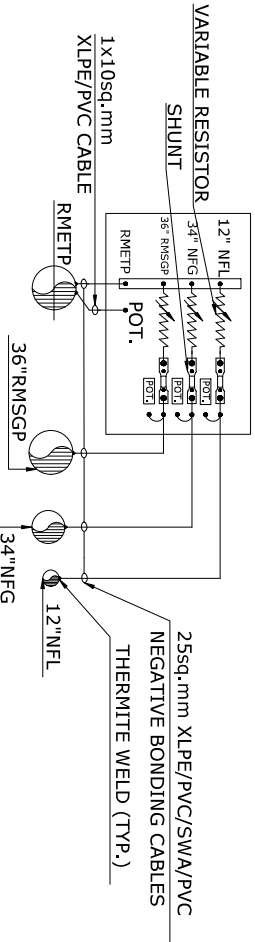
1. ALL DIMENSIONS ARE IN MM UNLESS OTHERWISE SPECIFIED.
2. ALL CABLES-TO-PIPE CONNECTIONS (EXCEPT DRAIN CONNECTION ON RME1P) FOR UNDERGROUND PIPELINE SHALL BE MADE VIA THERMITE WELDING AS PER DWG. STD.

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0	15.05.17	ISSUED AS STANDARD	SY	RD	AD	SK
REV NO.	DATE	PURPOSE	PREPARED BY	CHECKED BY	APPROVED BY	AUTHORIZED BY



EQUIPOTENTIAL BOND BOX

SECTION A-A



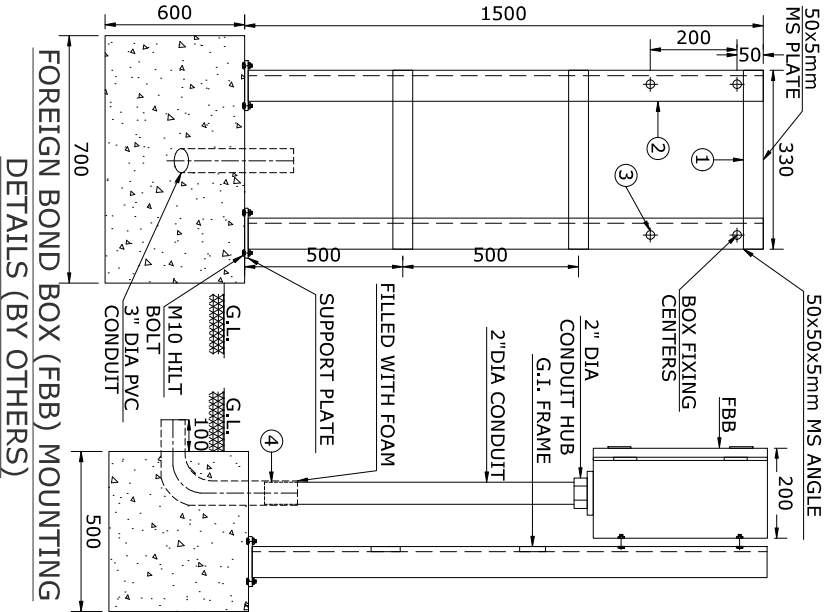
TERMINATION DETAILS

MATERIALS SCHEDULE

ITEM NO.	DESCRIPTION	QTY.
A.	PAINTED STEEL ENCLOSURE LOCKABLE TYPE RATED FOR IP 55 PROTECTION MIN. 1.6mm THICK.	1 No.
B.	PHENOLIC BOARD-6mm THICK	1 No.
C.	TINNED COPPER BUS BAR 25x5mm PLATE	1 No.
D.	SHUNT 10A, 100mV	3 No.
E.	VARIABLE RESISTOR 1.29 OHM 60 WATTS.	3 No.
F.	BRASS TERMINAL C/W WASHER, LOCK WASHER & NUTS	AS REQ.
G.	CRIMPED CABLE LUG	AS REQ.
H.	2" DIA G.I. CONDUIT HUB	1 No.

MOUNTING FRAME MATERIAL SCHEDULE (BY OTHERS)

ITEM NO.	DESCRIPTION	UNIT	QTY.
1.	MS FLAT SIZE 50x5mm, LENGTH TO SUIT	NO	3
2.	MS ANGLES SIZE 50X50x5mm, OVERALL LENGTH 1500mm	NO	2
3.	FRAME AND BOX FIXING HOLES, 11mm DIAMETER AND STAINLESS STEEL SET SCREWS, NUTS AND WASHERS	NO	4
4.	3: PVC CONDUIT LENGTH TO SUIT.	NO	1
5.	2" G.I. CONDUIT LENGTH TO SUIT.	NO	1



NOTES:

1. ALL DIMENSIONS ARE IN MM UNLESS OTHERWISE SPECIFIED.

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01	19.12.19	RE-ISSUED AS STANDARD DRAWING	SY	VV	AD	SK
0	15.05.17	ISSUED AS STANDARD	SY	RD	AD	SK
REV NO.	DATE	PURPOSE	PREPARED BY	CHECKED BY	APPROVED BY	AUTHORIZED BY



Energising Quality

VCS QUALITY SERVICES
PRIVATE LIMITED

CATHODIC PROTECTION SYSTEM FOREIGN
BOND BOX (FBB)
DETAILS (2CIRCUITS)

STANDARD DRAWING NO.

VCS-STD-EL-4517

SHEET NO.

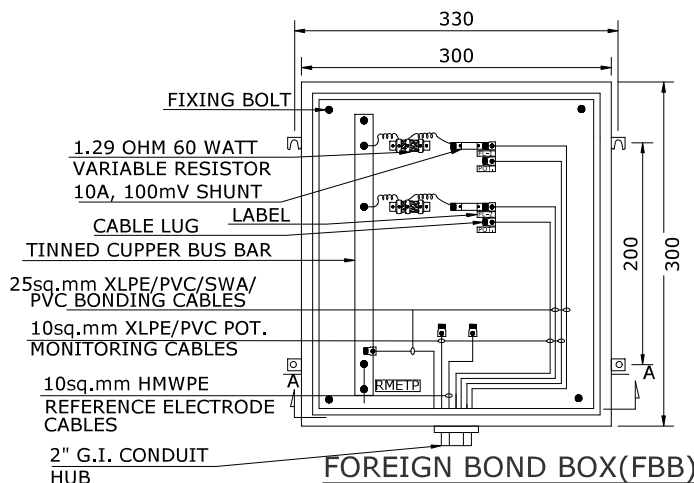
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REV.

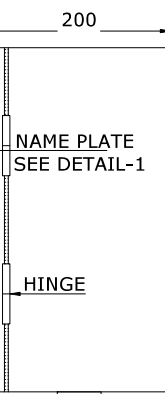
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SIZE

A4

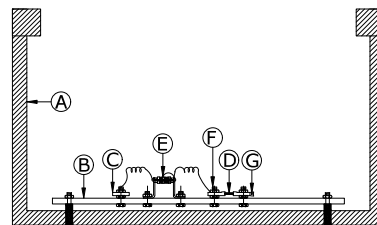


FOREIGN BOND BOX(FBB)

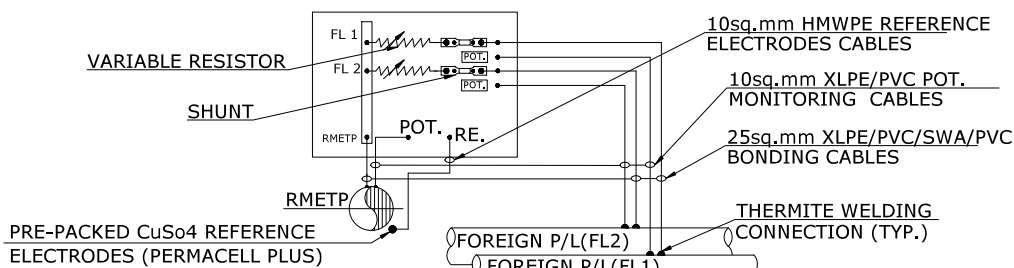


SIDE VIEW

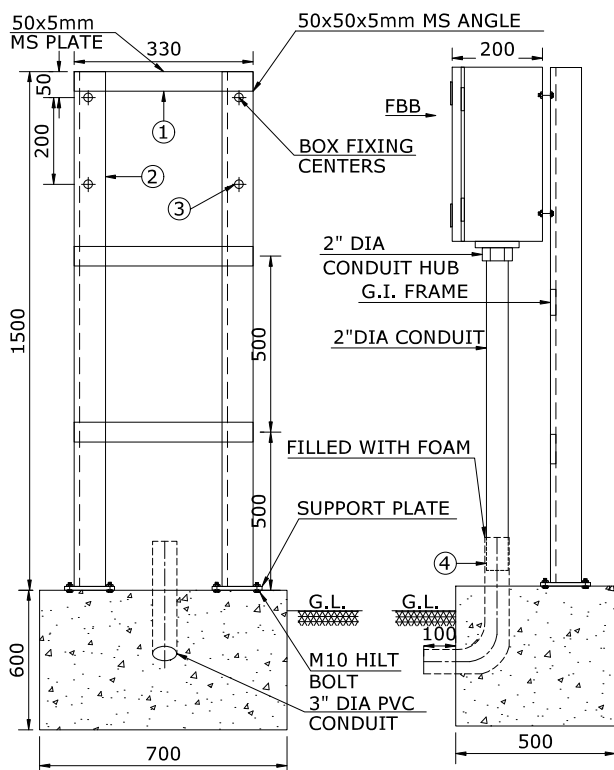
DETAIL-1
NAME PLATE DETAILS



SECTION A-A



TERMINATION DETAILS



FOREIGN BOND BOX (FBB) MOUNTING
DETAILS (BY OTHERS)

MATERIALS SCHEDULE

ITEM NO.	DESCRIPTION	QTY.
A.	PAINTED STEEL ENCLOSURE LOCKABLE TYPE RATED FOR IP 55 PROTECTION MIN. 1.6mm THICK.	1 No.
B.	PHENOLIC BOARD-6mm THICK	1 No.
C.	TINNED CUPPER BUS BAR 25x5mm PLATE	1 No.
D.	SHUNT 10A, 100mV	2 No.
E.	VARIABLE RESISTOR 1.29 OHM 60 WATTS.	2 No.
F.	BRASS TERMINAL C/W WASHER, LOCK WASHER & NUTS	AS REQ.
G.	CRIMPED CABLE LUG	AS REQ.
H.	2" DIA G.I. CONDUIT HUB	1 No.

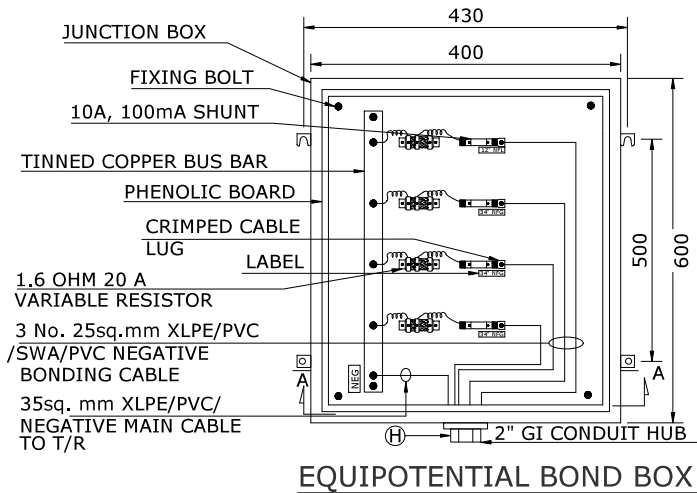
MOUNTING FRAME MATERIAL SCHEDULE (BY OTHERS)

ITEM NO.	DESCRIPTION	UNIT	QTY.
1.	MS FLAT SIZE 50x5mm, LENGTH TO SUIT	NO	3
2.	MS ANGLES SIZE 50x50x5mm, OVERALL LENGTH 1500mm	NO	2
3.	FRAME AND BOX FIXING HOLES, 11mm DIAMETER AND STAINLESS STEEL SET SCREWS, NUTS AND WASHERS	NO	4
4.	CONDUIT LENGTH TO SUIT.	NO	1
5.	2" DIA PVC CONDUIT LENGTH TO SUIT.	NO	1

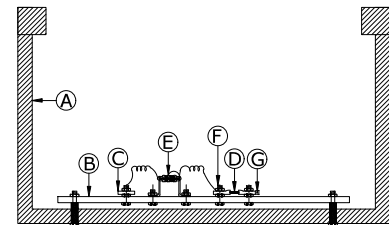
NOTES:

1. ALL DIMENSIONS ARE IN MM UNLESS OTHERWISE SPECIFIED.

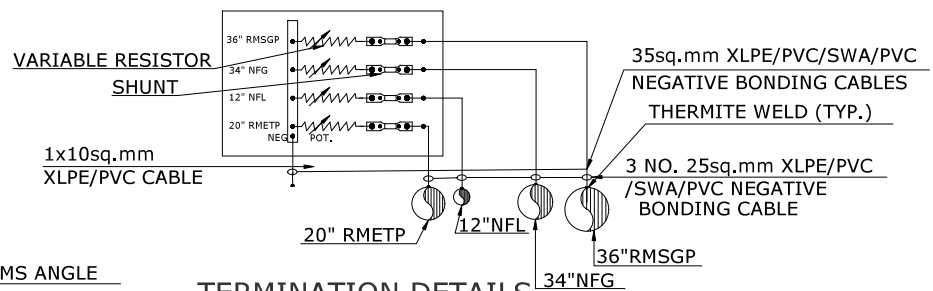
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REV NO.	DATE	PURPOSE	PREPARED BY	CHECKED BY	APPROVED Digitally signed by RANJAN TIWARI	AUTHORIZED BY



**DETAIL-1
NAME PLATE DETAILS**



SECTION A-A

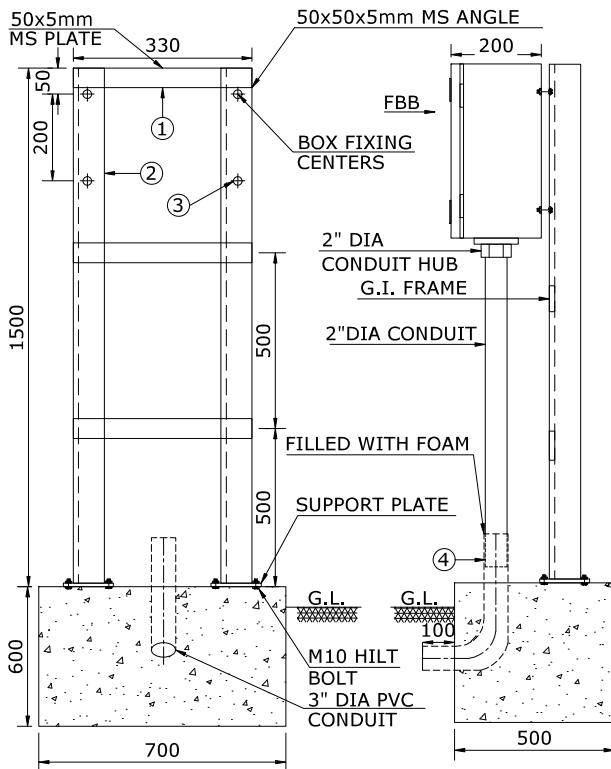


MATERIALS SCHEDULE

ITEM NO.	DESCRIPTION	QTY.
A.	PAINTED STEEL ENCLOSURE LOCKABLE TYPE RATED FOR IP 55 PROTECTION MIN. 1.6mm THICK.	1 No.
B.	PHENOLIC BOARD-6mm THICK	1 No.
C.	TINNED CUPPER BUS BAR 25x5mm PLATE	1 No.
D.	SHUNT 10A, 100mV	4 No.
E.	VARIABLE RESISTOR 1.29 OHM 60 WATTS.	4 No.
F.	BRASS TERMINAL C/W WASHER, LOCK WASHER & NUTS	AS REQ.
G.	CRIMPED CABLE LUG	AS REQ.
H.	2" DIA G.I. CONDUIT HUB	1 No.

MOUNTING FRAME MATERIAL SCHEDULE (BY OTHERS)

ITEM NO.	DESCRIPTION	UNIT	QTY.
1.	MS FLAT SIZE 50x5mm, LENGTH TO SUIT	NO	3
2.	MS ANGLES SIZE 50x50x5mm, OVERALL LENGTH 1500mm	NO	2
3.	FRAME AND BOX FIXING HOLES, 11mm DIAMETER AND STAINLESS STEEL SET SCREWS, NUTS AND WASHERS	NO	4
4.	3" PVC CONDUIT LENGTH TO SUIT.	NO	1
5.	2" G.I. CONDUIT LENGTH TO SUIT.	NO	1



NOTES:

1. ALL DIMENSIONS ARE IN MM UNLESS OTHERWISE SPECIFIED.

02	06.05.22	RE-ISSUED AS STANDARD DRAWING	SY	RD	AA	HK
01	19.12.19	RE-ISSUED AS STANDARD DRAWING	SY	VV	AD	SK
0	15.05.17	ISSUED AS STANDARD	SY	RD	AD	SK
REV NO.	DATE	PURPOSE	PREPARED BY	CHECKED BY	APPROVED	AUTHORIZED



Energising Quality

VCS QUALITY SERVICES
PRIVATE LIMITEDCATHODIC PROTECTION SYSTEM ANODE
JUNCTION BOX(AJB) DETAILS

STANDARD DRAWING NO.

VCS-STD-EL-4519

SHEET NO.

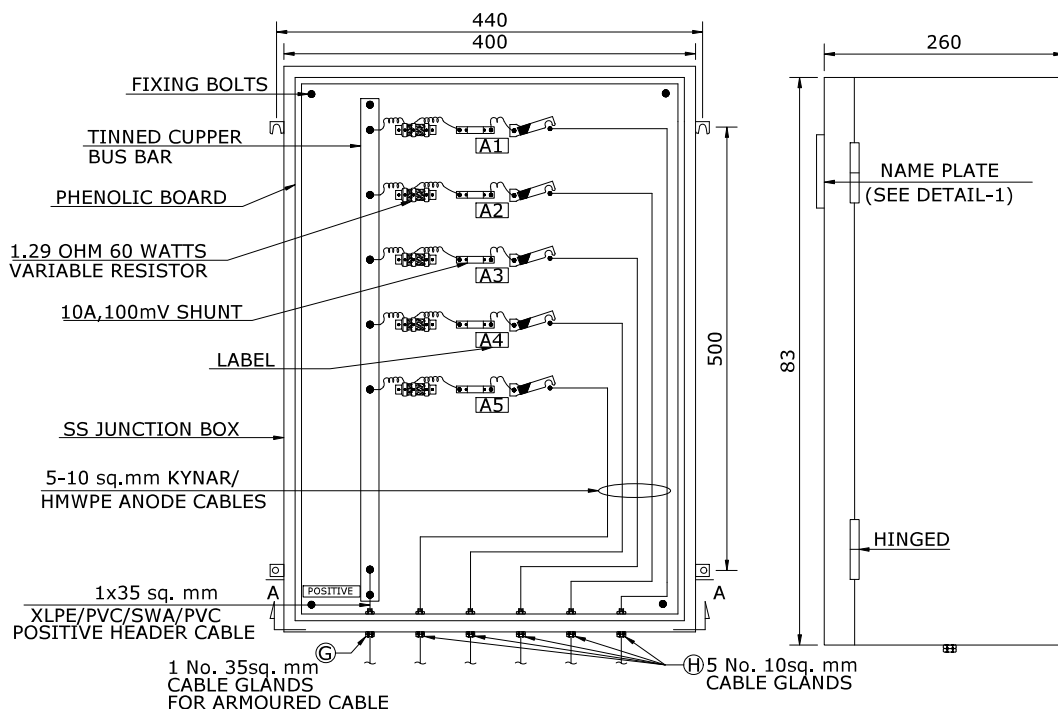
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REV.

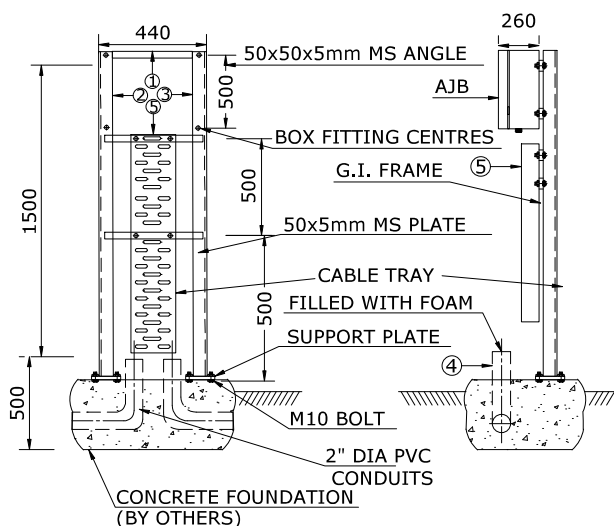
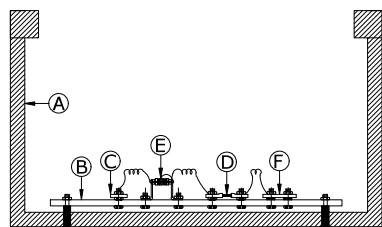
02

SIZE

A4



ANODE JUNCTION BOX

DETAIL-1
NAME PLATE DETAILSANODE JUNCTION BOX (AJB) MOUNTING
DETAILS (BY OTHERS)

SECTION A-A

MATERIALS SCHEDULE

ITEM NO.	DESCRIPTION	QTY.
A.	PAINTED STEEL ENCLOSURE LOCKABLE TYPE RATED FOR IP 55 PROTECTION MIN. 3mm THICK.	1 No.
B.	PHENOLIC BOARD-6mm THICK	1 No.
C.	TINNED CUPPER BUS BAR 25x5mm PLATE	1 No.
D.	SHUNT 10A, 100mV	5 No.
E.	VARIABLE RESISTOR 1.29 OHM 60 WATTS.	5 No.
F.	BRASS TERMINAL C/W WASHER, LOCK WASHER & NUTS	AS REQ.
G.	BRASS CABLE GLAND (35 sq. mm)	1 No.
H.	BRASS CABLE GLAND (10 sq. mm)	5 No.
I.	COPPER CABLE LINK	5 No.

MOUNTING FRAME MATERIAL SCHEDULE (BY OTHERS)

ITEM NO.	DESCRIPTION	UNIT	QTY.
1.	MS FLAT SIZE 50x5mm, LENGTH TO SUIT	NO	3
2.	MS ANGLES SIZE 50x50x5mm, OVERALL LENGTH 1500mm	NO	2
3.	FRAME AND BOX FIXING HOLES, 11mm DIAMETER AND STAINLESS STEEL SET SCREWS, NUTS AND WASHERS	NO	4
4.	2" DIA PVC CONDUIT LENGTH TO SUIT.	NO	2
5.	CABLE TRAY LENGTH TO SUIT (APPROX. 800mm)	NO	1

NOTES:

1. ALL DIMENSIONS ARE IN MM UNLESS OTHERWISE SPECIFIED.

02	06.05.22	RE-ISSUED AS STANDARD DRAWING	SY	RD	AA	HK
01	19.12.19	RE-ISSUED AS STANDARD DRAWING	SY	VV	AD	SK
0	15.05.17	ISSUED AS STANDARD	SY	RD	AD	SK
REV NO.	DATE	PURPOSE	PREPARED BY	CHECKED BY	APPROVED	AUTHORIZED





Energising Quality

**VCS QUALITY SERVICES
PRIVATE LIMITED**

**TYPICAL DRAWING FOR OVERHEAD
POWER LINE FOR PIPE LINES**

STANDARD DRAWING NO.

VCS-STD-EL-4521

SHEET NO.

1 OF 1

REV.

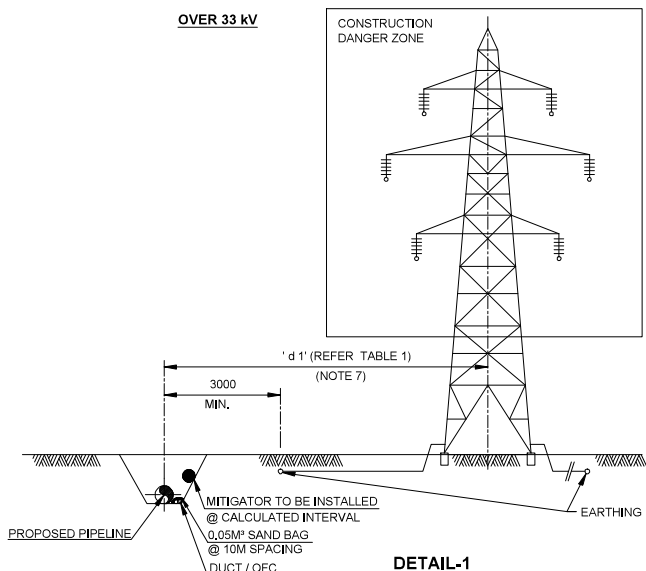
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SIZE

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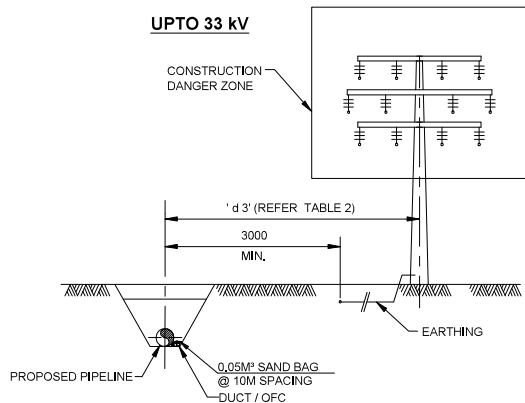
PARALLELISM TO HIGH VOLTAGE TRANSMISSION LINES

OVER 33 kV



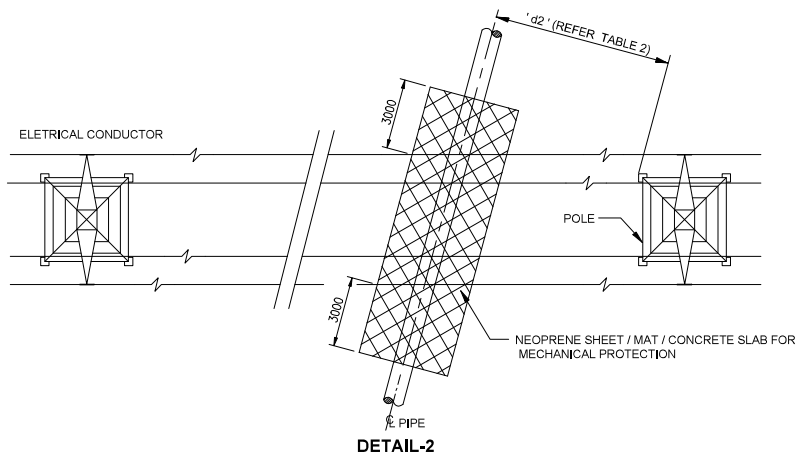
DETAIL-1

UPTO 33 kV

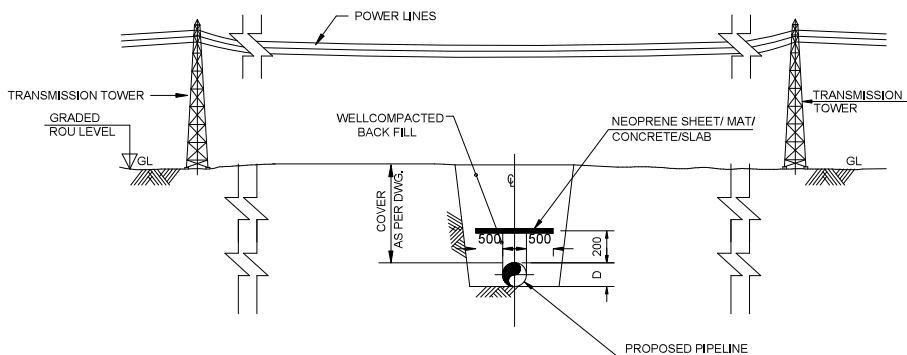


DETAIL-3

CROSSING OF HIGH VOLTAGE TRANSMISSION LINES



DETAIL-2



DETAIL-4

NOTES:

1. ALL DIMENSIONS ARE IN MM UNLESS OTHERWISE STATED.
2. IN CASE THE MINIMUM DISTANCE IS NOT MET, THE LOCAL ELECTRICAL COMPANY HAS TO BE CONTACTED FOR APPROVAL.
3. CONSIDERATION SHOULD BE GIVEN TO LIGHTNING FAULT, CURRENT PROTECTION OF PIPELINE & SAFETY OF PERSONNEL.
4. IN CASE OF CROSSING OF HIGH VOLTAGE TRANSMISSION LINES, MIN. DISTANCE SHALL BE MAINTAINED AS PER TABLE-1.
5. SUITABLE MEASURE SHALL BE TAKEN FOR THE PROTECTION OF THE LINE AS PER TABLE-2.
6. CONCRETE SLAB/ NEOPRENE / MAT SHALL BE PROVIDED FOR OHL CROSSINGS FOR 11 KV AND ABOVE AS PER REQUIREMENTS.
7. AS PER NOTE-4 MIN. DISTANCE IS NOT FEASIBLE THEN PLEASE REFER THE DETAILS-A

TABLE 1

IF THE OHL IS RUNNING PARALLEL TO THE PIPE LINE MORE THEN 100mtrs. MAINTAIN THE MINIMUM DISTANCE FROM CENTERLINE OF PIPELINE TO POWER TRANSMISSION STRUCTURES / LINE

Right of Way Clearance (As per Standard)

KV	Min. ROW
66 KV	18 Meter
132 KV	27 Meter
220 KV	35 Meter
400KV	52 Meter (Single Circuit)
400 KV	48 Meter (Double Circuit)

TABLE 2

Minimum Clearance Between Power Lines to other metal / human safety distance at Nominal System Voltage of line.

KV	METER
11 KV	2,44 Meter
33 KV	2,44 Meter
66 KV	2,44 Meter
132KV	3,05 Meter
220KV	4,58 Meter
400KV	6,10 Meter

02	06.05.22	RE-ISSUED AS STANDARD DRAWING	SY	RD	AA	HK
01	18.12.19	RE-ISSUED AS STANDARD DRAWING	SY	VV	AD	SK
0	15.05.17	ISSUED AS STANDARD	SY	RD	AD	SK
REV NO.	DATE	PURPOSE	PREPARED BY	CHECKED BY	APPROVED BY	AUTHORIZED BY

 Energising Quality	CONTRACTOR		QUALITY ASSURANCE PLAN FOR TCP WORKS			CLIENT:	M/S BHAGYANAGAR GAS LIMITED																																																																																															
	ORDER NO. & DATE					PROJECT	CITY GAS DISTRIBUTION PROJECT																																																																																															
	SUB-CONTRACTOR					PACKAGE NAME	TCP SYSTEM																																																																																															
	ORDER NO. & DATE																																																																																																					
INSTRUCTIONS FOR FILLING UP : 1. QAP shall be submitted for each of the equipment separately with breakup of assembly/sub-assembly & part/component or for group of equipment having same specification. 2. Use numerical codes as indicated for extent of inspection & tests and submission of test certificates & documents. Additional codes & description for extent of inspection & tests may be added as applicable for the plant and equipment 3. Separate identification number with quantity for equipment shall be indicated wherever equipment having same specifications belonging to different facilities are grouped together. 4. Weight in tonnes (T) must be indicated under column 5 for each item. Estimated weights may be indicated wherever actual weights are not available.				CODES FOR EXTENT OF INSPECTION, TESTS, TEST CERTIFICATES & DOCUMENTS: <table border="0"> <tr> <td>Code</td> <td>Description</td> <td>Code</td> <td>Description</td> <td>Code</td> <td>Description</td> <td>DOCUMENTS:</td> </tr> <tr> <td>1.</td> <td>Visual</td> <td>12.</td> <td>Routine test as per relevant IS other standard</td> <td>23.</td> <td>Short time rating</td> <td>D1. Approved GA drawings</td> </tr> <tr> <td>2.</td> <td>Dimensional</td> <td>13.</td> <td>Type test as per relevant IS/ other standard</td> <td>24.</td> <td>Operational & functional check</td> <td>D2. Approved single line/ schematic diagram</td> </tr> <tr> <td>3.</td> <td>Fitment & Alignment</td> <td></td> <td></td> <td>25.</td> <td>Over Speed Test</td> <td>D3. Approved</td> </tr> <tr> <td>4.</td> <td>Physical Test (Sample)</td> <td></td> <td></td> <td>26.</td> <td>Flame Proof Test</td> <td>data sheet</td> </tr> <tr> <td>5.</td> <td>Chemical Test (Sample) (Review of test report only)</td> <td>14.</td> <td>Impulse Test</td> <td>27.</td> <td>Clearance and creepage Distance</td> <td>D4. Approved bill of materials</td> </tr> <tr> <td>6.</td> <td>Ultrasonic Test</td> <td>15.</td> <td>Partial Discharge Test</td> <td>28.</td> <td>Acceptance Test</td> <td>D5. Unpriced P.O. copy</td> </tr> <tr> <td>7.</td> <td>Magnetic Particle Test (MPT)</td> <td>16.</td> <td>Heat run risc test\tempr.</td> <td>29.</td> <td>Material test</td> <td>D6. Calibration Certificate of all measuring instruments and gauges</td> </tr> <tr> <td>8.</td> <td>Radiography Test</td> <td>17.</td> <td>Enclosure Protection Test</td> <td>30.</td> <td>Coating Thickness (MMO Anode), Resistivity (MMO Anode) & consumption rate (For Mg, Zn & Zn Ribbon Anode only review of Test report)</td> <td></td> </tr> <tr> <td>9.</td> <td>Dye Penetration Test</td> <td>18.</td> <td>Calibration</td> <td>31.</td> <td>Contact Resistance anode to cable Joint</td> <td></td> </tr> <tr> <td>10.</td> <td>Measurement of IR Value a) Before HV Test b) After HV Test</td> <td>19.</td> <td>Noise & Vibration</td> <td>32.</td> <td>Destructive testing</td> <td></td> </tr> <tr> <td>11.</td> <td>High Voltage test/Dielectric test</td> <td>20.</td> <td>Test certificates for bought out components</td> <td>33.</td> <td>Test Station Connection Scheme check, Name plate and terminal check</td> <td></td> </tr> <tr> <td></td> <td></td> <td>22.</td> <td>Paint shade verification & Thickness check</td> <td>34.</td> <td>Chemical Composition & Open Circuit Potential (For Zn Ribbon Anode, Review of Test report only)</td> <td></td> </tr> </table>								Code	Description	Code	Description	Code	Description	DOCUMENTS:	1.	Visual	12.	Routine test as per relevant IS other standard	23.	Short time rating	D1. Approved GA drawings	2.	Dimensional	13.	Type test as per relevant IS/ other standard	24.	Operational & functional check	D2. Approved single line/ schematic diagram	3.	Fitment & Alignment			25.	Over Speed Test	D3. Approved	4.	Physical Test (Sample)			26.	Flame Proof Test	data sheet	5.	Chemical Test (Sample) (Review of test report only)	14.	Impulse Test	27.	Clearance and creepage Distance	D4. Approved bill of materials	6.	Ultrasonic Test	15.	Partial Discharge Test	28.	Acceptance Test	D5. Unpriced P.O. copy	7.	Magnetic Particle Test (MPT)	16.	Heat run risc test\tempr.	29.	Material test	D6. Calibration Certificate of all measuring instruments and gauges	8.	Radiography Test	17.	Enclosure Protection Test	30.	Coating Thickness (MMO Anode), Resistivity (MMO Anode) & consumption rate (For Mg, Zn & Zn Ribbon Anode only review of Test report)		9.	Dye Penetration Test	18.	Calibration	31.	Contact Resistance anode to cable Joint		10.	Measurement of IR Value a) Before HV Test b) After HV Test	19.	Noise & Vibration	32.	Destructive testing		11.	High Voltage test/Dielectric test	20.	Test certificates for bought out components	33.	Test Station Connection Scheme check, Name plate and terminal check				22.	Paint shade verification & Thickness check	34.	Chemical Composition & Open Circuit Potential (For Zn Ribbon Anode, Review of Test report only)	
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EQUIPMENT DATA							INSPECTION AND TESTS						Test Certificates & documents to be submitted to VCS	Acceptance Criteria Standards /IS/ BS/ASME/ Norms and Documents	REMARKS / SAMPLING PLAN																																																																																							
Sl. No	Description (With equipment heading, place of use, and Breif Specifications)	Identification No.	Quantity		Manufacturer's Name and Address	Expected schedule of Final Inspection	Raw Material and in process stage			Final Inspection/Test by																																																																																												
			No/M	T			MFR	CONTR	VCS// TPI	MFR	CONTR/ TPIA	CLIENT /VCS																																																																																										
1	CP Cables (1Cx6Sqmm, 1Cx10 Sqmm, 1Cx25Sqmm & 1Cx35Sqmm)		Meters				1,2,28	-	-	1,2,28	1,2,28	R	D1, D2, D3, D4, D5, D6, 20, 13	I.S., Approved Data Sheet & Specifications																																																																																								
2.	Test Stations (Big & Small Type)		Nos.				1,2,3,4,22, 29	-	-	1,2,3,4, 22,33	1,2,3,4, 22,33	R	D1, D2, D3, D4, D5, D6, 20, 13	I.S., Approved Data Sheet & Specifications																																																																																								
3.	Sacrificial Mg & Zn Anodes		Nos.				1,2,5	-	-	1,2,4, 5, 30, 32*	1,2,4, 5, 30, 32*	R	D1, D2, D3, D4, D5, D6, 20, 13	I.S., Approved Data Sheet & Specifications	* on 1% of total nos. of anodes																																																																																							
4.	Spark Gap Arrestor (100 kA)		Nos.				-	-	-	-	-	R	Manufacturer test certificates & Compliance Report	Approved Data Sheet & Specifications																																																																																								
Digitally signed by RAMAKANT TIWARI Date: 2025.10.13 18:20:32 IST																																																																																																						

5.	Polarisation Cell (Solid State)		Nos.				-	-	-	-	-	R	Manufacturer test certificates & Compliance Report	Approved Data Sheet & Specifications	
6.	External ER Probe		Set				1,2,3,5,13,29		-	1,2,3,5,13*,17*,21*,24,29	1,2,3,5,13*,17*,21*,24,29	R	D1, D3, D4, D5, D6, 20,12,13	Approved Data Sheet & Specifications	*on one no. of each type
7.	CTSU (Computerised Test Station Unit) & CTSU Reader		Nos.				1,2,3	-	-	1,2,3,22,24,33	1,2,3,22,24,33	R	D1, D3, D4, D5, D6, 20,12,13	Approved Data Sheet & Specifications	
8.	Permanent Reference Cell		Nos.				-	-	-	-	-	R	Manufacturer test certificates & Compliance Report	Approved Data Sheet & Specifications	
9.	Mg/Zinc Ribbon Anode		Mtr				-	-	-	1,2,30,34	1,2,30,34	R	D1, D3, D4, D5, D6, 20,12,13	Approved Data Sheet & Specifications	
For Manufacturer (Stamp & Signature)				For CONTR (Stamp & Signature)			For V C S (Stamp & Signature)								
												Q.A.P. NO. VCS/EL/TCP/ QAP			REV. 0
												SHEET 2 OF 2			