Indraprastha Gas Limited

LAYING & CONSTRUCTION OF U/G STEEL PIPELINE NETWORK & ASSOCIATED WORKS FOR CONNECTIVITY OF CNG STATION AT CONCOR CONTAINER DEPOT DADRI, GAUTAM BUDDHA NAGAR

Tender No: IGL/ET2/CP18422

Technical Volume

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INDRAPRASTHA GAS LTD.

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SCOPE OF WORK

1. BRIEF SCOPE

The Scope of work includes Laying/ Installation Testing & Commissioning of 8" & 4" dia. 3LPE coated CS pipes as per API 5L Gr. X52 and Gr. B (PSL-2) underground pipeline with associated facilities, obtaining permissions from statutory authorities including but not limited to Construction Management, HSE & Quality Management, all related Civil, Mechanical and Instrumentation work, Carrying out of GIS mapping of pipeline with land base creation for the network and Final documentation as specified in the Tender document.
IGL will supply 3 LPE Coated Steel Line Pipe of 8" & 4" diameter and valves sizing 2" or above, as free issue materials as specified in the tender document from the designated stores of Owner. The Transportation of Free Issue Line Pipes from Owner stores to work site is included in the scope of the Contractor. Pipe laying work also includes grading, stringing, welding, trenching, joint coating, lowering, crossings, tie-ins, NDT, backfilling, site restoration, hydro testing, dewatering, drying and pre-commissioning and Commissioning of Pipeline are included in the scope.

Stretch details are as follows:

Dia. x Length	Stretch	Total Length
8" x 3 Kms & 4" x 2 Kms	From Zeta 2 CNG station to CNG Station at CONCOR Container Depot Dadri in Gautam Buddha Nagar	5000 m

Note:
Applying permission, follow up and getting permission from the statutory authorities shall be in contractor's scope, only R.R charges shall be paid by Owner.

2. SCOPE OF SUPPLY

2.1. Materials to be supplied by Owner as Free Issue

Owner shall supply only the following materials as free issue from its store in respective state:

- Carbon Steel line pipe of API 5L Gr.B/X52(ERW/SMLS) with externally corrosion coated (Three layer polyethylene coating) of size and wall thickness - specified NB 8" x 6.4 mm and 4"x 6.4 mm.

- All underground and above ground Valves of size 2" and above

IGL shall supply above mentioned material as free issue material, all material other than this will be in scope of contractor. Free Issue Material shall be issued to the Contractor from the designated store(s) of Owner. Contractor shall be responsible for lifting the free issue material from Owner's storage point(s) located in Ghaziabad, Gautam Buddha Nagar, Muzzaffarnagar and Kanpur GAs in State of U.P and transporting the same to work site(s) at his own cost. Contractor shall also return material after completion of work to owner's designated stores as directed by owner / owner's representative.

2.2 Materials to be supplied by Contractor

All materials (other than those mentioned in clause 2.1 above, consumables,

equipment required for completion and successful commissioning of entire pipeline system shall be procured and supplied by the Contractor.

All fittings, elbows, flanges of all sizes etc. will be in scope of contractor and will be part of laying and shall not be paid separately.

Contractor shall take prior approval before finalizing the location of store and size from the EIC.

Size of store shall be such that all the linepipe issued against the total scope of allocated site shall get accommodated/ properly stacked inside the store. There shall be provision of proper ingress/ egress of trailer to load and unload the pipe from the stores.

3. GIS MAPPING

GIS data shall be collected of laid steel pipeline. Data like Geo Co-ordinates (latitude, longitude) of Pipeline and related features like fittings, valves, FRS, MRS, Markers etc. shall be collected along with 50 m land base corridor (25 m on either side of the pipeline) with min. accuracy of 50 cm.

Data format shall be in shape (.shp) or Geo Database (.gdb).

4. CONTRACT PERIOD

The period of Contract shall be for Six (6) months from the date of LOA (Letter of Award)/Contract.

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PTS – CONSTRUCTION OF NATURAL GAS CS PIPELINE

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1.0 DEFINITIONS AND INTERPRETATION

1.1 Particular Technical Specification (PTS) shall be read in conjunction with the General Conditions of Contract (GCC), Special Conditions of Contract(SCC), General Technical Specifications (GTS) of work, drawings, Schedule of rates(SOR), Instruction to Bidders (ITB) and other documents forming part of the tender wherever the context so requires.

1.2 Where any portion of the GTS is repugnant or variance with any provisions of the PTS, unless a different intention appears, the provision(s) of PTS shall be deemed to govern the provision(s) of GTS of contract. If there is no variance or repugnance between GTS and PTS, both clauses shall be applicable.

1.3 In case of conflict between the requirements of this specification and that of the referred codes, standards and specifications, the requirements of this specification shall govern.

1.4 Definition of Terms
The terms used in the technical document must be understood as follows:

"Additional Works"	: Works that are not part of the Agreement but that appear to be necessary during the execution of the Agreement. These works can only be executed at the demand of the Owner.
"Approval"	: Means written approval.
"Construction Site/Building Site"	: The area where the works are to be undertaken by the Contractor in accordance with the Agreement.
"Contractor"	: The natural person or legal entity with whom the Owner has concluded the Agreement.
"Days"	: They are the number of days stipulated in the Agreement. They are calendar days and not workdays, unless explicitly specified otherwise.
"Defective Joint"	: Each weld that has been declared unacceptable by the Owner/ Owner's representative and has to be repaired by welding.
"Equipment"	: Means all apparatus, tools and machineries of any kind whatsoever that are necessary for the construction, execution and maintenance of the Works specified in the Agreement.
"Goods and/or Services"	: Depending on the specific case, all or part of the Construction materials, equipment, constructions, appliances, tools, machines, works, etc. that are to be built, assembled,

	adapted or brought into operation by the Contractor pursuant to the Agreement, including all studies, performances, works and services specified within the Agreement. The terms Goods or Services can be used interchangeably according to the context.
"HDD"	:Horizontal Directional Drilling
"Line Work"	: Is the delivery and execution of all Works for the construction of pipelines that do not form part of a Special Point or CNC/DRS that are executed in accordance with normal accepted laying methods.
"Material"	: Means the materials or any other supplies that are intended to be part of or integral to the Works.
"Owner"	: Is the principal requesting the works to which the Agreement relates, i.e. INDRAPRASTHA GAS LTD (IGL), New Delhi.
"Owner's Representative/ CONSULTANT"	: Shall mean Owner's CONSULTANT.
"Over-Depth"	: Is the difference between the actual depth of the upper generatrix of the pipeline or installation upon laying and the planned minimum depth as stipulated in the Agreement, if this difference is greater than 50 cm.
TPIA	: Third Part Inspection Agency (IGL's Approved TPIA).
"Works"	: Are either the executions or having executed together with the design of works that complies with the requirements specified by the Owner. The work is the result of all the construction activities intended to have an economic or a technical function as such.
NA	:Not Applicable
LS	: Lump-sum

Mechanical Completion (MC)	: Shall mean completion of all pre-commissioning activities and associated requirements. It also includes completion of all work related to CP and civil activities deemed necessary for completion of pre-commissioning.
Pre-Commissioning	: It includes mechanical resistance test, tightness/leak test, cleaning including magnetic cleaning, GED survey, dewatering, swabbing, pre-drying activity, Golden Tie-ins connecting the stations and final acceptance dossier (As built document) and all other related activities. It also includes completion of all works related to CP and civil activities.
Commissioning	:It includes final drying, filling the Nitrogen (if required) and commissioning with gas, testing of golden tie-ins welds at Gas MOP, gas-in activity and final acceptance dossier. It also includes all works related to CP and civil activities.

1.5 Laws –Codes –Rules & Standards

1.5.1 General

Basically, the following are applicable:

- Petroleum and Natural Gas Regulatory Board (PNGRB) Act 2006: GSR 808 (E) – "Technical Standards and Specifications including Safety Standards for Natural Gas Pipeline Regulations" – 2009.
- Basic Laws – Codes – Rules & Standards, mandatory by law in Delhi, NCR and India.
- The complete set of Specifications and Standards which are part of the present technical volume.
- Particular Codes and Standards as per Section 1.5.2
- The "Rules of good Practice" commonly used by the worldwide gas industry.
- The "Rules of Art" and "Sound Practices" of the engineering.
- In general the pipeline and stations have to be built in accordance with the best states of engineering practice.

In case of contradiction, the above shall prevail in descending order of precedence.

1.5.2 Particular Codes & Standards (Latest Editions)

S. No.	Code No.	Description
1	ASME B.31.8	"Gas Transmission and Distribution Piping Systems" – Latest edition and all Codes it refers to.
2	API RP 1102	"Steel pipelines crossings Railroads and Highways"- Latest edition
3	API 1104	"Welding of pipelines and related facilities" – Latest edition.
4	AS/NZS 2885.5	Pipelines – Gas and liquid petroleum – Field Pressure Testing
5	OISD 141	"Design and construction requirements for cross- country hydrocarbon pipelines" - latest edition.
6	OISD 226	"Natural Gas Transmission Pipelines and City Gas Distribution Network"
7	DIN 30670	"Polyethylene coating for steel pipes and fittings".
8	DIN 30671	"Thermoset plastic coating for buried steel pipes "
9	DIN 30672	"Tape and shrinkable materials for the corrosion protection of buried or underwater pipelines without Cathodic protection for use at operating temperatures up to 50^0C."
10	DIN 30673	"Bitumen coatings and linings for steel pipes, fittings and vessels".
11	DIN 30675-1	"External corrosion protection of buried pipes & range of applications for steel pipes."
12	DIN 30677	"Protection of buried valves against corrosion coating (external) with duroplastics."
13	EN 12062	"Non-destructive examination of welds – General rules for metallic materials".
14	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."
15	IS 8062	"Code of practice for Cathodic protection of steel structures"
16	IS 12944-5	" Paints and Varnishes – Corrosion Protection of Steel Structures by protective paint system "
17	ISO-8502-3	"Preparation of steel substrates before application of paints and related products –

		Tests for the assessment of surface cleanliness".
18	ISO 9305	"Seamless steel tubes for pressure purposes full peripheral ultrasonic testing for the detection of transverse imperfections".
19	ISO 10124	"Seamless & welded (except submerged arc welded) steel tubes for pressure purposes. Ultrasonic testing for the detection of laminar imperfections".
20	ISO 12094	"Welded steel tubes for pressure purposes. Ultrasonic testing for the detection of laminar imperfections in strips/plates used in the manufacture of welded tubes".
21	ISO 15741	"Paints and varnishes – friction – reduction coatings for the interior of on – and offshore steel pipelines for non-corrosive gases."
22	ISO 15590-1	"Petroleum and Natural Gas Industries – Induction bends, fittings and flanges for pipeline transportation system – Part I : Induction Bends".
23	ISO 21809-3	Petroleum and natural gas industries – External coatings for buried or submerged pipelines used in pipeline transportation systems.
And all other relevant codes/standards, etc.		

2.0 SCOPE OF WORK

2.1 General

It broadly describes the scope of work to be executed by Laying Contractor pertaining to Mechanical, Civil, Temporary Cathodic Protection, Testing, pre-commissioning & commissioning, final documentation etc. of pipeline system. It also describes the responsibility of the Contractor to interface all such works so as to make the total pipeline system operational as intended.

All such works which are not listed below but are otherwise required to complete the work in all respects in accordance with specifications, drawings, operation & maintenance and other requirements shall also form part of Contractor's Scope of Work. All works described below shall be performed in accordance with Schedule of Rates, Particular Technical Specification, General Technical Specification, drawings and other requirements of Tender and shall be subject to review by the Owner/Owner's Representative and their approval. Technical audit shall be done by Owner/Owner's Representative during a sample production / Execution.

2.2 Project Planning, Control and Reporting

The scope of work of the Contractor includes but not limited to planning, scheduling, monitoring & interfacing of all activities for the entire project. The Contractor shall co- ordinate all activities from concept to successful commissioning, with his own sub-contractors, site, workers, vendors, suppliers, Owner/Owner's Representative, Owner

and Government agencies for specific clearances. It is also the responsibility of the contractor to prepare & perform the Quality Control of all the activities and expediting plan for all procured items at Vendor's factory. The Contractor shall expedite suppliers for timely deliveries and transportation.

The Contractor shall submit progress report as per tender requirement.

It is Contractor's responsibility to carry out proper documentation of inspection and quality assurance programs for all equipment, items and materials, duly approved/reviewed by Owner/Owner's Representative. The Contractor shall maintain an accurate and traceable listing of procurement records for the location, quality and character of all permanent materials in the Project.

The Contractor shall report to Owner/Owner's Representative of all changes which will affect material quality, recommended and take necessary corrective actions, after obtaining Owner/Owner's Representative approval.

2.3 Work Description

Work tendered in this bid package pertains to design/engineering, procurement, supply (as per scope of supply defined elsewhere in tender), installation of complete pipeline and all associated mechanical, civil and structural works, Temporary C.P works etc.

The contractor shall broadly carry out the following activities:

- Arrangement of Laying permission.
- Laying of Under Ground 4" & 8" NB Carbon Steel Pipeline complete with Associated Facilities.
- UG Pipeline and AG piping work is to be executed after placement of order.
- Installation of new SV stations as per instructions of Owner/Owner's representative.
- Valve Pits wherever required.
- Installation of pipeline at crossings of Rail, Road, Utilities, Underground Pipeline & water bodies (Drain, Stream & Nala etc.) if present along route.
- Hydro testing and pneumatic pass test of Valves.
- Testing and Commissioning of pipeline segments as defined in Technical Specifications.
- The scope of work shall be completed, as per instructions of the Owner.

3.0 SCOPE OF SUPPLY

3.1 Materials to be supplied by Owner as Free Issue

Owner shall supply only the following materials as free issue from its store in respective state:

- Carbon Steel line pipe of API 5L Gr.B/X52(ERW/SMLS) with externally corrosion coated (Three layer polyethylene coating) of size and wall thickness - specified NB 8" x 6.4 mm and 4"x 6.4 mm.
- All underground and above ground Valves of size 2" and above.

IGL shall supply above mentioned material as free issue material. All fittings, elbows, flanges of all sizes etc. other than line pipe will be in scope of contractor and will be part of laying and shall not be paid separately. Free Issue Material shall be issued to

the Contractor from the designated store(s) of Owner. Contractor shall be responsible for lifting the free issue material from Owner's storage point(s) located at various GAs in U.P and transporting the same to work site(s) at his own cost. Contractor shall also return material after completion of work to owner's designated stores as directed by owner / owner's representative.

3.2 Material to be supplied by Contractor

The procurement and supply, in sequence and at the appropriate time of all materials and consumable required for completion of the WORK as defined in the contract except the material specifically listed under clause 3.1 above, shall be entirely the Contractor's responsibility and item rates quoted for the execution of the contract shall be inclusive of supply of all these materials. The materials are, but not limited to, as follows applicable for carbon steel pipeline/piping:

- All fittings, elbows, flanges,
- All valves of below 2" size.
- All consumable for welding such as oxygen, acetylene, inert gases and all types of electrodes, filler wire, solder wire, brazing rods, flux etc. for welding/cutting and soldering purposes.
- All materials for all types of pipeline markers including paints conforming to normal corrosive environment as per spec, cement, sand, reinforcement etc.
- All equipment and consumables required for hydrostatic testing like pumps. Compressor, pressure gauge (Approved Make) and temperature gauges, Corrosion inhibitor for water used for hydrostatic testing, including water for testing.
- All materials required for continuous concrete coating for providing negative buoyancy, to the pipeline wherever required.
- All materials and consumable required for external field weld joint coating and protective coating of bends, tee as per specifications including supply of coating materials. Raychem's/Covalence "Dirax" or Denso field weld joint coating material for carrier pipes used for uncased HDD crossings.
- All material and consumable items required for external coating to the buried piping, flanges, valves, etc.,
- All materials required for repair of damaged corrosion coating of line pipe.
- Bare casing pipe size shall be, as per API 1102 (i.e. casing pipe should be at least two nominal pipe sizes larger than the carrier pipe) of materials IS 3589 FE 410/ API 5L Gr B or equivalent shall be procured by contractor for the Railway/ Road crossing. The minimum casing pipe thickness is 6.4 mm. However, if higher casing pipe thickness of railway/ Road crossing is requiring as per statutory requirement then contractor has to provide the same.
- Casing insulators and end seals are to be required for steel casing pipe.
- All materials required for sand/soft soil padding around pipeline and select approved quality backfill, bank stabilization of water crossings, etc.
- All materials required for repair/restoration of pavements, roads, bunds other structures affected/damaged by Contractor's construction activities. Materials shall be equivalent/superior to those used for original construction of the facility.
- All materials/compressed air/pigs as required for cleaning, gauging, filling. Dewatering, swabbing for CS pipeline etc.

- All temporary materials required for filling, pressurizing and dewatering in connection with hydrostatic testing including pipes, flanges, blind flanges, fittings, temporary gaskets, nuts, bolts, clamps, strainers etc. required for fabrication of test headers and all consumables.
- All types of Galvanized bolts/studs/nuts and gaskets of all sizes and ratings, thickness as required for the permanent installation in piping system in accordance with the relevant material specification. All fittings like elbows, tees, reducers, weldolets, nipples, flanges, blind flanges, spectacle blind flanges, valves, pipes pressure gauge (with calibration certificates) of sizes below 2" NB and of all ratings.
- Contractor shall submit the MTC and all inspection reports for the bought out items.
- All types of coating and, painting materials including primers, paints, solvents, sand blasting materials, cleaning agents, compressed air etc. shall be suitable for normal corrosive environment.
- All steel materials such as structural steels, reinforcement steels and steel for all types of supports, foundations, ladders, platforms, etc.
- All materials and equipment required for all types of tests such as radiography/ultrasonic testing, magnetic particle and dye penetrate examination.
- Shims, wedges, fire blankets and packing plates (machined wherever required).
- All materials for civil and structural works, grouting etc., including casing end seals required in pit.
- Warning Mat (1mm thick LDPE yellow color warning mat)
- All safety tools/tackles/devices/apparatus/equipment, etc. including ladders and scaffolding as required.
- All materials for corrosion protection of buried piping, pipe fittings, valves etc.
- All materials, equipment, labour for required pre-commissioning / commissioning works including supply of required quantity of Nitrogen.
- Pressure Gauges:
    - Pressure gauge dial shall be white, non-rusting plastic with black figures. Pointers shall have external micrometer adjustment for gauge zero adjustment.
    - Pressure gauges shall be weatherproof with dial size of 150 mm and shall have features like screwed bezels, externally adjustable zero, over range protection and blowout discs. Pressure gauge sensing element shall be SS 316 and movement material shall of SS 304, as a minimum. The design of pressure gauges shall conform to IS 3624 Pressure gauges shall have an accuracy of ±1% of UR V as a minimum.
    - Over range protector and pulsation dampener, whenever used, shall be of SS 304, as a minimum. Pulsation dampeners shall be used for all pulsating services. These shall be floating pin type, externally mounted and externally adjustable.
    - Connection shall normally be 1/2" NPTM bottom.
    - Cases shall normally be cast aluminum alloy or black phenol and weatherproof to IP-55 as per IEC-529/IS-2147. Blow-out discs shall be provided for all gauges.
    - Ranges shall be so specified that the gauge normally operates in the middle third of the scale and shall conform to IS 3624 standard dials wherever possible.
    - Shatter proof glass shall be provided for pressure gauges.
- All pipe & pipe fitting, Valves including bends, flanges etc of size below 2" NB.
- SS Tubing material along with required fittings and valves for SV actuator connectivity.

- Field jointing coating material (Heat shrink sleeve).
- Cold applied tape.
- Bar coded electro fusion (Automatically readable) machines with power generators of at least 5.5 KVA, pipe cutters, pipe straigtners , top loading clamp for fusing saddle tapings , clamps of all sizes for Electro – fusion fittings , rebounding tools & test ends etc. and other tools required for completion of work as per instruction of Engineer – in– charge.
- All other materials not specifically listed herein, but required for the successful
- execution of the work. & satisfaction of the owner/ owner's representative.
- **Rock Shield**: Supply and installation of rock shield is in contractor scope. Rock shield shall provide external pipe protection from backfill rock damage and/or abrasion damage during pipe operation of the exterior coating;
    - Minimum thickness of 11mm, flexible PVC (polyvinyl chloride), strand extruded rock shield pads. The rock shield shall be extruded from an elastomeric plastic material of which the basic resin is prime virgin polyvinyl chloride. The PVC compound shall not contain any scrapped, reclaimed or recycled material whatsoever. Minimum weight of rock shield should be 0 .825 lbs/square foot. Rock shield is to be constructed of randomly extruded strands of elastomeric PVC plastic and must be bi-directional. This means that it should sufficiently protect the pipe regardless which side of the rock shield faces the pipe. The color of the rock shield shall be yellow to provide higher visibility to third party excavators.
    - Performance Requirements as follows:

      Property Test Method Required Limits-Impact Resistance ASTM G-13 (Modified), Protection integrity < 6" rock drop

      Must be constructed from PVC plastic ASTM D-2240 Durometer 78 (+ /3)

      Cathodic Protection Shielding Flange method on free film Matrix must allow passage of CP current

      Impact resistance: ASTM G-13 testing consists of the following parameters:

      35 lbs of stones, ¾" in diameter.

      Dropped from a height of 6 ft. Through a funneling chute onto the test surface.
      This test is repeated 10 times or until a holiday (defect / damage) is discovered. If no holiday is present after 10 repetitions, the product is said to have passed. Provide non-metallic banding or durable filament tape to affix rock shield securely to the pipe.

      - INSTALLATION

      A. Rock shield pads shall be affixed to pipe utilizing non-metallic bands of filament tape.

      B. Spacing of non-metallic banding shall not exceed 80 cm on center.

      C. Rock shield shall completely encircle the pipe with a minimum overlap of 10cm. Overlap shall be located at the bottom radius (6 o'clock position).

      D. Back-fill should be "shaded" into the trench during back-fill procedure. Do not dump back-fill directly on protected pipe.

      E. Follow manufacturer's recommendations.

4.0 CONSTRUCTION

The Contractor's scope of work shall consist, but not limited to the following. However, all such works, which are not listed below but are otherwise required to complete the work in all respects shall form part of the Contractor's scope of work.

4.1 General

In order for the tender to be valid, the bidder must forward to the Owner/Owner's Representative, at least the following documents correctly, completely filled in and clearly legible:

- A detailed methodology of the works drawn up on the basis of the start and end dates for the works as stipulated in SCC. The various phases of the work must be included in this program in so far as they are applicable to the works.
- The Bidder must provide a detailed organization chart (including key personnel like Project Manager, Construction Manager, QA/QC In-charge and HSE Officer's qualification) indicating the organization or personnel and equipment for each phase of the Works and for each work site
- An explanatory note must be attached describing the organization of the Construction Site as well as the methods and phases of execution, the complete inspection plan that the Bidder intends to follow, the qualitative and quantitative description of the means of execution, the installations, the equipment, the material, the tools and the personnel that Bidder shall employ in each phase in order to complete the Works within the planned schedule.
- The Contractor must draw up working methodologies including equipment, man power and material needed for all phases of the construction of the pipeline.
- All job procedures must get approved by the Owner/Owner's Representative before start of work.
- Only approved job procedures will be strictly implemented at site during all construction stages.
- The Contractor shall deploy all equipment and material required to achieve the work as per his detailed methodology and agreed schedule.
- Contractor shall mobilize resources simultaneously for Pipe Laying, all crossings etc. in order to achieve commissioning activities in due time as specified in the SCC.
- If deemed necessary as per the job procedure and/or at the request of the Owner, Contractor must deploy extra equipment without being entitled to raise any compensation.
- This description is only binding upon the Contractor. He must provide, at his own expense, all the necessary equipment, machinery and personnel even in addition to those indicated in the offer.
- 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.

4.2 Main Activities

4.2.1 Main Pipeline (Carbon steel pipeline)

Contractor's scope of work defined in this heading shall consist but not limited to

following:

- Topographic Survey
- The contractor shall be deemed to have to familiarized themselves with route prior to quoting and take care of all the eventualities. No extra cost shall be admissible in any form at a later date. Route survey and their details required for pipeline has not been carried out by Owner for the above project and shall be carried out by the Contractor. However, laying and construction of entire pipeline including detoured portions and pipeline section/ section of pipeline, shall be within the scope of contractor and governed by SOR of tender without any additional cost implication. Contractor shall be deemed to have considered such eventualities while formulating his bid.
- To carry out and submit pre-construction surveys, detailed construction method statement and calculations for the approval of Owner/Owner's Representative.
- To carry out Soil resistivity survey for TCP design.
- To carry out all construction works as per drawings approved procedures, specifications and applicable codes and standards. Any changes at site shall also need prior approval from the Owner/Owner's Representative and revision of drawings.
- To prepare and establish safety procedures for laying of the pipeline and personnel associated with the project.
- To co-ordinate and supervise the work of all sub-contractor(s), if any.
- To mobilize and provide all equipment, manpower (skilled and unskilled), tools

and tackles, consumables and other resources etc. as required for the execution of the complete job defined and discussed herein and thereafter demobilizing the same upon completion of work.

- To provide all safety tools/tackles/devices/apparatus/ equipment, etc. including ladders and scaffolding as required.
- To provide camp facilities for personnel of pipeline construction.
- To transport the materials to work site, To Prepare and execute adequate Material Control Procedure at Work Site.
- Location and directions of the pipeline and dimensions of trench within the ROU shall get approved before execution of the work. No extra claim shall be entertained in this regard.
- Site preparation, arranging required land for setting up of string fabrication yard and obtaining necessary permissions from concerned authorities.
- During ROU clearing, the vegetation shall be cut off at ground level leaving the roots intact. Only stumps and roots directly over the trench shall be removed for pipeline installation.
- Welding of all tie-in joints including testing of joints on either side of major/ minor crossings / with adjoining pipeline including cutting of test header, re-beveling, WPS/PQR and other related operations etc.
- Staking, clearing, grading, trenching to all depths in all types of soils, transportation of coated pipes to ROU along the route, stringing, aligning, welding, NDT including radiographic inspection, field weld joint coating including supply of all materials corrosion protective coating of bends including supply of materials as per specifications, sand padding, laying and lowering of the pipeline, back filling, carrying out rail, road, canal, utility and submerged minor water course crossings including installation of carrier pipe by open cut method/HDD/rock drilling/moling, crossing of canal by conventional methods on approved drawings and as directed by Owner/Owner's Representative, installation of supports wherever required, supply of select backfill material as required, clean-up, pigging, flushing, gauging, hydrostatic testing, de-watering, swabbing, drying, pre-commissioning and commissioning of complete pipeline system, including all associated works as per relevant specifications, standards and approved drawings.
- Preparation of pipeline:- Launch way, repair of damages to corrosion, string preparation, field welding, NDT including radiography, pre-test of completed strings wherever required, corrosion coating of field joints, trenching, laying at approved depth, back filling including supply of select backfill material (where required), post installation hydrotest, capping, supply and installation of markers, etc.
- Valve pit/ Chamber

  The construction of the valve pit/ chamber provided on the pipeline shall be constructed in accordance with the standard drawing (enclosed in the tender). The construction of valve chamber shall be taken immediately after installation of

valve pit.

The excavation work shall be done at a location given by Owner/ Owner's representative. All care shall be taken not to damage existing facilities and surface of construction shall be restored to its original state.

- To lay Warning tape as per typical drawings.
- Supply and installation of casing pipe (size shall be, as per API 1102, i.e. casing pipe should be at least two nominal pipe sizes larger than the carrier pipe) of materials IS 3589 FE 410/ API 5l Gr B or equivalent shall be procured by contractor Railway/ Road crossing.
- Supply & Installation of Casing Pipe of material IS 3589 FE 410 / API 5L Gr. B / or equivalent shall be procured by contractor for the crossings.
- To install all field joint coating by heat shrink sleeves.
- Cold tapes/ R 95 shall be applied at specific location (wherever required) with prior approval.
- To carry out all Civil / Structural works TCP system, Pre-commissioning and commissioning works in accordance with relevant specifications and requirements enclosed elsewhere in the Tender.
- On Lowering & backfilling of 1 km pipeline, TCP to be installed. Over 1 km, pipeline patches to be temporarily protected. Moreover, TCP readings must be taken each month and included in the final completion documentation.
- To fabricate and install of all piping, structural components etc. as per drawings.
- To lay the carbon steel pipe (minimum cover of 1.20 m).
- To put in practice approved (by Owner/Owner's representative) Welding procedure specification (WPS) / PQR by approved qualified welders in accordance with API RP – 1104 (latest issue). Even if contractor is having qualified WPS but it shall be once again reviewed and approved by the third party inspection agency /Authorized Inspection Agency at site and at manufacturer's premises.
- To perform impact test as specified in the PTS.
- Fabrication, testing, painting etc. of underground valve installation with bypass and venting arrangement (any joint shall not be paid separately).
- Fabrication, testing, painting etc. of above ground piping in the CNG/ DRS /MRS station up to compressor flange or DRS /MRS flange as per instruction of EIC
- To provide, operate and maintain all temporary facilities required for the construction related works and remove after completion of work.
- To perform all works related to testing, dewatering, swabbing, drying, pre-commissioning and commissioning of pipeline system.
- All expenses and cost for attending Tests/Inspections related to construction, bought out items etc. at laboratory or at vendors' place for Owner/Owner's Representative/TPIA shall be borne by the Contractor.

- To prepare as built drawings, pipe books, documents, photographs, video shots and project records as per specification and instructions of the Owner/Owner's Representative including furnishing of all Test Certificates / Inspection reports for all materials used for permanent installation.
- All balance works are required to be performed in an operating/gas charged environment. It shall be Contractor's responsibility to obtain hot work permit and comply with all necessary instructions, restrictions and conditions imposed by the Owner.
- As far as possible, the Shallow HDD method shall be carried out to avoid the case crossing, wherever it is not mandatory to provide the casing.
- Clean-up and restoration of ROU and other conveniences like road, rail, canals etc. to original condition as per specification and drawings to the entire satisfaction of Owner and/or Authorities having jurisdiction over the same, including disposal of surplus construction materials to a location identified by the Contractor/Owner/Owner's Representative approved by local authority without causing any disturbance to environment, locals and to the entire satisfaction of Owner/Owner's Representative.
- No compensation will be made to the Contractor for temporary supports, if required for piping erection job.

  All incidental/associated works and any other works not specifically listed herein but are required to be carried out to complete entire works related to pipelines and the associated facilities.

4.3 Reconciliation of Owner Supplied Materials

4.3.1 The Contractor shall submit an account for all materials issued by Owner, Consumption and physical verification report of remaining materials in the Performa prescribed by the Engineer-in-charge on quarterly basis. On completion of the work, the contractor shall submit "Material Appropriation Statement/ Reconciliation Statement" for all materials issued by the Owner in the Pro-forma prescribed by the Engineer-in-charge.

All coated line pipes as per line pipe specifications enclosed elsewhere in the bidding document, shall be issued on linear measurement basis. All other piping materials shall be issued on numbers basis. All cut pieces pipes in length measuring 2 m to 9 m when returned to Owner's storage points after beveling, shall be considered as serviceable material. All cut pieces of pipes measuring less than 2 m will be treated as wastage/ scrap. All pipes above 9 m will be considered as good pipe.

a) For 3 LPE Coated Carbon Steel Line Pipes:

For the purpose of accounting of coated line pipes following maximum allowances shall be permitted,

i) Unaccountable wastage 0.1%

ii) Scrap (all cut pieces of pipes measuring less than 2m) 0.25%

Unaccountable wastage/ scrap shall be at actual as per site assessment subject to maximum as stated above.

4.3.2 All unused, scrap materials and salvageable materials shall be the property of the Owner and shall be returned by the Contractor category-wise at his cost to the Owner's designated store yard (s). In case the Contractor fails to do so or exceeds the limits of allowances specified above for scrap/ serviceable materials, then recovery for such quantities not returned as well as returned in excess of permitted limit by the Contractor will be done at the penal rate i.e. 200% of landed cost at the time of final bill/ closing of contract by Engineer-in-charge shall be effected from the Contractor's bill (s) or from any other dues of the Contractor to the Owner. Contractor shall be responsible for the adjustment and measurement of the surplus materials to be returned to the store. Contractor shall also be responsible for suitable segregation of returned materials into separate stacks of serviceable and scrap materials. Wherever certain material is covered under Contractor's scope of supply whether part or in full for any item of work covered under SOR, no allowance towards wastage/ scrap etc. shall be accounted for during execution stage.

4.3.3 Other Activities

The contractor’s scope of work shall consist but not limited to the following:

Soil Investigation : The soil investigation includes boring, collection of disturbed samples from bore holes and visual engineering classification of soil along the pipeline route and submission of detailed report to Company. Visual classification of soil shall be in accordance with IS-1498; :IS Classification and Identification of Soils for General Engineering Purposes” Geotechnical investigation of soil shall be carried out as per relevant clauses of IS 1892 and other applicable IS standards.

Bore Holes : Boreholes shall be made at locations as direct by Engineer in-charge along the pipeline route to find out the presence of rock strata.

Boring shall be carried out in accordance with the provision of IS:1892. Minimum diameter of boring shall be 150 mm. Auger boring shall be resorted to above water table, whereas below water table the boreholes shall be advanced by rotary drilling with mud circulation through all kinds of soil other than rock. While boring above water table, no water shall be introduced in boreholes. Casing shall be used to support the sides of boreholes in soft to firm soil.

Except for crossing location as defined below, the boring shall be carried out upto 10 m depth below NGL or 01

m. below the rock bed, if rock is encountered at a depth of less than 10 m.

In case of boring at Highways (National/State), River and Railways crossings, the boring shall either terminated at a depth of 15 m below NGL or 01 m. below the rock bed on top of bed rock, if rock is encountered at a depth less than 15 m.

Presentation of Survey Data : Results of soil investigation survey shall be submitted in the form of report covering minimum the followings,

Visual engineering classification of soils encountered along the pipeline route in bore log form. Depth of Ground Water Table (GWT) below NGL shall also be mentioned if encountered.

Soil profiles along the pipeline route shall also be prepared and attached with the report.

Regions along the pipeline route where hard rock is present and special excavation techniques like blasting, etc. needs to be adopted for excavation of pipeline trench shall be clearly indicated in the report.

Test shall be carried out at approved laboratory.

Summary of results obtained from tests and their interpretation to evaluate soil parameters.

Visual engineering classification of soils obtained from bore holes shall be shown in Alignment sheets also whenever preparation of Alignment sheets are in SURVEYOR'S scope of work."

Construction : Stringing, aligning, field welding, NDT including radiography, joint coating, protective coating for bends and underground fittings, valves etc. as per specifications, padding, lowering, execution of roads, canals, nala, rivers, railway, utility crossings backfilling, etc.

Attending repairs : To carry out repairs of line pipe and pipe coating (including supply of all materials) including defects/damages occurring during transportation and/or handling in co-ordination with Owner/Owner's Representative.

Tie-in : Welding of all tie-in joints, NDT and other testing.

Golden Joints	: To carry out NDT (RT with X-ray / Gamma rays), Manual UT If required.
Cathodic Protection	: Conducting soil resistivity survey, design, engineering, supply of all materials, installation, testing and commissioning of temporary Cathodic protection.
Documents	: To give updated approved documents in A3 / A4 (Periodically) to Owner / Owner's Representative for reference at site.
Permits	: To obtain all necessary approvals and work permits, as applicable for performing the work.
Preservation of Pipeline	: For preservation of pipeline during Idle time, if required, by filling the pipeline system with nitrogen at a positive pressure of 2 barg.
Restoration	: Clean-up and restoration of Right-of-Way as per specifications and other utilities like road, railway, canal, river, etc. to original condition, obtaining certification from concerned parties and to the entire satisfaction of Owner and/or concerned authorities having jurisdiction. Supply and installation of all types of pipeline markers including all associated civil works as per specifications and instructions of Owner/Owner's Representative. Restoration work for crossing to the satisfaction of authorities.
Testing	: Backfilling including supply of select backfill material where ever required, cleaning, gauging, pigging, hydrostatic testing, dewatering, swabbing, drying and commissioning of completed pipeline system as per specifications and direction of Owner / Owner's Representative.
Constructions (carbon steel)	:Carbon steel pipe shall be laid as defined above. Cleaning, flushing, testing, purging with nitrogen and commissioning of pipeline as per specification and approved procedures providing all tools & tackles, nitrogen, instruments, manpower and related accessories as directed by owner /Owner's representative.

5.0 STATUTORY PERMISSIONS

5.1 Guidelines

Prior to start of construction activity, Contractor shall prepare the route survey drawing, mark proposed gas pipe line and submit to IGL/Consultant for approval.

IGL shall apply for permission for laying of pipeline however obtaining the permission, necessary day to day clearances, approvals from all concerned authorities in respect of pipeline and all related work & reversal of BG / Security from statuary authority after completion of work shall be responsibility of contractor and cost of same shall be deemed to have included in quoted prices. On behalf of the Owner, Contractor shall co-ordinate with the relevant authorities along with the copy of required pipeline route drawings / certificates complete in all respect shall be prepared and submitted by the Contractor well ahead of time so that the actual construction of the work is not delayed for want of the approval / inspection / permission by concerned authorities. The inspection of work by authorities shall be arranged by Contractor and necessary co-ordination and liaison work in this respect shall be the responsibility of the Contractor. However, statutory fees / restoration charges, if any, shall be paid by IGL on production of documentary evidence.

IGL is responsible only for preparing the letter towards application for permission and submission of demand note raised by statutory authorities. In case, bidder fails in getting permission from statutory authority within a stipulated time, IGL may appoint another agency & complete the work at bidder's risk and cost.

Any change / addition required to be made to meet the requirements of the statutory authorities shall be carried out the Contractor without any extra cost to IGL. The inspection and acceptance of the work by statutory authorities shall however, not absolve the Contractor from any of his responsibilities under this contract.

5.2 Priorities

Owner may, at its sole option, assign priority of construction to any section of total pipeline length or to any part/segment of the WORK. Contractor shall comply with such priority of execution without any time and cost implication to the Owner.

5.3 Audits

Owner/ Owner's Representatives shall carry out audit of all Contractors' works/ site Offices/ Project Offices at regular intervals (Minimum two nos. of audits). Contractor/ Contractor's personnel have to extend full co-operation to Owner's audit team, including but not limited to providing access to all Project data/ information/ records, facilities etc. Contractor, hereby agrees to immediately act upon and rectify/ correct/ make good any findings/ observations of these audits.

□□□

ANNEXURE – A: ELECTRODE QUALIFICATION TEST RECORD

A Tested at Date:

Manufacturer's Name :

Brand Name :

Batch Number & Size tested :

Classification & Code :

Intended for Welding in positions :

In combination with :

(if any)

Code of Reference :

(used for testing)

Special requirements :

(if any)

B <u>All-weld Tensile Test</u>

Base Material used :

Pre-heat temp. :

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 <u>Impact Test Results</u>

Test Temperature : Notch in :

Type of Specimens : Size of

(Charpy) Specimens :

Specimen No.	Impact Value	Average
1.		
2.		
3.		
4.		
5.		

D Chemical Analysis Result

Electrode Size used :

Batch No. :

%	%S	%P	%SI	%Mn	%Cr	%Ni	%Mo	Other

ANNEXURE – C : STRESS RELIEF HEAT TREATMENT PROCEDURE SPECIFICATION

Name of the Heat-Treater :

Name of the Project :

Specification Reference No. :

1. General Details

   Name of the Equipment :

   Name of the Assembly/Part :

   Assembly / Part Drawing No. :

   Material :

2. Furnace Details

   Type of Heating: Gas/Oil/Elec.Res./Induction

   Type of Heating: (Tick Mark)

   Capacity (Size) :

   Maximum Temp. (OC) :

   Method of Temp. Measurement :

   Atmosphere Control :

3. Heat Treatment Cycle Details

   Changing Temp.OC :

   Rate of Heating, OC/Hr. :

   Soaking Temp.OC :

   Soaking Time, Hrs. :

   Rate of Cooling, OC/Hr.

   Mode of Cooling :

4. Other Details, if any
   Notes:
   The following documents shall be furnished alongwith the specifications:

   i. Material Test Certificates
   ii. Assembly Part Drawing

ANNEXURE – D: WELDING PROCEDURE QUALIFICATION TEST RECORD

Example of record form for welding procedure approval test:

Project/ Contract Pipe and Coating Material Process Outside Diameter Pipe Thickness Joint Design (Sketch Attached)			Contractor
Make and type of filler metal	Diameter	Current	Volts
Root Second Run Other Run Other Electrical Characteristics	A.C./D.C	Electrode + ve /-ve	
Shielding Gas : Type or mixture Flow Shielding Flux Position			
Direction of Welding : Vertical up/ Vertical down Root : Vertical up/ Vertical down Second Run : Vertical up/ Vertical down Other Runs : Vertical up/ Vertical down			
Number of Welders : Root Second Run Other Runs			

Time lapse between commencement of root and commencement of second run

Time lapse between commencement of Second run and commencement of other run

Minimum number of runs before joint allowed to cool

Maximum time between commencement and completion of weld

Type of line-up clamp

Removal of clamp after run :

Lowering off after run :
Cleaning
Preheating

Minimum temperature ^{O}C Ambient temperature ^{O}C

Type of heater to be used

Interpass temperature

Minimum OC Maximum OC

Post weld heat treatment

Speed of travel

Test results

State acceptable non-acceptable (with reasons) or give numerical results

Non-destructive test:-

Visual Radiograph

Destructive Test 1. 2. 3. 4

Transverse tensile

Tensile strength (with units)

Fracture location

Test temperature

Macro-examination

Fillet weld fracture

Hardness Survey:-

Type Load Location of hardness measurement (Sketch)

Hardness range:

Parental metal

Heat affected zone Weld

Charpy

V-notch impact tests

Specimen location and size

Notch location

Test temperature

Results (with units)

Additional test and tests and results e.g. chemical analysis, micro-examination, CTOD tests, bend tests etc.

The statements in this record are correct. The test joints were prepared, welded and tested in accordance with the requirements of this specification.

Inspector

Date: -

ANNEXURE – E: EXAMPLE OF RECORD FORM FOR WELDER APPROVAL 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
Electrode / Wire	
Root	Current Voltage
Second Run	Current Voltage
Full and cap	Current Voltage
Director of travel	Root: Vertical Fill and cap: Up/vertical Vertical up/ Down Vertical down

Reason for failure
Visual
Non-destructive testing
Butt Joint
Fillet weld
Number of attempts
Comments

ANNEXURE – F: WELDERS IDENTIFICATION CARD

Name :

Identification : Photograph Date of Testing :

Valid Until :

Approval of Welding :

Welding Position :

Material :

Diameter :

Wall Thickness :

Type of Welding :
Consumables :

Approved by : Employer's signature with seal

ANNEXURE – G: 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
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. Geometric Relationship (Source local spot size, max and min source strength, object to film distance, radiation angle with respect to weld and film)
12. Limit of film coverage
13. Film type and make
14. exposure Time
15. Processing (time temperature for development, stop bath or rinse, fixation, washing, drying etc.)
16. Density
17. Sensitivity
18. Type of penetrameter

Approval of the COMPANY

Signature of CONTRACTOR with Seal

ANNEXURE – H: DIFFERENCE BETWEEN THE WATER THERMAL EXPANSION FACTOR AND THE STEEL THERMAL EXPANSION FACTOR (OC-1) X10-6

°C bar	1	2	3	4	5	6	7	8
.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	-70.40	-52.72	-35.63	-19.14	-3.16	+12.29	+27.26
40	-85.32	-67.12	-49.58	-32.62	-16.24	-0.41	+14.93	+29.78
50	-81.90	-63.84	-46.43	29.60	-13.36	+2.36	+17.57	+32.31
60	-78.47	-60.55	-43.27	-26.58	-10.46	+5.15	+20.23	+34.85
70	-75.30	-57.25	-40.10	-23.54	-7.56	+7.92	+22.89	+37.39
80	-71.60	-53.96	-36.94	-20.51	-4.65	+10.70	+25.55	+39.94
90	-68.16	-50.66	-33.77	-17.47	-1.73	+13.50	+28.23	+42.50
100	-64.72	-47.35	-30.60	-14.43	+1.18	+16.29	+30.90	+45.05
110	-61.28	-44.05	-27.43	-11.38	+4.10	+19.08	+33.58	+47.61
120	-57.84	-40.74	-24.26	-8.34	+7.02	+21.88	+36.26	+50.18
130	-54.40	-37.44	-21.08	-5.29	+9.95	+24.68	+38.94	+52.75
140	-50.96	-34.13	-17.90	-2.25	+12.87	+27.49	+41.63	+55.32
150	-47.53	-30.83	-14.73	+0.80	+15.79	+30.29	+44.31	+57.89
160	-44.10	-27.53	-11.56	+3.85	+18.72	+33.10	+47.00	+60.46
170	-40.67	-24.23	-8.40	+6.89	+21.64	+35.90	+49.69	+63.04
180	-37.24	-20.94	-5.23	+9.94	+24.56	+38.70	+52.37	+65.62
190	-33.83	-17.65	-2.06	+12.98	+27.48	+41.51	+55.06	+68.19
200	-30.42	-14.37	+1.09	+16.01	+30.40	+44.30	+57.75	+70.77
210	-27.02	-11.09	+4.25	+19.04	+33.31	+47.10	+60.43	+73.34
220	-23.63	-7.82	+7.40	+22.06	+36.22	+49.90	+63.12	+75.90
230	-20.24	-4.56	+10.54	+25.08	+39.13	+52.69	+65.80	+78.48

240	-16.87	-1.30	+13.67	+28.10	+42.03	+55.48	+68.48	+81.05
250	-13.50	+1.94	+16.79	+31.11	+44.92	+58.26	+71.15	+83.61
260	-10.14	+5.17	+19.90	+34.12	+47.81	+61.04	+73.81	+86.81
270	-6.80	+8.39	+23.00	+37.11	+50.69	+63.80	+76.48	+88.73
280	-3.48	+11.60	+26.11	+40.09	+53.56	+66.57	+79.41	+91.29
290	-0.17	+14.80	+29.19	+43.07	+56.43	+69.33	+81.78	+93.83
300	+3.13	+17.98	+32.27	+46.03	+59.29	+72.08	+84.83	+96.38

°C bar	9	10	11	12	13	14	15
.981	+34.82	+49.22	+63.20	+76.78	+89.99	+102.83	+115.34
10	+36.97	+51.26	+65.15	+78.64	+91.75	+104.51	+116.93
20	+39.36	+53.55	+67.33	+80.71	+93.72	+106.39	+118.71
30	+41.76	+55.84	+69.51	+82.79	+95.70	+108.26	+120.49
40	+44.18	+58.14	+71.70	+84.87	+97.68	_110.14	+122.28
50	+46.60	+60.45	+73.90	+86.96	+99.68	+112.04	+124.07
60	+49.02	+62.76	+76.10	+89.07	+102.67	+113.93	+125.88
70	+51.44	+65.08	+78.32	+91.17	+103.68	+115.84	+127.69
80	+53.88	+67.40	+80.53	+93.29	+105.69	117.76	+129.50
90	+56.32	+69.73	+82.75	+95.41	+107.70	+119.67	+131.32
100	+58.77	+72.07	+84.98	+97.53	+109.73	+121.59	+133.15
110	+61.21	+74.41	+87.22	+99.66	111.75	+123.52	+134.98
120	+63.67	+76.74	+89.45	+101.79	+113.79	+125.46	+136.82
130	+66.12	+79.09	+91.69	+103.93	+115.83	+127.39	+138.67
140	+68.58	+81.45	+93.93	+106.07	+117.87	+129.34	+140.51
150	+71.05	+83.80	+96.18	+108.21	+119.90	+131.20	+142.37
160	+73.51	+86.15	+18.43	+110.36	+121.96	+133.74	+144.22

170	+75.97	+8851	+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	+88.30	+100.31	+111.97	+123.29	+134.29	+144.99	+155.42
230	+90.67	+102.67	+114.23	+125.45	+136.36	+146.96	+157.30
240	+93.22	+105.03	+116.48	+127.60	+138.42	+148.93	+159.18
250	+95.69	+107.39	+118.74	+129.76	+140.48	+150.90	+161.05
260	+98.14	+109.74	+121.00	+131.92	+142.54	+152.87	+162.93
270	+100.60	112.10	+123.25	+134.08	+144.61	+154.84	+164.81
280	+103.05	+114.44	+125.75	+136.24	+146.67	+156.84	+166.69
290	+105.50	+116.79	+127.75	+138.39	+148.73	+158.78	+168.57
300	+107.4	+119.13	+130.00	+140.54	+150.79	+160.75	+170.45

°C bar	16	17	18	19	20	21	22	23
.981	+127.52	+139.41	+151.00	162.31	+173.37	+184.18	+194.75	+205.08
10	+129.02	+140.83	+152.36	+163.58	+174.56	+185.30	+195.79	+206.07
20	+130.71	+142.42	+153.85	+165.00	+175.90	+186.55	+196.96	+207.07
30	+132.40	+144.02	+155.35	+166.42	+177.23	+187.80	+198.14	+208.26
40	+134.10	+145.62	+156.87	+167.85	+178.58	+189.07	+199.33	+209.37
50	+135.80	+147.24	+158.39	+169.29	+179.93	+190.34	+200.52	+210.49
60	+137.51	+148.86	+159.92	+170.73	+181.29	+191.62	+201.72	+211.61
70	+139.22	+150.49	+161.46	+172.64	+182.66	+192.91	+202.93	+212.74
80	+140.95	+152.11	+163.00	+173.64	+184.03	+194.20	+204.14	+213.88
90	+142.67	+153.75	+164.56	+175.10	+185.41	+195.50	+205.36	+215.03

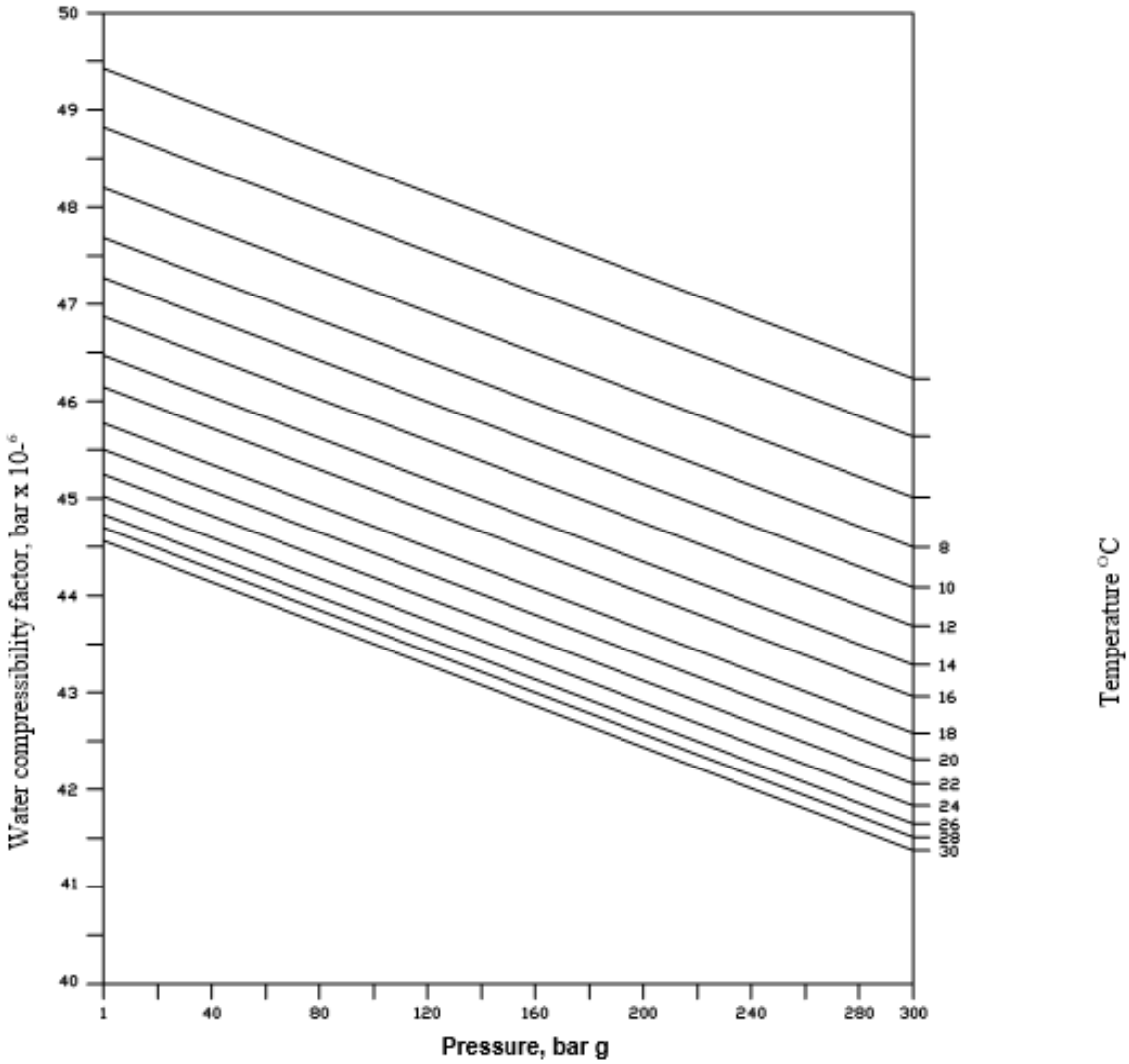
100	+144.42	+155.40	+166.11	+176.58	+186.80	+196.80	+206.59	+216.17
110	+146.15	+157.04	+167.66	+178.05	+188.20	+198.12	+207.82	+217.33
120	+147.90	+158.70	+169.24	+179.54	+189.59	+199.44	+209.06	+218.49
130	+149.65	+160.36	+170.81	+181.02	+191.00	+200.75	+210.31	+219.66
140	+151.40	+162.03	+172.39	+182.51	+192.41	+202.09	+211.56	+220.84
150	+153.16	+163.70	+173.98	+184.00	+193.82	+203.42	+212.81	+222.02
160	+154.93	+165.37	+175.56	+185.51	195.24	+204.76	+214.08	+223.20
170	+156.69	+167.05	+177.15	+187.02	+196.66	+206.10	+215.34	+224.39
180	+158.47	+168.73	+178.75	+188.53	+198.09	+207.45	+216.61	+225.58
190	+160.24	170.42	+180.35	190.05	+199.52	+208.80	+217.89	+226.79
200	+162.01	172.10	+181.95	+191.57	+200.97	+210.16	+219.17	+227.99
210	+163.80	173.80	+183.55	+193.09	+202.40	+211.53	220.46	229.20
220	+165.58	+175.49	+185.16	+194.62	+203.85	+212.89	+221.74	+230.41
230	+167.36	+177.19	+186.78	+196.14	+205.30	+214.26	+223.04	+231.63
240	+169.16	+178.89	+188.39	+197.68	+206.75	+215.63	+224.33	+232.85
250	+170.94	+180.59	+190.01	+199.21	+208.20	+217.00	+225.63	+234.08
260	+172.73	+182.30	+191.63	+200.75	+209.66	+218.40	+226.93	+235.31
270	+174.53	+184.00	+193.25	+202.29	+211.12	+219.77	+228.24	+236.54
280	+176.32	+185.70	+194.88	+203.83	+212.59	+221.16	+229.55	+237.77
290	+178.11	+187.42	+196.50	+205.37	+214.05	+222.54	+230.89	+239.01
300	+179.90	+189.13	+198.13	+206.92	+215.51	+223.93	+223.18	+240.26

°C bar	24	25	26	27	28	29	30
.981	+215.22	+215.14	+234.88	+244.41	+253.79	+263.00	+272.03
10	+216.13	+225.99	+235.66	+245.13	+254.44	+264.59	+272.57
20	+217.15	+226.94	+236.53	+246.75	+255.18	+264.27	+273.18

30	+218.18	+227.88	+237.41	+246.75	+255.69	+264.95	+273.80
40	+219.21	+228.85	+238.30	+247.58	+256.69	+265.64	274.42
50	+220.25	+229.82	+239.20	+248.40	+257.45	+266.33	+275.07
60	+221.30	+230.79	+240.11	+249.24	+258.22	+267.04	+275.70
70	+222.35	+231.78	+241.02	+250.08	+258.99	+267.75	+276.35
80	+223.43	+232.77	+241.94	+250.93	+259.78	+268.47	+277.01
90	+224.48	+233.77	+242.87	+251.79	+260.57	+269.19	+277.66
100	+225.56	+234.76	+243.79	+252.66	+261.36	+269.92	+278.33
110	+226.64	+235.78	+244.73	+253.53	+262.17	+270.77	+279.01
120	+227.73	+236.79	+245.68	+254.40	+262.98	+271.41	+279.69
130	+228.82	+237.81	+246.63	+255.28	+263.62	+272.16	+280.38
140	+229.92	+238.84	+247.59	+256.18	+264.62	+272.92	+281.08
150	+231.03	+239.87	+248.55	+257.07	+265.44	+273.69	+281.78
160	+232.14	+240.91	+249.52	+257.97	+266.28	+274.46	+282.49
170	+233.26	+241.96	+250.49	+258.88	+267.12	+275.23	+283.20
180	+234.38	+243.01	+251.47	+259.79	+267.97	+276.01	+283.20
190	+235.51	+244.06	+252.46	+260.71	+268.82	+276.80	+284.64
200	+236.64	+245.12	+253.45	+261.63	+269.67	+277.59	+285.37
210	+237.77	+246.18	+254.45	+262.50	+270.54	+278.39	+286.11
220	+238.91	+247.26	+255.45	+263.49	+271.40	+279.19	+286.85
230	+240.06	+248.33	+256.46	+264.43	+272.28	+280.00	+287.59
240	+241.21	+249.41	+257.46	+265.37	+273.16	+280.82	+288.35
250	+242.36	+250.49	+258.48	+266.31	+274.04	+281.63	+289.11
260	+243.52	+251.58	+259.49	+267.27	+274.92	+282.46	+289.86
270	+244.68	+252.66	+260.52	+268.23	+275.82	+283.29	+290.64
280	+245.84	+253.76	+261.54	+269.18	+276.71	+284.12	+291.40
290	+247.01	+254.86	+262.57	+270.15	+277.61	+284.95	+292.18

300	+248.18	+255.96	+263.60	+271.11	+278.51	+285.79	+292.95

WATER COMPRESSIBILITY FACTOR VS. PRESSURE AND TEMPERATURE



ΣΣΣ

AMENDMENTS TO GENERAL TECHNICAL SPECIFICATIONS

THE NUMBERING OF THE PARTS IN THE BELOW CORRESPONDS TO GENERAL TECHNICAL SPECIFICATIONS

The present specification (PTS) can confirm, complete, modify or delete certain sections/paragraphs of those clause numbers of appearing below.

Contractor shall note that relevant clauses pertaining to item rate contract in GTS are not applicable. The payment shall be made ONLY on the basis of Schedule of Rates (SOR) forming the part of bid document.

The qualifying statements and conditions against GTS clauses are detailed as below.

SITE OCCUPATION : 18422-CD-PL-SS-001

1.1 OCCUPATION OF THE SITE

Add:

Contractor will store excavated earth/soil over the existing pipeline after Owner's approval so that the adequate area in the newly acquired ROU is available for equipment movement.

The top-soil/arable soil removed during grading shall be stored and preserved separately from sub-surface excavated material.

1.2 MARKING OUT AND PROVISIONAL FENCING:

Fencing of the terrain shall be at the discretion of Contractor. However, area where work is being carried out above man height or below 1' ground depth must be barricaded. Contractor shall be fully responsible for any damage, accidents etc. arising during construction work along the route and any compensation thereof and shall suitably indemnify Owner/ Engineer for any such damage and accidents.

1.4 CLEARING OF THE SITE INSTALLATION

All the clauses of this section are applicable for pipe laying contractor (s) site installation.

DELIVERY AND HANDLING OF THE MATERIAL: 18422-CD-PL-SS-004

1. DELIVERY AND HANDLING OF THE MATERIAL

1.1. General

The materials to be supplied by Owner as mentioned in present PTS Clause No. 3.1

Technical description of all the material supplied by Owner shall be given in due line after award of contract.

Storage

All free issue items to be supplied by Owner and will be stored in one Warehouse located along the line pipe route. Contractor has to collect free

issue material from this Warehouse.

Cost of Transportation, loading from the warehouse and unloading shall be borne by Contractor.

1.2. Method of Delivery

All materials are supplied by the contractor except that indicated in para 3.1of present PTS.

During loading/unloading, lifting hooks shall be equipped with a plate curved to fit the curvature of the pipe and contact points with pipe shall be provided with soft material like rubber, Teflon or equivalent. Coated pipes shall be handled by means of slings and belts of proper width (min. 60 mm) mode non-metallic, non-adhesive materials. During handling, suitable handling equipment with proper length of booms like fork lifts shall be used.

The weld bead of the pipes shall be positioned in such a manner so as not to touch the adjacent pipes.

Contractor store points / stock yards shall be located within the vicinity of pipeline route and the location shall be approved by Owner. Plot acquisition for the store points / stock yards and maintenance of the same shall be as per instructions of the Owner/Owner's Representative at Contractor's cost.

1.6. Storage and Handling of Materials

Contractor must provide suitable covered, waterproof storage facilities for storage of supply material. Proper store management including receipt, inspection, storage, preserving the material in good condition and issuing material to construction site at appropriate time including arranging temporary land for storage of material shall be the responsibility of contractor. Store location & size shall be approved by EIC before finalizing by contractor.

WELDING : 18422-CD-PL-SS-006

1. WELDING

1.1. Qualification of Welders

- Welders shall be qualified in accordance with the API 1104 and other applicable specifications and as per WPS by the contractor at his expense.
- The butt weld test pieces of the qualification test shall meet the requirements of visual inspection and radiographic test requirements specified in GTS.
- A Welder who fails to complete successfully the qualification test session may be given a second opportunity to qualify after mutual agreement between Owner/Contractor as per section 6.7 of API 1104 code. Contractor shall submit the welder qualification test reports to Owner's representative for approval.
- Welders shall always have in their possession the identification card (certified by Owner's Representative). No welder shall be permitted to work without the possession of identity card.
- For pipeline welding one welder shall be engaged on each joint.

1.2. Welding procedure qualifications

- The welding procedure qualification test shall be carried out and qualified on the same line in accordance with requirements of API 1104 (latest edition) and other applicable specifications by the Contractor at his expenses.
- The test pieces for welding procedure qualification shall meet the requirements of visual inspection and radiographic test requirements specified in GTS.
- In addition to the mechanical tests mentioned in API-1104, other tests like macro/micro examination, hardness tests, dye penetration tests, Charpy V-notch (Impact test) etc. shall be carried out on test specimens as per GTS and present PTS. All the above tests shall be carried out in accordance with specifications.
- Essential variables for WPS of pipeline shall be in accordance with API 1104.
- The welding electrodes/filler wires supplied by the Contractor shall conform to the class specified in the qualified welding specification. The SMYS of electrodes / filler wires shall be equal to or more than the parent material to be welded.
- Physical properties of the welds produced by electrodes recommended for the welding of a particular base metal shall not be lower than the minimum values specified for the base metal. The choice of electrode shall be the sole prerogative of the Owner/Owner's Representative.
- The Contractor shall submit batch test certificates from the electrode manufacturer giving details of physical and chemical tests carried out for each batch of electrodes to be used.
- For each batch, electrode qualification test report shall be submitted as per Annexure
  – A to the Owner/ Owner's Representative for approval.
- All electrodes shall be preserved in good condition as recommended by manufacturer. Low-hydrogen electrodes shall be kept in oven. The baking period shall be strictly as per manufacturer's recommendations. The electrodes used shall be free from rust, oil, grease, earth and other foreign materials which affect the quality of welding.
- All other consumables (like shielding gas) equipment and accessories shall be strictly
  as per applicable standards, codes and instruction of Owner/Owner's Representative.
- The welding process for pipeline shall be shielded metal arc welding (SMAW).
- Acceptance of welding process is in prerogative of Owner/Owner's Representative.
- Shielding Gas - The composition and 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 Owner/Owner's Representative.

- Preheating temperature shall be maintained over the whole length of the joint during welding. Temperature indicating crayons of other indicating devices shall be provided by the Contractor as per instruction of Owner's Representative.
- 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 own expense as per relevant specifications, applicable standards and the instructions of the Owner/Owner's Representative.

1.2.4. Qualification Tests

1.2.4.1. Introduction

The pipes for qualification test shall be provided by Owner to Contractor on chargeable basis.

1.2.4.3. Non-Destructive Tests

In addition to the API 1104 requirements, the welds containing the following repairs are not acceptable.

- Cracks including crater cracks regardless of size or location are unacceptable.
- Any length of inadequate penetration (LP/IP) of the root bead as defined by API 1104 is not acceptable except root concavity is allowed as per API 1104.
- Any amount of incomplete fusion (LF) at the root of the joint as per API 1104 is not acceptable.
- Un-repaired burns through areas are not acceptable.

1.2.4.4. Destructive Tests

Impact test:

Specimens shall be prepared in accordance with ISO R 148 and ASTM A370. Three test specimens shall be taken from each sample (given below) and they shall be cut and prepared so that their length is transversal and perpendicular to the roller surface. Four type of samples are taken out.

a. At Weld Metal
b. At Fusion Line
c. 2 mm from Fusion Line
d. 5mm from Fusion Line

The test shall be carried out as per ISO R 148 "Beam impact test V – notch"

Test pieces shall be immersed in a thermostatic booth and maintained at the test temperature (0^{o}C) for at least 15 minutes.

Bend Testing: Bend test specimens shall be made and tested as per requirements of API 1104 (latest edition). Acceptance criteria for bend tests shall be in accordance with API 1104 (latest edition).

Additional Test Welds

Two specimens shall be taken from top and bottom of the weld for micro/macro examination. The specimens 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. Specimen shall be carefully examined under the microscope, with a magnification of at least 25:1. Owner may ask 5:1 magnification macrographs for records. However, test shall be carried out on the specimens used for macroscopic examination.

Same two specimens shall be used for hardness test. Vickers method with 10 kg.load indentations are to be made along transverse each approximately 1mm below the surface at both sides 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 traverse 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 transverse has to be made on parent metal. The indentations are to be made in the adjacent region as well as on the opposite side of the micro section along the specified transverse.

The test shall be carried out in accordance with recommendation ISO R81, Vickers hardness, using a diamond pyramid penetrator set at 2.37 rad (136°) with a load of 10 kg.

1.2.5 Qualification of Welding Procedure for Repairs

A separate welding procedure specification shall be qualified for the following two types of repairs:

i) Full through thickness repair

ii) Partial thickness repair

Procedure for weld repair shall be qualified as below

In addition to API 1104, including the special requirements of the specifications and shall also be subjected to radiography, visual inspection and destructive testing.

In addition to API 1104, following mechanical tests shall also be carried out:

i) Macro/Micro examination

ii) Hardness test and

iii) Impact Test

Acceptance criteria for the above tests shall be as per specifications mentioned above and following:

i) Single pass repair deposit shall not be allowed.

ii) Only one attempt at root portion shall be allowed. Repairs are limited to a maximum of 30% of circumferential weld length. For repairs, which open the weld root, only 20% of the weld length may be repaired. The

minimum length of a repaired area shall be 100mm as measured over the recapped length.

1.3. Welding of Pipeline Elements

1.3.1. Welding Conditions

Welding tent / houses or suitable protection shall be provided for the field welding.

1.3.2. Preparation of the welding work

1.3.2.4. Alignment

- The longitudinal welds shall be staggered in the top 90° of the pipeline except in case of sag and over bends and successive horizontal bends.
- The use of internal line-up clamp is recommended for pipeline welding. However, in some cases like tie-in welds, flanges, fittings, etc. where it is impossible to use internal clamps; an external line-up clamp may be used as per separate approved WPS.
- Every effort shall be made to reduce misalignment by the use of the clamp and rotation of the pipes to the best fit. However, suitable jacking and hammering as per approved procedure may be allowed to match both ends.
- The internal clamp shall not be released before the entire first pass has been completed. External clamp shall be released after at least 60% of the first pass shall be welded. Weld segments thus welded shall be equally spaced around the circumference of the pipe.
- The vertical up method of welding shall be used for the root pass of the tie-ins, special crossings, special parts, fillet welds, repairs and when an external line-up clamp is used.
- Root pass of butt joints shall be properly executed so as to achieve full penetration with complete fusion of the root edges. Weld penetration inside the pipe shall not exceed 2.5 mm wherever not specified by the applicable Codes.
- Normally, the time lapse between first and second pass shall not be more than 4 minutes and between second and third pass shall not be more than 5 minutes. However, time lapse shall be maintained as stated in the procedure specification.
- The number of Welders and the allowable welding sequence shall be as per stipulations laid down in the qualified welding procedure.
- Electrodes starting and finishing points shall be staggered from pass to pass.

INSPECTIONS AND TESTING OF PRODUCTION WELDS : 18422-CD-PL-SS-007

1. INSPECTION AND TESTING OF PRODUCTION WELDS

1.1. Generalities

The following specifications shall apply in conjunction with the following (all latest editions) codes and standards:

i) API 1104

ii) ASME B31.8

iii) ASTM E94

iv) ASTM E 142

v) ASNT, recommended practice no. SNT-TC-IA supplement A.

vi) ISO R 148

vii) ASTM A370

viii) ASME Sec. V

1.2. Testing Of Welded Joints and Acceptance Criteria

1.2.1. Non-destructive testing

1.2.1.1 Visual Inspection

No negative tolerance allowed on thickness.

1.2.1.2. Radiographic testing

All Radiographic films (100%) shall be submitted to Owner/Owner's Representative for
review and further acceptance.

Contractor has to submit procedure for repair of Arc ignition points to Owner for approval. After ground wall thickness of the pipe shall be within the tolerance specified in line pipe specifications.

Radiographic examination procedure to be demonstrated by Contractor and shall be submitted to Owner's Representative for approval. The procedure of radiographic examination to be followed as below:

- Lead foil intensifying screens, at the rear of the film shall be used for all exposures.
- Type 2 and 3 films as per ASTM E-94 shall be used.
- Densitometry shall be used to determine the film density. The transmitted film density shall be 1.8 to 3.5 throughout the weld. The unexposed base density of the film shall not exceed 0.3.
- All parameters recorded during procedure qualification like SFD/ (Source to Film Distance), exposure time, capacity of Radiography machine, type of film used, Image quality indicator, sensitivity and density achieved etc.
- The radiography procedure shall be established for different techniques (like, SWSI DWSI, DWDI, etc.).
- When a complete weld is radiographed in a single exposure using a source inside the pipe, four penetrameters approximately, equally spaced around the circumference shall be used. For radiographs made with the source on the outside, a penetrameter shall be placed on each side of the film with smaller one of the penetrameter tuned towards the end of the film itself.
- Radiographic examinations shall be carried out using X-radiations only. Radiographic examination by Gamma Ray may be allowed, at the discretion of the Owner's Representative in case of inaccessible joints.
- Whenever possible, pipeline welds shall be radiographed by panoramic exposure (360°) method. If it is impossible to place the radiation source

inside the pipe, the weld will be inspected with the source on the outside. An overlap of at least 40 mm at the ends of each film shall be required.

- The weld joints shall be re-radiographed in case of unsatisfactory quality of the radiography, at the expense of the Contractor.
- All the repaired joints shall be re-radiographed at no extra cost to the Owner. Repair welds shall be indicated with 'R' to indicate repair. Total repaired joints shall be radiographed to compare with original film in order to ensure the repair is correctly attended.
- The final disposition of all unacceptable welds shall be decided by the Owner's
  Representative.
- Contractor shall be responsible for the protection and personnel monitoring of every man with or near radiation sources. 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 Agency (ies) of India. All safety equipment, manpower, safety displays etc. shall be arranged by Contractor at his own cost.
- All pipeline radiographers shall be qualified in accordance with the requirements of API 1104 and to the satisfaction of Owner/Owner's Representative. All documentary proof related to qualification of all the radiographers shall be submitted to Owner/Owner's Representative for approval. The Contractor shall provide all the necessary facilities at site, such as a dark room with controlled temperature, film viewer etc. to enable the Owner to examine the radiographs.

1.2.1.3. Ultrasonic Testing

This clause is not relevant for this particular project

1.2.3 Destructive Tests

When laying a new pipeline the contractor shall cutout at least one production weld test
as per instructions of owner/ owner's representative to satisfaction of jobs, if required.

5 test specimens of impact test shall be carried out for production weld. One highest and onelowest energy value out of 5 test specimens to be discarded. Finally 3 test specimens of impact test shall be considered. In case of production weld failure, two (2) more additional joints has to be conducted for same days, same welders and same thickness for which production joint failed.

The destructive test must be carried out in accordance with section 5.6 of API 1104. All
tests will be carried out in laboratory approved by the Owner/Owner's PMC.

COATING : 18422-CD-PL-SS-009

1.1 General

1.1.1 Purpose of the coating

Maximum operating temperature to be considered is 60^0C.

All the girth weld joint coating material for buried pipeline section shall be of C-60 class as per EN 12068.

Application procedures must take into account the extreme weather condition i.e. high relative humidity, diurnal temperature above 40^0C.

Add DIN EN 10289 for Thermosetting Plastic coating in place of DIN 30673.

All coating material shall be DIN – DVGW certified.

1.1.2 Material to be coated

Line pipe shall be supplied with external coating as per clause 3.1 of present PTS.

External Coating shall be as per Standard DIN 30670 latest edition and relevant GTS/PTS.

The coating cut back for pipes is min. 110 mm [(+) 10 mm (-) 0 mm]

1.1.3 Obligation of the bidder

Add DIN EN 10289 for Thermoset Plastic coating in place of DIN 30673. EN 12068 for tape and heat shrinkable material

Functional Properties of Joint Coating System (As applied)

As applied field joint coating system shall comply with the requirements of DIN EN 12068 Table 1 & 2 corresponding to designation EN 12068 – C HT60 UV, except as modified below for Peel Strength:

Peel Strength	Test Temp.	Unit	Requirement (minimum)	Test Method
Outer to Inner	@ 23°C ± 2°C	N/mm	≥ 1.5	Annexure B of DIN 12068
	$@T_{max}$	N/mm	≥ 0.3	
To Pipe Surface	@ 23°C ± 2°C	N/mm	≥ 5.0	Annexure H of ISO 21809-3
	$@T_{max}$	N/mm	≥ 1.0	
To Factory Coating	@ 23°C ± 2°C	N/mm	≥ 5.0	
	$@T_{max}$	N/mm	≥ 1.0	
T_{max} shall be (+) 60 °C.				

1.1.5 Overview of the coating systems to be accepted by the Owner/Owner's Representative.

Polypropylene, bitumen (asphalt), 2 component- coal-tar epoxy and bituminous tapes reinforced with fibre glass are deleted.

Thermosetting plastic coating is included.

1.1.6 Definition of the type of coating according to application

Contractor shall provide with his Bid document a complete description of the

joint coating material (in line with the tender requirements), he intends to use for the entire work for Owner/Owner's Representative approval. In any case contractor must successfully demonstrate at least 10 Nos. joint coatings as per approved procedure, testing/quality control requirements. If the material proposed by Contractor is not approved by Owner/Owner's Representative, even after demonstration, then Contractor must revise the proposal and get Owner/Owner's Representative approval without any cost implication.

The coatings mentioned below are for undergrounds installations.

For HDD Joint Coating RAYCHEM/COVALANCE DIRAX or Denso shall be used. Directional drilling kit, multilayer sleeve system or equivalent to be approved by Owner/ Engineer.

Only coating material certified C-60 Class as per DIN 30675-1 and DVGW (heat shrinkable material) will be accepted for all material to be coated.

For the buried valve station (moulded piece, valves, elbows etc) Thermoset plastic coatings may be used. They will be of type S50 certified as per DIN 30671 & DIN 30677.

Underground bare valves if any will be coated with above material.

At the point of transition from the aboveground pipe to underground pipe special coating material FIBAROLL or equivalent to be used over the coated part of U.G. pipe and painted part of A.G. Pipe end overlapping shall be at least 500 mm inside the ground and 500 mm on painted AG line. Minimum thickness shall be 1.5 mm. The application of the material will be as per supplier's specification.

Wherever Thrust Boring (Jacking) method is carried out, for mechanical protection of coating of carrier pipe extra layer of hard cold applied tapes C-60 Class as per DIN 30675-1 or Solvent free PUR (1000 microns) as per DIN 30677/2 EP-50 types (also refer the requirements of GTS & present PTS) shall be applied. Surface preparation (sand blasting) of PE layer shall be appropriate as per applicator's recommendations. The type & thickness of coating must got approved by Owner/Owner's Representative prior to coating.

Field Joint Coating of 3LPE Coated Pipelines using Viscoelastic Corrosion Prevention Coating System

It shall be used to coat pipe joints wherever surface preparation with abrasive blasting is not possible in city limits. Minimum requirements for primer-less viscoelastic wrap coating materials to be used for the corrosion prevention of field joint coating of steel pipe network for city gas distribution network conforming to the requirements of ISO 21809 Part 3 and operating temperature 60°C. The field joint Coating system shall comprise of primer less viscoelastic tape for corrosion protection of power tool or hand brush cleaned steel girth weld surface followed by a Butyl Rubber based low pre-heat shrink sleeve for mechanical protection and sealing the overlap area of 3LPE Coating.

1.2 Preparation of the surfaces to be coated

Surface cleaning shall be as per SA 2½ (ISO 8502-3) for base items and will be achieved by shot or Copper Slag/sand blasting.
Minimum roughness range to be between 50 and 100 um

1.3 Identification of all Buried Joints

This clause is not relevant for this particular project.

1.5 Application of the Coating

1.5.1 Coating with plastic wrapping tape

1.5.1.1 Composition of the coating

Contractor shall provide methodology for application of coating only, to be approved by
Owner/Owner's Representative before commencement of coating.

Only approved heat shrinkable wraparound sleeve (Raychem/Covalence or Denso) material shall be acceptable. The material shall consist of radiation cross linked, thermally stabilized, ultra violet resistant, semi-rigid polyolefin dimpled backing with uniform thickness of high shear strength thermoplastic/copolymer, hot adhesive. Only material (HTLP 80 or equivalent) shall be acceptable.

Contractor to provide coating job procedure as per supplier application recommendation to be approved by Owner/Owner's Representative before starting coating work.

Only 3 layers system (with primer) will be accepted for the proposed joint coating system. The heat shrinkable sleeves will be of cross link polymer backing type.

The heat shrinkable sleeves should be suitable for application using gas torches. Heat shrinkable sleeves shall be applied over wet epoxy layer. The steel will be pre heated to 50°C prior to blasting to remove any moisture to prevent flash rusting. After blasting, the steel shall be preheated as per manufacturer's recommendation.

The total thickness of the coating shall not be less than the 3 LPE layers coating system applied for the line pipe as per DIN 30670 Standard. Min thickness for joint coating system shall be: 1.8 mm & 2.0 mm for dia. size 4" & 8" respectively. The min. thickness of the 1st layer (epoxy) should be compatible with the minimum roughness of the surface preparation." The minimum overlap with 3LPE Coating shall be 100 mm (50mm on either side).

For repair it would be as per manufacturer's recommendations, which have to be approved by Owner/Owner's Representative.

1.5.1.2 Applying the coating

Cold applied tape shall be used for coating purpose on irregular surfaces i.e. elbow &fittings etc. Holiday test shall be carried out at 25 KV.

1.6 Repairing of the Coating

1.6.1 Repairing PE Coating

1.6.1.2 Repairing PE coating with plastic repair patch

The repair material to be used for repair of 3LPE/ joint coating shall be certified to stress class C-80 as per EN 12068.

1.8 Quality Control of the Corrosion Protection

Owner reserves the right to remove and test one out of 50 joint coating or one joint
coating our of everyday's production whichever is stringent.

From each test piece, one or more stripes of size 25 mm x 200 mm shall be cut perpendicular to the pipe axis and slowly peels off.

Peel strength shall meet the code requirements and removal of strip the bulk of adhesive shall remain adhered to the pipe showing no bare metal, otherwise, test shall be considered fail.

The adhesive layer that remains on the pipe surface shall be free of voids resulting from air or gas inclusion.

If the sleeve taken away for test doesn't met the requirements of tender, the adjacent two sleeves shall also be removed and inspected. If the adjacent two sleeves are acceptable the test rate shall be increased to one sleeve per every twenty-five until Onwer's Representative is satisfied. If either or both of the adjacent two sleeves do not met the requirement of specifications, the field coating shall be stopped and further investigation shall be carried out.

Thickness shall be measured from 10 different locations on weld and body. The minimum thickness on weld shall be 1.8 mm & 2.0 mm for dia. size 4" & 8" respectively. Thickness shall be checked with calibrated coat / elchometre.

Coating thickness shall be checked by non-destructive methods for each field joint.

The entire surface of the joint section shall be inspected by means of a full circle holiday detector approved by Owner.

Inspection of the sleeves shall be conducted only after the joint has cooled below 50^0C.

1.8.1 Systematic Inspection

Specification of the test current for the inspection with the Holiday detector shall be 25 KV for all the coating thickness.

EARTHWORKS FOR LAYING PIPELINE : 18422-CD-PL-SS-010

1. EARTHWORKS

1.1. Excavation

1.1.2. Underground Obstacles

Replace the second last para as below:

"Unless otherwise stated in particular cross section drawings, the clear spacing between the gas pipeline and utilities will be between min 0.50 m at crossing point and min. 3.0m when the pipeline is running parallel to the utilities (OISD 141). Wherever it is possible the minimum distance must be

increased."

1.1.4. Trenches depth

1.1.4.1. Minimum depth

The trench shall be excavated to a minimum width so as to provide, on both sides of the installed pipeline, a clearance as indicated in the job standards/drawings and to a depth sufficient to provide the minimum cover as indicated below. The dimensions in the table below shall govern except as noted herein or as shown on the job standards or detailed construction drawings or as required by authorities having jurisdiction, whichever is greatest. Minimum depth of cover shall be measured from the top of pipe corrosion/concrete surface/casing of the pipe with respect to top of graded working strip or top of road or top of hill 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 Owner.

S. No	Location	Minimum Cover In Meters
1	Normal surface i.e. Road & Residential Areas	1.2
2	Minor Water Crossings/Canals	1.5
3	Drainage ditches at road	1.5
4	Rocky area	1.0
5	Uncased/Cased Road Crossings	1.5
6	Rail Road Crossings	3.5
7	Other Areas	1.2
8	Major Water Crossings / Canals	5 (below scour depth)
9	HDD/Micro-tunneling	2.5 (below scour depth)

Trenching to all depth in all types of soil including soft & hard rock etc. However, hard rock excavation to be paid as per separate SOR item. In any circumstances contractor is not entitled claim extra payments for excavation of increased depth due to site conditions
/ crossings / utilities and ground level differences etc. however in certain special cases with prior written approval of owner / owner's representative extra excavation may be
paid.

At points where the contour of the earth may require extra depth to fit the minimum radius of the bend as specified in the specification or to eliminate

unnecessary bending of the pipe according to customary good pipeline practice, or where a deep trench is required at the approaches to crossings of roadways, railroads, rivers, streams, drainage ditches, etc. Contractor shall excavate such additional depths without any cost/time implication.

A minimum separation of three meter should be maintained between the steel pipeline and footing of transmission tower.

In case of rivers/water bodies which are prone to scour and erosion, adequate safe cover (minimum 2.5 meter) shall be provided below the predicted scour profile expected during the lifetime of the pipeline.

The depth of cover shall be determined as per latest edition of OISD 141.

1.1.5. Trench Width

Typical sketches of cross sections for trench are enclosed under approved Job standards. This is indicative only. As per site conditions and instructions of Owner, trench width may have to be increased at no extra cost and time impact to the Owner.

1.1.8. Appearance of the Trench Bottom and Trench Walls

The trench shall be cut to a grade that will 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. Owner reserves the right to set the grade of the trench and locate 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. Owner desires to reduce to a minimum the required number of 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 Owner.

CONTRACTOR shall keep the trench in good condition until the pipe is laid, and no claim is to be made to the Owner by reason of its caving either before or after pipe is laid. All lumber, sheet-piling jacks or other materials that may be necessary to shore the trench, in order to prevent caving are to be furnished and removed by CONTRACTOR.

CONTRACTOR shall dewater, if necessary, using well point system or other suitable systems, shore or do what else might be required to excavate the trench, install the pipe in it and backfill the trench as per instruction of Owner's Representative.

CONTRACTOR shall excavate and maintain the pipeline trench on the staked centre line of the pipeline taking into account the curves of the pipeline. CONTRACTOR shall, by any method approved by Owner, dig the pipeline trench on the cleared and graded Right- of-Way. 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. 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 Way in order to guarantee soil stability.

1.1.9. Water Run-Off Drainage of the Trench and Work Pits

Wherever up-floating of the pipeline after backfilling shall be reckoned with, anti-buoyancy measures shall be provided by CONTRACTOR as may be encountered during construction as per instructions of Owner/Owner's Representative.

1.2. Backfilling the Trench

1.2.1. General

Backfilling shall be done after ensuring that pipe 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. Before backfilling, it shall be the responsibility of contractor to first get the approval of Owner/Owner's Representative. If any backfilling is done without Owner's approval, Owner 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.

Trench shall be back filled by 300 mm soft soil or sand from top of pipe first then by excavated material, if soft soil is not available in excavated material contractor has to arrange the same at no extra cost to IGL.

Backfilling shall be carried out immediately after the pipeline has been laid in the trench, inspected and approved by the Owner, thus avoiding long exposure of coating to high temperature, damaging actions of adverse weather conditions, sliding down of trench sides and pipe movement in the trench. If immediate back filling is not possible, a covering of at least 300mm 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 ROW be used for this purpose. In general, the trench shall be dry during the backfilling. Deviations thereof must have prior approval of the Owner. 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 to such a height which will, in Owner's opinion, provide adequately for future settlement of the trench backfill during the maintenance period and thereafter. 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 Owner. 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 Owner.

1.2.3. Working Method for Backfilling

The trench in irrigated and paddy fields shall be backfilled to within 300 mm of the top, then rammed and further backfilled until the trench is completely backfilled.

At the end of each day's work, backfilling shall not be more than 500 meters

behind the end of lowered-in pipe, which has been padded and approved for backfill. The backfill shall be maintained by CONTRACTOR against washouts etc., until the completion and final acceptance of the work by Owner/Owner's Representative.

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 backfill. The type of breakers installed shall be as per the drawings provided in specifications. Breakers shall be constructed of grout bags filled with a mixture of 4:1 (Sand: Portland cement) at Owner's direction. CONTRACTOR may propose other methods such as foam dams etc. which shall be subject to approval by Owner. Such works shall be at no extra cost to Owner. CONTRACTOR shall pay attention to the direction of backfilling in such steep areas.

Backfilling shall be laid immediately after obtaining approval from Owner's representative. It is not possible immediately at least a covering or 300 mm of earth, free of rock and hard lumps shall be placed over the pipe. For this purpose top soil (arable) shall not be used. Surplus material shall be neatly crowned directly over the trench as per instructions of Owner's Representative. Arable soil shall be replaced at its own position. Crown shall be high enough to prevent the formation of a depression in the soil when back fill has settled into its permanent position. Depression occurs after approval of backfill by Owner, Contractor shall be responsible for remedial work at no extra cost to Owner.

During execution of the road crossings or any other utility crossing the backfill material shall be thoroughly compacted by special compaction methods, such as moistening or ramming of the backfill in layers upto satisfaction of Owner/concerned authority. In these cases the surface of the backfill be gravelled with crushed rock or some other purchased materials and the road shall be reinstated at no extra cost to Owner.

1.2.3.3. Top Soil Layer (arable soil)

Protection of the arable soil and sub-soil.

In the cultivated land and other areas specifically designated by the Owner, top 300mm of the arable soil on the pipeline trench top with plus 500 mm on either side, shall be excavated and stored separately to be replaced in original position after backfilling and compacting rest of the trench as per instructions of Owner/Owner's Representative.

In the course 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.

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. Contractor fails to do so, Owner will give written notice to Contractor and if Contractor does not settle such claims within seven days after such notice, Owner shall have the authority to settle claims from the

account of Contractor.

1.2.4. Works during Backfilling

1.2.4.1. Reinforced Concrete Slabs as mechanical Protection for the Pipe

Concrete slabs shall be at utility crossings and overhead power lines as per job standards
enclosed in the tender, site conditions and instructions of Owner/Owner's Representative:

1.2.4.2. Warning Signs

1.2.4.2.1. Netting

This is not applicable for the present project.

1.2.4.2.2. Warning Tape

A warning tape made of 1.0 mm thick and 300 mm wide PE material shall be laid as per standard drawing.

LOWERING AND BALLASTING : 18422-CD-PL-SS-011

1. LOWERING –IN AND BALLASTING

1.1. Lowering-In

1.1.2. Conditions before Laying

Contractor shall submit pipe book upto Joint coating part to Owner's Representative. After certification of the pipe book only lowering in can be started. Prior to lowering in; a complete check by a full circle holiday detector for pipe coating and field joint coating in presence of Owner's Representative shall be carried out and all damages noted shall be repaired at Contractor's cost.

Before pipeline lowering & pipe string, Holiday test shall be carried out at 25 KV.

The pipeline shall be lifted and laid with all necessary suitable equipments of non- abrasive material having adequate width for the fragility of the coating.

The pipeline must be laid without interruption for the whole or the length of the section available. If water is present, no laying shall be carried out.

1.1.3. Precautions to be taken during lowering-in

A comprehensive report/method statement on the laying operation to be used shall be submitted to the Owner for approval. The report shall include, but not limited to the following:

i) Method of installation by lifting.

ii) Pulling method and related calculation wherever lifting method cannot be used.

iii) Pulling device and its characteristics.

iv) Characteristics of the pulling rope.

v) Braking device, if any.

TESTING, CLEANING AND DRYING : 18422-CD-PL-SS-014

1. TESTING, CLEANING AND DRYNG

1.1. General

Preamble

The pre-commissioning activities shall include all activities which are not under commissioning scope. It will include mechanical resistance test, tightness/ leak test, cleaning including Swabbing, drying activity and the final acceptance dossier and all related activities. The pre-drying includes runs of high density foam pigs till water content is acceptable by Owner/ Engineer.

The commissioning activities which concern complete pipeline system shall include the final drying, filling the nitrogen and commissioning with gas and all related activities. The nitrogen and all material for commissioning activity will be supplied by contractor. The drawing up of the Emergency Management Plan and safety measures, the testing of Golden Tie-in welds at Gas MOP (maximum operating pressure) the Gas-in activities and the final acceptance record shall be carried out by the contractor.

For Pre-commissioning and Commissioning:

Contractor shall identify and arrange for supply of manpower, spares, tools, tackles and consumables as required for pre-commissioning and commissioning activities.

The Contractor shall draw up the complete pre-commissioning and commissioning methodology in sequential order including equipment material, manpower to deploy, safety measures etc. methodology. Criteria of acceptance, final report etc. shall be drawn up as per International Code like AS/NZS 2285.5 latest edition or other recognized International code, and good engineering practice. Only approved by Owner/Owner's Representative, methodology will be implemented.

Contractor shall follow the safety practices during execution of pre-commissioning and commissioning works as detailed in the scope of work. 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. The rate for pre- commissioning & commissioning are included in SOR.

Filling of nitrogen for gas-in:

The nitrogen shall be injected in the pipeline before filling the pipeline with gas (gas-in) to prevent direct mixing of gas with air.

Nitrogen needed for Inertisation of the pipeline shall be provided by the contractor. The maximum allowable Oxygen content inside the pipeline shall be less than 1% by volume.

After completion of an entire pipeline system, the Contractor must proceed with final drying and commissioning with Gas filling activity as per approved methodology. If deemed necessary by Owner/ engineer shall be kept idle under 1barg of nitrogen as per approved methodology before gas in operation. Supply & Filling of nitrogen will be covered under item for SOR.

The pipeline will be tested, cleaned and dried, section after section.

In any case contractor shall draw up the entire job procedure to be approved by the
Owner/Owner's Representative before commencing any commissioning activity.

The connection with the pipeline (golden tie-in welds) will be made only after completion of the testing, cleaning and drying of the pipeline. The Contractor must submit his job procedure for Owner/Owner's Representative's approval.

The pipeline to be constructed has to meet the requirements of statutory bodies such as Chief Controller of Explosives (CCOE) / local concerned authority / Railways / Road department / River and Canal authorities etc.

Testing shall be performed on the entire length of the pipeline. Test shall be performed in accordance with approved Test Diagrams for each test section. The Contractor to detail the sections for testing and get approval from Owner/Owner's Representative.

Test shall commence only after mechanical and civil works completion, i.e., all welds have been accepted and the pipeline has been laid and backfilled according to the specifications. Contractor shall perform all works required for testing after obtaining prior written approval from the Owner.

Reference Codes, Standards and Specifications

Reference has been made in this specification to the latest edition/revision of the following codes, standards and specifications.

a) ANSI B 31.8 Gas Transmission and Distribution Piping systems.

b) API RP 1110 Pressure Testing of Liquid Petroleum Pipelines.

c) ASME Sec. VIII Div. 1 Boiler & Pressure Vessels Code.

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

I. Contractor shall submit for Owner's approval a test procedure. The procedure shall strictly comply with the requirements of this specification and shall be submitted to Owner for approval well in advance. The procedure manual shall include all temporary materials and equipment, but not be limited to the following items:

a) Cleaning of pipeline : Before starting the pigging activity, initial weight of the pig shall be measured at the Launching Station and after receiving the pig at the Receiving Station, the final weight of the pig shall also be measured. The difference between the initial and final weights of the Pig shall not exceed more than 20% of the initial weight of the pig.

b) Pre-Test Water Pressure and Final Hydrostatic Water Test Pressure shall be done at
1.4 times of design pressure.

c) A diagram indicating all fittings, vents, valves, test headers, temporary connections, relevant elevations and ratings. The diagram shall also indicate injection location and intake and discharge lines.

d) Cleaning, gauging, filling and flushing procedures, including a complete description of all proposed equipment and instruments (including spares), their location and set-up.

e) Estimated amount of test water, water sources, results of test sample, including required concentration of corrosion inhibitors and additives, procedure for inhibitor injection and control of concentration.

f) Air cleaning must be done by oil free compressors only.

g) P-V Graph shall be used for calculating air volume for air cleaning

h) 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.

i) 24 hours strength test and tightness test shall be carried out.

j) Procedures for leveling and stabilization after filling and for pressurization and to allow for temperature stabilization.

k) Procedure for detection and location of leaks.

l) Procedure for 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 along with the pig specifications.

m) Forms for recording the test data.

1.3. Mechanical Resistance Test

1.3.2. Hydraulic Resistance Test

Duration of test shall be minimum 24 hours after stabilization and the test pressure shall be as indicated in the specification.

Equipment and Instrumentation

The Contractor shall furnish all necessary equipment for performing the work as stated in cleaning, flushing, filling, leveling, stabilizing, testing and dewatering procedures.

This shall include, but not be limited to, the following equipment and instruments:

1) Pigs for filling:

- Cleaning pigs with foam.

The Contractor shall provide a sufficient number of pigs, including spares.

2) 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 200 m3/h Maximum 400 m3/h

If a single pump is used, a standby unit must be available.

3) Variable speed positive displacement pumps equipped with a stroke counter to pressurize the line with a known stroke and capable of exceeding the maximum test pressure by at least 20 bar.

4) Two positive displacement meters to measure the volume of water used for filling the line. These meters shall be provided with a calibration certificate not older than one month.

5) Pressure gauges of suitable pressure range (1.5 x pressure to be measured) and accuracy.

6) Pressure recording charts range shall be 1.5 x pressure to be measured.

7) Dead weight testers with an accuracy of ± 0.05 % of actual ratings with a calibration certificate not older than one month.

8) Two temperature recorders for fill water.

9) Thermocouples for measuring the pipe wall temperature.

10) Two laboratory thermometers 0°C to 60°C range, accuracy ± 0.5 degrees of graduation to be used in thermowells.

11) Water tanks during water filling.

12) Portable tanks of sufficient size to provide a continuous supply of water to the pump during pressurizing.

13) Means to measure the volume of water necessary to drop the line pressure by 0.5 bar (container on scales or graduated cylinder).

14) Injection facilities to inject additive for anti-corrosion into the test medium in the required proportions.

15) The temporary scraper traps shall be installed according to the testing sections fixed in the test procedure manual. Proper piping and valves arrangements shall be available to allow launching and receiving of each pig independently.

16) Communication equipment suitable for a continuous connection between the beginning and the end of the test section and with the inspection team along the line, in accordance with the requirements of Local Authorities.

17) Thermocouples for measuring the temperature of the pipe wall shall be installed on the pipeline to be tested:

- 1 thermocouple at about 250m distance from the pumping head.
- 1 thermocouple every 500 m of the pipe.
- 1 thermocouple at about 250 m distance from the terminal head.

In addition to above, Owner's Representative may demand to install more thermocouples
as per site conditions.

Thermocouples shall be attached on the external surface of the pipe after removal of external coating and shall be adequately protected and Owner's coating instruction shall be followed.

Procedures

If the difference of minimum and maximum atmospheric temperature should cause thermal instability on the pipe section directly exposed to atmospheric condition, the temporary scraper traps and above ground pipeline shall be properly protected.

The test medium shall be tested to confirm soft non-aggressive water. 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 Contractor shall furnish and install all temporary piping which may be necessary to connect from source of water to its pumps and manifolds/tankages.

Before filling operation the Contractor shall clean the pipeline by air driven pigs to remove all mill scale rust/sand from the internal of pipe sections. The finishing touch shall be executed with pigs provided with air jet holes or nozzles to keep the internal dust in turbulence ahead of the pigs. The number of pig runs is depending upon the cleaning results and shall be determined by the Owner at site.

Thermal Stabilization

After a check has been made to confirm if the pressure has attained at least 1 bar (g) on the highest section, the thermal stabilization can be started.

Thermal equilibrium between the pipeline and environment shall be checked through the thermocouples installed on the pipeline.

Temperature readings shall be made at 1 hours-intervals. Thermal stabilization shall be considered to have been achieved when a difference not higher than $1^{o}C$ is attained between the average values of the last two readings. Thermal stabilization completion shall be approved by Owner's Representative.

The pressurization rate shall not be more than 2 bar/min.. Pressure shall be recorded in dead weight tester and confirmation can be done with pressure gauge on the same header. Volume shall also be recorded with respect to pressure.

- Each 5 bar increments up to 80% of test pressure as recorded by the dead weight tester;
- Each 2 bar increment between 80% to 90% of the test pressure full test pressure as recorded by the dead weight tester.

Air Volume Ratio shall be calculated as per following:-

i) Pressurize to 50% of test pressure, hold pressure for 1 hour, collect water for air volume calculations.

ii) Drop pressure to static head of test section at test head.

iii) Pressurize 75% of test pressure, hold pressure for 1 hour, collect water for air volume calculation.

iv) Drop pressure to static head of test section at the test head.

v) Pressurize to test pressure.

During the pressurization to each test pressure, two tests shall be carried out for the calculation of air volume in the pipeline under test.

Air volume Calculation

In order to check the presence of air in the pipeline, two separate consecutive pressure lowerings of 0.5 bar shall be carried out.

For calculation of air in the pipeline the second pressure lowering shall be used, and the relevant drained water shall be accurately measured (V1). This amount measured shall be compared to the theoretical amount (V2) corresponding to the pressure lowering that has been carried out, by using the procedure outlined in the specification.

If no air is present in the length under test: V1/V2 = 1

In order that the above ratio is acceptable, it shall not differ from 1 by more than 6% (i.e. 1.06).

If ratio is within limits, pressurization can continue. If not, water refilling shall be carried out by passing of another pig.

Testing

After the section has been pressurized and the air volume test has given acceptable results the test pressure shall be held for a minimum of 24 hours after stabilization. After temperature and pressure has stabilized, the injection pump shall be disconnected and all connections at the test heads shall be checked for leakage. The pressure recorders shall then be started with the charts in a real time orientation for continuous recording throughout the test.

During testing all ball valves in position shall be in partially OPEN condition.

During the testing period the following measurements shall be recorded/reported:

- Every one hour pressure measurements from dead weight testers.
- Every two hours the ambient temperature and the pipe temperature at the thermocouples.

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.

1.8. Acceptance

The hydrostatic test shall be considered as positive if pressure has kept a constant value throughout the test duration, except for change due to temperature effects. Such changes shall be evaluated as described below.

The pressure change value as a function of temperature change shall be algebraically added to the pressure value as read on the meters. The 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.

If test section doesn't meet the above requirement, Contractor shall determine by search the location of leakage or failure. All leaks and failures within the pipe wall or weld seam shall be repaired by replacement of entire 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 Owner. Contractor shall comply with instructions of the Owner's Representative whether to replace a section of the line pipe that includes the line leak or whether to repair the circumferential weld. The repair shall be carried out as per specifications. Where failures occur in pipeline field bends, bends shall be replaced with same degree of bends. After completion of repairs, the hydrostatic test shall be repeated in full, as per this specification.

The cost of repairs or replacements, followed by refilling and repressurizing the line, due to poor workmanship, shall be borne by the Contractor. In the event of leaks or failures resulting from faulty Owner furnished materials as per Schedule of Rates (SOR). Contractor shall be entitled for time extension as per the provisions of the Contract.

Termination

After the positive results of testing and all the data have been gathered, the test shall be terminated upon written approval given by Owner.

The pipeline shall be slowly depressurized at a moderate and constant rate as instructed by Owner.

Details of the instruments:

Water Amount Measurement

The water volume added to the section to be tested shall be measured during the filling stage through a positive displacement meter (a turbine meter may also be used).

In the calculation, use shall be made of the geometrical volume of the section in question. The water amount that has been let into the section shall be measured during the pressurization stages through positive displacement meters or turbine meters.

Pressure Measurement

Pressure shall be measured with a dead weight tester. Pressure recorder and gauge shall be installed on line.

Pressure instrument shall have the following accuracy:

Accuracy : ± 1% of the full-scale value for analysis gauge.

The recording pressure gauge shall be checked by means of dead weight test at the beginning, during and at the end of the hydrostatic test.

The thermocouples sensitivity shall enable temperature readings with accuracy of ± 0.2°C.

Thermocouples/Readout units shall be calibrated with thermometer which should have NPL calibration certificate.

The recording thermometer shall feature the following characteristics:

Accuracy : ± 1% of the scale range

Scale : - 10° to + 40°C

Environmental temperature shall be recorded by thermometer which shall

have: Accuracy : ± 1% of the scale range

Scale : 0° to + 60°C Calculations

The theoretical water amount that is necessary for filling the section to be tested shall be obtained from the geometrical volume of the section considering the pipe tolerances.

The theoretical water amount that is necessary for pressurizing the section shall be calculated by means of the following formula:

$V_p = (0.884\ r_i / t + A) \times 10^{-6} \times V_t \times \Delta P \times K$

Where:

V_p = computed water amount required to raise by P the pressure in the section to be tested (m3).

V_t = geometrical volume of the section (m3).

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}) x 10^6.

(Refer water compressibility factor vs. pressure and temperature chart).

K = a dimensionless coefficient that is equal to a value of 1.02 for longitudinally welded pipe.

The pressure change due to a water temperature change shall be calculated through the following formula:

$$\Delta P = \frac{B \Delta T}{0.884 * \frac{r_i}{t} + A}$$

Where,

Δ P = Pressure change resulting from a temperature change (bar).

Δ T = Algebrical difference between water temperature at the beginning of the test and water temperature as measured at the end of the test (°C).

B = Value of the difference between the thermal expansion of water at the pressure and temperature as measured at the end of the test and that of steel (°C-1) x 10^6.

(Refer Table in Annex G)

A = Isothermal compressibility value of water as estimated at the pressure and temperature values obtained at the end of test (bar-1) x 10^6 (Refer Figure in Annex G).

r_i = nominal inner radius of the pipe (mm)

t = nominal pipe thickness (mm).

SITE RESTORATION AND MARKING OUT : 18422-CD-PL-SS-015

1.4. Aerial Beacons

Not Applicable for this Project.

1.5. Marking Out of the Pipeline

Reference Codes

Reference has been made in this specification to the latest revision of the following code:

API RP 1109: Recommended Practice for Marking Liquid Petroleum Pipeline Facilities.

The pipeline markers shall be fabricated and installed in accordance with the standard drawings included herein. Permanent marker & warning sign shall be powder coated type. Before starts of fabrication of the markers, Contractor shall prepare and submit for Owner's approval the detailed scheme for the marker plates as applicable for the project.

1.5.1 Concrete Marker Posts Route Marker

Route Marker shall be constructed as per enclosed standard drawing in tender. Route Marker will be installed at every 50m interval and as directed by the Owner/Owner's Representative.

1.5.2 Cast iron marker tiles Pipeline Warning Sign

Pipeline Warning Sign shall in general be installed at:-

- National and State Highway crossings (2 Nos.)
- Other Road crossings (2 Nos.)
- Minor Water crossings (2 Nos.)
- Major Water crossings (2 Nos.)
- Any at any other locations as shown in the approved drawings and as directed by the Owner/Owner's Representative.

Pipeline Warning Sign shall identify the existence of the pipeline and display the name of the Owner/Owner's Representation, with an emergency telephone number, as show in Standard Drawing and directions of Owner/Owner's Representative.

Painting and Coloring:

- For underground Steel Structure (except that embedded in concrete) coal tar epoxy of min. 300 micron thickness shall be applied.
- For over ground steel structure one coat of primer and two coats of specified yellow paint.
- Letters, except Warning (which shall be in red) shall be painted in black.
- Colour scheme for company monogram shall be as directed by company.
- Posts shall be painted with golden yellow colour. Owner name plate shall face the crossing.

Location of the Warning Markers shall be decided by the Owner at site. The foundation shall be made of concrete M20.

The dimensions of the post may be varied to suit field requirements.

PARTICULAR CONSTRUCTIONAL TECHNIQUES : 18422-CD-PL-SS-016

1. PARTICULAR CONSTRUCTION TECHNIQUES

Contractor shall take a note that any crossing, which is neither identified in the crossing list nor appearing in the alignment sheet; however made known to the contractor during detailed route survey or during pipeline construction, shall be executed by him at no additional cost to owner. Such additional crossing may include any unidentified UG utilities or any new facility (road/canal) constructed after the preliminary survey by owner. Contractor

based on his detailed design/engineering shall submit the proposed methodology for owner/owner's representative approval and also carry out necessary liaison/follow-up for obtaining the permission of concerned authority.

1.1. General

Method of execution of crossing (open cut, boring etc.) shall be submitted by Contractor for approval to Owner/concerned authority. Contractor shall carry out works as per approved method/instructions of concerned authority/Owner at no extra cost and time to Owner.

1.2. Trenchless Crossings

1.2.1. Boring

1.2.1.1. Geo-technical Survey Report

Contractor shall carry out the soil survey in different depths for relevant Crossings, If required and submit to Owner for their approval.

1.2.1.2. Working pits and shoring works

Location of the Anti-buoyancy measures to be considered (continuous concrete coating), if required. However, contractor has to submit to Owner detailed survey indicating locations where anti buoyancy measure to be taken with calculations for approval. Contractor shall qualify procedure for design mix of concrete coating proposed to be used.

1.2.1.3 Casings

The casing element to be supplied & installed by the contractor as

mentioned below, Casing pipe diameter shall be minimum two pipe sizes

bigger than carrier pipe. Casing
pipe size of 24"/16"/12"/8" shall be supplied by the contractor.

Casing Insulators and End Seal.

1.2.4. Horizontal Directional Drillings

1.3.1.1. Materials

Refer clause no. 1.2.1.3

PAINT WORK : 18422-CD-PL-SS-018

1.1 General :

The paintwork system has to be taken as a strict guideline. Contractor may propose
equivalent or better paint product for Owner/Engineer's approval.

Underground piping shall be painted/coated as illustrated in Coating (No. 18422-CD-PL- SS-009) of Present PTS. Contractor shall obtain approval from Owner/Engineer before commencement of painting/coating.

For station work (mechanical) all above ground pipes, valves, accessories, supports, etc. will be painted strictly in compliance with approved paint system.

The recommended painting system should be of Category C5 – I Very high (Industrial) as specified in the Standard ISO 12944 Part 1 to 8. The proposed Painting system shall conform to Table A 5 of ISO 12944 – 5 Standard.

The colour codes for final layer of Station Pipe Work & Metering Shed shall be as under:

S. No.	DESCRIPTION	FINAL LAYER COLOUR SHADE	RAL CODE
1	Pipe Work	Yellow	RAL 1004
2	Piping Support	Grey	RAL 7043
3	Hand Rail	Grey	RAL 7043
4	Gas O/L Actuator	Blue	RAL 5015
5	Valve Handle/Wheel	Black	RAL 9005
6	All Valves	Grey	RAL 7038
7	IJ	Grey	RAL 7038
8	Filter	Grey	RAL 7038
10	Bolts & Nuts	Grey	RAL 7038
11	Grating	Hot Galvanized	
12	Metering Station Shed		
12.1	Steel Frame	Beige	RAL 1018
12.2	Roof / Vertical Shed	Grey	RAL 7030
12.3	Control Panel	Grey	RAL 7032

1.1.1.1 Products chosen by the Owner:

The paint system proposed under clause 1.8 has to be taken as information

only. Only approved by Owner/Engineer, paint system will be applicable.

Contractor must propose a system of coating equivalent or better in quality for Owner/Engineer approval.

List of recommended Manufacturers

1. Asian Paints (I) Ltd.

2. Berger Paints Ltd.
3. Goodlass Nerolac Paints Ltd.
4. Shalimar Paints Ltd.
5. Coromandel Paints & chemicals Ltd.
6. Bombay Paints Ltd.
   and others subject to approval of Owner/Engineer.

ΣΣΣ

INDRAPRASTHA GAS LTD.

LAYING & CONSTRUCTION OF U/G STEEL PIPELINE NETWORK & ASSOCIATED WORKS FOR CONNECTIVITY OF CNG STATION AT CONCOR CONTAINER DEPOT DADRI, GAUTAM BUDDHA NAGAR

PTS – HORIZONTAL DIRECTIONAL DRILLING

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1.0 DEFINITIONS AND INTERPRETATION

1.1 Particular Technical Specification (PTS) shall be read in conjunction with the General Conditions of Contract (GCC), Special Conditions of Contract(SCC), General Technical Specifications (GTS) of work, drawings, Schedule of rates(SOR), Instruction to Bidders (ITB) and other documents forming part of the tender wherever the context so requires.

1.2 Where any portion of the GTS is repugnant or variance with any provisions of the PTS, unless a different intention appears, the provision(s) of PTS shall be deemed to govern the provision(s) of GTS of contract. If there is no variance or repugnance between GTS and PTS, both clauses shall be applicable.

1.3 In case of conflict between the requirements of this specification and that of the referred codes, standards and specifications, the requirements of this specification shall govern.

1.4 Definition of Terms
The terms used in the technical document must be understood as follows:

"Additional Works"	: Works that are not part of the Agreement but that appear to be necessary during the execution of the Agreement. These works can only be executed at the demand of the Owner.
"Approval"	: Means written approval.
"Construction Site/Building Site"	: The area where the works are to be undertaken by the Contractor in accordance with the Agreement.
"Contractor"	: The natural person or legal entity with whom the Owner has concluded the Agreement.
"Days"	: They are the number of days stipulated in the Agreement. They are calendar days and not workdays, unless explicitly specified otherwise.
"Defective Joint"	: Each weld that has been declared unacceptable by the Owner/ Owner's representative and has to be repaired by welding.
"Equipment"	: Means all apparatus, tools and machineries of any kind whatsoever that are necessary for the construction, execution and maintenance of the Works specified in the Agreement.
"Goods and/or Services"	: Depending on the specific case, all or part of the Construction materials, equipment, constructions, appliances, tools, machines,

	works, etc. that are to be built, assembled, adapted or brought into operation by the Contractor pursuant to the Agreement, including all studies, performances, works and services specified within the Agreement. The terms Goods or Services can be used interchangeably according to the context.
"HDD"	:Horizontal Directional Drilling
"Line Work"	: Is the delivery and execution of all Works for the construction of pipelines that do not form part of a Special Point or CNC/DRS that are executed in accordance with normal accepted laying methods.
"Material"	: Means the materials or any other supplies that are intended to be part of or integral to the Works.
"Owner"	: Is the principal requesting the works to which the Agreement relates, i.e. INDRAPRASTHA GAS LTD (IGL), New Delhi.
"Owner's Representative/ CONSULTANT"	: Shall mean Owner's CONSULTANT.
"Over-Depth"	: Is the difference between the actual depth of the upper generatrix of the pipeline or installation upon laying and the planned minimum depth as stipulated in the Agreement, if this difference is greater than 50 cm.
TPIA	: Third Part Inspection Agency (IGL's Approved TPIA).
"Works"	: Are either the executions or having executed together with the design of works that complies with the requirements specified by the Owner. The work is the result of all the construction activities intended to have an economic or a technical function as such.
NA	:Not Applicable
LS	: Lump-sum
Mechanical Completion (MC)	: Shall mean completion of all pre-commissioning activities and associated requirements. It also includes completion of all

work related to CP and civil activities deemed necessary for completion of pre-commissioning.

Pre-Commissioning	: It includes mechanical resistance test, tightness/leak test, cleaning including magnetic cleaning, GED survey, dewatering, swabbing, pre-drying activity, Golden Tie-ins connecting the stations and final acceptance dossier (As built document) and all other related activities. It also includes completion of all works related to CP and civil activities.
Commissioning	:It includes final drying, filling the Nitrogen (if required) and commissioning with gas, testing of golden tie-ins welds at Gas MOP, gas-in activity and final acceptance dossier. It also includes all works related to CP and civil activities.
Engineer	: designate the individual or legal entity to which the Owner has entrusted various tasks in relations with the carrying-out of his project.
Lump Sum	: is an overall fixed price that considers all foreseeable visible and latent obstacles, even if not reported by the Owner, whereby the Contractor will act as a responsible professional in accordance with the codes of good practice, including but not restricted to domestic connections for gas, water, effluent, electricity and telephone, street drainage points, anchor walls, etc.
Unit Price	: is the Fixed Price per unit

2.0 PROJECT DESCRIPTION

Indraprastha Gas limited (IGL) (hereinafter referred as Owner), is supplying Piped Natural Gas (PNG) to domestic, commercial and Industrial consumers and Compressed Natural Gas (CNG) to automobiles in U.P, Haryana, Rajasthan, NCT of Delhi & NCR. IGL intends to lay the pipeline for connectivity of CNG Station in Gautam Buddha Nagar UP.

The present work envisages Construction of pipe line through HDD method across major crossings which come in light at the time of laying and all other related works in conjunction with SOR, scope of work, GTS, drawings/documents etc required to complete the project in stipulated time frame.

3.0 PROJECT GENERAL

PREAMBLE:-

While analysing the cost of the SOR (as per tender documents), the Contractor should take into consideration the following:-

The width, depth, nature of crossings/obstacles may differ from the one reported on alignment sheet and/or crossing drawings.

Based on the above, the Contractor shall determine the exact number, characteristics, depth, width, nature of crossing/obstacles, etc. based on site visit or any other evidences or materials he may have.

At time of formulating his bid, the Contractor should take into account all such variations and must include it in the relevant price schedule. He will not be entitled for any compensation or raise extra cost for discrepancies between what has been reported in PTS.

3.1 Work Description

Pipeline to be laid through HDD method for crossings as instructed by owner / owner's representative.

All major crossings which come in light at the time of laying.

4.0 SURVEY OF CROSSINGS

4.1 CONTRACTOR as may be necessary for the execution of the work shall carry out survey of crossings, topographical/bathymetric, hydrological surveys, and any geotechnical investigations at his own cost.

4.2 OWNER does not assume any responsibility with regard to the correctness of the data furnished in the Bid Document. It shall be the responsibility of the CONTRACTOR to verify/establish the correctness and utility of this data to the extent required by him.

5.0 DESIGN AND OPERATING CONDITIONS

The Design and Operating conditions for the Pipeline crossings are as below:

Maximum Operation Pressure	:	39 Barg
Design Temperature	:	600C (Max.)
		0^0C (Min)

6.0 RIGHT OF USE (ROU)

6.1 The ROU will be arranged by the contractor. Contractor shall carry out all necessary survey work as per requirements of site conditions. It will be the responsibility of the Contractor to maintain the ROU until completion of the work

6.2 In case of encroachment on the ROU or extra land needed during construction, it will be the sole responsibility of the Contractor to relocate all issues (including any compensation) with the relevant land Owner, tenant or authorities. All related cost will be borne by the Contractor.

7.0 STATUTORY PERMISSIONS

7.1 Owner will provide necessary support in arranging general permission from the

authorities for construction of the pipeline. Contractor shall obtain the necessary day-to-day permits for all works from the authorities having jurisdiction before the actual execution of the various phases of the works and all stipulations/conditions/recommendations of the said authorities shall be strictly complied with at no extra cost to Owner. Contractor shall also obtain all necessary permissions from the concerned authorities for installation of pipeline at railways, roads and water crossings. Owner may, however, assist Contractor for obtaining such permissions, wherever required, by issuing recommendation letters, etc.

8.0 PRIORITIES

8.1 Owner may, at its sole option, assign priority of construction to any section or to any part/segment of the WORK. Contractor shall comply with such priority of execution without any time and cost implication to the Owner.

9.0 PROTECTION OF UNDERGOUND 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. The CONTRACTOR shall fully co-ordinate with all local and related statutory bodies for clearances and permissions.

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.

The CONTRACTOR, at his own cost shall design and provide any temporary supports such as under pinning or any other type and other protective devices as necessary to keep the interfering structure intact.

In case, should any damage to any structure/utility etc. occur despite all precautions, 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 OWNER and the concerned Owner/Authority. If CONTRACTOR fails to repair in reasonable time, Owner reserves the right to have the repair executed at the cost of the CONTRACTOR.

In case the pipeline crosses other utilities, viz., other pipelines, sewers, drain pipes, water mains, telephone conduits and other underground structures, the pipeline shall be installed with at least 50 cm free clearance from the obstacle or as specified in the drawings or such greater minimum distances as may be required by authorities having jurisdiction. Also, in all cases, the minimum covers specified above shall be maintained.

Whenever any utility/facility, etc. is encountered within the length of the pipeline to be installed by drilling, such utility/facility crossing shall be executed as part of the HDD crossing works at no extra cost/time to OWNER.

10.0 OWNER'S OBLIGATION

O General permission from authorities for laying of pipeline through HDD method.

11.0 OBLIGATIONS OF CONTRACTOR

Prior to quoting prices, Bidder shall be deemed to have satisfied himself regarding the feasibility of the method of construction for crossings. Any problems encountered at the time of construction due to any reason whatsoever shall be to CONTRACTOR's account, and CONTRACTOR shall not be entitled for any compensation or extension of time for this reason.

CONTRACTOR shall be paid as per the schedule of rates set forth in the bid document for completed crossing only.

12.0 FREE ISSUE SUPPLY BY OWNER

OWNER will supply only those materials which are specified in Cl. 3.1 of PTS – Construction Gas Pipeline to Contractor as free Issue except for line pipe Unloading, Receipt, handling, storage, erection and Commissioning of such 'Free Issue' material are in the Contractor's Scope of Work. Contactor shall be responsible for any demurrage payable to the transporters for any delay in unloading and any damage during storage and handling.

13.0 INSURANCE

As per GCC and SCC of Commercial Volume - IA

Unless specifically excluded in the Bidding Documents all insurance cover required during the construction, pre-commissioning and testing period shall be on account of the Bidder. The insurance shall cover all material in transit for construction, all work in progress, and completion of project, third-party liability, workmen compensation, and all statutory insurance covers. The Owner shall be the beneficiary of insurance Policies and nominated as Loss Payee.

14.0 PROJECT COMPLETION SCHEDULE

The Contractor shall ensure that the entire work shall be completed within a period that is specified in commercial volume II of II or purchaser's order letter of Intent, unless such schedule has been revised in accordance with the provisions of the Contract. In addition to this, contractor shall close out the project as defined below:-

The Contractor shall submit a detailed Project Plan within the time-frame specified in the Letter of Intent.

15.0 DISCLAIMER

As such it is an item rate contract, but the length of the pipeline / quantities of various items mentioned in the RFP are indicative only. Contractor / Bidder has to verify and confirm the same on its own based on RFP specification, Drawing, sheets and actual site conditions. No extra claim with regard to quantity variation to any extent in pipe laying shall be entertained by Owner. Only civil works quantities shall be paid as per actual basis of SOR, but no extra claim with regard to quantity variation to any extent shall be entertained by Owner. For station works, the indicative quantity shall be given. These must be verified and confirmed before quoting.

16.0 SCOPE OF SERVICES OF THE PMC

IGL has appointed different PMC agnecies, as the Project Management Consultant

(PMC). The PMC shall be responsible for the following:

- Basic Engineering
- RFP preparations
- PMC Services
- Construction supervision

17.0 EXECUTION

17.1 Minimum pipeline cover outside the river bed within the river limits shall be minimum 1.5 Mt.

17.2 OWNER has established the minimum scour depth profile for the river crossings, and the same is indicated in the reference drawings included in the bid package. Cover to top of pipe and cable conduit shall be minimum 5 meters below the scour profile at any point within the limits of the river crossings.

BIDDER shall note that to achieve this minimum requirement of cover, CONTRACTOR may have to actually install the pipe and cable conduit by drilling at greater depths at some locations below the river bed and banks. CONTRACTOR shall be deemed to have taken cognizance of such deeper drilling as may be necessary while formulating his bid, and no extra compensation shall be admissible on this account.

17.3 Depending upon width of crossing, minimum requirements of cover, and limitations of CONTRACTOR's equipment, CONTRACTOR may have to actually drill a larger length of pipeline for the crossings than shown in the Reference Drawings. CONTRACTOR shall be deemed to have taken cognisance of all such additional drilling lengths as may be necessary while formulating his bid and the lump sum price quoted by him for crossings shall remain valid irrespective of the actual length of pipeline installed.

17.4 CONTRACTOR shall ensure that his construction activities shall not cause inconvenience to public nor shall there be any undue interference with the normal use of the land and watercourses. Minimum necessary trees on the ROU to be felled shall be identified, recorded and records handed over to OWNER. No additional trees shall be allowed to be cut by CONTRACTOR or his sub-contractors for whom CONTRACTOR shall be solely responsible.

17.5 CONTRACTOR shall make all arrangements for access to his work site at his own cost and responsibility.

17.6 For crossing, the entire drilled crossing shall be accomplished in a single drilling operation.

18.0 BENDING

18.1 After pulling the pipeline across the drilled crossing, CONTRACTOR shall cut the extended portion of the pipeline at the entry and exit points. Thereafter, the drilled portion of the pipeline shall be cut at suitable location/depth and extended on either bank by installing a cold field bend with minimum bend radius of 40 times the pipe O.D. and a straight pipe of sufficient length, such that at the ends the top of the pipeline is minimum 1.0 m below the natural ground level.

19.0 OPTICAL FIBRE CABLE

Two HDPE encasements (one spare) shall be placed inside a protective 6" carbon steel pipe. [General characteristics of the HDPE pipe are enclosed]. In case of steel conduit it shall be of sufficient length and shall be fabricated by butt-welding pipes as per specification. The welds may only be visually inspected to check for any defect. If steel conduit is used HDPE pipe shall be installed in the steel pipe.

After the cable conduit have been installed, it shall be checked to ensure that there is no damage to the conduit caused by the pulling operation as per PTS-PLB HDPE.

20.0 PRIOR TO CONSTRUCTION

Prior to construction, CONTRACTOR shall submit a detailed methodologystatement for OWNER's approval for installation of pipeline and cable conduit including, but not limited to the following:

- Suggested diameter of reamed holes to facilitate smooth pulling operation..
- Methodology for bundling pipeline and cable conduit together. (If proposed).
- Minimum distance between entry points for pipeline and cable conduit and suggested methodology to ensure that clear distance between pipeline and cable conduit in as installed condition is 5.0 m.
- Method of pulling pipeline and cable conduit together in a bundle or separately, as applicable.
- Method of preventing the pipeline from rotating during pull-in, to ensure that cable conduit is not damaged during pulling operation, when CONTRACTOR proposes to install pipeline and cable conduit together.
- Method of inspection of cable conduit after installation.
- Method of blowing optical fiber cable.

Installation shall be carried out strictly in accordance with approved procedures.

21.0 SCOPE OF WORK

GENERAL

The Contractor's Scope of Work shall consist, but not limited to the following. However, all such works, which 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. Further, the scope indicated below shall be read in conjunction with the schedule of rates, specifications.

Contractor shall determine the exact number, characteristics, depth, width, nature of crossing/obstacles, etc. based on site visit or any other evidences or materials he may have etc. It is understood that for the below mentioned Scope of Work all the relevant equipment / machineries, testing instruments of work and manpower shall be supplied by contractor, except otherwise specified.

In order for the tender to be valid, the bidder must forward to Owner at least the following documents, correctly, completely filled in and clearly legible:

21.1 Site survey and the finalization of exact length of pipe line / quantities of various items, location of exit entry point, depth etc.

21.2 A detailed methodology of the works drawn up on the basis of the start and end dates for the works as stipulated in the special condition of contract (SCC). The various phases of the work must be included in this programme in so far as they are applicable to the works also Preparation of detailed project schedule in MS project or equivalent.

21.3 Expediting and Monitoring of all procurement and construction activities with approved vendors / sub-contractors.

21.4 An explanatory note must be attached describing the organization of the Construction Site as well as the methods and phases of execution, the complete inspection plan that the Bidder intends to follow, the qualitative and quantitative description of the means of execution, the installations, the equipment, the material, the tools and the personnel that he has to employ in each phase in order to complete the Works within the planned schedule.

21.5 The Contractor must draw up working methodologies including equipment, man power and material needed for all phases of the construction of the pipeline through HDD method.

21.6 All working methodology must get approved by the Owner and the Engineer before starting work.

21.7 Only approved working methodology will be strictly implemented at site during all construction stages.

21.8 The Contractor shall deploy all equipment and material required to achieve the work as per his detailed methodology and agreed schedule.

21.9 If deemed necessary as per the working methodology and/or at the request of Owner, Contractor must deploy extra equipment without being entitled to raise any compensation.

21.10 The Bidder must provide a detailed organizational chart (including key personnel qualification) indicating the organization or personnel and equipment for each phase of the Works along with their responsibilities.

The site Organisation shall include following managers:

Sl. No.	Position	Nature of Experience	Years of Experience	No. of personnel (minimum)
1	Construction Manager	Construction of Cross country pipeline (hydro-carbon pipeline) including HDD for the same	15	1
2	SHE Manager	Safety Management in construction of cross country pipeline (hydro-carbon pipeline) including HDD for the same	5	1

3	QA	Quality / NDT Management in construction of cross country pipeline (hydro-carbon pipeline) including HDD for the same	5	1

21.11 Radiography & Manual UT at wielding joints are in HDD contractor scope of work. It shall be done another agency. However, HDD contractor shall coordinate / assist to the agency to perform radiography & manual UT test.

22.0 MAIN ACTIVITIES

The Contractor's Scope of Work shall consist, but not limited to the following. However, all such works, which 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. Further, the scope indicated below shall be read in conjunction with the schedule of rates, specifications.

Contractor shall determine the exact number, characteristics, depth, width, nature of crossing/obstacles, etc. based on site visit or any other evidences or materials he may have etc. It is understood that for the below mentioned Scope of Work all the relevant equipment / machineries, testing instruments of work and manpower shall be supplied by contractor, except otherwise specified.

22.1 Construction & maintenance and dismantling of the site camp, site offices for Contractor's workshops etc.

22.2 To develop access from nearest road to entry exit location for mobilization of machinery, man power, tools, tackles consumables etc.

22.3 Marking out and clearing out of the ROU.

22.4 During ROU clearing, the vegetation shall be cut off at ground level leaving the roots intact. Only stumps and roots directly over the trench shall be removed for pipeline installation

22.5 Contractor shall carry out all necessary survey work as per requirements of site conditions. It will be the responsibility of the Contractor to maintain the ROU until completion of the work.

22.6 In case of encroachment on the ROU or extra land needed during construction, it will be the sole responsibility of the Contractor to relocate all issues (including any compensation) with the relevant land Owner, tenant or authorities. All related cost will be borne by the Contractor.

22.7 Hydrographical survey of river bed shall be carried out up to 100 m on either side of pipeline at 25 m center to center. The dry bed shall be surveyed up to 200 m away from existing bank and 200 m on either side of pipeline at 25 m center to center. For geotechnical survey at least 2 boreholes shall be carried out in river bed where bank width is less than 100 m, where bank width is wider than 100 m boreholes at 100 m center to center distance shall be carried out. On river bank at least 2 boreholes shall be carried out 1 on either side. Boreholes shall at least be carried out 5 m below the

level where pipeline is proposed to be laid.

22.8 All works for HDD crossing related to material handling, stringing of pipes, trenching, welding, inspection of welds, coating, earthworks, lowering-in and ballasting, site restoration, etc.

22.9 The Contractor shall also carry out the testing, cleaning, swabbing, pigging, gauging, hydrostatic testing, dewatering and pre-drying of the pipeline (Pre-commissioning activities).

22.10 Assistance to other Contractor during Commissioning.

22.11 Supply & laying of HDPE duct along the pipeline, If Owner will require.

22.12 Blowing of OFC, If Owner will require.

22.13 To provide casing pipe of 6" MS steel at crossings for inserting HDPE ducts, If Owner will require.

22.14 To install all field joint coating by heat shrinkable sleeves (Raychem / Covalence Dirax or Denso)

22.15 The Contractor shall lay, test, clean and dry the pipeline laid through HDD method before connecting to the main pipeline. Tie – in for HDD shall be done by the Contractor or laying Contractor whoever reaches the respective point later.

22.16 All activities related to liaison, co-ordination etc. with authorities needed to achieve the work as per schedule will be under Contractor's scope.

22.17 The Contractor will assure the interface and the coordination of his approved sub-Contractors and also other Contractors who may be working on different packages like TCP/PCP works, SCADA work, Telecom work, etc.

22.18 The Contractor will also submit as built documents/drawings, material reconciliation, pipe- books, project records and photographs as per specifications and instructions of OWNER/OWNER's REPRESENTATIVE

22.19 Carrying out all engineering, design calculations and preparation of all construction drawings and engineering for construction, as per requirements of CONTRACT document for carrying out crossings of pipeline and OFC by horizontal directional drilling method. Obtaining approvals from the Owner/Owner's representative of the above drawings and design packages before execution.

22.20 Supply including procurement, inspection, expediting, port clearance, transportation to site of all equipment/machines, materials and consumables to be supplied by CONTRACTOR as per "Scope of Supply", and of all construction, testing, survey and communication equipment etc. required for the installation of the crossings.

22.21 Preparation of procedures/work instructions, quality records. Obtaining approval from the Owner.

22.22 All additional topographic surveys, geo-tech/hydrological and any other soil surveys required for execution and as indicated in the drawings including preparation of plan and profile drawings as directed by OWNER's REPRESENTATIVE.

22.23 Construction: Stringing, aligning, bending, field welding, NDT including radiography,

joint coating, protective coating and installation of insulating joints with extension pipe pieces on both sides of the crossing.

22.24 Restoration: Backfilling, clean-up and restoration of right-of-way and obtaining certification from concerned parties as per specifications and instructions of Owner/Owner's Representative.

22.25 Making pipeline and optical fiber cable conduit bundle as per design approved by OWNER (if applicable).

22.26 Installation and testing of pipeline and cable conduit (together in a single drilled hole or separately by two independent drilling operations as per approved design packages).

22.27 Installation of optical fiber cable in cable conduit, by blowing.

22.28 Laying of OFC in separate trench (if applicable) to main pipeline trench and coiling 20M length of OFC on both sides of crossing as per instructions of owner/Owner's Representative.

22.29 Port testing of the crossing section.

22.30 Temporary Cathodic protection works on the buried crossing section.

22.31 CONTRACTOR shall dispose all surplus soil and bentonite slurry at locations duly approved by authorities having jurisdiction and/or as instructed by OWNER and prices quoted by CONTRACTOR shall be inclusive of all such works.

22.32 Any other work not specifically listed herein but required for the supply, installation and completion of the pipeline work crossings as per the requirements of this CONTRACT Document.

23.0 OTHER ACTIVITIES

23.1 Tie-in for HDD shall be done by HDD Contractor or laying Contractor whoever finishes work at the respective point later.

24.0 SCOPE OF SUPPLY

24.1 Materials to be supplied by Contractor

The procurement and supply, in sequence and at the appropriate time, of all materials and consumables required for completion of the WORK as defined in this contract shall be entirely the Contractor's responsibility and rates quoted for the execution of the contract shall be inclusive of supply of all these materials.

- Procurement and supply of components, consumables etc required for temporary and permanent installation and for completion of pipeline system.
- Vendor's Purchase Order, Purchase Specification, Design, Drawing and Data Sheets for review and approval of Owner / Owner's representative.
- Supply of all material for completion of work as per scope of work except free issue supply by Owner.
- Ensuring adequate quality assurance and control including stage wise inspection, testing and certification.

- Documentation and traceability of shop inspection and Acceptance Certificate by Third Party against supply items.

The materials to be supplied are, but not limited to the following:

i) All materials, equipment, trailers for transportation, loading, unloading, stringing etc.
ii) All welding machines, lifting equipment, instruments, transporting vehicles and consumables for welding such as oxygen, acetylene, inert gases and all types of electrodes, filler wire, solder wire, brazing rods, flux etc. for welding/cutting and soldering purpose.
iii) All materials, equipment and instruments required for all types of tests such as radiography, ultrasonic testing, magnetic particle and dye penetrant examination.
iv) All materials, equipment, instruments and consumables including primer calibrated pump required for external corrosion coating and concrete coating (where required) of field weld joints. All joint coating sleeves, other accessories related to field joint coating.
v) All materials, equipment, instruments and consumables required for repair of damaged corrosion coating of line pipe.
vi) All materials, consumables and equipment related to blasting of rock for excavating trench or grading the Right-Of-Way if applicable.
vii) All equipment for excavation.
viii) Corrosion inhibitor for water used for hydrostatic testing, including water for testing.
ix) All pigs for cleaning, gauging, filling, dewatering and swabbing of the pipeline.
x) All equipment, pumps, instruments, pipes, fittings and equipment, metallic blinds, temporary gaskets as required for filling, pressurizing and dewatering for hydrostatic testing, including pipe headers for air pigging and hydro testing etc.
xi) All materials, equipment, instruments for lowering and back filling of pipeline sections including supply of warning mats and nets.
xii) All equipment for restoration.
xiii) All material for fencing.
xiv) All safety tools/tackles/devices/apparatus/ equipment, etc. including ladders and scaffolding as required.
xv) All materials for corrosion protection of buried IJ (if installed).
xvi) HDPE casing, if required shall be procured by vendor and shall not be paid separately.
xvii) All equipment, materials and consumables for HDD.
xviii) All other materials not specifically listed herein, but required for the execution of the WORK.
xix) Lightening Arrestors.
xx) Line Pipe coating for HDD portion shall be 3 Layer polypropylene.

25.0 PARTICULAR INSTRUCTIONS

25.1 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.

25.2 Contractor proponent shall have to take prior approval of concerned Government agencies while carrying out blasting wherever required.

25.3 Contractor proponent shall have to preserve top soil dug and shall be restored to original condition on completion of the work.

25.4 Contractor proponent shall have to obtain clearance from the Forest Department for the portion of pipeline passing through reserve forest or any other type of Forest or wild life sanctuary, national park of other prohibited areas.

25.5 For the waste generated from the pigging and any other operation Contractor proponent shall have to provide sludge collection storage and disposal facility complying EPA-1986 with Hazardous Waste Rules 1989.

25.6 The applicant shall have to submit the returns in prescribed form regarding water consumption and shall have to make payment of water cess to the Board under the Water Cess Act – 1974.

25.7 Contractor shall construct the pipeline and other infrastructure by adopting safety measures as per the standards & specification laid down by the concerned agencies from time to time. All the safety and personnel protection measures shall be properly provided to meet any mishap / hazard / during operation and HDD method.

25.8 Contractor proponent is required to comply with the manufacturing, Storage and Import of Hazardous Chemicals Rules-1989 framed under the Environment (Protection) Act-1986.

25.9 On completion of all temporary work structures, surplus materials and wastes shall be suitably disposed of.

25.10 An Onsite-Offsite Emergency plan shall be prepared & submitted to Disaster Management Authorities under intimation to the state pollution control board.

25.11 The contractor shall act as per recommendation of the concerned authorities regarding safety measures and OHSAS-18002.

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INDRAPRASTHA GAS LTD.

LAYING & CONSTRUCTION OF U/G STEEL PIPELINE NETWORK & ASSOCIATED WORKS FOR CONNECTIVITY OF CNG STATION AT CONCOR CONTAINER DEPOT DADRI, GAUTAM BUDDHA NAGAR

QUALITY ASSURANCE / QUALITY CONTROL

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1.0 INTRODUCTION

This document covers and describes the Project Quality Data Requirements and Contractor's other obligations towards Quality Assurance which shall form a part of every Material Requisition (MR)/ Technical Specifications released by Contractor or documents submitted for approval, so as to ensure that all purchased products/ services consistently conform to planned Quality and project's stated and implied needs are met to Owner / Owner's Representative total satisfaction.

The TPIA is engaged for a defined motive to ensure that all quality related requirements during manufacturing are followed as per Owner/Owner's representative specifications and other approved documents. The extent of TPIA involvement as indicated in this document shall be binding on the contractor and no activity shall be accepted if not approved/certified by TPIA.

2.0 SCOPE

The requirements of this document are applicable to all Vendors/Contractors for supply of Packages, Equipments and Materials, which are purchased on behalf or directly by Contractor.

This document also indicates general quality control requirements for various activities pertaining to Gas Pipeline Projects.

3.0 DEFINITIONS

"Contractor"	: The natural person or legal entity with whom the Owner has concluded the Agreement.
"Vendor"	: shall mean the person(s), firm, and company, Organisation from which Contractor procures products/ services.
"Sub-Contractor", "Sub-Vendor", "Supplier", "Seller", "Agents"	:are considered synonymous to "Vendor".
"Certification"	: Certification shall have the meaning as provided by En 10204 Code and summarised as follow. "The manufacturer's authorized inspection representative independent of the manufacturing department and either the purchaser's authorised inspection representative or the inspector designated by the official regulations."
"MR"	: Material Requisition.

4.0 CERTIFICATION - QUALITY ASSURANCE & QUALITY CONTROL

All material and equipment to be permanently incorporated in the project shall be duly Quality Controlled - Inspected and certified for full compliance with the "Laws - Rules - Codes & Standards" prevailing for the project and as per approved quality assurance plan.

Quality Control, Inspection and Certification shall be as follow:

4.1 Basic Principles

Equipment Vendors must be duly approved, qualified and certified for their ability to supply basic materials and to fabricate the equipment according to the Codes and Specifications.

Sub-Contractors must be duly qualified and certified for their ability to assemble, erect, install, test commission, proceed to Civil Works, etc. as necessary to implement the project

All basic materials and equipment shall be the subject of 3.1. Certification before leaving the mills. The same applies to shop prefabrication or field construction/erection.

In addition, some activities may, as mandatory by Law or at the discretion of Owner/Owner's representative, be audited and/or subjected to 3.2 Certification.

4.2 Quality Plan

Vendor/Contractor shall, on due time, establish and submit to approval of Owner/Owner's representative a comprehensive Quality Assurance Program and Quality Plan stating clearly the organisation it proposes to set-up and the ways it intends to organise the Certifications.

It is responsibility of Vendor/Contractor to set-up any such organisation that is necessary to supervise and control the good execution of the agreed Quality Plan and to procure sub-contractors to achieve the necessary goals.

4.3 Certification Specific to Gas Related Facilities

Notwithstanding any other control-aimed necessary by Vendor/Contractor, Vendor/Contractor shall assure the Certification of its activities or works as well as of any Sub-contractors as follow:

4.3.1 Certification

Document issued by the manufacturer in which he declares that the products supplied are in compliance with the requirements of the order and in which he supplies test results.

The test unit and the tests to be carried out are defined by the product specification, the official regulation and corresponding rules and/or the order.

The document is validated by the manufacturer's authorised inspection representative,independent of the manufacturing department.

It shall be permissible for the manufacturer to transfer on to the inspection certificate 3.1 relevant test results obtained by the specific inspection or primary or incoming products he uses, provided that the manufacturer operates traceability procedure and can provide the corresponding inspection documents required.

4.3.2 Certification

Document prepared by both manufacturers authorized inspection representatives,

independent of the manufacturing departments and either the purchaser's authorized inspection representatives or the inspector designated by the official regulations and in which it is declare that the products supplied are in compliance with the requirements of the order and in which test results are supplied.

It shall be permissible for the manufacturer to transfer on to the inspection certificate 3.2 relevant test results obtained by the specific inspection or primary or incoming products he uses, provided that the manufacturer operates traceability procedure and can provide the corresponding inspection documents required.

Owner reserves the right to nominate one or more Third Party Inspection Agency (TPIA) to execute in its name all inspection and Certification it aims necessary or is mandatory by Law.

Owner/Owner's representative may also be nominated to act in name of Owner for the purpose and present for specific items or activities; in that case, "Owner" shall also mean" Owner's representative" in the frame of its "Commitment".

Owner/Owner's representative presence to Certification events and/or final issue of Certificates shall, in no way, reduce the obligation of Vendor/Contractor to proceed to its own 3.1. Certification or release Vendor/Contractor from its duties, obligations and liabilities.

Vendor/Contractor shall, in its Quality Assurance Plans (QAP), propose procedures to inform Owner/Owner's representative, on due time, to allow for 3.2 Certification. Events subjected to 3.2 Certification shall be confirmed to Owner/Owner's representative, in advance, according to the Plan and to actual time-schedule.

Too late notification to Owner/Owner's representative and resulting absence of its staff to Certification event shall lead to rejection of the event up to when Owner/Owner's representative will reasonably be able to be present.

For what relates to line pipes, valves, fittings, hot factory made bends and in general piping works, such 3.2 Certification shall at least cover the following:

a) Audits of the overall Certification of the Vendors/Contractors and their sub-contractors;

b) Audits of the 3.1. Certification Procedures and Organisation of the Vendor/Contractor, its sub-contractors and Vendors and sub-contractors/Vendors thereof;

c) Audits of the 3.1. Certification process, from time to time at Owner/Owner's representative discretion;

d) Assistance to main acceptance tests for line pipes, valves and main fittings.

As a general rule, 100% of all pipe welds shall be radio graphed with some specific weld to be submitted to ultrasonic testing also as per procedure and requirement of Owner's Representative.

Prior to shop prefabrication and field welding, the welding procedures shall be submitted to Owner/Owner's representative for comments. Vendor/Contractor shall proceed to all necessary Destructive and Non Destructive testing as provided by the codes and/or specifications for all Qualification Welds or Joints. The results thereof

shall be submitted to Owner/Owner's representative for final approval. In case of rejection by Owner/Owner's representative, Vendor/Contractor shall modify or adapt the proposed procedures and start again the entire process of approval by Owner/Owner's representative.

Each individual welder shall pass welding qualification in presence of Owner/Owner's representative, which may reject the qualification in case of non-conformity.

For shop prefabrication and field welding, Vendor/Contractor shall proceed to all necessary Non Destructive Testing and shall submit their results for Owner/Owner's representative 3.2 Certification.

Field Welds to be Non Destructively Tested in presence of Owner/Owner's representative shall be designated by Owner/Owner's representative; interpretation by Owner/Owner's representative shall be done as soon as reasonably possible; "non rejection" notification of the Weld shall be issued by Owner/Owner's representative as soon as reasonably possible. Such Welds shall not be coated nor back-filled before the issue of this "non rejection" notification.

Direct costs and relating travel expenses of Owner/Owner's representative's staff and/or compensation of the Third Party Inspection Agency appointed by Owner for 3.2 Certification shall be born by Owner for so far the relevant Certification is granted. Should the audited item be found faulty or not conform, Vendor/Contractor shall remedy with no delay to the default at no cost for Owner/Owner's representative and ask for a new audit. All cost incurred by Owner/Owner's representative for such new audit shall be borne by Vendor/Contractor.

All other costs incurred by Vendor/Contractor or its sub-Vendors or sub-Contractors for the audits or giving the auditor due evidence of conformity shall be borne by Vendor/Contractor.

4.4. Testing

Final acceptance tests (pressure and tightness) of the completed installation shall be performed in presence of Owner/Owner's representative or Third Party Inspection Agency and subjected to 3.2 Certification.

Pipelines shall be divided into sub-sections as necessary.

4.5 Non tested Tie-ins Welds

All tie-ins Welds (called "Golden Welds") which have not been the subject to Pressure Final Testing shall be 100% Radiographic and ultra-sonic controlled (steel Welds) and tightness tested under gas pressure (all Welds/joints) in presence of Owner/Owner's representative or Third Party Inspection Agency and duly 3.2 Certified.

5. INSTRUCTIONS

5.1. Third Party Inspection Agency (TPIA) appointed by Contractor.

Vendor shall appoint anoutside Third Party Inspection Agency, which shall maintain/review/monitor all Quality of the equipment as per the QAP approved by Owner/Owner's representative.

The Inspection Agency shall be appointed from the approved list of Third Party

Inspection agency as indicated in tender documents.

5.2 Quality Assurance Plan

Vendor during bidding stage shall confirm to the compliance to the Quality Assurance Plans (QAP) attached with this document. However, in post order stage they shall submit the detail QAP complying with all the requirements already confirmed by them in pre order stage duly reviewed by the Owner / Owner's Representative.

Other documents such as procedures covering various activities like design and engineering, material procurement, manufacture, inspection and testing, documentation, despatch to site, erection and commissioning where applicable and maintenance of Quality records shall be submitted for the review of Owner/Owner's representative.

Vendor shall submit the above documents duly reviewed within week time from the date of receipt of purchase order indicating the deviations/exceptions if any for approval.

5.3 Inspection & Test Plan

Vendor shall submit Inspection and Test plan for approval within 2 weeks or before to Owner/Owner's representative and obtain their approval before commencement of manufacture duly reviewed by the Owner / Owner's Representative.

5.4 Drawing Schedule

Vendor shall submit a total index of drawings and documents required for review / records based on the Vendor data requirement given in the MR along with the scheduled data of submission of each drawing/document within a week by Telefax/ Letter of Intent duly reviewed by the Owner / Owner's Representative. The drawing schedule shall be specific with regard to drawing/ document number.

5.5 Progress Report and Schedule

Vendor shall submit Fortnightly / Monthly Report and updated procurement, engineering and Manufacturing Schedule every month, beginning within 2 weeks and Telefax/ Letter of intent.

5.6 Waiver & Deviation

Vendor shall strictly comply with Purchase Order stipulations and no deviation shall be permitted. However, if the need for deviation arises under exceptional circumstances, on the post order stage, such deviation shall be subject to the approval of EIC and shall be submitted through EIC in the prescribed "WAIVER /DEVIATION /EXCEPTION REQUEST" format. The WAIVER/DEVIATION / EXCEPTION REQUEST shall also indicate the cost benefit to the Owner.

5.7 Procurement of Bought out Materials

All critical materials such as casting, forging, fittings, pressure holding parts, electrical and instrument accessories, etc. shall be purchased by the Vendors from approved Vendors meeting Qualification Criteria stipulated, if any. Vendor shall submit a list of bought out materials and sub-Vendors for these bought out materials for Owner/Owner's representative approval within 2 weeks by Telefax/ Letter of

Intent.

5.8 Calibration Records

Vendor shall use only calibrated measuring and test instruments and maintain calibration records. Vendor shall furnish records of calibration of measuring and Test instruments including recalibration records to Third Party Inspection Agency.

5.9 Inspection Test Status

Inspection test status of products shall be identified by using markings, authorised stamps, tags, route cards, inspection records etc. during the course of manufacture to clearly indicate acceptance/rejection of tests/stages of inspection performed during its manufacturing cycle. The identification of inspection and test status shall be maintained and records thereof shall be submitted as and when demanded by Owner/Owner's representative or Third Party Inspection Agency.

5.10 Quality Records

Vendor shall maintain quality records as per his procedures. Inspection Reports & Test Record copies shall be furnished to Owner/Owner's representative duly accepted by the Third Party Inspection Agency.

5.11 Non Conformity Reports (NCR)

TPIA will issue a NCR on observing any deviation to Owner/Owner's representative technical specifications or approved documents for EIC representative approval. On Receipt of NCR, the Vendor/Contractor shall submit a detailed corrective action procedure for EIC representative approval, and shall carryout all necessary corrective action so required to the satisfaction of Owner/Owner's representative/TPIA.

5.12 Identification and Traceability

5.12.1 Vendor shall establish and maintain a standard written procedure for identifying the products from applicable drawings, specification or other documents during all stages of production, delivery and installation. A copy of this standard procedure shall be made available to Owner/Owner's representative.

5.12.2 Besides other usual requirements for other equipment, Vendor shall pay due attention towards detailed traceability of all equipment's which are subjected to pressurised gas under normal operation. For such equipment, the following shall apply:

- All items of line pipes, pipefitting, valves and equipment to be permanently integrated in the project shall be duly identified such that its origin and history can be traced during the whole life of the project.
- When pipes are cut in piece, each piece shall be duly marked and identified.
- No piece shall be integrated in the project if not duly identified.
- All Welds shall be identified (up-stream and downstream line pipe identification and length) and date and circumstances of execution (including welder identification-results of "Quality Control"-etc.) recorded in adequate log book; identification code shall be indicated on the Weld itself by suitable marking system (stamping is strictly forbidden) before coating; after coating, the same code shall be indicated on the top of the Weld by suitable marking system.
- When line pipes are bend on site, the characteristics of the bend (original line pipe

identification number-degree of bending-length of remaining straight sections) shall be duly recorded in the above logbook.

- Logbooks shall be setup under the form of a comprehensive computer Database using Microsoft Access software or similar system.

As Built Survey:

All Welds, bends and fittings/equipment shall be duly topographically surveyed when in final place but before back filling and exact co-ordination added to the Weld logbook as well as on the "As built" drawings.

5.12.3 On job-to-job basis, Vendor shall confirm its validity and only revisions/deviations, if any, shall be submitted for approval. The Vendor shall ensure that each product, which is going in the process of fabrication/manufacture/construction/erection, has proper identification throughout the process including the final output.

The extent of TPIA involvement is indicated in the various quality control sheets attached with this document and also shall be as per final approved QA/QC procedures or as per codes and standards, wherever applicable. For items/construction activities for which, Assurance Plan are not attached, Vendor shall require submitting the Quality Control Sheets and Quality manual and shall obtain Approval of Owners/Owner's representative prior to start of any activity pertaining to supply of material or carrying out construction at site. Owner/Owner's representative shall get the above documents reviewed by the TPIA.

5.13 Contractor Documents for Owner/Owner's Representative's Review/ Records

5.13.1 General

1) All Documents shall be in ENGLISH language and unit of working shall be SI system.

2) Review of the Contractor drawings by Owner/Owner's representative would be only to review the compatibility with basic design and concepts and in no way absolve the Contractor of his responsibility to comply with Purchase Order requirements, applicable codes, specifications and statutory rules/regulations.

3) Unless otherwise agreed, submission of documents for Review/Records shall commence within 4 weeks from the date of Telefax/ Letter of Intent or as per the mutually agreed duration as per the duration of project.

4) Unless otherwise agreed, Contractor shall submit all Drawings and Documents in number of copies as stipulated in the Contractor Data Requirement. The Documents shall be supplied in soft copies where specified.

5) The Drawing/ Documents shall be checked, approved and duly signed / stamped by Contractor before submission. Revision Number shall be changed during submission of the revised Contractor Documents and all revisions shall be highlighted by clouds. Before submitting any sub-contractor drawings for review by Owner/Owner's representative, the Contractor shall ensure that these sub-Contractor drawings have been reviewed shall not be entertained.

6) While resubmitting the Drawings/ Documents, the Contractor shall send in a covering letter, specifically confirm whether all the comments have been

incorporated if not, shall furnish reasons with justification.

7) Multi-sheet Document other than Drawings shall be submitted in their entirety in the event of a resubmission even if only few sheets are revised.

5.13.2 Documents under Records Category

5.13.3 Final Documentation

Final Drawings/ documents consisting of Technical Data Manual/ Mechanical Catalogue are a compilation of "as built" certified, drawings and data, manufacturing and test records, installation and operating and maintenance instructions shall be submitted to Owner and Owners representative in multiple sets.

6. ATTACHMENT (WAIVER / DEVIATION PERMIT)

Waiver / Deviation Permit

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ATTACHMENT

Date…… **Report No……**

WAIVER/DEVIATION FORMAT

(TO BE RAISED BY CONTRACTOR/VENDOR)

PROJECT:
CLIENT:
CONSULTANT:
TPIA:
ORDER/CONTRACT NO:
CONTRACTOR:
ORGINATOR:

Requirement as per Specification / Drawing	Description of Waiver/Deviation sought

Why the Waiver / deviation is required?

Contractual implications if Waiver / Deviation is granted

- Time taken shall be More / No change
- Cost of item shall be attached Note :- Detailed break up of cost benefit to be
- Performance requirement shall be

Under present constraints requested waiver / deviation is most optimum for the Project and does not involve any security and safety hazard.

Date: Signature of Originator:
Name & seal:

Recommended by PMC (Site):

Date Signature of Originator:
Name & Seal:

Justification by PMC (H.O) when required:

Report No.:
Date:

Date: Signature:
Name & Seal:

Recommended by Owner (Site):

Date: Signature:
Name & Seal:

Recommended by TPIA (When required):

Date: Signature:
Name & Seal:

Final Approval by EIC:

Date: Signature:
Name & Seal:

Acceptance by Contractor/ Vendor:

Signature:

Date:
Name & Seal:

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LAYING & CONSTRUCTION OF U/G STEEL PIPELINE NETWORK & ASSOCIATED WORKS FOR CONNECTIVITY OF CNG STATION AT CONCOR CONTAINER DEPOT DADRI, GAUTAM BUDDHA NAGAR

PTS – THIRD PARTY INSPECTION AGENCY (TPIA)

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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 PTS 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

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/ Owner's 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 I.S.S.
- 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.

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LAYING & CONSTRUCTION OF U/G STEEL PIPELINE NETWORK & ASSOCIATED WORKS FOR CONNECTIVITY OF CNG STATION AT CONCOR CONTAINER DEPOT DADRI, GAUTAM BUDDHA NAGAR

PTS-TEMPORARY CATHODIC PROTECTION SYSTEM

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1.0 INTRODUCTION

This specification covers requirements of design, engineering, supply of material installation, testing and commissioning of temporary cathodic protection [TCP] system of external surface of cross country underground pipeline/structure including corrosion survey, investigation for interference/ interaction detection and mitigation with adjoining structures.

The Temporary cathodic protection [TCP] specification defines the basic guidelines to develop a suitable temporary cathodic protection [TCP] system for the structure [IGL underground pipeline for city gas distribution] required to be protected. All data required in this regard shall be taken into consideration to develop an acceptable design and for proper engineering of the TCP system.

1.1 Compliance with these specifications and/or approval of the Contractor's documents by Owner shall in no case relieve the Contractor of his contractual obligations.

1.2 All work to be performed and supplies to be effected as a part of contract shall require specific approval of Owner or his authorized representative. Major activities requiring approval shall include but not be limited to the following:

a) Methodology of Corrosion survey site data generation / verification and interpretation report and design basis for Temporary Cathodic Protection [TCP] System.
b) CP system design engineering package including pipeline layout with all crossing details and TCP Components in Graphical form (Chainage wise), graphical representation of soil resistivity survey and formula used & Design Calculation.
c) Quality Assurance and Control (QA/QC) methodology.
d) Detailed engineering package including Procedures, ITPs, QAPs, Data Sheets and Drawings for fabrication and construction.
e) Field testing and commissioning procedure.
f) Procedures for interference testing and mitigation.
g) Post installation system monitoring procedures.

2.0 CODES AND STANDARDS

- PNGRB standards
- BIS standards
- BS standards & Codes of Practice
- ANSI standards
- NFPA publications
- NACE publications & Codes, Recommended Practice
- IEC publications
- DNV publications
- IEEE publications
- DIN publications
- ASTM specifications & Codes, Recommended Test Practices
- O.I.S.D. standards
- C.C.E. norms
- Statutory Regulations
  (All latest available editions only)

In case of conflicting requirements amongst any of the above standards the publication having most stringent requirement shall be governing. However, the priority shall be:

- Statutory Regulations
- This Specification
- Codes & Standards

3.0 CORROSION SURVEY DATA

3.1 The corrosion survey including soil resistivity data measurement along ROW and Anode beds other data as required for CP design shall be in entirety the responsibility of the Contractor. In addition, Contractor shall have to generate additional data as required for completeness of the job. Contractor shall also carry out soil resistivity survey at temporary anode ground bed locations for proper design of ground beds. Wenner's 4-pin method or Owner approved equal shall be used for such measurements. Survey instruments shall have maximum AC and DC ground current rejection feature.

3.2 Additional Data to Be Collected

The following data shallbe collected to generate design data for evaluation of interaction/interference possibilities due to presence of other services in ROW / in vicinity:

i) 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 or any abandoned pipelines).
ii) Diameter, wall thickness, pressure, pipeline coating against corrosion, soil cover used in case of existing pipelines.
iii) Details of the existing cathodic protection systems protecting the services i.e., Location, rating, type of protection, anode beds, test station locations and their connection schemes if any.
iv) Graphical representation of existing structure/pipe-to-soil potential records.
v) Remedial measures existing on foreign pipeline/services to prevent interaction.
vi) Possibility of integration/isolation of CP systems, which may involve negotiations with owners of other services to achieve Equipotential.
vii) Crossing and parallel running of electrified and non-electrified traction (along with information regarding operating voltage, type AC/DC etc.) as well as abandoned tracks near ROW having electrical continuity with the tracks in use.
viii) Crossing or parallel running of any HT AC/DC overhead line (existing/proposed) along with details of voltage, type AC/DC etc.
ix) Voltage rating, number of cores and sheathing details of underground power cables, along ROW or-in its vicinity.
x) Information on existing and proposed DC/AC power sources and system having earth as return path, in the vicinity of the entire pipeline route such as HV DC sub- stations, fabrication yards with electric welding etc.
xi) Any other relevant information that may be useful and needed in designing and implementing proper protection scheme for the proposed pipeline.

Unless otherwise mentioned, Contractor shall conduct necessary potential gradient survey for any existing anode ground bed that may interfere with the CP system of the pipeline covered under this project.

3.3 REPORT

On completion of all field work a report incorporating all the results generated from Surveys and details of additional data collected shall be furnished. The report shall also contain detailed interpretation of survey results and resistivity data enclosed, probable interference prone areas, etc. to form design basis for the scheme of cathodic protection. This report shall also include various drawings prepared in connection with the above work. The soil resistivity values shall be plotted on semi-log graph sheets.

4.0 CATHODIC PROTECTION DESIGN PARAMETERS

Unless otherwise specified in the project specifications, following parameters shall

be used for design of temporary cathodic protection system.

4.1 Protection Current Density

Pipe lines having polyethylene [3XLPE] coating

Pipeline surrounding	Protection current density* Temporary CP (μA/m2)
Normal soil	30
Marshy area/submerged in water	40
Rocky area	25

Pipe to soil "ON" potential shall not be more negative than (-) 1.5 V w.r.t.Cu-CuSO2 reference electrode.

* Actual current density to be adopted shall be decided based upon soil and other environmental conditions, proximity of foreign pipe lines and structures affecting and causing interference. Where considered necessary for satisfactory protection of all pipeline the current density shall be suitably increased by Contractor for IGL pipeline.

4.2 Safety factor for current density: 1.3

4.3 Anode utilization factor : 0.85 for Centre Connected
: 0.55 for End Connected

4.4 Pipeline natural potential: (-) 0.45 V [To Be Measured at Site during survey].

4.5 Along the ROW where soil resistivity is higher than100 ohm-m temporary CP for the pipeline may not be provided-unless otherwise specified by Owner.

5.0 CATHODIC PROTECTION DESIGN CRITERIA

Cathodic protection system shall be designed to meet the following criteria.

5.1 The pipe to soil potential measurements shall be between -0.95 V and -1.5 V with respect to a copper/copper sulphate reference electrode, to be measured by insertion of reed switch.

5.2 In rare circumstances, a minimum polarization shift of greater than (-) 100 milli-volts shall indicate adequate levels-of cathodic protection for the pipeline.
Discretion to use any of the criteria listed above shall solely rest with the owner/owner's Representative.

5.3 A positive potential swing of ≥ 20 mV[P-S-P] shall be considered the criteria for presence of an interaction situation requiring investigation and incorporation of mitigation measures by the contractor.

6.0 SYSTEM DETAILS

The system shall include the following major equipment/sub-systems unless otherwise specified.

- Sacrificial anodes and anode ground beds
- Test stations
- Polarization cells
- Surge diverter
- Grounding cell
- Interconnecting cables
- Cable to pipe connections

All equipment shall be new and supplied by approved reputed manufacturers. Equipment offered shall be field proven. Equipment requiring specialized maintenance or operation shall be avoided as far as possible and prototype

equipment shall not be accepted. Make and construction of all materials shall be subject to owner's approval.
The detailed specification of each system and equipment shall be furnished by thE Contractor. However certain minimum requirements for the major equipment are highlighted in this document.
As far as possible equipment including test stations anode lead junction boxes etc., shall be located in safe area. All equipment located in hazardous areas shall be of flame proof type as per IS: 2148 for gas groups II A &ll B and temperature Class T3.

6.1. Anode Ground Beds

6.1.1. Along ROW where soil resistivity predominantly remains low and ranges from 0-10 - Ohm-m zinc anodes shall be provided.
6.1.2. Along ROW where soil resistivity is predominantly higher than 10 ohm-m magnesium anodes shall be provided.
6.1.3. At high resistivity area where resistivity is of the order of 50 ohm-m and above, magnesium ribbon anodes shall be provided.
6.1.4. Anodes shall be installed along the pipeline at suitable intervals as per pipeline Protection voltage attenuation calculations and ground bed resistance/current output of anode installations.
6.1.5. Each electrically continuous section of pipeline shall preferably be protected totally by one type (material) of anodes to avoid inter-anode-circulation currents.
6.1.6. The anodes shall be installed at sufficient depth to reach moist soil and shall be separated from the pipeline by at least 5 m and 2 m for magnesium and zinc anodes respectively. The anode connections to pipe line shall be routed through test stations.
6.1.7. At the temporary C.P. anode ground bed the leads of all the anodes shall be joined together in a junction box filled with epoxy and buried. A single cable shall be routed from the junction box to test station.
6.1.8. However, for sacrificial anode ground bed which shall be integrated with permanent [PCP] system, the leads of all the anodes shall be brought up to the test station and shall be terminated individually through a Variable Resistor and Shunt of Appropriate size.
6.1.9. 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, pipe coating resistance, cable resistance etc. Contractor shall prepare a table for number of anodes required at different soil resistivities to produce the specified protection current.

6.2. Anodes

6.2.1. Magnesium Anode

The anode shall conform to the-requirements of ASTM (1) C-843 standard. The anode shall be of high manganese, magnesium alloy packed with special back fill. The metallurgical composition, potential and consumption of anode shall be as below:

i) Composition:

Element	Weight
Manganese	0.15-0.7%

Copper	0.02% max.
Silicon	0.10 % max.
Zinc	2.5-3.5 % max.
Aluminium	5.3-6.7 % max.
Iron	0.003 % max.
Nickel	0.0002 % max.

Other metallic elements

- Each 0.05 % max.
- Total 0.3 % max.

Magnesium Balance

ii) Anode closed circuit potential (-) 1.5 volts w.r.t CSE

iii) Anode consumption rate 7.9 kg/Amp. Yr. Max.

6.2.2. Zinc Anode

The anode shall conform to the-requirements of ASTM (1) C-418 standard. The anode (other than ribbon anode) shall be packaged with special back fill. The metallurgical composition of anode, potential and consumption rate shall be as below:

i) Composition

Element	Weight %
Aluminium	0.3-0.5 % max
Cadmium	0.075-0.1 % max
Copper	0.005 % max.
Iron	0.002 % max.
Silicon	0.005 % max..
Lead	0.005 % max.

Zinc Remainder

ii) Anode closed circuit potential (-)1.1 volts w.r.t.CSE

iii) Anode consumption rate 11.24 kg/Amp.Yr) Max.

6.2.3. Contractor shall furnish spectrographic analysis from each heat both for zinc and magnesium anodes trace elements & chemical Analysis for [Mg, Zn] contents along with electrochemical test results.

6.2.4. Special Backfill

The composition of special back fill for anodes shall be as below:

Gypsum	75 %
Bentonite	20 %
Sodium sulphate	5 %

6.2.5. The anodes shall be provided with cable tail of sufficient length to reach junction Box/test station as applicable without tension and no in between splicing.

6.2.6. Tolerance in Fabrication of Anodes

The anode surface shall be free from cracks (which may reduce the performance of the anode).

Any cracks which follow the longitudinal direction of elongated anodes shall not be acceptable.

Small cracks in the transverse direction of elongated anodes and in anodes of other shapes may be accepted provided the cracks would not cause any mechanical failure during service of the anode considering that the combination of cracks and lack of bond to the anode core is detrimental.

For transverse cracks the acceptable limits shall be furnished by the bidders along with the offer.

The anode shall be free from excessive shrinkages. The limits shall be as follows:-

- Maximum 10% of the depth of anode or 50% of the depth of the anode cores whichever is less. The depression may be measured from the edges of one side.

  The surface of the anodes shall be free from coatings and slag/dross inclusions etc.

  The maximum deviation from straightness shall not exceed 2 %.

  The weight tolerance on individual anodes may be taken as + 5%. The total weight of the anodes shall not have negative tolerance.

  Recommended dimensional tolerance shall be as follows:

Length	+ 2.5 %
Width/thickness	+ 5 %

6.2.7. Test Stations

6.2.8. Test stations shall be provided along the pipeline ROW for monitoring the performance of the cathodic protection system at intervals not exceeding 1000 metres unless otherwise specified. In addition to above, test stations of requisite type [A,B,C,D,E] or Combination of any two of these shall also be provided at the following locations:

a. At both sides of major road crossings.

b. At all insulating joints.

c. At vulnerable locations with drastic changes in soil resistivity.

d. At connections of surge diverters, grounding cells and polarization cells.

e. At HT AC/DC overhead line crossings and selected locations where HT overhead line is in the vicinity of the pipeline.

f. At railway line crossings and running parallel to the pipe line.

g. At both sides of major river crossings.

h. At high voltage cable crossings or along routes where HV cables are running in parallel. ,

i. In the vicinity of DC networks or grounding system where interference problems are suspected.

j. At crossings/parallel running of other pipelines/structures.

k. At both sides of cased crossings.

l. At any other locations considered vulnerable locations where interference is expected.

m. At any other locations considered necessary by Owner/ Owner's representative.

6.2.9 Test stations for bonding shall be provided with shunt and resistor as a means to monitor and control current between the pipeline and foreign pipelines or structures that may exist in common ROW.

6.2.10 Test stations used for sacrificial anodes shall have shunt for measurement of anode current, and provision for resistance insertion to limitthe anode current output.

6.2.11 All test stations shall have weather proof enclosure, having degree of protection IP 55 with hinged lockable shutter. Enclosure shall be made of sheet steel of at least 3 mm thickness and shall be suitable for M.S. post mounting.

6.2.12 The test stations shall be installed with the front of the test station facing the pipeline. The name plate of test stations shall in minimum carry following information.

- Test station number
- Chainage in km
- Test station connection scheme type
- Distance from pipe line in meters
- Direction of product flow

6.2.13 Terminal blocks and different scheme of wiring as required shall be provided in the test station as per the test station connection scheme sketch on inside door of the test station.

6.2.14 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.

6.2.15 All cable entry and exit point on the test station shall be properly sealed by chemical sealing compound.

6.3. Surge Diverter, Grounding Cell and Polarisation Cell

6.3.1 At the crossing or parallel run of pipeline and overhead HT line of 66kV and above, the pipeline shall be grounded through polarization cell. Alternatively, grounding could also be done with galvanic anodes and Surge diverter at the discretion of the owner. The grounding shall be done at regular intervals (i.e. at 1000 M). where transmission line run parallel within 25 M of the pipeline; to ground any surges in the pipeline potential that may appear in case of transmission line faults.

6.3.2 Locations along pipeline where continuous induced over-voltage due to HT line etc., is expected or observed during commissioning, the pipe line shall be earthed through polarization cell to the HT tower earth system causing the voltage induction or to a separate earthing system. Alternatively the pipe line shall be grounded with galvanic anodes and Surge diverter at the discretion of the owner.

6.3.3 The polarization cell shall be installed in a vandal proof steel housing by the Contractor.

6.3.4 Spark gap Surge diverter with Grounding cell shall be provided for the protection of insulating joints located at the ends of the pipe line/at terminals. Owner on his own discretion may permit use of magnesium or zinc galvanic anodes for protection of insulating joints. Choice between magnesium or zinc anodes shall depend upon the potential values on either side of the insulating joint.

6.3.5 Surge diverter shall be provided for the protection of insulating joints located at the ends of the pipeline / at terminals. Alternatively owner on his own discretion may permit use of magnesium or zinc galvanic anodes for protection of insulating joints. Choice between magnesium or zinc anodes shall depend upon the potential valve on either side of the insulating joint. Surge Diverter, Polarization Cell, Galvanic anodes and Grounding cell shall be sized for the specified design life of permanent cathodic protection system.

6.3.6 The total system including cable, cable termination, galvanic anodes / grounding cell and surge diverter shall be suitable for the anticipated fault current at the location of its installation.

6.3.7 Unless otherwise specified the minimum rating of grounding cell, polarization cell and surge diverter shall be as below:

i) Grounding Cell

Type : Zinc, 2 or 4 plate types

Current rating : Suitable to pass more than 10 kA surge

ii) Polarization cell

Type : Stainless steel/nickel plated with potassium hydroxide electrolyte.

Current rating :The rating shall be based on actual fault current expected at site

(≥5KA)

iii) Surge diverter& Spark Gap Arrester

Type	:	Spark gap
(Current,8/20 µs wave)	:	150 kA
Spark over AC voltage 50 Hz	:	1 kV
Impulse (1.2/50 µs)	:	2.2 kV

Max. Allowable voltage (A.C) 230V, D.C. 350 Volt Turn onvoltage (D.C.) 430 (+/-)

10% voltage protective leave at 200 amp (8/20 micro sec.) 800- volt max. Energy (single short) 2micro sec. = 400 volt max. Single short surge withstand capacity (8/10 micro sec.) = 20 k Amps

6.3.8 The grounding system shall have minimum resistance to earth to restrict the pipeline voltage as per NACE criteria.

6.4 CP at Cased Crossing

At cased crossing, where metal casing exterior is coated, the casing shall be protected by sacrificial anode installations. The sacrificial anode installations shall be provided at both ends of such metal casing.

All HDPE casing shall be provided.

No additional CP for carrier bottom inside casing, if casing is less than 20 mtrs.

6.5. 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 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.

All unpainted steel parts shall be cadmium plated to prevent rust formation

6.6. Cables

Cables shall be annealed high conductivity, tinned, stranded copper conductor, PVC insulated 1100 V grade, armoured, PVC sheathed. The size of the copper conductor shall be 6 sq. mm for anode tail cable from anode to buried junction box, 10 sq. mm from junction box to test station, 10 sq. mm from test station to pipeline.The size of the conductor shall be 6 sq. mm for potential measurement and 25 sq. rnm for bonding, polarization cell/grounding cell and surge diverter connection purpose.

The length of anode tail cable shall be sufficient enough to reach junction box (buried) in case of temporary CP anodes.

7.0 INSTALLATION

7.1.Cable Laying

7.1.1 Cables shall be laid in accordance with approved layout drawings to be prepared by the Contractor. No straight through joint shall be permitted in a single run of cable. Cable route shall be carefully measured and cables cut to required length.

7.1.2 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 1.5 M. Cables shall be laid in sand under brick cover back filled with normal soil. Outside the station/plant area the routes shall be marked with Polyethylene cable warning mats placed at a depth of 0.9 M from the finished grade.

7.1.3 All underground unarmoured cables forming part of permanent CP system shall run through PE sleeves. Cables along the pipeline shall be carried along the top of the pipe by securely strapping it with adhesive tape or equivalent as required.

7.1.4 RCC or GI pipes of proper size shall be provided for all underground cables for road crossings.

7.1.5 Cables shall be neatly arranged in trenches in such a manner that crisscrossing is avoided and final take off to equipment is facilitated.

7.2 Cable to Pipe Connections

All cable connections to the pipeline shall be made using exothermic process such as Pin Brazing using a stud on a Lug or direct through a Lug Pin Brazed on pipe surface. Cable to pipe connection shall be encapsulated with 2 - pack solvent less epoxy and covered with heavy duty - coating, Holiday free to be checked by Spark Holiday detector. However for the charged foreign pipeline, Cable to Pipe Connection shall be made by using cold soldering method.

8.0 CIVIL WORKS

All civil works associated with the complete cathodic protection work shall be included in the scope of Contractor. This shall include providing cable trenches, foundation for equipment and all test stations, etc.

9.0 TESTING AND INSPECTION AT WORKS

9.1 Owner / Owner's representative shall visit the works during manufacture of various equipment to assess the progress of work as well as to ascertain that only quality raw material is used for be same. All necessary assistance during such inspections shall be provided.

9.2 The minimum testing, inspection requirements as per QA/QC for all components/equipments shall conform to the requirements as defined in the relevant codes and standards. Detailed inspection and testing procedures along with the acceptance criteria shall be prepared by Contractor for Owner's approval.

9.3 The certificates including test records, performance curves etc. shall be furnished. All test certificates shall be endorsed with sufficient information to identify equipment to which the certificate refers to and must carry project title, owner's

name and purchase order details etc.

9.4 Owner reserves the right to ask for inspection of all or any item under the contract and witness all tests and carry out inspection or authorize his representative to witness test and carry out inspection. Contractor shall notify the Owner or Owner's representative at least 20 days in advance giving exact details of tests, dates and addresses of locations where the tests would be carried out so as to enable owner's Representative to reach and Witness tests during fabrication .

10.0 PACKING AND TRANSPORT

All equipment/material shall be protected for inland/marine transport, carriage at site and outdoor storage during transit and at site. All packages shall be clearly, legibly and durably marked with uniform block letters giving the relevant equipment/material details. Each package shall contain a packing list in a water proof envelope. Copies of the packing list, in triplicate, shall be forwarded to owner prior to dispatch. All items of material shall be clearly marked for easy identification against the packing list.

11.0 SYSTEM TESTING, COMMISSIONING AND INTERFERENCE MITIGATION

11.1. System Testing At Site

11.1.1 Contractor shall furnish the detailed field testing and commissioning procedure for approval. Field tests as per the approved procedures shall be carried out on the equipment/ systems before being put into service. The acceptance of the complete installation shall be contingent upon inspection and field test results being O.K and Acceptable.

11.1.2 Before the CP facilities are placed in operation all observations to be carried out to establish that all equipment, devices, wiring and connection, etc. have been correctly installed, connected and are in good working condition as required for intended operation.

11.1.3 Owner/owner's representative may witness all the tests. At least one week's notice shall be given before commencing the tests.

11.1.4 All tools, equipment and instruments required for testing shall be provided by Contractor.

11.1.5 Generally following tests shall be carried out and recorded in Performa given in subsequent clauses:

Checking : Visual inspection, comparison with drawings and specifications

Inspection : Detailed physical inspection

Testing : Simulation tests of equipment to determine its operational fitness.

i) Cables

- Cable No.

- Voltage grade
- Conductor cross section
- Continuity check
- Voltage test
- Insulation resistance values between core and earth
- All cables shall be tested by 500 V megger.

ii) Insulating joint

Check of insulating joint for leakage, before and after energization of C.P. by means of insulating joint tester. Structure-to-electrolyte potential of both protected and non- protected sided of insulating joint shall be checked before and after energization of CP system.

iii) Polarization cell

- Location/ identification number
- Rating
- Check for electrolyte
- Check for wiring
- Check for standby current drain with CP energization (current drain with respect to voltage across the cell shall be recorded)

iv) Grounding Cell

- Location
- Type (no. of anodes)
- Ratings

v) Surge diverter

- Location/ identification number
- Ratings
- Check for healthiness

11.2 Commissioning

11.2.1 Natural pipe to soil potential shall be measured at each test station location prior to connecting anodes to pipe line. The pipe to soil potential observation shall be repeated after connecting the anodes and allowing sufficient time for Polarization. The current output of the anode installation shall also be measured to ensure that it does not exceed the output current capacity of the anodes. 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 Pipeto Soil Potential shall be

rechecked for adequacy of protection Additional anodes shall be provided where required to achieve desired level of protection

Each anode installation shall become individually operational as above.

11.2.2 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.

11.2.3 In case of insufficient protection as per the CP design criteria on any portion of the pipe line, Contractor shall carry out necessary additions/modifications to the provided protection in consultation with the Engineer In-charge.

11.3 Interference Mitigation

Investigation shall be made for stray current electrolysis of the pipeline, AC induction on pipeline due to overhead high voltage line, interference due to high voltage DC lines, electric traction etc.

Measurements including pipe to soil potential and pipe line current etc. on the pipeline/structure being CP protected shall be made to investigate the current discharge and collection locations.

In case of fluctuating stray currents, investigation shall be made continuously over a period of time and if required, simultaneously at different location to find out the stray current source for long time measurements, recorders / Data loggers shall preferably be used.

Where foreign pipeline (unprotected or protected by independent CP system) runs in parallel to the pipeline in same trench or very near to the pipeline, and not bonded to the pipeline then investigation shall be made for current discharge points on both the pipelines.

Mitigation measures shall be provided depending on type of interference These shall include installation of bond with variable resistor and diodes, installation of galvanic anodes for auxiliary drainage of current, adjustment / relocation (If Possible) of offending interference source, provision of electrical shield etc. depending on the type of interference.

Bonding with foreign pipeline/structure as a mitigation measure shall be provided where the owner of the pipeline/structure has no objection, otherwise alternative mitigation measure shall be provided. Where bonding is provided for mitigation bonding resistor shall be adjusted for optimum value for minimum interference. Galvanic anodes installed as a mitigation measure shall be sized for the life specified for permanent [PCP] system.

12.0 SYSTEM MONITORING

The temporary CP system provided shall be monitored at all test stations once in a month for healthiness/ adequacy of protection till commissioning of permanent CP or for design life of temporary CP specified, whichever is less. During this period, if any deficiency/ interference in protection system is noticed, the same shall be rectified/ augmented byCP Contractor by putting additional anodes as required. The monitoring report shall be submitted by CP Contractor regularly to owner for his review/information in Approved format.

13.0 DRAWINGS AND DOCUMENTS

13.1 General

13.1.1 Within three weeks from the date of issue of Purchase order Contractor shall submit four copies of the list of all drawings/data/manuals/procedures for approval identifying each by a number and descriptive title and giving the schedule date. This list shall be revised and extended, as necessary, during the progress of work.

13.1.2 All drawings and documents shall be in English and shall follow metric system. Number of copies of eachsubmission shall be as follows unless otherwise specified.

	Submission	No. of copies
a)	For review/approval	1 + 1 hard copies
b)	Drawings issued for execution/construction	3 hard copies
c)	Final As-built drawings execution / construction	6 hard copies and 1 soft copy in CD
d)	Operation/ Maintenance manual, vendor data.	6 hard copies 1 soft copy in CD

13.2. Contract Drawings and Documents

13.2.1 As a part of the contract, drawings and documents shall be furnished this shall include but not be limited to the following:

a) Report on corrosion survey including soil/water Ionic & Microbial analysis from samples collected from ROW and Anode bed locations,as specified or agreed by Owner.

b) Basis of system design and design calculations, equipment selection criteria and sizing calculations.

c) Bill of material, material requisitions, purchase, requisitions,Vendor for each item.

13.2.2. Detailed construction drawings (including as built status)

a) Sacrificial anode fabrication drawings

b) Typical layout drawing for anode ground bed installation and connection

c) Equipment layout, cable layout and schedules

d) Fabrication, installation and connection scheme drawing for different types of test stations.

e) Fabricationand installation details of surge diverter, grounding cell and polarization cell with its enclosure and housing.

f) Cable-to-pipe joint details for charged and non-charged pipe lines.

g) Incorporation of anode beds, polarization cell, surge diverters, test stations etc. and other relevant features of CP system-design in Pipeline alignment sheet and other related drawings.

h) Identification of section of pipeline affected by interference, Source of

interference and details of interference mitigation arrangements provided. Various measurement data at all relevant test stations with and without mitigation measures provided.

i) Detailed commissioning report including various measurement data at all test stations etc.

j) Vendor drawings and catalogues, test certificates.

k) Operation and maintenance manual

I) Miscellaneous

- Equipment inspection and testing procedure
- Construction, installation procedures
- Field testing and commissioning procedures
- Quality control procedures

14.0 INSTRUMENT, TOOLS AND SPARES

14.1 Contractor shall supply all instruments, tools and tackles necessary for proper operation and maintenance of complete cathodic protection system and associated equipment.

14.2 Contractor shall provide a list of spares and consumables required for proper operation and maintenance of part of cathodic protection to be integrated with permanent CP system / designed on the basis of permanent CP design parameters and associated equipment, for two years operation of the system.

ΣΣΣ

INDRAPRASTHA GAS LIMITED. (IGL)

LAYING & CONSTRUCTION OF U/G STEEL PIPELINE NETWORK & ASSOCIATED WORKS FOR CONNECTIVITY OF CNG STATION AT CONCOR CONTAINER DEPOT DADRI, GAUTAM BUDDHA NAGAR

HSE (Health Safety Environment)

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1.0 SCOPE

This specification establishes the Health, safety and Environment (HSE) aspects to be complied with by the contractor during construction at site.

2.0 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
- Reporting Formats

3.0 RESPONSIBILITY & ORGANISATION

Safety activities at site shall be under control of contractor's RCM. He 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 advise.

4.0 GENERAL REQUIREMENT

4.1. The contractor should follow HSE policy of owner as applicable to construction site.

4.2. The contractor shall deploy a full time HSE engineer / officer to coordinate the site.

The HSE officer shall be duly qualified in Industrial Health & Safety management with an experience of 4 -5 years.

4.3. The contractor shall ensure that HSE requirements are clearly understood & faithfully implemented at all level, at each site.

4.4. The contractor shall organize safety awareness programs regularly.

4.5. The contractor shall ensure his participation in the every HSE meeting called by owner/owner representative.

4.6. The contractor's shall conduct daily tool box talk.

4.7. The contractor shall submit Monthly HSE reports (Form attached in ANNEXURES).

4.8. The contractor shall provide all help and support to the injured person got injury at site during construction work and arrange compensation as per insurance policy / Act.

4.9. 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 without any cost time implication to owner. A penalty amount of Rs 1000/-shall be imposed on the contractor for the serious HSE violation.

4.10. Three times of this penalty may count as a serious violation of contractor in line with HSE. This may affect to new work assignment/award of contractor.

5.0 ACCIDENT, INCIDENT AND NEAR-MISS REPORTING

Accident
Unintended occurrence arising out of and in the course of employment of a person, which results in to injury with or without damage to plant/equipment/materials.

Incident
means an unplanned and uncontrolled event which results in damage to plant or equipment or loss of material without causing any injury to persons, like fire, spill, leak, property damage etc.

Near-miss
An unexpected, unwanted event not causing loss, injury or illness but which under slightly altered conditions can lead to an accident.
can be defined as "Any event which under slightly unfavorable circumstances, may have resulted in any of the following:

- Injury, fatal or otherwise or ill health to people
- Loss of property, damage to plant or materials
- Damage to the environment
- A business interruption"

Accident, Incident and Near miss reporting form listed in ANNEXURES

6.0 HSE REQUIREMENTS AT SITE

6.1. Personnel Protective Equipments

The contractors shall provide sufficient numbers of following personal protective equipments (PPEs) to workmen and supervisors/engineers to use them properly at work site.

Following five numbers of Personnel protective equipments are identified as MANDATORY for all.

- Safety Helmet
- Coverall
- Safety shoes/footwear
- Safety Glasses
- Hand Gloves(as per job requirement)

Other PPEs are depends upon

nature of job like Arc Welding –

Welding face shield

Grinding – Grinding face shild

Height work – Full Body harness (above 2 meters)

Ask site supervisor for proper use and selection of protective

clothing / equipment for specialised jobs

6.2. **Welding**

- Ensure that welding machine is in order and approved by site engineer.
- Ensure that welding cables are in order.
- Ensure that welding machine is properly earthed.
- Remove all combustible material from welding area to avoid fire
- Place a fire extinguisher near by 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 pin etc,
- Ground the work piece separately from the welding return connection only.

6.3. **Gas Cutting**

- 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 cylinders in vertical position (Cylinder trolley) and 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 near by welding premises.

6.4. **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 in position.
- Machine body without any damage like crack etc.
- 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 sticker showing 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 break etc.)
- 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.

6.5. **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.

6.6. **Material Handling and Storage**

The Contractor will only use crane/Hydra and lifting equipment that has been tested and certified as fit for purpose by 3rd Party. All crane operators and riggers will be adequately trained and certified. The Contractor will keep records of tests and certification of all lifting equipment crane employed on the Works.

Maintenance records shall be routinely inspected by the Contractor and made available for Safety audits.

LIFTING GEAR: Lifting machine, chains, ropes and lifting tackles used at site shall conform to the following:

- All parts shall be good construction, sound material and adequate strength and free from defects.
- Shall be properly maintained, thoroughly examined, load tested by competent person.
- No lifting machine and no chain, rope or lifting tackle shall except for purpose of test be loaded beyond safe working load and this safe working load must be plainly marked on the gear concerned.
- All material must be properly stacked and secured to prevent sliding, falling or collapse.
- Stairs and passage ways must be kept clear at all time.

6.7. **Trenches and Excavation**

Before commencing any excavation work the Site incharge will ensure that the proposed works have been adequately assessed and planned to ensure that they are executed safely and without risks to Health and safety. The factors to be assessed and planned will include: -

- The nature and stability of the material being excavated and the need for any support of walls.
- The effect of excavation on nearby area.
- The foreseeable presence of hazardous contaminants.
- The proximity of mobile plant.
- The provision of edge protection (fall prevention of people and materials)
- Access and egress

6.8. **Pipe Transportation and lowering**

- All drivers shall hold a valid driving license for the class of vehicle.
- Securing of the load shall be according to established and approved methods.
- All overhangs shall be made clearly visible and restricted to acceptable limits.
- Load shall be checked before moving off and after traveling a suitable distance.
- All vehicles used by Contractors shall be in worthy condition and in conformance to the Land Transport requirement.
- Use of certified side booms after 3rd Party inspection.
- Effective communication should be done among all involved personals.
- Signaling shall be done by authorized foreman only.
- Ensure appropriate measures are taken for overhead hazards.
- Persons are not allowed towards trench side / under the boom at the time of lowering.
- Co-ordination of lowering in by a single man only.
- Inspection of equipment before use.
- All personnel should stay clear of moving equipment.
- Use of certified lifting tools and tackles.

6.9. **Pressure / Leak Testing Hydraulic 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, radiographic 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

6.10. Scaffolding and Ladder

- All working platform must be constructed with the specific requirement of job.
- All portable ladders must be in good condition as per the site norms.
- 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.
- 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.
- Fall arrestor to be used where ever applicable.

6.11. **Work Permit Procedure**

- For working at more than 10' height the permission must be obtained from site in- charge.
- For doing any Hot work in the fire risk areas the permission must be obtained from site in charge or safety officer.
- For any Excavation work it must be ensured that there are no undergroup utilities like cables, Water pipeline etc.
- For any work inside confined space, entry permit must be obtained from site engineer.

6.12. **Barricades and Warning Signs**

- Area where work is being carried out above man height or below 1' ground depth must be barricaded.
- Follow the instruction of all types of warning signs like "NO SMOKING" "NO ENTRY" "DANGER"

  "Work at height"

6.13. **Emergency Plan and Procedures**

- All Contractor's employees should be aware of site Emergency control plan
- Periodic drill to train employees for their awareness & information should be followed.

6.14. **Road Safety Norms**

- For roadside working site to be barricaded as per approved barricading norms Penalty clause for road safety & barricading shall be applicable as per relevant clause of commercial part of tender.
- 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.

6.15. **Labour Welfare & Legal Requirement**

- All mandatory provisions with regard to safety as prescribed under contract Labour (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.

ANNEXURE – A

RELEVANT IS-CODES FOR PERSONNEL PROTECTION

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 & III)	:	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 moulding sole
IS : 5983 – 1978	:	Eye protectors
IS : 9167 – 1979	:	Ear protectors.
IS : 3521 – 1983	:	Industrial Safety belts and harness

ANNEXURE – B

FORMAT - 1.0
1.0 : 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
			Performance	Checker	Approver	Customer Review/ Audit Requirements

PREPARED BY REVIEWED APPROVED

2.0 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° 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				
Saftey 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 interruptors				
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 extinguiHSErs 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 cretches for children				
ERECTION				
Slings/ D'shakle 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 organised at site		
Number of HSE awareness programmes 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…..... 1 COPY
RCM/SITE-IN-CHARGE 1 COPY

SUPPLEMENTARY ACCIDENT, INCIDENT&NEAR MISS REPORT

Project:_____ Supplementary to Report No.:_____

(Copy enclosed)

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:_____

COTRACTOR_____

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

INDRAPRASTHA GAS LTD.

LAYING & CONSTRUCTION OF U/G STEEL PIPELINE NETWORK & ASSOCIATED WORKS FOR CONNECTIVITY OF CNG STATION AT CONCOR CONTAINER DEPOT DADRI, GAUTAM BUDDHA NAGAR

PTS – PIPING CLASSES

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1. SCOPE

Piping classes are established taking into account the following criteria:

- The medium to be handled.
- The surrounding.
- The referenced codes.
- The temperature-pressure rating.

1.1. Coding of Piping Classes

Each class is named by a code consisting in three

of four parts:

First part

A figure designating the rating and the code:

- 1 = 150 lbs ANSI
- 3 = 300 lbs ANSI
- 6 = 600 lbs ANSI
- 9 = 900 lbs ANSI

Second part

A letter designating the material:

- A = Alloy steel
- C = Carbon steel
- F = Fiberglass reinforced plastic/epoxy (FRP)
- G = Galvanized
- P = Plastic (PEHD, ...)
- S = Stainless steel
- V = PVC

Third part

A sequential number to differentiate two or more piping classes of the same rating and same material but presenting some differences related to the handled fluid.

Fourth part

A letter designating the underground:

- U = Underground

1.2. Wall Thickness

The wall thickness of pipe shall be as follows:

Wall thickness of pipe shall be calculated as specified in the applicable sections of :

- ANSI B 31.8 for classes covering the main process and auxiliary gas lines.
- ANSI B 31.3 for classes covering utilities lines.

1.3. Corrosion Allowance

The minimum corrosion allowance used to calculate wall thickness as follows:

- Carbon steel and ferritic alloys in classes calculated following ANSI B 31.8 : 1.6 mm
- Carbon steel and ferritic alloys in classes calculated following ANSI B 31.3 : 1.6 mm
- Stainless steel : 0 mm
- Plastic and FRP pipes : 0 mm.

1.4. Wall Thickness Calculation

a) Pipes for natural gas shall comply with ASME/ANSI B 31.8 code. Pipe wall thickness will be calculated as follows :

$$t = \frac{PD}{2xSxFxExT} + c \qquad (1$$

t = nominal wall thickness (mm)

P = design pressure (MPa)

S = minimum yield strength (MPa)

D = nominal outside diameter (mm)

F = design factor = 0.40

E = longitudinal joint factor

= 1.0 for API 5L Gr B / Gr 60 (seamless or ERW or SAW)

T = temperature derating factor = 1.0

c = corrosion allowance (mm)

b) Pipes for utilities lines have a wall thickness complying with ASME/ANSI B 31.3 code :

$$t = \left[\frac{PD}{2x(SE + PY)} + c \right] x \quad (1+a)$$

t	=	nominal wall thickness (mm)
S	=	allowable stress (MPa)
P	=	design pressure (MPa)
E	=	longitudinal joint factor
Y	=	coefficient as per table 304.1.1
C	=	corrosion allowance (mm)
a	=	negative fabrication tolerance (%)

INDRAPRASTHA GAS LTD.

LAYING & CONSTRUCTION OF U/G STEEL PIPELINE NETWORK & ASSOCIATED WORKS FOR CONNECTIVITY OF CNG STATION AT CONCOR CONTAINER DEPOT DADRI, GAUTAM BUDDHA NAGAR

PTS – WARNING MATS

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1.0 INTRODUCTION & SCOPE

INDRAPRASTHA UP GAS LTD. (IGL) plans to augment the PNG Network. It supplies natural gas to domestic & commercial consumers.

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 DEFINITIONS

Owner	Shall mean Indraprastha Gas Ltd. (IGL).
Manufacturer	Means the Manufacturer of the Warning Mat / Warning Grid / Warning Net / Warning Tape.
PTS	Means the present <<Particular Technical Specification>> and its entire appendix, if any.
TPIA	Means the Third Party Inspection Agency.

3.0 REFERENCE CODE

EN 12613 – Plastics warning devices for underground cables and pipelines with visual characteristics

4.0 FEATURES

4.1 Material

Warning Tape, Type 1 as per EN 12613 shall be used for the present project.

The material grade of Warning Mat shall be Virgin Low density polyethylene (PE) 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.

4.2 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.

4.3 Colour

The Warning Mat shall be of bright golden yellow colour. This colour must not take any alteration in the course of time.

4.4 Dimensions

Warning Mat shall have following dimensions:

Width 300 ± 2 mm
Thickness 1.0 mm (Minimum) Negative tolerance on the thickness is not allowed.

4.5. Marking

4.5.1 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 both English and Hindi, Chainage marking along with IGL's logo and IGL'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.

4.5.2 Vendor shall submit proposed Artwork to be marked on the Warning Mat for approval from Owner/ Owner's representative before start of production.

4.6 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:

4.6.1 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.

4.6.2 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 oC. 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 no 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.

4.6.3 Visual Warning Characteristics

The test shall be carried out in accordance with normative annexure A of EN 12613.

4.6.4 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. 65oC, a dry point of approx. 69oC and a density of approx. 0.68 gm/cm3.

After the test, the marking shall be easily legible.

4.6.5 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.

4.6.6 Warning Mat Virginity Test

Differential Scanning Calorimeter (DSC) Scan test along with the temperature of melting (Tm) 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 (Tm) shall then be compared with the DSC Scan curve and the Temperature of Melting (Tm) of its raw polymer (i.e. virgin LDPE).

To ensure the virginity of the Warning mat, the DSC Scan curve and Tm 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 Tm.

4.7. 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 per the commercial volume I of II.

7.0 RECOMMENDED MANUFACTURER FOR RAW MATERIAL

1. INEOS
2. BOREALIS
3. TOTAL PETROCHEMICALS
4. DOW
5. BASELL
6. RELIANCE
7. GAIL
8. HALDIA

However, any other reputed national or international Manufacturer may also be considering for supply of Raw material with approval of Owner / Owner's representative.

ΣΣΣ

INDRAPRASTHA GAS LTD.

LAYING & CONSTRUCTION OF U/G STEEL PIPELINE NETWORK & ASSOCIATED WORKS FOR CONNECTIVITY OF CNG STATION AT CONCOR CONTAINER DEPOT DADRI, GAUTAM BUDDHA NAGAR

GTS – SITE OCCUPATION

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1.0 SITE OCCUPATION

1.1 OCCUPATION OF THE SITE

The work site location will be specified in separate PTS.
As soon as the Contract is signed as per the contract agreement, the Contractor will proceed with the setting-up of the site camp / workshop in accordance with the stipulations of his price bid and as agreed with the Owner according to relevant approved drawings.

The Contractor shall excavate all the topsoil if necessary from the site and provisionally store it. The topsoil shall be treated in such a way that it remains free of weeds until it is put back again. The site shall be levelled, sealed and hardened with a layer of stone chippings (size 0-40, thickness 25 cm) and a top layer 12-20 (thickness 10 cm). The surface to be occupied will depend on the category of site camp / workshop and shall constitute one single unit for the section of the Owner. The Contractor's installation shall be located no more than 200 metres away from the Owner premises.

The Contractor shall take all the necessary precautions to ensure that the site always remains dry and usable. It must be possible to reach the site with trucks and cars from the public road. The site shall be arranged in accordance with the conditions set out in the building site regulations.

1.2 MARKING OUT AND PROVISIONAL FENCING

The entire terrain on which a site camp / workshop is to be located will be screened off by the Contractor with provisional fencing supply by the Contractor consisting of 2 metres high removable elements. The fencing shall be locked securely; display the necessary notices and is of such a design that it can only be dismantled with the use of tools. This enclosure shall be fitted with a lock and chain. The Contractor must hand over 2 keys to the Owner's representative.

1.3 EQUIPPING THE SITE CAMP / WORKSHOP

The term site camp / workshop shall be taken to include the area set aside for the storage of equipment.

Each installation shall comply fully with all the local rules and the statutory provisions.
If necessary, the Contractor shall take all necessary steps to ensure the timely acquisition of the licences for connections to the utilities and drainage from the Authorities involved.
During the work the Contractor must procure and maintain the camp and equipment which are necessary for the functioning of the workshop and additional equipment.

The Contractor shall make all the necessary arrangements to cater for an uninterrupted supply of fuel, lubricant, electricity, water, telephone, etc. during the work.

1.4 STORAGE OF MATERIAL

When the Contractor takes over the materials, he shall immediately store the materials supplied (or by the Owner, if any) in accordance with the code of good practice and the conditions set out in the building site regulations and GTS part 4. The Contractor shall provide a covered and locked storage area to store the protected materials. Each covered and locked storage area is provided with lighting. The material shall be stored in the immediate vicinity of the site offices.

1.5 CLEARING OF THE SITE INSTALLATION

The camp / workshop shall remain at the disposal of the Owner until restoration of the site is completed. After the site camp / workshop has been dismantled and removed, the Contractor shall restore the terrain to its original condition to the satisfaction of all Parties Concerned.

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GTS – DELIVERY & HANDLING OF THE MATERIAL

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1.0 DELIVERY AND HANDLING OF THE MATERIAL

1.1 GENERAL

The description and quantities of the materials supplied by the Contractor are described in the PTS and in the part lists.

The Contractor takes delivery of the items after a joint inspection with the Owner, after which the acceptance note drawn up by both parties is signed jointly.

When the materials are being received at site, the Contractor must take the required measures to:

- comply with the conditions of edited by the Owner in the purchase specification;
- avoid any form of damage and pollution;
- have sufficiently qualified personnel and equipment in relation to the quantity and type of deliveries available to handle and/or string them quickly;
- Facilitate the acceptance inspections.

All equipment used for taking delivery of, handling and/or stringing the materials must be approved by the Owner/Owner's Representative and accompanied by a certificate drawn up by the Owner's Representative.

Three sets of all documents delivered together with the materials must immediately be handed over to the Owner.

For pipeline elements (pipes, fittings, bends, etc.), the thickness specified in the parts lists are minimum thickness.

1.2 METHOD OF DELIVERY

1.2.1 Contractor's Responsibility

The Contractor will only be responsible for unloading on the construction site. The Contractor chooses the unloading site and ensures that the access roads are sufficiently stable and accessible for the trucks of the supplier. At least 5 working days prior to delivery, the Contractor sends an order form and a detailed plan indicating the unloading place and access roads to the representatives of the Owner/Owner's Representative on the worksite. The Contractor should be responsible to construct suitable covered stores, with proper safety measures, for storing all material which cannot be stored in the open shed or in the open.

1.3 ACCEPTANCE PROCEDURES

1.3.1 Direct deliveries on the site

The takeover by the Contractor of the pipe elements or other material directly deliver on the worksite will be carried out during the uplifting of the elements.

1.3.2 Take over report

The takeover report is drawn up jointly (Contractor and supplier) and must, among other things, include the following information:

- The length of each pipe and the individual number;
- The identification number of the equipment and pipeline element;
- Any visible damage (scratches, dents, etc.);
- An estimation in dm^2 of the defects in the pipe external coating, visible or detected by means of a holiday detector (for test voltage see GTS part 9);
- Any remarks regarding the deliveries.

1.4 MATERIAL TO BE SUPPLIED BY THE CONTRACTOR

1.4.1 Supplies

The materials indicated as “Contractor supply” on the part lists are supplied by the Contractor. For direct supplies to the worksite, the Contractor shall present the material supplied at least 2 working days prior to assembly to the Owner in order to control jointly the quantities supplied.

All costs resulting from late deliveries or from supply of damaged or defective material shall be borne by the Contractor. When some materials cannot be supplied, the contractor shall submit another option in writing to the Owner/Owner’s Representative, taking into consideration the initially fixed term of delivery. The option is not accepted without the Owner’s prior written consent. For the electrical equipment instruments and installation located in hazardous area classified as class 1 zone 0, 1 and 2 the Contractor will hand over to the Owner/Owner’s Representative the required certificate of conformity.

1.4.2 Extra supplies

Materials not listed on the part lists and that are required for normal operation shall be listed by the Contractor and communicated in writing to the Owner prior to the start of the works. These materials shall be purchased by the Contractor with no cost effect to the Owner.

1.5 DEFECTS NOTED IN PIPELINE ELEMENT AND/OR EQUIPMENT AND THEIR METHOD OF REPAIR

Damage and defects that are noticed at the time of delivery and expressly described in the takeover report will be borne by the Contractor. The repair and removal of damaged parts shall be carried out by the Contractor at their own expense.

Damage and defects noticed after delivery must be repaired at the expense of the Contractor, as well as any extra costs due to the inspection work of the Owner’s Representative. In the event of any non-conformity of the material at the time of delivery, the Contractor must immediately inform the Owner/Owner’s Representative before accepting the delivery. If this condition is not observed, the Contractor will be the sole responsible for all the consequences resulting therefrom.

1.5.1 Defect noted in pipeline element

Any defects noted in the pipeline element may under certain conditions be repaired. Nonetheless, the final decision whether or not to use repaired pipeline element rests with the Owner/Owner’s Representative.

1.5.1.1 Surface defects in the metal

Surface defects noted in the pipe metal may be removed by grinding/polishing as long as the thickness of the wall, obtained after grinding, remains within the tolerances of the relevant standard and codes.

All repaired superficial defects shall be examined by the inspection organisation by means of ultrasonic, electromagnetic or penetrant testing. If these wall thickness tolerances cannot be

respected, the damaged part must be cut away. The undamaged parts will be bevelled again and bear an identification number, etc.

1.5.1.2 Dents in the metal
The pipes must show no evidence of dents. The damaged part shall be cut out and the undamaged parts will be bevelled again and bear an identification number, etc.

1.5.1.3 Defects to the external coating
Defects to the external coating must be repaired by the Contractor as specified in GTS part 9.

1.5.2 Defects to equipment and accessories
All defects must be reported to the Owner/Owner's Representative. Defects noted in the equipment (shut-off valves, safety valves, relief valves, regulator, etc.) must be repaired by the equipment supplier in order to maintain the guarantee. Defects to accessories (fittings etc.) must be inspected by the Owner's Representative and repaired according to their instructions by the Contractor.

1.6 STORAGE AND HANDLING OF MATERIALS
The Contractor shall provide separate storage areas for all materials delivered by the Owner. Pipes, pipe parts and equipment must be handled with sufficient care so that all damage is avoided.

1.6.1 Storage and handling of equipment
The Contractor shall pay special attention to the handling and storage of control devices (regulator, filters, shut-off valves, operators, meter, etc.) so that this equipment is supported adequately and in a correct manner and completely protected against infiltration of dirt and humidity.

The Contractor should enquire with the Owner/Owner's Representative which method should be used for lifting special devices. The Contractor shall ensure that all openings in the equipment are sealed. The Contractor should provide all the means required to ensure that the external coating, paint and metallic paint are not damaged.

1.6.2 Storage and handling of pipes
The Bidder shall enclose a stacking drawing with his bid. The pipeline elements may not come into direct contact with the ground or be placed on unsuitable supports. Encrustation's of gravel, stones, wood, etc. must be carefully avoided. Continuous contact of the pipeline parts with each other - in particular, pipes stacked cross-wise - is forbidden. To this end, cushions, wickerwork, bags of straw or other flexible materials must be provided over a sufficiently large surface area. The Contractor will assure the stacking of pipes in such a way that rules out any permanent deformation of the pipeline element taking account of their weight and resistance.

The maximum stacking height for PE-coated pipes, depending on the diameter of the pipe, is shown in the table below:

Nominal diameter	Number of layers, stack height
□ 150	12
200 - 250	10
300 - 350	8
400 - 450	6
500 - 650	5
> 700	3

Between the ground surface and the first layer there shall be a free height of 20 cm. The pipes shall be placed on a suitable support so that damage to the coating and deformation of the pipes are avoided. The bottom layer of pipes will be sufficiently supported at the sides to ensure stable stacking. The lower pipes shall be supported from 0.75 m from their ends and crosswise

at least every 4th meter.

During periods of high temperature, the Owner may require protection of the coating against the sun. Newly manufactured pipes that are delivered directly by the pipe supplier to the site may contain static electricity which must be discharged before handling the pipes. All supplementary material (supports, cushions, wickerwork, etc.) must be delivered in suitable quantities by the Contractor. The use of hooks without Teflon protection is not permitted.

1.6.3 Storage areas

The Contractor shall provide the following storage areas on the site :

- A covered and locked storage room for the storage of all small material and all materials or packaging's that are not weather-resistant.
- A marked-off stacking area for all large material that is weather-resistant.

1.6.4 Stringing of the pipes (pipeline construction)

The Contractor specifies the method of handling in the execution method file. The pipes shall be distributed by the Contractor along the pipeline alignment in the working area. He shall ensure that they do not hinder the traffic and shall prevent their lying too long in a situation that would be harmful to them (intactness, quality of coating). Transportation will be effected with suitable equipment to prevent damage to pipes and terrain. In rainy weather or on unstable subsoil, transportation will only take place with vehicles fitted with caterpillar tracks. The pipes must be laid on wooden blocks at least 0.15m x 0.15m x 1m or sand bags. The blocks or sand bags shall be provided by the Contractor.

1.7 PIPE OFF CUT

1.7.1 General

The Contractor shall keep a detailed inventory of the pipes received, per type of pipe, and a note of their location. On every 15th and 30th day of the month, the Contractor shall provide the Owner//Owner's Representative with a detailed summary of:

- The pipes off-cut that can still be used in the lifetime of the Contract (minimum length, without defects and numbered, see Article 6);
- The rejected pipes, stating the reason for their rejection.

Before the end of the leak tests, the Contractor must provide the Owner with an inventory of the surplus pipes.

The term "surplus pipe" is defined as: Any pipe that can immediately be reused (undeformed, numbered, coating and chamfers in good condition), bearing the individual pipe number, stamp of the Owner's Representative, origin, type and length.

1.7.2 Pipeline construction

The pipe surpluses are the responsibility of the Contractor. Before termination of the strength and leak tests the Contractor will draw up a final account of the pipes and transmit it to the Owner/Owner's Representative.

1.8 RETURNING of owner's surplus materials

The Contractor shall be responsible for collecting, transporting and unloading surplus material. This material must be sufficiently clean so that it cannot be distinguished from new. Returned material shall always accompany a document that shall be drawn up by the Contractor and countersigned by the Owner/Owner's Representative. Material that is defective and/or unaccepted by the Owner will be charged to the Contractor.

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GTS – WELDING

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1.0 WELDING

GENERAL

This specification is based on the EN specification; if the API 1104 is applicable and stipulated in the PTS then the following paragraphs must be adapted as per API 1104.

1.1 QUALIFICATION OF WELDERS

Any welding procedure specification (W.P.S.) approved by the Owner's Representative can only be put into practice by approved qualified welders in accordance with EN 287.1 standard (latest issue).

The standard EN 287.1, latest issue "Approval testing of welders-fusions welding - part 1 - Steels" shall serve to qualified the welders.

- The Contractor will take all the necessary measures to implement the welder qualification tests.

  The qualification tests will be made using a coupon of a line-pipe. Every welder will execute a test weld using a qualified procedure.

- A welder who has successfully completed the qualification test shall be qualified.

- Every welder shall execute for his qualification test a weld at least on half the circumference of the pipe starting from the top of the pipe until the bottom.

- If the W.P.S. specifies a procedure for a single welder.

- The welder will execute the weld test on the entire circumference of the pipe.

- A welder can only participate once to the qualification test. If he didn't complete successfully the qualification test session, he will be disqualified for the present contract.

- Before production welding is started the Contractor will submit to the Owner/Owner's Representative as well as to the inspection organisation the list of the qualified welders he intends to employ and their actual welding post.

1.2 WELDING PROCEDURE QUALIFICATIONS

1.2.1 General

Otherwise stated in the Particular Technical Specification the welding procedures shall be drawn up, qualified and tested in accordance with the latest versions of the standards referred to below:

a) Pipeline construction

EN 288.1 :	Specification and approval of welding procedures for metallic materials - Part 1: General rules for fusion welding.
EN 288.2 :	Specification and approval of welding procedures for metallic materials - Part 2: Welding procedure specifications for arc welding.
EN 288.3 :	Specification and approval of welding procedures for metallic materials - Welding procedure test for the arc welding of steels.

EN 288.9 : Specification and approval of welding procedures for metallic materials - Welding procedure test for on land and offshore site butt welding of transmission pipelines.

b) Station construction and junctions.

EN 288.1 : Specification and approval of welding procedures for metallic materials - Part 1: General rules for fusion welding.
EN 288.2 : Specification and approval of welding procedures for metallic materials - Part 2: Welding procedure specifications for arc welding.

N.B.:

When interpreting the above standards, the Contractor must always assume that impact bar test and hardness measurements will be required.

The contract boundary shall be defined as the boundary between the pipeline work and the station construction.

The characteristics of the pipeline elements are described in the Particular Technical Specifications or in the invitation to tender. In any case, the Contractor himself shall at all times obtain the necessary information from the Owner concerning the characteristics of the pipeline elements.

The Contractor shall take into account that it is possible that the pipeline sections of different wall thicknesses or different steel qualities will have to be welded together.

The pipes are manufactured in accordance with the Standard specified in the PTS. The Contractor may obtain further information concerning the chemical composition of the materials from the Owner/Owner's Representative.

1.2.2 Preliminary welding procedure specifications

- The Bidder shall attach to every preliminary Welding Procedure Specifications (p W.P.S) he wishes to use during the execution of the work (station line work, etc.) the Bidder to use the template as show in the standard EN282.2.
- Each p W.P.S. will comply with the standard including additional requirements.
- Once the Owner has approved and ordered the work, the Contractor shall, on the basis of the p W.P.S submitted for approval to the Owner's Representative, establish and qualify a Welding Procedure Specifications (WPS). After qualification a final W.P.S. including the range of approval will be established.
- If when submitting the tender the Bidder already has some qualified W.P.S. (Welding Procedure Specifications) which meet the requirements of the specifications he may present the definitive WPS directly to the Owner.
- Once the Owner has approved and ordered the works, the WPSs will be submitted to the Owner's Representative for approval.

1.2.3 Additional essential variables

Over and above the provisions of the standards: - EN 288.3 (station construction) the Owner stipulates a number of additional requirements.

These additional requirements are described in the table below.

Additional essential variables marked "in accordance with EN 288.9" are interpreted both for pipeline construction and for station construction on the basis of the EN 228.9 standard and the additional requirements.

Additional essential variables	Range of Application	
	Piping fabrication	Station construction
1. Filler metal Cellulose electrodes used for the welding in an uphill or downhill direction have to be approved by the Owner's Representative. The Contractor shall support his compliance with an EN 10204-3. 1.B certificate issued by the manufacturer of the electrode. Subject to approval by the Owner, an EN 10204-2-2 certificate may be accepted for low pressure. The Owner/Owner's Representative may check the conformity and proper storage conditions of the filler metal at any time.	X	X
2. Heat management The heat input is measured and calculated on the basis of standard EN 13916.	X	X
3. Preheating The preheating temperature is measured on the basis of specifications imposed by standard EN 13916. The prescribed preheating temperature may not be exceeded by more than 100°C. If preheating is requested the equipment's installed will be able to sustain the preheating temperature specify in the W.P.S. If the ambient temperature is lower than +5°C and/or the weld joint is damp, the pipe must be preheated to a temperature between 50 and 70°C.	X	X
4. Cleaning method	X	X
5. Connection type according to EN 288.9 Significant changes in joint type, e.g. from a V-Groove to a U groove, require a new WPS. The bevel angle is not an essential variable. The root face must be equal to 1.6 mm ± 0.8 mm. In downhill welding, the actual joint opening must be equal to 2.5 mm with tolerances of +1 mm and - 0 mm. In uphill welding, the welding procedure remains valid as long as the actual joint opening is smaller than or equal to 1.4 times the qualified gap if this is smaller than 6 mm and 1.3 times if the qualified gap is more than 6 mm.	X	X
6. Pipe clamps Pipe clip type: internal clamp external clamp	X	

Additional essential variables	Range of Application	
	Piping fabrication	Station construction
7. Time interval between two passes according to EN 288.9		X
8. No. of welders according to EN 288.9 For pipelines in which diameters of ND 400 and greater are used, a minimum of two welders is required irrespective of the W.P.S.	X	X
9. Partially completed welds according to EN 288.9		X
10. Welding procedure for repairs according to EN 288.9 For repairs on both the external and internal surface, the fully-welded joint is ground out over a minimum length of 300 mm (repairs must always be carried out in an uphill direction).	X	X
11. Number of beads according to EN 288.9 • internal • external • weld sequence	X	X

1.2.4 Qualification tests

1.2.4.1 Introduction

The qualification test for the test weld and the inspection techniques are applied according to:

a) Pipeline construction : EN 288.9

b) Station construction, valves station : EN 288.3

Qualification tests must be carried out with the material which the Contractor will use for the execution of the works. The pipes for the qualification tests must be taken from a batch of line pipes which have been purchased for the execution of the works.

The preparation and execution of the weld, the inspections and qualification tests shall be attended by the Owner's Representative.

All costs associated with the qualification of a welding procedure such as materials, tests and work carried out by the Contractor and the Owner's Representative shall be borne by the Contractor. For all these operations, the Contractor shall order the work directly to the Owner's Representative prior to carry out the tests.

1.2.4.2 Additional requirements stipulated by the Owner

In order to complete all the tests required for a W.P.S. a certain number of test welds has to be performed the number of coupons depends on the diameter the thickness and the steel grade employed.

1.2.4.3 Non-destructive tests

All pipes with minimum yield strength equal to or higher than 415 N/mm² must, in addition to visual and radiography, are subject to an ultrasonic (100%) and electromagnetic (100% after grinding out the reinforcement on the internal surface) examination.

All pipes with minimum yield strength equal to or higher than 289 N/mm² must, in addition to visual and radiographic inspection, are subject to ultrasonic (100%) and electromagnetic (100% after grinding out the reinforcement on the internal surface) examination if the wall thickness of the pipe exceeds 8 mm.

The acceptance criteria for the visual inspection which must be applied are stipulated in Part 7, Article 7.2.1.1.

The acceptance criteria and the method of execution for the radiographic inspection are stipulated in API 1104. The ultrasonic testing is carried out according to ASME V - Art. 5 and assessed according to ASME VIII- Div 1-App 12. The electromagnetic inspection is carried out according to ASME V - Art. 7 and assessed according to ASME VIII- Div 1-App 8.

1.2.4.4 Destructive tests

- Before the tests are carried out, test welds using a cellulose electrode may be rendered hydrogen-free. This is carried out by heating the test weld to a temperature of 200 - 250°C for a minimum of six hours.

- Impact tests (Charpy V-notch)

  Impact tests are required for welds with a wall thickness of 5 mm or more.

  The test temperature is -20°C.

- The minimum impact values to be achieved are:

  per test piece: 35 J/cm²

  for one of the three test pieces: 28 J/cm²

  Average of the three test pieces: 35 J/cm²

- Bend testing

  Extra bending tests are required for pipelines. For further information refer to the impact test section of EN 288.3.

1.2.4.5 Additional test welds

a) Application:

An extra test weld is required for steel types with an yield strength in excess of 415 N/mm² in which only the penetration bead is performed. The shape and dimensions of the test piece shall be identical to those of the first test weld.

b) Non-destructive testing :

The test welds are (100%) examined electromagnetically along the inner surface of the pipe after the excess material has been ground off the penetration bead.

The electromagnetic examination is carried out according to ASME V - Art. 7 and evaluated in accordance with the acceptance criteria of ASME VIII - Div 1 - App 6.

c) Destructive testing :

- Macro graphic examination of the imperfections observed in the electromagnetic examination. 4 micrographics are taken.
- Hardness measurement at the level of the penetration bead, in the parent metal, in the heat affected zone and in the penetration bead. The hardness shall not exceed 400 HV10.
- No grinding is allowed, irrespective of its dimensions or location.

1.2.5 Qualification of the welding procedure for repairs

EN 288.9 applies to both station construction and pipeline fabrication.

1.3 WELDING OF PIPELINE ELEMENTS

1.3.1 Welding conditions

All welds and weld repairs shall be carried out in accordance with the welding procedures qualified by the Owner's Representative.

In the event of wind or rain affecting the stability of the arc, welding tents shall be used. The means of protection against rain and wind shall be subject to the approval of the Owner.

If the welding procedure specification, and by the same token the welding procedure qualification, do not give any special instructions concerning the interpass temperature and rest times between the different runs, the times between the different runs for steel types with an yield strength in excess of 350 N/mm² shall be kept to a minimum.

Each interruption in welding shall remain limited to 30 minutes and in any case to a maximum of the time required for the metal to cool down to 50°C.

One end of the pipe shall be sealed off during welding.

The welded pipe elements (modules or pipe sections) shall be supported in a stable manner without damaging the coating of the pipe.

The height of the supports must be such that each weld is at least 30 cm above the ground. Wooden blocks, 150 x 150 x 1000 mm or sand bags will be used.

In automatic ultrasonic testing the weld connections shall be at least 50 cm above the ground and all welds shall be free of splashes, corrosion and varnish, etc. over a distance of 12 cm on either side of the weld.

The reinforcement of the longitudinal or spiral weld on the external surface of the pipe shall be removed over the same distance.

The length of a single welded string will not exceed 1 000 meters.

1.3.2 Preparation of the welding work

1.3.2.1 Verification of good condition of pipes and fittings

The Contractor shall check the condition of the pipes and fittings. Any defects (scratches, indentations, chips in the bevels, etc.,) shall be reported to the Owner/Owner's Representative.

1.3.2.2 Preparation of the pipe ends

The Contractor shall take account of the fact that the pipe ends may be protected with an anti-rust primer.

The ends of the pipes (bevel and root face) shall be cleaned with a metal brush, file or grinder. The bevels shall have an even surface free from laminations tears, scale, slag, grease, paint, etc.

1.3.2.3 Joint preparation

The pipe ends are bevelled according to the pipeline technical delivery conditions.

If pipes of unequal thickness must be joined, the Contractor shall carry out the necessary additional joint preparation himself to bring the joint preparation into line with fig. 15 of standard ASME B 31.8.

Should a cut be made, the cutting material and the working method shall be subject to the approval of the Owner/Owner's Representative.

The unprocessed pipe ends shall be ground so that the bevels and root faces meet the requirements of the WPS.

The individual pipe number and the approval stamp of the Owner's Representative shall be transferred to the pipe element which does not contain this information. In the absence of these data, the pipe element in question shall be rejected and considered unfit for reuse.

1.3.2.4 Alignment

a) General

For both longitudinally seam and helical seam welded pipes, the pipes shall be positioned so that the ends of the longitudinal or helical welds of two successive pipes are offset from each other by at least 100 mm, measured on the circumference.

b) Pipeline fabrication

All longitudinal seam welds must be in a circular sector of 45° along either side of the lowest traced line of the pipe.

c) Station construction

For pipeline branches, a distance of 100 mm shall be maintained between the longitudinal seam or helical seam weld and the butt weld of the branch.

The zone cut out of the pipe shall be examined by ultrasound beforehand (zone of 100 mm along and around the complete weld).

If a distance of 100 mm cannot be maintained between the longitudinal or helical seam weld and the butt weld of the branch, the longitudinal seam or helical seam weld of the pipe shall be examined ultrasonically beforehand over a distance of at least one diameter along either side of the zone to be cut.

If these checks reveal any unacceptable imperfections, another zone shall be sought.

1.3.2.5 Handling of pipes during welding and support of the pipeline

The pipes shall not be manipulated during the welding of the first run (root bead). Thereafter they shall be supported on wooden blocks or sand bags without creating any additional stresses.

1.3.3 Arrangement of the pipe elements

1.3.3.1 Pipeline fabrication

Working in line:

The length of the pipes to be welded shall be at least twice the pipe diameter, with a minimum of 1 m. Bridging sleeves form an exception to this rule: their length shall be a minimum of 1 x □.

On either side of each circular joint, only one round joint shall be permitted within a distance of 8 m.

1.3.3.2 Gas Stations (and valve stations)

The number of welds shall be limited to a strict minimum. Should a bridging sleeve be used, it shall be at least 1 x □ in length.

The welds shall be carried out as pipe-to-pipe connections. Thus for a butt weld where moulded pieces are used, the pipe sections shall be welded to them first.

1.4 WELD NUMBERING AND WELD DATA RECORDS

1.4.1 Numbering

1.4.1.1 Pipeline fabrication

In accordance with the provisions of Part 2, the Contractor shall indicate the kilometre points along the working strip.

The welds between KP 0 and KP 1 are numbered 000/0001, 000/002, 000/003 etc. The welds between KP 1 and KP 2 are numbered 001/001, 001/002, 001/003 etc. All tie-in welds between KP 0 and KP 1 are numbered 000/101, 000/102, 000/103 etc.

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

1.4.1.2 Gas station construction and valve stations

In the gas stations, the welds shall be numbered according to the Owner particular numbering system or numbering system approved by him and/or Owner's Representative.

Example of a gas station numbering system (for information only):

9.99.999 / *ST*XX / 9999 where;

9.99.999 = the code number of the installation of the Owner

ST = standard 'ST' to indicate 'STATION'

XX = the first two letters of the name of the gas station

9999 = maximum of four figures for the individual weld number.

1.4.1.3 Applying the weld numbers

The Contractor will submit for approval to the Owner/Owner's Representative the way he will indicate the weld number on the pipes.

The Contractor shall apply the weld number next to each weld in a correct and legible manner using an indelible product.

1.4.2 Welding data records

The Contractor shall provide the Owner/Owner's Representative on a daily basis with all the information for inspection and technical files, i.e. for every weld, root head, filler beads and finish beads:

- The ID of the welders who have carried out the welds;
- The weld number
- The date of the execution of the weld
- The individual numbers of the joined pipes and/or accessories, their grade, nominal thickness, origin and length
- The WPS used
- The number of repairs or cut out welds, the reason for repair and the date of repair.

All these data must be signed by both the Owner/Owner's Representative.

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LAYING & CONSTRUCTION OF U/G STEEL PIPELINE NETWORK & ASSOCIATED WORKS FOR CONNECTIVITY OF CNG STATION AT CONCOR CONTAINER DEPOT DADRI, GAUTAM BUDDHA NAGAR

GTS – INSPECTION AND TESTING OF PRODUCTION WELDS

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1.0 INSPECTION AND TESTING OF PRODUCTION WELDS

1.1 GENERALITIES

Except otherwise specified in the PTS, the number of field butt welds selected for non-destructive examination the ASME code B 31.8 shall govern.

The Owner's Representative shall determine the non-destruction examination method applicable and their specific field application.

The Owner/Owner's Representative shall supervise and inspect the welding activities in accordance with the provisions laid down in the Codes.

The Owner/Owner's Representative is also exclusively responsible for its personal interventions and decisions as supervisor and inspector of the welding activities.

Except otherwise stated by the Owner and the Owner's Representative. The inspection and testing of production welds will be carried out in accordance with the provisions of the provisions of the ASME B 31.8 code and the standard mentioned in this chapter.

1.2 TESTING OF WELDED JOINTS AND ACCEPTANCE CRITERIA

The welded joints shall be tested prior to painting or coating.

1.2.1 Non-destructive testing

1.2.1.1 Visual inspection

The visual inspection shall be interpreted in accordance with API 1104 with the following additional requirements:

- Arc ignition points:
  - □ 0.5 mm: acceptable if ground out
  - > 0.5 mm: unacceptable and cut out
- Mass clamp craters
  - □ 0.5 mm: acceptable if ground out
  - 0.5 mm - 1.5 mm: acceptable if ground out and welded according to repair procedure
  - > 1.5 mm: unacceptable and cut out

1.2.1.2 Radiographic testing

1.2.1.2.1 Test method and acceptance criteria

- Radiographic testing with X or gamma rays shall be carried out in accordance with the provisions of API Std 1104.

1.2.1.2.2 Scope of the radiographic testing

Except otherwise stated in the PTS by the Owner/Owner's Representative for the number of field butt welds selected for examination the ASME code B.31.8 shall govern.

1.2.1.3 Ultrasonic testing

1.2.1.3.1 Test method and acceptance criteria

The ultrasonic testing shall be carried out in accordance with ASME V - Art. 5 and API 1104.

The number of field joints welds selected for ultrasonic examination is specified by the Owner/Owner's Representative.

1.2.1.3.2 Scope of the test

a) Minimum test planned

- For the stations and valves stations all welds will be inspected by ultrasound.
- Welded joints which are welded using external clamps (e.g. tie-ins welds) shall be 100% tested by ultrasound.

b) Supplementary tests

Further to a decision by the Owner/Owner's Representative (for example in the event of cracks), all the welds carried out in the course of that day may be tested with ultrasound and if necessary this inspection may be extended to all welds. If these tests bring to light any defective welds, the Contractor shall carry out the repairs at his own expense.

1.2.2 Other test methods

As well as the non-destructive tests described above, the Owner/Owner's Representative may decide to carry out additional destructive or non-destructive tests, such as

- magnetic particle test
- liquid penetrant test
- weld sampling
- Any other destructive or non-destructive test methods.

The acceptance criteria for the magnetic partial test and liquid penetrant test are defined on the basis of the following standards:

- Magnetic particle test
  - Method: ASME V - Art 7
  - Acceptance criteria ASME VIII- Div 1 - App 6 and API 1104.
- liquid penetrant test
  - method ASME V - Art 6
  - acceptance criteria ASME VIII- Div 1 - App 8 and API 1104

The acceptance criteria for the weld samples shall be the same as for the welding procedure qualification.

1.2.3 Destructive tests

When laying a new pipeline the Contractor shall cut out one production weld per 15 km (minimum one cut out if the pipeline is shorter than 15 km) with a minimum of 50 cm of material on either side of the weld.

The production welds to be cut out shall be selected by the Owner's representative on site or the Owner's Representative. The Contractor shall present this production weld for destructive testing in the laboratory of the Owner/Owner's Representative.

1.3 IDENTIFICATION OF INCOMPETENT WELDER(S)

The Contractor shall, within the limits of the welding procedure, form welding teams in such a way that incompetent welders can be identified at any time.

If the tests show that the majority of imperfections can be traced to the same welder(s), the Owner/Owner's Representative can require the exclusion of this/this welder/s.

1.4 IMPLEMENTATION OF THE NON-DESTRUCTIVE TESTS

Radiographic tests are usually carried out daily after the completion of the weld if the day's welding production is sufficient for the daily output of one radiologist.

No tests shall be carried out on strings which are still being welded even if the usual deadlines are compromised as a result.

Ultrasonic tests shall in principle be carried out 24 hours after welding.

1.5 ANNOUNCEMENT OF TEST RESULTS

Only binding for work carried out during normal working hours.

1.5.1 Welding of tie-ins, special points, and repairs

1.5.1.1 Radiographic testing

Subject to the approval of the Owner/Owner's Representative, in urgent cases, the Owner/Owner's Representative shall inform the Contractor verbally of the provisional test results within the hour following the photograph by interpreting the wet film.

The results shall not be definitive until the dry film has been examined.

The deadline for verbal communication of the definitive results shall be twelve hours following the announcement of the results when they have been interpreted from the wet film.

1.5.1.2 Visual and ultrasonic testing

The results of these tests shall be given verbally at the time of the test.

Written communication of the results shall be carried out in the same way as described in Article 7.5.1.

1.6 INSPECTION OF FILMS BY CONTRACTOR

Before carrying out any repairs, the Contractor may inspect the relevant film himself. The film remains the property of the Owner.

1.7 LOCAL REPAIRS AND CUT-OUT OF DEFECTIVE WELDS

1.7.1 General

The Contractor shall be obliged to repair welds or re-weld or cut out welds which are deemed defective by the Owner/Owner's Representative. This shall be carried out within normal working hours.

Each repair of a defective weld, whether local or total, shall be carried out within the two working days following the announcement of the results by the Owner/Owner's Representative. The performance of the repairs implies that the Contractor agrees with the interpretation of the non-destructive testing.

1.7.2 Pipeline construction

Cut-out welds shall be repaired by welding in a connection sleeve. The repair shall be prepared and undertaken in accordance with the requirements of this specification.

If local circumstances permit, and subject to the agreement of the Client and Owner/Owner's Representative, a cut-out weld may be remade without using a connection sleeve by displacing the adjacent pipe elements. The cut, as well as the new bevels, the positioning of the pipes and the performance of the new weld shall be carried out in accordance with the current specifications.

If there are separate procedures for tie-in welding and line welding, a cut-out weld shall be replaced according to the same welding procedure as for a tie-in weld.

1.8 SHARING OUT THE TEST COSTS

Testing during normal working hours

	Visual inspection	Radiographic testing	Ultrasonic testing	Other test methods	Destructive testing
Minimum inspection prescribed in Articles 7.2.1., 7.2.2., 7.2.3.	Contractor	Contractor	Contractor	Contractor	Contractor
Inspection above the minimum of Articles 7.2.1., 7.2.2	Contractor	Contractor	Contractor	Contractor	--
Inspection of repairs	Contractor	Contractor	Contractor	Contractor	--

1.9 NDT Agency

The list of NDT agency to be engaged for radiographic inspections is mentioned in List of recommended vendors (A. 21) in Technical Vol ii of ii. However in case vendor is willing to engage some other agencies, than same may be done upon approval of EIC, if found suitable as per technical standards and based on credentials and approvals/reports submitted by Vendor.

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GTS – COATING

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1.0 COATING

1.1 GENERAL

1.1.1 Purpose of the coating

The purpose of the external coating is to insulate the steel pipe as much as possible from the ground and from every incidental structure located in the ground.

1.1.2 Material to be coated

Except otherwise stated in the PTS the Contractor supplies:

- Line pipes with a polyethylene external coating that meets the requirements of standard DIN 30 670 unless otherwise specified in the Specifications.
- Uncoated fittings, uncoated moulded pieces, uncoated valves and uncoated hot bends.
- Valves with protegol coating.
- at the following places, for station construction, uncoated pipes that the Contractor shall coat:
  - For buried sections
    - All vertical pipes provided with a protection of reinforced polyester (ground passages).
    - All underground pipes □ □ 600 and a length < 1.5 m.
    - All underground pipes □ > 600 and a length < 2.5 m.

1.1.3 Obligation of the Contractor

The Tenderer shall specify in his bid the type of external coating that he will use and attach a certificate of conformity of the supplier specifying that the material to be used meets DIN 30 672 and/or DIN 30 673 and/or NEN 6909.

1.1.4 Obligation of the Contractor

The Contractor shall thus:

- Submit a quality control certificate from the supplier stating that all products supplied comply with the requirements
- Apply the coating on the buried bare pipeline parts
- Apply the coating on the buried welded joints
  - Make all the required repairs to defects in the external pipe coating.
- Provide special protection at places indicated in the special execution conditions of the PTS or drawings.

1.1.5 Overview of the coating systems to be accepted by the Owner/Owner's Representative

The pipeline sections can be coated by means of:

- bitumen (asphalt)
- bituminous tapes reinforced with fiber glass
- PE wrapping tape
- Heat shrinkable sleeves
- plastic instant repair, tape
- polypropylene
- 2 components: coal tar epoxy

1.1.6 Definition of the type of coating according to application

- Bare pipes and hot bends are coated with plastic wrapping tape.
- Welds joints can be coated with plastic wrapping tapes or heat shrinkable sleeves.
- Moulded pieces can be coated with plastic wrapping tape, or bituminous tape.
- Bare valves will be coated with Denso tape or equivalent.
- Valves with protegol coating will be repaired with 2 components: coal tar epoxy.
- Reinforced heat shrinkable sleeves or equivalent will be used for pneumatic impact mole or thrust boring system.

1.1.7 Material used by the Contractor

The properties of the devices and machines used for the coating process (melting equipment) must be approved by the Owner/Owner's Representative. This material must be properly maintained and checked.

1.1.8 Personnel

The personnel employed by the Contractor for onsite coating of the welded joints must be in possession of a certificate of qualification issued by the supplier of the coating products certified by Owner's Representative.

1.1.9 Safety measures for installations in service

- The Contractor must take the required safety measures when removing and applying the coating to live installations in accordance with a procedure agreed with the Owner/Owner's Representative. In each case, work may only be carried out on a live installation with a work procedure and fire licence and under the constant supervision of the Owner/Owner's Representative.
- The formation of condensation in live installations can be removed by heating the section of pipe to a maximum of 50° C on small surfaces with an electric hot air blower.

N.B.:

Before buried valves are coated, the Contractor will check that the position of the body relief valves and the lubricant valves are in the “open” position. The valves may only be operated in the presence of the Owner/Owner’s Representative.

1.2 PREPARATION OF THE SURFACES TO BE COATED

The products must be applied to a surface that is completely dry and free of all impurities such as rust, scales, lamination tears, slags, grease, oil, paint, etc. Tar, grease, oil and all other greasy substances must first be removed by means of an approved solution (e.g. 1,1,1-trichloro-ethane) or an emulsifier. White spirit or turpentine may not be used. The pipe surfaces and the welded area should then be mechanically cleaned to a degree of cleanliness ST 2 in accordance with ISO 8501-1.

This mechanical cleaning must be carried out by means of mechanically driven rotating steel brushes. After this surface preparation has been carried out, the surfaces should be completely free of weld spatters slags, rust, lamination tears scales, paint or varnish stains and other foreign substances and impurities.

The mechanical cleaning must be continued to at least 10 cm beyond the existing intact coating, in such a way that all dirt is removed and the coating is roughened to ensure good adhesion. The intact coating will be chamfered at the extremities to an angle of 15 to 30° in order to form a perfect joint.

1.3 IDENTIFICATION OF ALL buried JOINTS

The Contractor will identify each buried joint by means of small aluminium plates that must always be positioned on the upper side of the welded joint. A first self-adhesive aluminium plate with the information in accordance with Part 6 will be stuck to the welded joint after applying the primer coat. A second self-adhesive aluminium plate will be placed above the joint after applying the coating. The uppermost plate must be kept visible and secured at the sides with PE tape.

1.4 WEATHER CONDITIONS WHEN CARRYING OUT THE WORK

In order to achieve optimum results during the coating work, it is essential that no condensation occurs on the blasted or cleaned surface or between the different layers. For this reason, the temperature of the surface to be coated should be at least 3°C higher than the dew point or condensation temperature of the surrounding air. The dew point of the air is given in the table below for a number of conditions of air temperature and relative atmospheric humidity.

Air Temp.	**Dew point in °C with a relative humidity of**								
°C	50 %	55 %	60 %	65 %	70 %	75 %	80 %	85 %	90 %
5	- 4.1	- 2.9	-1.8	-0.9	0.0	0.9	1.8	2.7	3.6
6	- 3.2	- 2.1	-1.0	-0.1	0.9	1.8	2.8	3.7	4.5
7	- 2.4	- 1.3	-0.2	0.8	1.8	2.8	3.7	4.6	5.5
8	- 1.6	- 0.4	0.8	1.8	2.8	3.8	4.7	5.6	6.5
9	- 0.8	0.4	1.7	2.7	3.8	4.7	5.7	6.6	7.5
10	0.1	1.3	2.6	3.7	4.7	5.7	6.7	7.6	8.4

11	1.0	2.3	3.5	4.6	5.6	6.7	7.6	8.6	9.4
12	1.9	3.2	4.5	5.6	6.6	7.7	8.6	9.6	10.4
13	2.8	4.2	5.4	6.6	7.6	8.6	9.6	10.6	11.4
14	3.7	5.1	6.4	7.5	8.6	9.6	10.6	11.5	12.4
15	4.7	6.1	7.3	8.5	9.5	10.6	11.5	12.5	13.4
16	5.6	7.0	8.3	9.5	10.5	11.6	12.5	13.5	14.4
17	6.5	7.9	9.2	10.4	11.5	12.5	13.5	14.5	15.3
18	7.4	8.8	10.2	11.4	12.4	13.5	14.5	15.4	16.3
19	8.3	9.7	11.2	12.3	13.4	14.5	15.5	16.4	17.3
20	9.3	10.7	12.0	13.3	14.4	15.4	16.4	17.4	18.3
21	10.2	11.6	12.9	14.2	15.3	16.4	17.4	18.4	19.3
22	11.1	12.5	13.8	15.2	16.3	17.4	18.4	19.4	20.3
23	12.0	13.5	14.8	16.1	17.2	18.4	19.4	20.3	21.3
24	12.9	14.4	15.7	17.0	18.2	19.3	20.3	21.3	22.3
25	13.8	15.3	16.7	17.9	19.1	20.3	21.3	22.3	23.2
26	14.8	16.2	17.6	18.8	20.1	21.2	22.3	23.3	24.2
27	15.7	17.2	18.6	19.8	21.1	22.2	23.2	24.3	25.2
28	16.6	18.1	19.5	20.8	22.0	23.2	24.2	25.2	26.2
29	17.5	19.1	20.5	21.7	22.9	24.1	25.2	26.2	27.2
30	18.4	20.0	21.4	22.7	23.9	25.1	26.2	27.2	28.2

In certain exceptional cases where there is frost or dew, coating can be applied provided the Contractor properly dries the surfaces to be coated before applying it and for this purpose uses a method approved by the Owner/Owner's Representative.

1.5 APPLICATION OF THE COATING

1.5.1 Coating with plastic wrapping tape

1.5.1.1 Composition of the coating

- The coating material proposed by the Contractor to the Owner/Owner's Representative must comply with DIN 30 672 or EN 12068, class C for operating temperature up to 50°C and must be DIN DVGW certified.

  The heat shrinkable sleeves must comply with DIN 30672 or EN 12068 classes C for operating temperature up to 50°C.

- For moulded pieces, branching pieces and flanges, the plastic wrapping tape must meet:

  EN 12068 class C for operating temperature up 30°C or 50°C or DIN 30 672, class C for operating temperature up to 30°C or 50°C as stated in the PTS.

Note:

For the compression station and within an area of 1 000 meters after the station the wrapping will comply with DIN 30672 or EN 12068 class C for operating temperature up to 50°C.

- The plastic wrapping tape and primer must be supplied by the same manufacturer.

1.5.1.2 Applying the coating

The Contractor shall draw up a working procedure accordingly to the supplier instructions and recommendations for the welded joints, bare pipes etc. as well as for the fittings, valves, relief pipes etc.

1.5.2 Coating with bituminous tapes

1.5.2.1 Composition of the bitumen coating

The coating material proposed by the Contractor to the Owner/Owner's Representative must comply with the standard EN 12068 Class B for operating temperature up to 50°C.

The coating consists of:

- An oxidised bitumen-based priming or adhesive layer, solutions containing hydrocarbon and an adhesive to be applied to all blank metal parts. The product must comply with the provisions of the General Regulations for the Protection at Work.
- One or more petroleum bitumen-based plastic layers when the primer coat is sufficiently dry.
- A double reinforcement made of fibre glass (45 gr. per m2) set in the above-mentioned plastic layers.

The minimum thickness of the bitumen coating will be 4 mm and must at least be equal to the thickness of the existing pipe coating.

1.5.2.2 Application of the bituminous coating

The Contractor shall draw up a working procedure accordingly to the supplier instructions and recommendations for the welded joints, bare pipes etc. as well as for the fittings, valves, relief pipes etc.

1.5.3 Coating with heat shrinkable sleeves

1.5.3.1 Composition of the coating

The contraction sleeves must meet DIN 30 672 class C operating temperature up to 50°C.

1.5.3.2 Application of the heat shrinkable sleeves

The Contractor shall draw up a working procedure accordingly to the supplier instructions and recommendations for the welded joints, bare pipes etc. as well as for the fittings, valves, relief pipes etc.

1.6 REPAIRING OF THE COATING

Any defects detected will be repaired by the Contractor under the supervision of the Owner/Owner's Representative. In places where the coating has been removed, reworked or repaired, the inspection will be conducted by the Contractor by means of a holiday detector under supervision of the Owner/Owner's Representative.

The Contractor will only be paid for repairs that were accepted under the responsibility of the Owner at the time of the hand-over of the materials. In the case of adhesion defects, insufficient thickness of the coating, inaccurate positioning and/or bad impregnation of the

reinforcement, the presence of traces of humidity, of air-pocket and solid particles, the coating will be removed and completely repaired.

1.6.1 Repairing PE Coating

1.6.1.1 Repairing PE coating with plastic wrapping tape

a) Repairing small defects in the PE coating that do not reach down to the metal by means of plastic wrapping tape.

- Preparation :

  Roughen the PE surface around the point faults with a brush disk. Dry the PE surface over the entire pipe circumference with the propane burner to a pre-heating temperature of 30°C. Apply adhesive plastic wrapping tape over the entire pipe circumference in accordance with the supplier instructions and recommendations.

b) Repairs to other defects in the PE coating with plastic wrapping tape.

- Preparation :

  Cut out the damaged PE surface around the defect to the point where the coating is adhering properly. Chamfer and roughen the edges of the existing coating. Clean the whole surface to be coated with a brush disk to a degree of cleanliness S.T.2.

  Dry the entire part to be coated with a propane burner to 30°C. Apply primer to the cleaned steel surface and the PE coating over the entire pipe circumference.

  Fill in the hole that has appeared with mastic filler.

  Apply adhesive plastic wrapping tapes over the entire pipe circumference in accordance with the supplier instructions and recommendation.

1.6.1.2 Repairing PE coating with plastic repair patch

This method can be applied to all PE damage up to a maximum size of 350 mm x 350 mm. except for directional drillings The plastic repair patch must comply with DIN 30672 class C.

- Preparation :

  Cut out the damaged PE surface around the defect to the point where the coating is adhering properly. Chamfer and roughen the edges of the existing coating. Clean the entire surface to be coated with a brush disk to a degree of cleanliness S.T.2.

  Dry the entire part to be coated with a propane burner to 60°C. Fill in uneven spots and holes with mastic filler. Apply the correct size adhesive plastic repair patch and heat it until the pigment has disappeared. The repair patch must be smaller than the roughened PE surface area.

1.6.1.3 Repairing PE coating for directional drilling

The repair is carried out by means of a heat shrinkable sleeve reinforced with fibre glass or epoxy reinforced with fibre glass or of a specific proposal submitted by the Tenderer.

1.6.2 Repairing bituminous coating

1.6.2.1 Repairing small damaged areas □ 1cm²

Small damaged areas in bituminous coating must be repaired by heating the bitumen and sealing the defect using a spatula.

1.6.2.2 Repairing large damaged areas > 1cm²

- Preparation :

  The damage must be cut out in a rectangle. Clean the whole surface to be coated with a brush disk to a degree of cleanliness S.T.2. Dry the surface to be coated with a propane burner to 30°C and then apply a primer. Apply the bituminous coating in accordance with supplier instructions and recommendations.

1.6.3 Repairing protegol protection

Some valves are provided with a protective layer consisting of Protegol UT 32-10 R applied according to the supplier instructions and recommendations. The repairs must be carried out with Protegol UT 32-10 L applied with a brush and according to the instructions of the supplier.

1.7 REMOVAL OF COATING

The Contractor shall draw up the method for "removal of the pipe coating" and submit it to the Owner/Owner's Representative for approval.

1.8 QUALITY CONTROL OF THE CORROSION PROTECTION

Independently of the inspection of the method of execution, the conditions of use of the products and the material for the realisation of the coating, the Owner/Owner's Representative reserves the right to examine systematically the continuity of the insulation and to inspect the adhesion, the thickness, the position of the fibre glass fabric and his correct and complete impregnation, the presence of any trace of humidity, of any air pocket or of any solid particle by taking samples.

When pipelines are being constructed and laid, the Owner/Owner's Representative will check, after backfilling, the electrical resistance of the coating by means of detection devices suitable for detecting any drops in potential through the coating (see Part 13). The Contractor will bear all costs resulting from the repair of the defects detected.

1.8.1 Systematic inspection

The Contractor will check the quality of the pipes insulation protections over their entire length at the appropriate time by means of a detector or a holiday detector.

This inspection will be carried out in the presence of the Owner/Owner's Representative who reserves the right at any time to check the proper functioning of the device. The holiday detector will be clearly identifiable by means of an individual number engraved in an identification tag attached to the apparatus. A certificate, drawn up by the TPIA, will attest that the apparatus complies with a recognised code. Verification is effected with a high- voltage voltmeter HV-40, calibrated by a calibrated testing bench (ball diameter 20 mm) according to the 50 % method.

For a preset scale value of 0.65, the maximum permitted deviation of the output voltage for 5 V can be 15 %. For a preset scale value of 8.3 the maximum permitted deviation of the output voltage for 25 V can be 10 %.

Besides the calibration, the HV-cable and handle, the sealing ring, the earthing cable and earthing as well as the carrying case must be accepted by the Supervisory Body. The maximum validity of the certificate is one year.

The test current of the device must be in accordance with the type of coating and must meet the standard according to which this coating was executed. During holiday detection, the pipeline and the holiday detector will be interconnected continuously by means of a copper wire, regardless of the length of the pipeline.

Specification of the test current for the inspection with the holiday detector:

- 5 kV/mm of coating thickness + 5 kV; maximum equal to 25 kV unless otherwise instructed by the supplier (protegol = max. 5 KV).
- The holiday detector may only be used when the coating is completely dry and after thorough removal of dirt from the surface.
- Inspection with the holiday detector is carried out before laying and after the repair of the defects.

All welded joints will be checked with a holiday detector after application of the welded joint coating in the trench.

1.8.2 Inspection by sampling

A test sample with a surface area of 15 cm^2 will be cut out as soon as the coating has reached ambient temperature. There is a defect in the adhesion when this operation makes the plastic layer come loose without tearing.

Moreover, the Owner/Owner's Representative will check the thickness of the coating, the position of the reinforcement and his complete impregnation as well as the presence of any trace of humidity, air pocket or solid particles.

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GTS – EARTHWORKS FOR LAYING PIPELINE

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1.0 EARTHWORKS

1.1 EXCAVATIONS

1.1.1 General

1.1.1.1 Sequence of operations

As a general rule, the trench is excavated on the basis of the lengthwise profile. With specific soil types (rocks, solid blocks, etc.), it may nevertheless occur that the Owner/Owner's Representative require the excavation of the trench wholly or partially before the length profile has been drawn up and therefore before the changes of direction of the pipe have been carried out.

If this method is not prescribed, it may nevertheless be implemented at the suggestion of the Contractor who will then present to the Owner/Owner's Representative the necessary argumentation based on his surveys and soundings. In any case the permission of the Owner/Owner's Representative is required.

If the Owner/Owner's Representative requires or accepts this method, the Contractor shall draw up the lengthwise profile on the basis of the trench actually excavated. After the Owner/Owner's Representative has approved the lengthwise profile thus drawn up, the Contractor shall once more carry out the changes of direction of the pipe on the basis of this profile.

1.1.1.2 Method of execution

Before commencing excavations, the Contractor must in every case submit the work procedure and the material for the approval of the Owner and the Administrations concerned.

If the Contractor wishes to use explosives, he automatically undertakes to keep and use them in accordance with the regulations currently in force and with the approval of the Authorities concerned and of the Owner/Owner's Representative. The supply of the explosives is the responsibility the Contractor as is the procurement of the required permits from the authorised official bodies.

If due to local circumstances the Owner/Owner's Representative deems it necessary, the Contractor shall carry out the excavation work manually without entitlement to any further payment.

In particular, the Contractor must detect all the cables, pipelines, services, etc. of the concessionary companies by means of a sufficient number of inspection holes before any pipes and cables etc. are exposed. Uncovering them will be carried out manually and according to the rules set out in the Town Planning requirements. The capacity of the excavator is specified on the basis of the following tables:

- Using an excavator bucket is not allowed

Values can be obtained in these tables to limit the maximum force capacity of excavating machines working in the vicinity of the utility services to a certain maximum value in accordance with the practical possibilities. Two values are given in the tables, i.e. a force capacity (Fcap.) and a weight (W) derived from it based on average experimental values, and a force capacity (Fsafe) and a weight (Wsafe) derived from this based on a statistical lower limit for these experimental values. In the first instance, it is recommended to choose the values based on the lower limit and, if practically possible, lower still in order to incorporate a certain safety margin.

- Installations operated at a maximum working pressure of 66 bar

Diameter mm	s mm	F_{cap} kN	W ton	F_{safe} kN	W_{safe} ton
114.30	4.37	52.54	2.6	39.25	0.0
168.27	7.1	87.99	10.1	67.81	5.8
219.07	8.2	110.96	15.0	87.34	10.0
273.05	5.6	110.24	14.8	88.31	10.2
323.85	6.3	130.43	19.1	105.92	13.9
355.60	6.3	137.73	20.6	112.69	15.3
406.40	6.3	149.13	23.1	123.32	17.6
508.00	6.9	179.81	29.6	151.38	23.5
609.60	6.8	203.59	34.6	173.91	28.3
914.40	10.1	325.44	60.4	287.17	52.3
1016.00	13.6	409.90	78.1	364.04	68.6

- Installations operated at a maximum working pressure of 80 bar

Diameter mm	s mm	F_{cap} kN	W ton	F_{safe} kN	W_{safe} ton
114.30	4.37	53.78	2.9	40.18	0.0
168.27	7.1	89.92	10.5	57.11	3.6
219.07	8.2	113.64	15.5	78.39	8.1
273.05	5.6	113.73	15.6	81.61	8.8
323.85	6.3	134.71	20.0	100.45	12.7
355.60	6.3	142.55	21.7	111.30	15.0
406.40	6.3	154.80	24.3	119.75	16.8
508.00	6.9	187.23	31.1	140.98	21.3
609.60	6.8	212.52	36.5	165.73	26.6
914.40	10.1	339.81	63.5	244.82	43.3
1016.00	13.6	425.23	81.6	358.98	67.5

If it is deemed necessary for the laying of the pipe that cables, pipelines, poles or pylons have to be shifted or divert temporarily, this should take place in accordance with the directives of the Parties Concerned. If these activities cannot be carried out by the managers or owners concerned, they should be carried out by the Contractor or by a subcontractor in possession of the required professional qualifications or recognition.

If in spite of all safety measures a pipe or cable is nonetheless damaged, the works must immediately be halted and the Owner/Owner's Representative and the concessionary company concerned must be informed without delay. In addition, the Contractor shall provide all the assistance required for the repair work at his own expense.

If unforeseen obstacles appear during excavation work (old foundations, posts, bunkers, etc.), these must be removed in accordance with the indications of and in consultation with the Owner/Owner's Representative and possibly the Authorities concerned to at least 0.50 m below the underside of the pipe to be laid and evacuated from the site. "Good filling soil" should subsequently be used for backfilling.

If the subsoil appears to have several layers, each layer shall be stored separately from the other and later replaced in accordance with the original layering if these layers differ in density, elasticity or hydraulic permeability. If the excavated material is composed of layers of peat, the following rules shall be applied:

- peaty soil in layers with a thickness < 30 cm is not stored separately but mixed into the backfill soil;
- Peaty soil in layers with a thickness > 30 cm is stored separately and mixed into the arable soil. The excavated volume, less the volume of the pipeline, shall be replaced by stone-free soil.

In the case of clay or rocky soil, the Contractor shall choose his working method in such a way that the excavated material is sufficiently crushed to ensure correct backfill of the trench.

If the Contractor wishes to use a mechanical trencher in areas with different subsoil's, he must submit a study that indicates that the new structure of the subsoil is at least equivalent. In the following areas, the use of a mechanical trencher is forbidden because this causes irreparable structural damage:

- Areas with the presence of thin layers of silt clay (from 20 to 100 µm) and sand or clay layers.
- Areas with sedimentary chalk and peat.
- Areas with peat and clay layers.
- Areas with large presence of basic and carbon-containing material, and layers with very high iron content.

1.1.2 Underground obstacles

When the Contractor comes across buried cables, pipelines and drainage networks during excavation work, he must take the following measures:

- protect and support the cables, pipelines, drainage networks, etc. as the works progress;
- complete the inventory of fixture of the services encountered during excavation with the parties involved and the Owner/Owner's Representative;
- Immediately after digging the trench, the Contractor shall survey the existing drainage systems in the presence of the Owner/Owner's Representative.

  The drains must be made visible by placing blue-painted posts at the edges of the trench. The drains must be closed off on both sides of the trench if they are not directly included in a drainage system laid out by the Contractor.

  However, this does not diminish the Contractor's obligation to keep the existing drainage systems in operation and not to affect their functioning. After surveying the drains, the posts shall be positioned on the outside of the working area. These measurements shall immediately be set out by the Contractor in a 1/1000 layout drawing. This drawing shall mention for each Owner plot number:

  - the position of each drain measured in relation to a fixed reference point;
  - direction of slope;
  - type and inner diameter of the drainpipe;

- condition of the drain;
- Depth of the drain in relation to the surface.

And one copy of it shall be given to the Owner/Owner's Representative at the latest two working days after the excavation. The Owner/Owner's Representative will carry out the required inspection and if necessary the required corrections will be communicated to the Contractor. Three copies of the accepted drawing will be given to the Owner.

- The "Report of the Presence of Drainage Networks" (see Appendix 1) shall then be filled in together with the tenant/owner and the representative of the Owner;
- In the event of any damage, a proposal for repairs must be submitted for the approval of the Owner/Owner's Representative and the Parties Concerned;
- Observe a clearance of a least 0.20 m between the nearest parts of the cables, pipes and drains at points at which they cross and 0.40 m where they are parallel. These distances should be increased wherever possible especially where they approach large installation. So as to reduce, as far as possible, any risk to neighbouring installation inherent in the Contractor works.
- Adapt the profile design, if necessary.

1.1.3 Trench position

The trench shall be dug in such a way that is is symmetrical in relation to the axis of the channel actually market out.

Directional changes on the trench floor should tally with the draft longitudinal profile perfectly – both horizontally and vertically – and with changes in pipe direction, so that welded pipe sections lie in a continuous and uniform manner along the trench floor.

To ensure that the above changes correspond, the Contractor shall conduct a topographical survey, in the presence of the Owner/Owner's Representative, after the trench has been dug and before laying the pipe in the trench.

1.1.4 Trenches depth

1.1.4.1 Minimum depth

The trench depth should allow a minimum covering of 1.1 m between upper generatrix of the pipe and the general ground level even if the drawings require a smaller minimum covering. The covering is defined as the vertical distance between the reference levels. The provisions of this article take precedence over the measurements shown on the drawings.

The Contractor is not entitled to increase his price if in local circumstances the pipe has a covering varying between 1.10 m and 1.40 m and/or if the increased depth (greater than 1.40 m) has already been stipulated in the Particular Technical Specifications or detail drawings and/or statutory permissions.

If the local additional depth could not be known beforehand and no supplementary storage space for piling up soil was provided on that basis (cf. Part 2), the Contractor should store the supplementary excavated soil on the access road. Such storage should be carried out in conformity with Part 2 of the GTS.

The Contractor shall ensure that when storing another type of soil on the access way it shall be kept separate from any other soil thus stored and that during the works no mixing shall occur due to works traffic. The Contractor shall himself be responsible for the inspection of

the covering of the pipe after it has been laid in the trench, independently of the measurements that the Owner/Owner's Representative Carries out for drawing up the technical archives.

1.1.4.2 Depths greater than the minimum

Except otherwise stated in the Particular Technical Specifications or the detail drawings and the Authorities concerned, the Contractor shall provide a greater trench depth:

- when the pipeline lies underneath a road or crosses a road;
- In such cases, a covering of 1.2 m is required between the upper generatrix of the pipe and the road surface;
- When the pipeline crosses a watercourse in an open cut. In this case, a covering of minimum 1.3 m is required between the upper generatrix of the pipe and the theoretical profile if this profile is lower than the existing natural profile. If the theoretical profile is higher than the natural profile, a covering of minimum 1.3 m is required between the upper generatrix of the pipe and the natural profile;
- When the pipeline crosses a waterway by means of a borehole. In this case, a covering of minimum 1.3 m is required between the upper generatrix of the casing and the theoretical profile if this profile is lower than the existing natural profile. If the theoretical profile is higher than the natural profile, a covering of minimum 1.3 m is required between the upper generatrix of the casing and the natural profile;
- When the pipeline crosses a ditch. In this case, a covering of 1.1 m is required between the upper generatrix of the pipe and the natural profile of the dredged and deepened ditch, with gauging down to compact ground;
- When the pipe crosses a railway, a minimum covering of 1.6 m is required between the upper generatrix coating of the casing and the bottom of the rail. Except otherwise requested by the railway Authority, the crossing should be perpendicular to the rails.
- When the pipe is located in a casing.
- In this case, a covering of minimum 1.2 m is required between the upper generatrix of the casing and the surface;
- When the pipe has additional equipment (half shells, ballast, anchoring, etc.).
- In such cases, there shall be a minimum covering of 1.1 m measured between the top side of the protection and the surface;

N.B.

Concrete slabs are considered as a mechanical protection and not as an additional equipment and are placed 30 cm above the upper generatrix of the pipe;

Where under-ground obstacles are encountered, well-defined distances must be maintained.

1.1.4.3 Permitted reduction of the minimum trench depth

If, exceptionally, the minimum depth of the trench cannot be achieve due to local reasons, the Contractor will, provided he has received permission from the Owner/Owner's Representative, provide special protection (binders, half shells, concrete slabs, concrete tiles, etc.). The method of execution must be submitted beforehand for the approval of the Owner/Owner's Representative and the Parties Concerned.

1.1.5 Trench width

The foot of the trench must always have a minimum width equal to the outer diameter of the pipe with its coating and any mechanical protection plus at least 20 cm (10 cm on either side). If local circumstances dictate (ballast, anchoring, half shells, etc.), a wider trench shall be provided depending on the space required to ensure proper execution and complete filling up around the pipe.

When using a mechanical trencher, the foot of the trench shall have a width equal to the outer diameter of the pipe with its coating and any mechanical protection plus at least 40 cm (20 cm on either side). The Contractor must take the required precautionary measures to prevent the trench from caving in. In dry, non-cohesive ground, for example, the angle of the bank may at most be equal to the angle of the natural embankment.

In any case, the Contractor must take account of unfavourable factors such as water flowing into the trench, vibrations and excessive loads near the trench, heterogeneity of the ground, the trench remaining open for a long time, etc. Trench side shall under no circumstances be vertical.

1.1.6 Dimensions of the working pits

In places where welding must be carried out in the trench, the Contractor shall execute the working pits and/or connecting pits (“Under gas”) so as to facilitate welding as well as the inspection and coating thereof. The working pits must be kept dry. The minimum dimensions of these working pits are:

- length: distance between the welded joints + 2 x 1 m
- width: diameter of the pipe + 2 x 1 m
- the distance between a part fixed (e.g. valve) and the wall of the recess should be 0.60 m min;
- Depth: 0.6 m under the pipe.

The minimum dimensions of connecting pits “Under gas” are :

- Length: length of the pipe element to be put in place + 2 x 1.5 m.
- width : ∅ of the pipe + 2 x 1 m for a ø smaller than or equal to 300 mm

  ∅ of the pipe + 2 x 1.5 m for a ø of 300 to 600 mm

  ∅ of the pipe + 2 x 2 m for a ø larger than 600 mm
- Depth: free space of at least 0.8 m under the pipe.

1.1.7 Shoring the trench and/or work pit

If the type of terrain makes it difficult to obtain a stable trench and in the vicinity of buildings, existing structures, cables and pipelines, the Contractor must, among other things, with a view to safety, use the required means for shoring up the trench walls. As a matter of principle, all temporary timbering sheathing and sharing shall not be left behind in the trenches and/or work pits.

Nevertheless, the Owner/Owner’s Representative may, if he judges that the stability of the construction work requires it, oblige the Contractor to leave these struts in place. The

Contractor shall keep the trench dry and stable until after the topographical measurements and until after the activities of the Owner's Representative have been completed.

Moreover, the Contractor is obliged to provide the assistance required and to ensure the safety of all personnel working in the trench and/or work pit, even if certain activities take place after normal working hours in the interest of the progress of the site.

1.1.8 Appearance of the trench bottom and trench walls

1.1.8.1 Trench bottom

The trench bottom should be evened out depending on the changes of pipeline direction. The bottom of the trench must be completely flat and free of all stones, debris, tree trunks, tree roots, remains of welding electrodes, sharp objects, etc. which would impede the proper execution of the work and damage the pipeline coating.

If the bottom of the trench is rocky or gravely or contains hard objects, the Contractor must apply a layer of sand or light soil to protect the pipeline coating so that any protruding points are covered by at least 20 cm.

The application of top soil instead of sand or light soil is forbidden as is the separation of the subsoil into light soil and stones when this would change the properties of the subsoil in the trench in relation to the surrounding situation. The Contractor may apply a special protection with the approval of the Owner (lathes, neoprene, geo-textile fabric, etc.).

1.1.8.2 Trench walls

The trench walls must be free of hard and protruding points to avoid damaging the pipeline coating when it is being lowered in.

1.1.9 Water run-off drainage of the trench and work pits

Before starting the drainage operation, the Contractor should apply for the required licences from the administrations concerned. If there is no suitable discharge point to hand in the vicinity (waterway, brook, drain, etc.), closed discharge pipes must be installed to a suitable discharge point. Laying these pipelines, procuring the required licences for this purpose and the right of way and any compensation to be paid are the responsibility of the Agreement. Water from the drainage operation shall only be discharged into a canal, ditch, waterway or drain. The dewatering pipes shall extend to these drainage points laid just outside the working area and buried and protected if they cross the access way. Under no circumstances shall the dewatering pipes discharge onto the adjoining terrain outside the working area.

The pumps may be placed on the outside of the working strip. Only pumps muffled for sound may be used. Only electrically driven pumps connected to the mains electricity network may be used in the vicinity of houses.

The discharge water may not under any circumstances run freely over the terrain. The removal of discharge water may cause neither damage nor nuisance to third parties. Any pollution, silts, etc. accumulated during the work must be evacuated by the Contractor after completion of the work at his own expense. The Tenderer shall attach to his bid a note in which the different types of dewatering methods are described in detail.

Prior to the start of the works, the Contractor should ascertain the correct height of the water table. He should also carry out some test bore-hole or soundings. The Contractor shall at regular intervals analyse the discharge water at his own expense. The quality thereof should always conform to the standards laid down (inter alia, the content of salt, iron, heavy metals, foreign matter, pH, etc.).

The dewatering operation or horizontal drainage should be carried out in good time so that when excavations start the trench will be sufficiently dry and the Owner/Owner's Representative can check the condition of the trench bottom before lowering in the pipeline.

The dewatering operation should, moreover, be kept in operation if this is necessary for the execution of the works, the topographical measurements, the activities of the Owner's Representative, connecting up to the telemetry cable and backfilling.

The dewatering operation should be stopped in such a way that the water table rises slowly and regularly. When the dewatering wells are removed, the bore-holes must be filled in with sand.

In any case, care should be taken to prevent the pipeline from floating the dewatering operation fails or is stopped. The installation of the dewatering operation shall be carried out by an expert subcontractor or by the Contractor himself if he can prove that he is sufficiently competent and experienced in this field.

Any damage to third parties installations, buildings, plantations, crops, etc. as a consequence of drawing off ground water by the dewatering operation should be reported without delay to the Owner/Owner's Representative and to the Authorities or private persons concerned. The Contractor, and only the Contractor, will be held responsible for this.

More particularly, the Contractor shall take the required measures if in consequence of the dewatering operation certain water wells run dry or if the course and/or the flow of natural springs are affected by the laying operations.

The Contractor shall bear the consequences of any disruptions to the water discharge system that he causes as a result of works of any kind whatsoever, both within the construction sites and in the vicinity thereof. He must ensure the protection of the construction site continuously against water to prevent any detrimental effect on the execution of the works.

1.1.10 Rocky soil

1.1.10.1 General

In rocky soil, the trench must be excavated with a mechanical trencher fitted with suitable teeth which assures maximum fragmentation of the excavated material.

The rocky soil is excavated with a mechanical trencher and backfilled with fine crushed stone. If the use of a mechanical trencher is unfeasible for technical reasons, such as:

- terrain's with a slope greater than 20%
- in bends with a bending radius smaller than 40D
- at special points

Excavation is carried out with an excavator equipped with a toothed back-hoe which is permitted provided all stones with a diameter greater than 30 mm are crushed prior to backfilling or gathered, transported to a recognised waste disposal site and replaced by stone-free ground.

1.1.10.2 Classification of rocks

The classification of rocks on the basis of their natural cohesion comprises three classes:

- Class 1 Weathered rocks
- Class 2 Uneathered rocks

- Class 3 Compacted rocks

- Class 1 :

  All kinds of rocks can appear in this class provided the cohesion of their components are reduced by weathering or crumbling. In this way, small broken pieces occur which are referred to as weathering material. This material can be excavated with an ordinary excavator.

- Class 2 :

  These rocks show little or no sign of weathering or crumbling and can be excavated with a normal excavator equipped with a toothed back-hoe.

- Class 3 :

  The rocks show no sign of weathering or crumbling and can be considered as the mother rock. This rock can only be excavated with the use of a pneumatic rock breaking hammer mounted on an excavator. When encountering areas with a rocky soil structure, the Owner/Owner's Representative will determine to which class the rocks belong with the help of a geologist.

1.2 BACKFILLING THE TRENCH

1.2.1 General

Before backfilling the trench, the Contractor must make sure that all the required work has been completed before backfilling (cathodic protection, anchoring, ballast, etc.). In addition, he must take account of the work that has to be carried out during backfilling (teletransmission cable, mechanical protections such as half shells, concrete slabs, warning tape, warning net, etc.).

1.2.2 Survey to be carried out prior to backfilling

Before backfilling the trench, the Contractor will take measurements for drawing up the technical archives.

The measurements relate to:

- position of the pipe;
- covering of the pipeline;
- location of the welded joints, concrete slabs, anchorings, ballast, connections of the telemetry cable, cable and connection boxes of the potential measuring points, etc.;
- Determination of the angles and the position of each change of direction.

  Backfilling may in principle be started after the abovementioned measurements have been completed and the results communicated to the Owner/Owner's Representative.

1.2.3 Working method for backfilling

1.2.3.1 Lower part

The trench shall be backfilled to 10 cm above the pipe with light soil or sand. The light soil or sand must be free of all hard objects (stones, gravels, material that has been broken up, etc.) that might damage the coating. Filling in around the pipe must be carried out in such a way

that all voids are filled so that later no subsidence of any kind will occur. As a matter of principle, all the different layers of earth shall be replaced as they were excavated.

If the excavated material contains no light soil or sand that could serve for this first backfill without changing the characteristics of the excavated material in relation to the surrounding subsoil, the Contractor shall provide for the importation of light soil or sand. The use of salty sand, gravel, coal slag, iron slag, etc. is forbidden.

In certain special cases, the Owner/Owner's Representative may stipulate methods of protection during the course of the works that are better suited to the local circumstances (see table).

In hot weather, backfilling may only be carried out if resistance to depressions on the pipeline coating permits it. If this resistance is insufficient, the Contractor shall carry out the backfilling only if the coating and the backfilling material have cooled off sufficiently. Filling in with frozen soil is also forbidden.

- Backfilling systems

TYPE OF FILLING SOIL	BACKFILLING SYSTEM
good filling earth	backfill with excavated soil
crushed rocky soil from the trencher	apply geo-textile fabric, min. thickness 8 mm. Fill in with excavated soil
medium rocky soil (1) particles < 30 mm	sand bed of 20 cm in trench bottom (2) apply geo-textile (3) or rock shield (5) fill in with excavated soil max. 0/30
rocky soil with (1) particles > 30 mm	sand bed to 30 cm above and 20 cm under the pipe (2) or non-rotting interlocking wooden lathes, thickness min. 15 mm (4) or geo-textile fabric or rock shield (5) with infill with particles smaller than 30 mm(3) to 30 cm above and 20 cm under the pipe

(1) Filling method to be approved by Owner/Owner's Representative.
Drop height of the filling soil must be limited to the absolute minimum.

(2) Filling with sand-bed only applicable on flat terrain.
On sloping terrain, an alternative protection method shall be used.

(3) Geo-textile fabric must be approved by the Owner/Owner's Representative min. thickness 8 mm.

(4) Non-rotting interlocking wooden lathes, min. thickness 15 mm, must be approved by the Owner/Owner's Representative.

(5) Rock shield protection must be approved by the Owner/Owner's Representative.

1.2.3.2 Upper part

The thickness of the layers and the frequency of compacting depend on the type of backfilling material. If this backfilling material contains large stones or blocks of rock, these fragments shall be laid in the trench provided the stones are not heavier than 50 kg and the layer of light soil over the pipe must be at least 30 cm.

The upper part of the backfill shall be carried out in consecutive layers. Each layer must be tamped down to avoid hollow spaces which might later lead to subsidence. Each layer shall be put back in such a way that the original layering of the terrain is respected.

Backfilling is carried out with layers max. 30 cm thick. The Contractor must draw up a work procedure for compacting with a description of the compacting equipment that he wishes to use and their functioning. Compacting the filling soil must be carried out continuously by repeated processing of each layer with compacting equipment. The humidity shall be checked before compacting.

After compacting, the soil that has been put back must have the same penetration-resistance characteristics as the soil for the works, and this to a depth of 1m. This may be checked by the Owner/Owner's Representative using a penetrograph.

1.2.3.3 Top soil layer (arable soil)

In places where the arable soil has been taken away for storage, it shall be replaced and levelled in its original position. The top soil layer, which must be put back at its original height, shall be completely free of foreign objects.

If for one reason or another arable soil must be brought in from outside the working area, it must have the same physical and chemical characteristics as the original soil. The soil brought in should be free of debris or remains and of weed seeds.

Before placing the soil back on the working way, the subsoil should be raked up to restore the natural hydraulic permeability of the ground. The Contractor shall carry out an inspection in the presence of the Owner/Owner's Representative to determine the extent and depth of the compaction. The rake depth shall be determined by mutual consultation, depending on the results and taking account of the drainage presence.

1.2.4 Works during backfilling

1.2.4.1 Reinforced concrete slabs as mechanical protection for the pipe

The Contractor is responsible for the supply and placing of the reinforced concrete slabs in the places defined in the PTS or in the relevant drawings. The concrete slabs shall meet the specifications of the typical drawing.

The concrete slabs shall be laid in such a way that there is a 30 cm layer of soil or sand between the pipe and the concrete slabs. The slabs must be placed in a dry trench.

Partial backfilling of the trench to 30 cm above the pipe shall be carried out as described before. Prior to lay the concrete slabs, this partial backfilling shall be compacted in a adequate manner.

Before backfilling - necessary for the laying of the concrete slabs the Contractor shall take same measurements as described in para. 10.2.2.

The concrete slabs must be laid in such a way that they are centred on the centre-line of the pipe. The Contractor should take all the measures required to mark out the pipe's centre-line after partial backfilling to ensure that the concrete slabs are laid correctly. A warning tape (width 6") shall also be laid on the concrete slabs.

1.2.4.2 Warning signs

1.2.4.2.1 Netting

The Contractor is responsible for the supply and laying of the warning net over the entire length of the pipe.

- Characteristics: Plastified Minimum width: ∅ of the pipe + 2 x 0.2 m.
- The warning net shall be applied horizontally 30 cm above the upper generatrix of the pipeline.

  No warning net is laid on the concrete protection slabs.

1.2.4.2.2 Warning tape

The Contractor is responsible for the laying of the warning tape over the entire length of the pipe. Except otherwise specified in the PTS, the Contractor will supply the warning tape.

- Characteristics: Width: 8”
- The warning tape shall be attached horizontally 30 cm above the upper generatrix of the pipeline.

1.2.5 Backfilling at below-ground obstacles

1.2.5.1 Presence of underground cables or pipelines

In places where the trench meets underground cables or pipelines, the Contractor shall place protective devices in accordance with the requirement of the Public Services and Authorities, owners, tenants and/or operators concerned. Protective items already existing shall be reinstalled by the Contractor and if damaged replaced at his own expense.

1.2.5.2 Presence of drainage systems

1.2.5.2.1 Repairing drainage systems:

1. General:

For the repair work to the existing drainage system, it shall be assumed that the Contractor or his subcontractor is in possession of the necessary practical knowledge required for drainage work. He is therefore responsible for the repairs and should take all measures required and employ the working methods to supply a repaired drainage system that is free of deposits left behind after the repairs.

It must be emphasised that the repaired drains must be of the same type and have the same characteristics as the original drains (among other things, with regard to material, thickness, diameter, specific gravity, perforation pattern, resistance to compression, resistance to impact, tension, etc.).

It is in all cases forbidden to replace cut or damaged drainage pipes with drainage pipes of another type or with drainage pipes of a larger diameter slipped over the original pipe. The drainage pipes must be joined axially by means of fitted or threaded earth resist sleeves, so as to resist to axial forces. The sleeve must under no circumstances cover or hinder the perforations over a distance exceeding 300 mm.

2. Investigation before drain repair

Before commencing the drain repair, the Contractor shall investigate with suitable devices whether the drains have been moved, damaged or blocked by earth, mud, etc. If the Contractor proves that the drains on the working strip are not damaged, he may be discharged from responsibility for repair subject to the agreement of the Owner/Owner’s Representative.

3. Draft for drain repairing

The materials used and the working procedure must be submitted for approval to the Owner/Owner's Representative and the land owner/tenants. The Contractor shall submit a draft plan to the Owner/Owner's Representative at least five working days before repairing the drain. The draft plan shall be drawn up to a scale of 1/1 000 and shall mention the following:

- the position of the existing and new drains
- type and slope of the existing and new drains
- connections and closure points
- outlet point
- depth in relation to ditch bottom and gradient

The Owner/Owner's Representative will submit this draft to the Parties Concerned for the purpose of obtaining prior agreement for the working procedure and for the restoration of the site. If the Party concerned refuses a proposal for repairs with diverted drains, the drainage network must be repaired in the conventional manner.

4. Conventional drain repair

The repair of conventional drains must as a matter of obligation be carried out before the restoration of the site. The drainage systems must be repaired over the complete width of the trench and if necessary over the width of the working strip. Prior to the repairs, the extremities of the drains shall be dug free so that a repair drain can be put in place in accordance with engineering design and the approved procedure.

5. Repair by means of longitudinal drains

If the Contractor decides to repair the drains by means of an open trench technique, this shall be carried out before the restoration of the site. Techniques without trenches can be applied after restoration of the site provided they do not constitute a danger to underground installations. In particular, any mixing of arable soil with subsoil must be avoided and if necessary rectified.

Drainage collectors or drainage pipes laid in parallel with the pipe must discharge into ditches or drains in such a way that their function cannot be reduced due to the block-off of the outlet caused by a build-up of deposits. In particular, the outlet must be located at least 20 cm above the ditch bottom. The Contractor shall hand over to the Owner/Owner's Representative an "as built" drawing (scale 1/1000) with the layout of the longitudinal drains, the connections and closure points, the outlet point with the depth in relation to the ditch bottom and slope, as the case may be.

6. Visiting the site after drain repair

After repairing the drainage, the Contractor will invite the party concerned to come and confirm whether the repair has in his opinion been carried out correctly. The Contractor will complete the "Report of Presence of Drainage Networks" and will submit it to the party concerned for signing. The rest of the backfilling of the trench may only be carried out after acceptance without reservation of the repaired drainage system by the Party concerned.

1.2.5.2.2 Backfilling at drains

The first 30 cm shall be backfilled manually. An endeavour should be made to ensure that the different back-filled layers will have hydraulic permeability equivalent to the original surrounding layers of soil. Outside the first layer of 30 cm, each layer shall then be compacted to prevent any subsidence and to prevent the water finding a course other than through the drainage network after the repair of the drainage system.

New drains and drains to be repaired must be laid according to the rules of the trade and in water-permeable soil (water flow at least 1 cm/hour); this should be sufficiently raked through according to the circumstances.

1.2.5.3 Presence of section junctions

At pipeline tie-in joints, backfilling may not be carried out over a distance that is a function of the diameter of the pipeline, on either side of the places in question, to facilitate the tie-in of the elements to be welded.

1.2.5.4 Presence of holes where dewatering filters have been installed

Their lower part shall be carefully filled with sand. The upper part should be filled with arable soil (top soil).

1.2.6 Sloping terrain

When the slope requires, the Contractor shall take the necessary measures under his own responsibility to prevent washout of the backfill, such as:

- the immediate re-sowing of sloping terrain (such as road embankments)
- Non-removal of tree stumps in the working strip in wooded terrain (except in the trench) subject to the permission of the Owner/Owner's Representative and the Land Owner.
- The placement of a drain at the bottom, next to the pipe. Depending on the slope and the hydraulic permeability, setting of water pit trap, filled with gravel, into which the drain flows (buffer). Each water pit trap shall have minimum dimensions of 1 m x 1 m and a depth to 1 m under the level of the drain. 50 cm of the uppermost soil layers shall be replaced over these drainage pit trap.
- The placing of clay block-off wall.
- The placing of block-off wall composed of sand bags.
- Other proposals (in particular situations) made by the Contractor and approved by the Owner/Owner's Representative.

1.2.7 Inspection of the coating after backfilling

- After backfilling and before restoration of the site, the Contractor will carry out a supplementary inspection of the coating.
- In order for this inspection to be carried out in the best possible manner, the Contractor shall free the extremities of the sections to be checked and ensure the accessibility and the stability of the trenches (shoring) and ensure that the connection pits are kept dry.
- There must be absolutely no contact of bare metal with the surrounding ground. Bare metal shall be insulated from the ground by means of wooden blocks or equivalent. The sections of pipe to be inspected shall be a maximum of 5000 metres long.
- If the ground is too dry, the Contractor shall dampen the backfill by means of ± 1 000 litres of water per 250 metres of length.
- The Contractor shall immediately unearth all indicated defects and repair them in accordance with an approved procedure (see part 9).

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LAYING & CONSTRUCTION OF U/G STEEL PIPELINE NETWORK & ASSOCIATED WORKS FOR CONNECTIVITY OF CNG STATION AT CONCOR CONTAINER DEPOT DADRI, GAUTAM BUDDHA NAGAR

GTS – LOWERING-IN & BALLASTING

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1.0 LOWERING-IN AND BALLASTING

1.1 LOWERING-IN

1.1.1 General

The working method that the Contractor will apply and the material that he will use for laying must:

- Be adapted to the local circumstances (site configuration, geological and hydro- geological properties of the ground, diameter of the pipe, etc.);
- Be approved by the Owner/Owner's Representative.

1.1.2 Conditions before laying

A pipe string section may only be laid if:

- The changes of direction were effected in accordance with the specifications of G.T.S. Part 5.
- the requirements provided in G.T.S. Part 10 have been met,
- inspections of the welding seams have been carried out and accepted by the Owner's Representative,
- The external coating has been checked to see that it is in good condition with holiday detector immediately before laying (see G.T.S. Part 9). The inspection is carried out in the presence of the Owner/Owner's Representative,
- Prior to lowering-in work the Owner's Representative may (at the Owner/Owner's Representative request) check the pipeline coating by means of a holiday detector. This random inspection will be carried-out at the same time as the Contractor's inspection work and will not release the Contractor from his responsibility of his own inspection work.
- The temperature is such that the coating will not be damaged.

1.1.3 Precautions to be taken during lowering-in

1.1.3.1 Presence of the Owner

Lowering-in must be carried-out in the presence of the Owner's Representative. The Contractor must notify him in time.

1.1.3.2 Protection of the pipe and its coating

During lowering-in, the Contractor must ensure that:

- the pipe is not subjected to inadmissible stresses;
- The Contractor will submit the required calculation notes in the work procedure;
- The pipeline is supported over a sufficient surface area to prevent the supports from penetrating the coating;

- A sufficient number of machines with the required capacity will be used for lowering-in the pipeline strings (as per calculation note).

1.1.4 Inspection of the pipeline after lowering-in

1.1.4.1 Inspection of the stress in the metal

After lowering-in, the pipeline shall be completely stressed free in the trench. Joining the different sections may not cause any inadmissible stresses in the pipeline. Tie-ins joints are only executed on consecutive sections at their definitive level.

1.1.4.2 Inspection of the profile of the pipe

In the absence of concordance between the changes of direction of the pipeline and the trench, both in the horizontal and in the vertical plane, the Owner/Owner's Representative may require the Contractor to make the necessary adjustments, it being understood that this does not entitle the Contractor to any price supplement.

These adjustments comprise:

- widening or deepening the trench,
- backfilling and compaction of the trench bottom,
- cutting out and replacing bends that are not adapted to the profile of the trench,
- If necessary, the complete adaptation of the section concerned.

All material supplied by the Owner and damaged as a result of such activities will be replaced by the Contractor at his own expense.

1.1.5 Tie-in pipe strings

1.1.5.1 General

The Contractor will carry out all the work required to tie-in the different welded and lowered-in sections together so that a continuous string is produced.

After digging out the working trenches, the Contractor will take all measures necessary to ensure their stability to guarantee the safety of his personnel, the personnel of the Owner/Owner's Representative.

1.1.5.2 Moving sections after lowering-in

It is forbidden to shift or move the sections on the trench bottom with lifting gear or other means to bring the pipe ends to be joined closer together. The only method that shall be accepted in this case consists of welding in an additional piece.

1.1.6 Tie-in contract-boundary

The Contractor should take account of the fact that he may be asked to provide the necessary assistance in this tie-in work after his normal in-line activities have been completed.

These works comprise:

- signposting the construction site
- dewatering of the working pit

- excavations, manual and mechanical
- shoring up
- coating of the pipeline and welded joint
- filling up + compaction
- reinstatement

This work will be charged in the price list.

1.2 BALLASTING OF THE PIPE

1.2.1 General

In places where the type of ground is such that the pipe might rise as a result of the hydrostatic pressure, ballast should be placed on the pipeline.

The ballast will be applied in places that will be indicated in the P.T.S. and or the relevant drawings.

The Contractor is responsible for the supply and the placement unless otherwise stipulated in the P.T.S.

1.2.2 Nature of the ballast

The ballast consists of ballast blocks or blocks of prefabricated reinforced concrete, bags of cement, or a continuous coating of reinforced concrete on the most important section.

The reinforcement of the concrete may not come into contact with the pipe. The concrete in contact with the coated pipe should be sufficiently smooth. The cement must be resistant to the earth or the water with which it comes into contact.

1.2.3 Protection of the pipeline coating

Protection material must be placed between the pipeline coating and the ballast except for those applications where the ballast is applied by guniting. The costs for this should be included in the price for ballast.

The Contractor should indicate in his bid the method(s) of ballasting he intends to use as well as the sizes, the intermediate distances and the ballast materials. The depth of covering mentioned in the P.T.S. Part 10 is calculated between the upper generatrix of the anchoring or ballast fittings and the natural ground level.

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GTS – TESTING AND CLEANING

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1.0 TESTING AND CLEANING

1.1 GENERAL

Except otherwise stated in the P.T.S., the following statutory acceptance tests shall be carried-out after construction of the pipeline in accordance with the provisions of the ASME code B31.8 latest edition and where applicable, with additional and overriding provisions that may be imposed by OISD 141.

At latest 30 days prior to the start of the tests, the Contractor shall submit to the Owner/Owner's Representative a detailed work schedule and a work procedure file for the execution of the testing and cleaning operations. The Contractor shall provide the labour, test medium, temporary supports, ladders and scaffolding, all material including test heads, the measuring apparatus and any spare parts that may be required for the tests and trials.

Such equipment shall be approved in its entirety by the Owner/Owner's Representative. Measuring instruments, such as manometers, manometrographs, manometric scales, barometers, thermometers etc., shall be sufficiently sensitive to give the required degree of precision. Such instruments shall be accompanied by the required valid calibration certificates. The pumps, compressors, etc. should have sufficient capacity and output to permit rapid filling.

The tightness test shall be carried out following the resistance test.

Exception

The following equipment shall not undergo any mechanical test on the worksite:

- gas meters, gas regulator, shut-off valves, safety valves, instruments, thermo wells, boilers, pressure vessels, etc., provided such parts have an acceptable pressure certificate;
- discharge lines to the atmosphere such as open vent pipes without noise mufflers and drains;
- (For the testing of instrumentation pipes, see Article 14.9. and Part 17 of the G.T.S.).

1.2 TEST PREPARATIONS

1.2.1 Required documents

- Plan of the section to be tested:

a) For pipeline construction:

For the purposes of the resistance test, the Contractor shall submit to the Owner/Owner's Representative a pipeline split up plan ten working days before the test. Due account should be taken in the split up plan of the minimum pressure at the highest point and the maximum pressure at the lowest point. This maximum pressure may under no circumstances exceed the test pressure of the pipes in the factory (i.e. 95 % of the Specified Minimum Yield Strength).

b) For station construction:

For each test section, an overall sketch or isometric drawing shall be submitted to the Owner/Owner's Representative. Such documents shall include the following information:

- the location of the test inlet pipe, measuring instruments and bleeders;
- The adjustments that will be carried out for the test.

e.g.:

- removal of internal parts of check valves or bridging of the same by means of a bypass or instrumentation bosses;
- bridging carried out for non-tested "in-line" parts (see exceptions above);
- physical limits of the pipe by means of blind plates, blanks, hollow bases, etc.;
- as a general rule, it is not permissible to subject the shut-off valves in the closed position to one side test pressure;
- Copy of the valid calibration certificates of the devices and equipment's used for the tests.
- Pressure data of the test apparatus used (manifold) such as valves, test heads, etc.
- Copy of all Non-Destructive Testing documents drawn up by the Owner's Representative.
- Copy of the weld log book.
- Form giving:
  - date of the test;
  - identification of the test equipment;
  - test medium and origin;
  - the maximum operating pressure;
  - Test pressure and duration.
- Description of the working method and the material for filling up with water and purging of water from each section.

1.2.2 Inspections prior to the tests for station construction

- All welds, screw and flange joints must be clean (free of rust, paint, etc.);
- All welds must be accessible for visual inspection:
  - no temporary supports on the welds or flange connections;
  - Provide all necessary ladders or scaffolding for the safe inspection of the welds.
- All heat treatments shall be carried out prior to the tests;
- All reinforcement plates shall already be tested;
- All welds for the preparation of the testing work shall be subjected to the same non-destructive tests as those which are required for the piping to be tested;

- Inspection of conformity with the isometric drawing;
- Inspection of the half-open position of the valves;
- All spring supports and expansion joints shall be anchored in good time according to the manufacturer's instructions;
- All precision instruments or regulators which may be damaged shall be temporarily removed by the Contractor;
- Inspection of the connection of the filler pipe, manometer and pressure recording device;
- Cut-off valves which are used to close the testing system (e.g. test equipment) shall have a nominal pressure higher than or equal to the test pressure;
- The valves of drainage and bleeding points shall remain open during the tests and the ends must be fitted either with a flange with a blind flange or a screwed cover;
- For gas filters, check that the filter elements are removed;
- Inspection of marking-off of the test zone;
- When testing with nitrogen in a closed space, the Contractor shall assure constant ventilation. Furthermore, oxygen measurements shall be taken regularly;
- During the tests, the recording and testing devices shall be at least 10 m away from the tested pipe.

Exceptions

- If the trenches hinder the further construction of the station, at the request of the Owner/Owner's Representative, the pipe shall be clad and the trench shall be backfilled before the mechanical resistance test and tightness test are carried out. The tightness test (with dry air or nitrogen only) must then be carried out with a manometric scale (see Article 14.4).
- If the scraper trap station is connected to a pipe, everything must be backfilled before the start of the resistance test (in conformity with the stress calculations).
- If exceptionally some parts of the pipeline sections under testing are not backfilled, those parts, will be covered by means of thermal insulation sheet.

1.3 MECHANICAL RESISTANCE TEST

1.3.1 General

- The test medium and the necessary accessory apparatus shall be supplied by the Contractor;
- For the pipeline, the pressure test shall be submitted to the Owner's Representative for approval on the basis of the split up plan. The maximum length per section is 30 km;
- The backfilling of the trench must be completed before starting the mechanical resistance test. During the resistance test, all traffic over the pipeline is forbidden;
- All reinforcement plates should preferably be tested in advance in the prefabrication workshop with nitrogen at 3.4 bar. The air bleed opening shall remain open until after the mechanical resistance test unless the trench is backfilled before the execution of the

mechanical resistance test and tightness test (with dry air or nitrogen only) with a manometric scale;

- The choice of the test medium shall be made according to the following overview table.

Overview table - Resistance test for pipelines and mains to operate at less than 30% of the specified minimum yield strength of the pipe, but in excess of 100 PSI.

Situation	Test medium	Test pressure	Test time	Safety measures *
Backfill	Dry air, nitrogen or water	As specified in ASME CODE B31.8	6 hours	Around intersections and non-buried parts
Above-ground or underground (but not backfilled) on supports				Everywhere

Overview table - Resistance test for pipelines and mains to operate at hoop stresses of 30 % or more of the specified minimum yield strength of the pipe.

Situation	Test medium	Test pressure	Test time	Conditions	Safety measures *
Backfill	Water	Min : 1.4 x MOP Max : testing pressure of factory	6 hours		Around intersections and non-buried parts
Above-ground or underground (but not backfilled) on supports and stations					everywhere
Gas supplied actuators and stations	Dry air or nitrogen	1.25 x MOP	6 hours	Only for ND □ 3" pipe sections with max. volume □ 2m³ and if pipes have no low points where water can be drawn off (drains)	

Overview table - Resistance test for stainless steel control and instrumentation piping or tubing.

Situation	Test medium	Test pressure	Test time	Conditions	Safety measures *
Control and instrumentation piping	Dry air or nitrogen	1.1 x MOP	soaping time	see Article 14.9.	everywhere

* safety measures :

During the pressurisation of the installation and up to one hour after the test pressure has been reached, there is a general safety zone of 10 metres which all personnel and persons are forbidden to enter. Subsequently, until the installation is free of pressure, a safety zone of 5 metres must be observed. All valves and flange connections shall be marked with a sticker bearing the warning "Danger: under pressure". The zone in which the test is carried out must be marked out and indicated with pictograms and a rotating light.

1.3.2 Hydraulic resistance test

- General

  When the outside temperature is below + 4 °C, no hydraulic tests shall be carried out with water unless the water is mixed with glycol.

  - Pipeline construction

    A caliper plate or-pig shall be used to check that there are no unacceptable deformations in the pipeline before starting the resistance test. Sections with unacceptable deformations shall be cut out and replaced before any resistance test shall start.

    For pipelines construction, a bi-di pig or scraper is used to fill the pipe. A quantity of clean water should be pumped in front of the scraper (i.e. approx. 150 m of pipeline volume depending with the pipeline routing).

    The scraper and the test heads shall be supplied by the Contractor. The type of scraper must be approved by the Owner/Owner's Representative. The test heads must have the necessary approval certificates (non-destructive testing and hydraulic tests. After filling up the pipeline, the valves must be in the half-open position.

    Any pressure fluctuations noted during the passage of the scraper should not indicate the presence of obstacles which hinder the free passage of the section.

    The pressure increase shall be affected under the supervision of the Owner/Owner's Representative and shall be monitored by Owner's Representative.

    Once these operations have started, it is strictly forbidden to cross the pipeline with heavy equipment.

  - Station construction

    For station construction, all high points of the pipe section to be tested must be vented. The system must then be pressurised.

- Test water

  The test water shall be supplied by the Contractor. It must be clean (eventually after filtering), not silty, with a pH between 6 and 8 and non-corrosive. For stainless steel pipes, the test water shall contain max. 5 ppm of chlorides.

  The water shall be sand-free. A compulsory analysis shall be carried out by a Owner's Representative at the expense of the Contractor (with the exception of potable tape water). If, after analysis of the water, any doubt persists, a corrosion inhibitor - supplied by the Contractor and submitted to the Owner/Owner's Representative for approval - may be added to it, or another water supply source shall be sought.

  If for any reason the test water has to remain in the pipeline for an unusually long period of time, it should have corrosion inhibitors added to it (supplied by the Contractor and submitted to the Owner/Owner's Representative for approval). In the case of longer storage periods, the Owner/Owner's Representative reserves the right to have a titration test carried out at the expense of the Contractor.

- De-watering & Swabbing

  - Pipeline construction

The Contractor shall under the supervision of the Owner/Owner's Representative inspect the complete open position of the valves before starting de-watering pipeline.

The type of pigs and foam pigs shall be approved by the Owner/Owner's Representative.

The discharge of the test water shall be carried out in such a way that there is no damage to installations or adjacent plots of land. The Contractor shall request the necessary discharge permit from the competent authorities.

Conventional pigs and foam pigs shall be run through the pipeline as many times as necessary to de-water and clean satisfactorily the pipeline sections. This is subject to the judgement of the Owner/Owner's Representative who must be present at the installation when removing the pigs from the pipeline.

- Swabbing

The swabbing operation consists of running several pig trains through the pipeline. During the swabbing operation, the remaining water in the pipeline shall be reduced and spread out in the form of a thin water film over the pipeline wall to obtain a more efficient drying operation.

The CONTRACTOR shall submit the detailed procedure and the duration of the swabbing operation and obtain OWNER approval before starting the operation.

The pig velocities during the complete swabbing operations shall not exceed 7.0km/hr. CONTRACTOR may use polyurethane cup pigs followed by foam pigs for the swabbing operation.

If dewatering pigs are used, the minimum speed and the backpressure of the pigs to maintained during dewatering operation shall be proposed by the contractor to do continuous operation and without pig getting stuck.

CONTRACTOR shall weigh and measure the pigs prior to launching and on arrival of the pigs at the receiving end.

Contractor shall ensure that the pipeline shall be free from dust and debris after swabbing operation and final cleanliness of the pipeline shall be subject to approval of the OWNER's representative.

Acceptance criteria of the swabbing Operation-Difference in weights of pig before and after passing through the pipeline shall be limited to 5% of its original weight.

- Station construction

If water is the test medium, the water may be drained through the bleeders and drains provided. During assembly, the Contractor shall check whether any additional drains and bleeders must be provided.

The valves shall be drained as much as possible in the half-open position under air pressure through the bleeder pipes under the supervision of and in consultation with the Owner/Owner's Representative. The discharge of the test water shall be carried out in such a way that there is no damage to installations or adjacent installations. The Contractor shall request the necessary discharge permit from the competent authorities.

1.3.3 Dry air or nitrogen resistance test

- Pipe construction

(Only applicable if approved by the Owner/Owner's Representative.)

For pipe construction, the pipe shall be completely buried. Only applicable for pipelines and mains to operate at less than 30 % of the specified minimum yield strength of the pipe, but in excess of 6.9 bar (100 P.S.I.) and within the limits set in the ASME CODE B31.8.

- Station construction

General safety regulations

- For the pneumatic test (air excluded) in enclosed spaces, the premises must be constantly ventilated if any personnel are present. Furthermore, oxygen measurements shall be taken regularly;
- Care must be taken to ensure that the pressure in the test system does not exceed the permissible limit (e.g. under the influence of heat from the sun);
- It is forbidden to hammer the piping;
- Weld, screw and flange connections found to be leak-free shall be marked with an indelible colour code on the piping;
- The paint or coloured markers used must not damage the material of the installation.

1.3.4 Measurements - measuring devices for the mechanical resistance test

- Pressure measurement

The pressure measurement shall be carried out by at least three devices:

- At least one manometer, which must be mounted on one of the piping of the test system;
- A pressure recording device and at least one manometer, mounted near to the pressure recording device.

Such measuring devices shall have an identification number and be accompanied by a calibration certificate. The two types of devices shall have a suitable scale position and range (preferably 1.5 x the pressure to be measured).

When the difference between the readings of two of these devices is greater than 4 % of the arithmetic average of the readings on these 2 devices, the two measuring devices must be recalibrated. The recorded test pressure diagram shall be marked with the test system number and the identification number of the recording device and shall be appended to the test file.

- Pressure loss

In the event of pressure loss, the cause must be investigated. If it is due to any defect in materials supplied by the Owner, any costs arising from any reworking and test re-runs shall be borne by the Owner. In all other cases, the Contractor undertakes to bear the consequences and the costs.

1.4 TIGHTNESS (LEAK) TEST

1.4.1 Pipelines and mains to operate at less than 6.9 bar (100 P.S.I.)

Overview table of tightness test for pipeline sections with maximum operating pressure (M.O.P) 6.9 bar.

Situation	Test medium	Test pressure	Test time	Safety measures*
Buried	Dry air or nitrogen	Min. 6 bar	6 hours	around intersections and non-buried parts
Above-ground or underground (not backfilled) on definitive supports			soaping time	everywhere

* Safety measures:

During the pressurisation of the installation and up to one hour after the test pressure has been reached, there is a general safety zone of 10 metres which all personnel and persons are forbidden to enter. Subsequently, until the installation is free of pressure, a safety zone of 5 metres must be observed. All valves and flange connections shall be marked with a sticker bearing the warning “Danger: under pressure”. The zone in which the test is carried out must be marked out and indicated with pictograms and a rotating light.

1.4.2 Pipelines > 6.9 bar (maximum operating pressure)

- Buried pipes

  Except if otherwise specified in the P.T.S., tightness test shall be performed with water.

  The tightness test may be combined with the strength test.

  The tightness test pressure shall not be higher than the Resistance test pressure. The test pressure shall not be less than D.P. (Design Pressure).

  The test duration shall be determined on the basis of the characteristics of the structure and the accuracy of the measuring instruments. It shall not be less than 24 hours. For volumes of less than 20 m^3 or for uncovered sections which can be fully inspected visually, this duration may be reduced for so far duly approved by the Owner/Owner’s Representative.

  Before carrying out the tightness test, it shall be ascertained that the quantity of air in the pipe is sufficiently small not to affect the test results.

  The pipe is considered leak-tight if the temperature and pressure measurements show that the volume of test medium is maintained throughout the test.

  If the test reveals that the pipe is not perfectly leak-tight, the Contractor may only be indemnified for the cost of finding the fault if he can prove that the leak was the result of a defect in the Owner’s supplies and that in any case this fault could not have been detected at the time when the pipe sections were received.

- For the installations which have been (resistance) tested with dry air or nitrogen as test medium

  The installation shall be brought to 6 bar air pressure and all welds and joints shall be soaped (bubble test) after 24 hours in the presence of the Owner’s Representative.

1.5 CLEANING

1.5.1 Pipe construction - **Deleted**

1.5.2 Station construction

1.5.2.1 Cleaning – General

During the works, the Contractor shall take the utmost care to keep the inside of the piping clean. He shall carry out the necessary inspections and fit protective covers where necessary.

During de-watering through the purges and drains, the necessary samples shall be taken in glass bottles to check the cleanliness of the pipelines. If it is discovered that these samples have an excess of dirt, the piping shall be cleaned again.

1.5.2.2 Methods of cleaning

- Compressed air

  The piping system shall be pressurised with pure, dry and oil-free air or nitrogen which shall subsequently be blown out with sufficient force through the specially designed valves. For the noise pollution caused by the venting, the Contractor shall as a general rule comply with the legislation on work and the environment of the Country concerned.

  If the cleanliness is insufficient, the blowing operation shall be continued. For low- pressure pipes, the pressure of blowing used shall under no circumstances be higher than ¾ of the max. operating pressure. For cryogenic pipelines, following cleaning only the upper flanges of the valves shall be dismantled to check the cleanliness of the pipes.

- Flushing (only applicable for small diameters)

  The water speed (m/s), depending on the impurities in the case of construction in horizontal pipes (welding slags, rust and loose particles) can be calculated on the basis of the following experimental formula:

  U = [0.225(R)0.12 X (H)0.48] x 1.251

  where :

  - U = flushing water velocity (m/s)
  - R = inner radius of pipe (mm)
  - H = dimension of the impurity (mm)

  The flushing shall be continued until the desired cleanliness is achieved.

- High-pressure cleaning

  Can be applied when:

  - the injected water can be removed;
  - the pipe diameter □ 3";
  - the pipe has no inner coating;
  - There are no obstacles such as purges or valves with soft joints.

- Chemical cleaning (Pickling)

  Only applicable for certain piping processes (e.g. oil cooling circuit of compressors). If pickling is desired, it must be carried out by a specialised firm. When selecting, care must be taken to ensure that the proposed method will not damage the basic material and the welds.

  Immediately after this treatment, the pipes shall be thoroughly rinsed and dried. If possible, they should be passivated. As a protection, the pipe should be brought to a slight overpressure with dry air or nitrogen (0.2 bar).

1.5.2.3 Drying - Deleted

1.6 INSPECTION OF UNTESTED TIE-IN CONNECTION WELDS (GOLD WELDS)

The connection spool piece to be welded must already have successfully undergone a resistance test. The Owner's Representative must be informed at least 4 working days before the execution of the tie-in connection welds. Tie-in connection welds which do not undergo the resistance and tightness tests must:

- undergo all the necessary NDT inspections,
- Be soaped (bubble test) when the pipe is brought into service at a pressure of 6 bar and at operating pressure.

These inspections shall be carried out in the presence of the Owner/Owner's Representative. Certain gold welds determined by the Owner/Owner's Representative may only be soaped (bubble test) at a later stage. Consequently, these must be temporarily coated. The terrains shall be temporarily restored to their original condition.

Subsequently, the welds shall be uncovered once again in order to carry out the necessary inspections and to carry out definitive coating and backfill.

1.7 BRINGING INTO SERVICE

- All above-ground flange and screw connections shall be soaped (bubble test) at operating pressure (including instrumentation);
- The Contractor shall provide the necessary material and labour for this purpose.

1.8 ACCEPTANCE

The Contractor shall hand over the final dossier to the Owner/Owner's Representative. The final dossier includes:

- a split-up plan or isometric drawing of each tested section;
- a copy of the calibration certificates for the tested devices;
- a duly completed test form mentioning :
  - the date of the test;
  - the identification of the test system;
  - the test medium;
  - the test pressure;

- the test temperature (the ambient and pipe temperature);
- The differences of any Nonconformity Reports and derogations with regard to the test, signed by the Owner/Owner's Representative.

- the recording disks or pressure level diagrams of the resistance tests that have been interpreted and completed by the Owner's Representative;
- the QRN of the Owner's Representative;
- The NDT inspection reports.

1.9 INSTRUMENTATION AND REGULATION CIRCUITS < 2"

- Instrumentation and regulation circuits smaller than 2" (instruments, coupling, control line and accessories), insofar as these parts (e.g. thermowell) have not been included in a resistance test of a section of piping, shall be tested for their respective operating pressure during the pre-commissioning (carried out by the Contractor). The instrumentation contractor shall include in his assembly price the necessary material and personnel, test medium and accessories (i.e. regulators flexible tubes, etc.);
- These tests need not be submitted to the Owner's Representative for approval;
- The instrumentation contractor shall submit the necessary proof that the materials supplied by him withstand the required operating pressure;
- The instrumentation connection pipes between the mini-cabins, the regulator, etc. and the gas pipe shall be tested with nitrogen at 1.1 x MOP.

1.10 Testing of Above Ground Piping & Valves

1.10.1 PIPING

Pressure tests shall be performed as per ANSI B 31.8 latest edition or appropriate piping material specification class chart per Piping Specification.

The field test pressure shall not be less than the highest of the following:

a) 1.5 times the design line class pressure.

b) 1.5 times the maximum operated pressure

c) 1.5 times the maximum pipeline static pressure

d) Sum of the maximum sustained operating pressure or maximum operating or maximum pipe line static pressure and the maximum calculated surge pressure.

The hold period shall be minimum 6 hours.

The testing shall be carried out in convenient section as approved by site engineer. The joints of pipe connecting the testing section shall be 100% radiographed and UT tested and shall be tested with other applicable NDT method as specified in specification.

If some defects are noticed during the hydrostatic testing, the same shall be brought to the notice of the OWNER. Joints, if leaking, shall be rectified as per welding specification and instructions and tested to the complete satisfaction of the OWNER.

The following items shall not be subjected to field pressure testing

a) Pressure relieving devices such as rupture discs and pressure relief valves.

b) Locally mounted pressure gauges.

c) Control valves, shutdown/ isolation valves etc.

d) Any other equipment designated by the OWNER.

All the elements, which are not to be tested along with the piping, shall either be blanked off during testing or spool pieces inserted during testing.

Any temporary corrosion protection coating given on piping at manufacturer's shop/ fabrication yard is to be removed at all inspection points, before final testing.

Prior to Hydro testing, vessels and piping are to be flushed by high pressure, high volume fresh water or inhibited water.

Following are the general requirements for testing of piping:

a) Test pressures shall be maintained for a sufficient length of time to permit through Inspection of all the joints for a leakage or sign of failure. The duration shall in no case be less than six (6) hours.
b) Instrument take-off piping up to the first block valve shall be tested with the connected piping.
c) Lines open directly to atmosphere such as vents, drains, safety valve discharge etc. shall be leak tested and all the joints shall be visually inspected.

1.10.2 MAXIMUM ALLOWABLE VALVE TEST PRESSURE

Test pressure applied to valves under closed position shall not be greater than the manufacturer's recommendations nor less than required API 6D latest edition where the required test pressure is greater than the allowable seat pressure, test shall be made through the 50% open valve.

1.10.3 HYDROSTATIC TEST FLUID

- Fresh potable water shall be used as the testing medium for hydrostatic testing of piping in fabrication yard and at site.
- The lines shall be completely drained and dried by air immediately after the successful completion of testing.
- Salt water shall not be used for testing.
- A strainer shall be installed in the line to minimize the possibility of foreign matter being introduced into the system during the pressure test and flushing operations.

1.10.4 PNEUMATIC TESTING

- Pneumatic testing of piping system, valves assembly and Instruments shall be performed with Nitrogen. The test pressure shall be 98 bar (g) in case of 600# and 49 bar (g) in case of 300# rating piping.
- In addition to hydro test, all the station piping and valve assemblies shall be pneumatic tested. The test pressure shall be per above mentioned point.

- When pneumatic testing at over 25 psi, a preliminary test at 25 psi shall be made to locate major leaks. Then the pressure shall be increased gradually to test pressure.

1.10.5 TEST PROCEDURE

- All events and other connections, which serve as vents, shall be open during filling so that all air is vented prior to applying test pressure to the system.

- Gauges used for testing shall be installed as close as possible to the highest point of the piping system.

- Care shall be exercised to avoid increase in pressure due to temperature variation during the test.

- After completion of the recorded test pressure recorder, the pressure shall be reduced to the design pressure and all valves, including check valves, in the section of the line shall be tested by being closed for a ten (10) minutes period with pressure contained by specific valve at one end and by positive closure at the other to determine whether each valve is in turn positively shutting off and holding pressure.

- After completion of hydrostatic test, the pressure shall be released gradually in steps. All the vents and drains shall be kept open till the lines are fully drained. The CONTRACTOR shall then dry the system by blowing compressed dry air and reinstall items removed during Hydro testing.

- Record shall be made of each piping system during the testing. These records shall be prepared in tabulated foams and shall include.

  Date of Test

  Identification of piping and equipment tested with medium

  Test medium

  Test Pressure

  Test Duration

  Acceptance of Test Results by OWNER's representative.

  Calibration certificates of test gauges, recorders and PSV's.

- Testing shall be deemed as complete only after defects noticed during testing have been rectified and testing of the system / line has been done to the satisfaction of the OWNER's representative.

- The CONTRACTOR shall supply all plain test blanks required for the pressure testing.

- Gauges and pressure recorders used for testing shall be calibrated at a reputed laboratory at least every 6 months.

- Temporary supports shall be provided wherever required during testing to the satisfaction of OWNER's representative.

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GTS – SITE REINSTATEMENT & MARKING OUT

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1.0 SITE REINSTATEMENT AND MARKING OUT

1.1 SITE REINSTATEMENT - GENERAL

The Contractor will restore the Construction Site and any other places that have been damaged as a result of the Works to their original condition and this to the entire satisfaction of the Parties concerned.

These works must be carried out within the shortest possible time and at least within 8 weeks following the opening of the working area. In unfavorable weather conditions, the Owner may halt the schedule of the reinstatement work if no effective work can be carried out under these circumstances.

1.2 REINSTATEMENT WORK

The reinstatement of the terrain consists, among other things, of the works summarised in the following non-exhaustive list:

- The works arising out of the conditions, requirements and wishes of the public authorities and administrations;
- Removal of all remaining and surplus material and equipment;
- Reinstatement of drainage and outflow systems, canals, streams, waterways, dikes, road metal, roads, paths, etc;
- Removal of all debris of whatever type as well as stones or broken pieces that might hinder the farming of the land;
- Before replacing the topsoil, the Contractor will even out, level, and break down the subsoil in the working strip to the agreed depth (cf. Part 3, Article 3.2.3.3);
- The machines used for this purpose must be adapted to the different types of ground strata and the depth of the drains; these layers must each be break down without mixing them. The processing of the soil must finally result in a ground structure that shows properties in the areas of texture, permeability, fertility, etc. comparable with those that existed prior to the work operations;
- Replacing the topsoil in its original condition;
- After replacing the top soil, it will be evened out and levelled and thereafter made ready for sowing by raking and hoeing over the entire width of the working area;
- Placement of banks consolidation devices, concrete slabs or posts, wooden posts and sleepers, water fascines, blocks and/or sections of lawn. Wooden materials will be treated against rotting to guarantee a lifetime of 15 years;
- Repair of closures, access ways, walls, slopes, embankments, retainings walls and installations;
- Replacement of removed and/or damaged hedges, closures etc. to the entire satisfaction of the Parties concerned;
- Positioning and/or re-positioning of displaced or removed markers, beacons, property markers etc. with the aid of a surveyor;

- Dismantling and removal of provisional installations. See also part 2 art. 2.2.3.2a.;
- Clearing of the constructions sites;
- Any other special point mentioned in the inventory of fixtures.

1.3 SITE CONDITIONS AND SITE REINSTATEMENT REPORT

The reinstatement of site report will be drawn up by the Owner's representative. All remarks in connection with the reinstatement will be reported therein. The representatives of the Contractor and the Owner will together:

- measure and estimation of the off-working Strip area;
- State whether the terrain has been restored to its original condition (cf. Article 15.2). The Contractor will draw up a "List of plots of land for release" on the basis of this assessment. The Contractor undertakes to finish off the reinstatement of the terrain completely, including the markings and accessories, before the evaluation can be made.

On the basis of the "List of plots of land", a site visit will be organised within 15 days between the representative of the Owner (the Negotiator), the representative of the Contractor and the Parties concerned. They will together complete the "Declaration of release of plot", see Appendix 1.

If there are no reservations about the reinstatement of the site:

- the Contractor may no longer have access to the plot;
- the "Declaration of release of plot" will be signed by all parties;
- the Party concerned may have the use of his land;
- The Owner's Negotiator will make an arrangement with the Party concerned for the subsequent administrative settlement and payment joint assessment of the damage/satisfaction, see Appendix 2.

However, if there are any reservations:

- The reservations will be noted in the "Declaration of release of plot" together with a deadline for these to be made good. The Contractor undertakes to adhere to the agreed deadline;
- it will be mentioned whether the Party concerned may or may not have the use of his land;
- the "Declaration of release of plot" will be signed by all parties;
- A date will be specified for a new site visit.

If during the second visit to the site it is noticed that the works cannot be carried out or if the works yet to be carried out on the terrain are so inextensive, compensation can be awarded and the "Settlement" document will be completed (see appendix 3). These cases must be kept to a strict minimum by the Contractor and clearly justified before he requests permission from the Owner.

The Owner reserves the right to pay the Parties concerned directly for any damage caused by the Contractor during the course of the works and not repaired in the appropriate time by the latter, at the expense of the Contractor.

This will include the damage that might result from poorly executed reinstatement, in particular with regard to composition of the topsoil and the soil backfilled above the drainage pipes. This also includes abnormal damage, all damage arising or exacerbated by the non- observance of the contractual obligations including those relating to deadlines and working strip.

1.4 AERIAL BEACONS

The purpose of the definitive markings is:

- To indicate the correct location of the pipeline;
- To indicate the position of the pipeline for the purpose of survey with a helicopter.

The pipeline must be marked out during site reinstatement and before the terrain release. Positioning and placing the markers is carried out by the Contractor in accordance with the relevant drawings. Except otherwise specified the aerial beacons will be supplied by the Contractor. They will be in accordance with the relevant drawing and approved by the Owner's Representative.

The Contractor will place the markers and attach the marker plates thereto in accordance with the instructions of the Owner's Representative. The Contractor will be paid in accordance with the quantities actually supplied and the work actually carried out and on the basis of the price given in the bid in pricelist.

1.5 MARKING OUT OF THE PIPELINE

1.5.1 Concrete Marker posts

The positioning of the marker posts is carried out by the Contractor in consultation with the Owner's Negotiator if the marker posts are located on private land and with the authorities concerned for the public domain in accordance with the relevant drawings and before the terrain release.

The concrete marker posts will be supplied by the Contractor. The Contractor will submit to the Owner's Representative (for approval) the type of marker he intends to use. The Contractor will place the marker posts, attach the Owner identification signs and fix the information on them. Immediately after the placing of the marker posts by the Contractor these will be checked by the Owner's surveyor for their correct positioning.

1.5.2 Cast iron marker tiles

The positioning of the marker tiles is carried out by the Contractor in consultation with the Owner's Negotiator if the marker tiles are to be located on private land and with the authorities concerned for the public domain according to the relevant drawing and before the terrain release.

The marker tiles will be supplied by the Contractor. The Contractor will submit to the Owner's Representative (for approval) the type of marker he intends to use. The Contractor will be responsible for the positioning and placing of the marker tiles in places indicated on the relevant drawing. Immediately after the placement of the marker tiles by the Contractor these will be checked by the Owner's surveyor for their correct positioning.

APPENDIX 1

JOINT ESTIMATE OF DAMAGE / DECLARATION OF SATISFACTORY EXECUTION

CDF
IMP
OPSRA
Pipeline:
Owner:
Width of the working strip: m. Contractor:
Negotiator: Date:

PLOTS OF LAND LOCATED ON THE TERRITORY OF THE MUNICIPALITY :									**NIS :**
DS no.	**Land Register**			**Surface**			**Place name or street and no.**	**Nature and cultivation**	**Length of the working strip (m)**
	Div.	**Sect.**	**No.**	**ha**	**a**	**ca**			

OWNER Name : Address : Account no. :	CRS : First name :	OPERATOR Name : Address : Account no. :	CRS : First name :

ESTIMATE OF THE DAMAGE

Damage for which OWNER is liable	**Damage for which contractor is liable**
TOTAL :	**TOTAL :**

TOTAL :

TO BE DEDUCTED: PREPAID AMOUNTS:

BALANCE TO BE PAID :

Agreement with the above amounts and signing of the certificate of the declaration of Site release on ... / ... / 20... is valid as declaration of satisfactory execution.

The payment of the latter amount is valid as the definitive settlement for the damage, inconvenience and losses caused by the works.

Signature of the owner or operator For agreement	Signature of the representative in the negotiations of OWNER	Read for agreement by the representative of the contractor	Read for agreement by the expert

APPENDIX 2

SETTLEMENT

BETWEEN

OWNER N.V
Represented by its mandatory ....., hereinafter referred to as **OWNER**

AND

Mr, Mrs. (*)..... ,
hereinafter referred to as THE OWNER or OPERATOR (*)

The following agreement has been reached:

The OWNER or OPERATOR (*) exploits the following plot(s) in the municipality of
.....

DS NO.	LAND REGISTER		
	DIV.	SECT.	NO.

As it has been jointly established that within the framework of the laying of (the works carried out on) the pipe.....The rectification of the following damage :

1.

2.

3.

Cannot reasonably be technically effected by the contractor
Or
Has not been effected by the contractor by the agreed deadline (*);

With the understanding that the extent of the damage has been jointly estimated at ……, taking account of possible future damage;

OWNER will from now, by way of settlement, pay the above amount to the OWNER or the OPERATOR (*)

- By transfer to account no.....or
- by postal order

This definitive lump-sum compensatory payment settles all existing or future damage caused by the works carried out in 20 ... on the aforementioned plot(s).

Consequently, the OWNER or else OPERATOR (*) definitively waives any claim, legal or otherwise, which he could lodge in future on account of the aforementioned works and undertakes to have any successor(s) comply with the provisions of the present agreement. If necessary, he will also inform the owner of the plot(s) of this.

Drawn up in..... copies, in ....., on ..... /..... / 20.... .

Signature of the owner or operator (*)	Signature of the representative of the contractor	Signature of the representative of Owner

(*) delete where inappropriate

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GTS – PARTICULAR CONSTRUCTION TECHNIQUES

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1.0 PARTICULAR CONSTRUCTION TECHNIQUES

1.1 GENERAL

The Particular Technical Specifications define the specific construction method to be used.

In his bid, the Contractor may suggest a different construction method. The Owner/Owner's Representative must approve of this method.

1.2 TRENCHLESS CROSSINGS

1.2.1 Boring

1.2.1.1 Geo technical survey report

If the Owner possesses a Geo technical report, he shall inform the Contractor of the results and mention them in the Particular Special Specifications for his interpretation. This report shall be informative in nature. The Contractor must carry out the required supplementary tests himself to obtain actual parameters for his design and implementation.

The results will be brought to the attention of the Owner/Owner's Representative. The soil depths described in the drawings are estimated depths. Before starting the works, soundings must be carried out in order to ascertain the correct profile of the watercourse, or other obstacles to be crossed.

1.2.1.2 Working pits and shoring works

The supporting sheet piles of the working pits must always be higher than the highest possible level of the water course to be crossed so that if water breaks through there will be no danger of flooding the surrounding areas.

The calculation notes, including the design and construction method for supporting of the working pits, must be submitted by the Contractor to the Owner/Owner's Representative. However, the Contractor remains responsible for any damage or accident.

The Owner/Owner's Representative must be informed of any changes to the shorings during the works. No material may be left behind on the site. The works comprise, among other things, delivery, placing, maintenance, dismantling and removal of the provisional shorings, including driving unit parts, scaffoldings and all attendant obligations.

1.2.1.3 Casings

The casing elements to be used must be delivered by the Contractor. These pipes may be of the following types:

- approved reinforced concrete pipes;
- approved reinforced concrete pipes with steel plate core;
- Approved concrete pipes reinforced with steel fibres.
- Approved steel pipes with proper wall thickness.

Any other types are not approved by the Owner/Owner's Representative.

If the Owner/Owner's Representative prescribes a special type of casing, this shall be mentioned in the Particular Special Specifications. The section of the casing to be drive must be specified in the Particular Special Specifications or the relevant drawings. The casing elements used must comply with the following requirements:

a) They must comply with all the external loads during construction and after completion of the work. To this end, the Contractor will submit with his bid a detailed calculation note and detailed drawing for the casing mentioning all technical characteristics;

b) The casing elements (reinforced concrete or asbestos concrete pipes) must be fitted with a watertight joint able to resist at least the maximum prevailing water pressure;

c) Required tolerances of the casing elements :

- on the length of the segment : + 30 mm;
- on the inner side ∅ : + 1 cm;
- on the total thickness of the casing wall : +4 % and -2 % of the theoretical wall thickness;
- On the straightness of the casing : the straightness of the casing may deviate from the theoretical center-line at most 2.5 mm per metre.

d) Where necessary, the casing is provided with injection openings to enable lubrication of the casing during driving between the soil and the outside wall with thixotropic or equivalent fluids in order to reduce the friction between the outside wall and the soil as well as the driving force to be used. Following the driving, the lubricant must be pushed aside, stabilised or bound through injection of a mortar based on trass, lime or cement, after which the remaining cavities must be filled (blocking injection). Finally, the injection openings must be sealed with a durable air and watertight seal (e.g. a screw-cap);

e) Unless otherwise mentioned in the Particular Special Specifications, the following external pressures apply :

- soil pressure : volume weight = 2 t/m3
- dry weight = 1.6 t/m3;
- water pressure : water table level = ground level;
- Traffic load : heavy convoy in accordance with relevant standard.

As far as soil covering and water levels are concerned, refer to the applicable drawings. Account must also be taken of the local soil characteristics in the soil analysis. The easing must be resistant to the various influences that may occur during transportation, handling and the driving operation itself.

1.2.1.4 The driving

If the Contractor deems that carrying out the driving is difficult or even impossible because of special circumstances (geographical situation, geology, special conditions imposed by the Particular Special Specifications, etc.), the Contractor must accordingly inform the Owner in his price bid. Otherwise, he is obliged to use all means to carry out the driving works to full completion.

The choice of the driving unit to be used for the driving of the casing as well as the method for excavation at the leading edge come under the responsibilities of the Contractor. However, he must take into account the construction requirements set by the Owner/Owner's

Representative. The methodology suggested by the Contractor must guarantee reliable construction within the set timescale. The operating principle must be specified by the Tenderer in his bid. In his work procedure file, the Contractor must submit to the Owner/Owner's Representative a complete and detailed description of his operating method supported by calculations.

The proposed method must comply with the following conditions:

- The driving may start only after the working pits has been constructed and finished completely and the assembly between the wall and the driving unit has been carried out to the satisfaction of the Owner/Owner's Representative;
- An adapted device must guarantee sufficient pressure distribution over the walls of the working pit and the circumference of the casing;
- During construction of the bore holes for the entry and exit working pits, the Contractor must take into account all legal safety measures. He must submit for approval to the Owner a detailed description of the method of construction of these access ways;
- Approval of this method does not discharge the Contractor of any responsibility;
- During the driving process, a cutting head must be pushed gradually into the virgin soil. As the driving progresses, the soil excavated by the cutting head must be removed using a soil transportation device. The excavation face must under no circumstances go beyond the cutting head. Consequently, the excavation must always be fully lined along the sides;
- Where necessary, the works must be carried out by exercising a counter-pressure at the excavation face to prevent any water from bursting through;
- Depending on the nature of the soil, the groundwater level and the drilling shield used, this face support may consist of:
    - air pressure;
    - mechanical support;
    - drilling fluid or equivalent;
    - a combination of the above techniques.
- The front face must at all times be sealed tight against water and soil and separated from the area in which the labourers are operating the drilling shield. The cutting head must be manageable by itself and provided with the necessary guiding jacks which must be able to be driven independently;
- In case of driving with pressurised air as front support, the air pressure must be constantly maintained where there is a danger of water seepage and/or collapse. The Contractor must submit a calculation note illustrating that, under all circumstances, the front face support air pressure will preserve the equilibrium of the soil;
- The Contractor must provide all deliveries and works for the filling of any cavities that may arise at the front face;
- The casing must have a sufficient number of injection openings to enable lubrication of the casing, during driving, between the soil and the outside wall with thixotropic or equivalent fluids in order to reduce soil friction;

- After the driving operations, the injection openings must be sealed to air- and water-tightness;
- The maximum capacity of the entire driving unit must be specified by the Contractor. If this capacity is insufficient to drive the entire casing from the entry pit to the exit pit or if the driving pressure on the casing is too high, the Contractor must, where necessary, provide for intermediate driving stations;
- During the driving operation, the Contractor must take the following measurements:
    - measurement of the number of metres drived in, including the cutting head in each work shift of 8 hours;
    - measurement of the peak pressure of the main jacks and that of any intermediate driving stations required to start moving the casing at the commencement of the work of each work shift;
    - measurement of the centre of the cutting head in x, y and z co-ordinates after driving each pipe with an accuracy of 5 mm and comparison with a fixed center-line system independent of the driving wall and casing train;
    - the automatic recording of the front face support pressures (drilling fluid, air, soil, water).
- If the measurement reveals that the center-line of the cutting head deviates by more than 10 cm from the theoretical center-line, the Contractor must stop the work and determine with the Owner/Owner's Representative what measures must be taken to improve the manageability of the driving;
- The maximum permitted deviation throughout the entire duration of the driving process is 10 cm both vertically and horizontally measured in relation to the connection line of the centres of the boreholes in the entry and exit working pit walls. If, following the termination of the driving the deviations are greater at any point than permitted, the works will not be accepted by the Owner/Owner's Representative;
- The Contractor must submit the layout of his safety installation;
- A permanent guard must be present (on ground level) when work is carried out by workers in the casing;
- If work is being carried out with the front face supported by air pressure, the air pressure installation must be able to provide sufficient flow and pressure to turn back the groundwater; stand-by compressor unit must be provided;
- A backup electric generator must also be present to take over automatically the supply the power in case of electric power failure;
- The Contractor must take into account that the pipes used (for the casing) must be able to withstand all loads during driving without showing damages or cracks;
- Special attention must be given to the contact materials between two pipes element during the driving operation;
- The Contractor must provide for the finishing of the joints on the inside of the casing in such a way that they do not damage the pipeline and/or its accessories while being driving through.

1.2.1.5 Spacer collars

The spacer collars must be placed at 2.50 m from each other. At the extremities of the casing, two spacer collars must be placed whereby the outer spacer collars must be located at least 30 cm inside the casing.

The support points of the successive spacer collars may not be located in one line, but must be regularly staggered. The spacer collars must be supplied by the Contractor. They will be made completely of PEHD material with a minimum height of 10 cm and must be submitted to the Owner/Owner's Representative for approval.

1.2.1.6 Driving the pipeline through the casing

When the pipe is inserting into the casing, the presence of the Owner/Owner's Representative is required. The insertion must be carried out with a sufficient number of suitable machines.

The pipeline must be kept completely in line with the casing. Damage to the coating must be excluded altogether. The progress of the pipeline in the casing must be gradual and under control. The front end of the pipe must be equipped with a slider-shoe and drawn by a cable through the casing.

1.2.1.7 Description of the works

The execution of an intersection by means of boring includes, in addition to the abovementioned works:

- The drafting of a length profile as described in GTS;
- The preparation of the site, entry as well as exit working pit;
- The installation of appropriate road signs;
- The placement of work site warning signs in GTS;
- The excavation and piling-up of the arable soil;
- The provision of thoroughfare for worksite traffic;
- The exact location and the accessibility of the complete drilling facilities;
- The excavation of the working pits up to a sufficient depth for the driving of the casing including the temporary piling-up of the soil, the necessary excavation supports, keeping the working pits and the installation dry, manipulation and removal of all necessary materials;
- The execution of all the works stipulated in the foregoing articles;
- The clearing of all excess excavation soil to a recognised waste disposal site;
- The temporary sealing of the casing ends after execution of the driving operation;
- The maintenance of the entry and exit working pits until after the tie-in with the line;
- The insertion of a PE encasement for the passage of a teletransmission cable and, where appropriate, the insertion of a HDPE encasement for the optic fibre cable if the pipe is equipped accordingly;
- The backfilling and compacting in layers of 30 cm of all excavations according to GTS;
- The restoration of the site according to GTS.

1.2.1.8 Filling the casing with sand and sealing the extremities of the casing

The working methods of filling and sealing the ends of the casing as proposed by the Contractor must guarantee sufficiently against subsequent subsidence at the extremities of the conduit. In any case, the method must guarantee that at least 95% of the casing will be filled with sand after filling.

1.2.1.9 Information to be provided by the tenderer

The Tenderer must include in his bid an outline and description of the excavation and working methods that he wishes to use as well as of the materials used both for the excavation and transportation of the excavated soil.

- Driving method: He will construct the required entry and exit working pits in accordance with his own working method. He must respect the minimum length measurements of the casing as indicated in the attached basic drawings;
- Level at the upper generatrix of the casing;
- Evaluation of the maximum driving force considered that must be taken into account;
- Number of possible intermediate driving unit;
- Planning and progress in metres per day of the casing. The Tenderer will also take the following into account while drafting his bid:

➢ The drafting of:

- a driving report in which progress and any deviations must be noted daily;
- a diagram of the works showing:
  - the driving forces;
  - progress, delays, break down, etc.;
  - The measured deviations.

➢ The supply of:

- a (continuous) calibrated recording manometer on the main driving unit and any intermediate driving unit(s).

➢ The supply of :

- the required testing and manufacturing certificates of the casing as well as the date of manufacture;
- The concrete casing must have at least six weeks of drying before they can be used; if they must be used earlier, they must at least have the strength guaranteed by the manufacturer.

➢ The tolerances relating to the results.

If the Tenderer cannot adhere to the required tolerances he must mention this in his bid and must indicate and guarantee the tolerances of his driving method - all of which taking into account his experience as well as the examination of any soil tests attached to the Particular Special Specifications.

- Before starting the works, the Contractor must have his calculations and working methods approved by the Parties concerned and by the Owner/Owner's Representative. Furthermore, all these documents must be accompanied by the required certificates that confirm the basic data used by the Contractor;

These documents must include:

- Technical notes that define the characteristics of the Contractor's supplies, for example: casing pipes, sheet piles, etc.;
- Calculations notes accompanied by sufficient justification, mainly referring to the following elements of the project:

1) The distance between the upper generatrix of the casing and the bottom of the water course, the foundations of railways and roads;
2) The sheet piles, coffer dams, supports, anchorings that form the entry and exit working pits;
3) The calculations of the settings as a result of the driving;
4) The provisions relating to injection, the use of lubricants, the construction details of the joints;
5) The casing elements during the following stages:

   - during driving and over the largest possible driving length, i.e. before reaching the exit pit;
   - termination of the driving, empty casing;
   - during the insertion of the gas pipeline;
   - The completed installation, i.e. the remaining space filled with sand.

- For the driving of casing underneath roads and railways, the working pits are located completely outside the area bordered by a line at an angle of 45° with the horizontal starting from the outermost edge of the road or rail construction (unless otherwise indicated in the drawings);
- The driving of the sheet piles may not start until such time as the Contractor has obtained the approval referred to above;
- The Contractor must consider the construction of the working pits in such a way that, following driving, all provisional sheet piles can be removed. If some sheet piles cannot be pulled out and as a consequence must remain in the ground, there must be explicit agreement on this between the Parties concerned. The working floor (gravel, concrete, steel plates, etc.) must also be removed completely.

This list is not exhaustive.

1.2.2 Ramming of product-carrier pipe

The intersection to be constructed must be limited to 2 complete pipe lengths (approx. 26 m) and the pipe must be clad with adequate PE.

1.2.2.1 Description

The construction of a crossing by means of ramming with the product-carrier pipe comprises:

- The setting-up of a length profile as described in GTS;
- The preparation of the construction site, both entry and exit working pits;
- The placement of appropriate road signs;
- The placement of work site warning signs as described in GTS;
- Excavating and storage of the arable soil;
- Provision of an access way for worksite traffic;
- The exact location and the accessibility of the entire ramming installation;
- The excavation of the working pits to a sufficient depth for driving by ramming the pipeline, including provisional storage of the soil, the required support, keeping the working pits and the installation dry, manipulation and removal of all required equipment (compressors, driving unit installation, cleaning installation, etc.);
- The execution of the welding joint in accordance with approved welding procedure. The crossing may contain at most 1 welding joint. The welding joint must be milled flat prior to carrying out the welding checks;
- The preparation and coating of the welding joint with previously approved coating products for ramming. The approved products in Article 9.1. are not valid for ramming method;
- The ramming of the product-carrier pipe. The removal of the soil in the product-carrier pipe may under no circumstances be carried out by compressed air. The pipe must be absolutely clean inside;
- The transportation of the surplus excavated soil;
- The temporary sealing of the pipe ends after carrying out the ramming;
- The maintenance of the entry and exit working pits until after tie-in with the line;
- The insertion of a PE encasement for the passage of a teletransmission cable and the insertion - if any - of a HDPE-encasement for the optical fibre cable if the pipe is equipped accordingly;
- The backfilling and compacting in layers of 30 cm of all excavations according to GTS;
- The restoration of the site according to GTS.

1.2.2.2 Working method

The working method must be described in the bid. Before starting the works, the Contractor will submit a complete and detailed description of his working method to the Owner/Owner's Representative.

The detailed description includes:

- The working method description and illustrations of the power transfer system on the product-carrier pipe;

- The description of the Working method for the insertion of the PE/HDPE encasements;
- The static calculation of entry and exit working pits;
- A sketch on which the entry and the exit working pits are indicated, among other things;
- The welding procedures to be used;
- The coating products for the welded joints;
- The dynamic force of the driving unit, percussion frequency and duration of the operation.

1.2.2.3 Inspections

The ramming of product-carrier pipes must be subjected to a number of technical tests:

- The preceding technical tests for the materials;
- Radiographic and US examination of the welded joints;
- Inspection of the coating of the welded joints and the pipe with a holiday detector prior to position the driving unit;
- Systematic checks, as the progress of the pipes demands, to verify whether the work is conform to the instructions in the drawings and to the specifications;

In this regard, the following must be checked in particular:

- The prescribed profile, direction lines and level markers;
- The condition of the pipes;
- The cutting of 30 cm of pipe at the pneumatic hammer side and US (ultrasonic test) or liquid penetrant test inspection of about 30 cm of the product-carrier pipe after removal of the 30 cm pipe section;
- Inspection of the coating by the cathodic protection company after the driving of the product-carrier pipes prior to tie-in with the line. For this purpose, the uncoated extremities of the pipe must be clean and lie completely free and dry. The cathodic protection current in the not yet coupled pipeline section must not exceed 1 µA per m².

1.2.3 Micro-tunnelling

1.2.3.1 General

This construction method is limited to a maximum of 2 entire pipe lengths (approx. 26 m) and the pipe must be coated with adequate PE.

1.2.3.2 Description

The construction of a crossing by means of dry-excavating and directly driving of the product-carrier pipe includes:

- The drafting of a length profile as described in GTS.
- The preparation of the construction site, both entry and exit working pits;

- The placement of worksite signs as described in GTS;
- The placement ofappropriate road signs;
- Excavation and storage of the arable soil;
- Provision of an access way for worksite traffic;
- Exact location and the accessibility of the entire micro-tunnelling installation;
- The excavation of the working pits, to a sufficient depth, necessary for driving the pipe through, including temporary storage of the excavated soil, the required support, keeping working pits and installation dry, manipulation and removal of all required equipment (including guiding and driving unit, jacks, drilling head, electrical generator, hydraulic sets, vacuum installation, soil transport system, drilling fluid, installation, etc.);
- Execution of the welding joint in accordance with an approved welding procedure with a maximum of one welded joint in the crossing;
- The preparation and coating of the welding joint with coating products that have been approved for micro-tunnelling. The approved products in GTS are not valid for micro-tunnelling;
- The driving of the pipes in loose or compact soil and the removal of the excavation soil to be carried away through the pipe which has been drived in;
- This may under no circumstances be carried out by means of compressed air;
- The transportation of surplus excavated soil;
- The works arising from and accompanying the foregoing works:
    - the injection of thixotropic or equivalent fluids to reduce friction;
    - the temporary sealing of the pipe ends after the driving;
    - the maintenance of the entry and exit working pits until after tie-in to the line;
    - The insertion of a PE encasement for the passage of the teletransmission cable and the insertion of an HDPE encasement to the optical fibre cable if the pipe is equipped accordingly.

1.2.3.3 Construction method

The construction method must be described in the bid. Before starting the works, the Contractor must submit a complete and detailed description of his working method to the Owner/Owner's Representative and Parties concerned. The detailed description comprises the following, among other things:

- A description and illustrations of the power transfer system on the product-carrier pipe;
- The description of the working method for the insertion of the PE/HDPE encasements;
- The static calculation of entry and exit working pits;
- The provisions relating to the injection and use of lubricant;

- A sketch in which the entry and exit working pits are indicated;
- The welding procedure to be used;
- The coating products for the welded joints.

1.2.3.4 Inspections

The drived pipes must be subjected to a number of technical tests:

- The previous technical tests of the materials;
- Radiographic and US examination of the welded joints;
- Inspection of the coating of the welded joints and the pipe with a holiday detector prior to driving;
- Systematic checks, according to the progress the pipes, in order to verify whether the works are conform to the instructions in the drawings and/or the specifications.

In this regard, the following will be checked in particular:

- The described profile, direction lines and level markers;
- The condition of the pipes;
- The coating by the cathodic protection company after driving of the pipe. For this purpose, the extremities of the pipe must lie completely free and dry. The cathodic protection current in the pipe not yet coupled pipeline section must not exceed 1 µA per m².

1.2.4 Horizontal directional drillings

Refer to PTS for HDD

1.3 OPEN TRENCH CROSSING

1.3.1 Casing in open trench

1.3.1.1 Materials

The casing elements to be used for the works must be supplied by the Contractor. They may be of the following types:

- approved reinforced concrete pipes, open trench type
- approved fibre-cement conduits, sewage type
- any other types of conduits approved by the Owner

The inner diameter of the pipe must be at least 300 mm larger than the pipe diameter.

1.3.1.2 Description

The construction of a crossing by means of a casing includes:

- The drafting of a length profile as described in GTS;
- The preparation of the construction site;

- The placement of worksite warning signs as described in GTS;
- The placement of appropriate road signs;
- Location of underground obstacles by means of sounding pits;
- Excavation of the trench including temporary storage (temporary transportation where necessary) of the soil, the required support, keeping the trench dry;
- The placing of casing element on a bed of 15 cm of stabilised sand;
- The backfilling and compaction of the trench;
- The transportation of the surplus soil to an approved waste disposal site;
- The temporary or final repair works of the roads;
- The insertion of the pipe into the casing;
- The placement of a HDPE encasement for the optical fibre cable if the pipe is equipped accordingly for the teletransmission cable if any;
- The placement of a 2" ø PE encasement with pulling cable;
- The placement of Mg anodes, supplied by the Owner, for casing longer than 40 m.;
- The filling of the casing with sand.

1.3.1.3 Spacer collars

See Article 1.2.2.5.

1.3.1.4 Insertion of the pipe in the casing

See Article 1.2.2.6.

1.3.1.5 Filling the casing with sand

See Article 1.2.2.8.

1.4 SINKERS/SYPHONS

1.4.1 Temporary assembly and construction sites

Moving already existing structures must be the subject of a special permit issued by the Parties concerned. The Contractor must carry out or have these works carried out in accordance with the instructions and requirements of the Owner/Owner's Representative and the Parties concerned. Permanent access must always be ensured along both banks of waterway.

The constructions of dikes and support dikes, provisional access roads, coffer dams, encasement sheet piles, excavation works, protections as well as reinstatement of existing installations, more particularly banks and dikes, construction of a slipway (where necessary), may only take place after having obtained the necessary permissions of the Parties concerned.

1.4.2 Sheet piles and coffer dams

The Contractor must carry out the required supplementary tests or measurements if he deems that the information (relating to currents, tides, sediment movement, soil characteristics, etc.) provided for in the Particular Special Specifications are inadequate to guarantee professional work.

The Contractor must mention this in his bid. The results of any supplementary tests must be communicated to the Owner. The top level of the temporary sheet pile screens must always be higher than the highest possible water level of the waterway to be crossed to ensure that there is no danger of flooding of the surrounding areas if water should break through. For carrying out the excavation works, the Contractor must provide for coffer dams and/or sheet piles in accordance with the soil stability.

The sheet piles must be constructed over both dikes in such a way as to provide for maximum safety against water break-through. For instance, at no time when the works are being carried may free passage exist between the waterway and the surrounding land, even while the sinker is being put in place. The Contractor will be held fully responsible for any damage caused by the infiltration of water through the sheet piles or coffer dams.

Important note:

The coffer dams must be designed and constructed in the area specially provided for this purpose and indicated on the basic drawing in order not to obstruct any shipping activities. In his bid, the Contractor will provide a description of:

- measurements and installation of these coffer dams and/or sheet piles;
- Type and characteristics of the sheet piles provided.

The installation as well as the measurements of coffer dams and sheet piles will be subject to an implementation drawing and a calculation to be submitted to the Owner/Owner's Representative as well as to the Parties concerned for approval. This approval does not in any way diminish the responsibility of the Contractor. The ramming of the sheet piles may not commence until the Contractor has obtained the approval mentioned above.

The specifications of Article 10.1. are also applicable to the realisation of the sinker trench. For this purpose tolerances of ±10 cm apply. The proposed working method must be selected in such a way that this method is in accordance with the planning, safety and stability of the entire works.

1.4.3 Anchoring, ballasting, mechanical protection of the sinker

Weight of the sinker per linear metre prior to application of a protection:

- $G_L = \frac{1}{4} \pi (\varnothing \text{ coated steel pipe})^2$ x weight of displaced water.

Weight of the coated pipe:

- G_B = Weight $_1$ (steel pipe + P.E. coating) + Weight $_2$ protection.
- G_1 = see manufacturer
- $G_2 = \frac{\pi}{4} (\varnothing_{2_B} - \varnothing_{2_L})$ x specific gravity of concrete.

  $\varnothing_B$= average outer diameter of the pipe after application of the protection (based on at least 5 measurements)

  $\varnothing_L$= $\varnothing$ coated steel pipe.

- $G_B/G_L > 1.3$ unless otherwise specified in the Particular Special Specifications

The form work used for the application of the concrete protection must be removed. The concrete protection must be at least 10 cm tick everywhere. The application there of may not damage the coating anywhere. The concrete must be reinforced. In the case of injected concrete, the Contractor must guarantee the specific gravity of the concrete.

1.4.3.1 Specifications relating to shipping

All floating material to be used (dredging vessels, floating derricks, pontoons, containers, tugs, etc.) must be provided with the required lighting, signalling devices, transmitter and transceiver equipment, in conformity with the requirements of the Parties concerned. In particular, during the sinking manoeuvre proper communications with the shore must be assured. The relevant instructions and requirements of the Parties concerned must be followed promptly and strictly.

The Contractor must submit the characteristics of his floating equipment for approval to the Owner/Owner's Representative and the Parties concerned in good time. In particular, all floating equipment or the accompanying support vessel must have sufficient motor capacity in order to ensure adequate manoeuvrability. Shipping may not be hindered during the dredging works; the shipping route must therefore always be freed in good time and provided with beacons according to the instructions of the Parties concerned. Non-operational floating equipment must always be moored alongside the shores according to regulations.

All work activities (profile narrowing, presence of floating equipment, etc.) must be announced through "Messages for Shipping" to the Parties concerned within the stipulated timescale. The date of the sinking works must also be announced in good time; this date may not be changed afterwards except in the case of unforeseen weather circumstances (ice-drift, fog, etc.).

1.4.3.2 Dredging

The characteristics of the soil to be dredged may be mentioned for information in the soil analysis attached to the Particular Special Specifications. If this information is not available, the Contractor himself must carry out the necessary investigations and present the results to the Owner/Owner's Representative and the Parties concerned before starting the works.

The minimum covering described on the drawings must be adhered to everywhere. The transversal banks of the temporary trench must be made in such a way as to avoid any danger of shearing and/or earth depletions that may affect the stability of constructions in the vicinity. Furthermore, the Contractor must adapt his working method to the speed of silting of the trench to be dredged.

If the Particular Special Specifications do not mention a waste disposal site, the Contractor himself must take the necessary steps. The waste disposal site must comply with the applicable

legislation.

If during the dredging works it becomes clear that there are unforeseen and bulky obstacles at the bottom of the sinker trench, such obstacles must be removed to a minimum of 1 metre below the lowest generatrix line of the protected pipe. The resulting cavities must be filled with soil of which the characteristics are roughly equivalent to those of the soil from the dredging trench.

Before starting the works the Contractor must carry out a detailed sounding of the waterway to be crossed. This sounding must be repeated before the sinker is placed and after the backfilling has been carried out. In his bid, the Contractor must mention which method will be used for this sounding (determination of depth - positioning).

1.4.3.3 Sinking

The Contractor is free to suggest an alternative method of launching and sinking. He must submit this method, supported by the required calculations, for approval to the Owner/Owner's Representative and the Parties concerned. To his bid, the Contractor must attach a theoretical drawing and a detailed description that must provide clear insight into the various stages from prefabrication of the sinker on the land up to and including the process of laying it in the trench.

This work schedule must clearly show, among other things, which temporary measures are considered by the Contractor (including the application of temporary sheet pile constructions, coffer dams, dikes, bridge constructions, etc.) that will reduce the free profile of the waterway. If the Parties concerned do not agree with a certain working method, the Contractor must work out an acceptable working method at his own expense. The approval of a working method by the Owner/Owner's Representative and the Parties concerned, however, in no way discharges the Contractor of his responsibility in this matter.

In particular, special attention must be paid to the hoisting plan drawn up by the Contractor. It must be designed in such a way that during the entire operation no inadmissible stresses may occur in the pipeline and that there will be no danger of lateral kinking or folding. The hoisting belts may not damage either the pipe or the cladding around it.

During the sinking works, the Contractor must have sufficiently trained staff and equipment at his disposal. If necessary, the sinker must be ballasted evenly during launching, proportionate to the water displacement of the pipe during sinking. The filling of the trench may only start after measuring the correct position of the sinker and after explicit agreement by the Owner/Owner's Representative. This must be carried out with filling material that complies with the instructions of the Parties concerned and guarantees sufficient safety against floating. This must be submitted for approval to the Owner/Owner's Representative.

The filling must be carried out carefully to 1 metre above the pipe. In each case the filling soil must be free of stones, fragments or sharp objects that could damage the pipeline and its protection. The soil remaining after filling the trench and the rising banks becomes the property of the Contractor and must be transported away from the site or from the temporary waste disposal site to a recognised waste disposal site.

1.4.3.4 Crossing of bank reinforcements, sheet pile supports coffer dams, embankments, etc.

The demolition works at the crossing must be limited to a minimum area, compatible with the implementation of the work in accordance with the code of good practices. In order to render the sinker compatible in terms of stability and form with existing constructions, the Contractor must request the relevant drawings, calculations and working methods of the constructions to be crossed from the Parties concerned in good time.

If these are not available and/or provide insufficient information, the Contractor must carry out the necessary supplementary surveys (excavating test trenches, taking soundings, measuring, soil analysis, etc.). Based on the information thus obtained, the Contractor must draw up his

design and construction drawings and submit them to the Owner/Owner's Representative and the Parties concerned for approval. The instructions of the latter must be strictly followed, and during reconstruction special attention must be given to the connection between old and new parts in order to avoid water seepage around and under the construction.

If certain demolition materials are, in the opinion of the Parties concerned, fit to be reused after cleaning, they must be stored temporarily. Removed piles, asphalt concrete, rush mats,

filter cloth, fascine mattresses, concrete, masonry, etc., however, become the property of the Contractor and must be carried away to a recognised waste disposal site.

1.4.4 Description of the works

The placement of a sinker also includes, in addition to the abovementioned works:

- The drafting of a length profile as described in GTS;
- The preparation of the worksite, for any working pits;
- The placement of appropriate road and waterway signs;
- The placement of worksite signs as described in GTS;
- The excavation and piling-up of arable soil;
- The provision of a access for worksite traffic;
- The excavation up to a sufficient depth for the placement of the sinker, including the temporary piling-up of the soil, the necessary support, keeping the work pit and the installation dry, manipulation and removal of all necessary materials;
- The execution of all works stipulated in the foregoing articles;
- The removal of all excess excavation soil to a recognised waste disposal site;
- The temporary sealing of the pipe ends after the placement of the sinker;
- The maintenance of the tie-in work pits until after the connection with the line;
- The insertion of a PE encasement for the passage of a teletransmission cable and, where appropriate, the insertion of an HDPE encasement for the optic fibre cable if the pipe is equipped accordingly;
- Backfilling according to GTS;
- The restoration of the site according to the aforementioned articles and GTS.

1.5 ABOVEGROUND PIPELINE WORK

FOR INFORMATION ONLY.

1.5.1 General

To guarantee maximum security during Works near existing structures with underground access ways for persons, the following measures shall be taken:

- the demolition materials shall be removed immediately;
- the excavation shall be backfilled or removed the same day;
- the trenches may not remain open after 5 p.m.

1.5.2 Ground level transition protection

1.5.2.1 General note

The brand names of products used in this article are the result of a procedure approved by the Owner for treating the pipeline at above/underground transition point. It is not the intention to promote these products in one way or another. Consequently, the Contractor is free to suggest to the Owner equivalent products from other suppliers or with other brand names. The working method described here below are approved recommended method only. The Contractor must submit for approval his working method to the Owner/Owner's Representative.

1.5.2.2 Method 1 - In accordance relevant drawing

Application of Fibaroll; see part 18 article 18.5

1.5.2.3 Method 2 - In accordance with relevant drawing

Placing and filling of protection casing.

1.5.2.3.1 Required materials:

- Casings: these consist of concrete or fibre cement with an internal diameter that is 100 mm larger than the outer diameter of the pipe to be protected and a length of 1 metre + the nominal outer diameter. For the protection of existing pipelines two half-shells must be used. For new pipelines casings made out of one piece must be used;
- Centring collars must be placed in the middle of the part of the pipe to be protected;
- Closing device: to be placed on each end of the conduit. On new pipelines these rubber closing devices must be of the closed type;
- Other materials: steel casing pipes and specifications mentioned elsewhere in the tender document.
  - PU paint Voss Chemie type K6 S.
  - Liquid polyurethane, 2 components.
  - Special glue for gluing the 2 half-shells: Mono-component polyurethane-based glue, PU type Glue 10.

1.5.2.3.2 Working procedure

❖ Treating the pipe

➢ Existing pipe (one part painted, the other part coated):

- Remove the pipe coating in accordance with a working method recognised by the Owner/Owner's Representative;
- Cleaning the unclad part by means of a solvent;
- The coating must not be removed further than point A of the below-ground section. Point A is located at 600 mm + nominal diameter of the casing below the surface;

- Sand-blasting SA 3 or mechanical brushing ST3;
- Application of a first layer of Voss Chemie PU paint type K6 S diluted with 20% trichloroethylene;
- Application of a sufficient number of undiluted layers of K6 S to obtain a dry layer 250 microns in depth. The surface to be treated with K6 S extends from point A, below-ground section, to 50 mm past the location where the closing device is to be fixed to the above ground section, to ensure a good connection with the paint.

➢ New coated pipelines:

- Pipes coated with extruded polyurethane : the placement and filling of the casing may be carried out without removing the coating;
- Pipes coated with tapes or with a damaged coating: identical treatment as for existing pipelines.

❖ Filling the casing

➢ Existing pipe:

- The casing consists of 2 half-shells that are glued on site with PU glue 10;
- The closing device must be of the open type and glued on site (Special glue for vulcanising the rubber).

- 1. In vertical position:
  - placing the centring collars in the middle of the part to be protected;
  - placing and gluing the 2 half-shells, centring the casing;
  - placing the bottom closing device;
  - filling the conduit with polyurethane in order to ensure the adhesion of the coating at point A;
  - repairing the painted part of the pipe above ground level;
  - securing the upper closing device after polymerisation of the polyurethane;
  - repairing the layers of paint according to code 01 of the Owner.
- 2 In horizontal position:
  - placing the centring collars in the middle of the casing to be protected;
  - fixing and securing the 2 half-shells, centring the glued casing to connect the coating point A with polyurethane;
  - placing the rubber closing devices at the extremities of the casing (to be glued by means of vulcanistion);
  - filling the casing with polyurethane;
  - removing the closing devices after polymerisation and examining the surfaces injected;

- retouching the layers of paint on the side where the pipe is unclad.

➢ New pipe:

The filling of the casing is performed in the workshop. The conduit is filled with polyurethane in accordance with the procedure under 1.b) or 1.a) according to whether they are pipes with PE coating or not. A casing made out of one piece will be used. Further steps are according to 2. (vertical position).

The products must be applied according to the specifications of the manufacturer.

1.5.3 Placing stainless steel clamping rings that serve as sliding sleeves on in service pipelines

In accordance with relevant drawing

1.5.3.1 General

Clamping rings may only be applied to pipelines that are protected with paint against corrosion in accordance with code 01.

1.5.3.2 Materials

- 2 clamping ring halves made of stainless steel 304 or 304 L, 3 mm thick;
- neoprene mat 5 mm thick;
- silicone-based sealing product;
- stainless screws.

1.5.3.3 Inspection and examination before applying the clamping rings

- Make sure that the pipe has already been treated with anti-corrosion paint (complete 01 system) at the location of the clamping rings. The paint must be dry and hard;
- The indicated locations must be cleaned with cloths soaked well in trichloro-ethane, solvetane or chlorothene. There may be no grease or oil, humidity, scale, etc. on the contact surfaces between the neoprene sheet and the pipe. Where a new layer of paint must be applied at the locations of the clamping rings, this layer must be dry and hard before the clamping rings can be placed (24 to 48 hours);
- Where necessary, dry the surface prior to application;
- Check the length and width of the neoprene sheet; its width must be 5 to 10 mm less than the width of the clamping rings, and the circumference of the neoprene sheet must be ± 1 mm less than the circumference of the pipe;

1.5.3.4 Placing the clamping rings

- Indicate with chalk the final position of the clamping ring on the pipe taking into account that the axis of the clamping ring must lie in the axis of the support;
- Place the neoprene sheet close to the pipe, taking into account that the seam is located on the bottom line of the pipe at the same level as the seam of the stainless steel clamping rings. For fixing the seam, adhesive tape or glue paper may be used, to be applied crosswise to the pipeline;
- Moisten the outside of the neoprene sheet slightly with soapy water in order to facilitate

the sliding of the clamping ring halves when securing;

- Place the uppermost half of the clamping ring;
- Place the lower half of the clamping ring;
- Connect the two clamping ring halves with stainless steel bolts without applying excessive force to prevent the neoprene creeping between the clamping rings. The bolts must be fixed with one of the following products:
  - PERMA BOND no. 118;
  - LOCTITE Stud Loc. no. 270.
- Filling of the space between the clamping rings and the pipe by means of silicone jointing compound that must be properly smoothed in such a way that no rainwater or condensation can infiltrate between the clamping rings and the pipe.

1.5.4 Placing of PVC half-shells as protection against discharge water at expansion joints of bridges and structures

In accordance with relevant drawing

1.5.4.1 Materials

- Casing halves made of PVC with an inner diameter equal to the outer diameter of the pipe + 20 mm and a minimum length of 1.5 m;
- Rubber tape 20 mm thick;
- Special glue for rubber tapes;
- PVC fixing tape, “Colson” type or equivalent.

1.5.4.2 Inspection and examination prior to placing the half-shells

- The half-shells may only be placed around the pipe after being covered with a complete anti-corrosion paint treatment and after cleaning the surface to be treated;
- The rubber bands may not be glued to the pipeline.

1.5.4.3 Placing the half-shells

- Gluing the rubber bands on the PVC casing halves;
- Placing the casing halves on the pipe at the fixed locations;
- Placing the ring connection around the pipe.

N.B. : To secure the PVC casing halves only fixing clasps made of PVC may be used.

1.5.5 Replacing existing supports by new supports

1.5.5.1 Preparatory precautions

Prior to starting the works, the Contractor must:

- Measure the position of the pipe - both vertically and horizontally - at the level of the existing support and the ground exits. The measurements must by carried out by the Contractor in the presence of the Owner's representative. The markers must be indicated on the installation and set out in the drawing by the Contractor. One or more copies of this drawing must be permanently present on the Construction site;

- Take all required measures to prevent stresses in the pipe;

- Start by dismantling the fire protection taking into account the approved procedure. The elements of the fire protection may only be reassembled at their definitive location when the new supports have been set in place;

- The different parts of the supports must be delivered, finished and painted. Consequently, the Contractor must take all necessary precautions to avoid damage to the paintwork during unloading at the construction site and during assembly operations.

1.5.5.2 Working method for dismantling a support

- Check that all preparatory measures have been taken;

- Remove sliding supports or rollers below the pipe;

- Grind away all metal parts that will no longer be used for the mounting of the new support;

- Sand-blast all places where welding will be carried out.

1.5.5.3 Procedure for mounting the new supports

Except otherwise stated in the Particular Technical Specification the mounting and welding of the gliders or stainless steel shells shall be made by the Contractor under the express supervision of the Owner's representative.

1.5.5.3.1 Preparatory works and precautionary measures

- Before placing the supports the Contractor must have the Teflon plates (gliders) already mounted on the supports;

- All new supporting parts to be welded to the structure or the already existing support must be welded over the entire circumference in order to ensure complete tightness;

- After welding new parts to the existing support, the support must be painted completely.

1.5.5.3.2 Mounting

- Presenting, placing, adjusting and welding of the basic parts of the support to the existing structure;

- Presenting, placing, adjusting and welding of the lateral guides;

- Presenting, placing, adjusting and welding of the base plate or cross beam of the support. Painting of the entire assembly after welding;

- Assembly and adjustment of the lowest sliding plate taking account of the time necessary for the paint previously applied to dry;

- Assembly and adjustment of the base plate or uppermost transverse plate. A clearance of 0.2 mm must be provided between the pipe and the Teflon plate;

- After the final adjustment, paint the entire support.

1.5.6 Removal, repair and replacing of the fire-resistant screens

1.5.6.1 Description of the fire-resistant screen

The fire-resistant screen consists of a [-shaped plate of galvanised metal painted prior to mounting and protected on the side of the pipe with a plate of asbestos cement with natural mineral fibres.

All fire-resistant elements must be mounted on the pipe support between the pipe and the structure of the bridge over the entire length of the construction. The elements of the fire-resistant screens will nearly always be used as support for the teletransmission cables.

1.5.6.2 Procedure

Before starting the works, the Contractor, in cooperation with the Owner, must make a site description to evaluate the scope of the works to be carried out and of the materials to be replaced. To this end, each fire-resistant part will be checked for distortion as well as the asbestos-cement plates, the connections, the paintwork, etc.

1.5.6.3 Scope of the works

- Before dismantling the fire-resistant elements, the Contractor must determine the correct location of these elements because the distances between the supports may vary. The reinforcement steel plates (150 x 6 mm) will be prepared;
- Dismantling the fire-resistant elements;
- Remove the existing reinforcement steel plates from the supports by grinding;
- Repair the damaged elements, where necessary replacing the plates of asbestos-cement, retouch the paintwork;
- Mount the reinforcement steel plates on the elements of the fire-resistant equipment (steel bars 150 x 6 mm). The holes for fixing may be drilled in the steel plates beforehand (see detailed drawing). The last two elements on the upstream side of the bridge will be shortened to allow expansion (see detailed plan);
- The new reinforcement steel plates on the support must be mounted and welded by means of continuous welding beads;
- After the welding of the new reinforcement plates, retouch the paintwork;
- Assembly and adjustment of the fire-resistant elements. The corner irons must be welded free of stress so that the axes can slide easily. Furthermore, they must be lubricated when they are mounted;
- The new parts will be painted before delivery. Consequently, the Contractor must take all the necessary precautions to avoid any damage to the paintwork.

1.5.7 Welding of stainless steel shells to pipelines

The work must be carried out according to relevant drawing.

1.5.7.1 Preparation

- The marking of locations of the shells, in accordance with the instructions in the drawing

and specifications, taking into account the expansion of the pipe, in such a way that the welding of the shells remains at a distance of at least 300 mm from the welded joints ofthe pipes. If this distance is unfeasible, it may be reduced provided that supplementary checks are made of the round seam weld of the pipe;

- Cleaning by sandblasting (Sa 3) or mechanical brushing (St 2.5) of the area(s) before placing and welding the stainless steel shells;
- U.S. and E.M. inspection of the area concerned of the pipe before welding the shells;
- Inspection of the outer diameter of the pipe at places where the stainless steel shells will be welded;
- Apply the shells to the pipe and tighten them using a special tool intended for this purpose (clamping ring or chain) after, where necessary, grinding away the surplus thickness of the existing lengthwise weld on the pipe leaving a surplus thickness of 0.5 mm on the welding joint.

1.5.7.2 Welding procedure for stainless steel shells, stainless steel 304L, on above ground pipes to be laid or on existing pipes which are not in service or under pressure

The procedure is valid for welding on pipes made of steel API. Gr.B up to X60 with wall thicknesses of at least 4.5 mm and with a cooling rate limited to 75ºC/minute with min. temp. of 80ºC at the welding end.

1.5.7.3 Electrodes to be used

- Soudochrom L309 L.N.D. 2.5 mm;
- Soudochrom A.D. D.N. 2.5 mm exclusively for downward welding.

1.5.7.4 Inspection of the pipe before welding

U.S. inspection according to ASME V, art. 5 and API 1104 assessed according to ASME VIII, Div. 1, App. 12 and E.M. inspection according to ASME V, Art. 7 and acceptance criteria according to ASME VIII, Div. 1, App. 6 and API 1104.

If during inspection an error is discovered, another location must be chosen or if necessary a section of the pipe will be replace. Where necessary, however, the welding joint must be ground with a surplus thickness of approximately 0.5 mm, among other things for helical seam welded pipes or longitudinal seam welded pipes. The pipe must be perfectly cleaned, free of grease, scale, residue of metallisation and humidity.

1.5.7.5 Welding sequence

- Press the stainless steel shell solidly against the pipe by means of the appropriatetools;
- Pre-heat.

➢ For the lengthwise welding of stainless steel shells:

The entire surface of the shells must be pre-heated with a burner to ± 100º C in order to remove all traces of humidity between the pipe and the shell. Weld in accordance with the indicated sequence 1-2-3-4 on fig. 1 and/or 2.

➢ For round seam welding:

Pre-heat the pipe with a burner to 150 - 200 º C. Try to avoid heating the shell to such an

extent that it might come loose from the pipe by expansion. Carry out the entire welding joint A following the sequence of the arrows of fig. 1 and/or 2, after which the same working method must be repeated for welding joint B. After welding, the shell must be neutralised, cleaned and polished with a product approved by the Owner (passivation - Betspastor type, AVESTA-JOHNSON & Co. N.V.).

1.5.7.5.1 Inspection after the welding

The welding seams must be thoroughly checked 100%.

1.5.7.5.2 Welding procedures approved by a Owner's Representative

The Contractor shall submit for approval the welding procedure he intends to use.

1.5.7.5.3 Special conditions for painting the round seam welds of the stainless steel shells welded on pipelines

The round seam welds between the stainless steel shells and the steel pipe must be protected against atmospheric influences by painting. To this end, a collar of approx. 20 mm at both ends of the stainless steel shell must be sand-blasted (Sa 3) or mechanically brushed (St 2.5) and painted in accordance with system code 01 approved by the Owner.

During these operations, the central parts of the stainless steel shells must be protected against sand-blasting or stripping. These parts must remain polished in order to facilitate the sliding of the shells on the Teflon sliding supports.

1.6 DISCONNECTING EXISTING PIPELINES

FOR INFORMATION ONLY

1.6.1 General

The Particular Special Specifications determine which parts of the pipes must be disconnected. The interventions under gas will be carried out by the Contractor well trained team with a recognised experience and the Contractor will also carry out the following work :

- The required excavation works in accordance with the specifications of the G.T.S.;
- The removal of the existing coating as described in GTS over the entire length of the working pit except for 0.5 metres along each extremity;
- The supply of all materials and the execution of all work as described in Art. 19.8.2. according to the specific status and service pressure of the pipe;
- The removal of the pipe parts indicated in the P.T.S. (valve station, sample pieces, etc.);
- The restoration of the site in accordance with GTS;
- The transportation and unloading of the pipeline parts indicated in the P.T.S. to the worksites of the Owner.

The Contractor will supply all the materials that are not included in the parts lists.

1.6.2 Status of the pipe to be disconnected and special applications

1.6.2.1 Disconnection of pipelines to remain in service

- Low-pressure pipes (≤ 14,7 bar):

The pipe must be disconnected with a conical terminal plug with a 1" vent. The Owner will supply the end cap and the materials for the 1" pressure release point. The Contractor will carry out all the necessary works in accordance with the relevant drawing.

The 1" pipe Sch.80 of the pressure release point must be bent cold by the Contractor. All welding seams must be tested non-destructively (Rγ for butt welding and liquid penetrant testing for the corner welded seams). The Contractor will deliver and place an approved 16 mm² cable in accordance with GTS. The welding of the terminal part to the pipeline is carried out by the Contractor well trained team. The Contractor must carry out the required coating works in accordance with GTS. The tie-in joint must be soaped at 6 bar and at operating pressure.

- High-pressure pipelines > 14.71 bar:

The pipe must be disconnected with an end-piece in accordance with the relevant drawing. The Contractor will deliver all materials in accordance with the parts list. The Contractor must construct the end-piece in accordance with the drawing mentioned above. All welded joints must be radiographied. The Contractor will carry out a resistance test (1.4 x M.O.P.) and a leak test (soaping at 6 bar). The tie-in joint will be carried out by the Contractor well trained team, radiographied and soaped at 6 bar and operating pressure. The Contractor will supply and place an approved 16 mm² cable in accordance with GTS and carry out the coating work in accordance with GTS.

1.6.2.2 Disconnecting pipelines to be left behind permanently

The pipe must be disconnected with a terminal cap in accordance with the relevant drawing. The Contractor will supply all materials in accordance with the parts list. The Contractor will construct the end cap in accordance with the relevant drawing and weld it to the existing pipe after rinsing it with nitrogen and after the Owner/Owner's Representative's approval.

The Contractor will deliver the nitrogen required for rinsing the pipe. The Contractor will deliver and place an approved 50 mm² cable in accordance with GTS and will carry out all the coating works in accordance with GTS. The Contractor will fill the pipe to be left with nitrogen with an over-pressure of 100 gr.

INDRAPRASTHA GAS LTD.

LAYING & CONSTRUCTION OF U/G STEEL PIPELINE NETWORK & ASSOCIATED WORKS FOR CONNECTIVITY OF CNG STATION AT CONCOR CONTAINER DEPOT DADRI, GAUTAM BUDDHA NAGAR

PAINTWORK FOR PIPES AND FITTINGS

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1. PAINTWORK

1.1. GENERAL

1.1.1. Choice of paint products

The term system will be taken to mean the whole of two or more layers that will be applied consecutively to the base to be protected and which must finally constitute the homogeneous, continuous and sealed protective layer.

The Contractor will consult the paint manufacturer for the technical description of the paint systems stipulated in these specifications. The chosen paint systems will be included in the price quotation. The Contractor will indicate the methods of application for the different systems and the environmental conditions.

The Contractor will refer to the paint supplier of his choice to obtain all the guidelines for the addition of additives and solvents to obtain the required finish regardless of the environmental conditions of temperature and wind speed and the method of applying the coats (brush, roller or spray gun).

1.1.1.1. Products chosen by the Owner

FOR INFORMATION ONLY

The Owner has selected complete paint systems with a number of paint manufacturers for different applications. The selected systems along with the conditions for use and application are specified by the paint manufacturer in these Specifications.

1.1.1.2. Environment - Aggressiveness

When a particular part of work is being carried out, the painting system should be chosen in accordance with the environment in which the material to be painted will be located. Indeed, the degree of aggressiveness of the atmosphere that will be encountered in the environment of the work can range from an environment which is not very aggressive to an extremely aggressive environment, depending on whether the location is in a rural area, a non-industrial built-up area, ventilated workshops, in the vicinity of the sea, at chemical plants, in humid rooms or in the vicinity of sources of cold or heat.

Taking account of these uncertainties, different painting systems can be recommended, and it is consequently important to mention at the time of the invitation to tender the degree of aggressiveness in which the material to be painted will be located so that the Contractor can mention this to the supplier of the paint products to determine the system to be applied.

1.1.2. Composition of the paint products used

1.1.2.1. 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).

Thinning on the building site of paint products with two components will be carried out in accordance with the specifications of the supplier.

1.1.2.2. Quality control - Sampling

While the works are in progress on the construction site, the Owner and/or the Engineer 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 the analyses reveal a non-conformity in the composition of the products used (tolerance of $\pm$ 3 % of the dosage of every component), the Owner and/or the Engineer may refuse application of the product under consideration, halt the work and have the nonconforming product already applied removed.

Before proceeding with the work, a product that does conform will be required. The only purpose of the analyses 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.

1.1.3. Conditions of delivery

1.1.3.1. 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, like the lid, are marked with a strip of colour identical to the contents.

1.1.3.2. Identification

Every recipient will bear the following information:

- Name of the manufacturer;
- Date and number of manufacture;
- Name of the product type;
- Net weight of the product or the contents of the recipient.

At the time of delivery, this packaging must be bear labels in conformity with the legal stipulations in force.

1.1.4. 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.

1.2. PREPARATION OF THE SURFACES

1.2.1. 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 the 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.

The method of preparation of the surface will be implemented in accordance with the preparation methods described below:

- Cleaning (bright blast-cleaning);
- Mechanical cleaning;
- Manual derusting.

The Contractor should have the required material at his disposal to clean the surfaces to be coated thoroughly in accordance with the preparation methods specified regardless of the form or the condition of such surfaces. Devices that might be damaged during the preparation will either be taken away by the Owner or screened off by the Contractor. The latter will inquire about this during his exploration of the site for the works.

1.2.2. Sandblasting

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 get 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 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 - e.g. INOX (stainless steel).

The abrasive to be used must conform to the local low i.e. it may contain no carbon and less than 1 % free silicone dioxide. The Sa 3 will always be requested and must at least reach Sa 2 1/2 during the initial stage of the paintwork. For blasting followed by metallisation, 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 SS 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.

1.2.3. Mechanical cleaning

If sandblasting is not permitted or if the metal structures are not easily accessible for blasting or blasting for one reason or another is technically unfeasible, mechanical derusting 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 fulfils the requirements.

If parts are present that are so corroded that St 3 is difficult to achieve, this should be notified to the Owner's 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, Chlorothene NU).

1.2.4. Manual derusting

Manual derusting with the aid of scrapers, steel brushes, sandpaper etc. shall only be permitted in exceptional cases for local repairs. Any deviation therefrom must be requested from the Owner and/or the Engineer.

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.

1.2.5. 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 D3359, method A. The adhesion should be at least 4A.

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.

1.2.5.1. Galvanised surfaces

Galvanised 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.

1.2.5.2. Metallised 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.

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.

1.2.6. 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.

1.2.7. 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 much rust, dust and grease as possible and treat it 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 neutralise it if necessary.

1.2.8. 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 and/or the Engineer will be informed in advance of any toxicity or flammability. All measures must be taken to prevent any risk of fire and to rule out any possibility of poisoning (ventilation). The Contractor will provide drip collectors to keep the environment free of pollution.

1.2.9. Condition of the metal after stripping

The Contractor must call in a representative of the Owner and/or the Engineer or of the Approved Supervisory Body responsible for checking the condition of the metal during stripping and informing the Owner and/or the Engineer 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

1.2.10. 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.

1.3. METALLISATION

1.3.1. Applying the metallisation

- Metallisation must be carried out in accordance with ISO 2063;
- Metallisation is carried out as rapidly as possible after blasting in order to limit corrosion of the pipes (max. 3 hours later). With metallisation, a surface preparation degree Sa 3 is compulsory. The roughness of the blasted surfaces should be from 25 to 50 □ R_{max} ;
- The metallizing is always carried out on dry parts in good weather conditions (maximum relative humidity 80 %);
- For metallisation, a wire composed of 85 % zinc and 15 % aluminium 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 after metallisation;

- The sealant must be thinned and applied A visual inspection whereby the sealant completely covers the metallisation will suffice here;

- When evaluating the metallisation, a negative deviation from the minimum coating thickness, as prescribed, 80 □ for 20% of the measurements will be permitted.

N.B.:

For the metallisation of the surfaces that are exposed to high temperatures such as chimneys, ZINACOR 850 (85/ZN/15 AL) will be used of which the systems. CARRYING OUT THE PAINTWORK

1.3.2. 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 and/or the Engineer.

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 if 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.

1.3.3. 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 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.

1.3.4. 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 homogenised.

1.3.5. 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 top coats;
- 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 the site for places that are difficult to reach with the brush. In this case, a request must be made to the Owner and/or the Engineer 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.

1.3.6. 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 colour stipulated, which clearly differs from the previous layer, taking account of the colour 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 colour of the coats is not mentioned the colour difference in consecutive coats must, if possible, be at least 100 RAL.

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 thicknesses indicated in the description of the paint systems are minimum thicknesses. In this connection, the Contractor is obliged to contact the paint manufacturer and conform to his guidelines. The Contractor must respect the thicknesses specified by the supplier.

1.3.7. 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 polymerisation of the paint.

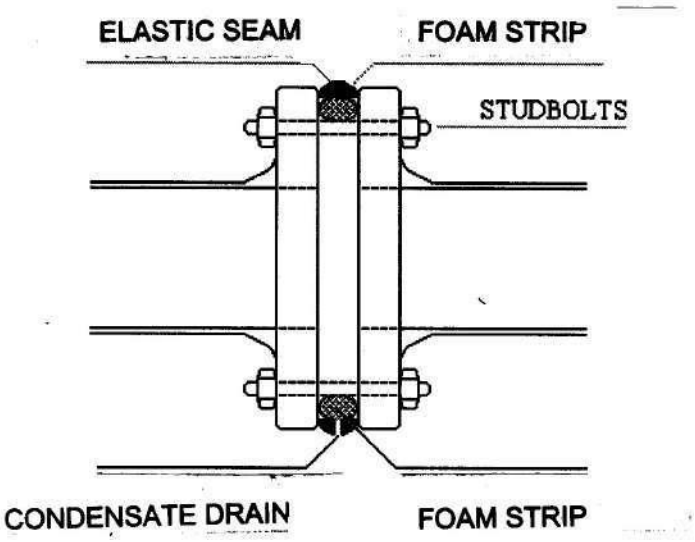
1.3.8. Finishing the flanges, support surfaces, thread ends and stud bolts

Between flanges and around neoprene supports, polyurethane gaskets will be provided that will be covered with the last paint layer, except for the support of the above ground crossing. Some thread ends will be lightly sandblasted and protected with system 02 or 33. Stud bolts fitted in the workshop for metallised flanges may not be sandblasted but system St 3 - 01A will be applied.

After the paintwork, the flange will be finished off as follows:

- A foam strip will be placed between the flange on the stud bolt;

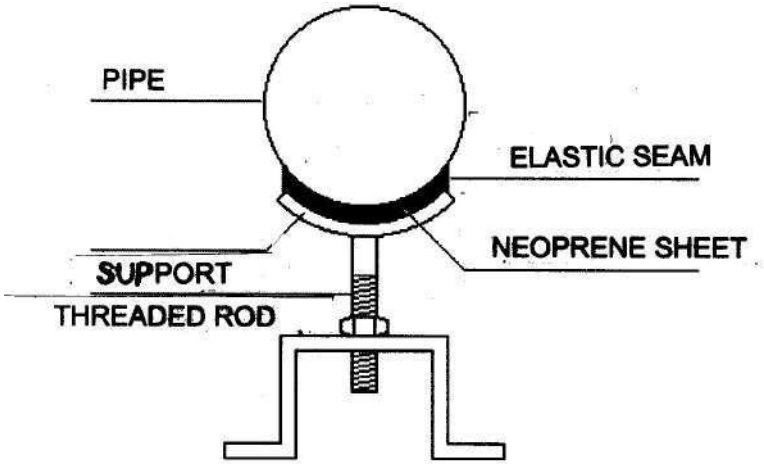
- The space will then be filled with an elastic seam in accordance with the chosen paint system (see Article 18.1.2);
- An opening on the underside of at least 8 mm will be kept as a condensation outlet;
- The seam will finally be wiped smooth with white spirit so that a good appearance is obtained. Finally, the seam will be covered with the last coat of paint (see Article 18.4.7).



- Maintenance of the support surfaces

In order to maintain the support surface, the pipe or device support must be lifted up or lowered sufficiently. The existing supports shall be lowered, taken out and/or removed under the supervision of Owner's teams. They can then be moved by the Contractor in accordance with his needs for the painting operation. The local person in charge will indicate how this work will be carried out. The support surface will be treated in the same manner as the other parts. After the paintwork, the support will be refitted. Between the support and the pipe, there will be a NEOPRENE gasket supplied by the Owner.

Finally, the whole unit will be sealed with an elastic seam that will finally be covered with the last layer of paint between the support and the pipe. In the case of above-ground crossing, this grouting may not be covered with the last layer of paint



1.4. GROUND-LEVEL TRANSITION POINT

1.4.1. 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 Sa 3:

1) The primer of system 01a

2) Reinforced polyester □ 20 cm above the ground level marker and □ 5 cm on the asphalt cleaned beforehand. (application of reinforced polyester is carried out in accordance with the work method prescribed by the manufacturer - see appendix 2). Moreover, in the case of PE, in contrast to asphalt, he will apply a polyken primer to the 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 polyken primer will be applied to PE and then subsequently processed as described under point 2.

1.4.2. Transition protection system

The transition point will be treated in accordance with the products and methods described in the G.T.S. Part 16.

1.5. 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 pricelist;
- 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;
- For certain works, the Owner will provide scaffolding himself to carry out his own works. This scaffolding will be made available to the Contractor;
- A report will be drawn up when the scaffolding is handed over. The duration of the period when this scaffolding is made available free of charge is the number of working days necessary for the paintwork given in the pricelist, plus any delay resulting from bad weather conditions.

1.6. QUALITY CONTROLS AND GUARANTEE

1.6.1. Inspection of the works

The Contractor is responsible for checking the weather conditions to ascertain whether the paintwork can be carried out within the technical specifications mentioned in the present specifications (see Article 18.4.1 & 18.4.2.).

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 required 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 (C45-N) (APPENDIX 3) 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 does 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.

1.6.2. 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 recognised 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 condition 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.

1.6.3. 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 D1212;
- The dry layer thickness of the film will be measured electronically, with complete statistical information, in accordance with 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 judgement 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.

1.6.4. Guarantee

1.6.4.1. 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.

1.6.4.2. 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.

1.6.4.3. Guarantee criterion

Every protection system is considered to give satisfaction during the period of guarantee. The Owner requires the conditions as described in the General Terms and Conditions of Purchase.

1.7. PRODUCTS CHOSEN BY THE OWNER *(FOR INFORMATION ONLY)*

SUPPLIER : N.V. LAVENNE

CODE	APPLICATION	TYPE	NO. OF LAYERS	DESCRIPTION OF SYSTEM	COLOUR	DRY LAYER DEPTH IN MICRONS		TOTAL DRY LAYER DEPTH IN MICRONS
						MIN	MAX	
LV01	Surfaces (to 90°C) Sa3	Epoxy + polyurethane (2 components)	1 1 1 1	RUSTOZINC EP 4024 RUSTOCOAT SEALANT 4230 RUSTOCOAT HB FINISH 4448 MURATHANE FINISH 5456	GREY RAL 9007 BEIGE ***SEE APPENDIX 5***	35 70 60 35	60 120 130 50	200
LVO1a	Surfaces (to 90°C) Sa3 or St3 Welding seams or repairs in system 01, 63 and stud bolts	Epoxy + polyurethane (2 components)	1 1 1	RUSTOCOAT HB PRIMER 4048 RUSTOCOAT HB MIOX 4248 MURATHANE FINISH 5456	RED-BROWN GREEN ***SEE APPENDIX 5***	75 100 35	100 150 50	210
LV02	Ground exit (see **Art. 18.5**) NETWORKS Sa3 INSTALLATIONS St3	Epoxy + polyurethane (2 components)	 1 1 1 (1	see system 01a RUSTOCOAT HB PRIMER 4048 RUSTOCOAT HB MIOX 4248 REINFORCED POLYESTER Polyken primer in case of PE) idem for nets but with St3 (remove all existing paint)	 RED- BROWN GREEN	 75 100	 100 150	75
LV03	Warm surfaces - with insulation (90° - 120° C)Sa 3 or St 3	EPOXY (2 components)	1 1	RUSTOCOAT HB MIOX 4248-102 RUSTOCOAT HB MIOX 4248-101	GREEN DARK GREY	75 75	150 150	150
	- without insulation (90° - 120° C)Sa 3 or St 3	EPOXY POLYURETHANE (2 components)	1 1 1	RUSTOCOAT HB PRIMER 4048 RUSTOCOAT HB MIOX 4248 MURATHANE FINISH 5456	RED- BROWN GREEN ***SEE APPENDIX 5***	75 100 35	100 150 50	210
LV15	Pipelines in cellars	EPOXY	1	RUSTOZINC EP 4024		35	60	

	Sa 3	(2 components)	2	RUSTOTAR HB 4428		100	150	235
	Pipelines in cellars St 3	EPOXY (2 components)	1 2	RUSTOCOAT HB PRIMER 4048 RUSTOTAR HB 4428		50 100	80 150	250

SUPPLIER : N.V. LAVENNE

CODE	APPLICATION	TYPE	NO. OF LAYERS	DESCRIPTION OF SYSTEM	COLOUR	DRY LAYER DEPTH IN MICRONS		TOTAL DRY LAYER DEPTH IN MICRONS
						MIN	MAX	
LV21	New galvanisation in the workplace	Synthetic resin dispersed in water		Preparation Degreasing with DEGREASER ZS 8014 Rinse off with clean water RUSTOCOAT HB PRIMER 4048 MURATHANE FINISH 5456	 CREAM ***SEE APPENDIX 5***	 75 35	 100 50	 110
			1 1					
LV22	Galvanisation still in good condition (max. 10 % rust) St 3 or Sa 3	Synthetic resin dispersed in water		Preparation Rinse with clear water and dry. After removing rust, degrease with DEGREASER ZS 8014. Retouch with RUSTOCOAT EP PRIMER 4054 RUSTOCOAT HB PRIMER 4048 MURATHANE FINISH 5456	 GREEN BLUE CREAM ***SEE APPENDIX 5***	 40 75 35	 60 100 50	 110 / 150
			1 1 1					
LV33	Steel Sa3 or St 3	Vinyl Alkyd and Vinyl		RUSTOGALV VA PRIMER 1352 RUSTOGALV UNDERCOAT TC2350 RUSTOGALV MIOX 2351 RUSTOGALV FINISH 3350		30 50 50 30	60 70 70 50	 160
			1 1 1 1					
LV41	Concrete plinths	EPOXY POLY-URETHANE (2 components)		Bare metal : remove rust RUSTOCOAT HB PRIMER 4048 On concrete RUSTOCOAT IMPREGNATION 4000 *In small holes and cracks* RUSTOCOAT CONCRETE 4002 or RUSTOCOAT FILLER 4810 *On surfaces* RUSTOCOAT HB FINISH 4448 MURATHANE FINISH 5456	 BEIGE ***SEE APPENDIX 5***	 (50) 60 30	 (60) 130 50	 90
			1 1 1 1					

SUPPLIER : N.V. LAVENNE

CODE	APPLICATION	TYPE	NO. OF LAYERS	DESCRIPTION OF THE SYSTEM	COLOUR	DRY LAYER DEPTH IN MICRONS		TOTAL DRY LAYER DEPTH IN MICRONS
						MIN	MAX	
LV51	Chimneys 450° C max. Sa3	Silicone resin and zinc		On the site				
			1	THERMOSIL PRIMER 5982		30	50	
			2	THERMOSIL MIOX 3181		25	40	80
				In the workshop				
				Metallisation ZN 100				
				ZINACOR 85/15		100		
			1	RUSTOZINC ST 4028		40	60	
				On the site				
			1	RUSTOZINC ST 4028		40		180
LV51a	Chimneys 600° C max. Sa 3 (rugosity : R max. 50 □)	Silicone	1	METALLISATION ALU		120		
			1	THERMOSIL 600 3186		20	30	140
LV63	Metallisation Sa 3 (rugosity : R max. 50 □)	EPOXY (2 components) Top coat POLYURETHANE (2 components)		In the workshop				
				Metallisation				
			1	ZINACOR 85/15		100		
			1	RUSTOCOAT SEALANT 4230 (20% thinned)	RAL 9007 BEIGE	40 80	120 130	220
			1	RUSTOCOAT HB FINISH 4448				
				On the site	***SEE APPENDIX 5***	35	50	255
				MURATHANE FINISH 5456				
LV70	Non-ferrous metals and special steel (Alu - Inox)	POLYURETHANE (2 components)		Preparation				
				Degreasing with DEGREASER ZS 8014				
				Rinse off with clean water and allow to dry				
			1	MURATHANE AZP 5032		30	50	
			1	MURATHANE FINISH 5456		30	50	60

SUPPLIER : N.V. LAVENNE

CODE	APPLICATION	TYPE	NO. OF LAYERS	DESCRIPTION OF THE SYSTEM	COLOUR	DRY LAYER DEPTH IN MICRONS		TOTAL DRY LAYER DEPTH IN MICRONS
						MIN	MAX	
LV81	Concrete floors Dry blast free of dust and oil	POLYURETHANE (2 components)	 1 1 or 2	After blasting and on a dry floor free of dust, dirt etc. MURATHANE FLOOR PAINT 5440 50 % thinned MURATHANE FLOOR PAINT 5440			 □ 10 m²/L	
LV85	Concrete floors Antislip idem LV81	POLYURETHANE (2 components)	 1	Idem LV81 + strew the still wet film liberally with silica of desired grain-size. After polymerisation, brush away excess silica and apply a new layer of MURATHANE FLOOR PAINT 5440			 □ 10 m²/L	
LV90	Indoor Masonry, concrete, stones	POLYVINYL ACETATE	 1 1 or 2 1 1 or 2	<u>On ceilings</u> MUR ECRAN 41 MURTEX 141 <u>On concrete and bricks</u> PREMUR 47 MURTEX 141			 □ 8 to 10m²/L □ 13 m²/L □ 8 m²/L □ 13 m²/L	
LV91	Outdoor concrete and bricks	ACRYL	1 2	ACROMUR 42 MURCRYL 145			□ 10 m²/L □ 10 to 15 m²/L	
LV92	Outdoor Damaged concrete	Coating on basis of QUARTZ	1 1 1	ACROMUR 42 CREPIMUR 163 MURCRYL 145			□ 10 m²/L □ 2à 4,5 kg/m² □ 10 to 15 m²/L	

SUPPLIER : LIBERT

CODE	APPLICATION	TYPE	NO. OF LAYERS	DESCRIPTION OF THE SYSTEM	COLOUR	DRY LAYER DEPTH IN MICRONS		TOTAL DRY LAYER DEPTH IN MICRONS
						MIN	MAX	
L01	Surfaces (up to 90°C) Sa3	Epoxy and polyurethane (2 components)	1 1 1 1	GALVOXY, zinc-rich primer coat OXYPAINT FF 1100, metallic finish CRYLTANE AC, middle coat gloss CRYLTANE AC, top coat gloss	GREY BLUE PINK ***SEE APPENDIX 5***	40 70 45	75 120 90	200
L01a	Surfaces (up to 90°C) Sa3 or St3 Welding seams or repairs of system 01, 63 and stud bolts	Epoxy and polyurethane (2 components)	1 1 1 1	OXYPAINT FA 503 Primer coat OXYPAINT FF 1100 Middle coat CRYLTANE AC, Middle coat CRYLTANE AC Top coat	RED BLUE PINK ***SEE APPENDIX 5***	40 70 45	75 120 90	200
L02	Ground exit (see **Art. 18.5**) NETS Sa3 INSTALLATIONS St3	Epoxy + polyurethane (2 components)	 1 1 1 (1	see system 01a OXYPAINT FA 503 Primer coat OXYPAINT FF 1100, metallic finish REINFORCED POLYESTER Polyken primer in case of PE) idem nets but with St 3 (removal of all existing paint)	 RED BLUE	 40 70	 75 120	40
L03	Warm surfaces - with insulation (90° - 120° C) Sa 3 or St 3	Polyurethane 1 component	1 1	CRYLTANE AC Primer coat CRYLTANE AC Top coat	PINK GREY	80 80		160
	- without insulation (90° - 120° C) Sa 3 or St 3	Polyurethane (2 components)	1 1 1	OXYPAINT FA 503 Primer coat OXYPAINT FF 1100 Middle coat CRYLTANE AC Top coat	RED BLUE ***SEE APPENDIX 5***	40 70 45	75 120 90	200
L15	Pipelines in cellars	EPOXY	1	GALVOXY, zinc-rich Primer coat	GREY	40	75	

	Sa 3	(2 components)	2	OXYTAR Epoxy tar	***SEE APPENDIX 5***	150	200	340
	Pipelines in cellars St 3	EPOXY (2 components)	1 2	OXYPAINT FA 503 Primer coat OXYTAR Epoxy tar	RED ***SEE APPENDIX 5***	60 150	75 200	360

SUPPLIER : LIBERT

CODE	APPLICATION	TYPE	NO. OF LAYERS	DESCRIPTION OF THE SYSTEM	COLOUR	DRY LAYER DEPTH IN MICRONS		TOTAL DRY LAYER DEPTH IN MICRONS
						MIN	MAX	
L21	New galvanisation in the workplace	Water-thinned paint		Preparation a or b a) Degreasing with trichloro-ethane 1.1.1. and clean with Lithoform 2. Wash off with clean water + dry b) variant : With steam degreasing (high pressure) Steam Devil Type				
			1	CRYLTANE AC Primer coat	PINK	60	100	
			1	CRYLTANE AC Top coat	***SEE APPENDIX 5***	60	90	120
L22	Galvanisation still in good condition (max. 10 % rust) St 3 or Sa 3	Water-thinned paint		Preparation a or b a) degreasing with trichloro-ethane 1.1.1. and clean with Lithoform 2. Wash off with clean water + dry b) Variant : Steam degreasing (high pressure) Rub down rust spots, retouch with		60	100	
			1	CRYLTANE AC Primer coat	BROWN RED	60	100	
			1	CRYLTANE AC Primer coat CRYLTANE AC Top coat	PINK ***SEE APPENDIX 5***	60	90	180 / 120
L33	Steel Sa3 or St 3	Vinyl Copolymer	1	DUROZINC SA 507 Primer coat	RED	50		
			1	DUROZINC SA 820 Primer coat	GREY	50		
			1	SM MIDDLE COAT	PINK	40		180
			1	SM TOP COAT	***SEE APPENDIX 5***			

SUPPLIER : LIBERT

CODE	APPLICATION	TYPE	NO. OF LAYERS	DESCRIPTION OF THE SYSTEM	COLOUR	DRY LAYER DEPTH IN MICRONS		TOTAL DRY LAYER DEPTH IN MICRONS
						MIN	MAX	
L41	Concrete plinths	Epoxy (2 components)		Blast - remove dust Protect uncovered and derusted				
			1	steel with OXYPAINT FA 503	RED	40-		
				Impregnate cracks with		80		
			1	AQUAPOX DW/FM 1000	WHITE			
				Repair the cracks with epoxy FX/SL product				
			1	AQUAPOX DW/FM 1000, soak	WHITE			
			1	CRYLTANE AC, primer coat	PINK		90	
			1	CRYLTANE AC, top coat	***SEE APPENDIX 5***	45 45	90	90
L51	Chimneys Blast Sa 3 450° C maximum	Silicic acid salt ethyl of zinc (2 components)		<u>On the site</u>				
			2	SILIKA GALVEX (brush)		25	50	50
				<u>In the workshop</u>				
			1	Metallisation Zinacor 85/15		100		
			1	SILIKA GALVEX (Airless)		60	90	160
L51a	Chimneys up to 600° C	Silicone Aluminium	1	Aluminisation (rugosity R.max 50 □)		120		
			2	WP 1110		30		180
L63	Metallisation Sa 3 (rugosity : R max. 50 □)	Polyurethane (2 components)		<u>In the workplace</u> Metallisation ZINACOR 85/15				
			1	CRYLTANE AC PRIMER 30 % thinned	RED	100		
			1	CRYLTANE AC PRIMER	PINK	80	100	
				<u>On the site</u>				
			1	CRYLTANE AC, top coat, gloss	***SEE APPENDIX 5***	60	80	240

SUPPLIER : LIBERT

CODE	APPLICATION	TYPE	NO. OF LAYERS	DESCRIPTION OF THE SYSTEM	COLOUR	DRY LAYER DEPTH IN MICRONS		TOTAL DRY LAYER DEPTH IN MICRONS
						MIN	MAX	
L70	Non-ferrous metals and special steel (Alu., Inox...)	Polyurethane (2 components)	 1 1 1	Degreasing with trichloro-ethane 1.1.1. and clean Lithoform 2 Rinse off thoroughly and dry Variant: Degreasing with high-pressure steam CRYLTANE AC primer CRYLTANE AC primer CRYLTANE AC, top coat gloss	 RED PINK ***SEE APPENDIX 5***	 60 60 60	 80 80 80	 180
L81	Concrete floors Dry blast free of dust and oil	Polyurethane 1 component	 1 2	Light sandblasting - remove dust, wash off with warm soda (oil). Rinse and dry POLYFLOOR primer POLYFLOOR finish		0,14-0,15L/m² 2 x 0,15 L/m²		
L85	Concrete floors Antislip idem L81	Polyurethane 1 component	 1 1 1	Light sandblasting - remove dust, wash off with warm soda (oil). Rinse and dry POLYFLOOR primer POLYFLOOR anti-slip POLYFLOOR finish		0,14-0,15L/m² 2 x 0,15 L/m² 2 x 0,15 L/m²		
L90	Indoor Masonry, indoor concrete, bricks	Acrylate	1 1	RESACRYL A.F. thinned 10 % to 20 % RESACRYL A.F. not thinned		0,15 L/m² 0,2 L/m²		
L91	Outdoor Concrete and bricks	Acrylate	1 1	RESACRYL A.F. thinned 10 % to 20 % RESACRYL A.F. not thinned		0,15 L/m² 0,2 L/m²		
L92	Outdoor Damaged concrete and bricks	Acrylate	1 1 1	RESACRYL A.F. thinned 10 % to 20 % water LIBOQUARTZ		0,15 L/m² 0,8 L/m² 0,2 L/m²		

				RESACRYL A.F. not thinned			

SUPPLIER : RIPOLIN BENELUX

CODE	APPLICATION	TYPE	NO. OF LAYERS	DESCRIPTION OF THE SYSTEM	COLOUR	DRY LAYER DEPTH IN MICRONS		TOTAL DRY LAYER DEPTH IN MICRONS
						MIN	MAX	
RB01	Surfaces (up to 90°C) Sa3	Epoxy Polyurethane (2 components)	1 1 1	VIGOR ZN 302 VIGOR EP 235 VIGOR PU 801 ST	GREY-GREEN RED- BROWN ***SEE APPENDIX 5***	50 80 80	100 150 150	210
RB01a	Surfaces (up to 90°C) Sa3 or St3 Welding seams or repairs of system 01, 63 and stud bolts	Epoxy Polyurethane (2 components)	1 1 1	VIGOR EP 235 VIGOR EP 235 VIGOR PU 801 ST	RED- BROWN OCHRE BEIGE ***SEE APPENDIX 5***	80 80 80	150 150 150	240
RB02	Ground exit (see **Art. 18.5**) NETS Sa3 INSTALLATIONS St3	Epoxy + polyurethane (2 components)	 1 1 1 (1	see system 01a VIGOR EP 235 VIGOR EP 235 REINFORCED POLYESTER Polyken primer in case of PE) idem nets but with St 3 (removal of all existing paint)	 OCHRE BEIGE RED- BROWN	 80 80	 150 150	80
RB03	Warm surfaces - with insulation (90° - 120° C) Sa 3 or St 3	Epoxy	1 1	VIGOR EP 235 VIGOR EP 235	RED- BROWN OCHRE BEIGE	80 80	150 150	160
	- without insulation (90° - 120° C) Sa 3 or St 3	Epoxy	1 1 1	VIGOR EP 235 VIGOR EP 235 VIGOR PU 801 ST	RED- BROWN OCHRE BEIGE ***SEE APPENDIX 5***	80 80 80	150 150 150	240

RB15	Pipelines in cellars Sa 3	Epoxy	1 1 1	VIGOR ZN 302 VIGOR EP 235 VIGOR EP 235	GREY-GREEN OCHRE BEIGE GREY	50 80 80	100 100 100	210
	Pipelines in cellars St 3	Epoxy Epoxy - Tar	1 1 1	VIGOR EP 235 VIGOR EP 235 VIGOR EP 235	RED- BROWN OCHRE BEIGE GREY	80 80 80	100 100 100	240

SUPPLIER : RIPOLIN BENELUX

CODE	APPLICATION	TYPE	NO. OF LAYERS	DESCRIPTION OF THE SYSTEM	COLOUR	DRY LAYER DEPTH IN MICRONS		TOTAL DRY LAYER DEPTH IN MICRONS
						MIN	MAX	
RB21	New galvanisation in the workplace	Epoxy		(see art.2.5.2.) degreasing, clean and rinse with clean				
			1	water	WHITE-GREY	40	60	
			1	CENTREPOX PZ	***SEE APPENDIX 5***	80	150	120
				VIGOR PU 801 ST				
RB22	Galvanisation still in good condition (max. 10 % rust) St 3 or Sa 3	Epoxy		After degreasing with trichloro-ethane, clean with P2-Henkel and rinse with				
			1	clean water	WHITE-GREY	40	60	
			1	CENTREPOX PZ	OCHRE BEIGE	80	150	
			1	VIGOR EP 235	***SEE APPENDIX 5***	80	150	200
				VIGOR PU 801 ST				
RB33	Steel Sa3 or St 3	Vinyl Alkyd	1	FREITANYL HB PRIMER		60	100	
			1	FREITANYL HB MIO		60	100	
			1	FREITANYL HB Top coat		60	100	180
RB33 a	Repair of system RB33 Sa3 or St 3	Vinyl Alkyd	2	FREITANYL HB Top coat	***SEE APPENDIX 5***	50	70	100
RB41	Concrete plinths	Epoxy + Polyurethane		On metal after careful brushing				
			1	VIGOR EP 235	OCHRE BEIGE	80	150	
				On concrete after the correct				
			1	preparation		40	50	
				ENDOKOTE 426.20				
			1	fill with epoxy mortar		5 mm		
			1	FREITAGSOL EP250	***SEE APPENDIX 5***	80	150	
				VIGOR PU 801 ST				
RB51	Chimney up to 400° C Sa 3	Zinc ethyl silicate		Metallisation ZINACOR 85/15		100		
			1	VIGOR ZN 304, 30% thinned		35	60	135
			1	damage: layer of ECOLZINC no. 2 after removal of the zinc salts on the site				

SUPPLIER : RIPOLIN BENELUX

CODE	APPLICATION	TYPE	NO. OF LAYERS	DESCRIPTION OF THE SYSTEM	COLOUR	DRY LAYER DEPTH IN MICRONS		TOTAL DRY LAYER DEPTH IN MICRONS
						MIN	MAX	
RB51a	Chimney up to 600° C Sa 3 - rugosity: Rmax 50 µ	Silicone resin aluminium		Metallisation ALUMINIUM		120		
			2	SUPERTHERMOVIT 600	SILVER GREY	25	35	
			1	SUPERTHERMOVIT 600	ALUMINIUM	20	30	190
RB63	Metallisation Sa 3 (rugosity : R max. 50 □)	Epoxy + Polyurethane (2 components)		In the workshop, Metallisation ZINACOR 85/15		100		
			1	CENTREPOX PZ	WHITE-GREY	40	60	
			1	VIGOR EP 235	RED-BROWN	80	100	
				On the site				
			1	VIGOR PU 801 ST	***SEE APPENDIX 5***	40	60	260
RB70	Non-ferrous metals and special steel (Alu., Inox...)	Epoxy + Polyurethane		After degreasing with trichloro-ethane and rinse with clean water				
			1	CENTREPOX PZ	WHITE-GREY	40	50	
			1	VIGOR EP 235	RED-BROWN	80	150	
			1	VIGOR PU 801 ST	***SEE APPENDIX 5***	40	60	160
RB81	Concrete floors Dry blast free of dust and oil	Epoxy-phenol		For new floors: remove the surface milk-skin of the cement by a mechanical procedure For old floors : degrease and remove dust				
			1	SOLENDOKOTE 442.40 15%		□ 250 gr./m²		
			1	thinned SOLENDOKOTE 442.40		□ 250 gr./m²		

SUPPLIER : RIPOLIN BENELUX

CODE	APPLICATION	TYPE	NO. OF LAYERS	DESCRIPTION OF THE SYSTEM	COLOUR	DRY LAYER DEPTH IN MICRONS		TOTAL DRY LAYER DEPTH IN MICRONS
						MIN	MAX	
RB85	Concrete floors Antislip idem RB81	Epoxy-phenol	 1 1	<u>For new floors:</u> remove the surface milk-skin of the cement by a mechanical procedure <u>For old floors</u> : degrease and remove dust For the use of anti-slip powder SOLENDOKOTE 442.40 15% thinned SOLENDOKOTE 442.40 The anti slip is obtained by anti slip powder min. 5% in the last layer		 □ 250 gr./m² □ 250 gr./m²		
RB90	Indoor masonry, concrete, stones inside buildings	Acrylate	 1 1 to 2	Before starting work take humidity measurements Thoroughly clean surface and remove dust Check all joints GUIPRIM adhesive coat, thinned RIPALO Facade		 □ 8 m²/kg □ 5 m²/kg		
RB91	Outdoor concrete and bricks outside	Acrylate	 1 1 to 2	Before starting work take humidity measurements Thoroughly clean surface and remove dust Check all joints GUIPRIM adhesive coat, thinned EUCRYL Facade		 □ 8 m²/kg 11-14 m²/kg		
RB92	Outdoor damaged concrete and bricks	Acrylate		Before starting work take humidity measurements Thoroughly clean surface and remove dust.				

			1 1 to 2	Check all joints RIPONOV adhesive coat, thinned RIPONOV		3 m²/kg 3 m²/kg	

SUPPLIER : SIGMA COATINGS N.V.

CODE	APPLICATION	TYPE	NO. OF LAYERS	DESCRIPTION OF THE SYSTEM	COLOUR	DRY LAYER DEPTH IN MICRONS		TOTAL DRY LAYER DEPTH IN MICRONS
						MIN	MAX	
S01	Surfaces (up to 90°C) Sa3	Epoxy and polyurethane (2 components)	1 1 1	SIGMACOVER ZN PRIMER SIGMACOVER CM MIOCOAT SIGMADUR HS SEMIGLOSS	CREAM BEIGE ***SEE APPENDIX 5***	60 70 70	80 150 100	200
S01a	Surfaces (up to 90°C) Sa3 or St3 Welding seams or repairs of system 01, 63 and stud bolts	Epoxy and polyurethane (2 components)	1 1 1	SIGMACOVER ALU PRIMER SIGMACOVER CM MIOCOAT SIGMADUR HS SEMIGLOSS	GREY BEIGE ***SEE APPENDIX 5***	70 70 70	200 150 100	210
S02	Ground exit (see **Art. 18.5**) NETWORKS Sa3 INSTALLATIONS St3	Epoxy + polyurethane (2 components)	 1 1 1 (1	see system 01a SIGMACOVER ALU PRIMER SIGMACOVER CM MIOCOAT REINFORCED POLYESTER Polyken primer in case of PE) idem Networks but with St3 (removal of all existing paint)	 GREY BEIGE	 70 70	 200 150	70
S03	Warm surfaces 90° C - 120°C Insulated Sa 3 - St 3	Epoxy	1 1	SIGMACOVER CM MIOCOAT SIGMACOVER CM MIOCOAT 9553	GREEN BEIGE	70 70	100 100	140
	Warm surfaces 90° C - 120°C Not insulated Sa 3 - St 3	Epoxy	1 1 1	SIGMACOVER ALU PRIMER SIGMACOVER CM MIOCOAT SIGMADUR HS SEMIGLOSS	GREY BEIGE ***SEE APPENDIX 5***	70 70 70	200 150 100	210
S15	Pipelines in cellars Sa 3	Epoxy (2 components)	1 1 1	SIGMACOVER ZN PRIMER CHEMIKOTE T BROWN CHEMIKOTE T BLACK	CREAM ***SEE APPENDIX 5***	40 100 100	100 180 180	240

	Pipelines in cellars St 3	Epoxy (2 components)	1 1 1	SIGMACOVER PRIMER CHEMIKOTE T BROWN CHEMIKOTE T BLACK	KHAKI ***SEE APPENDIX 5***	50 100 100	100 180 180	 250

SUPPLIER : SIGMA COATINGS N.V.

CODE	APPLICATION	TYPE	NO. OF LAYERS	DESCRIPTION OF THE SYSTEM	COLOUR	DRY LAYER DEPTH IN MICRONS		TOTAL DRY LAYER DEPTH IN MICRONS
						MIN	MAX	
S21	New galvanisation	Epoxy	 1 1	Degreasing and clean. Rinse with clean water and dry. SIGMACOVER PRIMER SIGMADUR HS SEMIGLOSS	 KHAKI ***SEE APPENDIX 5***	 50 70	 100 100	 120
S22	Galvanisation still in good condition (max. 10 % rust) St 3 or Sa 3	Epoxy	 1 1 1	Degreasing and clean. Rinse with clean water and dry. Remove rust from the rusted parts St 3 Retouch the derusted parts SIGMACOVER PRIMER SIGMACOVER PRIMER SIGMADUR HS SEMIGLOSS	 KHAKI KHAKI ***SEE APPENDIX 5***	 50 50 70	 100 100 100	 170
S33	Steel Sa3 or St 3	Vinyl Alkyd	1 1 2	VINYL ALKYD PRIMER 7023-2051 SIGMA VINYL MIO 7025-5051 SIGMA VINYL top coat 7027		40 40 40	70 70 70	 160
S41	Concrete plinths	Two components solvent-free	 1 1	Any repairs : abrade down to clean concrete and remove rust from steel to St 3 apply COLTURA PRIMER MAC to steel and concrete to be repaired after application of the still wet primer fill with COLTURA PRIMER EPU SIGMARITE WL PRIMER 30 % thinned with 91-92	 WHITE			 grouting

			1 1	SIGMACOVER CM MIOCOAT SIGMADUR HS SEMIGLOSS	BEIGE ***SEE APPENDIX 5***	70 70	100 100	layer 140

SUPPLIER : SIGMA COATINGS N.V.

CODE	APPLICATION	TYPE	NO. OF LAYERS	DESCRIPTION OF THE SYSTEM	COLOUR	DRY LAYER DEPTH IN MICRONS		TOTAL DRY LAYER DEPTH IN MICRONS
						MIN	MAX	
S51	Chimneys 450° C Sa3			In the workshop Metallisation ZN 100 ZINACOR 85/15		100		
			1	SIGMASILGUARD MC, thinned 50% with 90-53		35	55	
				On the site Remove chloride by washing off with water to which a detergent has been added, with a hard brush				
			1	SIGMASILGUARD MC, 50 % thinned with 90-53		35	55	□ 170
S51a	Chimneys up to 600° C Sa 3 - rugosity: Rmax 50 µ	Alu silicate	1	Metallisation Alu.		120		
			1	SIGMATERM SILICAAT ALUMINIUM		30		150
S63	Metallisation Sa 3 (rugosity : R max. 50 □)	Epoxy (2 components)		In the workshop Metallisation ZN 100 ZINACOR 85/15		100		
			1	SIGMARITE SEALANT 20% thinned	GREEN	40	60	
			1	SIGMACOVER CM MIOCOAT	BEIGE	70	150	
		Polyurethane		On the site				
			1	SIGMADUR HS SEMIGLOSS	***SEE APPENDIX 5***	70	100	280
S70	Non-ferrous metals (Alu, Inox ...)	Epoxy (2 components)		Preparation Remove the oxidation layer with Deoxidiser 670 solution and. hard nylon brush. Rinse off to remove every trace of Deoxidiser. On the still wet surface, apply Alodine 1200* (ready for use)				
			1	* Instructions Henkel	KHAKI	50	100	
		Polyurethane	1	SIGMACOVER PRIMER	BEIGE	70	150	

			1	SIGMACOVER CM MIOCOAT SIGMADUR HS SEMIGLOSS	***SEE APPENDIX 5***	70	100	190

SUPPLIER : SIGMA COATINGS N.V.

CODE	APPLICATION	TYPE	NO. OF LAYERS	DESCRIPTION OF THE SYSTEM		DRY LAYER DEPTH IN MICRONS		TOTAL DRY LAYER DEPTH IN MICRONS
						MIN	MAX	
S81	Concrete floors Dry blast, free of dust and oil			Below-ground free of dirt, dust, cement slag and other impurities				
			1	SIGMARITE GP Finish, 20 % thinned with 91-92		yield 5 m²/L		
			1	SIGMARITE GP Finish		yield 5 m²/L		
S85	Concrete floors Antislip idem S81	Anti-slip paint		Below-ground free of dirty, dust, cement slag and other impurities				
			1	SIGMARITE GP Finish, 20 % thinned with 91-92		yield 5 m²/L		
			1	SIGMARITE GP Finish + 5 % anti-slip powder		yield 5 m²/L		
S90	Indoor masonry, concrete, bricks	PV acetate	2 to 3	SIGMATEX SUPERLATEX 1st layer 10 % thinned with water 1 or 2 layers unthinned		yield 10m²/L		
S91	Outdoor concrete and brick	Acrylate	1	SIGMAFIX UNIVERSAL 1/4 parts water				
			2	SIGMACRYL FACADE		yield 10m²/L		
S92	Outdoor damaged concrete and brick	Quartz finishing	1	SIGMAFIX UNIVERSAL 1/4 parts water				
			2	KWARTSTONE		400 gr/m²/low		

1.8. SURFACE AREA CALCULATIONS

The measurement statement must allow an estimate to be made of the quantities and/or surface area of the work carried out or yet to be carried out.

1.8.1. Pipes and fittings

The surface area per linear metre of the pipes is given in table 1. The equivalent length that must be taken into consideration for the calculation of the surface area of the fittings is given in table 2. Any fittings not mentioned in table 2 will not be considered for the supplementary equivalent length.

Cut-off valves and operators are mentioned in table 2. For a T-piece and a reducer, the largest nominal diameter will be considered. For smaller diameters not mentioned in the tables, the larger diameter will be considered.

1.8.2. Construction elements

I, L, T, U profiles

- the surface area of the profiles is given in table 3;
- profiles not mentioned will be calculated ;
- openings or off-cuts will be deducted if they exceed 50 % of the part considered.

1.8.3. Screw thread, nuts & bolts

The surface is the length of the screw thread and nut multiplied by a coefficient (see table 4).

TABLE 1

Nominal diameter INCH	Nominal diameter MM	Outside diameter MM	Surface area per linear M-M2
1	25	33.7	0.11
2	50	60.3	0.19
3	80	88.9	0.28
4	100	114.3	0.36
6	150	168.3	0.53
8	200	219.1	0.69
10	250	273	0.86
12	300	323.9	1.02
14	350	353.6	1.12
16	400	406.4	1.28
18	450	457	1.48
20	500	508	1.60

24	600	609.6	1.92
28	700	711.2	2.24
32	800	812.8	2.35
36	900	914.4	2.87
40	1000	1016	3.19
42	1050	1066	3.35
48	1200	1220	3.83
56	1400	1420	4.46
64	1600	1620	5.09
72	1800	1820	5.72
80	2000	2020	6.35

TABLE 2

Outside diameter MM from - up to	T- Piece	Flange Blind flange
6 - 50	0.30	0.3
65 - 200	0.75	0.5
250 - 2000	1.50	0.7

VALVES :

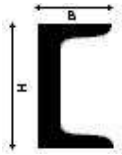
Outside diameter	DS-Surface area (m^2)
2"	0.38
3"	0.64
4"	0.83
6"	1.22
8"	1.58
10"	2.24
12"	2.65
14"	2.91
16"	3.33
20"	4.16
24"	4.99
28”	5.84
36"	7.46
40”	8.34

OPERATORS

Outside diameter	DS-Surface area (m^2)
8"	2.64
10"	3.20
12"	3.31
14"	3.38
16"	3.72
20"	4.18
24"	4.65
28”	5.11
36"	6.05
40”	6.51

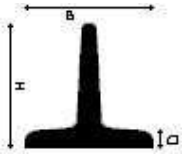
TABLE 3

U-PROFILES



Name	H x W (mm)	m² / m	m²/to
	30 x 15	**0.103**	59.19
	30 x 33	**0.174**	40.74
	40 x 20	**0.142**	49.47
	40 x 35	**0.199**	40.86
	50 x 25	**0.181**	46.89
	50 x 38	**0.232**	41.50
	60 x 30	**0.215**	42.41
	70 x 40	**0.276**	41.02
UPN 8	80 x 45	**0.312**	36.10
UPN 10	100 x 50	**0.372**	35.10
UPN 12	120 x 55	**0.434**	32.40
UPN 14	140 x 60	**0.489**	30.60
UPN 16	160 x 65	**0.546**	29.--
UPN 18	180 x 70	**0.611**	27.80
UPN 20	200 x 75	**0.661**	26.10
UPN 22	220 x 80	**0.718**	24.40
UPN 24	240 x 85	**0.775**	23.30
UPN 26	260 x 90	**0.834**	22.--
UPN 28	280 x 95	**0.890**	21.30
UPN 30	300 x 100	**0.950**	20.60
	320 x 100	**0.982**	16.50
	350 x 100	**1.047**	17.30
	380 x 102	**1.110**	17.70
	400 x 110	**1.182**	16.50

SYMMETRICAL T-PROFILES

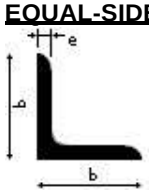


H x W	D	m² / m	m²/ton
15 x 15	3	**0.055**	84.60
20 x 20	3	**0.075**	85.20
25 x 25	3.2	**0.094**	72.90
30 x 30	4	**0.114**	64.40
35 x 35	4.5	**0.133**	57.10
40 x 40	5	**0.153**	51.70
45 x 45	5.5	**0.171**	46.60
50 x 50	6	**0.191**	43.--
60 x 60	7	**0.229**	36.80
70 x 70	8	**0.268**	32.20
80 x 80	9	**0.307**	28.70
90 x 90	10	**0.345**	25.70
100 x 100	11	**0.383**	23.40
120 x 120	13	**0.459**	19.80
140 x 140	15	**0.537**	17.20
160 x 160	15	**0.617**	17.20
180 x 180	18	**0.693**	14.30

ASYMMETRICAL T-PROFILES

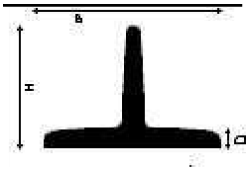
H x W mm	D	m² / m	m²/ton
30 x 60	5.5	**0.171**	47.--
35 x 70	6	**0.201**	43.10
40 x 80	7	**0.233**	37.50
45 x 90	8	**0.258**	32.20
50 x 100	8.5	**0.287**	30.50
60 x 120	10	**0.345**	25.70
70 x 140	11.5	**0.402**	22.50
80 x 160	13	**0.460**	19.80
90 x 180	14.5	**0.518**	17.80
100 x 200	16	**0.576**	16.20

EQUAL-SIDED ANGLE IRONS



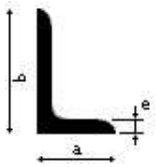
b x b (x e)	P Kg/m	Surface m²/m
20 x 20 x 3	0.88	**0.077**
x 4	1.14	
25 x 25 x 3	1.11	**0.097**
x 4	1.45	
x 5	1.78	
30 x 30 x 3	1.36	**0.116**
x 4	1.78	
x 5	2.18	
35 x 35 x 3	1.60	**0.136**
x 4	2.10	
x 5	2.57	
40 x 40 x 3	1.84	**0.155**
x 4	2.42	
x 5	2.97	
x 6	3.52	
45 x 45 x 3	2.09	**0.174**
x 4	2.74	
x 5	3.38	
x 6	4.00	
50 x 50 x 3	2.33	**0.194**
x 4	3.06	
x 5	3.77	
x 6	4.47	
x 7	5.15	
x 8	5.82	
60 x 60 x 4	3.70	**0.233**
x 5	4.57	
x 6	5.42	
x 8	7.09	
x 10	8.69	
70 x 70 x 5	5.37	**0.272**
x 6	6.38	
x 7	7.38	
x 8	8.36	
x 10	10.30	

EUROPEAN SERIES



b x b (x e)	P Kg/m	Surface m²/m
80 x 80 x 6	7.34	**0.311**
x 7	8.49	
x 8	9.63	
x 10	11.90	
x 12	14.10	
90 x 90 x 6	8.31	**0.351**
x 8	10.90	
x 9	12.20	
x 11	14.70	
x 13	17.10	
100 x 100 x 6.5	9.98	**0.390**
x 8	12.20	
x 10	15.00	
x 12	17.80	
x 15	21.90	
120 x 120 x 8	14.70	**0.469**
x 10	18.20	
x 12	21.60	
x 15	26.60	
150 x 150 x 10	23.00	**0.586**
x 12	27.30	
x 15	33.80	
x 18	40.10	
180 x 180 x 15	40.90	**0.705**
x 18	48.60	
x 20	53.70	
200 x 200 x 16	48.50	**0.785**
x 18	54.20	
x 20	59.90	
x 24	71.10	

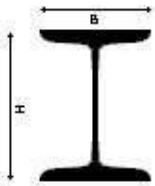
UNEQUAL-SIDED ANGLE IRONS **EUROPEAN SERIES**



b x a (x e)	P Kg/m	Surface m²/m
30 x 20 x 3	1.11	**0.097**
x 4	1.45	
x 5	1.78	
40 x 20 x 3	1.36	**0.117**
x 4	1.77	
x 5	2.17	
40 x 25 x 4	1.93	**0.130**
x 5	2.37	
45 x 30 x 4	2.25	**0.146**
x 5	2.77	
50 x 30 x 4	2.41	**0.156**
x 5	2.96	
x 6	3.51	
60 x 30 x 5	3.37	**0.175**
x 6	3.99	
60 x 40 x 5	3.76	**0.195**
x 6	4.46	
x 7	5.14	
65 x 50 x 5	4.35	**0.224**
x 6	5.16	
x 7	5.97	
x 8	6.75	
70 x 50 x 5	4.56	**0.233**
x 6	5.41	
x 7	6.25	
x 8	7.07	
75 x 50 x 5	4.74	**0.244**
x 6	5.63	
x 7	6.51	
x 8	7.39	
80 x 40 x 5	4.55	**0.234**
x 6	5.41	
x 7	6.25	
x 8	7.07	

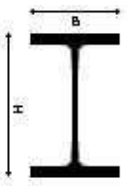
b x a (x e)	P Kg/m	Surface m²/m
90 x 65 x 6	7.07	**0.300**
x 7	8.19	
x 8	9.28	
x 10	11.44	
100 x 50 x 6	6.85	**0.292**
x 7	7.93	
x 8	8.99	
x 10	11.1	
100 x 65 x 7	8.77	**0.350**
x 8	9.94	
x 9	11.1	
x 10	12.25	
100 x 75 x 8	10.6	**0.342**
x 10	13.0	
x 12	15.4	
120 x 80 x 8	12.2	**0.391**
x 10	15.0	
x 12	17.8	
130 x 65 x 8	11.9	**0.381**
x 10	14.6	
x 12	17.3	
150 x 75 x 9	15.36	**0.471**
x 10	17.0	
x 12	20.17	
150 x 90 x 10	18.2	**0.469**
x 12	21.6	
x 15	26.6	
200 x 100 x 10	23.0	**0.587**
x 12	27.3	
x 14	31.6	
x 16	35.9	

NORMAL I-PROFILES OF 80 MM AND MORE EUROPEAN SERIES



Usual name	P Kg/m	H mm	B mm	Surface m²/m
IPN 8	5.95	80	42	**0.30**
IPN 10	8.32	100	50	**0.37**
IPN 12	11.2	120	58	**0.44**
IPN 14	14.4	140	66	**0.50**
IPN 16	17.9	160	74	**0.58**
IPN 18	21.9	180	82	**0.64**
IPN 20	26.3	200	90	**0.71**
IPN 22	31.1	220	98	**0.78**
IPN 24	36.2	240	106	**0.84**
IPN 26	41.9	260	113	**0.91**
IPN 28	48.0	280	119	**0.97**
IPN 30	54.2	300	125	**1.03**
IPN 32	61.1	320	131	**1.09**
IPN 34	68.1	340	137	**1.15**
IPN 36	76.2	360	143	**1.21**
IPN 38	84.0	380	149	**1.27**
IPN 40	92.6	400	155	**1.33**
IPN 42.5	104	425	163	**1.41**
IPN 45	115	450	170	**1.48**
IPN 47.5	128	475	178	**1.55**
IPN 50	141	500	185	**1.63**
IPN 55	167	550	200	**1.80**

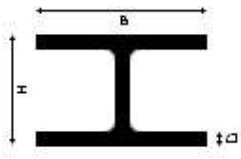
SYMMETRICAL IPE PROFILES



Usual name	P Kg/m	H mm	B mm	Surface m²/m
IPE 80	6.00	80	46	**0.33**
IPE 100	8.10	100	55	**0.40**
IPE 120	10.4	120	64	**0.48**
IPE 140	12.9	140	73	**0.55**
IPE 160	15.8	160	82	**0.62**
IPE 180	18.8	180	91	**0.70**
IPE 200	22.4	200	100	**0.77**
IPE 220	26.2	220	110	**0.85**
IPE 240	30.7	240	120	**0.92**
IPE 270	36.1	270	135	**1.04**
IPE 300	42.2	300	150	**1.16**
IPE 330	49.1	330	160	**1.25**
IPE 360	57.1	360	170	**1.35**
IPE 400	66.3	400	180	**1.47**
IPE 450	77.6	450	190	**1.61**
IPE 500	90.7	500	200	**1.74**
IPE 550	106	550	210	**1.88**
IPE 600	122	600	220	**2.01**

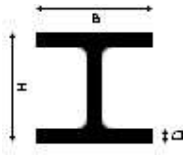
PROFILES WITH WIDE PARALLEL FLANGES

EUROPEAN PROFILES: EURONORM 53-62



No. of profile profile	Name	P Kg/m	H mm	B mm	Surface m²/m
10	HE 100 A	16.7	96	100	**0.561**
	HE 100 B	20.4	100	100	**0.567**
	HE 100 M	41.8	120	106	**0.619**
12	HE 120 A	19.9	114	120	**0.677**
	HE 120 B	26.7	120	120	**0.686**
	HE 120 M	52.1	140	126	**0.738**
14	HE 140 A	24.7	133	140	**0.794**
	HE 140 B	33.7	140	140	**0.805**
	HE 140 M	63.2	160	146	**0.857**
16	HE 160 A	30.4	152	160	**0.906**
	HE 160 B	42.6	160	160	**0.918**
	HE 160 M	76.2	180	166	**0.970**
18	HE 180 A	35.5	171	180	**1.024**
	HE 180 B	51.2	180	180	**1.037**
	HE 180 M	88.9	200	186	**1.089**
20	HE 200 A	42.3	190	200	**1.136**
	HE 200 B	61.3	200	200	**1.151**
	HE 200 M	103.0	220	206	**1.203**
22	HE 220 A	50.5	210	220	**1.255**
	HE 220 B	71.5	220	220	**1.270**
	HE 220 M	117.0	240	226	**1.322**
24	HE 240 A	60.3	230	240	**1.369**
	HE 240 B	83.2	240	240	**1.384**
	HE 240 M	157.0	270	248	**1.460**

PROFILES WITH WIDE PARALLEL FLANGES



Name	P Kg/m	H mm	B mm	Surface m²/m
HD 100 x 15	14.9	96.5	100.0	**0.564**
x 20	19.6	101.6	100.0	**0.573**
x 24	23.8	103.0	102.0	**0.579**
HD 130 x 20	20.3	124.0	128.0	**0.729**
x 24	23.8	127.0	127.0	**0.737**
x 28	27.5	130.0	127.6	**0.744**
x 33	33.2	125.0	123.0	**0.705**
HD 160 x 30	29.96	157.0	155.0	**0.896**
x 35	34.87	160.0	156.0	**0.904**
x 40	39.82	163.0	157.0	**0.912**
x 46	46.06	167.0	158.0	**0.922**
HD 210 x 43	43.45	201.0	204.0	**1.174**
x 50	49.85	204.0	205.0	**1.182**
x 56	56.31	207.0	206.0	**1.190**
x 63	62.81	210.0	207.0	**1.198**
x 71	70.99	214.0	208.0	**1.208**
x 83	82.39	219.0	210.0	**1.222**
x 94	94.25	225.0	211.0	**1.236**
x 117	116.59	235.0	213.0	**1.256**

SPECIAL PROFILES: COLUMNS

Name	P Kg/m	H m	B mm	Surface m²/m
HD 260 x 240	240.37	314	273	**1.625**
274	273.76	326	276	**1.654**
333	333.39	346	282	**1.707**
HD 310 x 94	93.91	306	305	**1.767**
106	105.92	310	306	**1.777**
118	117.99	314	307	**1.787**
135	135.05	319	309	**1.801**
155	154.71	325	311	**1.817**
177	177.00	332	313	**1.835**
207	207.15	341	316	**1.859**
240	240.23	351	319	**1.885**
274	273.77	361	322	**1.912**
308	307.79	371	325	**1.938**
350	350.43	383	329	**1.970**
435	434.78	407	336	**2.032**
HD 360 x 135	135.18	355	369	**2.117**
152	152.49	360	370	**2.129**
176	175.67	366	372	**2.145**
199	199.03	372	374	**2.161**

x 139	139.12	245.0	216.0	**1.283**
x 162	162.02	255.0	219.0	**1.308**
x 200	200.22	271.0	225.0	**1.356**
x 252	251.53	291.0	232.0	**1.410**
HD 260 x 60	59.99	248.0	253.0	**1.452**
x 68	67.92	251.0	254.0	**1.460**
x 78	77.89	255.0	255.0	**1.470**
x 90	89.94	260.0	256.0	**1.482**
x 104	104.15	265.0	258.0	**1.496**
x 121	120.56	271.0	260.0	**1.512**
x 141	141.15	278.0	262.0	**1.530**
x 160	160.15	286.0	264.0	**1.550**
x 184	183.66	294.0	267.0	**1.573**
x 209	209.47	302.0	270.0	**1.595**

HD 400 x 190	190.04	369	391	**2.226**
214	214.34	375	393	**2.242**
237	237.10	381	394	**2.255**
262	261.74	387	396	**2.271**
287	286.56	393	398	**2.287**
312	311.57	399	400	**2.303**
337	336.77	405	402	**2.319**
370	370.48	413	405	**2.342**
404	403.78	421	407	**2.361**
446	445.88	431	410	**2.387**
488	488.45	441	413	**2.413**
531	531.49	451	416	**2.439**
577	577.37	461	420	**2.468**
621	621.43	471	423	**2.494**
679	678.56	481	426	**2.510**

TABLE 4

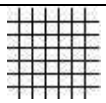
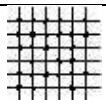
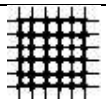
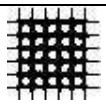
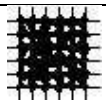
Diameter of screw thread INCHES up to	Diameter of screw thread MM up to	Coefficient
1	25	20
1 1/4	32	25
1 1/2	40	30
2	50	40

APPENDIX 1 - adhesion tests

ADHESION TEST ON COATINGS BY MEANS OF THE GRID TEST

DIN 53 151
ISO 2409

ASTM D3359-B
BS 3900-E6

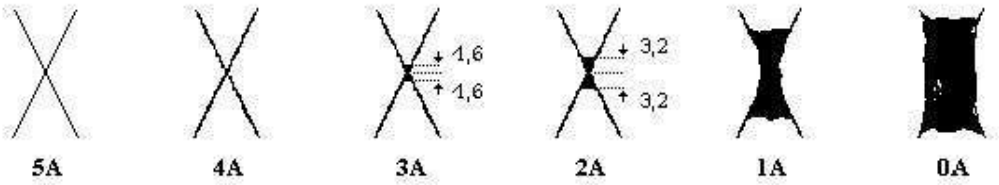
Description	Surface of the gridded area that is peeling. (Example for 6 grooves)	Classification DIN	Classification ASTM
The sides of the cuts are completely smooth. Not one square in the grid pattern has come loose.		**0**	**5B**
Small coating particles have come loose at the cutting points. Less than 5% of the surface is affected.		**1**	**4B**
Small coating particles have come loose along the sides and at the corners of the cuts. 5 to 15% of the surface is affected.		**2**	**3B**
The coating crumbles away along the sides of the cuts and on parts of the little squares. 15 to 35% of the surface is affected.		**3**	**2B**
Much of the coating crumbles away along the sides of the cuts and complete squares have peeled loose. 35 to 65% of the surface is affected.		**4**	**1B**
Crumbling and peeling to a greater extent than that of DIN4	More than 65% has peeled.	**5**	**0B**

Carrying out the GRID test

- For dry coating layer less than 50 □m, a Cross-Cut blade is used with a distance between blades of 1 mm. For coating layer larger than 50 □, a Cross-Cut blade should be used with an interspacing of 2 mm.
- The application of incisions is carried out in two stages, each in one continuous movement. First a cut of ± 20 mm is made, followed by a second cut of about the same length but at 90 degrees to the direction of the first incision.
- The grid pattern is then rubbed away with a soft brush or cloth. The result is subsequently compared with the table above.

- If this work is carried out in accordance with ASTM D3359-87, a piece of adhesive tape specified in accordance with that standard will then be applied to the grid pattern and peeled off.

TABLE Cross Cut Adhesion Test (acc. to ASTM)



APPENDIX 2 WORK METHOD FOR REINFORCED POLYESTER

- Information about the product
  - is a polyester coating in rolls;
  - is a plastic easy to work with, reinforced with glass fibre (G.R.P.);
  - is made in sheets and delivered as standard in 10 m x 2 mm rolls;
  - in its untreated form is extremely flexible; it can be cut to any shape or in accordance with the required format; it can then be fashioned, adapted, rolled up, rolled out and/or fitted to practically any object or surface;
  - when exposed to UV light, it begins to harden after a few minutes and will become hard over a period of a few hours;
  - once hardened is:
    - an extremely strong and inalterable material with an exceptional lifetime and good resistance to heat;
    - waterproof;
    - resistant to a large number of acids, chemical products and solvents;
  - offers numerous possibilities:
    - clean, safe and extremely easy to use;
    - quality always guaranteed;
    - maintains its strength, weight and lifetime;
    - has a resistance stronger than UV;
    - minimum waste.
- Painting firms

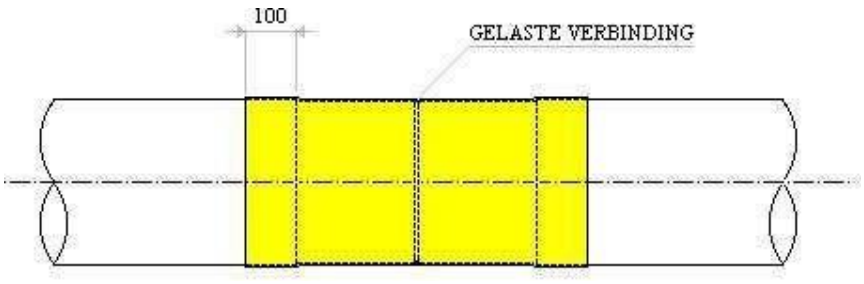
  Paint appliers :
  - must be officially recognised and registered;
  - must be known and given a permit by DuPol Benelux;
  - once registered and given a permit, they will undergo training by the instructors of DuPol;
  - after the training and practical experience, they will be taken on as “recognised appliers of reinforced polyester”;
  - every year an assessment will take place regarding the working method used and the

knowledge developed with reinforced polyester.

Application

- requires the use of suitable tools and accessories of good quality, such as:
  - cutting table;
  - ruler;
  - universal knife and scissors;
  - cutting machine safety bar;
  - pressing roll;
  - wide transparent adhesive tape;
  - thick black polyethylene film.
- the application of reinforced polyester may only be carried out in dry weather with a minimum temperature of ± 5ºc;
- the site must always be protected from direct sunlight;
- it is highly advisable to cut reinforced polyester beforehand to the required sizes (protected from sunlight);
- unused reinforced polyester must immediately be protected from sunlight by means of the thick black polyethylene film.

- On new steel pipes
  - clean the steel surface to be treated by sandblasting Sa3;
  - protect the site from direct sunlight;
  - apply a layer of reinforced polyester having the width of the surface to be treated with a longitudinal and transversal overlap of 100 mm; press hard and/or roll all over these overlaps (see drawing: the dotted section represents the reinforced polyester);



  - fix the applied reinforced polyester with wide transparent adhesive tape;

- exposed to sunlight, reinforced polyester will harden in ± 20 min.;
- in the absence of sunlight, UV lamps may be used (min 300 W); the hardening time will then be a little longer;
- after hardening, remove the transparent adhesive tape;
- for increased protection, it is recommended to use UV resin (UVH-100) on the transversal and longitudinal overlaps;
- use UV resin (UVH-100) beforehand for jointing with already hardened reinforced polyester.

- On existing steel pipes (after sandblasting)
  - remove the old coating;
  - sandblast Sa3 to check the condition of the surface;
  - repair or replace the metal, if necessary;
  - derust manually to St3;
  - apply a layer of ALUTEC and/or PRIMER (D400);
  - protect the site against sunlight;
  - after drying, apply reinforced polyester over the width of the surface to be treated with an overlap of 100 mm; press hard and/or roll all over these overlaps;
  - spread the extremities with UV resin (UVH-100);
  - fix the applied reinforced polyester with wide transparent adhesive tape;
  - exposed to sunlight, reinforced polyester will harden in ± 20 min.;
  - in the absence of sunlight, UV lamps may be used (min 300 W); the hardening time will then be a little longer;
  - use UV resin (UVH-100) beforehand for jointing with already hardened reinforced polyester.
- Existing steel pipes (without sandblasting)
  - do not remove the old coating, but do remove dust;
  - apply 1 layer of PRIMER (D400);
  - protect the site from direct sunlight;
  - after drying (± 1 to 1 ½ hours), apply reinforced polyester over the width of the surface to be treated with an overlap of 100 mm; press hard and/or roll all over these overlaps;
  - spread the extremities with UV resin (UVH-100);

- fix the applied reinforced polyester with wide transparent adhesive tape;
- exposed to sunlight, reinforced polyester will harden in ± 20 min.;
- in the absence of sunlight, UV lamps may be used (min 300 W); the hardening time will then be a little longer;
- use UV resin (UVH-100) beforehand for jointing with already hardened reinforced polyester.

- Concrete
  - clean the surface to be treated and, if necessary, smooth it;
  - apply 1 layer of PRIMER (D400);
  - protect the site from direct sunlight;
  - after drying (± 1 to 1 ½ hours), apply reinforced polyester over the width of the surface to be treated with an overlap of 50 mm;
  - press hard and/or roll over the reinforced polyester;
  - it is recommended to use UV resin (UVH-100) and vulcanising on the overlaps for a better seal before applying the next layer of reinforced polyester;
  - exposed to sunlight, reinforced polyester will harden in ± 20 min.;
  - in the absence of sunlight, UV lamps may be used (min 300 W); the hardening time will then be a little longer;
  - use UV resin (UVH-100) beforehand for jointing with already hardened reinforced polyester.

APPENDIX 3 PAINTWORK - DAILY REPORT

Supervisor_____ Hours worked: by supervisor _____
Activity:_____ Hours worked on site : _____

General weather conditions: Dry □ Humid □ Rain □

Site personnel	Number	Hours

Site equipment	Number	Hours

WEATHER CONDITIONS								
TIME	Td	Th	RH	DP	Tobj	□T	OK	NOK

Ts : Temperature dry - Th : Temperature humid - RH :Relative humidity - DP :Dew point - Tobj : Temperature of object - □T : Tobj - DP

COMMENTS: The paintwork was only started when the weather conditions were acceptable.

Humidity and temperature were continuously measured during and after execution of the work

OWNER / Material - Paintwork - Daily report

Object	Preparation of surface**	Layers & Depths	Paint used	Paint system
Pipe ☐	Sa 3 ☐	❶ ☐m		
Shut-off valve ☐	St 2 ☐	❷ ☐m		
Filter ☐	Dgr ☐	❸ ☐m		
..... ☐	None ☐	❹ ☐m		
Pipe ☐	Sa 3 ☐	❶ ☐m		
Shut-off valve ☐	St 2 ☐	❷ ☐m		
Filter ☐	Dgr ☐	❸ ☐m		
..... ☐	None ☐	❹ ☐m		
Pipe ☐	Sa 3 ☐	❶ ☐m		
Shut-off valve ☐	St 2 ☐	❷ ☐m		
Filter ☐	Dgr ☐	❸ ☐m		
..... ☐	None ☐	❹ ☐m		
Pipe ☐	Sa 3 ☐	❶ ☐m		
Shut-off valve ☐	St 2 ☐	❷ ☐m		
Filter ☐	Dgr ☐	❸ ☐m		
..... ☐	None ☐	❹ ☐m		
Pipe ☐	Sa 3 ☐	❶ ☐m		
Shut-off valve ☐	St 2 ☐	❷ ☐m		
Filter ☐	Dgr ☐	❸ ☐m		
..... ☐	None ☐	❹ ☐m		
Pipe ☐	Sa 3 ☐	❶ ☐m		
Shut-off valve ☐	St 2 ☐	❷ ☐m		
Filter ☐	Dgr ☐	❸ ☐m		
..... ☐	None ☐	❹ ☐m		

** SA3 = Sand-blasted - St2 = Rust removed manually - Dgr = Degreased

Supplementary notes in appendix (Second page of Daily Report - Form C42N) *Yes* ☐ *No* ☐

SUPERVISOR - DS Name & Signature	OPERATOR Name & Signature

Copies:

WHITE : Operator
YELLOW : Supervisor
PINK: Person in charge of Works

C45-N BLAD 2/2

APPENDIX 4. ATMOSPHERIC CONDITIONS

- No paintwork may be carried out if the atmospheric conditions are not suitable.

- To obtain the best results when carrying out paintwork, it is of essential importance that no condensation appears on the cleaned or blasted surface or between the different layers.

For this reason, the temperature of the surface to be painted should be at least 3º higher than the dew point or condensation temperature of the ambient air. In the table below, the dew point of the air is given for a number of conditions of air temperature and relative humidity. Correlation between relative humidity, air temperature and dew point

Air temp. °C	Dew point in ºC with a relative humidity of :								
	50%	55%	60%	65%	70%	75%	80%	85%	90%
5	-4.1	-2.9	-1.8	-0.9	0.0	0.9	1.8	2.7	3.6
6	-3.2	-2.1	-1.0	-0.1	0.9	1.8	2.8	3.7	4.5
7	-2.4	-1.3	-0.2	0.8	1.8	2.8	3.7	4.6	5.5
8	-1.6	-0.4	0.8	1.8	2.8	3.8	4.7	5.6	6.5
9	-0.8	0.4	1.7	2.7	3.8	4.7	5.7	6.6	7.5
10	0.1	1.3	2.6	3.7	4.7	5.7	6.7	7.6	8.4
11	1.0	2.3	3.5	4.6	5.6	6.7	7.6	8.6	9.4
12	1.9	3.2	4.5	5.6	6.6	7.7	8.6	9.6	10.4
13	2.8	4.2	5.4	6.6	7.6	8.6	9.6	10.6	11.4
14	3.7	5.1	6.4	7.5	8.6	9.6	10.6	11.5	12.4
15	4.7	6.1	7.3	8.5	9.5	10.6	11.5	12.5	13.4
16	5.6	7.0	8.3	9.5	10.5	11.6	12.5	13.5	14.4
17	6.5	7.9	9.2	10.4	11.5	12.5	13.5	14.5	15.3
18	7.4	8.8	10.2	11.4	12.4	13.5	14.5	15.4	16.3
19	8.3	9.7	11.2	12.3	13.4	14.5	15.5	16.4	17.3
20	9.3	10.7	12.0	13.3	14.4	15.4	16.4	17.4	18.4
21	10.2	11.6	12.9	14.2	15.3	16.4	17.4	18.4	19.3
22	11.1	12.5	13.8	15.2	16.3	17.4	18.4	19.4	20.3
23	12.0	13.5	14.8	16.1	17.2	18.4	19.4	20.3	21.3
24	12.9	14.4	15.7	17.0	18.2	19.3	20.3	21.3	22.3
25	13.8	15.3	16.7	17.9	19.1	20.3	21.3	22.3	23.2
26	14.8	16.2	17.6	18.8	20.1	21.2	22.3	23.3	24.2
27	15.7	17.2	18.6	19.8	21.1	22.2	23.2	24.3	25.2
28	16.6	18.1	19.5	20.8	22.0	23.2	24.2	25.2	26.2
29	17.5	19.1	20.5	21.7	22.9	24.1	25.2	26.2	27.2
30	18.4	20.0	21.4	22.7	23.9	25.1	26.2	27.2	28.2

From this table we can deduce that paintwork may not be carried out when the relative humidity of the air is higher than 80% (in theory 82%). With an air humidity of 82% and higher, the temperature of the steel surface should be higher than the air temperature.

Application of the paint is also not permitted if there is a danger that the film of paint will not be dry before dew, condensation or frost sets in.

APPENDIX 5 colour code

COLOUR CODE				
COMPRESSION STATIONS				
DESCRIPTION	COLOUR	RAL CODE		
High-pressure gas	White	RAL 9010		
Low-pressure gas	Orange	RAL 2003		
Surplus gas burners	Yellow	RAL 1004		
Fire extinguishers	Red	RAL 3000		
Air	Blue	RAL 5009		
Water	Green	RAL 6010		
Oil	Brown	RAL 8003		
Valves - devices	Grey	RAL 7038		
Supports	Black	RAL 9005		
Doors	Dark blue	RAL 5010		

PRESSURE REGULATING				
Pipes - valves Supports etc.	Grey	RAL 7038		
Fences, doors	Green	RAL 6020		
High-pressure arrow	Red	RAL 3000		
Low- or medium-pressure arrow	Orange	RAL 2003		

STANDARD SPECIFICATION FOR SEAMLESS FITTINGS AND FLANGES {SIZE UPTO DN 400MM(16")}

		ISSUED AS STANDARD SPECIFICATION			
		DESCRIPTION			

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
CE	Carbon Equivalent
LTCS	Low Temperature Carbon Steel
LPG	Liquefied Petroleum Gas

CONTENTS

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2.0 REFERENCE DOCUMENTS .....

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9.0 PACKING & SHIPPING .....

10.0 DOCUMENTATION .....

1.0 SCOPE

This Technical specification specifies the minimum requirements for the design, manufacture and supply of following carbon steel flanges (such as welding neck flanges, blind flanges, spectacle blinds, spacers and blind etc.) and seamless fittings (such as tees, elbows, reducers, caps, outlets etc.) size DN up to 400 mm (16") 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

Reference has 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)

B31.4	:	Pipeline Transportation system for liquid Hydrocarbon & other liquids.
B 31.8	:	Gas Transmission and Distribution Piping Systems.
B16.5	:	Pipe Flanges and Flanged Fitting.
B16.9	:	Factory made Wrought Butt Weld Fittings.
B 16.11	:	Forged Steel Fittings, Socket welding and Threaded.
B 16.48	:	Steel Line Blanks.
Section VIII	:	Boiler and Pressure Vessel Code - Rules for Construction of Pressure Vessels.
Section IX	:	Welding and Brazing Qualifications.

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-97	:	Forged Carbon Steel Branch Outlet Fittings- Socket Welding, Threaded and Butt Welding Ends

In case of conflict between various requirements of this specification and the requirements of above referred Codes and Standards, more stringent requirement shall apply unless otherwise agreed by Purchaser.

3.0 MATERIALS

The Material of flanges & fittings shall be as indicated in purchase requisition. In addition, the material shall also meet the requirements specified hereinafter.

3.1 The Carbon Steel used for the manufacture of flanges and fittings shall be fully killed.

3.2 The carbon equivalent (CE) shall not exceeding 0.45, based on check analysis calculated in accordance with following.

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

3.3 For flanges and fittings specified to be used for gas service or LPG service, Charpy V-notch test shall be conducted on each heat of steel. Unless specified otherwise, the Charpy V-notch test shall be conducted at 0^0 C in accordance with the impact test provisions of ASTM A 370 for flanges and MSS-SP-75 for all fittings.

The average absorbed impact energy values of three full-sized specimens shall be 27 joules. The minimum impact energy value of any one specimen of the three specimens analyzed as above shall not be less than 22 Joules.

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

3.4 For flanges and fittings specified to be used for Gas service or LPG service, Hardness test shall be carried out as per ASTM A 370 for each heat of steel used. A full thickness cross section shall be taken for this purpose and the maximum hardness of base metal, Weld metal and heat affected zone shall not exceed 248 HV_{10}.

3.5 In case of RTJ (Ring Type Joint) flanges, the groove hardness shall be minimum 140 BHN. Ring Joint flanges shall have octagonal section of Ring joint.

4.0 DESIGN AND MANUFACTURE

4.1 Flanges such as weld neck flanges and blind flanges shall conform to the requirements of ASME B 16.5.

4.2 Spectacle blind and spacer & blind shall conform to the requirements of ASME B 16.48.

4.3 Fittings such as tees, elbows, reducers, etc. shall be seamless type and shall conform to ASME B 16.9 for sizes DN 50mm (2") to DN 400mm (16") (both sizes included) and ASME B 16.11 for sizes DN 15mm(1½") &below.

4.4 Fittings such as weldolets, sockolets, nippolets, etc. shall be manufactured in accordance with MSS-SP-97.

4.5 Repair by Welding on flanges and fitting is not permitted.

4.6 All butt weld ends shall be beveled as per ASME B 16.5/ASME B 16.9/MSS-SP-97 as applicable

4.7 Type, face and finish of flanges shall be as specified in purchase requisition. The interpretation of range of face finish shall be as follows:

Serrated Finish/125 AARH	:	Serration with 125 to 250µ in AARH.
63 AARH	:	32 to 63µ in AARH.

4.8 Flanges and fittings manufactured from bar stock are not acceptable.

5.0 INSPECTION AND TESTS

The Manufacture shall perform all inspections and tests in accordance with the requirements of this specification and the relevant codes, at his works, prior to shipment. Such inspection and testing shall include, but not be limited to, the following:

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 flanges and fittings shall be visually inspected. The internal and external surface of the flanges and fittings shall be free from any strikes, gauges and other detrimental defects.

Dimensional checks shall be carried out on finished products as per ASME B 16.5 for flanges, ASME B 16.48 for spacers and blinds and ASME B 16.9/MSS-SP-97 as applicable for fittings and as per this specification.

5.3 NON-DESTRUCTIVE EXAMINATION

All finished wrought weld ends subject to welding in field, shall be 100% tested for lamination type defects by ultrasonic test. Any lamination larger than 6.35 mm shall not be acceptable.

5.4 The Purchaser reserves the right to perform stage wise inspection and witness tests as indicated above, at the Manufacturer's works, prior to shipment. The Manufacturer shall give reasonable notice of date and time for such inspection and shall provide reasonable access and facilities required for inspection, to the Purchaser's Inspector.

The Purchaser reserves the right to require additional testing, at any time, to confirm Or further investigate a suspected fault. All costs incurred shall be for the Manufacturer's account. In no case shall any action of the Purchaser, or his Inspector, relieve the Manufacturer of his responsibility for material, design, quality, or Performance of the materials concerned. Inspection and tests performed/witnessed by the Purchaser's Inspector shall in no way relieve the Manufacturer of his obligation to perform the required inspection and tests.

6.0 PAINTING

Once all inspection and test have been carried out all external surface shall be thoroughly cleaned to remove grease, dust & rust. Standard mill coating shall be applied on external surface to protect against corrosion during transmit and storage. The coating shall be removable type in field.

7.0 MARKING

All Flanges & fittings shall be stamped with the requirements of applicable dimensional manufacturing standard. The marking shall also include following:

- PO Number.
- Item Code.

8.0 TEST CERTIFICATES

Manufacture who intends bidding for fittings must possess the records of a successful proof test, in accordance with the provision of ASME 16.9/MSS-SP-75,as applicable.

Manufacturer shall furnish the following certificates:

- Test certificates relevant to the chemical analysis and mechanical properties, including hardness of the materials used for manufacture of flanges and fittings in accordance with the requirement of relevant standards and this specification.
- Test reports on radiography, ultrasonic and magnetic particle examination.
- Certificates for each fitting stating that it is capable of withstanding without leakage a test pressure, which results in a hoop stress equivalent to 100% of the specified minimum yield strength for the pipe with which the fitting is to be attached without impairment of serviceability.

9.0 PACKING & SHIPPING

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

10.0 DOCUMENTATION

The Manufacturer shall supply documentation in accordance with the Vendor Data Requirements List (VDRL) as attached with Purchase Order.

STANDARD SPECIFICATION FOR FIELD JOINT COATING

		ISSUED AS STANDARD SPECIFICATION			
		DESCRIPTION			

ABBREVIATIONS:

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

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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.

SS-PL-002 Standard Specification for 3-Layer polyethylene coating

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 e heat shrinkable wraparound sleeve suitable for a maximum operating temperature of (+) 60°C (Tmax) 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”	1.8	1.4
4” – 10”	2	1.6
12” – 18”	2.2	1.8
20” – 30”	2.5	2.0
≥32"	3.0	2.5

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.

Heat shrinkable wraparound field joint coating system manufactured by M/s Raychem - Covalence and M/s Canusa are acceptable for the supply of field joint coating materials. The Contractor shall propose the specific grade of field joint coating system meeting the requirements of this specification from these manufacturers. In case the Contractor proposes to

supply heat shrinkable wraparound sleeve from any other manufacturer, then the Contractor shall propose only those coating systems that have been previously used for

pipelines of size same or higher than the size indicated in tender, for a length of 50 km and above in a single project for similar operating conditions.

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/mm2	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 Disbondment 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	3.5	Annexure C
	@ T**max**	N/mm	0.5	
To Factory Coating	@ 23°C	N/mm	3.5	
	@T_{max}	N/mm	0.5	
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-adjoining 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 commence 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. Disbonded 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 150 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 he 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.

	STANDARD SPECIFICATION FOR INDUCTION BENDS		
		TOTAL SHEETS	12
DOCUMENT NO	SS	PL	013

STANDARD SPECIFICATION
FOR
INDUCTION BENDS

		ISSUED AS STANDARD SPECIFICATION			
		DESCRIPTION			

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

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1.0 SCOPE

This specification covers minimum requirements for manufacture, testing and supply of hot induction 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).

2.0 REFERENCE DOCUMENTS

Fabrication, testing and supply of hot induction bends shall comply with the applicable sections of the latest edition (edition enforce 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 Liquid Hydrocarbon & Other Liquids.
B 31.8	:	Gas Transmission and Distribution Piping Systems.
B16.25	:	Butt Welding Ends.

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.

OIL INDUSTRY SAFETY DIRECTORATE (OISD)

Std. 141	:	Design and Construction Requirements for Cross Country Hydrocarbon Pipelines.

INTERNATIONAL ORGANISATION FOR STANDARDISATION (ISO)

ISO 15590	:	Petroleum and Natural Gas Industries - Induction Bends, Fittings and Flanges for Pipeline Transportation System; Part-I: Induction Bends.

PURCHASER'S SPECIFICATIONS FOR LINE PIPE

SS-PL-018	:	Standard Specification for Longitudinal Seam Submerged Arc Welded Line Pipe.

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 MATERIALS

Line pipe used by the manufacturer for fabrication of bends shall conform to applicable Purchaser's Specification referred under Section 2. The pipe with positive wall thickness tolerance shall be used for fabrication of bends.

Mechanical properties of the bends after fabrication shall conform to that indicated in applicable line pipe specification. Manufacturer shall carry out heat treatment of finished bends when deemed necessary to comply with the specified mechanical properties and to ensure microstructure stability of the material of the finished bends. Requirement of the heat treatment as well as the heat treatment procedure shall be established during Bend Manufacturing Procedure Qualification.

Destructive testing of production bends for mechanical properties is not required provided bends are fabricated employing bend manufacturing procedure duly qualified by manufacturer and approved by Purchaser. In the event of any deviation from approved bending parameters and / or heat treatment parameters, Purchaser reserves the right to seek destructive testing of bends thus manufactured at the cost of manufacturer.

4.0 MANUFACTURE

4.1 GENERAL

The line pipe size, bend angle and bend radius shall be as indicated in Purchase Order. The specified bending radius is from the center of curvature to the pipe centerline and is expressed as a multiple of the specified outside diameter of the line pipe. Unless specified otherwise bend radius shall be six times the specified outside diameter of line pipe.

4.2 MANUFACTURING PROCEDURE

4.2.1 BENDING PROCESS

Bends shall be manufactured by a high frequency induction heating and forming method. The bend manufacturing procedure in accordance with Annexure -I shall be qualified by manufacturer and approved by the Purchaser prior to regular production of bends. Bending shall be continuous from start to finish. Stoppage during bending process is not permitted. The Manufacturer shall maintain continuous records of the forming conditions for each bend.

A minimum of four temperature-monitoring probes shall be in continuous operation throughout all operations. If bending temperatures, bending rate, cooling medium volume or heat treatment temperature departs from the qualified manufacturing procedure, or if the bending process is interrupted, the pipe shall be discarded. Cost of such discarded pipes shall be borne by the Manufacturer.

4.2.2 The pipe to be bent shall be cleaned to remove any loose mill scale etc.

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

For bends manufactured from the welded pipes, the longitudinal weld seam shall be located in the plane of minimum deformation i.e. bend neutral axis. The acceptable tolerance on location of the longitudinal weld seam shall be $\pm 5^0$.

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. Excess weld material at the inside of bend for a distance of 100 mm from the ends shall be removed by grinding in case of bends made from SAW pipes.

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. Beyond 100mm from pipe ends, 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 pipe. 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 the ends. Tangent lengths shall be minimum 500 mm or equal to pipe outside diameter whichever is more.

4.10 TOLERANCES

Tolerances shall be as per MSS SP-75. In addition, the finished bends shall also conform to the dimensional tolerances given below. However the ends of the finished pipe bend shall meet the dimensional tolerances of API 5L.

- Weld Seam : ± 5°.
- Bend Angle : ± 0.5° from the specified angle.
- Bend Radius : ± 1% of Bending Radius.
- Wall Thickness : As per (A) below.
- Ovality : As per (B) below.
- Off Plane : As per (C) below.

A. WALL THICKNESS

Wall thickness shall be measured ultrasonically. Four readings equally spaced around the circumference shall be taken at every 300 mm along the length of pipe before bending. The reading shall be taken again after bending at the same location. Out of four circumferential readings, one shall be at outer radius of bend and one shall be at inner radius of bend.

Minimum thickness after bending shall be equal to or greater than ‘tmin’ calculated by

following formula.

tmin = 0.95 (ta - Δ t) .

ta = Actual wall thickness before bending.

Δ t = 0.35 mm for ta < 10 mm.

= 0.5 mm for ta ≥ 10 mm.

B. OVALITY TOLERANCE

Ovality in any radial plane along the finished bend shall not exceed 2.5%.Ovality shall be calculated using the following formula:

$$\text{Ovality} = \frac{(D_{max} - D_{min})}{D_{specified}}$$

Where: - Dmax = Maximum Measured Outside Diameter

Dmin = Minimum Measured Outside Diameter

Dspecified = Specified Outside Diameter as per API 5L

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

C. OFF PLANE

Off plane of bends shall be measured in accordance with MSS SP-75. Off plane of bends shall not exceed (θ /90) x 10 mm, where θ is the bend angle in degrees or the tolerance limit specified in MSS SP-75 whichever is less.

5.0 INSPECTION AND TESTS

5.1 GENERAL

The Manufacturer shall carryout all inspection and tests required as per this specification and listed under clause 5.3 below.

5.2 Company's Inspector reserves the right to perform stage wise inspection and witness tests on all bends as indicated in Clause 5.3 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.

5.3 INSPECTION AND TESTING

In addition to the requirements of MSS SP-75, the following inspection and testing shall be carried out:

a) Verification of manufacturing records of incoming pipes for compliance with the Purchaser Specification indicated in Purchase Order.

b) Visual inspection of all bends

c) Dimensional checks for compliance to specified tolerances.

d) All finished bends shall be subjected to non-destructive inspection as given below.

- All seam welds of bends fabricated from SAW welded pipes shall be 100% radiographed and seam welds of bends manufactured from EW pipe shall be 100% ultrasonic inspected. Reference standard and acceptance criteria shall be as specified in applicable Line Pipe Specification.

- The full circumference of both ends of all finished bends shall be ultrasonically tested for laminations over length of 100 mm from the end. Acceptance limits shall be as specified in applicable Line Pipe Specification.

- The finished bends shall be magnetic particle inspected on 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.

e) Check heat treatment, if carried out, as required and maintain its records.

f) Temperature against time recorder charts for each induction heating.

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

including its dimensions shall be approved by Company.

h) 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 20 sec.

i) Hardness testing shall be performed on the extrados and interdos of all bends. Unless otherwise specified, hardness shall not exceed HRC 22.

6.0 MARKING

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

Package of bends shall be marked with following:

- Purchaser's Name.
- Order Number.
- Package Number.
- Size (Inches), Wall Thickness (mm) and Bend Radius (mm).
- Manufacturer's Name and Place of Manufacture.
- Destination of dispatch.

7.0 TEST CERTIFICATES

The Manufacturer shall submit the following Certificates:

a) Test certificates of chemical analysis, mechanical tests, heat treatment, NDT, dimensional inspection and hydro test 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.

b) Certificates of non-destructive test/examination carried out on bends.

c) Records of heat treatment, if carried out for bends.

d) Certified reports of dimensional tolerance of bends.

e) Certificates of all other tests as required in this specification.

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

8.0 PACKING & SHIPPING

Packing, shipping and handling of all materials to be in accordance with the instructions in the RFQ and the following:

- All bends shall be supplied with an anti-rust paint to prevent corrosion during transit. The paint shall be easily removable by shot blasting without damaging the shots.
- All bends shall be cleaned from inside of all foreign materials, grease, rust etc prior to packing.
- 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.

9.0 DOCUMENTATION

The Manufacturer shall supply documentation in accordance with the Vendor Data Requirements List (VDRL) as attached with Purchase Order.

	STANDARD SPECIFICATION FOR FLOW TEES		
		TOTAL SHEETS	10
DOCUMENT NO	SS	PL	021

STANDARD SPECIFICATION
FOR
FLOW TEES

		ISSUED AS STANDARD SPECIFICATION			

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

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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 of the applicable following codes and standards.

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

OIL INDUSTRY SAFETY DIRECTORATE (OISD)

Std. 141	:	Design and Construction Requirements for Cross Country Hydrocarbon pipelines.

Std. 226 : Natural Gas Transmission Pipelines and City Gas Distribution Network.

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 MATERIALS

3.1 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.

3.2 All carbon steel used for fabrication of various components of Flow Tees shall be fully killed.

3.3 For Flow Tee 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. A full thickness cross section shall be taken for this purpose. The maximum hardness of base metal, weld metal & HAZ of all the pressure containing parts shall not exceed 248 HV_{10}.

3.4 The carbon equivalent (CE) based on product analysis calculated by the formula shall not exceed 0.45%

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

The Vendor shall submit the material test certificates and product analyses for materials used in the manufacture of the Flow Tees.

3.5 For Flow Tee 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 in accordance with ASTM A370.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 specimen tested at 0°C shall be 27 J. The minimum impact energy value of any one specimen of three specimen analyzed as above shall not be less than 22J.

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.

4.0 DESIGN AND MANUFACTURE

4.1 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.

4.2 DESIGN

4.2.1 WELDING

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 3.3 and 3.5 of this specification respectively.

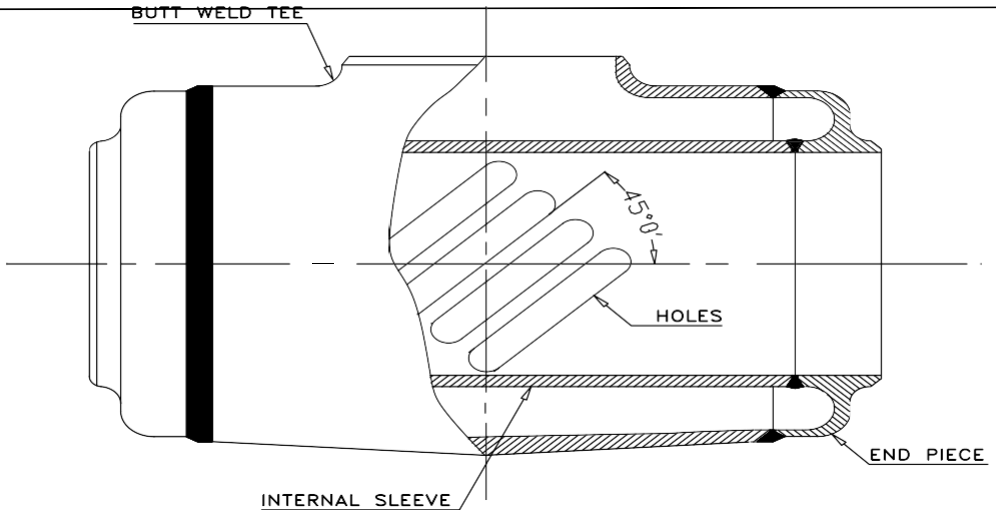


Figure 4.1

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.

All pressure containing welds made for fabrication of Flow Tees shall be butt welds. Other welds shall be full penetration girth or fillet welds.

All weld ends shall be checked for surface defects using dye penetrate prior to welding.

4.2.2 END BEVEL

Bevel ends for field welding of Flow Tees shall be in accordance with ASME B31.4 or B31.8, as applicable.

4.2.3 STRESS RELIEVING

All flow tees shall be completely stress relieved as per the provisions of MSS-SP-75.

5.0 INSPECTION AND TESTS

Following inspection and testing shall be carried out prior to painting, marking and shipment of Flow Tees.

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 referred in corresponding Material Specification.

5.2 VISUAL INSPECTION AND DIMENSIONAL CHECK

All Flow Tees shall be visually inspected for visible surface defects. Bevels at butt weld ends shall show a smooth contour. All dimensions shall be checked for conformance with approved drawings and/or datasheets.

5.3 NON-DESTRUCTIVE EXAMINATION

a) Full length of all pressure containing butt welds, including welds that have been repaired, shall be examined by radiography. Acceptance limits shall be as per ASME Section IX.

b) Final closure weld and 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 closure weld shall also be examined by magnetic particle inspection method.

c) Butt-welding tees made by cold forming and where extreme fiber elongation exceeds 5% shall be examined by magnetic particle or liquid penetration in accordance with Supplementary Requirement SR 3 of MSS-SP-75.

d) 100 percent surface of all forgings shall be wet magnetic particle inspected. Method of inspection and acceptance shall comply MSS-SP-53.

e) Wet Magnetic Particle Inspection of all bevel surfaces shall be carried out for all Flow Tees. Any lamination extending into bevel face and having transverse dimension greater than 6.4 mm shall not be acceptable.

5.4 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.

5.5 INSPECTION REQUIREMENT

The Purchaser reserves the right to inspect the manufacture of the Flow Tees at the Manufacturer premises at any time. The Purchaser may also appoint a third party inspector to act on his behalf.

The Manufacturer shall submit an Inspection and Test Plan (ITP) for approval prior to commencement of manufacture.

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.

6.0 PAINTING

SURFACE PREPARATION

After completion of all required inspection and testing, flow tee surface shall be thoroughly cleaned free from rust and grease. Surface preparation shall be carried out by shot blasting to SP-6 in accordance with "Steel Structures Painting Council - Visual Standard SSPC-VIS-I".

ABOVE GROUND PAINTING

Exterior surfaces of all Flow Tees, specified for above ground installation, shall be applied with sufficient coats of corrosion resistant paint suitable for the environment as per Manufacturer's standard.

BELOW GROUND COATING

External surfaces of all Flow Tees, specified for underground installation, shall be coated with three coats of coal tar epoxy resin with a minimum total dry film thickness of 400 microns.

7.0 MARKING

All Flow Tees shall be marked using low stress stamps in accordance with MSS SP-75.

- Manufacturer's name or trademark (on body and nameplate).
- Size (run and branch size).
- Nominal OD and wall thickness of butt weld ends (run and branch).
- Tee and End Piece material and grade.
- Test Pressure.
- Year of Manufacture.

8.0 TEST CERTIFICATES

The manufacturer shall submit following test certificates.

- All certificates of chemical and mechanical test.
- Test certificates of required NDT inspection.
- Certificates of all other tests specified in this specification.
- Certified reports of dimensional tolerances.
- Certified report of painting/coating thickness checks.
- Records of successful proof test.

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.

9.0 PACKING & SHIPPING

All Flow Tees shall be packed and prepared for shipment/transport in with the procedures included in the Request for Quotation (RFQ).

Butt weld ends of all Flow Tees shall be suitably protected by means of metallic or high impact plastic bevel protectors to avoid any damage during transit.

The Manufacturer shall supply packing and shipping procedure with the tender.

10.0 DOCUMENTATION

The Manufacturer shall supply documentation in accordance with the Vendor Data Requirements List (VDRL) as attached with Purchase Order.

	STANDARD SPECIFICATION FOR INSULATING JOINTS		
		TOTAL SHEETS	12
DOCUMENT NO	SS	PL	022

STANDARD SPECIFICATION
FOR
INSULATING JOINTS

		ISSUED AS STANDARD SPECIFICATION			
		DESCRIPTION			

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

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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 Hydrocarbon & Other Liquids.
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.

OIL INDUSTRY SAFETY DIRECTORATE (OISD)

Std. 141	:	Design and Construction Requirements for Cross Country Hydrocarbon Pipelines.
Std. 226	:	Natural Gas Transmission Pipelines and City Gas Distribution 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 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), 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. Manufacture 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. A full thickness cross section shall be taken for this purpose. The maximum hardness of base metal, weld metal & HAZ of all the pressure containing parts shall not exceed 248 HV10.

3.1.5 The carbon equivalent (CE) based on product analysis calculated by the formula shall not exceed 0.45%.

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

3.1.6 The Manufacturer shall select materials as indicated in the data sheet along with the as 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) as/ if required by the corresponding approved weld procedures. The Manufacturer shall prove by calculations to ASME VIII Division I 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 in accordance with ASTM A370. 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 specimen 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.

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 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 TV, Group G.1.1 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 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.

4.0 <u>DESIGN AND MANUFACTURE</u>

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 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. When specified in data sheet, the insulating joint shall be able to sustain an internal vacuum of five (5) 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. Calculations shall be provided to show that the designed joint can withstand torsional stress up to 10% of the SMYS of the pup piece material.

m. The electrical resistance of the joint shall not decrease with time. The joint shall include permanent terminals for survey lead connections.

n. The insulating joint material shall be resistant to creep.

o. 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-II of ASME, Boiler and Pressure Vessel Code. Design factor shall be in accordance with the data sheet.

b. Design shall be checked for both design and hydro-test conditions considering an axial force equal to 10% of total force developed due to internal pressure.

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^{o}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 SAW 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 diameter tolerance and out of roundness at the ends to be field welded shall be as per API 5L.

4.2.3 ELECTRICAL

a. The average dielectric strength of the insulating joint shall be 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 10mm^2 and 50mm^2 cables for measurement/shorting purposes. 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 I. The weld design shall conform to the ASME acceptable standards. Fillet welds if required, shall have minimum two passes.

b. Welding end of the pipe pups to be welded to the insulating joint 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 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.

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.

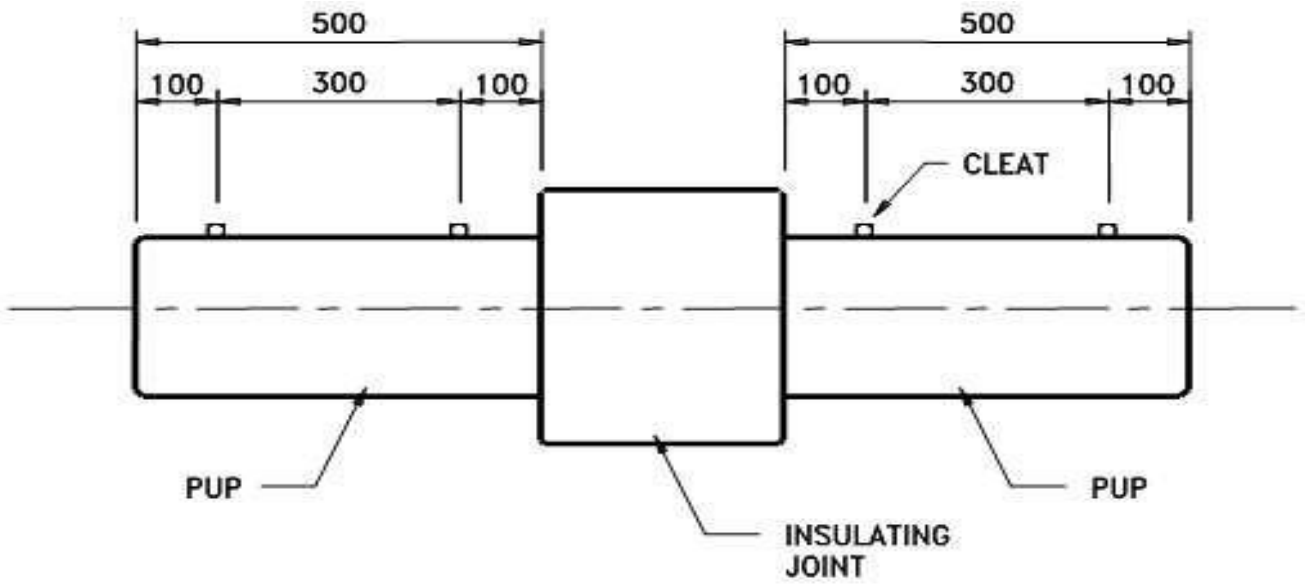


FIG. 4.1

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 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. 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 by radiography. Acceptance limits shall be as per ASME Section IX.

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. 100 percent surface of all forging shall be wet magnetic particle inspected. Method of inspection and acceptance shall comply MSS-SP-53.

d. Wet Magnetic Particle Inspection of all finished bevel surfaces shall be carried out. Any lamination extending into bevel face and having transverse dimension greater than 6.4 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 ≥ 6 mm	:	100% by Ultrasonic Testing, acceptance criteria as per ASME Sec VIII Appendix 12 respectively.

f. All NDT shall results 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.

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 to coating Manufacturers recommended standard or to SSPC-SP-10 surface preparation for coating as a minimum.

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^{o}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.

10.0 DOCUMENTATION

The Manufacturer shall supply documentation in accordance with the Vendor Data Requirements List (VDRL) as attached with Purchase Order.

DATA SHEET-PRESSURE GAUGE

UNITS: Flow<-> Liquid- m*3/hr Gas- Sm*3/hr Steam- kg/hr Pressure-> kg/cm*2 G Temperatu**re<-> oC Level/Length<-> mm**

1	Type:-	Direct	
2	Mounting:-	Local	
3	Dial Size:-	150 mm	
	Colour:-	White with black inscriptions	
4	Case Material:-	SS316	
5	Bezel Ring:-	Beyonet type SS316/Screwed	
6	Window Material:-	Shatterproof glass	
7	Enclosure:-	WP to IP 65 as per IEC 60529 / IS 2147	
8	Pressure Element:-	Bourdon	
9	Element Material:-	SS316	
10	Socket Material	SS316	
11	Accuracy:-	+/-1% of FSD	
12	Zero adjustment:-	Micropointer	
13	Connection:-	1/2" NPT(M)	
	Connection Location:-	Bottom	
14	Movement:-	SS316	
15	Diaphargm Seal:-	--	
	Type:-	--	
	Wetted Parts Material:-	--	
	Others Material:-	--	
	Process Connection: Size & Rating	--	
	Facing & Finish:-	--	
	Capillary Material:-	--	
	Armour - Flexible Material:-	--	
	Capillary Length:-	--	
	Flushing/Filling connection with:-	--	
16	Over Range Protection:-	130% of FSD	
17	Blow Out Protection:-	Yes	
18	Options :-	a) Snubber	
	b) Syphon	c) Gauge Saver	
	d) Liquid Filled casing	e) Vaccum Protection	
	f) Solid front		
	g) Two valve manifold	Yes	
19	Quantity :-	*	

SL. NO.	TAG NO.	RANGE	PRESSURE kg/cm2			TEMPERATURE °c			SERVICE	OPTIONS
			OP.	MAX.	DES.	MIN	MAX.	DES.		
	*	*	0-40	-	49	-	65	-	Natural Gas	e,f,g

NOTES:

'*' : Venodr to furnish

1 Since the natural gas is saturated with water and has corrosive constituents CO2-2.08%, the wetted parts of the instruments shall be suitable for that accordingly.
2 Vendor shall furnish Make and Model No. with product catalogues along with the offer.
3 Above data-sheet is typical for all Pressure Gauges used in the respective P&ID.Vendor shall submit the individual data sheet of each pressure gauge .
4 Make of the PG shall be Waree / A N Instruments / General Instruments.

☐ DEVIATION ☐ NO DEVIATION ☐ VENDOR'S SIGNATURE WITH SEAL

Sheet No. 1 of 1	CLIENT: INDRAPRASTHA GAS LTD.					
	PROJECT: LAYING & CONSTRUCTION OF U/G STEEL PIPELINE					
		0	31.05.2023	AK	DG	AK
	VENDOR:	REV.	DATE	ATHR	CHKD	APPD

			TOTAL SHEETS		03
DOCUMENT NO	1068	CD	MC	DS	001

DATA SHEET

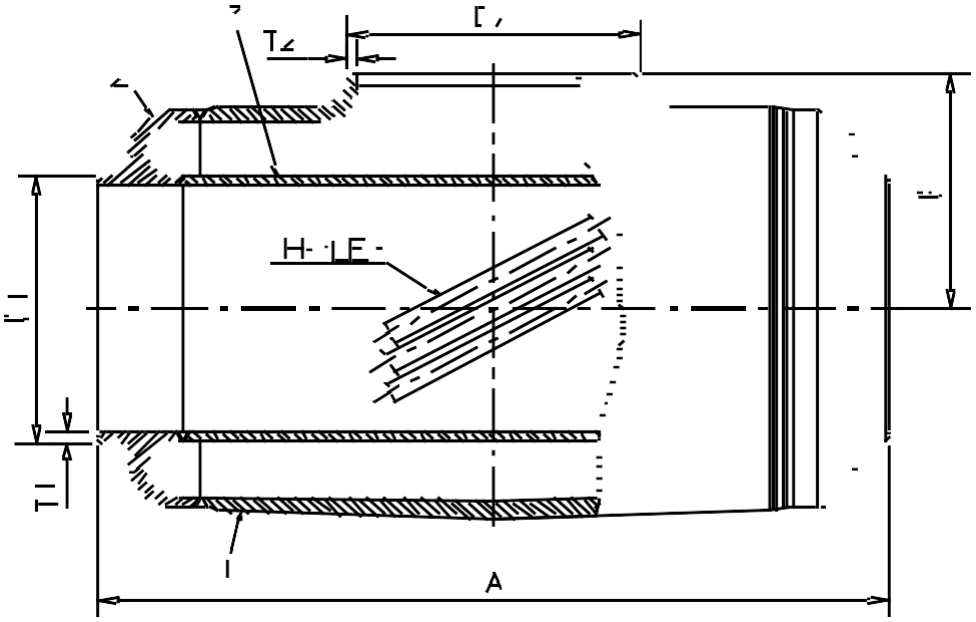
FOR

FLOW TEE

		DESCRIPTION			

PROCESS DATA		
S. NO.	**DESCRIPTION**	
I.	**PROCESS DATA**	
1	Pipe Class	3C1
2	Fluid	Natural Gas (NG)
3	Operating Pressure (barg)	13-30
4	Operating Temperature (°C)	Min. 0 / Max. 60
5	Design Pressure (barg)	49
6	Design Temperature (°C)	-29 to 65
II.	**DESIGN DATA**	
1	Applicable specification	Standard Specification for Flow Tee (SS-PL-021)
2	Design code	ANSI B 31.8
3	Size & Quantity	As per MR
4	Dimension standard for Tee	Manufacturer to indicate
5	End connection	ANSI B 16.25
6	Pressure Temp. Rating	300#
7	Design Factor	0.5
8	Number & area of slot (opening)	To be furnished by manufacturer
9	Corrosion allowance	1.5 mm
10	Hydrostatic test pressure	1.5 x Design Pressure
11	Pigging suitability for all types of pig including intelligent pigging	Yes
12	Flow direction	Bi-Directional
13	Charpy Impact Test	Required, at (-)29 Deg C
14	Hardness Test	Required, as per specification
15	Flow tee, both main & branch ends to be welded to main pipe	ASTM A 694 Gr.F60 / MSS-SP-75 Gr. WPHY-60 / Connecting Pipe Material for 16" & 12"
		ASTM A 105 or equivalent for 8" , 6" & 4"
16	Inner casing/sleeve	API 5L Gr. B or Equivalent
17	Pup piece	As per Connecting Pipe Detail

CONNECTING PIPE DETAIL						
S.NO	Run Pipe Details			Branch Pipe Details		
	Dia. NB (mm)	Min. Wall Thickness (mm)	Material Grade	Dia. NB (mm)	Min. Wall Thickness (mm)	Material Grade
1	16	7.9	API 5L X-60 PSL2	16	7.9	API 5L X-60 PSL2
2	16	7.9	API 5L X-60 PSL2	12	6.4	API 5L X-60 PSL2
3	16	7.9	API 5L X-60 PSL2	10	6.4	API 5L X-60 PSL2
4	16	7.9	API 5L X-60 PSL2	8	6.4	API 5L X-60 PSL2
5	12	6.4	API 5L X-60 PSL2	12	6.4	API 5L X-60 PSL2
6	12	6.4	API 5L X-60 PSL2	8	6.4	API 5L X-60 PSL2
7	12	6.4	API 5L X-60 PSL2	6	6.4	API 5L X-60 PSL2
8	8	6.4	API 5L X-52 PSL2	8	6.4	API 5L X-52 PSL2
9	8	6.4	API 5L X-52 PSL2	6	6.4	API 5L X-52 PSL2
10	8	6.4	API 5L X-52 PSL2	4	6.4	API 5L X-52 PSL2
11	6	6.4	API 5L X-52 PSL2	6	6.4	API 5L X-52 PSL2
12	6	6.4	API 5L X-52 PSL2	4	6.4	API 5L X-52 PSL2
13	4	6.4	API 5L X-52 PSL2	4	6.4	API 5L X-52 PSL2



I. NOTES:

- Manufacturer to indicate dimensions A, B, T1 and T2 marked in the Sketch above.
- Holes/ Slots in the sleeve shall be arranged at 45° to the centre line of Flow Tee.
- For the welding end, the out of roundness (i.e. difference between maximum and minimum ID at pipe end) shall be 3.0 mm and tolerance on internal diameter at pipe ends shall be same as diameter tolerance for the pipe ends indicated in API 5L Table 8.
- Thickness at the branch connection end shall not be less than the branch pipe thickness indicated above.
- Straight welding end shall be at least 50 mm.

DATA SHEET – INSULATING JOINT

		ISSUED FOR PROCUREMENT			
		DESCRIPTION			

Insulating Joint Manufacturer	-
IJ Specification No.	SS-PL-022
DESIGN DATA FOR INSULATING JOINT FOR CS LINE	
Service	Natural Gas (NG)
Size (OD), mm (inch)	406.4 (16”) 323.9 (12”) 219.1 (8”) 168.3 (6”) 114.3 (4”)
Design Pressure	49 Barg
ANSI Rating / Design Factor	300#
Design Temperature (°C)	-29 to 65.0
Corrosion Allowance (mm)	1.5
Hydrostatic Test Pressure	73.5 Barg
Design Code (Pipeline / Insulating Joint)	ASME B31.4 & OISD 214 / ASME SEC. VIII DIV. I
End Connection	Butt weld ends
Installation	Above ground
Charpy Impact Test	Required, at (-)29 Deg C
Hardness Test	Required, as per specification

INSULATING JOINT MATERIAL (EQUIVALENT OR SUPERIOR)

Part	**Material of Construction**	
	Specified	**Offered**
Body	ASTM A 105 / ASTM A694 Gr. F60/F52/F42	
Pups	API 5L Gr. X-60/ X-52/ Gr. B	
Insulation	As per Manufacturer’s standard	

ATTACHED PIPE SPECIFICATION

S. No.	**Outside Diameter, OD mm (inch)**	**Wall Thickness, (mm)/ Schedule**	**Material**
1.	406.4 (16”)	7.9 mm	API 5L Gr. X-60
2.	323.9 (12”)	6.4 mm	API 5L Gr. X-60
3.	219.1 (8”)	6.4 mm	API 5L Gr. X-52

4.	168.3 (6”)	6.4 mm	API 5L Gr. X-52
5.	114.3 (4”)	6.4 mm	API 5L Gr. B
Insulating Joint Manufacturer			-
IJ Specification No.			SS-PL-022

Notes:

1. For the welding end, the out of roundness (i.e. difference between maximum and minimum ID at pipe end) shall be 3.0 mm and tolerance on internal diameter at pipe ends shall be same as diameter tolerance for the pipe ends indicated in API 5L.
2. Insulating Joint shall be suitable for pigging operation including intelligent pigging.
3. Insulating Joint shall be boltless Monoblock type.
4. The Charpy Impact temperature specified in data sheet shall supersede the temperature requirement specified in Specification.

INSPECTION AND TEST PLAN – LR BENDS FOR ONSHORE PIPELINES

		ISSUED AS STANDARD			
		DESCRIPTION			

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

1.0 SCOPE:

This Inspection and Test Plan covers the minimum testing requirements of LR Bends.

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 SUPPLIER	SUPPLIER	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	H	R	R
3.0	**In-Process Inspection**						

3.1	Material Identification	Heat No/Marking verification, Grade etc. Positive thickness , Diameter, etc.	100%	Mill TC & Pipe Receiving Report	-	H	R
3.2	Bend Manufacturing Procedure Qualification	Bend forming parameters and all the testing as per purchase specification	100%	Test Reports	-	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	-
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 tests	Soundness / Leak check	100%	Test Reports	-	H	RW

4.3	Final visual and dimension	Visual and Dimension	100%	Inspection Report	-	H	RW
4.4	Gauging Pig Passing	Verification of ID / Profile	100%	Inspection Report	-	H	RW
4.5	Mechanical Testing as applicable	Destructive Tests	100%	Testing Report	-	H	H
5.0	**Documentation & IC**						
5.1	Documentation & Inspection Certificate(IC)	Review of Stage Inspection Reports / Test Reports & Issue of IC	100%	Manufacturer TC & IC	-	H	H
5.2	Final documents as applicable	Verification & compilation of inspection & test records for submission to customer	100%	Final dossier	-	H	H

Legend:

H - Hold (Do not proceed without approval),

P - Perform,

RW - Random Witness (As specified or 10% [min.1 no. of each size and type of Bulk item]),

R - Review,

W - Witness (Give due notice, work may proceed after scheduled date).

NOTES (As applicable):

1. This document describes the generic test requirements. Any additional test or Inspection scope if specified in contract documents shall also be Applicable (unless otherwise agreed upon).

2. Acceptance Norms for all the activities shall be as per PO/PR/STANDARDS referred there in /Job Specification /Approved Documents.

INSPECTION AND TEST PLAN – FLOW TEE

		ISSUED AS STANDARD			
		DESCRIPTION			

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

1.0 SCOPE:

This Inspection and Test Plan covers the minimum testing requirements of Onshore Flow Tee.

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 SUPPLIER	SUPPLIER	TPIA
1.0	**Procedure**						
1.1	Heat Treatment, 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	Design Proof Test *(To be conducted under TPI appointed by supplier)	Hydrostatic proof test	100%	Proof test record	-	H*-New R-Already qualified	R
2.0	**Material Inspection**						

2.1	Pipes / Fittings / Forgings (Pressure containing parts) *(supplier/sub supplier to arrange TPIAcertification)	Chemical, tensile, impact, hardness, NDT, Heat treatment and other applicable Properties	100%	Test Certificates	H	H*	R
3.0	**In Process Inspection**						
3.1	Raw Material Identification Of pressure containing parts	Verification of marking & correlation with MTC	100%	MTC, Inspection Report	-	H	W
3.2	Raw Material Identification Of non-pressure parts	Chemical & Mechanical Properties	100%	MTC, Inspection Report	-	H	-
3.3	Welding	Welding Parameters as per WPS / PQR	100%	Inspection Reports	-	H	-
3.4	Heat Treatment as applicable	Heat treatment temperature and time	100%	HT chart / Record	-	H	R
3.5	RT of pressure containing Butt welds	Defects	100%	RT Film / Report	-	H	R

3.6	UT/DPT/MPT as applicable	Lamination / Defects	100%	NDT Report	-	H	R
4.0	**Final Inspection**						
4.1	Visual and Dimensional Inspection (VDI	Surface Condition / Dimensions, Marking, etc	100%	Inspection Report	-	H	RW
4.2	Final Stamping	Stamping of accepted flow tees	100%	Inspection Report	-	H	H
5.0	**Painting**						
5.1	Corrosion protection painting & Colour Coding as applicable	Visual Inspection & Colour Coding	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%	Manufacturer TC & IC	-	H	H

6.2	Final Document submission	Compilation of Inspection reports ,drawings, etc as per VDR / PR	100%	Final data folder /Completeness certificate	-	H	H

Legend:

H - Hold (Do not proceed without approval),

P - Perform,

RW - Random Witness (As specified or 10% [min.1 no. of each size and type of Bulk item]),

R - Review,

W - Witness (Give due notice, work may proceed after scheduled date).

NOTES (As applicable):

1. This document describes the generic test requirements. Any additional test or Inspection scope if specified in contract documents shall also be applicable.(unless otherwise agreed upon)
2. Acceptance Norms for all the activities shall be as per PO/PR/STANDARDS referred there in /Job Specification /Approved Documents.

3. For orders placed on stockist, items shall be accepted based on manufacturer's TC with EN310204 type 3.2 certification from PMC / OWNER approved suppliers.
4. Precaution shall be taken in selection of raw material so as to meet finished product values especially in regard to Yield Strength.

INSPECTION AND TEST PLAN FOR INSULATING JOINT

		ISSUED AS STANDARD			
		DESCRIPTION			

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

1.0 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 SUPPLIER	SUPPLIER	TPIA
1.0	**Procedure**						
1.1	NDT and Other procedure (as applicable)	Documented Procedure	100%	Procedure Record	~	H	R
1.2	WPS,PQR & WPQ	Documented procedures.	100%	Procedure Record	~	H	W- New R- Existing
2.0	**Material Inspection**						
2.1	Fittings, Forged Ring, Gasket, Pipe, Insulating Ring, Filling Material, etc.	Chemical / Mechanical Properties, NDT, HT and other requirement as per purchase Specification.	100%	MTC & Inspection records	H	H	R
3.0	**In-Process Inspection**						

3.1	Welding	Welding Parameters, NDT (as applicable)	100%	NDT Records / RT Film	~	W	R
4.0	**Final Inspection**						
4.1	Hydro Testing, Air Leak test, Vacuum test(As applicable)	Leak check	100%	Test Report	~	H	H
4.2	Visual and Dimensional Check up	Visual / Dimension check-up	100%	Inspection Report	~	H	RW
4.3	Dielectric Test	Insulating Resistance	100%	Inspection Report	~	W	RW
5.0	**Painting**						
5.1	Final painting (as applicable)	Paint Scheme , Visual & Paint thickness check	100%	Inspection Report	~	H	~
6.0	**Documentation**						
6.1	Stamping and review of inspection documents, issue of IC	Review of documents for compliance as per PR.	100%	IC	~	~	H

6.2	Review of final documentation	Compilation of documents as per VDR attached with PR.	100%	Dossier / Completion certificate	~	H	H

Legend:

H - Hold (Do not proceed without approval),

P - Perform,

RW - Random Witness (As specified or 10% [min.1 no. of each size and type of Bulk item]),

R - Review,

W - Witness (Give due notice, work may proceed after scheduled date).

NOTES (As applicable):

1. This document describes the generic test requirements. Any additional test or Inspection scope if specified in contract documents shall also be Applicable (unless otherwise agreed upon).

2. Acceptance Norms for all the activities shall be as per PO/PR/STANDARDS referred there in /Job Specification /Approved Documents.

INSPECTION AND TEST PLAN – FORGED, SEAMLESS & WELDED FITTINGS

		ISSUED AS STANDARD			
		DESCRIPTION			

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

1.0 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 SUPPLIER	SUPPLIER	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 (Qualified under reputed TPIA)
2.0	**Material Inspection**						

2.1	Raw Material Identification (Billets, Rounds, Pipes, Coil, Plates, etc.)(** Special services like NACE, H2,HIC, UOP, AXEN, etc)	Review of MTC's for Chemical, Mechanical Properties, size & steel Making process, etc.	100%	Mill test certificate, Supplier's Inspection Report	-	H	RW-For CS W- For AS, SS, LTCS & CS with special services **
3.0	**In Process Inspection**						
3.1	Forming & Welding	Forming & Welding Parameters	100%	Supplier's records	-	H	-
3.2	Heat Treatment	Stress Relieving, Normalising, Tempering, Solution Annealing, Stabilization Heat Treatment etc. as applicable	100%	HT chart / report	-	H	R
3.3	Ferrite Check Of SS Welds (If Applicable)	% Ferrite Check	100%	Inspection Report	-	H	R
3.4	Identification of Test Samples	Product Chemical, Mechanical, Impact, IGC and Other test as applicable	Lot as per specification	Test Reports	-	H	H
3.5	NDT-RT as applicable	Surface & Internal Imperfections	As per PR/Purchase Specification	RT Film & Reports	-	H	R (Film Review)
3.6	NDT-UT (as applicable)	Surface & Internal Imperfections	As per PR/Purchase Specification	UT Reports	-	H	R

3.7	NDT-DPT / MPT of bevel ends	Surface / sub surface defects	100%	Test Report	-	H	R
3.8	Identification of Test Samples	Product Chemical, Mechanical, Impact, IGC and Other test as applicable	100%	Test Reports	-	H	H
3.9	Product Analysis (As applicable	Chemical Composition	As per PR/Purchase Specification	Test Reports	-	H	R
3.10	Destructive Testing	Mechanical, Impact, IGC and Other test as applicable	100%	Test Reports	-	H	H
3.11	Galvanizing (If Applicable)	Integrity Of Galvanised Coating	100%	Inspection Report	-	H	-
4.0	**Final Inspection**						
4.1	Visual and Dimensional	Size, Thickness / Schedule, Dimensions, Surface quality, Marking, etc.	100%	Inspection report	-	H	RW
4.2	Hardness testing on fittings (** Special services like NACE, H2,HIC, UOP,AXEN,etc)	Hardness value of base metal & Weld / HAZ as applicable	Random 10%	Test report	-	H	R-For CS SS & RW- For AS, LTCS & CS with special services **
4.3	PMI Check	Chemical Check	As Per IGL Spec.	Inspection report	-	H	RW
4.4	Final Stamping	Stamping of accepted Items	Stamping of Fittings which are witnessed by PMC/ TPIA	Inspection report	-	H	H

5.0	**Painting**						
5.1	Shot Blasting 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%	Supplier TC & IC	-	H	H

Legend:

H - Hold (Do not proceed without approval),

P - Perform,

RW - Random Witness (As specified or 10% [min.1 no. of each size and type of Bulk item]),

R - Review,

W - Witness (Give due notice, work may proceed after scheduled date).

NOTES (As applicable):

1. This document describes the generic test requirements. Any additional test or Inspection scope if specified in contract documents shall also be Applicable (unless otherwise agreed upon).

2. Acceptance Norms for all the activities shall be as per PO/PR/STANDARDS referred there in /Job Specification /Approved Documents.

3. For orders placed on stockist, items shall be accepted based on manufacturer's TC with EN310204 type 3.2 certification from PMC / OWNER approved suppliers.
4. For welded fittings, it is recommended to use low hydrogen consumable for AS, SS 410 fittings & HIC resistant consumable for HIC service fittings.
5. PMC/ TPIA reserves the right to check raw material consumption and traceability records.

INSPECTION AND TEST PLAN – FLANGES SPECTACLE BLINDS & DRIP RINGS

		ISSUED AS STANDARD			
		DESCRIPTION			

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

1.0 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 SUPPLIER	SUPPLIER	TPIA
1.0	**Procedure**						
1.1	Heat Treatment, 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
2.0	**Material Inspection**						
2.1	Raw Material Inspection	Chemical & Mechanical Properties	100%	Test Certificates	-	H	R

3.0	**In Process Inspection**						
3.1	Welding / Forging	Forging /Welding Parameters	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	Identification of Test Samples	Product Chemical, Mechanical, Impact, IGC and Other test as applicable	100%	Test Reports	-	H	H(Note-1)
3.4	Product Analysis (As applicable	Chemical Composition	As per PR/Purchase Specification	Test Reports	-	H	R
3.5	Destructive Testing	Mechanical, Impact, IGC and Other test as applicable	100%	Test Reports	-	H	H(Note-1)
3.6	NDT as applicable	Surface & Internal Imperfections	As per PR/Purchase Specification	NDT Reports	-	H	R
3.7	Galvanizing (If Applicable)	Integrity Of Galvanised Coating	100%	Inspection Report	-	H	-
4.0	**Final Inspection**						

4.1	Final Inspection	1. Visual 2. Dimensions 3.Hardness 4. Marking etc	100%	Inspection report	-	H	H(Note-1)
4.2	PMI Check	Chemical Check	As Per IGL Spec.	Inspection report	-	H	RW
4.3	Final Stamping	Stamping of accepted Items	Stamping of Items which are witnessed by TPIA.	Inspection report	-	H	H(Note-1)
5.0	**Painting**						
5.1	Rust Preventive Coating & Colour Coding	Visual Inspection & 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%	Supplier TC & IC	-	H	H

Legend:

H - Hold (Do not proceed without approval),

P - Perform,

RW - Random Witness (As specified or 10% [min.1 no. of each size and type of Bulk item]),

R - Review,

W - Witness (Give due notice, work may proceed after scheduled date).PR- PURCHASE REQUISITION

NOTES (As applicable):

1. For Non NACE & Non Hydrogen service Carbon Steel Flanges, Spectacle Blinds & Drip Rings up to size 24"-300ANSI Class Will be accepted on review of Supplier Test Certificates. Supplier Test Certificate to be reviewed by TPIA.

2. This document describes the generic test requirements. Any additional test or Inspection scope if specified in contract documents shall also be Applicable (unless otherwise agreed upon).

3. Acceptance Norms for all the activities shall be as per PO/PR/STANDARDS referred there in /Job Specification /Approved Documents.

4. For orders placed on stockist, items shall be accepted based on manufacturer's TC with EN310204 type 3.2 certification from PMC / OWNER approved suppliers.

	PIPING SPECIFICATION	SPECIFICATION NO 3C1
		SHEET 1 OF 6
		REV 0

BASIC PIPING SPECIFICATION DATA		MAXIMUM DESIGN CONDITIONS			
		TEMPERATURE ° C		PRESSURE bar g	
PRIMARY FLANGE RATING	300#-RF	**NG**	**0 to 45**	**NG**	**49.00**
		AG	**60**	**AG**	**49.00**
BASIC MATERIAL	CARBON STEEL				
CORROSION ALLOWACE	1.5 mm				
X-RAYS	100%				
SIZE RANGE	1/2"-18"				
CODE	**ANSI B 31.8**				

FLUIDS

NG : NATURAL GAS

AG : ACTUATING GAS

	DESCRIPTION				

	PIPING SPECIFICATIONS	SPECIFICATION NO 3C1 SHEET 2 OF 6 REV 0

ITEM	SHORT CODE	SIZE FROM-THRU	END CONNECTION	RATING AND/OR SCHED.	DIMENSION STANDARD	MATERIAL	REMARKS
PIPES	**P**	1/2" - 2"	BE-ANSI B16-25	80	ANSI B36-10	ASTM A 106 Gr. B	SEAMLESS
		4"	BE-ANSI B16-25	6.4 mm	API 5L	API 5L Gr. B	ERW
		6"	BE-ANSI B16-25	6.4 mm	API 5L	API 5L Gr. B	ERW
		8"	BE-ANSI B16-25	8.2 mm	API 5L	API 5L Gr. B	ERW
		12"	BE-ANSI B16-25	6.4 mm	API 5L	API 5L X 60	ERW / SMLS / LSAW / HSAW
		16"	BE-ANSI B16-25	7.9mm	API 5L	API 5L X 60	ERW / SMLS / LSAW / HSAW
		18"	BE-ANSI B16-25	8.7mm	API 5L	API 5L X 60	ERW / SMLS / LSAW / HSAW
ELBOWS 90 LR	**E**	1/2"- 12"	BW - ANSI B16-25	SEE PIPE	ANSI B16-9	ASTM A 234 WPB	SEAMLESS (Excluding 12")
		12" 16" 18"	BW - ANSI B16-25	SEE PIPE	ANSI B16-9	API 5L X 60 or ASTM A860 WPHY 60	
ELBOWS 45 LR	**E45**	1/2"- 12"	BW - ANSI B16-25	SEE PIPE	ANSI B16-9	ASTM A 234 WPB	SEAMLESS (Excluding 12")
		12" 16" 18"	BW - ANSI B16-25	SEE PIPE	ANSI B16-9	API 5L X 60 or ASTM A860 WPHY 60	
ELBOWS 30 LR	**E30**	1/2"- 12"	BW - ANSI B16-25	SEE PIPE	ANSI B16-9	ASTM A 234 WPB	SEAMLESS (Excluding 12")
		12" 16" 18"	BW - ANSI B16-25	SEE PIPE	ANSI B16-9	API 5L X 60 or ASTM A860 WPHY 60	
ELBOWS 22.5 LR	**E22.5**	1/2"- 12"	BW - ANSI B16-25	SEE PIPE	ANSI B16-9	ASTM A 234 WPB	SEAMLESS (Excluding 12")
		12" 16" 18"	BW - ANSI B16-25	SEE PIPE	ANSI B16-9	API 5L X 60 or ASTM A860 WPHY 60	
ELBOWS 15 LR	**E15**	1/2"- 12"	BW - ANSI B16-25	SEE PIPE	ANSI B16-9	ASTM A 234 WPB	SEAMLESS (Excluding 12")
		12" 16" 18"	BW - ANSI B16-25	SEE PIPE	ANSI B16-9	API 5L X 60 or ASTM A860 WPHY 60	
REDUCERS	**RC**	3/4"- 12"	BW - ANSI B16-25	SEE PIPE	ANSI B16-9	ASTM A 234 WPB	SEAMLESS (Excluding 12")
CONCENTRIC		12" 16" 18"	BW - ANSI B16-25	SEE PIPE	ANSI B16-9	API 5L X 60 or ASTM A860 WPHY 60	
REDUCERS	**RE**	3/4"- 12"	BW - ANSI B16-25	SEE PIPE	ANSI B16-9	ASTM A 234 WPB	SEAMLESS (Excluding 12")
ECCENTRIC		12" 16" 18"	BW - ANSI B16-25	SEE PIPE	ANSI B16-9	API 5L X 60 or ASTM A860 WPHY 60	
TEES EQUAL	**T**	1/2"- 12"	BW - ANSI B16-25	SEE PIPE	ANSI B16-9	ASTM A 234 WPB	SEAMLESS (Excluding 12")
		12" 16" 18"	BW - ANSI B16-25	SEE PIPE	ANSI B16-9	API 5L X 60 or ASTM A860 WPHY 60	
TEES RED	**TR**	3/4"- 12"	BW - ANSI B16-25	SEE PIPE	ANSI B16-9	ASTM A 234 WPB	SEAMLESS (Excluding 12")
		12" 16" 18"	BW - ANSI B16-25	SEE PIPE	ANSI B16-9	API 5L X 60 or ASTM A860 WPHY 60	
WELDOLETS	**WEL**	3/4"-18"	BW - ANSI B16-25	SEE PIPE	MANUFACTURER	ASTM A 105	SEAMLESS
CAPS	**C**	1/2"- 12"	BW - ANSI B16-25	SEE PIPE	ANSI B16-9	ASTM A 234 WPB	SEAMLESS (Excluding 12")
		12" 16" 18"	BW - ANSI B16-25	SEE PIPE	ANSI B16-9	API 5L X 60 or ASTM A860 WPHY 60	
NIPPLES	**NBEP**	1/2" - 1.1/2"	BOTH ENDS PLAIN	80	ANSI B36-10	ASTM A 106 Gr. B	SEAMLESS-LG=100mm
	NOET	1/2" - 1.1/2"	ONE END THRD-MNPT	80	ANSI B36-10	ASTM A 106 Gr. B	SEAMLESS-LG=100mm
	NBET	1/2" - 1.1/2"	BOTH ENDS THRD-MNPT	80	ANSI B36-10	ASTM A 106 Gr. B	SEAMLESS-LG=100mm
FULL COUPLINGS THRD	**CF**	1/2" - 1.1/2"	FNPT ANSI B1-20-1	3000#	ANSI B16-11	ASTM A 105	SEAMLESS
CAPS THRD	**C2**	1/2" - 1.1/2"	FNPT ANSI B1-20-1	3000#	ANSI B16-11	ASTM A 105	SEAMLESS
PLUGS THRD	**PL**	1/2" - 1.1/2"	MNPT ANSI B1-20-1	3000#	ANSI B16-11	ASTM A 105	SEAMLESS

PIPING SPECIFICATIONS

SPECIFICATION NO 3C1
SHEET 3 OF 6
REV 0

ITEM	SHORT CODE	SIZE FROM-THRU	END CONNECTION	RATING AND/OR SCHED.	DIMENSION STANDARD	MATERIAL	REMARKS
WN FLANGES	**F**	1/2"-12"		300# RF	ANSI B16-5	ASTM A 105	(Excluding 12")
		12" 16" 18"				ASTM A 694 F 60	Always to be weilded on 3C1 pipe
ORIFICE FLANGES	**FO**	1" - 12"		300# RF	ANSI B16-36	ASTM A 105	COMPLETE WITH GASKET BOLTS, NUTS JACK-SCREWS AND PLUGS
		12" 16" 18"				ASTM A 694 F 60	
BLIND FLANGES	**FB**	1" - 12"		300# RF	ANSI B16-5	ASTM A 105	(Excluding 12")
		12" 16" 18"				ASTM A 694 F 60	
DRIP RINGS	**DR**	1" - 12"		300# RF	ANSI B16-36	ASTM A 105	3/4" FNPT OUTLET CONNECTION
		12" 16" 18"				ASTM A 694 F 60	
SPECTACLE BLINDS	**SB**	1" - 12"		300# RF	ANSI B16-5	ASTM A 515 GR 70	(Excluding 12")
		12" 16" 18"				ASTM A 694 F 60	
RESTRICTION ORIFICES	**RO**	1" - 12"		300# RF	ANSI B16-5	ASTM A240 GR 304	(Excluding 12")
		12" 16" 18"				ASTM A 694 F 60	
MONOLITHIC	**IJ**	2"-12"	BW - ANSI B16-25	300#	ANSI B16-5	PIPE PUPS:Same as pipe Material Forged Ring - ASTM A 105	(Excluding 12") REFER DATA SHEET
INSULATING		12"	BW - ANSI B16-25	300#	API 5L	PIPE PUPS:API 5L X 60 Forged Ring - ASTM A 694 F60	REFER DATA SHEET
		16"	BW - ANSI B16-25	300#	API 5L	PIPE PUPS:API 5L X 60 Forged Ring - ASTM A 694 F60	REFER DATA SHEET
JOINTS		18"	BW - ANSI B16-25	300#	API 5L	PIPE PUPS:API 5L X 60 Forged Ring - ASTM A 694 F60	REFER DATA SHEET
STUD BOLTS	**B**	1/2" - 18"		300# RF	ANSI B18.2.1 ANSI B18.2.2	ASTM A 193 B 7 HEXAGONAL NUTS ASTM A194 GR 2H	
GASKETS SPIRAL WOUND	**G**	1/2"-18"		300# RF	API 601 MSS SP 44	WINDING ANSI 304 FILLING PURE GRAPHITE CENTERING RING CS	4.5 mm THK

	PIPING SPECIFICATIONS	SPECIFICATION NO 3C1 SHEET 4 OF 6 REV 0

ITEM	SHORT CODE	SIZE FROM-THRU	END CONNECTION	RATING AND/OR SCHED.	DIMENSION STANDARD	MATERIAL	REMARKS
BALL VALVES	VBA	1/2" - 11/2"	FLGD RF:ANSI B16-5	600#	ANSI B16-10	BODY: ASTM A 105 BALL: SS 316	FULL BORE WRENCH OPERATED. FIRE SAFE
		2"- 4"	FLGD RF:ANSI B16-5 or BW :ANSI B16.25	300#	ANSI B16-10	BODY: ASTM A 216 WCB BALL: ASTM A 216 WCB / A 234 WPB / A 395 with ENP (75 microns)	FULL BORE / REDUCED BORE AS INDICATED DATA SHEET DOUBLE BLOCK & BLEED WRENCH OPERATED. FIRE SAFE
		6"- 8"	FLGD RF:ANSI B16-5 or BW :ANSI B16.25	300#	ANSI B16-10	BODY: ASTM A 216 WCB BALL: ASTM A 216 WCB / A 234 WPB / A 395 with ENP (75 microns)	FULL BORE / REDUCED BORE AS INDICATED DATA SHEET DOUBLE BLOCK & BLEED GEAR OPERATED. FIRE SAFE
		12"- 18"	BW :ANSI B16.25	300#	ANSI B16-10	BODY: ASTM A 105 BALL: ASTM A 105	FULL BORE / REDUCED BORE AS INDICATED DATA SHEET DOUBLE BLOCK & BLEED GAS OVER OIL ACTUATED VALVE FIRE SAFE
GLOBE VALVES	VGL	1/2"-1 1/2"	FLGD RF:ANSI B16-5	600#	ANSI B16-10	BODY: ASTM A 105 TRIM: ASTM A182 F6	HANDWHEEL FIRE SAFE
		2" - 18"	FLGD RF:ANSI B16-5	300#	ANSI B16-10	BODY: ASTM A 216 WCB TRIM: ASTM A 216 WCB	HANDWHEEL FIRE SAFE
SWING CHECK VALVES	VCH	1/2" - 11/2"	FLGD RF:ANSI B16-5	600#	ANSI B16-10	BODY: ASTM A 105 TRIM: ASTM A182 F6	HORIZONTAL INSTALLATION VERTICAL INSTALLATION FLOW UPWARDS
		2"-18"	FLGD RF:ANSI B16-5	300#	ANSI B16-10	BODY: ASTM A 216 WCB TRIM: ASTM A 216 WCB	HORIZONTAL INSTALLATION VERTICAL INSTALLATION FLOW UPWARDS

	PIPING SPECIFICATIONS	**SPECIFICATION NO 3C1**
		SHEET 5 OF 6
		REV 0

REDUCERS CHART

SMALL SIZE

LARGE SIZE

	1/2"	3/4"	1"	1.1/2"	2"	3"	4"	6"	8"	10"	12"	14"	16"	18"	20"	24"	28"	30"	32"	36"	42"
1/2"																					
3/4"	X																				
1"	X	X																			
1.1/2"	X	X	X																		
2"		X	X	X																	
3"			X	X	X																
4"			X	X	X	X															
6"				X	X	X	X														
8"					X	X	X	X													
10"						X	X	X	X												
12"						X	X	X	X	X											
14"							X	X	X	X	X										
16"								X	X	X	X	X									
18"									X	X	X	X	X								
20"										X	X	X	X	X							
24"																					
28"																					
30"																					
32"																					
36"																					
42"																					

LEGEND

X :CONCENTRIC AND ECCENTRIC REDUCERS-BW

	LIST OF RECOMMENDED VENDORS FOR BOUGHT OUT ITEMS				
				TOTAL SHEETS	58

LIST OF RECOMMENDED VENDORS FOR BOUGHT OUT ITEMS

		Issued for Vendor's			
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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. Ahmedngr, 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)

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 Industeries (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 Valves Ltd.

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

w. Shivshakti Engineering works

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

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, Itly

q. Petrol Valves SRL

r. Tormene Gas Technology S.P.A (VALVITALIA)

s. Petro Valves Pvt. Limited, Ahmedabad

3.0 TEE

3.1 FLOW TEE

a. Coprosider SPA, Italy

b. GEA Energy System India Limited, Chennai

c. Multitex Filteration

d. Pipeline Engineering, UK

e. Scomark Engg. Limited (U.K.)

f. Skeltonhall Limited, Engaland(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.

LIST OF RECOMMENDED VENDORS FOR BOUGHT OUT ITEMS

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

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
y. Ranco Industries

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. Siiritec 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 make Lincon

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

c. BERRY Plastics Corporation, Belgium- Covalence Brand

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. CYG Changtong New material Co. Ltd., China (Rigil Techno India Pvt. Ltd.)

d. SHRI NARAYAN IMPAC INDIA LLP (SNI 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

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. Filteration 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

20.0 FILTER ELEMENT

a. Peco – Facet

b. Velcon

c. Pall – Filterite

d. Burgress 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. Riya NDT

k. Aditya NDT

l. Kritika Engineering Co. , Delhi (Kritika NDT)

m. Matrix Inspection engineering services Pvt Ltd.

n. TCR Engineering, Mumbai

o. Ndtech Inspection Services, Mathura

p. Technical testing & Inspection services, Bihar (Begusarai)

q. SRP NDT Services, Samastipur

r. Saroj NDT Services

This list is tentative, other NDT agencies may be engaged upon receiving approval form Owner EIC.

22.0 Cold Applied Tapes

a. Denso GmBH
b. Polyken (Berry Plastics Corporation)

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 / PMC / 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 / PMC.

3) The details of vendors indicated in this list are based on the information available with PMC, 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 (Apcolite), Berger Paints (Luxol). Goodlass Nerolac Paints (Nerolac), Jenson & Nicholson Paints Ltd (Borolac)
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	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,

LIST OF RECOMMENDED VENDORS FOR BOUGHT OUT ITEMS

	Anodized	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
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

LIST OF RECOMMENDED VENDORS FOR BOUGHT OUT ITEMS

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
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)

LIST OF RECOMMENDED VENDORS FOR BOUGHT OUT ITEMS

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,
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 VENDORS FOR BOUGHT OUT ITEMS

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 (Apcolite), 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.

C. ELECTRICAL

LIST OF SUPPLIERS OF MAJOR BOUGHT-OUT ITEMS

1.0 AIR CONDITIONER

a. O General.
b. Daikin.
c. Hitachi.
d. LG.
e. Samsung.
f. Blue star.
g. Haier.
h. Voltas.
i. 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. Luminous Power Technologies Pvt Ltd.
f. Su-Kam Power Systems Ltd.
g. Base Corporation Ltd.
h. Okaya Power Ltd.
i. Southern Batteries Pvt Ltd.
j. True Power International Ltd.
k. Evolute Solutions Pvt Ltd.
l. Greenvision Technologies Pvt Ltd.
m. Artheon Electronics Ltd.

3.0 BATTERIES (NICKEL CADMIUM)

a. Amco Batteries Ltd.
b. HBL Power Systems Ltd.
c. SAFT.

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. Dubas.

f. HBL Nife Power Systems Ltd..

g. Universal Industries Products.

h. Universal Instrument Mfg. Co Pvt Ltd.

i. Hitachi HI-REL Power Electronics P. Ltd

j. Mass-Tech Controls Pvt Ltd

k. Dubas Engineering Pvt Ltd

l. Chloride Power Systems & Solutions Ltd

5.0 CABLE – FIRE ALARM & COMMUNICATION CABLES

a. Cords Cable Industries Ltd.

b. CMI.

c. Delton cables Ltd.

d. ELKAY Telelinks.

e. KEI Industries Ltd.

f. Reliance Engineers Ltd.

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 Switchigear

j. Keyson Techno Equipments,

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.

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. Telemechanique.

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 EARTHING MATERIALS

a. Rukmani Electrical & Components Pvt Ltd.

b. Indiana Grating Pvt Ltd.

c. Jef Techno Solutions Pvt Ltd.

d. Flame proof LDB's/ JB,s/Control Station/ switches

e. FCG

f. Sudhir

g. Prompt Engineering Works

h. Flame Proof equipments pvt. Ltd.

i. Baliga Lighting Equipments Pvt. Ltd.

j. Flexpro Electricals Pvt. Ltd.

17.0 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.

18.0 HIGH MAST

a. Bajaj Electricals Limited.

b. Crompton Greaves Limited.

c. Philips India Limited.

d. Surya Roshani.

19.0 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.

20.0 INDICATING LAMPS

a. Alstom Ltd.

b. BCH.

c. L&T Ltd.

d. Siemens Ltd.

e. Vaishno Electricals.

f. Tecknik

g. ABB

21.0 INDICATING METERS

a. ABB.
b. AMCO.
c. AE.
d. Alstom Ltd. (EE).
e. Conzerv/Schneider
f. Elecon Measurement Pvt. Ltd.
g. HPL Electric & Power Pvt. Ltd.
h. MECO Instruments Ltd.
i. Minilec.
j. Rishabh Instruments Pvt. Ltd.
k. Trinity energy system.
l. Kaycee.
m. Salzer.

22.0 LIGHTING FIXTURES

a. GE Lighting Pvt. Ltd.
b. Bajaj Electricals Ltd.
c. Crompton Greaves Ltd.
d. Philips India Ltd.

23.0 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.

24.0 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

25.0 MOULDED CASE CIRCUIT BREAKER (MCCBS)

k. ABB.

l. Andrew Yule.

m. Larsen & Toubro.

n. Schneider.

o. Siemens.

p. Control and Switchgear.

q. Indo Asian,

r. Hager.

s. Merlin Gerin.

t. Havell's India Ltd

26.0 PROTECTION RELAYS – THERMAL

a. BCH.

b. L&T Ltd.

c. Siemens Ltd.

d. Tele-menchanique & Controls (India) Ltd.

27.0 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.

28.0 PUSH BUTTONS

a. BCH.

b. Alstom Ltd.

c. L&T.

d. Siemens Ltd.

e. Tele-Menchanique & Controls (India) Ltd.

f. Vaishno Electricals.

29.0 SWITCHES-CONTROL

a. BCH.

b. Easum Reyrolle Relays & Devices Ltd.

c. Alstom.

d. Kaycee Industries Ltd..

e. L&T.

f. Siemens Ltd.

30.0 SWITCHES – 5/15A PIANO/ PLATE, SWITCH SOCKET

a. Anchor Electronics & Electricals Pvt. Ltd.

b. Kingal Electricals Pvt. Ltd.

c. North-West Switchgear Ltd.

31.0 SWITCH SOCKET OUTLETS (INDUSTRIAL)

a. Alstom Ltd.

b. Best & Cromption Engineering Ltd.

c. BCH.

d. Crompton Greaves Ltd.

e. Essen Engineering Company Pvt. Ltd.

32.0 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.

33.0 SOLAR STREET LIGHTING

a. Tata BP Solar (I) Ltd.
b. REIL, Jaipur.
c. CEIL, Sahibabad.
d. HBL.

34.0 TERMINALS BLOCKS

a. Connectwell.
b. Controls & Switchgear Co. Ltd.
c. Elmex Controls Pvt. Ltd.
d. Essen Engineering Co. Pvt. Ltd.

35.0 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.

36.0 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.

37.0 GI-OCTAGONAL POLE

a. Bajaj.

b. Transrail.

c. Wipro.

d. K.L. Industries.

38.0 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.

39.0 LIST OF RECOMMENDED MANUFACTURERS FOR 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.

40.0 CATHODIC PROTECTION AGENCIES/CONTRACTOR/ VENDERS

a. Raychem-RPG Private Limited.
b. CALTECH Engineering Service.
c. Universal Corrosion Prevention India.
d. Cathodic Technology Limited.
e. Cathodic Control Company Pvt. Ltd.
f. CORRTECH International Pvt Ltd.
g. MITCORR Cathodic Protection Pvt Ltd.
h. Underground Pipeline & NDTS Pvt. Ltd.
i. JG Corrosion Solution.
j. Mercury Cathodic Protection Service.
k. UNDTS Corrosion Service.
l. Statum Infra ServicesCorrosion Technology Services Pvt. Ltd., Mumbai
m. Sark EPC, Ahmedadbad UNDTS, Noida
n. BSS Tech, Mumbai
o. Vijaya Engineering Universal Corrosion Prevention India , Kolkata
p. AMR Engineering Products , Mumbai
q. A.A Projects Cathodic Protection
r. Himoya Corrosion Technology , Kolkata
s. Consultech ,Baroda M.Tech Engineers , Surat
t. Corrtech Energy Limited , Ahmedabad
u. Cortigo Technologies Pvt. Ltd , Ahmedabad

41.0 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

42.0 PERMANENT REFERENCE CELL

a. PERMACELL/ HARCO (USA)

b. CORRTECH (ZULU), INDIA

c. TINKER RASOR, USA

d. SILVION, UK

43.0 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.

44.0 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. Shaktianode Pvt. Ltd.

45.0 CP PORTABLE REFERENCE CELL

a. MC Miller (USA) .

b. Borin, USA

c. Krick

d. corrtech.

46.0 CP PERMANENT REFERENCE CELL

a. Borin Manufacturer USA

b. MC Miller USA

c. Corrtech

d. Krick

47.0 CPTR (AC OPERATED)

a. Canara Electric

b. (Raychem RPG Ltd)

c. CATHODIC CONTROL COMPANY PVT LTD.

d. Raychem RPG Ltd

e. Kriston Systems

48.0 PIN BRAZING

a. SAFETRACK, SWEDEN

b. BAC, UK

49.0 THERMITWELD

a. ERICO, USA

b. THERMOWELD, USA

c. ERICO, EUROPE

50.0 CP SURGE DIVERTER/SPARK GAP ARRESTOR (EX-D)

a. Dhen, OBO

b. Corrpro system

c. Sohne

51.0 DIGITAL MULTIMETER

a. MOTWANE,

b. Rishabh,

c. Fluke .

52.0 CTSU

a. Kriston systems .

53.0 CP SOLID STATE POLARISATION CELL.

a. Dairyland

b. Corrpro systems

c. Mc Miller

d. Krik Engineering

54.0 PETROLEUM COKE BREEZE:

a. Goa Carbon , Goa

b. India carbon, Durgapur (WB)

55.0 PIN BRAZING

a. BAC

b. Safetrack

56.0 CP ANODE (MMO TYPE):

a. Corrtech

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)

57.0 CP ANODE BACKFILL MATERIAL

a. Goa Carbon (Goa).

b. India Carbon (Calcutta),

c. Petro carbon & Chemical Company (Haldia).

58.0 HEAT SHRINK CAP FOR CP ANODE

a. RAYCHEM

b. MATCOR (USA) To Cable Joint

59.0 ER- PROBE (EXTERNAL CORROSION)

a. Rose Corrosion Services UK

b. Metal Samples, USA. .

c. Monitoring) Roharbak Cosasco USA

d. Caproco UK

60.0 ER- PROBE & CORROSION COUPON

a. Rose Corrosion Services UK

b. Metal Samples

c. USA Assembly. .

d. Roharbak Cosasco, USA

e. Caproco, UK

61.0 HEAT SHRINK CAP FOR ANODE TO CABLE JOINT

a. Raychem, USA

b. Matcor (USA)

62.0 MMO WIRE ANODES (WITH FACTORY PRE-PACKED COKE BREEZE)

a. Matcor (USA)

b. Covalence (USA)

c. Berry Plastics (USA) – (Seal for Life Industries)

63.0 MMO WIRE ANODES (WITHOUT FACTORY PRE-PACKED COKE BREEZE)

a. GROUPPO DENORA, GOA, INDIA

b. CERANODE TECHNOLOGIES, USA

c. TELPRO, USA

64.0 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/ ONSULTANT/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.

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.

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

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.

15.0 JUNCTION BOXES AND CABLES GLANDS

a. Ex-Protecta

b. Flameproof Control Gears

c. Baliga

d. Flexpro Electricals

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

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 (Deutchland 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

l. Biffi Italia Srl,

m. Ledeen(Italy)

n. Virgo Valves & Control ltd.-India,

o. Voith,

p. Bettis,

q. Rotork-UK, USA, India,

r. Rotex,

s. Schuck Group,

t. 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

e. Fouress Engg. (New Delhi)

f. Fisher Xomox (New Delhi)

g. MIL Control Ltd. (Noida)

h. KOSO India Pvt ltd

i. Samson Control (Thane)

j. Dresser Valves India Pvt Ltd.

k. Fisher Controls

l. Valvitalia Italy

m. CCI Valve technology

n. Flowserve Pvt Ltd.

o. Metso Singapore Pvt Ltd.

p. Instrumentation Ltd Palghat

q. Dresser Inc. USA

25.0 FLOW COMPUTERS

r. Emerson

s. Instromet International (Belgium)

t. FMC Measurement Solutions (UK)

u. RMG (Germany)

v. OMNI Flow Computers Inc.

w. Thermo Fisher, USA

26.0 INDICATORS & CONTROLLERS

x. Yokogawa

y. Eurotherm Chessel

z. Honeywell

aa. Emerson

27.0 BARRIERS

bb. MTL

cc. STHAL

dd. P&F

ee. Phoenix

28.0 GAS CHROMATOGRAPH

ff. ABB

gg. Emerson

hh. Instromet International, NV

ii. RMG Regal+Messtechnik GmbH

jj. Yokogawa

29.0 I/P CONVERTERS

kk. ABB

ll. Emerson

mm. IMI Watson Smith Ltd.

nn. Moore Controls Ltd

oo. Shreyas Instruments Pvt Ltd, India

pp. Thermo Brandt Instruments

30.0 SS FITTINGS, INSTRUMENT VALVES & MANIFOLDS

30.1 FOR CNG WORK:

qq. DK-LOK

rr. Swagelok Co.

ss. Parker

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

31.0 SS TUBES

31.1 FOR CNG WORK:

a. Swagelok Co.

b. Parker

c. Sandvik

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.

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 FITTINGS & MDPE VALVES

a. Aliaxis,

b. George Fischer,

c. Al-Aziz,

d. Kimplas,

e. Banides,

f. Agru,

g. Friatech,

h. Plasson

2.0 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

3.0 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.

4.0 FORGED GI FITTING (FOR HIGH RISE SEGMENT)

a. Jainsons Industries

b. B.M. Meters Pvt. Ltd.

5.0 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

6.0 BRASS FITTINGS

a. Chandan Enterprises

b. Paras Industries Ltd.

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.

8.0 BRASS FITTINGS

a. Chandan Enterprises

b. Paras Industries Ltd.

c. Chokhawala Distributors – Brass Adaptor.

9.0 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

10.0 CORRUGATED FLEXIBLE METAL HOSES (ANACONDA)

a. KPC Flex Tubes

b. Vestas Hose Division

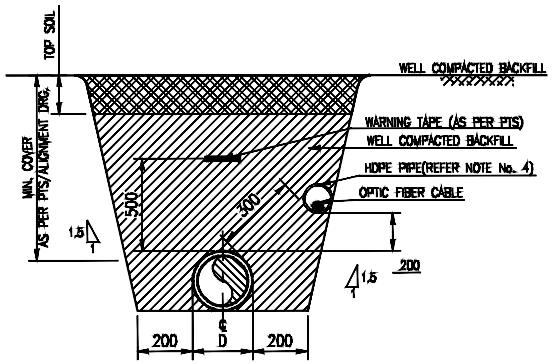
c. Alpha Flexi Tubes

d. Chandan Enterprises

Note:

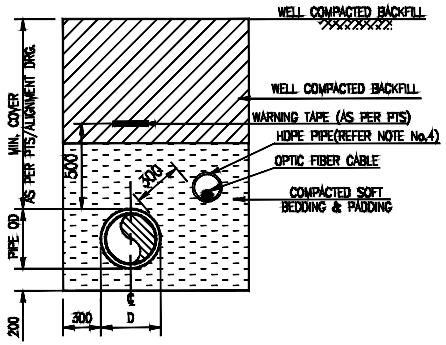
1. Vendor may procure material from any of approved vendors listed.
2. For equipment/components other than the above, vendor shall submit past track record for the proposed sub-vendors and obtain written approval from Owner / Consultant before placing order.
3. In case of exigencies like long delivery 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/ PMC.



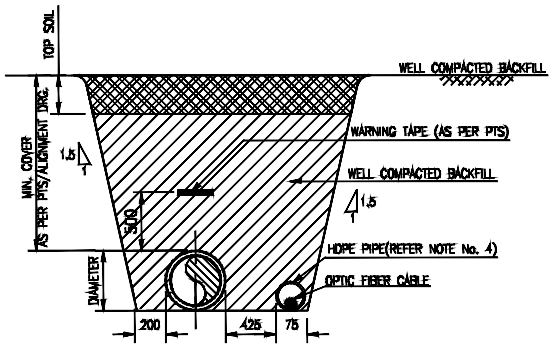
TYPICAL TRENCH DETAILS IN NORMAL SOIL

TYPE-1



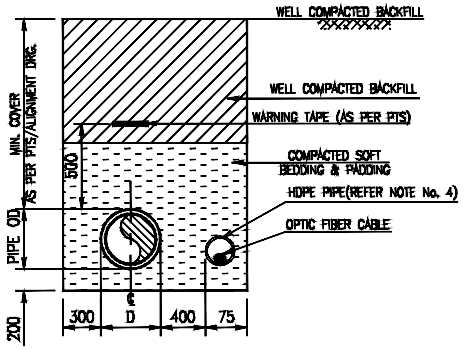
TYPICAL TRENCH DETAILS IN ROCK AREA

TYPE-3



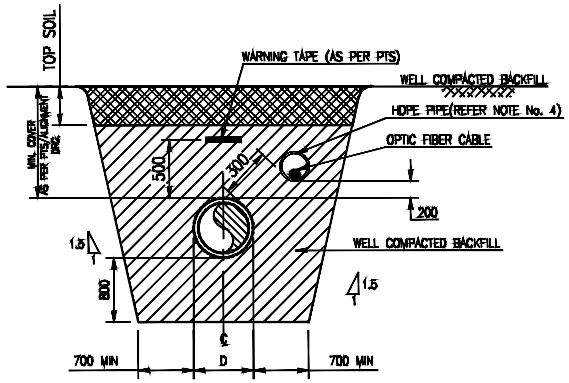
TYPICAL TRENCH DETAILS IN NORMAL SOIL

TYPE-2



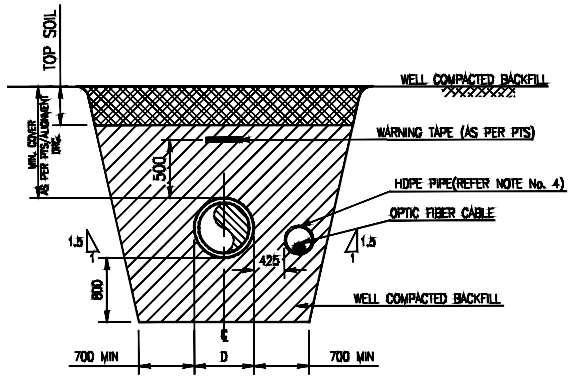
TYPICAL TRENCH DETAILS ROCK

TYPE-4



TYPICAL TRENCH DETAILS FOR SEISMIC FAULT(IN NORMAL SOIL) AREAS

TYPE-5



TYPICAL TRENCH DETAILS FOR SEISMIC FAULT (IN ROCK) AREAS

TYPE-6

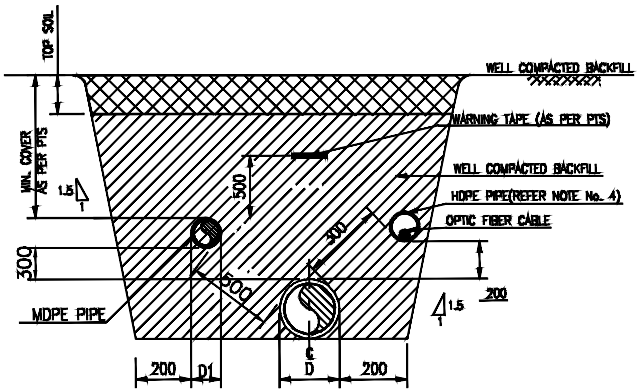
NOTES:-

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.

CLIENT: INDRAPRASTHA GAS LIMITED (IGL)

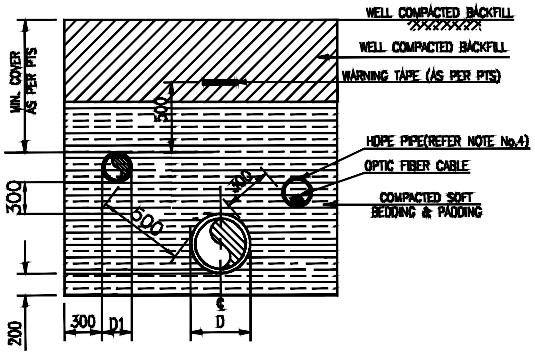
TITLE: TYPICAL TRENCH DETAILS

SCALE	DATE	CAD FILE/ DATE						
NTS							CAD	A3
OFFICE	PROJECT NO.	AREA	DIGS	TYPE			DRG NO.	SHEET	REV



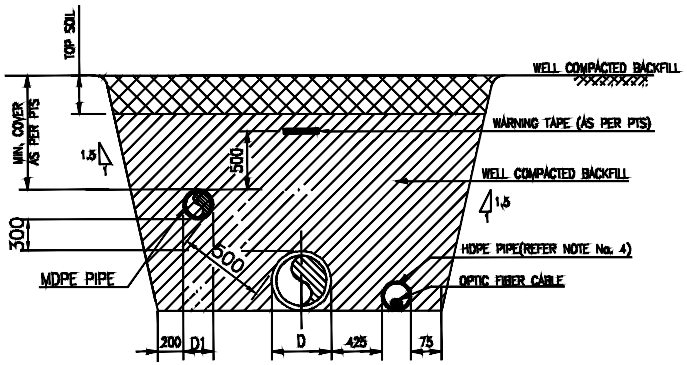
TYPICAL TRENCH DETAILS IN NORMAL SOIL

TYPE-1



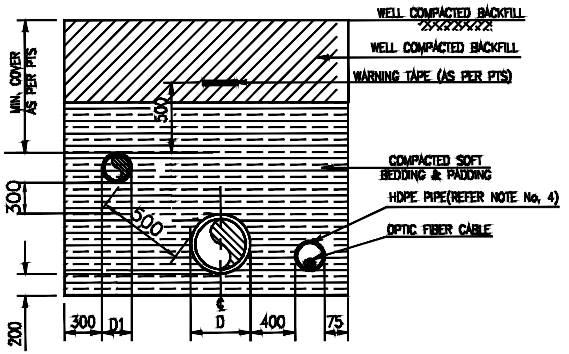
TYPICAL TRENCH DETAILS IN ROCK AREA

TYPE-3



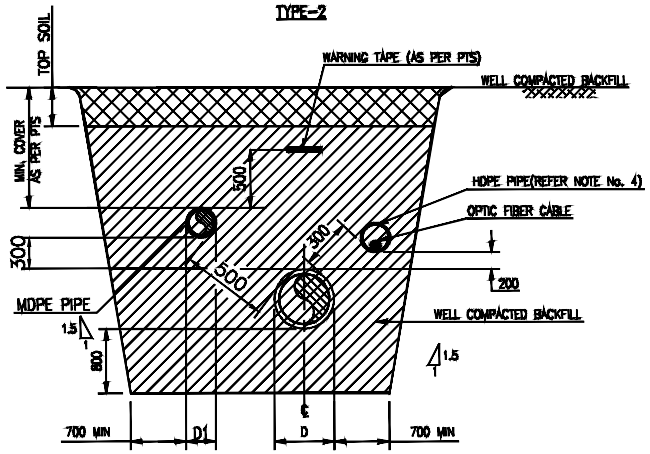
TYPICAL TRENCH DETAILS IN NORMAL SOIL

TYPE-2



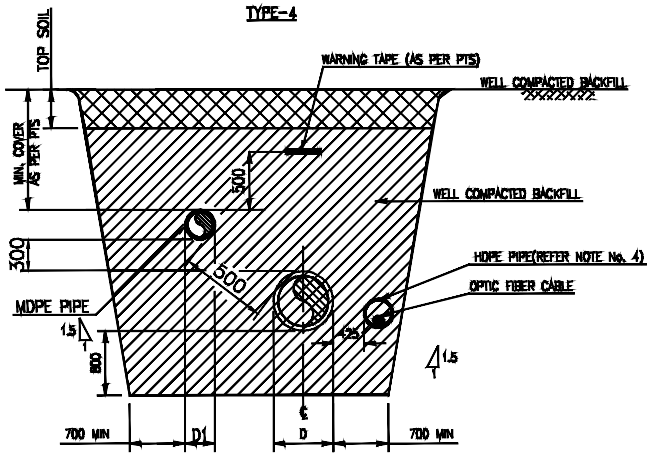
TYPICAL TRENCH DETAILS ROCK

TYPE-4



TYPICAL TRENCH DETAILS FOR SEISMIC FAULT(IN NORMAL SOIL) AREAS

TYPE-5



TYPICAL TRENCH DETAILS FOR SEISMIC FAULT (IN ROCK) AREAS

TYPE-6

NOTES:-

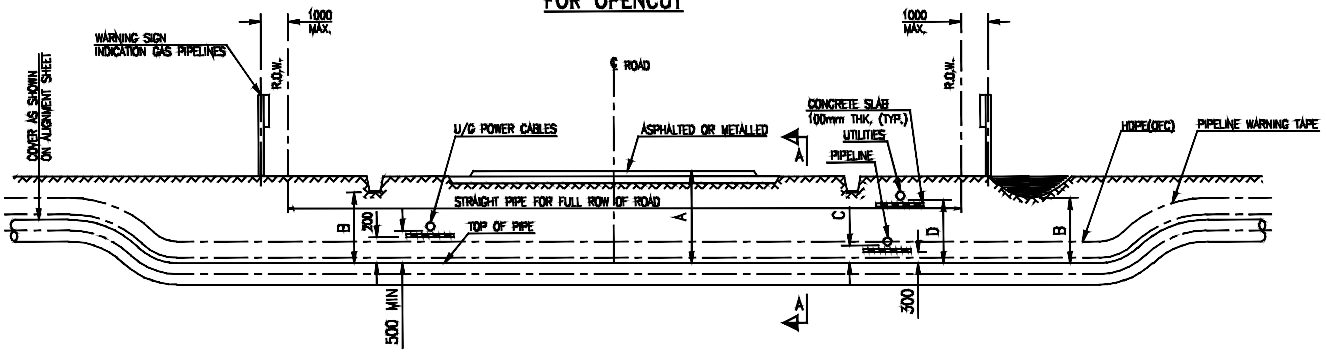
1. ALL DIMENSIONS ARE IN MM UNLESS NOTED OTHERWISE.
2. MINIMUM COVER OVER LINEPIPE SHALL BE AS PER PTS AND REQUIREMENT OF CONCERNED AUTHORITY.
3. THIS SKETCH IS INDICATIVE ONLY.
4. IF, AS PER SPECIFICATION, ARMOURED OFC IS TO BE PROVIDED, IT WILL BE LAID ALONGWITH LINEPIPE AS PER THE APPROVED PROCEDURE.
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. FOR MIN. COVER PLEASE REFER CL.-4.2.1 OF PTS-13823-CD-PL-SP-001.

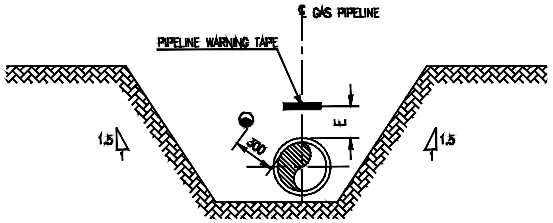
CLIENT: INDRAPRASTHA GAS LIMITED (IGL)
NEW DELHI

TITLE
TYPICAL TRENCH DETAIL

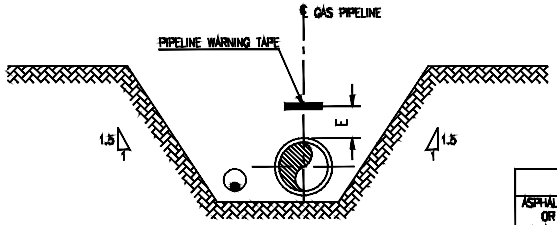
SIZE	CLIENT JOB NO.	DRAWING NUMBER	SHEET	REV.
A3			1 OF 1	1

FOR OPENCUT





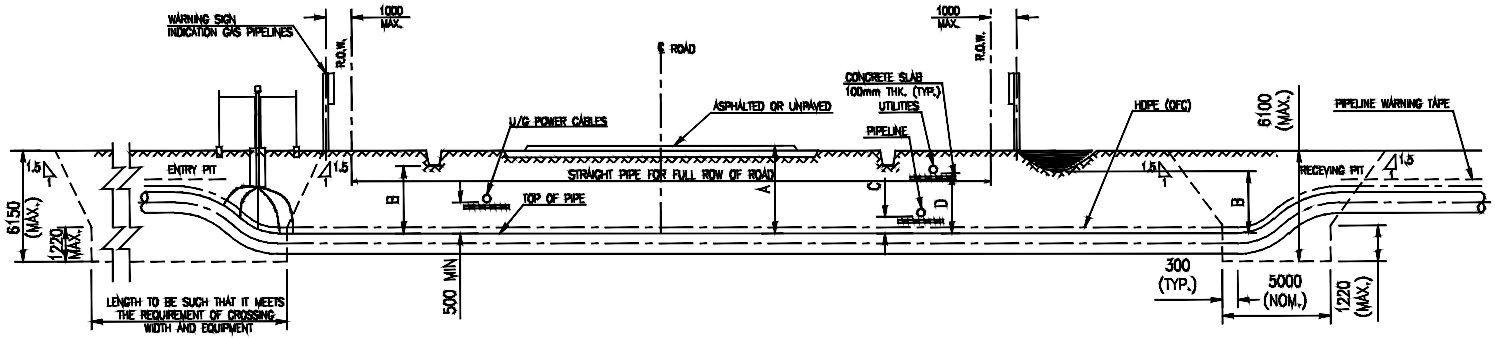
SECTION A–A TYPE–1



SECTION A–A TYPE–2

	A	B	C	D	E
ASPHALTED OR METALLED ROAD	1500 (MIN.)	2000 (MIN.)	600 (MIN.)	850 (MIN.)	500 (MIN.)

FOR JACKING METHOD



	A	B	C	D
REQUIRED DIMENSION	1500 (MIN.)	2000 (MIN.)	500 (MIN.)	600 (MIN.)

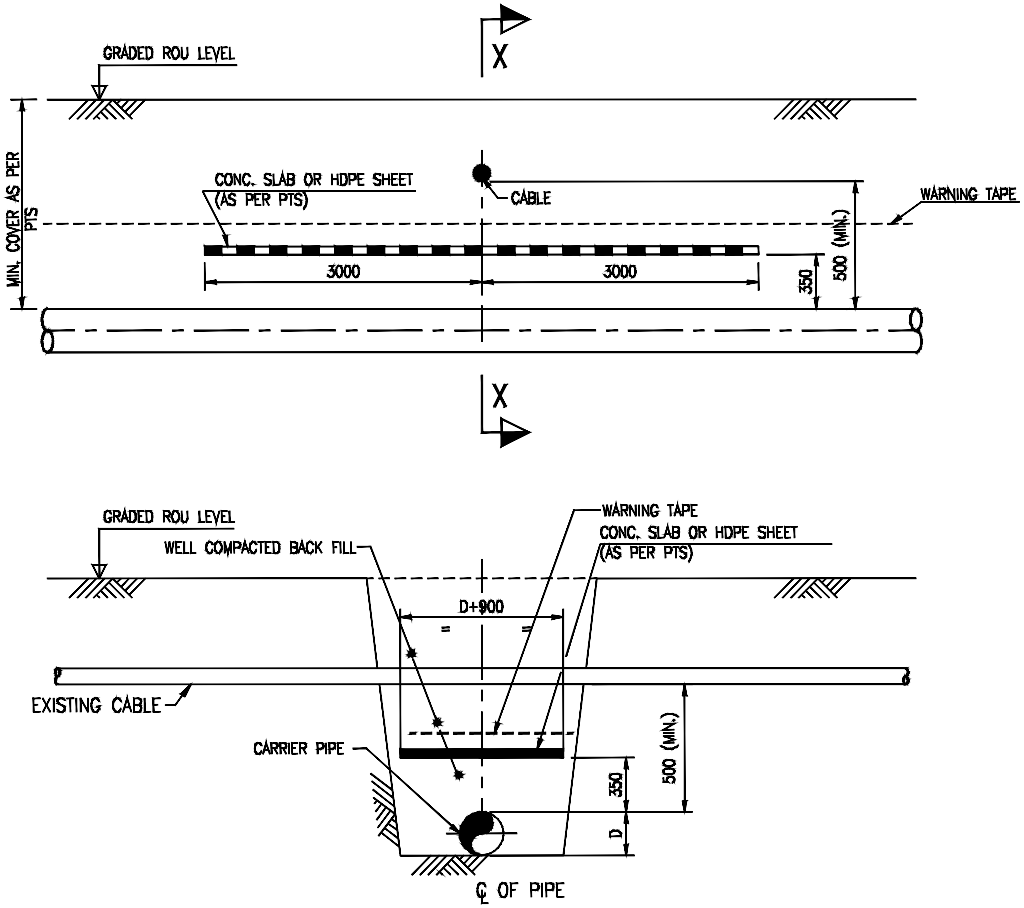
NOTES:-

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 AUTHORITIS HAVING JURISDICTION.
3. REFER API RP 1102 -OR OTHER DESIGN AND INSTALLATION REQUIREMENTS.
4. ANGLE OF INTERSECTION BETWEEN PIPELINE AND THE ROAD/HIGHWAY SHALL BE AS CLOSE TO 90° AS POSIBLE BUT IN NO CASE < 30°.
5. IN CASE PIPELINE COATING IS LIABLE TO DAMAGE WHILE BORING/JACKING, A PROTECTIVE COATING OF CONCRETE OR ANY OTHER SUITABLE MATERIAL SHALL BE PROVIDED ON CARRIER PIPE IN ACCORDIANCE WITH PTS & AS DIRECTED BY OWNER/OWNER'S REPRESENTATIVE.
6. CONTRACTOR SHALL VERIFY THE ACTUAL DIMENSIONS WITH RESPECT TO SURVEY DETAILS FOR EACH ROAD/HIGHWAY CROSSING AND PREPARE DETAILED DRAWING FOR INDIVIDUAL CROSSING FOR OWNER'S APPROVAL BEFORE COMMENCEMENT OF CONSTRUCTION.
7. FOR DETAIL OF CONCRETE SLAB REFER DWG NO, TECPL-STD-M-19-0007.
8. THE TABLES INDICATES THE MINIMUM DIMENSIONS. THE APPLICABLE MOST STRINGENT DIMENSION SHALL BE FOLLOWED.

CLIENT: INDRAPRASTHA GAS LIMITED (IGL)

TITLE: TYPICAL ROAD CROSSING (OPEN CUT / JACKING METHOD)

SCALE	DATE	CAD FILE DATE				CAD	A3
NTS							
OFFICE	PROJECT NO.	AREA	DISC	TYPE	DWG NO.	SHEET 1	REV



SECTION X-X

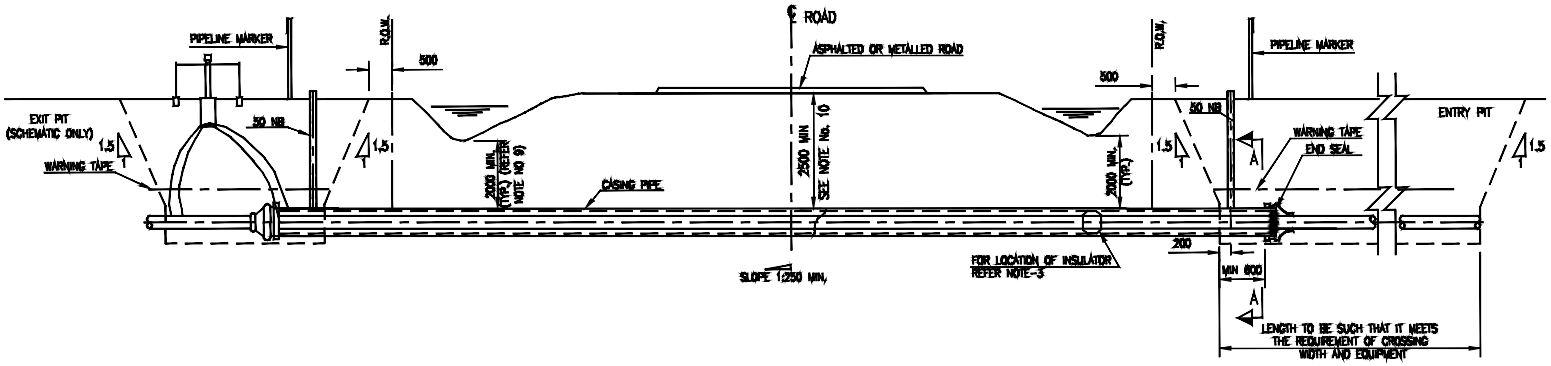
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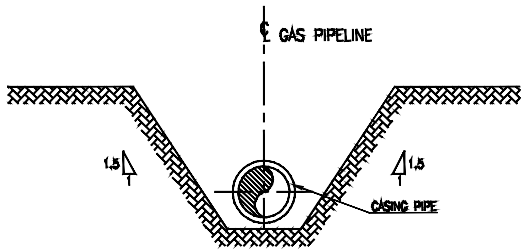
1 ALL DIMENSIONS ARE IN MM UNLESS NOTED OTHERWISE.
2 A MODIFIED PIPELINE WARNING SIGN SHALL BE INSTALLED CLOSE TO THE CROSSING.
3 IN CASE OF ARMOURED OFC CABLE, C.P. BONDING IS TO BE PROVIDED BETWEEN PIPELINE AND CABLE ARMOUR, IN CASE OF UNARMOURED CABLE, ARRANGEMENT FOR SHIELDING (BY PROVIDING CASING ON EITHER SIDE OF THE PIPELINE OR CABLE) SHALL BE CONSIDERED.
4 APPROVAL OF THE CROSSING SHALL BE OBTAINED FROM CONCERNED AUTHORITIES.
5 FOR CONCRETE SLAB, REFER STD. DRG No. TECPL-STD-M-19-0007.

CLIENT: INDRAPRASTHA GAS LIMITED (IGL)
NEW DELHI

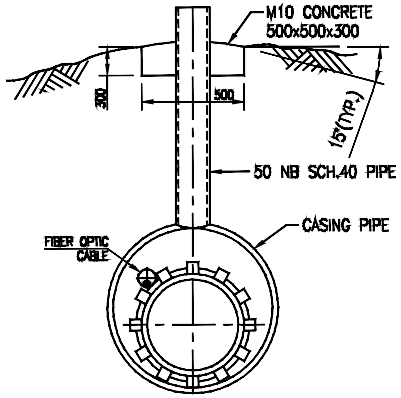
TITLE: TYPICAL UNDERGROUND CABLE CROSSING DETAILS

SCALE	DATE	CAD FILE: DATE						
NTS							CAD	A3
OFFICE	PROJECT NO.	AREA	DISC	TYPE	DRG NO.	SHEET 1	REV	

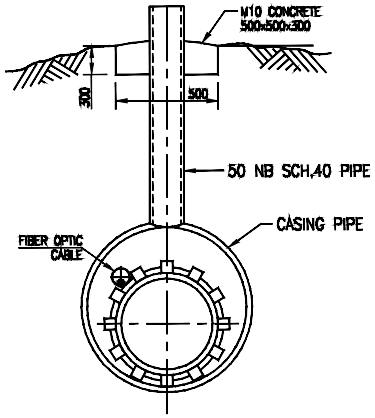




SECTION A–A
TYPICAL BORE PIT EXCAVATION



BENTONITE FILLING POINT



VENT

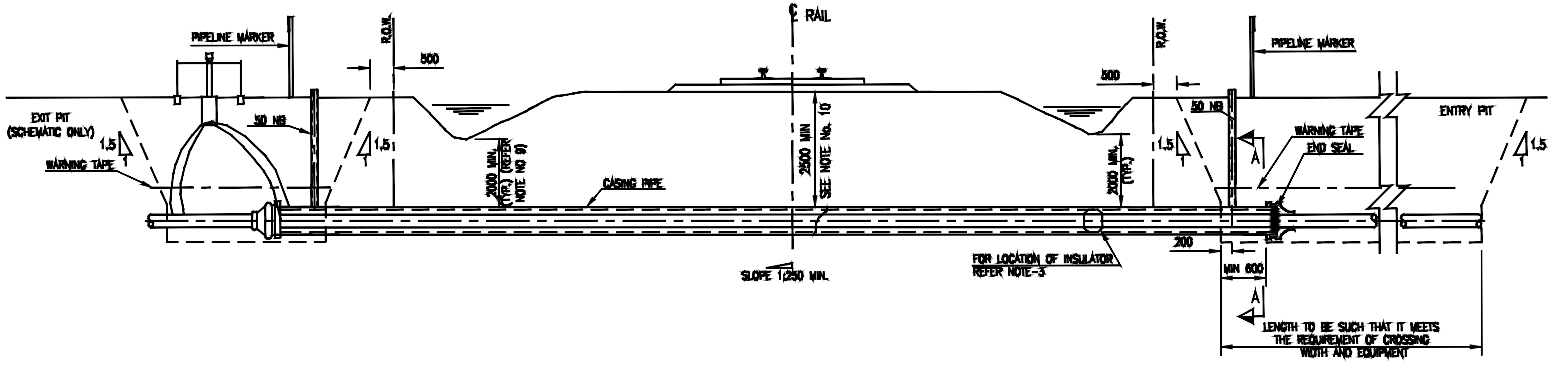
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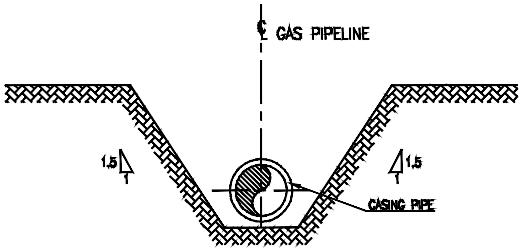
1 ALL DIMENSIONS ARE IN MM UNLESS NOTED OTHERWISE.
2 THE CROSSING WORKS SHALL BE EXECUTED IN ACCORDANCE WITH API RECOMMENDED PRACTICE 1102 LATEST EDITION.
3 500mm AWAY FROM BOTH ENDS, TWO NOS. INSULATORS SHALL BE PLACED. IN BALANCE LENGTH MAX. SPACING OF INSULATORS SHALL BE 2000 mm.
4 ELECTRICAL INSULATION BETWEEN THE CASING AND CARRIER PIPE SHALL BE CHECKED WITH A SUITABLE MEGGER.
5 MATERIAL OF THE CASING INSULATORS SHALL BE HDPE. END SEALS SHALL BE HEAT SHRINKABLE TYPE (MAKE RAYCHEM OR EQUIVALENT), CONTRACTOR SHOULD TAKE PRIOR APPROVAL FOR MATERIAL OF CONSTRUCTION FOR END SEAL & SHALL SUBMIT MATERIAL CERTIFICATES TO OWNER/ CONSULTANT FOR APPROVAL.
6 1:250 SLOPE TO BE PROVIDED FOR DRAINING DURING INSTALLATION OF CASING PIPE.
7 CASING PIPE SHOULD EXTEND MIN. 600mm BEYOND THE TOE OF THE SLOPE OR BASE GRADE, OR MIN 900mm BEYOND THE BOTTOM OF THE DRAINAGE DITCH, WHICHEVER IS MORE.
8 CONTRACTOR SHOULD SUBMIT DETAILED WORK PROCEDURE ALONG WITH SKETCHES AND MATERIAL TEST CERTIFICATES FOR APPROVAL.
9 THE CROSSING SHALL BE DONE ACCORDING TO THE GOVERNING DIMENSION OUT OF THESE DEFINED DIMENSIONS, AS THESE ARE ONLY GUIDING DIMENSIONS.
10 BENTONITE FILLING PROCEDURE SHALL BE DONE AS PER OWNER/ CONSULTANTS INSTRUCTIONS.
11 CROSSING MAY BE CARRIED OUT PRIOR TO MAINLINE ACTIVITIES ADDITIONAL ROU, IF REQUIRED, FOR APPROACH TO CROSSING, PIPELINE STRING, HYDROTESTING WORKING PIT FOR CROSSING TO AVOID CAVING OF SOIL SHALL BE PROCURED BY CONTRACTOR WITHOUT ANY COST IMPLICATION.
12 CATHODIC PROTECTION :- ALL CASING PIPES FOR CROSSING SHALL BE C.P. PROTECTED.
13 TEST STATION ON BOTH SIDE OF CROSSING.
14 THE LOCATION OF ENTRY AND EXIT PIT SHALL BE DECIDED AT SITE TO SUIT THE SITE REQUIREMENT.
15 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.
16 ALL CARRIER PIPELINE JOINTS SHALL BE RADIOGRAPHED.
17 PIPELINE SECTION SHALL BE PRETESTED HYDROSTATICALLY SEPARATELY FROM THE MAIN LINE TESTING WHEN REQUIRED BY CONCERNED AUTHORITIES OR AS DIRECTED BY CLIENT.

CLIENT: INDRAPRASTHA GAS LIMITED (IGL)
NEW DELHI

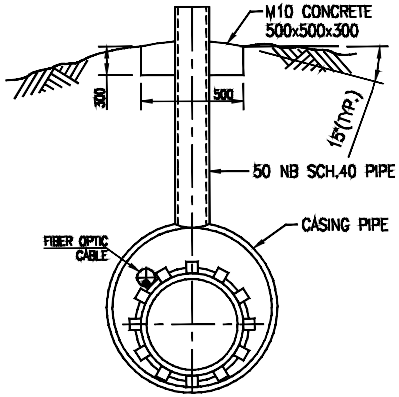
TITLE: TYPICAL ROAD CASED CROSSING (B+C)

SCALE	DRAWN	CHECKED						
NTS		DATE				CAD		A3
OFFICE	PROJECT NO.	AREA	DISC	TYPE		DRG NO.	SHEET	REV
							1	

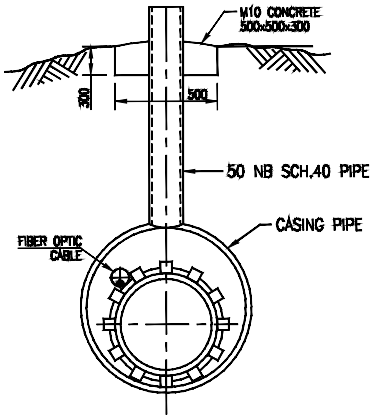




SECTION A–A
TYPICAL BORE PIT EXCAVATION



BENTONITE FILLING POINT



VENT

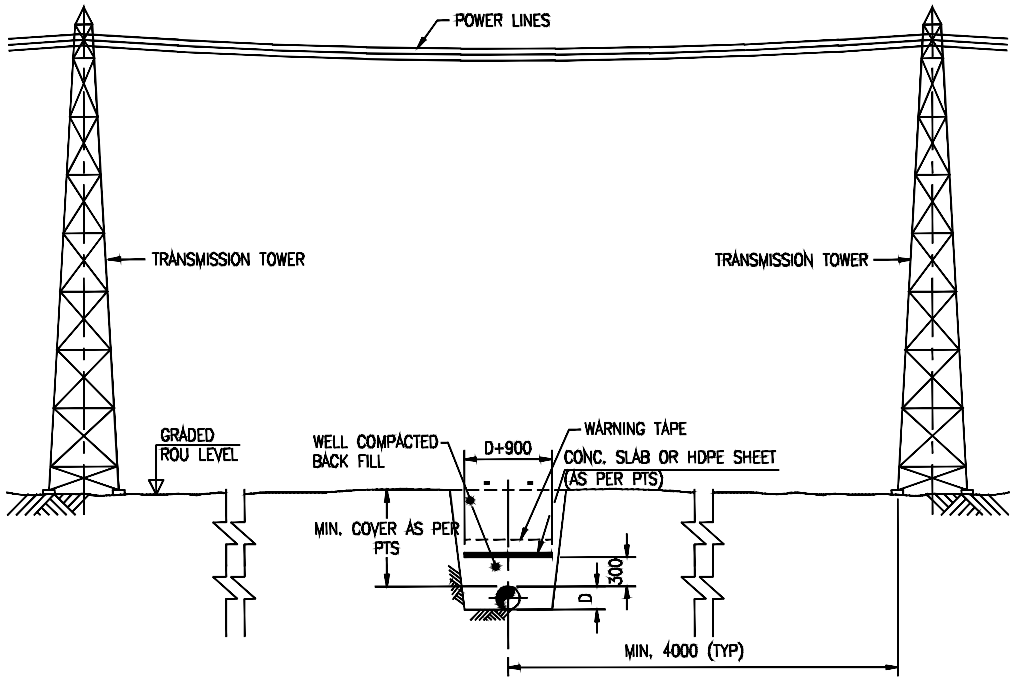
NOTES:-

1 ALL DIMENSIONS ARE IN MM UNLESS NOTED OTHERWISE.
2 THE CROSSING WORKS SHALL BE EXECUTED IN ACCORDANCE WITH API RECOMMENDED PRACTICE 1102 LATEST EDITION.
3 INSULATORS ARE TO BE PLACED 500mm AWAY AT BOTH ENDS SHALL BE PLACED IN BALANCE LENGTH MAX. SPACING OF INSULATOR SHALL BE 2000mm.
4 ELECTRICAL INSULATION BETWEEN THE CASING AND CARRIER PIPE SHALL BE CHECKED WITH A MEGGER.
5 MATERIAL OF THE CASING INSULATORS SHALL BE HDPE. END SEALS SHALL BE HEAT SHRINKABLE TYPE (MAKE RAYCHEM OR EQUIVALENT). CONTRACTOR SHOULD TAKE PRIOR APPROVAL FOR MATERIAL OF CONSTRUCTION FOR END SEAL & SHALL SUBMIT MATERIAL CERTIFICATES TO OWNER/CONSULTANT FOR APPROVAL.
6 1:250 SLOPE TO BE PROVIDED TOWARDS DRAIN DURING INSTALLATION OF CASING PIPE.
7 CONTRACTOR SHOULD SUBMIT DETAILED WORK PROCEDURE ALONG WITH SKETCHES AND MATERIAL TEST CERTIFICATES FOR APPROVAL.
8 THE MINIMUM 2.5M COVERAGE SHALL BE MAINTAINED BETWEEN TOP SURFACE OF CASING PIPE AND BOTTOM OF RAIL EXCEPT OTHERWISE STATED IN PTS OR REQUESTED BY RAILWAY AUTHORITIES.
9 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.
10 ALL CARRIER PIPELINE JOINTS SHALL BE RADIOGRAPHED.
11 PIPELINE SECTION SHALL BE PRETESTED HYDROSTATICALLY SEPARATELY FROM THE MAIN LINE TESTING WHEN REQUIRED BY CONCERNED AUTHORITIES/OR AS DIRECTED BY CLIENT.
12 CASING PIPE SHOULD EXTEND A MIN OF 600mm BEYOND THE TOE OF THE SLOPE OR BASE GRADE, OR 900mm BYOND THE BOTTOM OF THE DRAINAGE DITCH WHICHEVER IS GREATER.
13 THE CROSSING SHALL BE DONE ACCORDING TO THE GOVERNING DIMENSION OUT OF THESE DEFINED DIMENSIONS, AS THESE ARE ONLY GUIDING DIMENSIONS.
14 CROSSING MAY BE CARRIED OUT PRIOR TO MAINLINE ACTIVITIES ADDITIONAL ROU, IF REQUIRED, FOR APPROACH TO CROSSING, PIPELINE STRING, HYDROTESTING WORKING PIT FOR CROSSING TO AVOID CAVING OF SOIL SHALL BE PROCURED BY CONTRACTOR WITHOUT ANY COST IMPLICATION.
15 CATHODIC PROTECTION :- ALL CASING PIPES FOR RAILWAY CROSSING SHALL BE C.P. PROTECTED.
16 TEST STATION ON BOTH SIDE OF CROSSING.
17 BENTONITE FILLING PROCEDURE SHALL BE DONE AS PER OWNER/ CONSULTANTS INSTRUCTIONS.
18 THE LOCATION OF ENTRY AND EXIT PIT SHALL BE DECIDED AT SITE TO SUIT THE SITE REQUIREMENT.

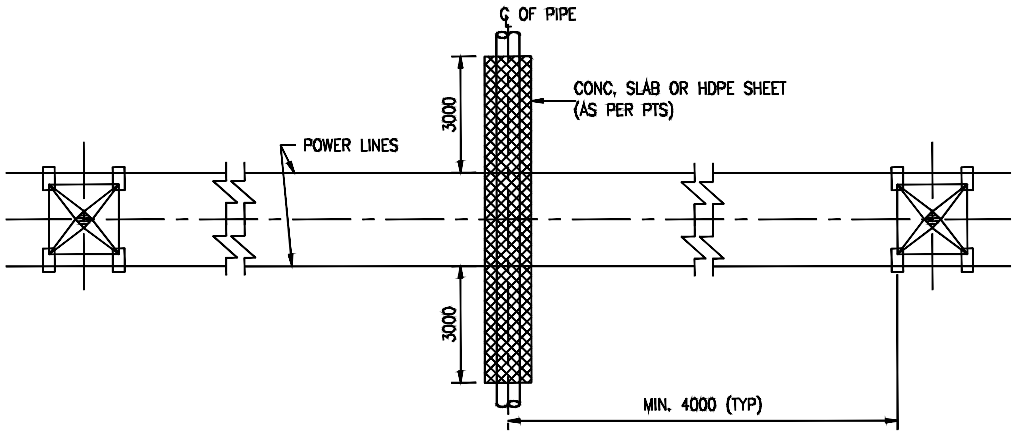
CLIENT: INDRAPRASTHA GAS LIMITED (IGL)
NEW DELHI

TITLE: TYPICAL RAILWAY CASED CROSSING (B+C)

SCALE	DATE	CAD FILE: DATE						
NTS						CAD		A3
OFFICE	PROJECT NO.	AREA	DISC	TYPE		DRG NO.	SHEET	REV
							1	



SECTION



PLAN

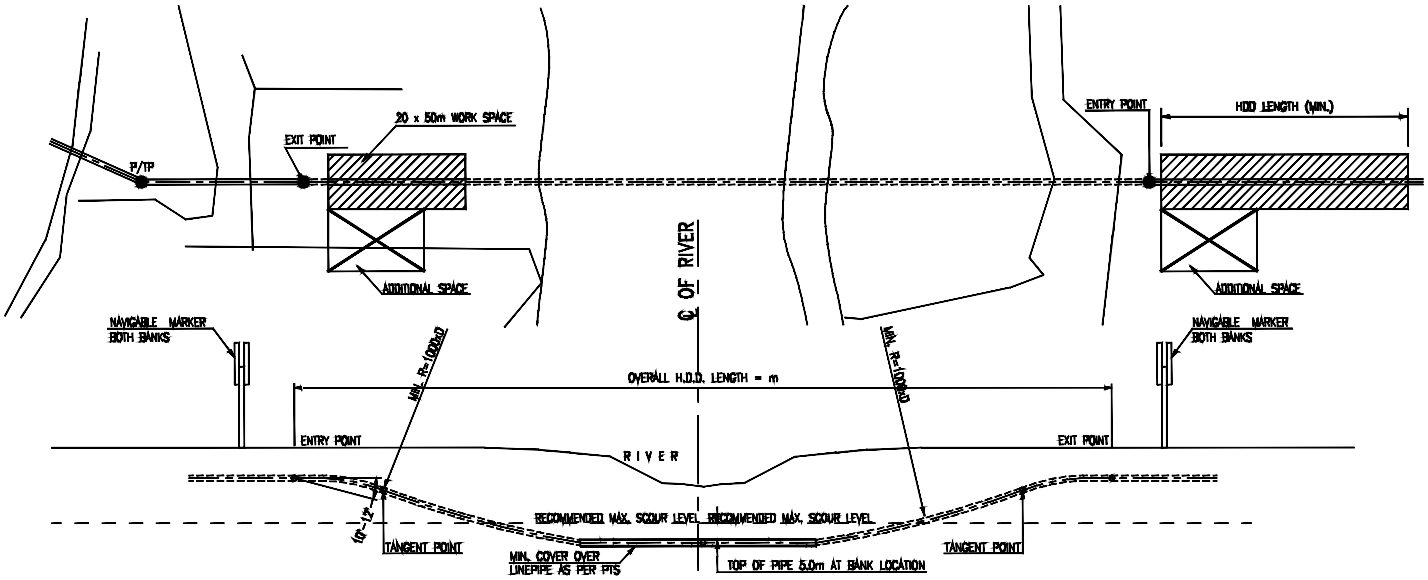
NOTES:-

1 ALL DIMENSIONS ARE IN MM UNLESS NOTED OTHERWISE.
2 SUITABLE MEASURES SHALL BE TAKEN FOR THE PROTECTION OF THE LINE AND SECURITY OF PERSONNEL WHEREVER FOUND NECESSARY.
3 APPROVAL OF THE CROSSING SHALL BE OBTAINED FROM CONCERNED AUTHORITIES.
4 FOR CONCRETE SLAB REFER STD DWG
5 THIS CONCRETE SLAB/HDPE SHEET PROTECTION SHALL BE PROVIDE FOR VOLTAGE OF 11KV AND ABOVE.

CLIENT: INDRAPRASTHA GAS LIMITED (IGL)
NEW DELHI

TITLE: TYPICAL OVERHEAD POWER LINE CROSSING DETAILS

SCALE	DATE	CAD FILE/ DATE						
NTS						CAD		A3
OFFICE	PROJECT NO.	AREA	DIVS	TYPE		DWG NO.	SHEET 1	REV



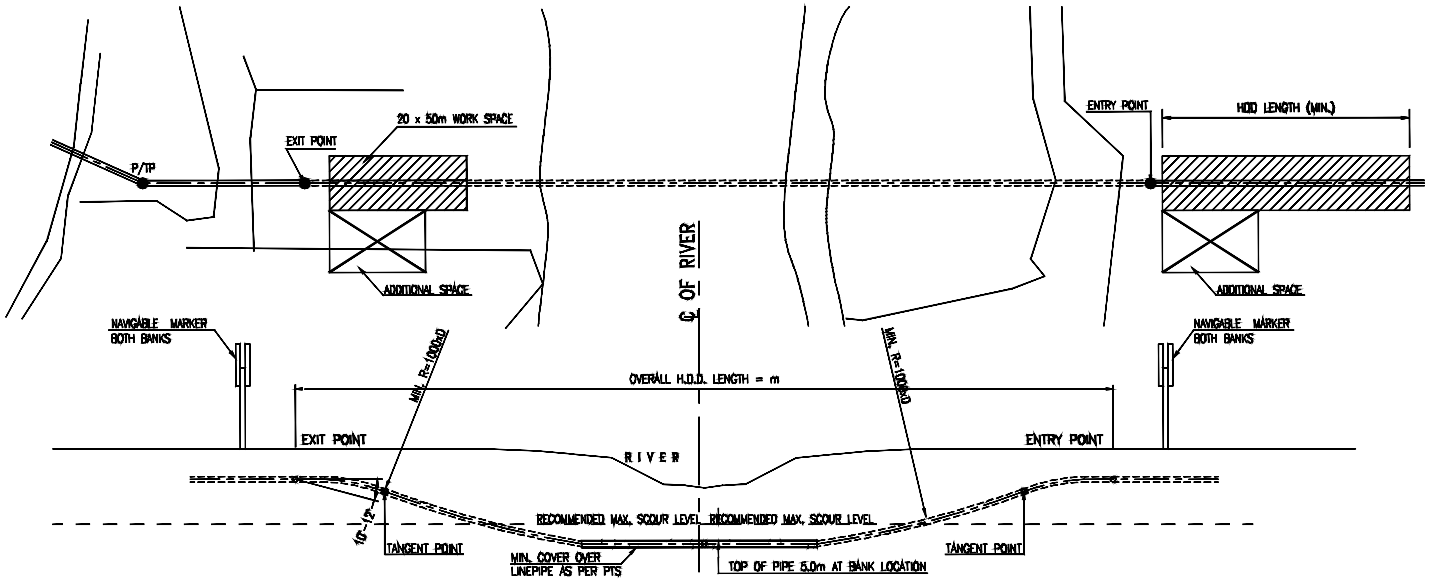
NOTES:-

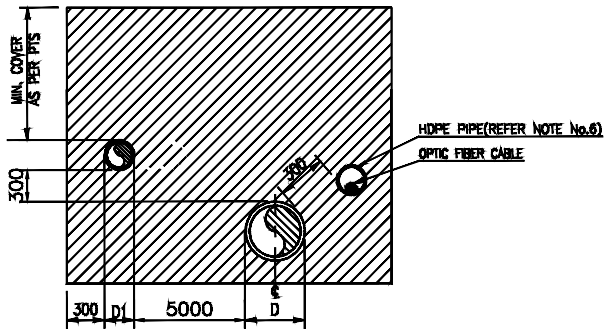
1. ALL DIMENSIONS ARE IN MM UNLESS NOTED OTHERWISE.
2. THE MINIMUM TEMPORARY WORKING SPACE ALLOCATED TO CONTRACTOR BY THE OWNER SHALL BE 75Mx75M AT THE DRILLING SITE & 50Mx50M AT THE OPPOSITE SIDE.
3. IF THE DRILLING POINTS (ENTRY/EXIT) ARE LOCATED BELOW THE HIGHEST WATER LEVEL THE CONTRACTOR SHALL PROTECT THE DRILLING POINTS BY CREATING A DYKE 50M MINIMUM ABOVE THE HIGHEST RECORDED WATER LEVEL. FOR PIPE LINE WITH NB >500mm THE CONTRACTOR SHALL SPECIFY THE BALLASTING METHOD HE INTENDS TO USE TO LIMIT THE FRICTION DRILLING PULL BACK.
4. PRIOR TO HDD THE PROFILE/DESIGN SHALL BE SENT TO OWNER /OWNER'S REPRESENTATIVE FOR THEIR APPROVAL.
5. ADDITIONAL ROU, IF REQUIRED, FOR WORKING AND EXCAVATION OF CROSSING TO AVOID CAVING OF SOIL SHALL BE PROCURED BY CONTRACTOR WITHOUT ANY COST IMPLICATION.

CLIENT: INDRAPRASTHA GAS LIMITED (IGL)
NEW DELHI

TITLE: TYPICAL HDD RIVER CROSSING SHOWING MAX. SCOUR LEVEL & MIN. COVER FOR PIPE

SCALE	DATE	CAD FILE DATE						
NTS							CAD	A3
OFFICE	PROJECT NO.	AREA	DIGS	TYPE		DWG NO.	SHEET 1	REV





TYPICAL TRENCH DETAILS IN ROCK AREA
TYPE-3

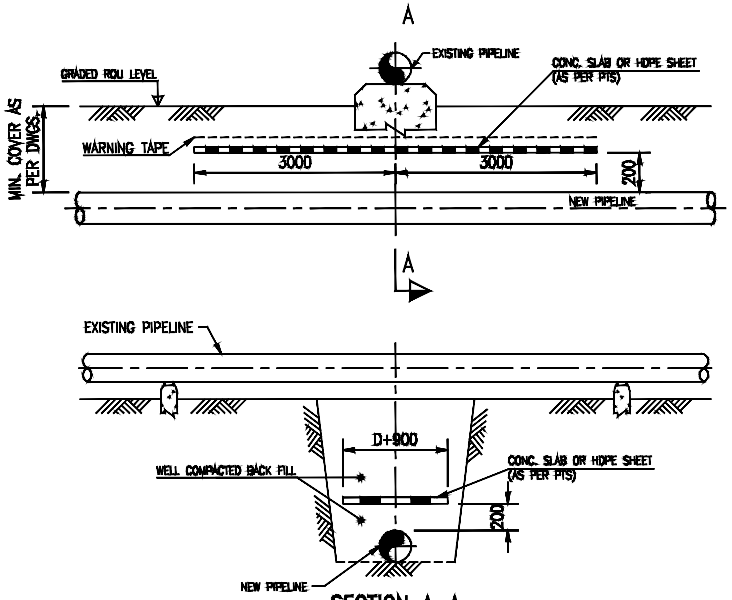
NOTES:-

1. ALL DIMENSIONS ARE IN MM UNLESS NOTED OTHERWISE.
2. THE MINIMUM TEMPORARY WORKING SPACE ALLOCATED TO CONTRACTOR BY THE OWNER SHALL BE 75Mx75M AT THE DRILLING SITE & 50Mx50M AT THE OPPOSITE SIDE.
3. IF THE DRILLING POINTS (ENTRY/EXIT) ARE LOCATED BELOW THE HIGHEST WATER LEVEL THE CONTRACTOR SHALL PROTECT THE DRILLING POINTS BY CREATING A DYKE 50M MINIMUM ABOVE THE HIGHEST RECORDED WATER LEVEL. FOR PIPE LINE WITH NB >500mm THE CONTRACTOR SHALL SPECIFY THE BALLASTING METHOD HE INTENDS TO USE TO LIMIT THE FRICTION DRILLING PULL BACK.
4. PRIOR TO HDD THE PROFILE/DESIGN SHALL BE SENT TO OWNER /OWNER'S REPRESENTATIVE FOR THEIR APPROVAL.
5. ADDITIONAL ROU, IF REQUIRED, FOR WORKING AND EXCAVATION OF CROSSING TO AVOID CAVING OF SOIL SHALL BE PROCURED BY CONTRACTOR WITHOUT ANY COST IMPLICATION.
6. IF, AS PER SPECIFICATION, ARMOURED OFC IS TO BE PROVIDED, IT WILL BE LAID ALONG WITH LINE PIPE AS PER APPROVED PROCEDURE.

CLIENT: INDRAPRASTHA GAS LIMITED (IGL)
NEW DELHI

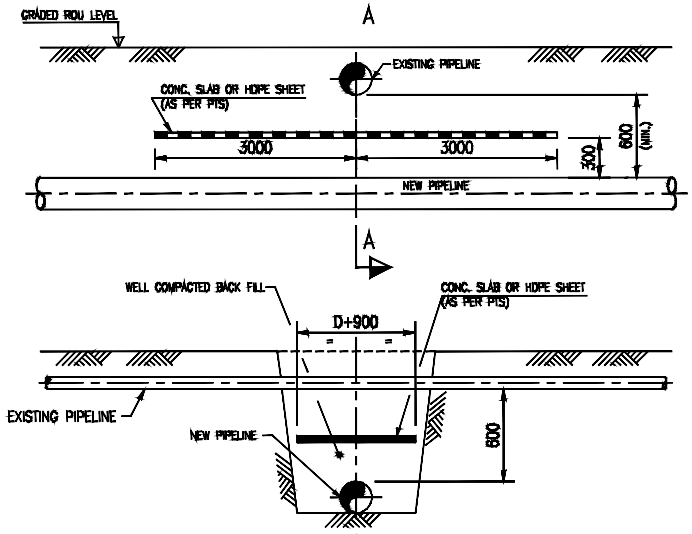
TITLE: TYPICAL HDD RIVER CROSSING SHOWING MAX. SCOUR LEVEL & MIN. COVER FOR PIPE

SIZE	CLIENT JOB NO.	DRAWING NUMBER	SHEET	REV.
A3			1 OF 1	0



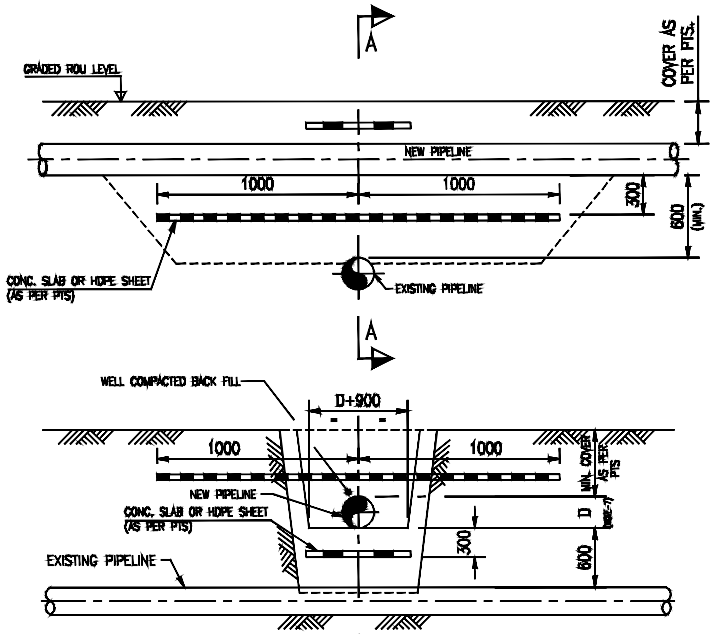
SECTION A–A

EXISTING ABOVEGROUND PIPE CROSSING



SECTION A–A

EXISTING UNDERGROUND PIPE CROSSING(TYPE–1)



SECTION A–A

EXISTING UNDERGROUND PIPE CROSSING(TYPE–1)

NOTES:-

1. ALL DIMENSIONS ARE IN MM UNLESS OTHERWISE STATED.
2. A MODIFIED PIPELINE WARNING SIGN SHALL BE INSTALLED WHERE THE PIPELINE CROSSES AN EXISTING PIPELINE CARRYING HAZARDOUS FLUID.
3. FOR CONCRETE SLAB REFER DWG.
4. SUITABLE CATHODIC PROTECTION BONDING SHALL BE PROVIDED BETWEEN CROSSING PIPELINES. IN SOME CASES THE NEW PIPELINE MAY REQUIRE ELECTRICAL ISOLATION.
5. TRENCH DIMENSIONS SHALL BE IN ACCORDANCE WITH RELEVANT STANDARDS/SPECIFICATIONS.
6. APPROVAL OF THE CROSSING SHALL BE OBTAINED FROM CONCERNED AUTHORITIES.

CLIENT: INDRAPRASTHA GAS LIMITED (IGL) NEW DELHI

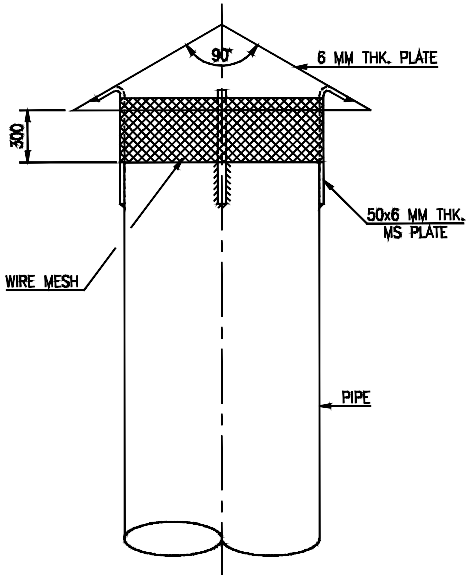
TITLE: TYPICAL EXISTING PIPELINE CROSSING

SCALE	DATE	CAD FILE: DATE						
NTS						CAD		A3
OFFICE	PROJECT NO.	AREA	DISC	TYPE	DWG NO.	SHEET 1	REV	

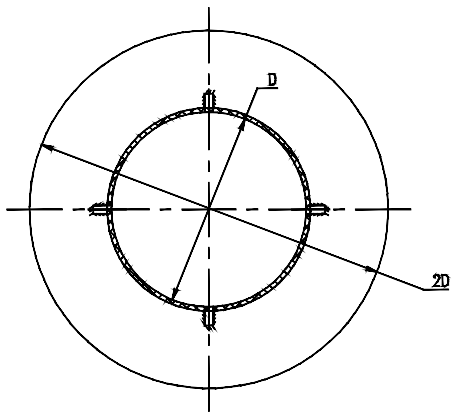
NOTES:-

1. ALL DIMENSIONS ARE IN MM UNLESS NOTED OTHERWISE.
2. HINGE DETAILS TO BE DECIDED BY VENDOR.
3. MATERIAL OF CONSTRUCTION OF FLAP SHALL BE ALUMINUM.
4. 1/2" CIRCULAR RING SHALL BE PROVIDED AROUND THE FLAP.
5. STOPPER TO BE PROVIDED SO THAT THE FLAPPER GOES BACK TO ITS ORIGINAL POSITION AFTER COMPLETION OF VENTING.

TYPE-I

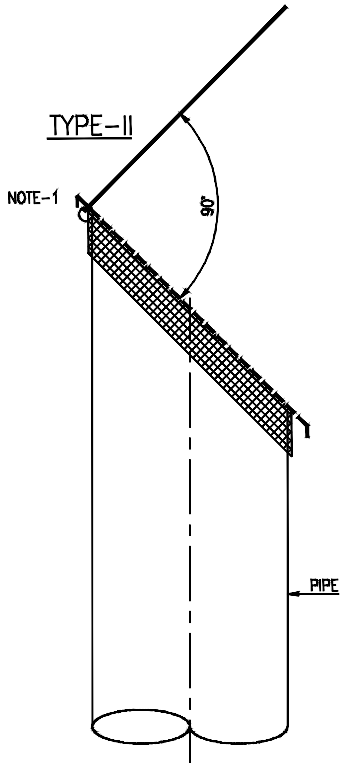


ELEVATION

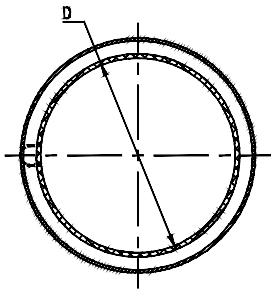


PLAN

TYPE-II



ELEVATION

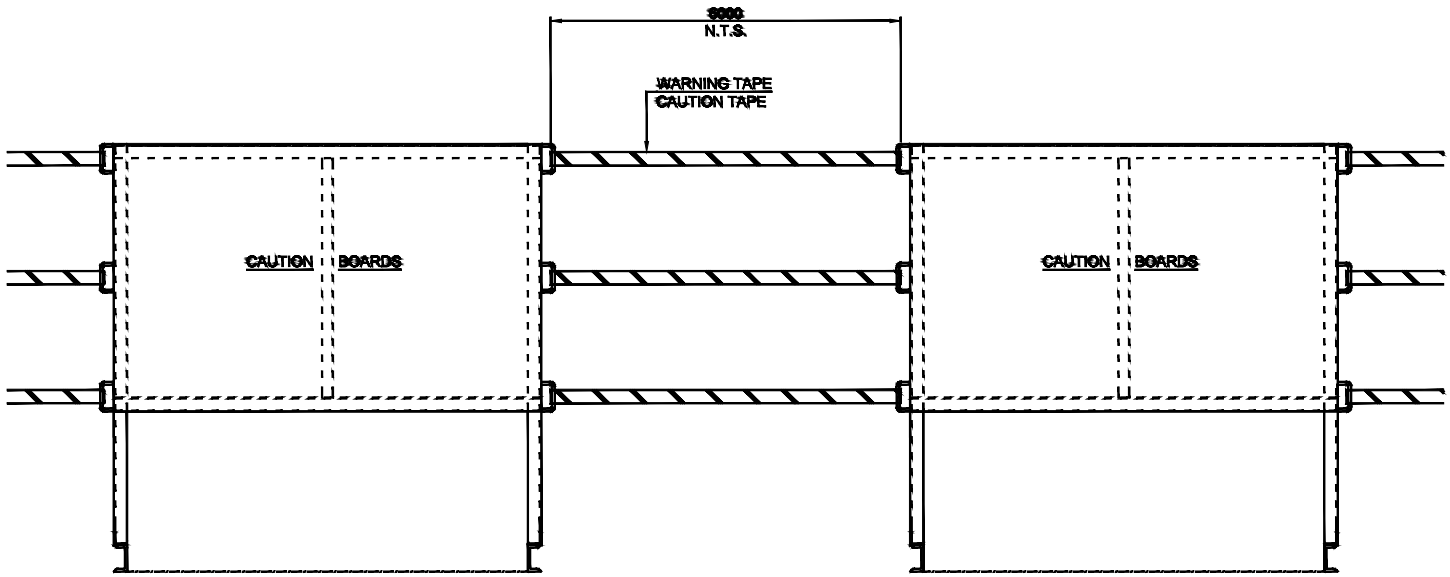


PLAN

CLIENT: INDRAPRASTHA GAS LIMITED (IGL) NEW DELHI

TITLE: TYPICAL RAIN CAP FOR VENT PIPES

SCALE	DATE	CAD FILE / DATE						
NTS						CAD		A3
OFFICE	PROJECT NO.	AREA	DISC	TYPE	DRG. NO.	SHEET 1	REV	



SCHEMATIC LAYOUT OF CAUTION BOARDS AND BARRICADING

NOTES:-

1. ALL DIMENSIONS ARE IN MM UNLESS NOTED OTHERWISE.
2. FOLLOW WRITTEN DIMENSIONS ONLY. DO NOT SCALE THE DRAWINGS.
3. FOR DETAILS OF CAUTION BOARDS, REFER DRAWING NO. 13823-30-03-12 REV-0.

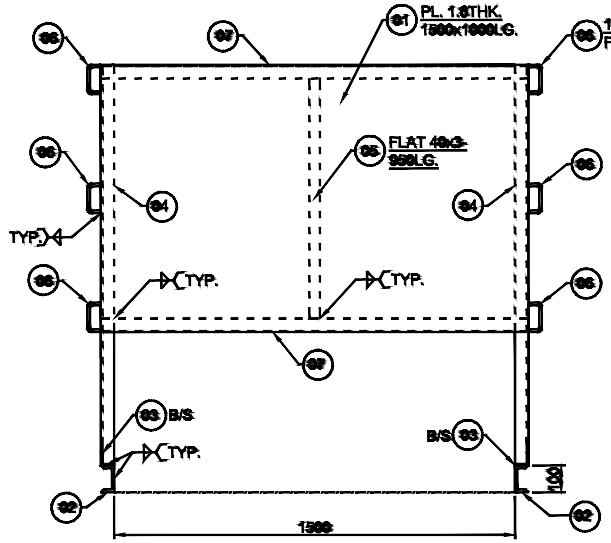
CLIENT: INDRAPRASTHA GAS LIMITED (IGL)
NEW DELHI

TITLE: BARRICADING

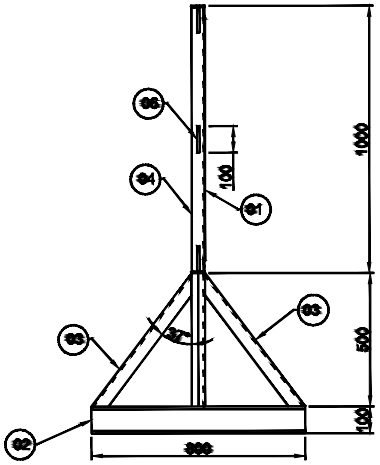
SCALE	DATE	DRG FILE: DATE	CAD	A3

NOTES:-

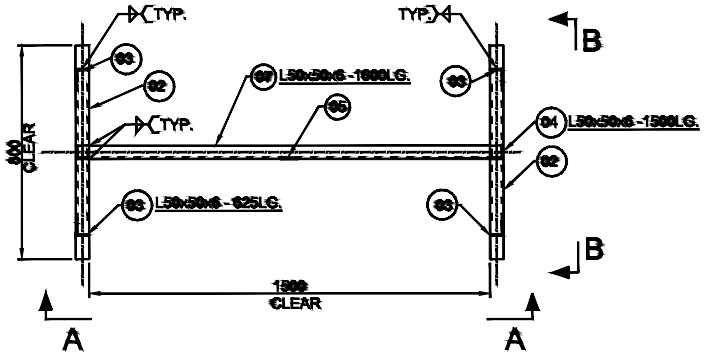
1. ALL DIMENSIONS ARE IN MM UNLESS NOTED OTHERWISE.
2. FOLLOW WRITTEN DIMENSIONS ONLY. DO NOT SCALE THE DRAWINGS.



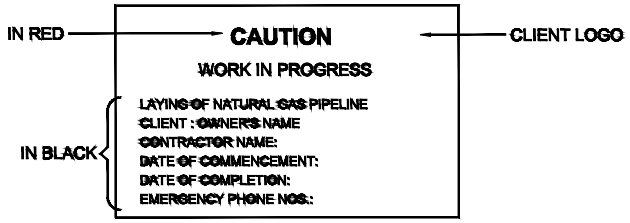
ELEVATION A-A



ELEVATION B-B



PLAN VIEW



TO BE PRINTED ON ITEM NO. 01

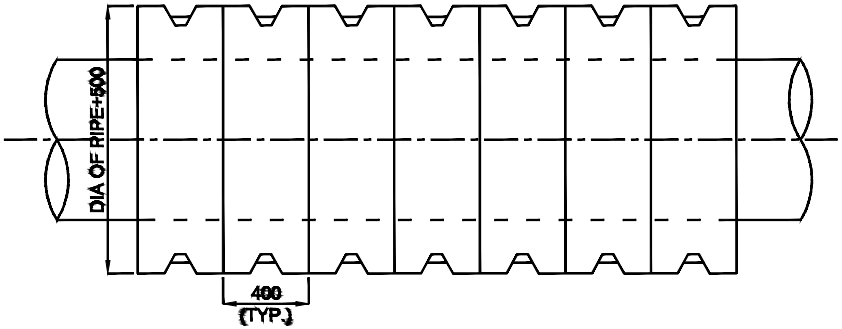
BILL OF MATERIAL

Item Mkd.	Section	Width	Length	Item Qty. (All Marks)	Weight Kgs./M,Mt2	Total Weight In Kgs.
1.	PL. 1.6 THK.	1000	1000	1	12.56	20.10
2.	ISMC 100	–	990	2	9.20	14.72
3.	L50x50x6	–	625	4	4.50	11.25
4.	L50x50x6	–	1500	2	4.50	13.50
5.	Flat 3Thk.	990	40	1	0.94	0.03
6.	16Ø Rod	–	200	6	0.62	0.74
7.	L50x50x6	–	1600	2	4.50	14.40
				Grand Total (Kg)		74.74

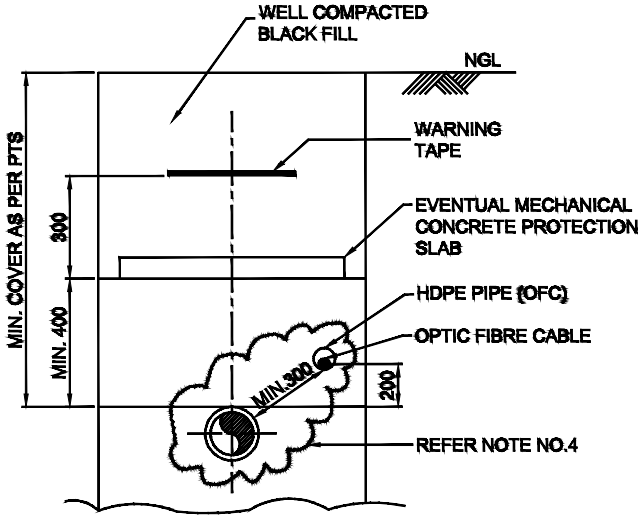
CLIENT: INDRAPRASTHA GAS LIMITED (IGL) NEW DELHI

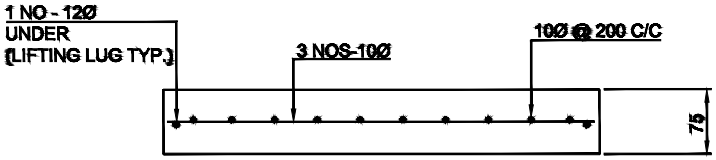
TITLE: CAUTION BOARD

SCALE	DATE	DWG FILE: DATE	CAD	A3

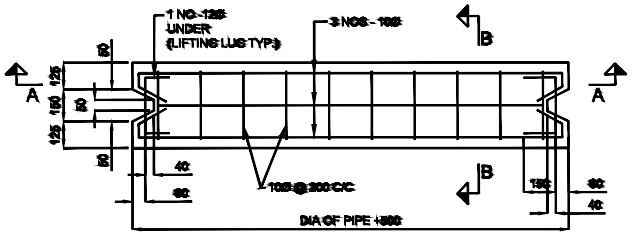


PROTECTIVE CONCRETE SLAB PLAN

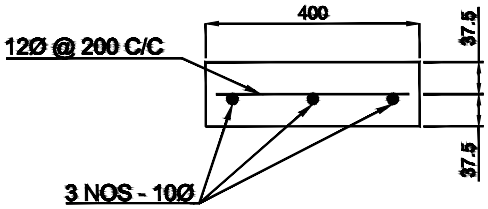




SECTION A-A



REINF. DETAIL OF PROTECTIVE CONCRETE SLAB



SECTION B-B
SCALE 1:10

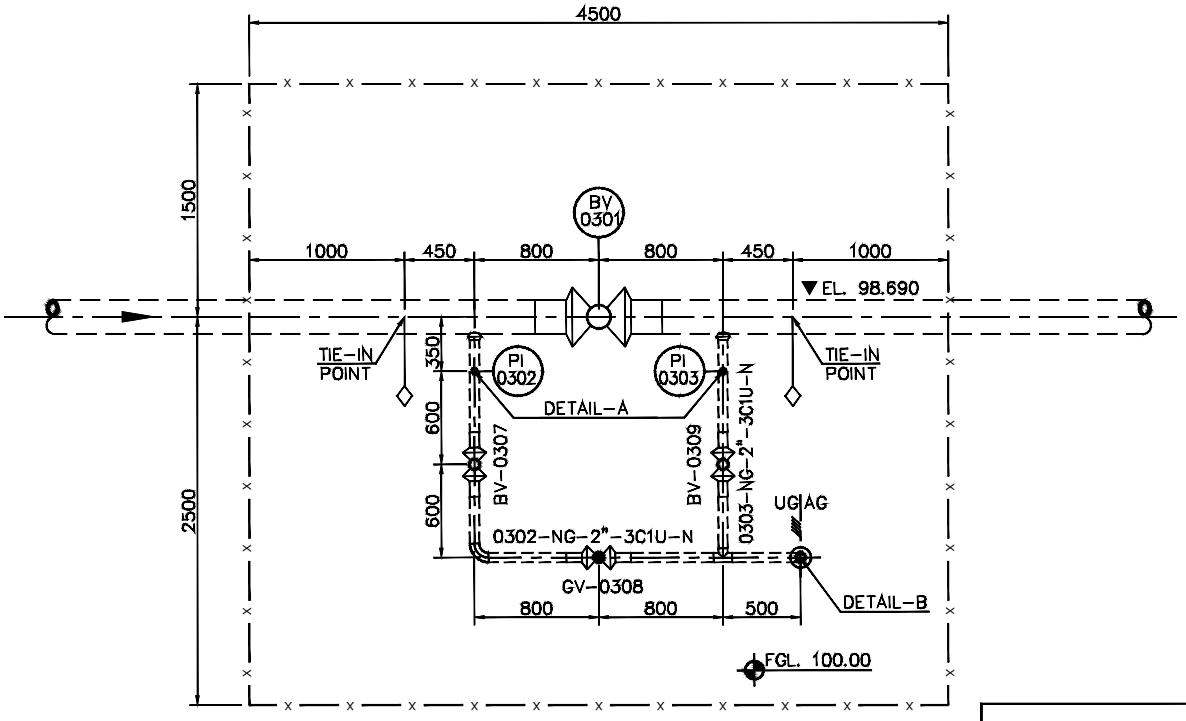
NOTES:-

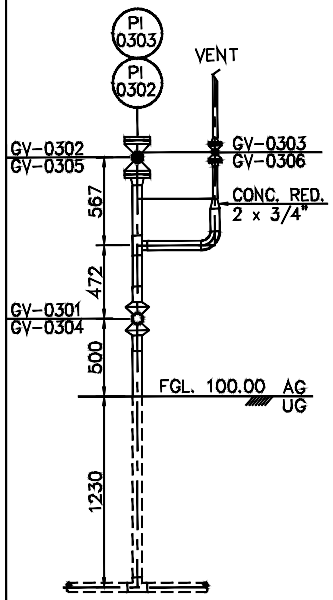
1. ALL DIMENSIONS ARE IN MM UNLESS NOTED OTHERWISE.
2. FOLLOW WRITTEN DIMENSIONS ONLY. DO NOT SCALE THE DRAWING.
3. MINIMUM COVER OVER THE PIPELINE SHALL BE AS PER DIRECTION OF ENGINEER-IN-CHARGE.
4. TYPE OF TRENCHING SHALL BE AS PER PTS AND APPROVED PROCEDURE.
5. THIS SKETCH IS INDICATIVE ONLY.
6. CONCRETE MIX M-20 SHALL BE USED.

CLIENT: INDRAPRASTHA GAS LIMITED (IGL)
NEW DELHI

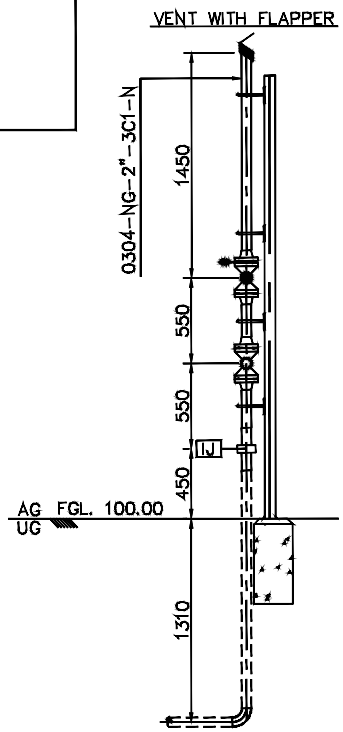
TITLE: **TYPICAL MECHANICAL PROTECTION CONCRETE SLAB DETAILS**

SCALE 1:25	DATE	DWG FILE DATE	CAD	A3





DETAIL - A



DETAIL - B

REFERENCE DRAWINGS / DOCUMENTS

S.NO.	TITLE	NO.
1.	PIPING & INSTRUMENTATION DIAGRAM	T3823-35-05-PI

NOTES:-

1. ALL DIMENSIONS ARE IN MM, & ALL LEVELS ARE IN METERS.
2. QUANTITIES ARE INDICATIVE & SUBJECT TO CHANGE DURING DETAIL ENGG.
3. LAYING OF PIPELINE AND STATION PIPING VENDOR SHALL MAINTAIN SPECIFIED COVER OF PIPE TO KEEP THE STEM EXTENSION HEIGHT 600 mm FROM FGL.

LEGEND:-

- ABOVE GROUND
- UNDER GROUND
- BUTT WELD BALL VALVE (B.V.)
- BUTT WELD GLOBE VALVE (G.V.)
- FLANGED GLOBE VALVE
- FLANGED BALL VALVE
- BOTTOM OF PIPE
- CENTER OF PIPE
- T.O.P. TOP OF PIPE
- CHAINLINK FENCING
- FINISHED GROUND LEVEL (FGL)

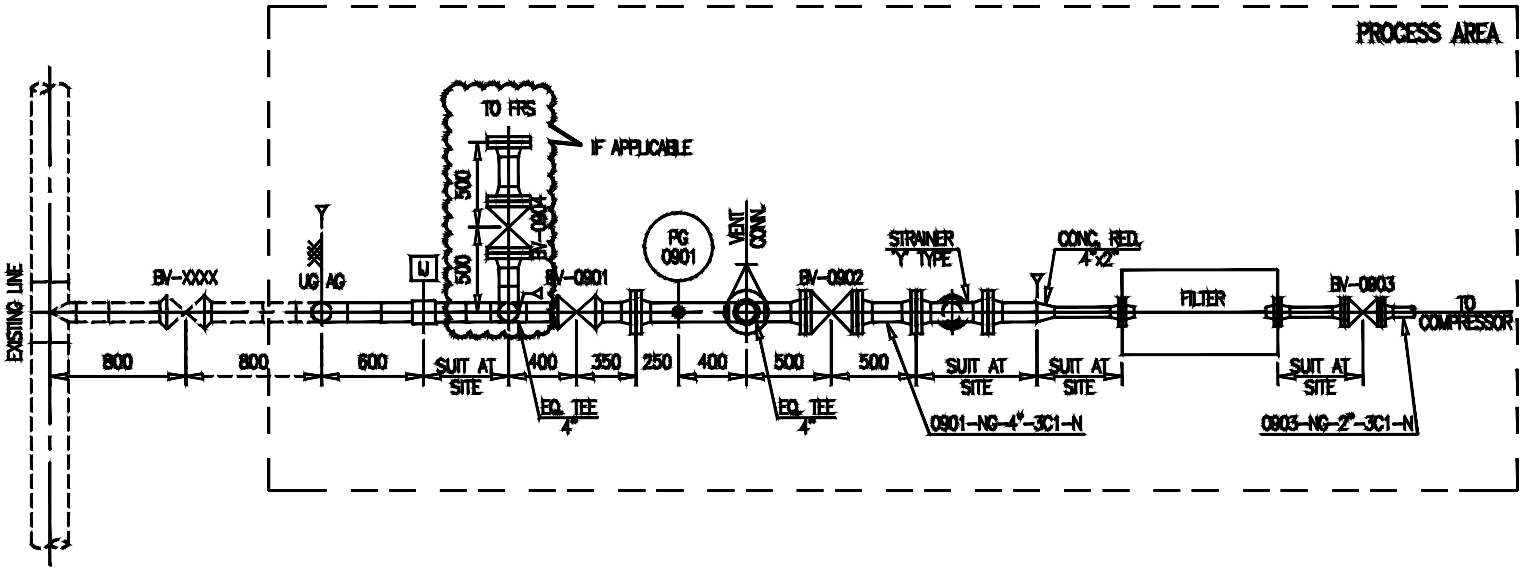
CLIENT: INDRAPRASTHA GAS LIMITED (IGL)
NEW DELHI

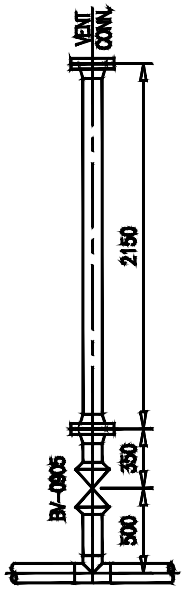
TITLE: PIPING GENERAL ARRANGEMENT DRAWING FOR SV STATION (TYPICAL FOR 8" LINE)

SIZE	CLIENT JOB NO.	DRAWING NUMBER	SHEET	REV.
A3	-		1 OF 1	0

NOTES

1 DRAWING IS NOT TO SCALE.
2 ALL DIMENSIONS ARE IN MM UNLESS OTHERWISE SPECIFIED.

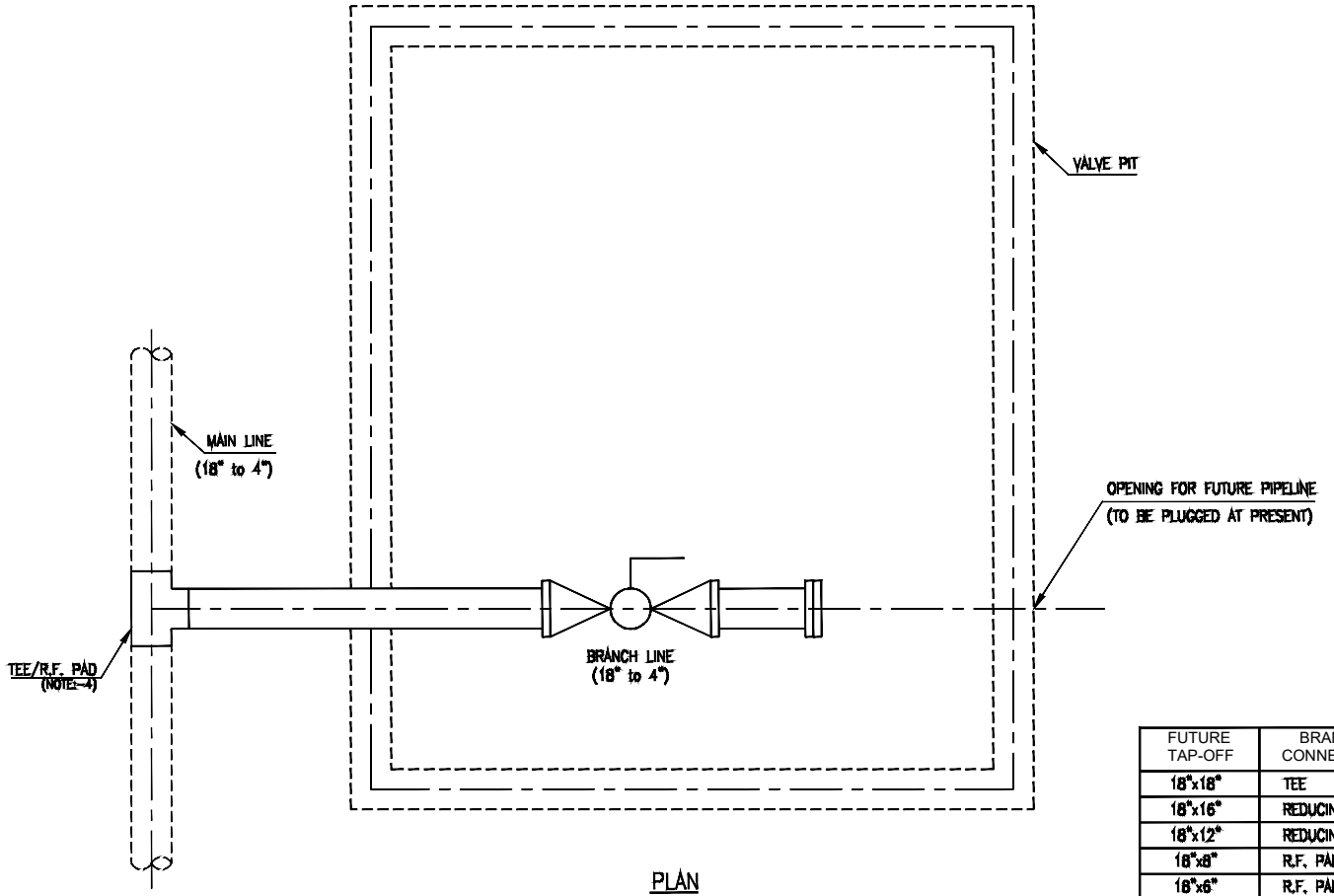




VENT DETAIL

CLIENT:	INDRAPRASTHA GAS LIMITED (IGL) NEW DELHI
TITLE	PIPING GENERAL ARRANGEMENT DRAWING FOR CONNECTIVITY TO RO/CNG STATION

SIZE	CLIENT JOB NO.	DRAWING NUMBER	SHEET	REV.
A3			1 OF 1	0



PLAN

FUTURE TAP-OFF	BRANCH CONNECTION
18"x18"	TEE
18"x16"	REDUCING TEE
18"x12"	REDUCING TEE
18"x8"	R.F. PAD
18"x6"	R.F. PAD
16"x16"	TEE
16"x12"	REDUCING TEE
16"x8"	REDUCING TEE
16"x6"	R.F. PAD
12"x12"	TEE
12"x8"	REDUCING TEE
12"x6"	REDUCING TEE
12"x4"	R.F. PAD
8"x8"	TEE
8"x6"	REDUCING TEE
8"x4"	REDUCING TEE
6"x6"	TEE
6"x4"	REDUCING TEE
4"x4"	TEE

NOTES

1. TOP OF THE PIPE SHALL BE AT MINIMUM 1.2M DEPTH.
2. APPROXIMATE SIZE OF THE PIT WILL BE 2M×2M & 2M×1.5M. IT DEPENDS ON THE SITE CONDITION.
3. FOR DETAIL DRAWINGS OF THE PIT, REFER DRAWING NO. : P.003960-C-20-2002 TO P.003960-C-20-2005.
4. BRANCHING CONNECTIONS (TEE/ R.F. PAD) SHALL DEPEND UPON THE MAIN LINE & BRANCH LINE.

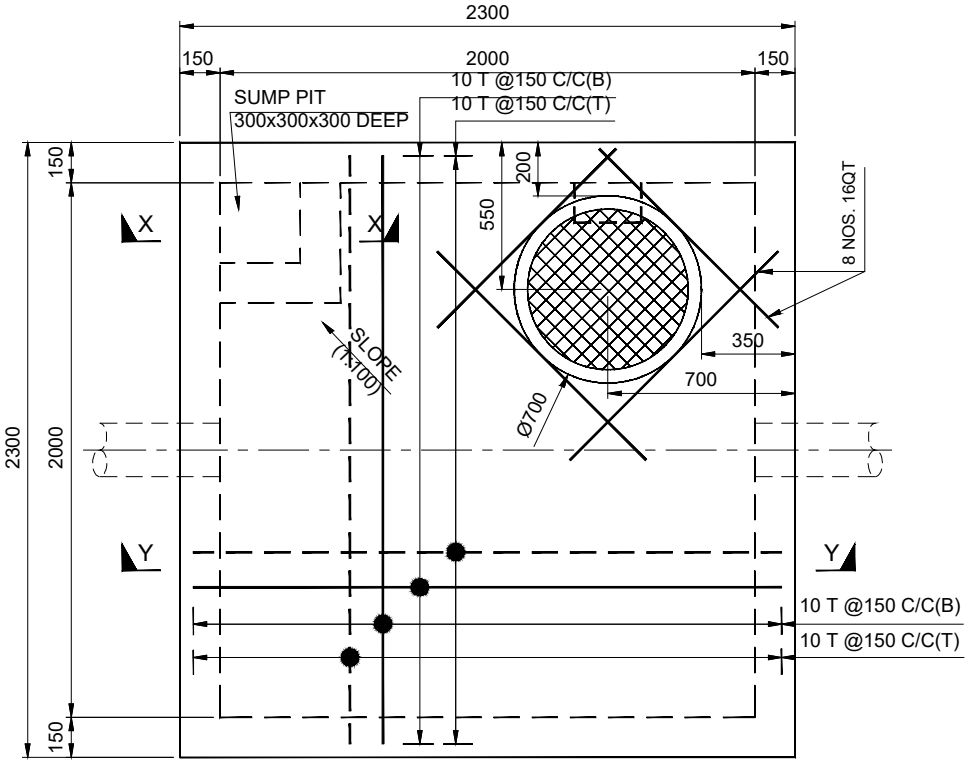
LEGEND

BW BALL VALVE

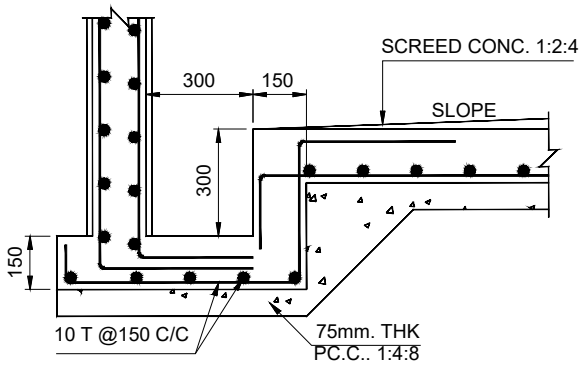
CLIENT: INDRAPRASTHA GAS LIMITED (IGL)
NEW DELHI

TITLE: GAD FOR FUTURE TAP OFF POINTS

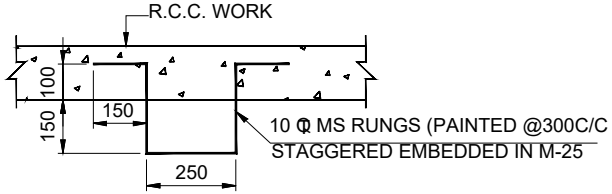
SCALE	DATE	CAD FILE/ DATE					
NTS						CAD	A3
OFFICE	PROJECT NO.	AREA	DISC	TYPE	DRG NO.	SHEET 1	REV



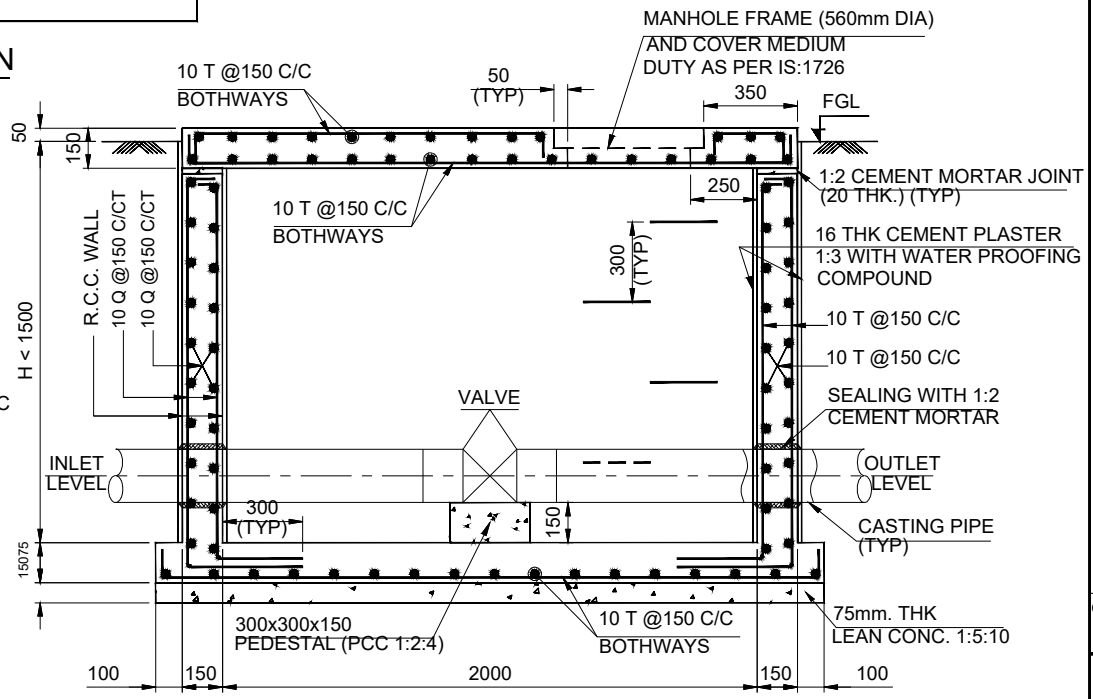
VALVE PIT PLAN
(SCALE 1:20)



SECTION X-X
(SCALE 1:15)



TYP. DET. OF MS RUNGS
(SCALE 1:15)



SECTION Y-Y
(SCALE 1:20)

REFERENCE DRAWINGS / DOCUMENTS

S.NO.	TITLE	NO.

NOTES:-

1. ALL DIMENSIONS ARE IN MM.
2. APPROVED SEALANT TO BE PROVIDED IN VALVE PIT ENTRY & EXIT OF PIPELINE TO INGRESS OF WATER INTO PIT.
3. GRADE OF CONC MIX SHALL BE M25 CONFORMING TO IS 456:2000.
4. REINFORCEMENT SHALL BE HYSD BARS OF GRADE Fe 500 CONFORMING TO IS 1786.
5. CLEAR COVER TO MAIN REINFORCEMENT SHALL BE AS FOLLOWS:-
   1) SLAB = 20mm

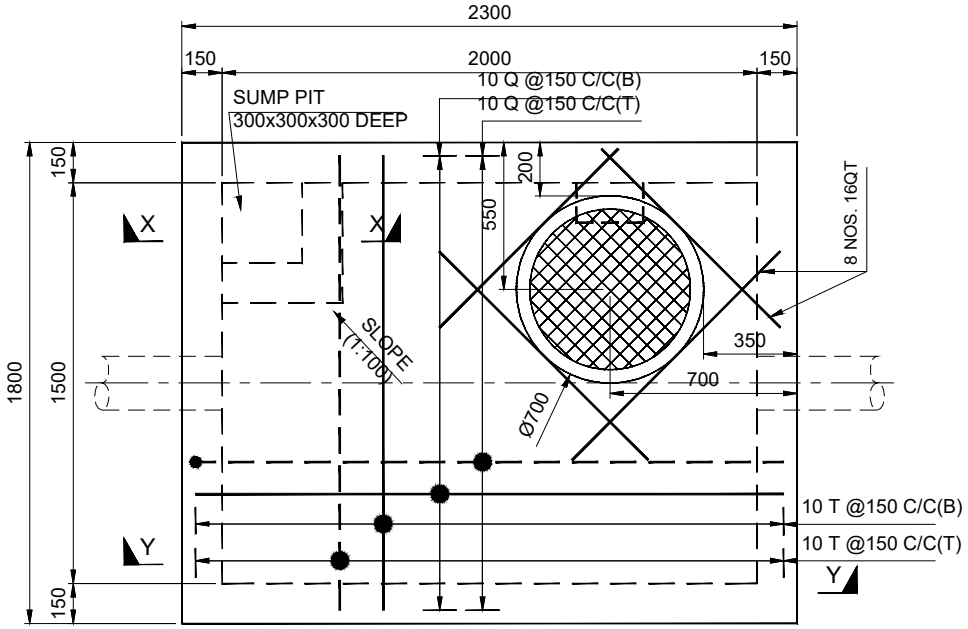
LEGEND:-

TYP. = TYPICAL
THK. = THICK
TOP BAR
BOTTOM BAR

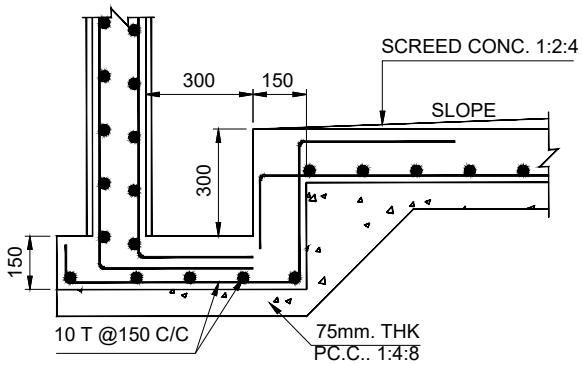
CLIENT:
INDRAPRASTHA GAS LIMITED (IGL)
NEW DELHI

TITLE
STANDARD DETAIL OF RCC VALVE CHAMBER 2x2m. (TYPE-1)

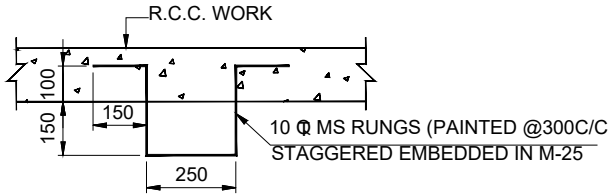
SIZE	JOB NO.	DRAWING NUMBER	SHEET	REV.
A3			1 OF 1	



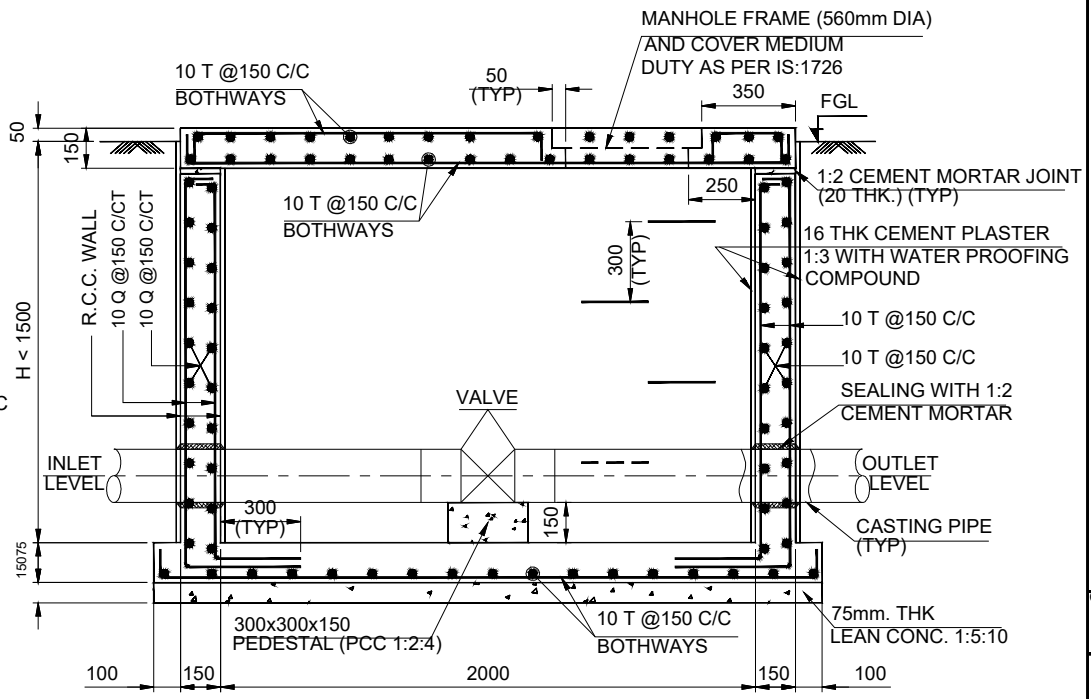
VALVE PIT PLAN
(SCALE 1:20)



SECTION X-X
(SCALE 1:15)



TYP. DET. OF MS RUNGS
(SCALE 1:15)



SECTION Y-Y
(SCALE 1:20)

REFERENCE DRAWINGS / DOCUMENTS

S.NO.	TITLE	NO.

NOTES:-

1. ALL DIMENSIONS ARE IN MM.
2. APPROVED SEALANT TO BE PROVIDED IN VALVE PIT ENTRY & EXIT OF PIPELINE TO INGRESS OF WATER INTO PIT.
3. GRADE OF CONC MIX SHALL BE M25 CONFORMING TO IS 456:2000.
4. REINFORCEMENT SHALL BE HYSD BARS OF GRADE Fe 500 CONFORMING TO IS 1786.
5. CLEAR COVER TO MAIN REINFORCEMENT SHALL BE AS FOLLOWS:-
   1) SLAB = 20mm

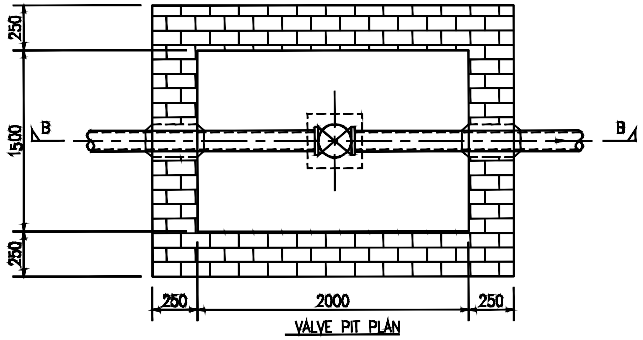
LEGEND:-

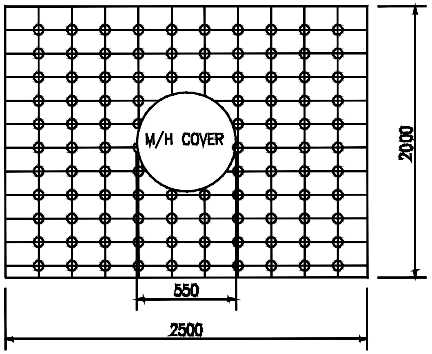
TYP. = TYPICAL
THK. = THICK
TOP BAR
BOTTOM BAR

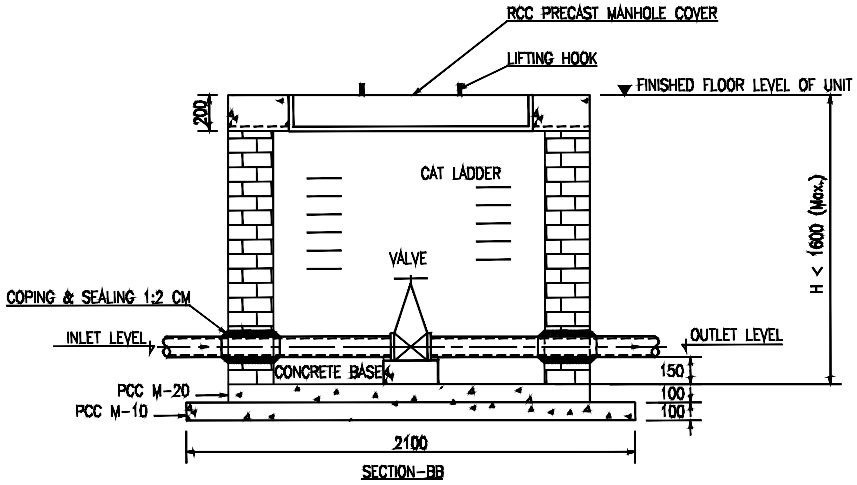
CLIENT:
INDRAPRASTHA GAS LIMITED (IGL)
NEW DELHI

TITLE
RCC VALVE CHAMBER (2mx1.5m.)

SIZE	JOB NO.	DRAWING NUMBER	SHEET	REV.
A3			1 OF 1	







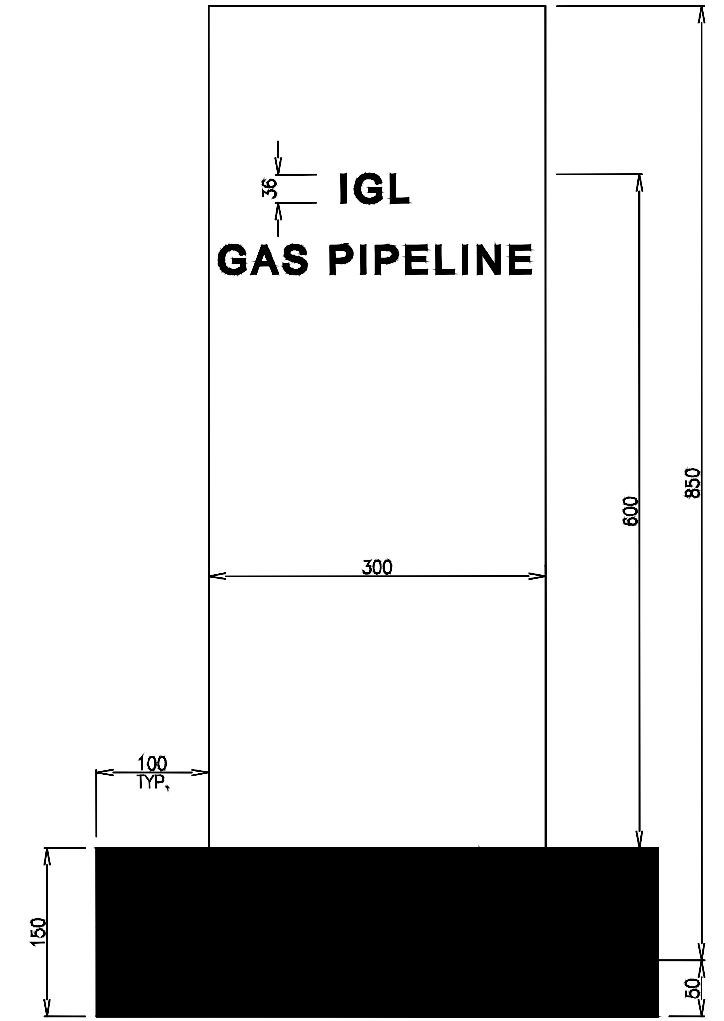
NOTES

1 ALL DIMENSIONS ARE IN MM UNLESS NOTED OTHERWISE.
2 FOLLOW WRITTEN DIMENSION ONLY, DO NOT SCALE.
3 BRICK SHALL BE OF 75 CLASS & PCC OF M-10
4 DRAWING SHOWN IS SUGGESTIVE ONLY. DETAIL CONSTRUCTION DRAWING PREPARATION SHALL BE IN THE SCOPE OF CONTRACTOR.
5 MAIN HOLE LOCATION SHALL SUIT VALVE OPERATION.

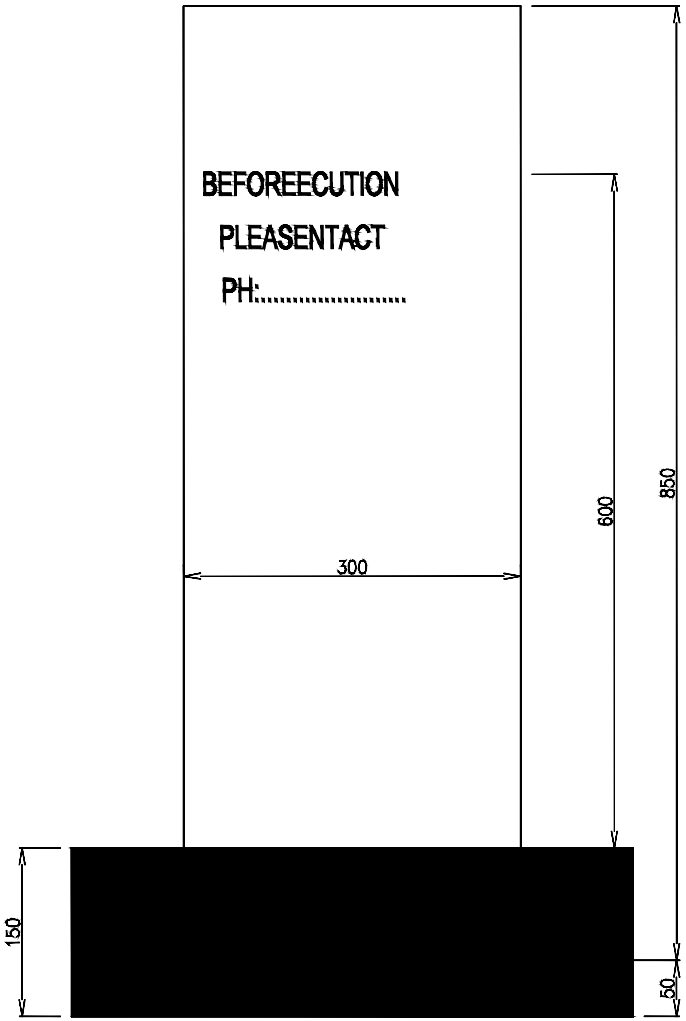
CLIENT: INDRAPRASTHA GAS LIMITED (IGL)
NEW DELHI

TITLE: BRICK VALVE CHAMBER (2m X 1.5m)

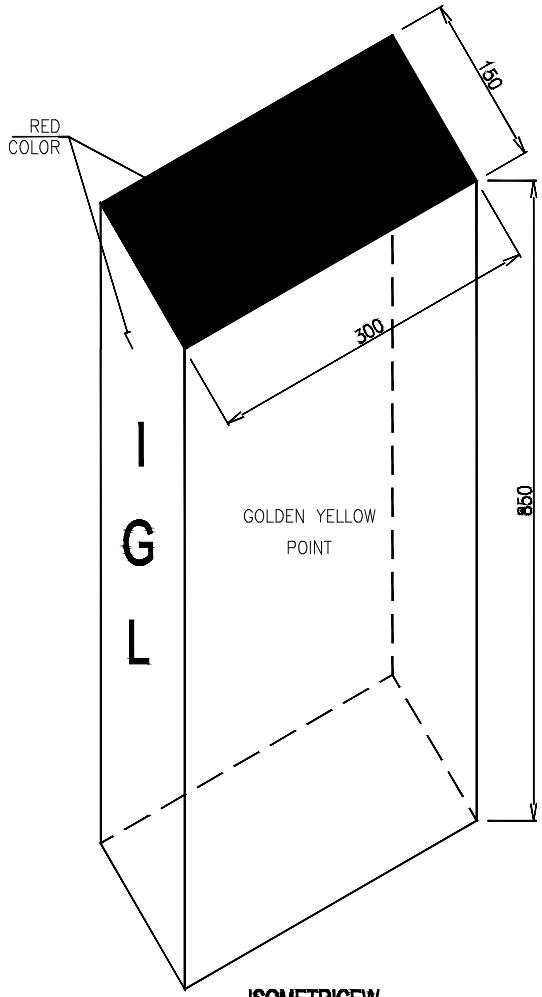
SCALE	DATE	CHD FILE DATE				CAD	A3
NTS							
OFFICE	PROJECT NO.	AREA	DIGS	TYPE	DRG NO.	SHEET 1	REV



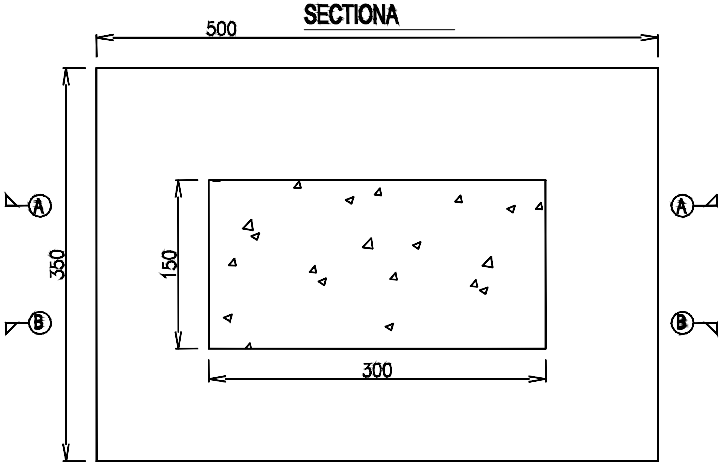
SECTIONA



SECTIONB



ISOMETRICEW



PLANEW

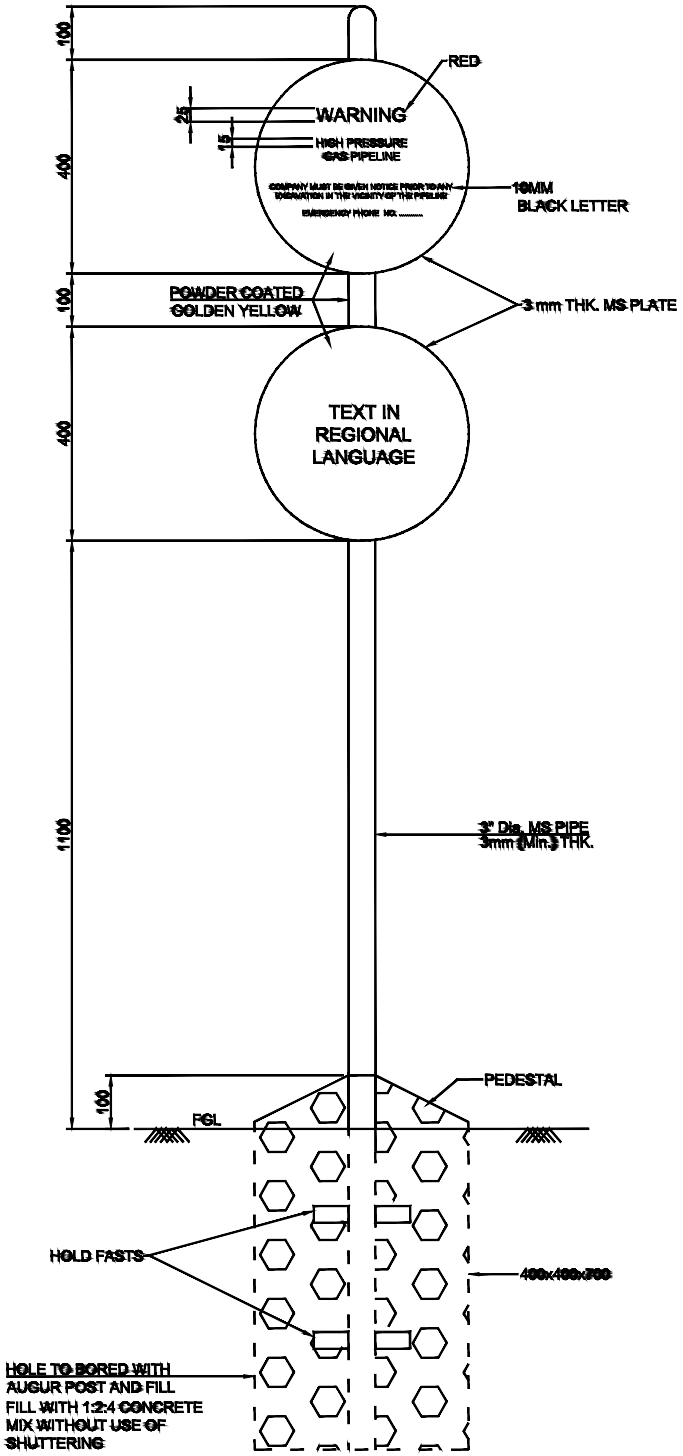
NOTES

1. ALL DIMENSIONS ARE IN MM. UNLESS OTHERWISE SPECIFIED.
2. FOLLOW WRITTEN DIMENSIONS ONLY. DO NOT SCALE.
3. ALL TEXT SHOULD BE WRITTEN IN BLACK COLOR.
4. GRADE OF CONCRETE SHALL BE M20.

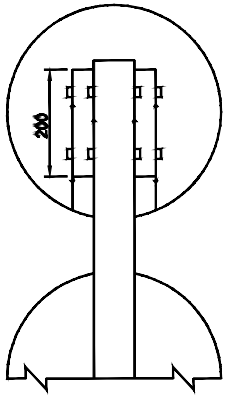
CLIENT: INDRAPRASTHA GAS LIMITED (IGL)
NEW DELHI

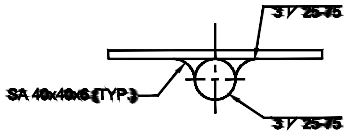
TITLE
TYPICAL DETAILS OF RED STONE MARKER

SIZE	CLIENT JOB NO.	DRAWING NUMBER	SHEET	REV.
A3	-		1 OF 1	0



FIXING DETAILS





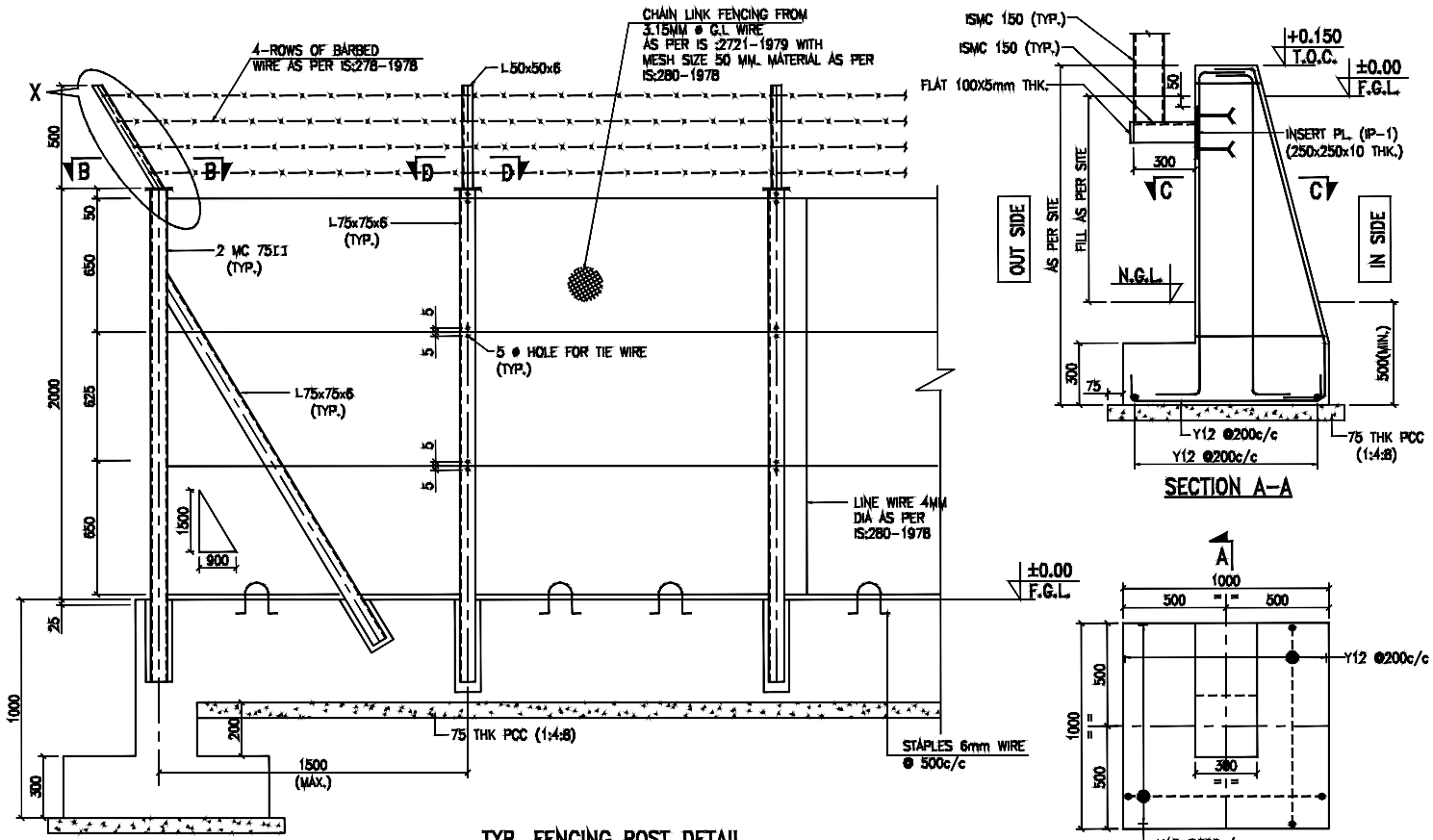
NOTES:-

1. ALL DIMENSIONS ARE IN MM UNLESS NOTED OTHERWISE.
2. WARNING TEXT AND MARKER SIZES ARE INDICATIVE AND ARE SUBJECT TO THE APPROVAL BY OWNER / OWNER'S REPRESENTATIVE BEFORE FABRICATION.
3. SCHEME FOR POWDER COATING AND COLORING : ONE COAT OF PRIMER & TWO COATS OF SPECIFIED PAINTS. ALL LETTERS EXCEPT 'WARNING' TO BE PAINTED BLACK.
4. APPROVAL OF WARNING MARKER DESIGN SHALL BE OBTAINED BEFORE THE COMMENCEMENT OF WORK.

CLIENT: INDRAPRASTHA GAS LIMITED (IGL)
NEW DELHI

TITLE: **POLE MARKER WITH FOUNDATION**

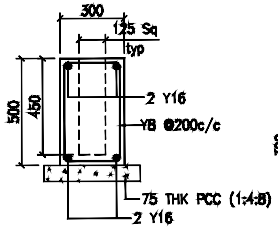
SCALE	DATE	DWG FILE DATE		
1:10			CAD	A3



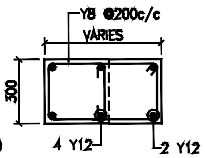
TYP. FENCING POST DETAIL

SECTION A-A

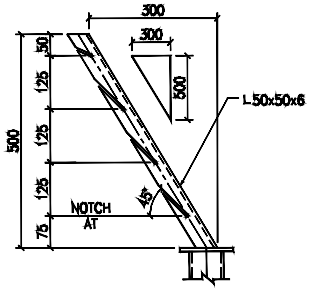
TYPICAL FOOTING PLAN



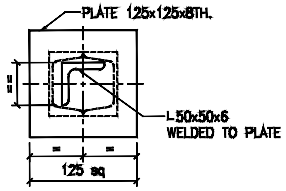
TYP. BEAM DET.



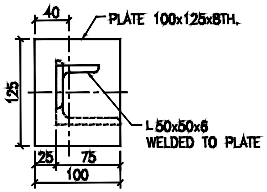
SECTION C-C



DETAIL X



SECTION B-B

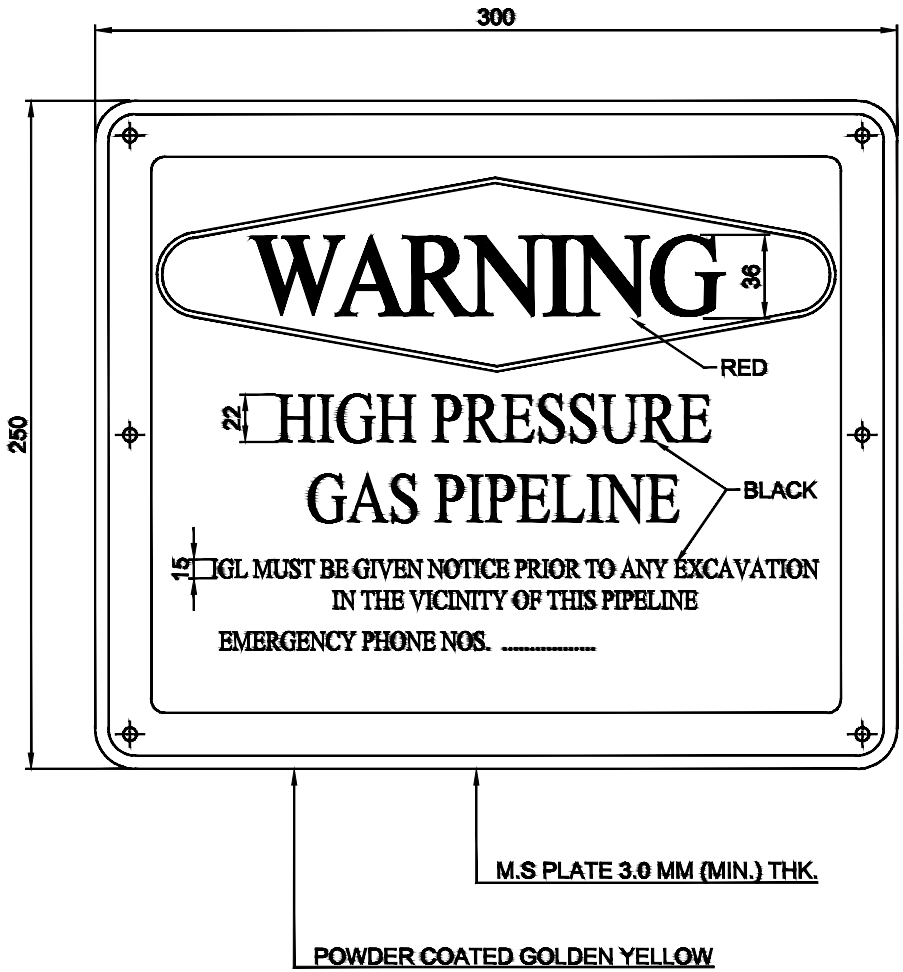


SECTION D-D

CLIENT: INDRAPRASTHA GAS LIMITED (IGL) NEW DELHI

TITLE: TYPICAL DETAILS OF FENCING

SCALE	DATE	CHECKED DATE				CAD	A3
NTS							
OFFICE	PROJECT NO.	AREA	DIGS	TYPE	DRG NO.	SHEET 1	REV



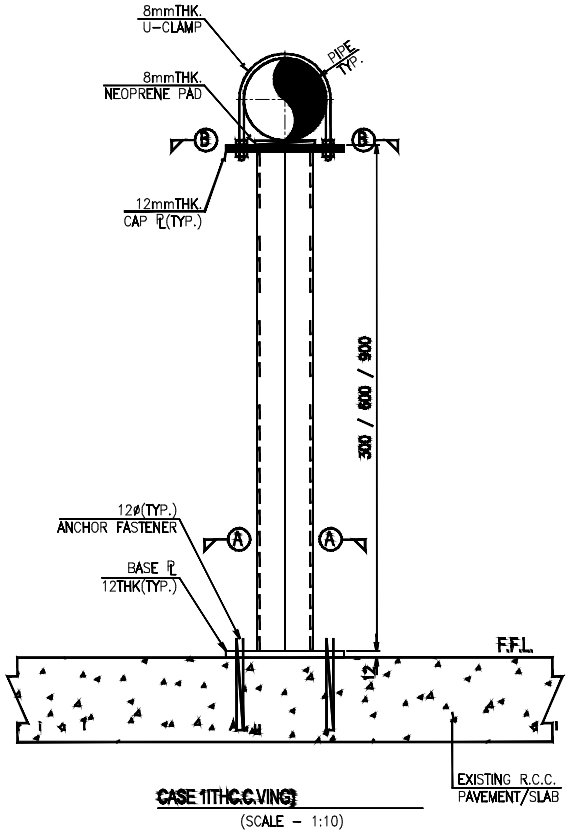
NOTES:-

1. ALL DIMENSIONS ARE IN MM UNLESS NOTED OTHERWISE.
2. FOLLOW WRITTEN DIMENSIONS ONLY. DO NOT SCALE THE DRAWINGS.

CLIENT: INDRAPRASTHA GAS LIMITED (IGL)
NEW DELHI

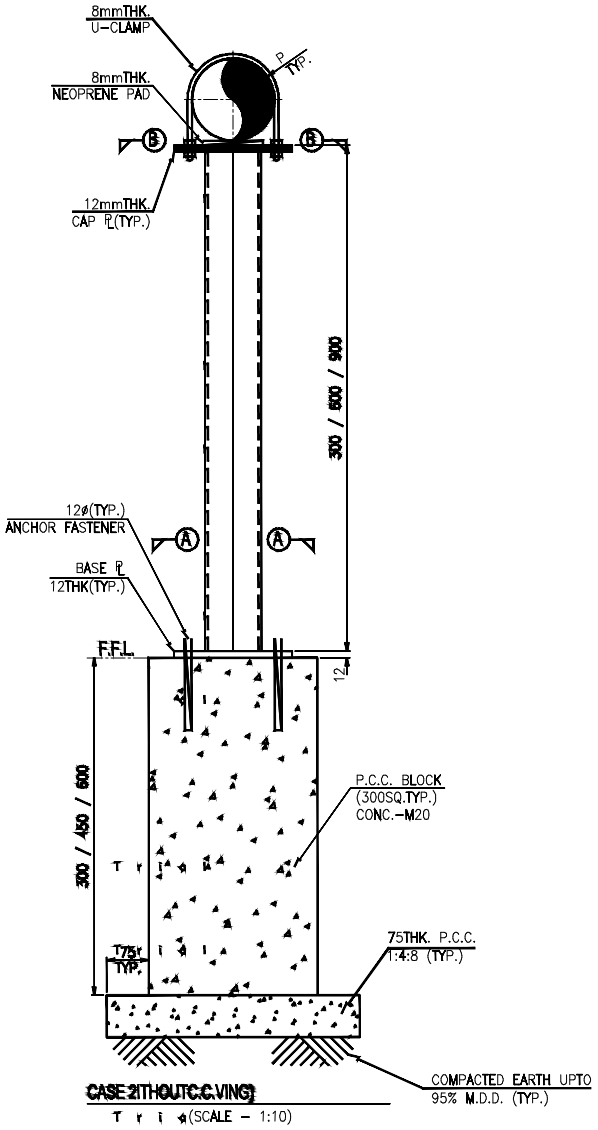
TITLE: **PLATE MARKER**

SCALE	DATE	DRG FILE DATE		
1:2			CAD	A3



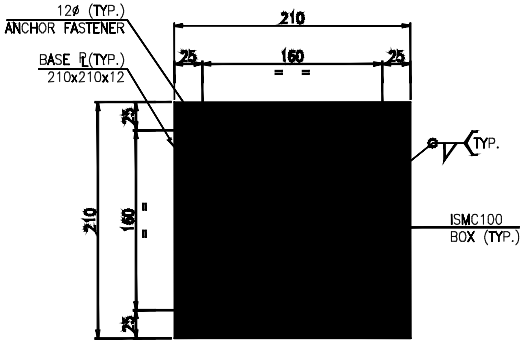
CASE 1(WITH C.C. WING)

(SCALE – 1:10)



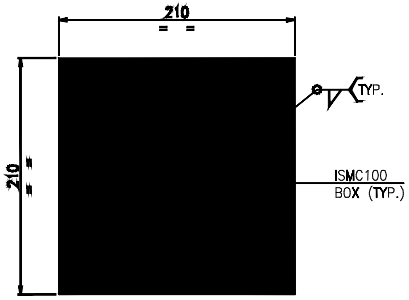
CASE 2(WITHOUT C.C. WING)

(SCALE – 1:10)



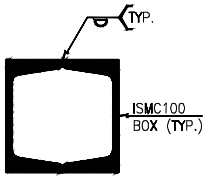
TYP. SEAT DETAIL

(SCALE – 1:5)



SECTION B

(SCALE – 1:5)



SECTION A

(SCALE – 1:5)

NOTES:-

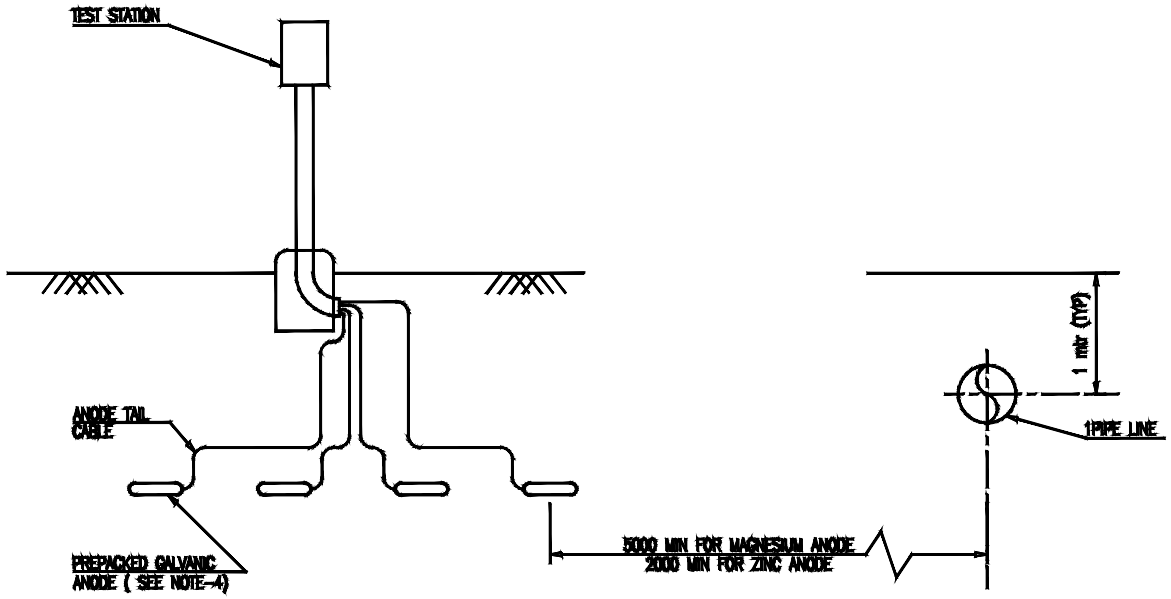
1. ALL DIMENSIONS ARE IN MM. UNLESS OTHERWISE SPECIFIED.
2. FOLLOW WRITTEN DIMENSIONS ONLY. DO NOT SCALE.
3. THE PIPE SUPPORTS (CASE–1 & CASE–2) IS APPLICABLE UP TO 8"ø PIPE ONLY.

CLIENT: INDRAPRASTHA GAS LIMITED (IGL)
NEW DELHI

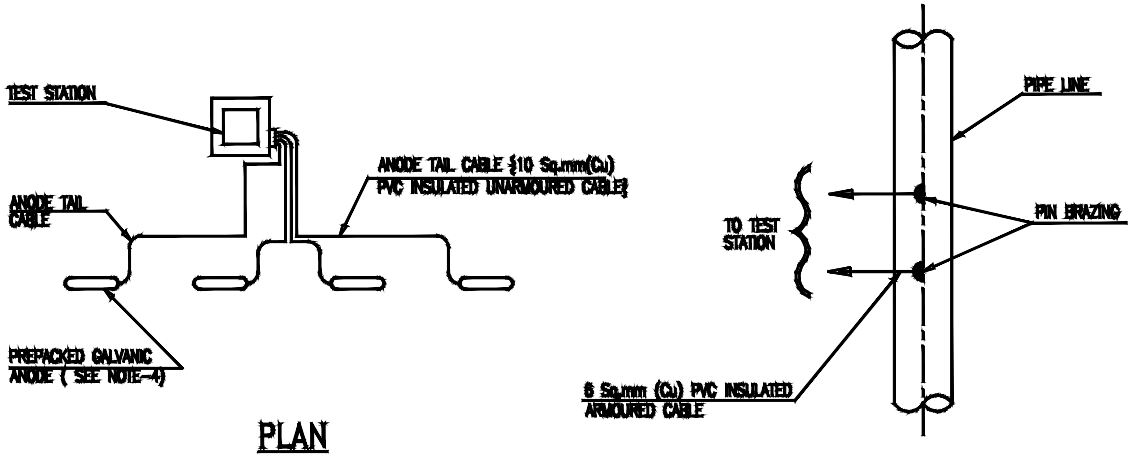
TITLE

TYPICAL PIPE SUPPORT DETAIL

SIZE	CLIENT JOB NO.	DRAWING NUMBER	SHEET	REV.
A3	-		1 OF 1	0



ELEVATION



PLAN

NOTES

1 ALL DIMENSIONS ARE IN MM UNLESS OTHERWISE SPECIFIED.

2 FOLLOW WRITTEN DIMENSIONS ONLY, DO NOT SCALE.

3 THE PREPACKED GALVANIC ANODE SHALL BE INSTALLED AT A MINIMUM DEPTH EQUAL TO BOTTOM LEVEL OF THE PIPE LINE.

4 ALL NATIVE BE LAID BACKFILL SHALL BE FREE OF ROCKS, GARBAGE, PAPERS ETC.

5 CABLE SHALL BE LAID WITH ENOUGH SLACKNESS TO AVOID DAMAGE TO CABLES DURING BACKFILLING ETC.

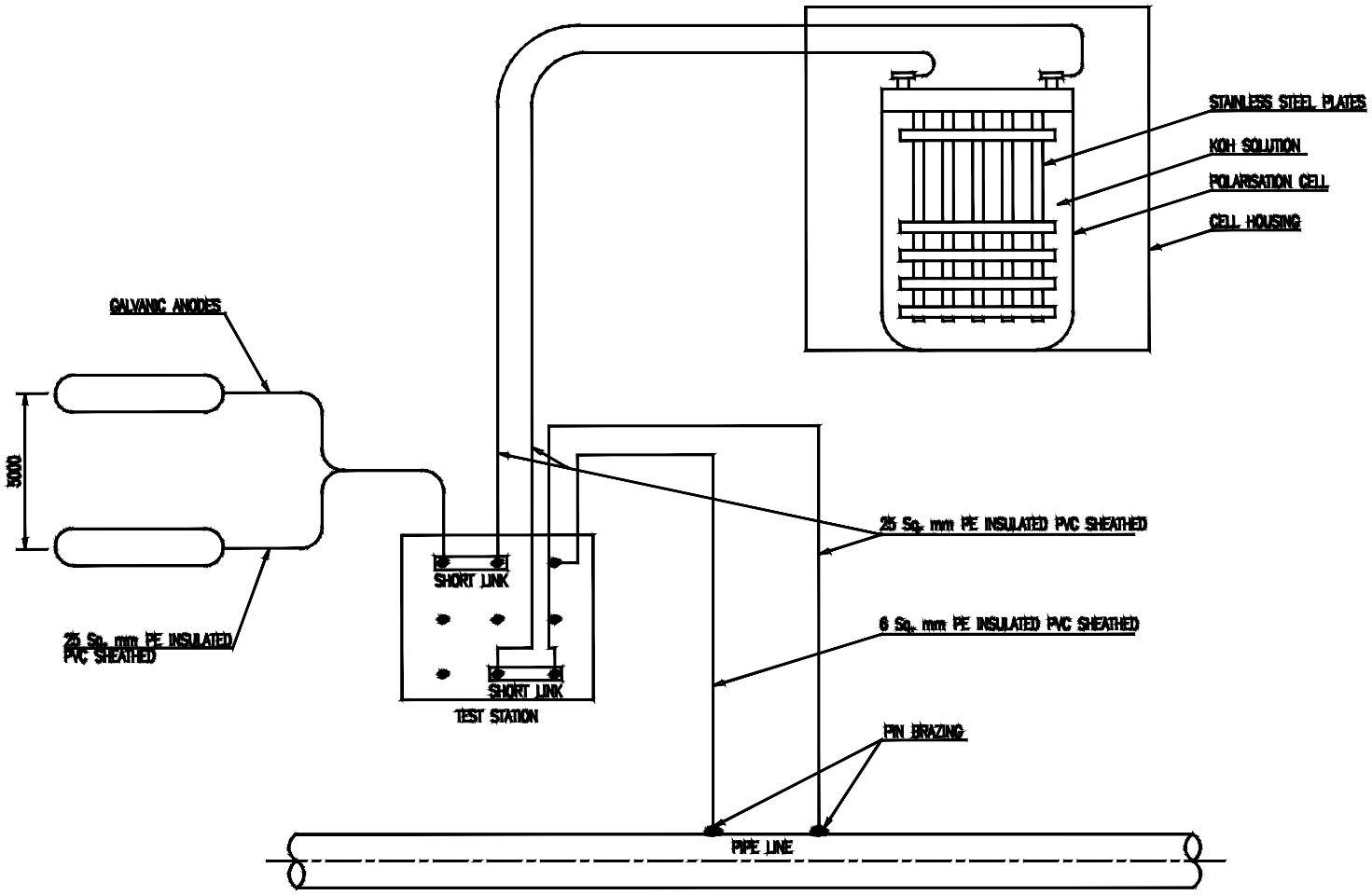
6 THE ANODES ARE SHOWN HORIZONTALLY LAID, ALTERNATIVELY THE ANODES MAY BE LAID VERTICALLY.

7 ANODE TAIL CABLE TO TEST STATION FOR TEMP C.P., ANODE PVC INSULATED TYPE.

CLIENT: INDRAPRASTHA GAS LIMITED (IGL)
NEW DELHI

TITLE
GALVANIC ANODE INSTALLATION

SIZE	CLIENT JOB NO.	DRAWING NUMBER	SHEET	REV.
A3	-		1 OF 1	0



CONNECTION SCHEME

TYPE H : HIGH TENSION LINE CROSSING.

NOTES

1 ALL DIMENSIONS ARE IN MM UNLESS OTHERWISE SPECIFIED.

2 FOLLOW WRITTEN DIMENSIONS ONLY, DO NOT SCALE.

3 THE POLARISATION CELL ANODES, CABLE, CABLE JOINT ETC SHALL MINIMUM BE RATED FOR THE EXPECTED FAULT CURRENT AT THE LOCATION OF THE INSTALLATION & SIZED FOR PERMANENT C.P. LIFE.

4 THE POLARISATION CELL SHALL BE HOUSED IN A VANDALISM PROOF HOUSING.

5 CELL SHALL HAVE GOOD VENTILATION TO ATMOSPHERE & SHALL BE PROTECTED AGAINST DIRECT SUN LIGHT & RAIN WATER.

6 ANODE TAIL CABLES OF EACH ANODE SHALL BE TERMINATED INDIVIDUALLY IN TEST STATION.

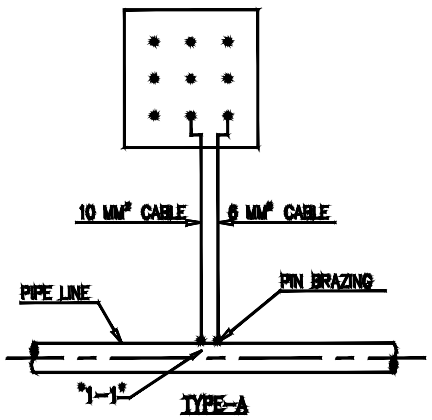
7 CONTRACTOR SHALL FURNISH DRAWING WITH ACTUAL DIMENSIONS AND RATINGS.

8 EASY ACCESS TO CELL SHALL BE PROVIDED FOR PERIODIC INSPECTION.

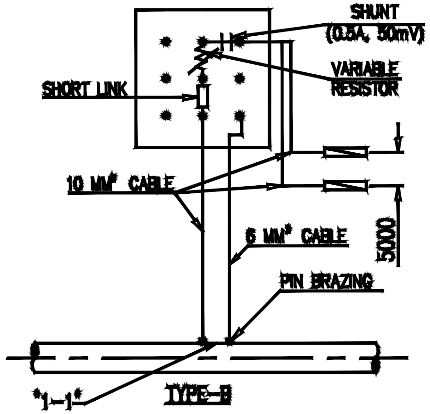
CLIENT: INDRAPRASTHA GAS LIMITED (IGL)

TITLE: PIPELINE GROUNDING THROUGH POLARIZATION CELL & GALVANIC ANODE

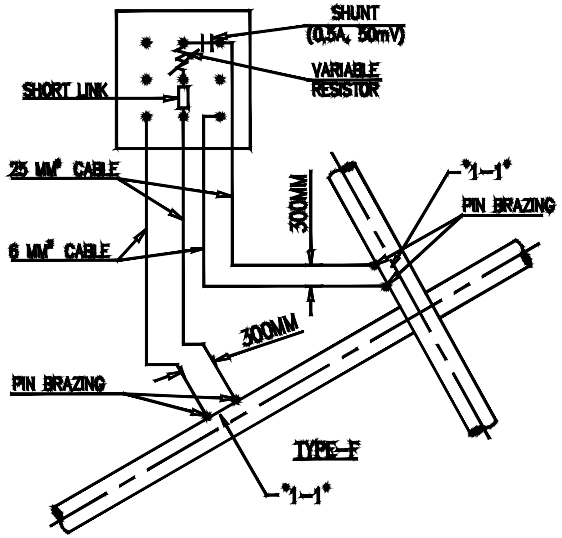
SIZE	CLIENT JOB NO.	DRAWING NUMBER	SHEET	REV.
A3	-		1 OF 1	0



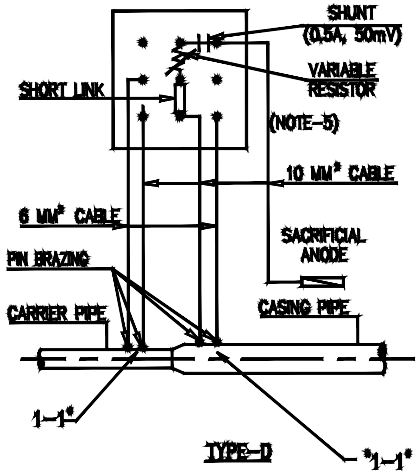
TYPE-A



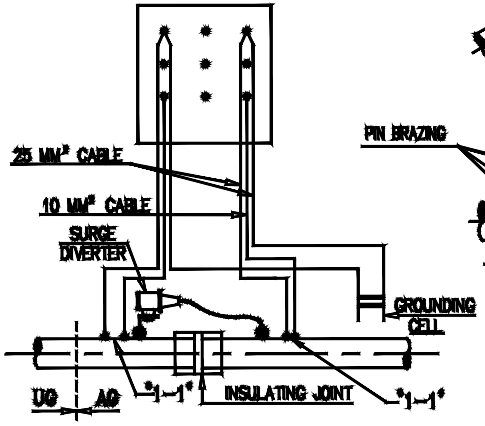
TYPE-B



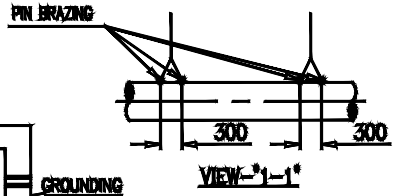
TYPE-F



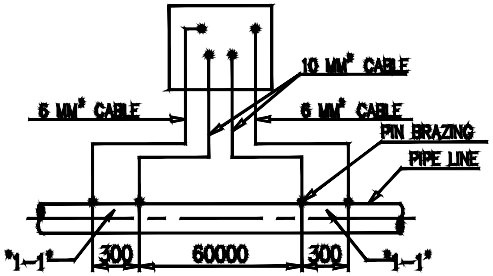
TYPE-D



TYPE-E



VIEW-*1-1*



TYPE-A1

DETAILS OF CONNECTION SCHEME

TYPE A : PSP MONITORING ONLY.
TYPE A1 : LINE CURRENT MEASUREMENT.
TYPE B : ANODE TO PIPE CONNECTION.
TYPE D : CASED CROSSING.
TYPE E : INSULATION JOINT.
TYPE F : FOREIGN PIPE LINE CROSSING.

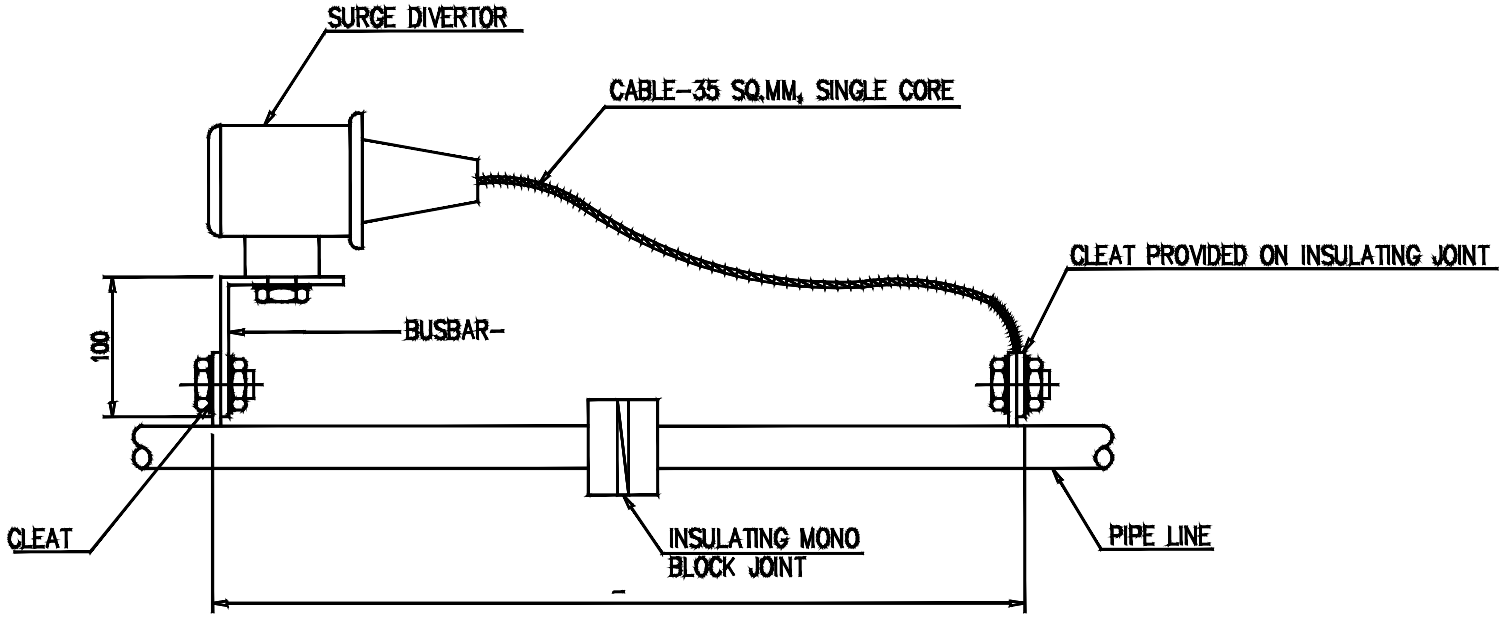
NOTES

1 ALL DIMENSIONS ARE IN MM UNLESS OTHERWISE SPECIFIED.
2 FOLLOW WRITTEN DIMENSIONS ONLY, DO NOT SCALE.
3 THE CONNECTION SCHEMES ARE TYPICAL.
4 REQUIRED CONNECTION SCHEME SHALL BE PROVIDED ON THE TERMINAL PLATE OF TEST LEAD POINT.
5 CASING PROTECTION IS APPLICABLE ONLY WHEN CASING PIPE IS COATED/ PAINTED.

CLIENT: INDRAPRASTHA GAS LIMITED (IGL)
NEW DELHI

TITLE: TEST STATION CONNECTION SCHEME (TYPICAL) DETAIL

SIZE	CLIENT JOB NO.	DRAWING NUMBER	SHEET	REV.
A3	JOB-NO		1 OF 1	0



S.NO.	DESCRIPTION	QTY.
1	TINNED COPPER BUS BAR 25mm X 3mm THK 550mm LONG 90°SMOOTH BEND AT 100mm AT ONE END BOTH END WILL HAVE M12 HOLES	1
2	TINNED COPPER BUS BAR 25mm X 3mm THK 'L' SHAPE BEND AT CENTER FOR TOTAL LENGTH 200mm TO BE DIVIDED IN TWO PART BOTH END WILL HAVE M12 HOLES	1
3	2 NOS M 10 SIZE BRASS NUT BOLTS, WASHERS 2 NOS NUT BOLTS ARE PROVIDED WITH EACH SPARK GAP ARRESTOR.	2

NOTES

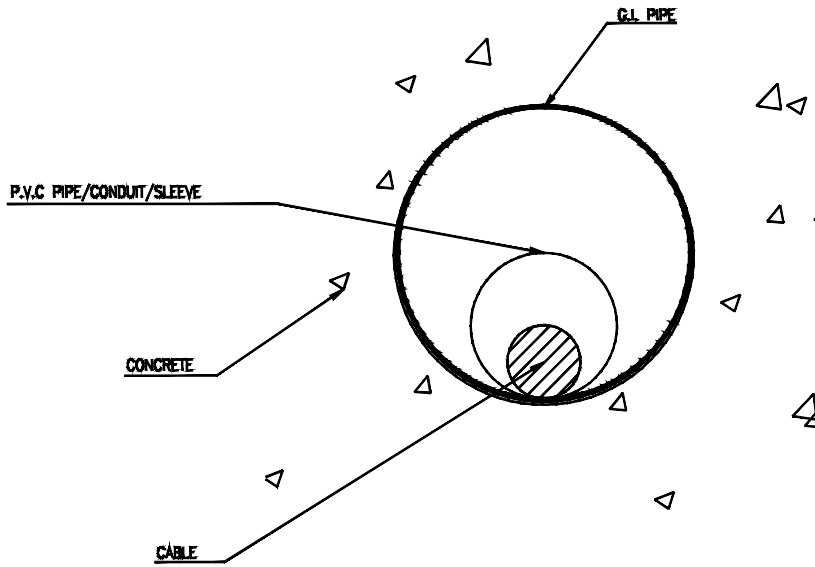
1 ALL DIMENSIONS ARE IN MM UNLESS OTHERWISE SPECIFIED.

2 FOLLOW WRITTEN DIMENSIONS ONLY. DO NOT SCALE.

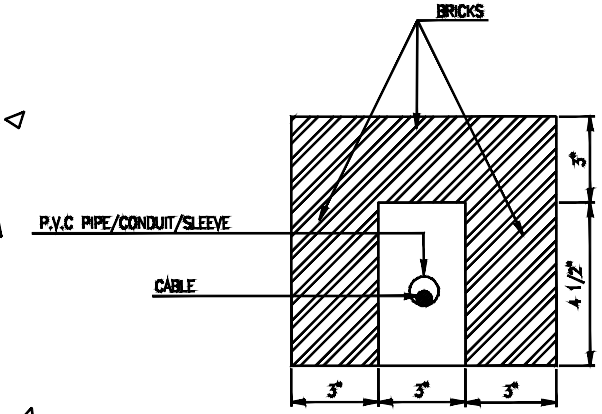
CLIENT: INDRAPRASTHA GAS LIMITED (IGL)
NEW DELHI

TITLE
SURGE DIVERTOR INSTALLATION

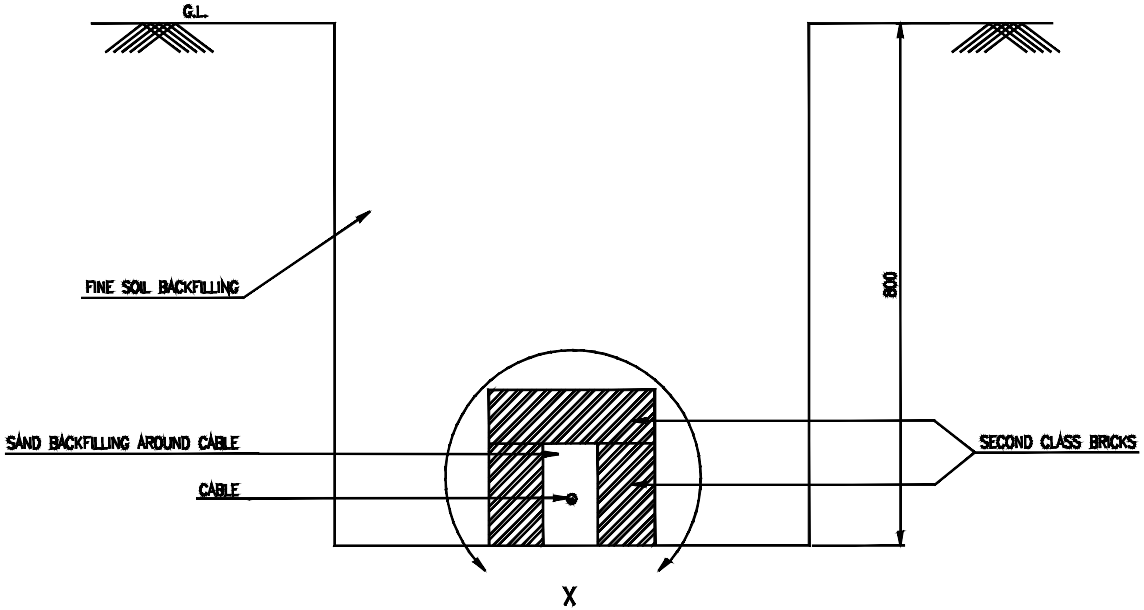
SIZE	CLIENT JOB NO.	DRAWING NUMBER	SHEET	REV.
A3	-		1 OF 1	0



SECTION VIEW OF CABLE LAYOUT IN CONCRETE



ENLARGED DETAIL–X
FOR NORMAL LAYING IN EARTH



TYPICAL CROSS–SECTION OF CABLE LAYING IN EARTH

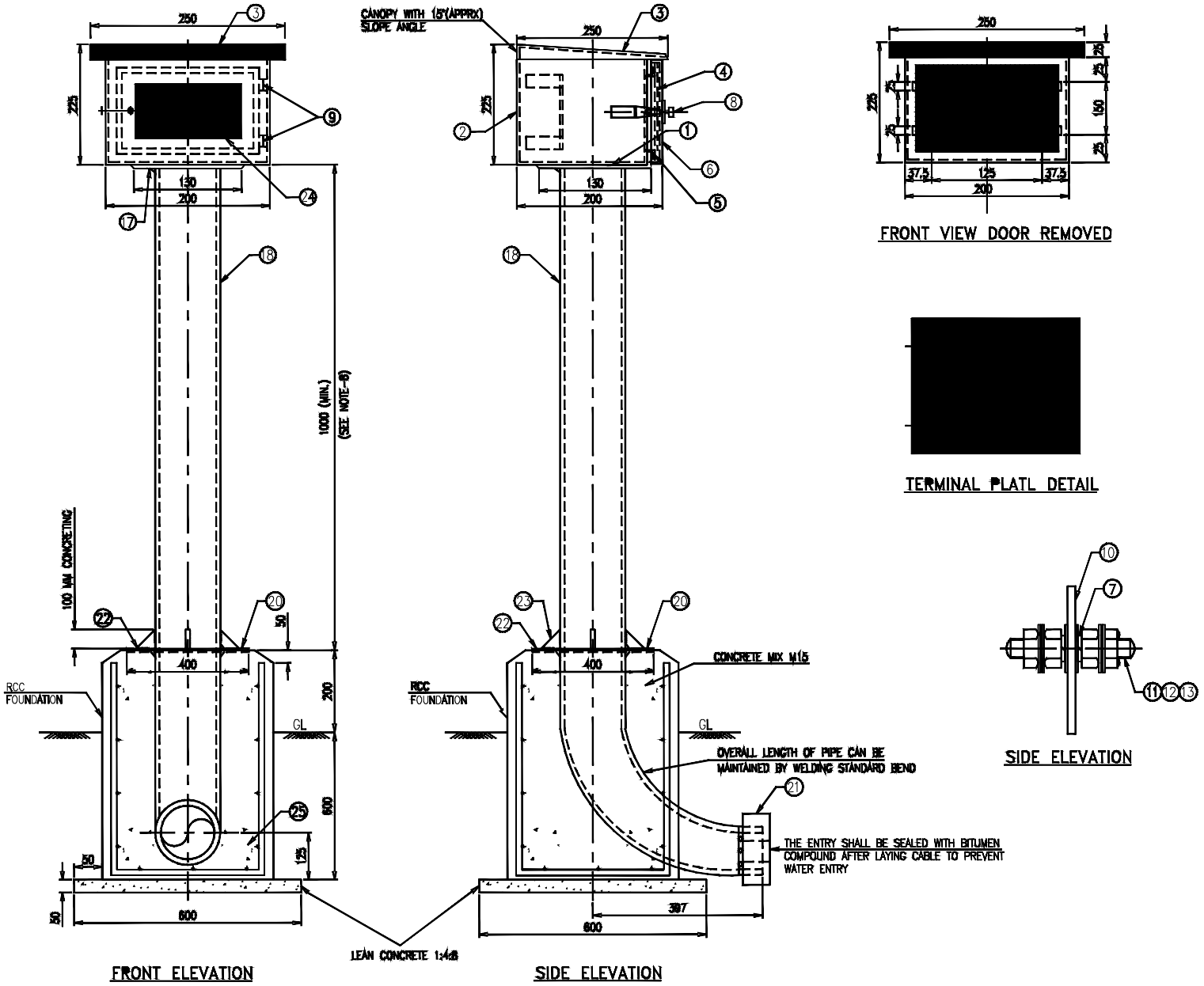
NOTES

1 ALL DIMENSIONS ARE IN MM UNLESS OTHERWISE SPECIFIED.
2 FOLLOW WRITTEN DIMENSIONS ONLY. DO NOT SCALE.
3 ALL UNDERGROUND CABLE SHALL BE LAID IN BRICK COVERING WITH SAND BACKFILL.
4 FOR MORE THAN ONE CABLE IN THE SAME CABLE TRENCH, CABLE SHALL BE LAID SIDE BY SIDE IN SEPARATE BRICK COVERING.
5 AT BOTH ENDS OF CABLE TERMINATION, A LOOP OF ONE METER (MINIMUM) SHALL BE KEPT AS SPARE.
6 WHEREVER TERMINATION IN BETWEEN IS REQUIRED, T–JOINTS OR ELBOWS SHALL BE PROVIDED.
7 AT ROAD/NALA CROSSINGS, G.I. PIPE CONDUIT SHALL BE USED.

CLIENT: INDRAPRASTHA GAS LIMITED (IGL)
NEW DELHI

TITLE: FABRICATION & INSTALLATION DETAIL OF CABLE LAYING FOR CATHODIC PROTECTION

SIZE	CLIENT JOB NO.	DRAWING NUMBER	SHEET	REV.
A3	-		1 OF 1	A



FRONT ELEVATION

SIDE ELEVATION

FRONT VIEW DOOR REMOVED

TERMINAL PLATL DETAIL

SIDE ELEVATION

NOTE

1 ALL DIMENSIONS ARE IN MM UNLESS OTHERWISE SPECIFIED.
2 FOLLOW WRITTEN DIMENSIONS ONLY. DO NOT SCALE.
3 THE SHUTTER SHALL BE HINGED TYPE WITH CONCEALED LOCK & SHALL HAVE DOOR GASKET TO MAKE THE TEST STATION WEATHER PROOF(IP:56)
4 THE INNER & OUTER SURFACE OF THE TEST STATION SHALL BE EPOXY PAINTED.
5 THE NAME PLATE SHALL BE OF ANODISED ALUMINIUM WITH BLACK BACKGROUND & WHITE LETTERS & SHALL BE FIXED TO THE INNER SIDE OF SHUTTER.
6 TEST STATION SHALL BE ERECTED WITH THEIR SHUTTERS PARALLEL TO THE LINE OF AXIS AND FACING THE PIPE LINE. THE DIMENSIONS OF THE TEST STATION WILL VARY DEPENDING ON THE TYPE OF THE TEST STATION.
7 THE CHAINAGE OF TEST STATION SHALL BE WRITTEN WITH BLACK PAINT ON THE OUTER SIDE OF THE FRONT SHUTTER.
8 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.
9 AFTER INSTALLATION OF FOUNDATION BOLT,4" (100MM) CONCRETING TO BE DONE ABOVE THE PLATES AS AN EXTENSION OF PCC(M-15) FOUNDATION. TOTAL DEPTH OF THE FOUNDATION SHALL BE 900 MM AND 300 MM ABOVE THE GRADED LEVEL.

BILL OF MATERIAL

SL NO.	DESCRIPTION	QTY.
1.	BOTTOM PLATE, 5THKx194 MS PLATE	1No
2.	REAR & SIDE, 2.67x217x704 MS	1No
3.	TOP, 2.67x250x300 MS	1No
4.	FRONT TOP 2.67 x190x81 MS	1No
5.	FRONT BOTTOM, 2.67x190x81 MS	1No
6.	SHUTTER 2.67x234x234 MS	1No
7.	SPRING WASHER SC. 8.6	66Nos
8.	CASTLE LOCK WITH MASTER KEY (3NOS. KEY)	1No
9.	HINGE FOR SHUTTER	9Nos
10.	TERMINAL PLATE, 8x150x150 PHENOLIC LAM SHT.	1No
11.	BRASS STUD M6x50LONG (FOR TERMINALS)	1No
12.	BRASS NUT M6	44Nos
13.	BRASS WASHER	44Nos
14.	MS. ANGLE 5THKx50x50x30	4Nos
15.	STEEL SCREW, M6x16	4Nos
16.	LATCH FOR SHUTTER	1No
17.	MS COUPLING PLATE, 5THKx130x130 MS PLATE	1No
18.	MS PIPE, 100 NB x 5.4 THKx 1275MM	1No
19.	NEOPRENE RUBBER GASKET 6 THK.	1SET
20.	FOUNDATION PLATE 6THKx400x400	2Nos
21.	RUBBER BUSH	1No
22.	FOUNDATION BOLT M14x125 LONG WITH SPRING WASHER AND NUT	1No
23.	STIFFENER PLATE 6THKx100x100	1No
24.	NAME PLATE ANNODISED AL 0.9x120x160	1No

CLIENT: INDRAPRASTHA GAS LIMITED (IGL)
NEW DELHI

TITLE: TEST LEAD POINTS & JUNCTION BOX WITH FOUNDATION DETAIL

SIZE	CLIENT JOB NO.	DRAWING NUMBER	SHEET	REV.
A3	-		1 OF 1	A