Sabarmati Gas Ltd.

(A Joint Venture of GSPC and BPCL)

ANNUAL RATE CONTRACT FOR CARRYING OUT CASED & UNCASED CROSSINGS THROUGH HDD METHOD AT VARIOUS LOCATIONS IN GANDHINAGAR, MEHSANA, SABARKANTHA,ARAVALI AND PATAN DISTRICTS

OPEN DOMESTIC COMPETITIVE BIDDING

TECHNICAL VOLUME

(VOLUME – II OF II)

Tender No. REPL/SGL/HDD/010/22

SGL Ref No.: SGL: TEND: 101:202-23

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Rev.	**Date**	**Prepared By**	**Checked By**	**Approved By**

1. PROJECT DESCRIPTION

M/s SGL proposes to supply Natural Gas to various customers (Industrial, Commercial, Domestic and CNG) located within the Gandhinagar, Mehsana and Sabarkantha districts.

For connectivity of networks, SGL has float a Tender for Annual Rate Contract for Cased / Uncased crossing of Underground Utilities, Canal, Drain, Railway, Road, minor River etc through Horizontal Directional Drilling (HDD) method at various locations in Gandhinagar, Mehsana, Sabarkantha & Patan Districts

Contract shall be valid for TWO YEAR from the date of award and completion period for each crossing will be 6 week & 8 weeks for Uncased & Cased crossing respectively including mobilization, Qualification tests etc from the date of intimation from SGL as mentioned in the LIT.

After completion of ONE year, Contract may be extended further ONE year after mutual consent.

2. SCOPE OF WORK

The contractor's scope of work shall consist of preliminary activities, detail engineering, supply of material as required, fabrication, installation, nitrogen purging (as per site requirement), testing and pre-commissioning and assistance during commissioning along with all associated mechanical, civil, structural, and instrumentation works. 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, standards, specifications.

i) Preliminary Activities – Welding Procedures Specifications (WPS), Procedure Qualification Records (PQR), Welder Qualification Test (WQT), Electrode Qualification Test (EQT),
ii) Soil Investigation
iii) Prepare & submit the crossing Profile with required calculation to SGL EIC for approval,
iv) Submit execution plan with milestone,
v) Mobilization of HDD machine with required capacity as per crossing details,
vi) Mobilization of adequate manpower, equipment & other required resources,
vii) Crossing canal, drain, Roads, Railways etc as per SGL standards & specifications,
viii) Welding of carrier pipe & casing pipe as per approved welding procedures,

3. REFERENCE SPECIFICATION, CODES AND STANDARDS

The contractor shall carry out the work in accordance with the requirement of latest relevant applicable standards, this specification, PNGRB guidelines and Technical Specifications (T4S), ASME B 31.8, Section IX, API 1102, OISD-226 and SGL's approved procedures (if any) during the tenancy of the contract.

If SGL find any discrepancy, ambiguity or conflict in or between any of the Standards and the contract documents, then this should be promptly referred to the SGL Committee / Engineer-in-Charge (EIC) for his decision, which shall be considered binding on the contractor.

4. RESTORATION OF EXISTING FACILITIES

All restoration works damaged during construction such as roads, pavements, utilities, cables, pipeline, sewers, streams, drains, ditches, farm, Private plot, Shop and any other facilities (which are not mentioned above). All restoration work shall be carried out to original condition to entire satisfaction of Owner and concerned authorities.

5. DESCRIPTION OF PIPELINE ROUTE AND SITE VISIT

Bidders are advised to make site visits to familiarize themselves with all the salient features of terrain and available infrastructure along the crossing section prior to execution. Contractor shall be deemed to have considered all constrains and eventualities on account of site conditions along pipeline route while execution the crossing. Contractor shall not be eligible for any compensation in terms of cost and/or time, on account of site conditions along pipeline route varying to any extent from whatever is described in the bid package

6. STATUTORY PERMISSION

Basic permissions will be made by available by contractor from concerned Authorities to cross their pipeline / Utilities etc. and contractor shall be responsible for obtaining further specific approval or liaising from statutory authorities as required for the completion of the Work. Moreover, prior or during the execution, if any issues arise from Authorities or Local People at site then Contractor will liaise with them and deal with the situation and complete the work as per their satisfaction with at no extra cost to Owner. Any changes /additions in depth, route, alignment etc. required to be made to meet the requirements of statutory authorities, shall be carried out by the contractor in the consultation of SGL EIC, within the contract Price / Rate and no additional charges shall be paid by SGL for the same. Contractor shall obtain the necessary works permits / consultation / discussion for all works from the authorities having jurisdiction before the actual

execution of the various phases of the works.

7. SAFETY

The contractor shall observe safe working practices in the storage and handling of cleaning fluids, flammable fluids, etc., and ensure smoking or naked flames are not permitted in the vicinity when these materials are being used.

Trench walls shall be battered with sufficient slope in order to minimize a trench collapse. Where there is a danger of an earth slide or collapse, the trench shall remain open for the minimum time possible. The contractor is to ensure that no person enters a trench, which is of a depth of 1.5 meters or greater, unless the trench has adequate shoring or the sides are battered to such an extent as to prevent a trench collapse.
The contractor shall also protect all worksites with **warning signs, barricades and night lighting.** The contractor shall inspect all fenced excavations daily, and maintain them in good order.

The Contractor shall adhere consistently to all provisions of HSE requirements as mentioned in the Specification ***"HSE Management"***. In case of non-compliance or continuous failure in implementation of any of HSE provisions; SGL may impose stoppage of work without any Cost & time implication to Owner and / or impose a suitable penalty for non-compliance with a notice of suitable period, upto a cumulative limit of 1.0% (one percent) of Contract value with a ceiling of Rs. 10 Lakhs. This penalty shall be in addition to all other penalties specified elsewhere in the contract. The decision of imposing stoppage of work, its extent & monitory penalty shall rest with SGL & binding on the Contractor.

People from the Contractor side i.e. Senior officers, Managers, Engineers, Supervisors, Technicians, skill & unskilled labours should in PPE's (Hard Helmet, Safety Shoes, Fluorescent Strips Jackets) at site. In absence of the same, suitable penalties of Rs. 1000/- per head per day shall be levied till such time the same is provided.

Any accident causing injury to any person or damage to property or equipment shall be reported to the Engineer-in-charge on immediate basis.
Where the Engineer-in-charge determines that the contractor is performing the work in an unsafe manner, he may suspend the work until the contractor takes corrective action and that period will be considered during the completion of project.

8. PENMAUTIC PRESSURE TESTING

Pressure testing will be carried out with compressed air. Compressed air will be provided by Contractor for testing purposes and is to be included in the rates.

For MDPE pipelines work the Contractor shall perform progressive pressure testing to avoid having to find leaks in long lengths of pipe. The test pressure shall be 6.0 bar (g), and there shall be no unaccountable pressure loss during the test period.

For main line the test duration shall be 24 Hrs. with these tests the pressure should be allowed to stabilize for a period of 30 minutes after pressurization. The holding period may then commence and continue for 24 hours. Measuring instruments shall have been calibrated and their accuracy and sensitivity confirmed. For testing of Network, calibrated pressure gauges of suitable range shall be supplied by the contractor. The pressure gauges shall be calibrated from time to time as desired by Engineer-in-Charge. All testing shall be witnessed and approved by the EIC or his delegated representative. Tie-in joints may be tested at working pressure following commissioning.

For service lines in some cases testing will be carried out independently of the testing of the mains for which the test duration may be reduced to 4 Hrs. The service testing in this case will be performed after the service installation is complete but before the service tee has been tapped. Also in some cases the tapping of the service tee will be delayed pending the completion and purging of the main pipelines.

9. HYDROSTATIC TEST PRESSURE

The carbon steel pipeline shall be pre & post hydrostatically tested to a minimum test pressure of 1.4 times of design pressure. The section of the pipeline for the crossings shall be tested as a single string. Unless specified otherwise in the CONTRACT, the test pressure shall be the one resulting in a hoop stress corresponding to 90% of SMYS of pipe material. Test pressure shall be retained in the pipeline for minimum period of 6 hours. Test section shall be visually examined for leaks / defects, etc.

10. DRYING AND COMMISSIONING

Contractor shall dry pipeline by using compressed air or other suitable means to ensure removal of physical moisture and assist in commission the complete pipeline system including nitrogen purging (nitrogen required for purging i.e. 2Kg/Cm2 pressure), supply of all manpower, consumables, equipments etc. A detailed procedure shall be developed by contractor for commissioning of pipeline and shall be implemented after approved by owner.

11. CROSSINGS BY AUGAR BORING / HORIZONTAL DIRECTIONAL DRILLING (HDD)

Contractor shall cross the Railway line/ National Highway / Road / Canal / River etc. by Augar Boring / HDD at locations as directed by Owner/ Consultant as per crossings survey drawing or as per guided by the concern authorities. Before start of Crossing, the contractor shall ascertain by pre-construction survey all underground obstacles namely electrical/ telecommunication cable, foreign pipeline, water line, drain / sewerage line and prepare crossing profile drawings showing all elevations & levels. The contractor shall also ascertain the type of soil & their terrain whether rocky or normal by way of trial pit etc. before start of job. The contractor shall submit procedure, profile drawing with complete design calculations of Boring / HDD as per requirement of PNGRB / ASME B31.8/ OISD norms and safety requirement that pipe is not under stress during and after crossing for owner/ consultant's approval prior to start the execution of works.

Contractor will manage to the local people for Installation of Machine etc and stringing of casing or carrier pipes prior to commencement of crossing activity. SGL will provide the only basic approvals from the concern authority but contractor will also get the final approval for commencement of the crossings activities.

12. PRIORITIES

The contractor shall start the execution work for Cased / Uncased crossings at various locations simultaneously and shall deploy adequate manpower, machinery, tool & tackles etc. accordingly or as decided by Engineer-in-charge.

However, owner may, at its sole option:

i. Contractor shall act in accordance with priority of execution and their deployment without any time and cost implication to the owner.

ii. Can change the pipeline route due to unwanted / unfeasible site conditions. Contractor shall comply with such re-routing of execution and their deployment without any additional cost implication to the owner and within mutual agreed re-scheduling.

13. CROSSING

13.1 ROAD CROSSING

i) The method of crossing of roads such as open cut/ boring shall be firmed up by contractor in consultation with concerned authorities and owner/ consultant. The contractor shall also take due care to identify and take due precautions so as not to disturb or damage the utilities like cables, water lines and their structures.

ii) The contractor shall provide proper caution boards during day time and danger lights during night time when the cutting operation of the road is going on.

13.2 CROSSING OF STREAMS / CANALS BY CONVENTIONAL METHOD

i) No damage should be caused to any irrigation sources, while laying the pipeline through canal crossings.

ii) The flood banks of the canal should be brought to the original condition, if they are damaged by the laying of the pipeline. Stabilization of banks shall be carried out as per requirements of concerned authorities.

iii) In general the top of the pipeline shall be taken at least 1.5 meter below the scour level of river/ canal crossing. If scour level is not known minimum 2.5m cover should be kept unless specified otherwise, bending and test pressure shall not exceed 90% of the SMYS of pipe material.

iv) MAXIMUM EQUIVALENT STRESS DURING SERVICE

Permissible values of maximum equivalent stress during service shall be governed by the requirements of ANSI N31.8/ B31.4 as applicable.

The contractor shall ensure that no any u/g existing utilities/ pipelines/ cable etc. are damaged. If shall be responsibility of contractor to compensate any loss or damage to other agency if damaged while crossing. HDD for hydrocarbon lines and approval of agency shall be sought before deploying HDD agency.

14. SCOPE OF SUPPLY

Materials to be supplied by owner as free issue from its designated storage points at/ near to respective cities:

14.1 LINE PIPE & OTHER MATERIALS

i) Line pipe Steel API 5L, externally corrosion coated with three layer side extruded polyethylene coating of following sizes and wall thickness:

- API 5L Gr.B, X-52, 4”NB x 6.4mm WT
- API 5L Gr.B, X-52, 6”NB x 6.4mm WT
- 2’’ sch-80 Line Pipe ASTM A 106 Gr-B for Venting & drain
- MDPE Pipes – 125mm, 90mm,

Company storage point for issue of materials shall be from the company’s designated store. Exact address shall be indicated at the time of order finalization.

14.2 CONDITIONS FOR ISSUE OF COMPANY SUPPLIED MATERIAL

Contractor shall prepare and submit material issue vouchers to enable stage wise issue of materials. All materials shall be issued for incorporation in permanent works only and shall not be used for any temporary or ancillary works without the written consent of Engineer-in-charge. These materials shall be issued to the contractor from the owner's storage points. Contractor shall be responsible, at this own cost, for lifting, unloading, transportation and return of materials to designated storage points. Contractor shall also be responsible for constructing covered godowns with adequate supports and clearances for safe storage of materials.

Every month the contractor shall submit an account for all the materials issued by the owner in the proforma prescribed by the Engineer-in-charge. On completion of the work, the contractor shall submit materials appropriation statement for all materials issued by owner.

All materials supplied by the COMPANY shall be duly protected by the CONTRACTOR at his own cost with appropriate preservative like primer/ lacquer coating, grease etc, if required.

The contractor shall be required to take Insurance Cover in terms of general conditions of contract.

Openings of equipment, machinery, valves etc. shall be kept blocked/ covered with blinds to prevent entry of foreign matter.

12.3 Reconciliation of Owner supplied materials

Every month, the contractor shall submit an account for all materials issued by owner in the proforma prescribed by the Engineer-in-charge. On completion of the crossing contractor shall submit "Material Appropriation Statement" for all materials issued by the owner in the proforma prescribed by the Engineer-in-charge.

a) For the purpose of accounting of coated line pipes (4" & 6'' NB) following maximum allowances shall be permitted.

i) Unaccountable wastage - 0.1%

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

iii) Serviceable materials (all cut pieces of pipes measuring 2m upto 9m) - 0.5%

Unaccountable wastage / scrap shall be at actual as per site assessment subject to maximum as stated above. All unused, scrap materials and salvageable materials shall be the property of the Owner and shall be returned by the contractor at his cost to the SGL's designated store yard and 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 by the Contractor will be done @ 120% of landed cost from Contractor's bill for Coated line pipes as well as Station Piping.

b) For the purpose of accounting of Bare pipe (2"NB), all cut pieces measuring in length of 1m and above when returned to owner's storage points after beveling, shall be treated as

serviceable materials. All cut pieces of pipes measuring less than 1m will be treated as scrap. For the purpose of accounting of station piping following maximum allowances shall be permitted

- Unaccountable wastage - 0.1%
- Scrap (all cut pieces of pipes measuring less than 1m) - 1 %
- Serviceable materials (all cut pieces of pipes measuring 1 m and above- 2 %

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

c) For the purpose of accounting of MDPE pipe, material reconciliation will as under…

12.4 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 the contract except the material

Item	Scrap
P.E. Pipe (100 mtrs length)	Scrap Permissible/Construction Allowances 0.5 %, Serviceable materials (all Pieces of Pipe above 15 mtrs)
P.E. Pipe (50 mtrs length)	Scrap Permissible/Construction Allowances 0.5 % Serviceable materials (all Pieces of Pipe above 8 mtrs)
P.E. Pipe (12 mtrs length)	Scrap Permissible/Construction Allowances 0.5 % Serviceable materials (all Pieces of Pipe above 3 mtrs)
Valves & Fittings	0%

specifically listed mention 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 by way of limitations, as follows as applicable for carbon steel pipeline / piping.

a) Casing pipe (10" &12"NB), shall be designed in accordance with API 1102 and minimum thickness shall be 6.4mm
b) Assorted pipes below 2'' Size for Vent & drain at crossings points
c) Flanges & pipe fittings (for above/under ground piping)
d) Warning mat (300mm width & 1mm thick)
e) SS spiral wound graphite Gaskets & fasteners
f) SS tubing & manifolds for instruments.
g) MDPE Fittings – Bend, Coupler, End cap, Tees
h) Electro fusion Machine
i) Fire extinguisher
j) Steel Casing Pipe for crossings, if require
k) Steel to PE – Transition Fittings from approved vendors

l) PE fittings for the MDPE pipe line laying
m) Electro Fusion Machine etc.

All other items except line pipe

i) All 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 purposes.

ii) All materials for all types of pipeline markers including cement, sand, reinforcement etc. alongwith painting material.

iii) All equipment and consumables required for hydrostatic testing like pumps, compressor, temporary headers and pressure and temperature gauges, corrosion inhibitor for water used for hydrostatic testing, including water for testing.

iv) All material and consumable required for external field weld joint coating and protective coating of bends as per specifications including supply of coating materials – Raychem's "Dirax" or other company approved equivalent field weld joint coating materials for carrier pipes used for unused HDD crossing as per specification.

v) All materials/ compressed air/ pig required for cleaning, gauging, filling, dewatering, swabbing for CS pipeline etc.

vi) All types of 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.

vii) 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.

viii) Casing insulators and end seals and materials for casing vents and drains as per drawings.

Detail grid line route survey shall be furnished to the successful bidder. Any additional survey and data required to complete above shall be done by contractor without any extra cost.

After completion of crossing(s), contractor shall incorporate all the correction in drawings, prepare and issue the drawings "as-built drawings" as listed below to owner as final submission of drawings - pipeline alignment sheet, all X-ing details, pipe book etc. layout drawing, piping GAD, isometric drawing, all civil drawings. For final submission only 2 sets of documents plus the original transparencies shall be handed over by contractor. Any construction done by contractor without duly approved drawings shall be wholly at his risk and cost. Contractor shall also submit soft copy of pipe book in excel alongwith hard copy. Soft copy of all as-built drawings shall be also submitted in AutoCAD.

13 COMMERCIAL CONDITIONS AS PER CONDITIONS OF CONTRACT

13.1 TESTS AND INSPECTION OF WORKS

i) The contractor shall carry out the various testes as enumerated in the technical specifications of this tender document and the technical documents that will be furnished to him during the performance of the work and no separate payment shall be made unless otherwise specified in schedule of rates.

ii) All the tests either on the field or at outside laboratories concerning the execution of the work and supply of materials by the contractor shall be carried out by contractor at his own cost.

iii) The work is subject to inspection at all times by the Engineer-in-charge. The contractor shall carry out all instructions given during inspection and shall ensure that the work is being carried out according to the technical specifications of this tender, the technical documents and the relevant codes of practice furnished to him during the performance of the work.

iv) The contractor shall provide for purpose of inspection, access ladders, lighting and necessary instruments at his own cost including low voltage (24 V) lighting equipment for inspection work. Compressed air for carrying out works shall be arranged by the contractor at his own cost. Before erection all prefabricated spool pieces, pipes, fittings, valves etc. shall be cleaned inside & outside by compressed air or by suitable means as specified in technical specification at no extra cost to company.

v) Any work not conforming to the execution drawings, specifications or codes shall be rejected forthwith and the contractor shall carryout the rectifications at his own cost.

vi) All results of inspection and tests will be recorded in the inspection reports, proforma of which will be approved by the Engineer-in-charge. These reports shall form part of the completion documents.

vii) For materials supplied by owner, contractor shall carryout the tests, if required by the Engineer-in-charge, and the cost of such tests shall be reimbursed by the owner at actual to the contractor on production of documentary evidence. Contractor shall inspect carefully all equipment before receiving them from owner for installation purposes. Any damage or defect noticed shall be brought to the notice of Engineer-in-charge immediately.

viii) Inspection and acceptance of the work shall not relieve the contractor from any of his responsibilities under this contract.

ix) MDPE pipe line work shall be as per SGL's Technical specification and instructed by SGL EIC.

14. RECRUITMENT OF PERSONNEL BY CONTRACTOR

The contractor shall not recruit personnel of any category from among those who are already employed by the other agencies working at the sites but shall make maximum use of local labour available.

15. CONSTRUCTION WATER, POWER SUPPLY & OTHER UTILITIES

No water, power and other utilities will be provided by the owner. It should be the responsibilities of the contractor to arrange water and power at his own cost as per the site requirements.

Bidder shall provide office space for TPI / PMC and Owner in their project office with proper working arrangement.

Contractor has the responsibility of getting the required inspection done in time by TPI / PMC. All transportation facilities for the inspection work will be done by the bidder.

16. LAND FOR RESIDENTIAL ACCOMMODATION

Owner shall not provide any land for residential accommodation of contractor's staff and labour.

17. MEASUREMENT OF WORKS

i) Payment will be made on the basis of joint measurements, taken by contractor and checked & certified by TPI /PMC / Engineer-in-charge. Measurement shall be based on "Approved for Construction" drawings, to the extent that the work conforms to the drawings and details are adequate.

ii) Wherever work is executed based on instruction of Engineer-in-charge, or details are not available or inadequate, physical measurements will be taken by the CONTRACTOR in the presence of the representative of the Engineer-in-charge/PMC/TPI.

iii) Indian standard methods of measurement (IS 1200), as last amended, shall be referred for measurement purposes, wherever, applicable.

iv) Measurement of weights shall be in metric tones, correct to the nearest kilogram. Measurement of lengths shall be in maters, correct to the nearest centimeter.

v) Bolts, nuts, washer and weld metal weights shall not be added on for structural work and no deduction shall be made for holes drilled. Weights shall be assessed from fabrication drawings/ bills of material prepared by contractor and reviewed/ approved by Engineer-in-charge, on the basis of IS/ manufacturers hand book. No allowance shall be made for rolling tolerance.

vi) Linear measurement will be in maters corrected to the nearest centimeter.

vii) Wherever the units of items have been indicated as lumpsum, the payment shall be made on lumpsum basis on completion and no. mode of measurement shall be applicable.

18. VOID

19. VOID

20. INFORMATION REQUIRED

i) The tenderer shall sign for acceptance of schedule of labour rates as per enclosed Annexure with this tender document for such categories of labour as are likely to be employed for carrying out works covered in this contract. These rates are required for making payment to the contractor in case of extra works those may be required to be done at site other than the scope of work covered in this contract, as certified by the Engineer-in-charge and at the entire discretion of Engineer-in-charge.

ii) Details of present commitments giving contract values, details of work, date of commencement of work, percentages completed as on date and the schedule date of completion as per proforma attached Annexure __in this bid document.

iii) The contractor shall without prejudice to his overall responsibility to execute and complete the work as per specifications and time schedule, progressively deploy adequate equipment, tools and tackles at his cost and augment the same as decided by the Engineer-in-charge depending upon the exigencies of the work so as to suit the construction schedule. The tenderer shall submit a list of construction equipment, he proposes to deploy for the subject work alongwith deployment schedule in the proforma given in the tender as per Annexure__ of proposal forms.

iv) Power of attorney in the name of person who has signed the tender document.

v) Catalogue information about all the equipment/ materials which are to be supplied by contractor.

21. Void

22. Void

24. LABOUR LAW

Before starting of work, contractor shall obtain a license from concerned authorities under the Contract Labour (Abolition and Regulation) Act 1970, and furnish the following details at the time of Billing:

1. Copy of Work Order / Agreement.
2. Copy of Labour License
3. Copy of W.C. Policy (FOR PROJECT)
4. Copy of EPF Code Draft./ESI
5. Copy of EPF Challan for the period of last 3 months.
6. Copy of Form 12A/3A/6A/5/10 for the Last 1 Year.
7. Half Yearly Return Form - XXIV
8. Yearly Return Form - III
9. Muster Roll (XVI)
10. Wage Register (XVII)
11. Register of Advance (XXII)
12. Register of Deduction for damage of loss (XX)
13. Register of Overtime (XXII)
14. Register of Employees (XIII)
15. Undertaking (format is attached herewith) Every month

25. PROVIDENT FUND ACT

i) The contractor shall strictly comply with the provisions of employees provident fund act and register themselves with RPFC before commencing work. The contractor shall deposit employees and employers contributions to the RPFC every month. The contractor shall furnish along with each running bill, the challan / receipt for the payment made to the RPFC for the preceding months.

ii) In case the RPFC's challan/ receipt, as above, is not furnished, owner shall deduct 16% (Sixteen percent) of the payable amount from contractor's running bill and retain the same as a deposit. Such retaining amounts shall be refunded to contractor on production of RPFC challan/ receipt for the period covered by the related running bill.

26. SITE CLEANING

i) The contractor shall take care for cleaning the working site from time to time for easy access to work site and also from safety point of view.

ii) Working site should be always kept cleaned upto the entire satisfactions of the Engineer-in-charge.

iii) The contractor shall sort out, clear and stack the serviceable materials obtained from the dismantling / renewal at places as directed by the Engineer-in-charge.

iv) No extra payment shall be paid on this account.

v) Before handing over of work to owner, the contractor in addition to other formalities to be observed as detailed in the document shall clear the site to the entire satisfaction of Engineer-in-charge.

27. PROJECT PLANNING, SCHEDULING & MONITORING

a) Time Schedule

The completion time schedule for the work (including mobilization period) as per Appendix – I to invitation for bid, from the date of issue of LOI/ Fax Of Intent.

The bidder is required to submit a project time schedule in bar chart form, alongwith the bid. The schedule shall cover all aspects like sub-ordering,

b) Scheduling & Monitoring System

The bidders should describe their system of project scheduling and monitoring, the extent of computerization, level of detailing, tracing methodology etc. with the name of computer package & sample outputs with the Manpower details.

28. PROCEDURES

Various procedures and method statements to be adopted by CONTRACTOR during the construction as required in the respective specifications shall be submitted to TPI/PMC/ Owner in due time for their approval. No such construction activity shall commence unless approved by owner in writing.

29. DOCUMENTATION

"As Built" Drawings

Notwithstanding the provisions contained in standard specifications, upon completion of work, the contractor shall complete all of the related drawings to the "As Built" stage and provide the owner, the following:-

a) One complete set of original tracings + Two copy.

b) One complete set of full size reproducible + Two copy.

c) Soft copy of all the as built drawings prepared in AutoCAD in one set of rewritable compact disc and photographs covering measure activities at site.

d) The contractor shall submit the progress report or other areas of work in 2 sets to Engineer-in-charge at site office alongwith monthly progress report. Similarly photographs for problem areas should be submitted well in advance with a proposed methodology to execute the works and meet the construction schedule. The cost of same shall be deemed to be inclusive in the rates and no separate payment shall be made.

30. COMPLETION DOCUMENT (One Original + 2 Copies)

a) Welding procedure qualification report.
b) Welder qualification report.
c) Radiographic procedure qualification.
d) Radiographic report alongwith certified radiographs (Radiographs only with the original).
e) Labour License Copy
f) Batch test certificate from manufacturers for electrodes.
g) DPR & Graph for MDPE Laying,
h) Certificate of MDPE Fusion Operator,
i) All other requirements as specified in the respective specifications.
j) Pneumatic & Hydro Test results and reports.
k) Pre-commissioning/ commissioning check list.
l) Completion certificate issued by PMC / Owner's site engineer.
m) No claim certificate by the contractor.
n) Consumption statements of steel, MDPE pipes & Transition Fittings certified by owner's site engineer.
o) Completion certificate for embedded and covered up works wherever applicable.
p) Recovery statement, if any.
q) Statement for reconciliation of all the payment and recoveries made in the progress bills.
r) Copies of deviation statement and order of extension of time, in granted.

CONTENTS

1.0 SCOPE

1.1 This specification covers the minimum requirements for the various activities to becarried out by CONTRACTOR for or about the construction of cross-country pipelines.

1.2.1 The various activities covered in this specification include the following works of pipeline construction

- Clearing, grubbing and grading of Right – of – way
- Construction of all temporary facilities required in connection with the WORKS
- Staking of the pipeline route.
- Handing, hauling, stringing and storing of all materials.
- Trenching
- Field – bending of line pipe
- Lining – up
- Pipeline laying
- Backfilling
- Tiring–in
- Installation of auxiliary facilities and appurtenances forming a part of pipeline installation.
- Clean-up and restoration of Right-of-way
- Maintenance during defects liability period.

1.3 Specification shall be read in conjunction with the conditions of all specifications and documents included in the CONTRACT between COMPANY and CONTRACTOR.

1.4 CONTRACTOR shall, with due care and vigilance, execute the work in compliance with all laws, by-laws, ordinances, regulations etc. and provide all services and labor, inclusive of supervision thereof, all materials, excluding the materials indicated as “COMPANY” Supplied materials” in the “CONTRACT”, equipment, appliances or other things of whatsoever nature required in or about the execution of the work, whether of a temporary or permanent nature.

1.5 CONTRACTOR shall take full responsibility for the stability and safety of alloperations and methods in involved in the WORK.

1.6 CONTRACTOR shall be deemed to have inspected and examined the work area(s) and its surroundings and to have satisfied himself so far as practicable as to the form and nature thereof, including sub – surface conditions, hydrological and climatic conditions, the extent and nature of the WORK and materials necessary for the completion of the WORK, and the means of access to the work area(s).

1.7 CONTRACTOR shall be deemed to have obtained all necessary information subject as above mentioned as to risks, contingencies and all other circumstances, which may influence the WORK.

1.8 CONTRACTOR shall, in connection with the WORK, provide and maintain at his own costs, all lights, guards, fencing, watching etc., when and where necessary or required by COMPANY or by any duly constituted authority and / or by the authorities having jurisdiction thereof for the protection of the WORK and properties or for the safety and the convenience of public and / or others.

2.0 REFERENCE CODES, STANDARDS AND SPECIFICATIONS

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

a)	ANSI B 31.8	-	Gas Transmission and Distribution Piping Systems.
b)	ANSI B 31.4	-	Liquid Petroleum Transportation Piping Systems.
c)	API 1104	-	Standard for Welding pipelines and Related Facilities.
d)	API 1105	-	Bulleting on Construction Practices for Oil and Products Pipelines.
e)	Part 1992	-	Transportation of Natural and Other Gas by Pipeline Title 49 (US Department of Transportation – Pipeline SafetyStandards)
f)	Part 195	-	Transportation of Liquids by Pipeline (US Department of Transportation – Pipeline Safety Standards.)

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

2.2 For the purpose of this specification the following definitions shall hold :

- the words “Shall” and “ Must” are mandatory.
- the works “ Should, “May” and “Will” are non-mandatory, advisory or recommended.

3.0 REQUIREMENTS OF R.O.U. AND ACCESS THERETO

CONTRACTOR shall, before starting any clearing operations, familiarize himself with all the requirements of the Authorities having jurisdiction over the Right of Way for work along the pipeline route or in connection with the use of other lands or roads for construction purpose.

CONTRACTOR shall notify COMPANY well in advance during work progress, the method of contraction for crossing road pipeline, cable, railway, river and other existing obstacles.

CONTRACTOR shall not commence work on such crossing before having obtained approval from the authorities and land owners concerned to the satisfaction of COMPANY. T crossing shall be installed to meet at all times the requirements and conditions of the permit issued by the authorities concerned. In the absence of any specific requirements by authorities, CONTRACTOR shall comply with COMPANY'S instructions.

The right of ingress and egress to the ROW shall be limited to pints where such ROW intersects public roads, Arrangements for other access required by the CONTRACTOR shall be made by him at his own cost and responsibility. And for such access, the conditions of this specification shall also apply.

Where the ROW comes within 30 meters of an existing line or facility CONTRACTOR shall propose and provide methods to safe guard the existing line or facility (e.g. a demarcation fence) No work is allowed in such area without COMPANY'S prior approval.

3.1 Safety measures during construction of pipelines inside the area influenced by high voltage lines.

3.1.1 General

Pipelines which are constructed inside the area of high voltage lines may be electrically influenced by the high voltage lines. The voltage caused by the influence may at times be high enough to pose danger to personnel working on the pipeline. It is imperative therefore that the instructions given below should be strictly observed.

3.1.1.1 It is a necessity that all personnel working on the pipeline which is being laid in the area influenced by the high voltage systems, be given clear instructions on measures to be taken

3.1.1.2 Vehicles and equipment must be earth-connected This may be effected by attaching an annulated cable or chain (which touches the ground) of adequate length to the underside of the vehicle.

3.1.1.3 It is not impossible for plant and/or materials to come within 50m of the centre of the high voltage systems, special measures, must be taken to prevent any approach beyond that distance, unless article 3.1.2 is complied with.

3.1.1.4 DURING THUNDERSTORMS OR WHEN DISCHARGES ARE OBSERVED ON INSULTORS ALL PERSONNEL MUST LEAVE THE AREA OF THE HIGH VOLTAGE LINE AND PIPELINE.

3.1.1.5 To prevent electrical voltage in a non-buried section of the pipeline from rising to dangerous levels, the length of the pipeline section which has been welded together before burial must not exceed the length at which the max. admissible voltage may be induced. This length may be calculated using an approved calculation method.

3.1.1.6 Before a pipeline section is lower into the trench the structure's earth electrodes indicated in the drawings or determined with calculation method must have been installed and connected both to the pipeline section already buried and to the section which is about to the buried. The electrical connections which serve the purpose of preventing dangerous voltages must have a min. area of 35mm2

Said connections must not be interrupted until after the permanent safety earth connections have been installed and connected to the entire uninterrupted pipeline.

3.1.1.7 The welded connection between the pipeline section and the section already buried must be installed at a distance of at least 50m from the nearest point ofa pylon base.

3.1.1.8 Personnel doing work inside the area of influence of the high voltage system must wear electrically insulating foot-wear. (e.g. rubber knee boots) and wear insulating rubber or. Plastic gloves.

3.1.2 Additional measures for work at less than 50m from the centre of the high voltage system.

If work is done at less than 0m from the centre of the high voltage system, the regulations below must be complied with in addition to the rules specified in clause 3.1.1.

3.1.2.1 The work must not be started until agreement has been reached with the authorities which controls the high voltage system, about the implementation of the safety measures specified in this section.

3.1.2.2 Measures must be taken to prevent excavating and hoisting equipments from approaching high voltage lines to within any of the following distances.

This distance depends on the voltage carried, For individual connections the distance must be :

0	-	50 KV	3m
40	-	200KV	5m
200	-	380KV	8m

The measures taken may be as follows:

1. Special selection of equipment, or limiting or blocking certain directions of movement, or limiting the operational area, thereby making it impossible for any work to tee done at a distance from the high voltage line of less than the accepted minimum.

2. In case the measures recommended in 1. above are not feasible, installation of clearly visible markers of sufficient height of laying out a “no passage beyond this point” line of drums painted bright red and white must prevent any work being done inside the danger area. Further, an inspector must be prevent all the time.

3.1.2.3 In the event that a vehicle, crane etc. should accidentally come into contact with a live cable of a high voltage system or flash – over of electrical charge occurs, the driver must not leave his vehicle because this will pose a serious threat to his life.

The vehicle or crane must break the contact WITHOUT ANY HELP FROM OUTSIDE.

The driver must not leave his vehicle until be has managed to leave "the dangerous area, or alternatively, when the Electricity Authorities have given notice that the cable(s) have been put out of circuit. In case a serious fire starts in the vehicle, he is permitted to jump from the vehicle, clearing it as far as possible, while the jump should possible be to a dry spot.

4.0 RIGHT-OF-WAY

The CONTRACTOR is required to perform his construction activities within the width of Right-of-way set aside for construction of pipeline, unless he has made other arrangements with the land owner and/or tenant for using extra land. Variation in this width caused by local conditions or installation of associated pipeline facilities or existing pipelines will be identified in the field or instructed to the CONTRACTOR by COMPANY.

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

4.1 Staking

Prior to cleaning operations CONTRACTOR shall:

1) Install Bench Marks, Intersection Points and other required surveymovements.

2) Stake markers in the centerline of the pipeline at distance of maximum 100 meters for straight line sections and maximum 10 meters for horizontal bends. Wherever ROW centerline has been staked on ground, CONTRACTOR shall exercise, care in accurately staking the pipeline centerline, in consultation with COMPANY.

3) Stake two ROW markers at least at every 100 meters.

4) Set out a reference line with respect in pipeline centerline at aconvenient location. Markers on reference line shall be at a distance of

maximum 100m for straight line sections and maximum 10m for horizontal bends.

5) Install distance markers location and indicating special points, such asbut not limited to :

- Contract limits, obstacle crossings, change of wall thickness, including corresponding chain age, etc.

ROW markers shall be staked out at the boundary limits of Right-of-way wherever possible. Row markers shall be painted red with numbers painted in white. Number shall be identical to centerline marker number with letters A (left side) and B (right side) added, (looking, in flow direction) Reference markers shall also carry the same information as its corresponding centerline markers.

Markers shall be of suitable material so as to serve their purpose and shall be colored distinctly for easy identification. CONTRACTOR shall be responsible for the maintenance and replacement of the reference line markers until the permanent pipeline markers are place and the as-built drawings aresubmitted and approved.

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

4.2 Monuments

All shrines, monument, border stones, stone walls and the like shall be protected and shall be subjected to no harm during construction. Any violation of the above by the CONTRACTOR shall be brought to the notice of the COMPANY and other concerned authorities, Restoration of the above shall wholly be the responsibility of the CONTRACTOR.

4.3 Fencing

Prior to clearing or grading of the Right-of-way or stringing of pipe, CONTRACTOR shall open fences on or crossing the construction Right-of- way and install temporary gate of sound construction made of similar materials and suitable quality to serve purpose of original fence. Adjacent post shall be adequately braced to prevent slackening of the remainder of the

fence. Before such fences are cut and opened, CONTRACTOR shall notify the land owner or tenant, and where practicable, the opening of the fences shall be in accordance with the wishes of said owner and tenant. In all cases where CONTRACTOR removes fences to obtain work route, CONTRACTOR shall provide and install temporary fencing, and on completion of construction shall restore such fencing to its original condition.

CONTRACTOR shall install temporary fencing on either side or ROW where in COMPANY's opinion, It is considered essential to ensure safety and noninterference, especially in areas like grassing lands, villages etc..

Fencing shall be removable type wherever necessary, to permit crossing of traffic. The type of fencing must be suitable for the situation in accordance with user. The pole distance shall not be greater than6m. The minimum height of the fencing shall be 1.2 m above grade. Fencing can consist of one of more rows of smooth wire and/or of barbed wire.

4.4 Row Clearing and Grading

4.4.1 All stumps shall be grubbed for a continuous strip, with a width equal to tragic top width plus two meters on either side centre on the pipeline centerline Further all stumps will be grubbed from areas of the construction Right-of- way, where Right-of-way grading will be required. Outside of these areas to be graded and the mentioned trench strip at the option of CONTRACTOR, the stumps may either be grubbed or cut off to ground level. Any stump out off must be left in a condition suitable for rubber-typed pipeline equipment traffic.

4.4.2 All grubbed stumps, timber, bush undergrowth and root cut or removed from the Right-of-way wall be disposed of in a manner and method satisfactory to COMPANY, land owner and/or tenant, and Government Authorities having jurisdiction and as soon as practical after the initial removal in no case, it shall be left to interfere with the grading and laying operations, Whenever stumps are grubbed and a hole is left in the ground, CONTRACTOR shall back-fill the hole and compact it to prevent water from gathering in it and creating a big hole.

4.4.3 CONTRACTOR shall grade the pipeline Right-of-way as required for proper installation of the pipeline, for providing access to the pipeline during construction, and for ensuring that the pipeline is constructed in accordance with the good engineering and construction practices.

4.4.4 CONTRACTOR shall grade sharp points or low points, without prejudice to section 6.0 of this specification to allow the pipe to be bent and laid within the limits set forth in these specifications and drawings as regards the minimum elastic curvature permitted and shall drill, blast or excavate and rock or other material which cannot be graded off with ordinary grading equipment in other to make an adequate working space along the pipeline.

4.4.5 No temporary or permanent deposit of any kind of material resulting from clearing and grading shall be permitted in the approach to roads, railways, streams, ditches, drainage ditches and any other position which may hinder the passage and/or the natural water drainage.

4.4.6 The Right-of-way clearing and grading operations shall in no case involve embankment structures of any type and class without prior approval of the authorities having jurisdiction over the same.

4.4.7 In the case of natural or artificial deposits of loose soil, sand, heaps of earth, or other fill materials, these wall be removed till stable natural ground level is reached so as to ensure the construction of the pipeline ditch is in stable ground.

4.4.8 In the case of Right-of-way clearing and grading on hillside or in steep slope areas, proper barriers or other structures shall be provided to prevent the removed materials from rolling downhill. The Right-of-way cross fall shall not exceed 10%.

4.4.9 Wherever the pipeline Right-of-way runs across plantations, alongside farmyards, built up areas, groups of trees, horticultural spreads, gradients grass fields, ditches, roads, paths, railways or any other area with restrictions of some kind, CONTRACTOR shall grade only the minimum area required for digging and constructing the pipeline. In the said places, CONTRACTOR shall carry out and constructing the pipeline. In the said places, CONTRACTOR shall carry out the works in such a way that damage done from the pipeline construction is kept to a minimum.

4.5 Provision of Detours.

CONTRACTOR shall do all necessary grading and bridging at road, water and other crossings and at other locations where needed, to permit the passage of its men and equipment it is understood that the CONTRACTOR has recognized such restrictive features of the Right-of-way and shall provide

the necessary detours and execute the works without any extra cost to COMPANY Public travel shall not be inconvenienced nor shall be wholly obstructed at any point.

CONTRACTOR at his own cost shall furnish and maintain watchman detours lanterns, traffic lights, barricades, signs, wherever necessary to fully protect the public.

CONTRACTOR shall be responsible for moving its equipment and men acress or around watercourses. This may require the construction of temporary, bridges or culverts. Temporary bridging or access to fording required for Right-of-Way crossing water courses shall be constructed. CONTRACTOR shall ensure that such temporary works shall not interfere with normal water flow, avoid overflows, keep the existing morphology, unchanged and shall not unduly damage the banks or water courses. No public ditches or drains shall be filled or bridged for passage or equipment until CONTRACTOR has secured written approval of the Authorities having jurisdiction over the same. CONTRACTOR shall furnish COMPANY a copy of such approval.

4.6 Steep and Rocky Terrain.

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

In rough or steep terrain, CONTRACTOR may have to grade access roads and temporary bypass roads for its own use. Where such access roads do not fall on from land owners and tenants and be responsible for all damages caused by the construction and use of such roads, and at no extra cost to COMPANY, Wherever rocky terrain is encountered, grading shall be carried out in all types of solid rocks which cannot be removed until loosened by blasting, drilling, wedging or by other recognized means of quarrying solid rocks.

Where use of explosives is required in connection with Right-of-way grading and trenching, CONTRACTOR shall comply fully with requirements of the use of explosives as provided under clause 6.3 of this Specification.

4.7 Off Right – of –Way Damages

CONTRACTOR shall confine all its operations within limits of the Right-of- Way. Any damage to property outside ROW shall be restored or settled to the CONTRACTOR'S account.

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

5.0 HANDLING, HAULING, STRINGING AND STORING OF MATERIALS.

5.1 General

The CONTRACTOR shall exercise utmost care in handling in pipe and other materials. CONTRACTOR shall be fully responsible for all materials and their identification until such time that the pipes and other materials are installed in permanent installation. CONTRACTOR shall be fully responsible for materials, however, method of storage shall be approved by COMPANY.
CONTRACTOR shall reimburse the COMPANY for the cost of replacement ofall COMPANY supplied materials damaged during the period in which suchmaterials are in the custody of the CONTRACTOR. It shall be CONTRACTOR's responsibility to unpack any packing for the materialssupplied by COMPANY.

5.1.2 "Taking Over" of Line Pipe

The following stipulations shall apply in case CONTRACT provides for supply of line pipe, bare and / or corrosion coated, by COMPANY.
CONTRACTOR shall receive and 'take over' against requisition, line pipe from the COMPANY'S designated place(s) of delivery as defined in the CONTRACT.

CONTRACTOR shall perform visual inspection of the bare pipes and coating of the corrosion coated pipes, as the case may be, in the presence of COMPANY and all damages shall be recorded. In the case of corrosion coated pipes CONTRACTOR at his option may carry out holiday detection at a prescribed set voltage and record such holidays, in the presence of COMPANY, at the time of 'taking over'. However, if CONTRACTOR proposes to perform only visual inspection of coating, then repair of all holidays found at

the time of laying the pipeline shall be carried out by the CONTRACTOR at no extra cost to COMPANY. The CONTRACTOR shall be entitled to extra compensation for repair and rectification of defects recorded at the time of taking over as per the rate set forth in the "CONTRACT". Repair of all damages after taking over the delivery of the materials shall be to the CONTRACTOR'S cost. In case of delay in handing over of COMPANY supplied material, CONTRACTOR shall be fully responsible for stopping and rearranging means of transportation at no extra cost to the COMPANY.

5.2 Handling and Hauling of Line Pipe

5.2.1 Bare Pipe

CONTRACTOR shall unload, load, stockpile and transport the bare pipes using suitable means and in a manner to avoid denting, flattening, or other damage to pipes. Pipe shall not be allowed to drop or strike objects which will damage the pipe but shall be lifted or lowered from one level to another by suitable equipment. Lifting hooks when used, shall be equipped with a plate curved to fit the curvature of the pipe. In loading pipe on trucks each length shall be lowered to position without dropping and each succeeding length shall rest on special supports on the truck and shall be separated from the adjacent pipes. After loading, suitable chains and padding shall be placed on suitable skids to keep them clear of the ground and flood water. The CONTRACTOR shall provide all necessary timber or other materials required for the stock-piling. While stacking, the number of allowable layers of bare pipes shall be calculated as per SGL RP5L1 and shall be agreed with COMPANY. The stacks must be property secured against sliding and shall consist of pipes of the same diameter and wall thickness. Adjacent stacks of pipes having different dimensional characteristics shall be clearly separated.

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

5.2.2 Corrosion coated Pipes

The CONTRACTOR shall load, unload, transport and stockpile the coated pipes using approved suitable means and in a manner to avoid damage to the

pipe and coating. CONTRACTOR shall submit to the COMPANY, a complete procedure indicating the manner and arrangement used for handling and stacking of coated pipes for COMPANY approval prior to commencement of handing operations.

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

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

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

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

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

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

Coated Pipes stacked in open storage yards/dump yards shall be suitably covered on top to decrease direct exposure to sunlight.

The ends of the pipes during handing and stacking shall always be protected with bevel protectors.

The lorries/rail wagons shall be equipped with adequate pipe supports having as many round hollow beds as the number of pipes to be placed on the bottom of the lorry bed. Supports shall be provided for at least 10% of the pipe length. These supports shall be lined with a rubber protection and shall be spaced in a manner as to support equal loan from the pipes. The rubber protection shall be free from all nails and staples where pipes are in contact. The second layer and all subsequent layers shall be separated from other layers with adequate number of separating layers of protective material such as straw in plastic covers or otherwise to avoid direct touch between the coated pipes.

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

5.3 Stringing of pipe

Pipes shall be unloaded from the stringing trucks and lowered to the ground by means of by means of boom tractor or swinging crane or other suitable equipment using lifting devices as mentioned earlier. Dragging or sliding of pipe shall not be permitted. Special precaution shall be taken during stringing so corrosion coated pipe as per the special requirements previous para. Stringing of pipe shall only be carried out in daylight and after clearing and grading operations have been completed. Pipes shall not be strung along the

ROW in rocky areas where blasting may be required, until all blasting is completed and the area cleared of all debris.

The stringing of the pipe on the ROW shall be done in such a manner so as to cause the least interference with the normal use of the land crossed and to avoid damage to and interference with the pipes. The sequence of pipes must be interrupted at suitable intervals, spaced to coincide with passages, roads, railways, water crossings as well as at other places if requested by landowner
/ tenants to permit use of land.

In case line pipe supply is by different manufacturers CONTRACTOR shall string all line pipes of one manufacturer before commencing the stringing of line pipes of another manufacturer.

When parallel pipelines are being constructed, bumping against and contact with the strung sections of pipe shall be avoided, whether the stringing of the pipes for the individual lines is carried separately or simultaneously.
The pipe lengths shall be property spaced in order to make easier the handling during the welding phase.

It shall be the responsibility of the CONTRACTORS to see that pipe is strung as per the approved drawings for the proper placement of pipe by size, thickness, grade and other specifications. Any additional handling of pipes due to failure to comply with the requirements shall be at the CONTRACTOR'S expense.

5.4 Repair of Damaged pipes :

After the pipes have been strung along the ROW, they shall be inspected by the CONTRACTOR and by the COMPANY. All defective pipe ends shall have to be repaired as per the directions of the COMPANY or as per the requirements of this specification.

5.5 Materials other than line pipe

CONTRACTOR shall receive and take over against requisition all COMPANY supplied materials form COMPANY's designated place(s) of delivery as defined in the CONTRACT, CONTRACTOR shall perform visual inspection and defects, if any noted, shall be recorded separately. The CONTRACTOR shall be entitled to extra compensation for repair and rectification of such defects at the rates set forth in the "CONTRACT".

The CONTRACTOR shall perform the necessary loading, unloading, hauling from points designated by the COMPANY and storing, if necessary of all materials. The CONTRACTOR shall exercise care in handing, storing and distribution of materials in order to avoid damage and deterioration of these materials and prevent their theft or loss.

Materials excluding line pipe shall be stored in sheltered storages. Such materials shall not be strung on the Right-of-way but shall be transported in covered conveyances for use only at the time of installation.

CONTRACTOR shall ensure that all valves and whenever applicable, other materials are fitted with suitable end covers of the type approved by COMPANY Materials with worked surfaces such as flanges, pipe fittings, etc. must be stacked and handled so as to avoid contact with the ground or with substances that could damage them.

The manufacturer's instructions regarding temperature and procedure for storing materials which are subject to alteration of the original properties and characteristics did to unsuitable storage must be strictly complied with and, if required, an adequate heat conditioning shall be provided for these materials. When supplied in containers and packages they must not be thrown or dropped, not handled using hooks which could damage the container or the materials, either during loading / unloading or during successive handing, until their final use.

Storage of coating materials which are susceptible to deterioration or damages especially due to humidity, exposure to high thermal conditions or other diverse whether conditions, shall be suitably stored and protected. These materials shall be kept permanently in store, supported above the ground in a dry place, protected against the weather and transported for use only at the time and in quantities necessary for immediate application. Deteriorated materials shall not be used and replaced with no extra cost to COMPANY.

5.6 Identification

CONTRACTOR shall provide all pipes, bends, etc. greater than 2" with serial numbers as soon as possible and measure their length and state is on the pipes, etc. Pipes to be bent shall be measured prior to bending. Identification (i.e. letter, number and length) shall be indelible.

All serial numbers shall be recorded in a list, which shall also state appurtenant pipe numbers.

Beside recording the stamped – in pipe numbers, length of pipe and painted- on serial numbers, the stamped-in-numbers of T-pieces, bends, valves, etc. and the batch numbers of bends, T-pieces, valves, etc. and the make of valves, shall also be recorded in said list.

Before a pipe length, pipe end, etc. is cut the painted serial number and stamped-in pipe number shall be transferred by CONTRACTOR in the presence of COMPANY to either side of the joint which is to be made by cutting, and the changes shall be recorded in the above mentioned list stating the(new) length. The results shall be such that all pipes, pups, etc. of diameter greater then 2" bear clear marks painted on.

CONTRACTOR shall explicitly instruct his staff that parts which cannot be identified must not be removed, except after permission by COMPANY.

As a general rule parts must be marked as described above before being moved. In no conditions may unmarked parts be incorporated into the WORK.

6.0 TRENCHING

6.1 Location

CONTRACTOR shall, excavate and maintain the pipeline trench on the staked center line of the pipeline taking in to account the curves of the pipeline.

6.2 Excavation

6.2.1 CONTRACTOR shall, by any method approved by COMPANY, dig the pipeline trench on the cleared and graded Right-of-way. In cultivable land and other areas specifically designated by the COMPANY, top 600mm of the arable soil on the pipeline trench top and 500mm on either side shall be excavated and stored separately to be replaced in original position after backfilling and compacting rest of the trench.

Suitable crossing shall be provided and maintained over the open ROW where necessary, to permit general public, property owners or his tenants to cross or move stock or equipment from one side of the trench to the other.

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

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

6.2.3 On slopes where there is danger of landslide, the pipeline trench shall be maintained open only for the time strictly necessary, Forever, the COMPANY may require excavation of trench by hand, local route detours and limiting the period of execution of the works.

6.2.4 In certain slope 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.

6.2.5 All sewers, drains ditches and other natural waterways involved in the execution of the works shall be maintained open and functional. The same applied to canals, irrigation canals, pipelines and buried facilities crossed by the ditch for which temporary pipeline shall be laid, if required, and proper temporary installations provided.

6.3 Blasting

Blasting for trenching and the related removal of scattered rock and debris caused by the blasting from the Right-of-way and / or adjacent property, shall be performed by CONTRACTOR as part of his work.

Every possible precaution shall be taken to prevent injuries and damages to personal and properties during blasting operations, which shall be performed in accordance with Standard Rules for Blasting.

CONTRACTOR shall obtain necessary permits for storage and use of explosives and comply with the laws, rules and regulations of the respective Governmental agencies having jurisdiction thereof. No blasting will allowed

without prior and due notice given by CONTRACTOR to COMPANY Government authorities, land – owners, property occupants, adjacent work crew, and other concerned parties.
CONTRACTOR shall employ only such workmen who are experienced in the type of work to be performed, to supervise, handle and use explosives.

6.3.1 Blasting Effects

No blasting should be carried out within city limits and near any third party structures / facilities. In any case blasting shall only be used after proper authorization from civil authorities even if it is safe to carry out such operations.

6.3.2 All necessary precautions shall be taken to prevent stones from falling outside the Right-of-way and in cultivated areas and to avoid any damage to the installation and properties existing nearby.

6.3.3 Blasting and removal of debris shall be carried out prior to stringing the pipes.

6.3.4 Ground vibration due to blasting – near the existing structures shall be continuously monitored using certified instruments to be provided by CONTRACTOR and approved by COMPANY and the peak particle velocities shall not exceed 50mm/sec.

COMPANY reserves the right to refuse blasting where possible danger exists to property, existing utilities or other structures, In such locations other methods of extracting rock shall be proposed by CONTRACTOR and shall be approved by COMPANY.

6.4 Normal Cover and trench Dimensions:

The trench shall be excavated to a minimum so as to provide, on both sides of the installed pipeline, a clearance as indicated in the job standard / 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 weight coating (as applicable) to the top of undisturbed surface of the soil or top of graded working strip or top of road or top of rail whichever is lower. Fill materials in working strip shall not be considered to add to the depth of cover.

However, surface of fill material placed to fill hollows may be used to determine the depth of cover subject to prior approval by COMPANY.

Minimum Cover Requirements for Steel Pipelines	
Location	**Min. Cover (Mtr.)**
Normal / Rocky terrain	1.0
Minor river / unlined canal / nala crossings, tidal areas and other watercourses.	1.5
Major river crossings	2.5
Rivers with rocky bed	1.5
Lined canals / drains / nalas etc..	1.5
Drainages ditches at roadway and railrods	1.0
Rocky areas	1.0
Cased / uncased road crossings	1.2
Cased railroad crossings	1.7

NOTES:

1. Cover shall be measured from the top of coated pipe to the top of the undisturbed surface of soil or the top of graded working strip, whichever is lower. The fill material in the working strip shall not be considered in the depth of cover.

2. For river / watercourses that are prone to scour and / or erosion, the specified cover shall be measured from the expected lowest bed profile after scouring / erosion. Where scour level cannot be established, an additional cover of minimum 1 meter shall be provided from the existing bed of the river/water course.

3. The cover shall be measured from the top of road or top of rail, as the case may be. Whenever the above provisions of cover cannot be provided due to site constraints,additional protection in form of casing/ concreting etc. shall be provided.

4. Buried piping inside the CGS area shall have a minimum depth of cover of 1.2 m. Where buried pipes come out of the ground, the underground coating on the pipe will continue for a length of at least 300 mm above ground.

6.5 Cutting and Removal of Paving

Whenever it is permitted by Authorities and / or COMPANY to open cut a paved road crossing, or where the line is routed within the road pavement. CONTRACTOR shall remove the paving in accordance with the restrictions and requirements of the authorities having jurisdiction thereof or as directed by COMPANY. The open cut for the road crossing shall be carried out only when the section of pipeline to be laid is complete. After laying the pipeline, backfilling shall be immediately performed and all the area connected with the works shall be temporarily restored.

Throughout the period of execution of such works, CONTRACTOR shall provide and use warning signs, traffic lights or lanterns, barricades, fencing, watchman, etc. as required by the local authorities having jurisdiction and / or COMPANY.

For all roads, paths, walkway etc. which are open-cut, CONTRACTOR shall provide temporary diversions properly constructed to allow the passage of normal traffic with the minimum of inconvenience and interruptions.
The paving shall be restored to its original condition after the pipeline isinstalled.

6.6 Extra Depth and Clearance

At points where the contour of the earth way require extra depth to fit the minimum radius of the bend as specified 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, and the like, CONTRACTOR shall excavate such additional depth as may be necessary at no extra cost to the COMPANY.

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

Where the pipeline crosses areas whose easements specifically require grater than normal depths of cover, the trench shall be excavated to extra depth in accordance with the Right-of-way Agreements or as required.

CONTRACTOR shall excavate all such additional depths as may be necessary at no extra cost to the COMPANY.

6.7 Grades, Bends and Finish of Trench

The trench is to 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. COMPANY 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. COMPANY desires to reduce to a minimum the required number of cold field bends to lay the pipe to conform to the general contour of the ground and maintain a normal cover. This can be accomplished by cutting the trench slightly deeper at the crest of ridges and by gradually deepening the trench in approaches to crossings. Such trenching work shall be done by CONTRACTOR at no extra cost to the COMPANY.

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

6.8 Padding

In all cases where rock or gravel or hard soil is encountered in the bottom of the trench, COMPANY will decide the exact extent of trench padding, that will be required. The thickness of the compacted padding shall not be less than150mm. In those areas that are to be padded, the trench shall be at least 150mm deeper than otherwise required, and evenly and sufficiently padded to keep the pipe, when in place, at least 300 mm above bottom of excavated trench.
Acceptable padding shall be placed under the pipeline before its installation, and around after installation to establish at both sides and on top of the pipe a permanent layer of padding. The thickness of compacted padding on top of pipe shall be at least 300 mm. Padding materials that are approved by COMPANY shall be graded soil/ sand and / or other materials containing no

gravel. Rock, or lumps of hard soil. Sand used for padding shall pass through sieve size ASTM-10 or ISo-2.00.

When specified in the CONTRACT, rock shield may be used in place of or in addition to sand padding as indicated above. Such rock shield shall be in accordance with the specification issued for the purpose and shall be subjected to COMPANY approval.

6.9 Protection of Trench

CONTRACTOR shall keep the trench in good condition until the pipe is laid, and no claim is to be made to the COMPANY by reason of its caving either before or after 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 system, shore, or do what else might be required to excavate the trench, install the pipe in it and backfill the trench in accordance with these specification at no extra cost to COMPANY.

6.10 Protection of Underground Utilities and Special Methods

Details of some underground utilities, as far as acquired by COMPANY, shall be indicated in the Drawings. However, CONTRACTOR shall obtain plans and full details of all existing and planned underground services from the relevant Local Authorities and shall follow these plans closely at all times during the performance of work. CONTRACTOR shall be responsible for location and protection of all underground lines and structure. In special locations the use of trenching machine, backhoe may result in damage to property and subsurface structures likely to be excavate the trench manuallyto same specification at no extra cost.

Where the pipeline crossed another underground utilities/ structures, the CONTRACTOR shall first manually excavate to a depth and in such a manner that the utilities/ structures are located.

Temporary under pinning or any other type of supports and other protective devices necessary to keep the interfering structure intact shall be provided by

the CONTRACTOR at his own cost and shall be of such design as to ensure against their possible failure.

6.11 Encroachments and Working near other Utilities

In locations, where pipeline has to be lid in the body of a road, canal, dyke or other locations under jurisdiction of Government/ Public Bodies, the CONTRACTOR shall perform such work without extra compensation, according to the requirement of concerned Authorities. When it becomes necessary that CONTRACTOR has to resort to hand digging, well point, erection of sheet piling or any other special construction methods in these areas, no extra compensation shall be paid. CONTRACTOR shall contact the Authorities concerned in order to become familiar with their requirements.

In locations, where the pipeline has to be laid more or less parallel to an existing pipeline, cable and / or other utilities in the Right-of-way, CONTRACTOR shall perform the work to the satisfaction of the Owner / Authority of the existing pipeline / cable/ utility. In such locations CONTRACTOR shall perform work in such a way that even under the worst weather and flooding conditions, the existing pipeline/ utilities remain stable and shall neither become undermined nor have the tendency to slide towards the trench.

CONTRACTOR shall be liable for any damage occurring to, or resulting from damage to other pipelines, underground structure/ utilities, as laid down in clause 6.10 of this specification.

6.12 Provisions for negative buoyancy to the pipe

CONTRACTOR shall check if up-floating danger is present in open trench and then shall take appropriate measures to prevent up-floating such as applying soil dams and dewatering of trench or temporary filling of water into the line (in exceptional cases).

In the case of water on the ditch bottom when the pipeline is being laid, the ditch shall be drained to the extent and for the time required to make a visual inspection of the ditch bottom. After this inspection, the presence of water will be allowed provided its level does not cause siding of the ditch sides and pipe floating before backfilling when no concrete weighting is provided.

The water pumped out of the ditch shall be discharged into a natural water course.

Wherever up-floating of the pipeline after backfilling is to be reckoned with, antibuoyancy measures shall be provided by CONTRACTOR for areas indicated in the drawings or as may be encountered during construction, using one or a combination of the following methods:

- Weighting by applying a continuous concrete coating around the pipe;
- Weighting by installing saddle weights;
- Installing metal anchors screwed into the subsoil in pairs;
- Deeper burial of pipeline;
- Provision of select backfill material.

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

Anti-buoyancy measures adopted shall be such that specific gravity of resulting installation is 1.10 or more.

Pipelines and mains installed in the areas normally under water or subject to flooding (i.e lakes, bays, or swamps etc.) shall be provided with addition anti- buoyancy measures such as concrete weight coating geo-textile bags filled with graded stones or anchorages etc to prevent floatation. Minimum specific gravity of installation be 1.2 after providing anti-buoyancy measures.

7.0 BENDING

CONTRACTOR shall preferably provide for changes of vertical and horizontal alignment by making elastic bends CONTRACTOR may provide cold field bends, at its option for change of direction and change of stop COMPANY at its option, may authorize fabricated bends for installation at points where in COMPANY's judgment the use of such bends is unavoidable.

Over bends shall be made in such a manner that the center of the bend clears the high points of the trench bottom Sag bends shall fit the bottom of

the trench and side bends shall conform and leave specified clearance to the outside wall of the trench.

7.1 Elastic Bends

The minimum allowable radius for elastic bends in the buried pipeline including that for continuous concrete weight coated pipe shall be in accordance with relevant job standards. The elastic bend shall be continuously supported over its full length. A radius smaller than permitted in elastic bending shall require a cold bend.

7.2 Cold Field Bends

7.2.1 The radius of cold field bends shall not be less than 40 times the pipe nominal diameter for pipe diameter 18 inch and above and shall not be less than 30 times the pipe nominal diameter for pipe diameter less than 18 inch.

7.2.2 CONTRACTOR shall use a bending machine and mandrel and employ recognized and accepted methods of bending of coated pipe in accordance with good pipeline construction practice. However, bending machines shall be capable of making bends without wrinkles, buckles, stretching and with minimum damage to the coating.

7.2.3 CONTRACTOR shall before the start of the work, submit and demonstrate to COMPANY a bending procedure which shall conform with the recommendations of the manufacturer of the bending machine. The procedure shall include amongst other steps-lengths, maximum degree per pull and method and accuracy of measurement during pulling of the bend. This procedure and the equipment used shall be subject to COMPANY'sapproval.

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

shall be positioned on the plane passing through the neutral axis of the bend to the right and left alternatively.

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

7.2.6 The ends of each bent length shall be straight and not involved anyway in the bending. The length of the straight section shall permit easy joining in no event shall the end of the bend be closer than 1.5 m from the end of a pipe or within one meter of a girth weld.

7.2.7 The ovalisation cause on each pipe by bending shall be less than 2.5% of the nominal diameter at any point. Ovalisation is defined as the reduction or increase in the internal diameter of the pipe compared with the nominal internal diameter. A check shall be performed on all bends in the presence of COMPANY by passing a gauge consisting of two discs with a diameter equal to 95% of the nominal internal diameter of the pipe connected rigidly together at a distance equal to 300mm.

7.2.8 Cold bent pipes on site shall have the corrosion coating carefully checked with the aid of a holiday detector for cracks in the coating down to the pipe wall. It must also be checked whether the coating has disbanded from the pipe wall during bending by beating with a wooden mallet along the outer radius. Any defects or disbanding of the coating caused during bending (also forced ridges in the coating) shall be repaired at the CONTRACTOR's expense in accordance with COMPANY approved procedures.

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

7.3 Miter and Unsatisfactory Bends

All bends showing buckling, wrinkles, cracks or other visible defects or which are in any way in disagreement, in whole or in part, with this specification shall be rejected.

No miter bends shall be permitted in the construction of the pipe line. CONTRACTOR shall cut out and remove any bend or bends which do not meet additional cost to the COMPANY. In the event the CONTRACT provides for supply of line pipe by COMPANY. The pipes required for replacement will

be furnished by COMPANY, but the cost of replacement of such pipes shallbe borne by CONTRACTOR.
Cutting of factory made bends and cold field bends for any purpose are not permitted.

8.0 LINING UP

Each length of pipe shall be thoroughly examined internally and externally to make sure that it is free form visual defects, damage, severe corrosion (seawater pitting), dirt, animals or any other foreign objects. Each length of the pipe shall be adequately swabbed either by use of canvas belt disc of proper diameter or by other methods approved by the COMPANY, Damaged / corroded pipes shall be kept separate. Each length of pipe shall be pulled through just before being welded.

8.1 Pipe Defects and Repairs

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

8.1.1 Acceptability of defects in the pipe detected during inspection at the work site shall be determined in accordance with latest edition of COMPANY'S own materials specification or CODE ANSI B31.8/B31.4 whichever is more stringent.

8.1.2 The maximum permissible depth of dents in pipes up to and including 12 to 3/4 OD is 5mm and for pipes over 12 OD is 2% of the nominal pipe diameter.

8.1.3 Dents which contain a stress concentrator such as scratch, gauge, arc born or groove, and dents located at the longitudinal, spiral or circumferential weld shall be with pipe identification number is to be submitted to the COMPANY.

8.1.4 Repair on line pipe shall be executed as specified in COMPANY's material specification or Code ANSI B 31.8/B 31.4 whichever is more stringent. A record of all repairs is to be maintained by CONTRACTOR. This record, provided with the pipe identification number is to be submitted to the COMPANY.

8.1.5 If due to cutting or repairs, the pipe identification number is removed, it shall be reprinted immediately by CONTRACTOR in the presence of COMPANY. In the event, the CONTRACT provides for supply of line pipe by COMPANY,

CONTRACTOR shall be charged for any pipe length due to loss of identification number. No pipe without identification number shall be transported and / or welded into the pipeline.

8.1.6 Repair of damaged pipe ends by hammering and / or heating is not allowed. If the dented area is minor and at least 200mm away from the pipe end, and the steel is not stretched, severed or split in the COMPANY's opinion, the pipe may be straightened with a proper jack.

8.2 Pipe Handling And Skid Spacing

8.2.1 When lifting pipe, care must be taken not to kink or overstress it Proper pipe slings approved by COMPANY shall be used. CONTRACTOR shall submit his method of skidding and skid spacing for COMPANY'S approval. A strip of soft material shall be placed in between skid and pipe to protect the external coating of the pipe. The material shall be approved by the COMPANY.

8.2.2 The maximum skid spacing is not allowed before the stringer bead and the top and bottom reinforcements are completed, provided that the distance between the incomplete weld and the skid shall not exceed 9(nine) percent of the skid spacing.

8.2.3 Skids shall be atleast 1.20 meter long. For pipe with an O.D. of 12-3/4 inch and larger the skids in contact with the pipe shall have a width of at least 200mm. For pipe with an O.D. of less than 12 inch the skids in contact with the pipe shall have a width of atleast 150mm. Pipe supports shall be stable, so that pipe movement will not cause the supports to move. Skids shall not be removed under a string before lowering in. The welded pipe shall be maintained on skids at the minimum distance of 500mm above ground. Crotches shall be installed at frequent intervals (atleast ever 10^{th} support) with a greater number required at bends and undulation grounds.

8.3 Night Caps

At the end of each day's work or every time when joining and welding operations are interrupted, the open ends on the welded strings of pipes shall be capped with a securely closed metal cap or plug as approved by COMPANY so as to prevent the entry of dirt, water, or any foreign matter into the pipeline. These covers shall not be removed until the work is to be resumed. The caps/plugs used shall be mechanical type and shall not be

attached to pipe by welding or by any other means which may dent, scratch or scar the pipe.

8.4 Temporary Caps

Whenever the welded strings of pipes are left open at intervals to be tied in later after an appreciable time lag, under roads, railroads, rivers, marshy crossings, etc. temporary caps approved by COMPANY shall be welded to the ends of the pipe.

9.0 LAYING OF PIPE

9.1 Lowering In Trench

9.1.1 Lowering can start after removal from ditch bottom of all off cuts, pipe supports, stones, roots, debris, stakes, rock projections below underside of pipe and any other rigid materials which could lead to perforation or tearing of the coating. Sand padding and / or rock shield shall be provided as requiredin accordance as per specification.

9.1.2 Lowering shall follow as soon as possible, after Certification of the Pipe book up to joint 100 Coating the completion of the joint coating of the pipeline. In the case of parallel pipelines, laying shall be carried out by means of successive operations, if possible without interruption.

9.1.3 Before lowering in, a complete check by a full circle holiday detector for pipe coating and for field joint coating shall be carried out and all damages repaired at CONTRACTOR'S cost. All points on the pipeline where the coating has been in contact with either the skids or with the lifting equipment during laying, shall be carefully repaired. If, after checking, it becomes necessary to place the pipeline again on supports at the bottom of the trench, these must be padded in such a way as to prevent damage to the coating, thus avoiding necessity for further repairs when the pipe is finally raised and laid. Before the last operation, a check must be made of the coating at points of contact with the supports.

9.1.4 Before lowering in, short completed sections of the pipeline shall be cleaned with compressed air in order to remove all dirt, etc. from the inside of pipe sections.

9.1.5 The pipeline shall be lifted and laid using, for all movements necessary, suitable equipment of non-abrasive material having adequate with for the fragility of the coating. Care shall be exercised while removing the slings form around the coated pipe after it has been lowered into the trench. Any damage caused to the coating shall be promptly repaired. Lowering in utilizing standard pipe cradles shall be permitted if CONTRACTOR demonstrates that pipe coating is not damaged. No sling shall be put around field joint coating.

9.1.6 Wherever the pipeline is laid under tension, as a result of an assembly error (for example, incorrect positioning of bends, either horizontal or vertical), the trench shall be rectified or in exceptional cases a new assembly shall be carried out, to be approved by COMPANY, so that it fits the excavation andthe laying bed.

9.1.7 Laying shall be carried out under safe conditions so as to avoid stresses and temporary deformations of the equipments which may cause damage to the pipeline itself and to the coating. In localized points where the right-of-way is restricted to the minimum necessary for the transit of mechanical equipment, the laying, shall be carried out using other suitable means. The pipe shall be placed on the floor or the excavation, without jerking, falling, impact or other similar stresses. In particulars, care must be taken that the deformation caused during the raising of the pipe work from the supports, does not exceed the values for the minimum allowable radius of elastic curvature, so as to keep the stresses on the steel and on the coating within safe limits. The portion of the pipeline between trench and bank shall be supported by as many crane as required and approved by COMPANY for holding the line in gentle S-curve maintaining minimum elastic bend radius as specified in job standard Lowering in and back-filling shall preferably be carried out at the highest ambient temperature.

9.1.8 The pipeline must be laid without interruption for the whole or the length of section available. Where water is present, no laying shall be permitted until the ditch has been drained to the extent and for the time necessary to make visual inspection possible of the bed on which the pipe is to be laid. Following such inspections, the presence of water will be permitted, provided that it is not so high as to cause cave in of the walls of the trench or floating of the pipeline before backfilling, when weighting is not provided for the pipe.

9.1.9 CONTRACTOR shall take precautions immediately after lowering in to prevent the movement of the pipe in trench.

9.1.10 Clearance between Pipelines or Mains and other underground structures

(a) When a buried steel pipeline or main has to cross any existing underground pipeline, cable, drain or other services, the pipeline shall be laid at least 500 mm below such services.

(b) When laid parallel to any existing underground cable, drain or other utilities, the pipeline or main shall be laid with a clear horizontal distance of at least 500 mm from existing utility.

(c) As far as practical, a minimum separation of three (3) meter should be maintained between the steel pipeline or main and footing of transmission tower.

(d) A clearance sufficiently large to avoid electrical fault current interference shall be maintained between the pipeline and the grounding facilities of electrical transmission lines.

(e) Clear distance between new steel pipeline or main running parallel to existing pipeline should be minimum 5.0 meters when heavy conventional construction equipment is expected to be utilized. This distance may be reduced, after careful assessment of construction methodologies, to three
(3) meters, provided it does not result in unsafe conditions during construction. Existing pipeline should be clearly marked on the ground during construction. Bi-language (local language and Hindi / English) caution signs should be installed while working in such areas.

(f) While laying more than one new pipelines or mains in the same trench, clear separation of minimum 500mm shall be maintained between adjacent pipelines.

(g) No pipeline or main should be located within three (3) meters of any habitable dwelling or any industrial building unless it is provided with at least 300 mm of cover over and above minimum cover specified under Table (Sr. No. 6.4) above or special protective measures such as concrete slab, steel casing are provided.

9.2 Overhead Sections and Sections in Tunnel.

9.2.1 The following works shall be completed before proceeding with the assembly and laying of overhead pipelines:

- Construction of the pipe support structures or of mounts onsupports.
- Paints and / or coating of the Pipe Work, as indicated in theengineering specification.

9.2.2 The erection of the supports shall be carried out taking care that the elevation and alignment is in accordance with the drawings.

In the case of metal work supports, prefabrication and / or assembly shall take into account the maximum allowed free span and the supports shall not interfere with the pipeline welds.

9.2.3 In case roller supports are used, the roller shall be lubricated, then checked for smooth rotation and, in case of seizure, the defect shall be repaired or roller shall be replaced. In the case of overhead section where the pipeline is slanting, the alignment of the end supports shall be made after placing the pipeline in position. Before installation of the pipe section, all the rollers shall be perfectly centered acting on the seat of the support plates.

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

9.2.4 Lifting, moving and laying of the pipeline shall be carried out in accordance with the provisions of clause 9.1.5.

An insulation sheet shall be installed to isolate the pipe from the support orsupport from the earth.

The sheet shall be hard polyethylene at least 5mm thick.

It shall extend at least to 1cm outside the saddles or clamps.

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

9.2.6 A comprehensive report / method statement on the laying operation to be used shall be submitted to the COMPANY well in advance for approval. The report as a minimum shall include, but not limited to the following.

(a) Method of installation by lifting (as a preferred method)

(b) Pulling method and related calculations, whenever lifting methodcannot be used.

(c) Pulling device and its characteristics.

(d) Method of anchoring the pulling device.

(e) Characteristics of the pulling rope.

(f) Braking device, if any

(g) Pipeline assembly systems.

10.0 BACK – FILLING

10.1 Backfilling shall not be done until the pipe and appurtenances have the proper fit and the pipe is following the ditch 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 any such work is done, it shall be the CONTRACTOR's responsibility to first secure the approval of COMPANY. If any backfilling is done without COMPANY's approval, COMPANY will have the right to require removal of the backfill for examination, and the cost of such uncovering and refilling shall be borne by CONTRACTOR. Backfilling of trench in water courses shall be carried out as per the relevant specification issued for the purpose.

10.2 Backfilling shall be carried out immediately after the pipeline has been laid in the trench, inspected and approved by the COMPANY, so as to provide a natural anchorage for the pipeline, thus avoiding long exposure of coating to high temperature, damaging actions of adverse weather conditions, sliding down of trench sides and pipe movement in the trench. If immediate back filling is not possible, a covering of at least 200mm of earth, 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 backfilling. Deviations there of must have prior approval of the COMPANY. The backfill material shall contain no extraneous material and / or hard limps of soil which could damage the pipe / coating or leave voids in the backfilled trench. After the initial backfill has been placed in to the trench to a level slightly above the surrounding ground, CONTRACTOR shall compact the backfill material. The surplus material shall be neatly crowned directly over the trench and the adjacent excavated areas on both sides of the trench as per clause 6.2.1, to such a height which will, in COMPANY's opinion. Provide specification 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 in to its permanent position. Should depression occur after backfill, CONTRACTOR shall be responsible for remedial work at no extra cost to COMPANY. Surplus material, including rock, left from this operation shall be disposed of the satisfaction of land owner or authority having jurisdiction at no extra cost to the COMPANY.

For further requirements reference is made to Section of 14.0 "Clean-up and Restoration of Right-of-way of this specification.

10.3 Rock, gravel, lumps of hard soil or like materials shall not be backfilled directly onto the pipe unless 'padding' and/or rock shell has been provided as per Section 6.0 of this specification. When "Padding" as described in Section 6.0 of this specification is to be used the following shall be applicable.

Where rock, gravel, lumps of hard soil or like materials are encountered at the time of trench excavation, sufficient earth, sand or select backfill materials shall be placed around and over the pipe to form a protective cushion extending at least to a height of 150mm above the top of the pipe. Select backfill materials for padding that are acceptable to COMPANY shall be soil, sand, clay or other material containing no gravel, rock or lumps or hard soil. Whether such padding material would be taken from the adjacent spoil bank or imported from elsewhere shall be directed by COMPANY. All these works shall be carried out by CONTRACTOR at no extra cost to COMPANY. Loose rock may be returned to the trench after the required selected backfill material has been placed, provided the rock placed in the ditch will not interfere withthe use of the land by landowner or tenant.

10.4 When the trench has been dug through drive ways or roads, all backfills shall be executed with sand or a suitable material as approved by COMPANY and

shall be thoroughly compacted. In certain cases, special compaction methods, such as moistening or ramming of the backfill in layers may be required by COMPANY. COMPANY and any public or private authority having jurisdiction over a road, street or drive way may require that the surface of the backfill be graveled with crushed rock or some other purchased material and the road shall be repaved. In such instances, CONTRACTOR shall comply with said requirements at no extra cost to COMPANY.

10.5 Trenches excavated in dykes which are the property of railways or which are part of main roads shall be graded and backfilled in their original profile and condition. If necessary, new and/or special backfill materials shall be supplied and worked-up. The materials required may include gravel, special stabilization materials or stabilized mixtures. However, special processing and / or compacting methods shall require the approval of COMPANY and / or competent authorities.

10.6 The trench in irrigated and paddy fields shall be backfilled to within 300mm of the top then rammed and further backfilled until the trench is completely backfilled. Surplus material remaining after the operation shall be spread over the ROW as specified in Section 14.0 “Clean-up and Restoration of Right-of- Way” of this specification.

10.7 At the end of each day’s work, back fitting shall not be more than 500 meters behind the head end of lowered-in pipe, which has been padded and approved for backfill. The backfill shall be maintained by CONTRACTOR against washouts etc., until the completion and final acceptance of the work by COMPANY.

10.8 CONTRACTOR shall furnish materials and install breakers in the trench in steep areas (stopped generally 10% and more) for the purpose of preventing erosion of the backfill. The type of breakers installed shall be as per the approved drawings, Breakers shall be constructed of grout bags filled with a mixture of 4:1 sand-Portend cement at COMPANY’s direction. CONTRACTOR may propose other methods such as foam dams etc. which shall be subject to approval by COMPANY, Such works shall be at no extra cost to COMPANY. CONTRACTOR shall pay attention to the direction of backfilling in such steep areas.

10.9 When backfilling the trenches in sloping terrains or steep areas, where in the opinion of the COMPANY, the backfill may be washed out of the trench, sheet piling or other effective water breakers across the trench shall be

provided by CONTRACTOR. This is to divert the flow of water away from the trench into normal drainage followed before laying the line. In no case, the water is to be drained via the trench or via channels other than those followed before the line was laid.

10.10 CONTRACTOR shall leave the pipe uncovered at certain location to allow COMPANY to survey the center line of the pipe and the level of the pipeline in the backfilled trench. Within 48 hours after backfilling, COMPANY shall have carried out such survey and informed CONTRACTOR of any realigning if required. Thereafter CONTRACTOR shall compact the backfill.

The maximum allowable deviation from the centerline for land sections as staked out by COMPANY and as referenced by CONTRACTOR after backfilling is limited to:

Pipeline dia up to and including 24" = 200mm Pipeline

greater than 24" = 300mm

10.11 Before backfilling of the trench, CONTRACTOR shall comply with the requirement of Clause 6.12 of this specification. (as per specification).

10.12 Stabilization of backfill shall be carried out by the CONTRACTOR in sandy areas and other such places to obtain consolidated cover as directed by the COMPANY. CONTRACTOR shall carry out the stabilization over the pipeline at no extra cost to COMPANY.

The backfill shall be stabilized preferably with 150mm layer of marl, mattresses of batch other than straw or other stable materials. The width of stabilizations shall be at least 5.0 meters on either side of the pipeline, plus one meter for every 10 meters of dune (where the line passes through the dune areas).

10.13 Temporary workers shall be installed during backfilling and the survey as per clauses 10.10 to locate the pipeline axis. These markers shall then be replaced with permanent pipeline markers.

10.14 Backfilling shall be preferably carried out at the highest ambient temperature.

11.0 TIEING – IN

11.1 The unconnected sections of the pipe line at various locations have to be tied in after the sections are coated, lowered and backfilled. The sections to be connected shall have at the ends, sections of over lapping, uncovered pipe of sufficient length to absorb, without inducing excessive stresses in the steel, small displacements necessary for perfect alignment and connection of the ends.

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

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

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

11.5 If a pup end cannot be avoided for tie-in, the minimum length that shall be added is 1.0 meters and two or more such pups shall not be welded together. All cut-off lengths greater than 1.0 meters shall be moved ahead in order to be welded into the pipeline at a suitable location. Tie-in with two or more pups may be used provided that they each have minimum length of 1.0 meter and are separated by an entire length of pipe. In no case more than three (3) welds shall be permitted on a 10 meter length of pipeline.

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

11.7 For tie-in of adjacent sections of pipeline already pressure tested, the pup used for tie-in shall be of single length or off-cuts of pipe which have already

been hydrostatically tested. CONTRACTOR shall take care that sufficient number of protested pipes with different wall thicknesses are readily available.

12.0 SPECIAL INSTALLATIONS ON THE PIPELINE

12.1 General

12.1.1 In addition to constructing the pipeline, CONTRACTIOR shall also installcertain other auxiliary facilities and appurtenances.

CONTRACTOR shall do all work necessary at each of the installations to provide facilities which are complete in all respects and ready for operation.

Without limiting the generality thereof, the work required to complete the installations shall, where applicable, include all site surveys, site preparation, filling, grading, fencing, foundations, installation of block valves, side valves, pipe work, pipe supports, pressure gauges, mechanical facilities, civil work painting, installation of all electrical equipments, motors, cables, conduit, wiring and fixtures and hooking up of same; installation of all instruments, piping, valves and fittings; mount all instruments and make all piping and electronic connections, etc.

On completion, all elements of each installation shall be checked out and tested for full and correct operation in the presence of and to the satisfaction of COMPANY. All work shall be carried our strictly in accordance with the appropriate codes, the approved drawings, and this and other related specifications.

CONTRACTOR shall fabricate all piping and install valves and fittings as required by the detailed engineering drawings prepared by him and approved by COMPANY.

Stainless steel lines will be “swaged” using permanent fittings installed with a hydraulic device.

Cold bending for the fitting of ½” and ¼” pipes is allowed when special bending tools are used with guides to prevent flattening. The minimum radius allowed shall not be less than R=10 D where D is the outside diameter of pipe.

The bending tool shall be subject to COMPANY's approval.

CONTRACTOR shall ensure that the piping assemblies are not in a strain prior to the final bolting or welding CONTRACTOR shall also ensure that all equipment and piping are thoroughly swabbed clean of all dust, refuse, welding spatter, scale, or any potentially detachable matter prior to the tie-inor final bolting.

12.1.2 Dimensional tolerances

These tolerances apply to in line items and corrections for other lines. These tolerances can be executed on items such as vents, drains, dummy supports, field supports, temperature and pressure connections, where the deviation will not affect another spool.

a) General dimension such as face to face, face or end to end, face or end to center, and center to center : $\pm$ 3 mm.

b) Inclination of flange face from true in any direction: 4 mm per meter.

c) Displacement of branch connection from indicated location: $\pm$ 1.6mm. When multiple branches are involved, the displacement of the branches shall not exceed 3mm from a common point.

d) Rotation of flange bolt holes shall not exceed 1.6mm.

12.1.3 Flanged connections

CONTRACTOR shall ensure that all flange faces are parallel and centered, according to standard practice, prior to final bolting. CONTRACTOR shall not use bolting forces as means for attaining alignment. A gasket of proper size and quality shall be installed between the flanges at each joint.
Bolts shall be tightened in diagonal sequence and shall be centered with equal amounts of thread visible on both sides. Bolts shall be uniformly tightened to produce a leak – proof joint. Bolts that yield during tightening shall be remover and discarded. It is mandatory that a torque wrench is used for bolt tightening.

12.1.4 Threaded Connections

Damaged threads shall be cut from the end of a run and the pipe shall be rethreaded.

CONTRACTOR shall properly align all threaded joints. Pipe entering unions shall be true to centerline so the union will not be forced during tightening. The threaded pipe shall not project through fittings to cause interference with valves or other operating mechanisms.

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

12.1.5 Welded connections

Where the Ends of the piping components being welded have an internal surface misalignment exceeding 1.6mm, the wall of the component extending internally shall be trimmed by machining so that the adjoining internal surfaces will be approximately flush. All welding shall be performed in accordance with the specification “Specification for welding of pipelines and related facilities”.

Tie-ins between fixed points shall be made at maximum ambient temperature.

12.1.6 Civil Work

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

12.1.7 Painting

All exposed surfaces like piping, valves, structures, and miscellaneous appurtenances shall be painted in accordance with the specifications issued for this purpose. The corrosion coating on pipe surface will end approximately
0.3 meter above the finish grade and it will be necessary for CONTRACTOR to provide a clean interface at the junction of the protective coating and the paint.

12.1.8 Coating of buried – Installations, etc.

All buried valves, insulating joints, flow tees, bends, other in-line fittings and appurtenances shall be coated with minimum three coats of approved quality of coat-tar epoxy or any other equivalent suitable COMPANY approved coating at no extra cost to the COMPANY. For buried pipes either heat shrink tapes conforming to COMPANY a report used along with all the test certificates. Only after obtaining written approval from the COMPANY CONTRACTOR shall commence the work of coating.

12.1.9 Clean-up

After all required tests have been concluded satisfactorily CONTRACTOR shall clean up the site as laid down in the specifications issued for the purpose. The Site finish shall be graded in accordance with the approved drawings.

12.2 Installation of Valves and Valve Stations

12.2.1 Block and sectionalizing valve stations shall be installed as shown on the approved drawings. It is CONTRACTOR's responsibility to have the units completely assembled tested and made fully functional including all related instruments etc.

12.2.2 In steel distribution mains valve spacing should normally not be more than 3 km.

12.2.3 The civil and structural work shall be carried our in accordance with the relevant specifications issued for the purpose and in accordance with the approved drawings as directed by COMPANY. This work as a minimum shall include clearing, grading, fencing, foundations, etc, as required. All above ground structures shall be painted as per the specification and color code given by the COMPANY.

12.2.4 A suitable concrete foundation as directed by COMPANY shall be constructed on which the valve shall be firmly installed, after embedding an insulating sheet of hard polyethylene with a thickness of at least 5mm or equivalent. Such insulating sheet is also to be installed under pipe clamps, etc..

12.2.5 Valves with flow arrows shall be installed according to the normal flow in the pipeline, during welding, the valves shall be in fully open position. In addition all manufacturers' instructions shall be followed.

Care shall be taken to avoid entry of sand particles etc. to valve body, sealsetc during transportation, storage, assembly and installation.

12.2.6 For valves and piping installed below ground and / or above ground, the anticorrosion coating / painting shall be as per the requirements of the relevant specifications issued for the purpose. The anti-corrosion coating below ground shall extend up to 300mm above grade at the lowest point.

12.2.7 Sectionalizing valves shall be installed on sections of the pipeline in the horizontal position only or with an inclination not greater than that allowed by the valve manufacturer. Installation shall be done in such a way that there is no strain in the welded joint while the pipeline at upstream and downstream sides are straight.

12.2.8 All valves shall always be handled using equipment and methods to avoid impact, shaking and other stresses. In particular, the equipment and tools for lifting and handing shall never be done through hand wheel, valve stem, joints and other parts which may suffer damage.

12.2.9 All sectionalizing valve and any other inline assemblies, shall be prefabricated and tested hydrostatically as per applicable specification. All such assemblies shall be installed at the locations shown in the drawings only after successful completion of the hydrostatic test and dewatering. Thereafter the ends of the assembly shall be closed off. CONTRACTOR shall carry out necessary excavation, cutting, beveling and welding of the tie-ins required for the installation of such assembly. The tie-in joints shall be epigraphically examined over 100% length and also 100% ultrasonically examined prior to backfilling. All works shall be executed in accordance with the relevant specifications issued for the purpose.

12.3 Installation of Scraper Launchers and Receivers.

12.3.1 Scraper stations shall be fabricated and installed as per the approved drawings and whenever applicable as per the requirements of clause 12.2 of this specification. It is CONTRACTOR's responsibility to have the units completely assembled, tested and made fully functional including all instruments & related piping.

12.3.2 The civil and structural works for the scraper stations shall be carried out as per the relevant specifications, in accordance with the drawings and as directed by the COMPANY. The work as a minimum shall include site survey, site preparation, clearing, grading, fencing, foundations, etc. as required.

12.3.3 It shall be CONTRACOTR's responsibility to maintain elevations shown on the approved drawings and to carry out any pipe work adjustments, necessary for this purpose. Field cuts shall be square and accurate and field welds shall not be performed under stress of pipe ends.

12.3.4 The painting for the scraper stations shall be carried out as per "Specifications for Painting" the underground sections shall be coated as specified for the pipeline up to at least 300mm above grade.

12.3.5 The hydrostatic testing of the scraper station shall be executed after installation in accordance with the relevant specification issued for the purpose.

12.4 Installation of Insulation Joints.

12.4.1 Insulation joints shall be installed at the locations shown in the drawings. CONTRACTOR shall obtain approval from the COMPANY before installation of the insulation joints.

12.4.2 Handing and installation of the insulating joints shall be carried out with all precautions required to avoid damage and excessive stresses and that the original pup length is not reduced.

12.4.3 The insulation joints and the welded joints shall be protected by external coating as per relevant specifications issued for the purpose.

12.4.4 The in-line inserting shall be made on the buried pipeline; care shall be taken to operate at an external temperature as close as possible to the pipeline operating temperature.

The joints shall be inserted on straight sections and laid on a fine sand bed.

12.4.5 During the execution of the in-line connection welding, the propagation of heat shall be avoided. To achieve this, the joint shall be kept cold by means of nags continuously wetted.

12.4.6 Insulating joints shall be electrically tested before welding into the pipeline. The electrical conductance test shall be carried out using Meggers. Measurement of the insulation resistance across the joints shall be approx. One (1) Megs. Ohm. The tests shall be repeated after installation and welding of the joint into the pipeline to verify that the assembly is undamaged.

13.0 WORKING SPREAD LIMITATIONS

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

Between ROW grading, clearing and backfilling	:	40 Kms
Between backfilling and final clean – up	:	15 Kms

The above limitations do not apply to point spreads such as continuous rock blasting, river crossing, etc.

Any deviations from the above shall require prior approval of COMPANY. COMPANY reserves the right to stop the work, in case the approved spread limitations are exceeded and CONTRACTOR shall not be paid any compensation for stoppage of work.

14.0 CLEAN – UP AND RESTORATION OF RIGHT OF WAY

14.1 CONTRACTOR shall restore the ROW and all sites used for the construction of pipelines, water crossing and other structures in accordance with COMPANY's instructions, and deliver them to the satisfaction of COMPANY.

14.2 Surplus Materials

The following stipulations shall apply in case CONTRACT provides for supplyof line pipe, bare and / or corrosion coated, by COMPANY.

All surplus and defective materials supplied by COMPANY shall be collectedby CONTRACTOR and delivered to designated stockpile areas.

All Pipe-ends shorter than 1.0m shall be returned to COMPANY being scrap, all pipes longer than 8.0m shall be reconditioned (bevels, coating, provided with pipe letter, number and length) and be returned to COMPANY'S designated stockpile areas together with all undamaged, unused COMPANY supplied materials. All pieces between 1.0 and 8.0 m shall be charged to CONTRACTOR by COMPANY, contractor

shall record these returned materials in the Material account, to be prepared by him.

14.3 Disposal

14.3.1 All surplus and defective materials supplied by CONTRACTOR and all trash, refuse and spoiled materials shall be collected and disposed of by CONTRACTOR.

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

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

14.3.4 All dumping fees connected with the disposal of materials shall be to the account of CONTRACTOR.

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

14.4 Temporary Structures.

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

14.5 Repair of Damage

Damages to roads, bridges, private property shall be repaired by CONTRACTOR. All fences and other structures which are damaged during construction shall be restored to original condition.

Slopes, water course sides or banks which have been partially or totally demolished during the execution of the works shall be property consolidated and restored without waiting for their natural consolidation and setting.

All boundary stones which have been moved or removed during the work must be reset in their original location to the satisfaction of the landowner concerned.

14.6 On completion of clean-up, the ROW shall be restored to such stable and usable

condition as may be reasonably consistent with the condition of the ROW prior to laying the pipeline. The COMPANY shall be completely indemnified and held harmless by CONTRACTOR from any and against all claims, demands, losses; expenses etc. that may arise in this behalf or the COMPANY may require from the CONTRACTOR signed Releases from land owners regarding satisfactory indemnification and restoration of their lands.

14.7 Special precautions shall be taken near slopes prone to erosions and land slides. All necessary steps shall be taken to ensure the rapid growth of grass by providing wicker barriers sand by regulating the drainage of surface waters.

14.8 All cadastral or geodetic markers which may have been removed during the execution of the works shall be restored in their exact position.

14.9 Ditches for which no instructions for restoration have been issued, or restoration cannot be done according to existing banks because of the absence of it, shall be restored as instructed by COMPANY. The bed of ditches crossed by the pipeline shall be cleaned over the full width or the ROW, also outside the ROW if necessary. This restoration might involve the supply and installation proper materials for backfill and protection, sod ding or other precautions to prevent erosion or guarantee the stability. Work has to be done after deliberation and acceptance of the authorities and COMPANY. Other field drains have to be restored by hand and/or special equipment to be used for that purpose as soon as possible and if necessary, also outside the ROW.

14.10 Any subsidence, cave-ins, wash-outs, which have been caused during the pipeline construction and maintenance, caused by whatever reason within the edge of ditches and open drains, shall be repaired by CONTRACTOR immediately or at first notice given by COMPANY.

14.11 After the clean-up, the ROW of pastures has to remain fenced and to be removed during the maintenance period. When agricultural and other traffic (requested by tenant) have to cross the ROW the cross-over's have to be fenced with the same material as the ROW. If necessary, special materials have to be used to allow traffic on the cross-over. Fencing of the right-of-way as specified shall not be removed until CONTRACTOR has obtained written permission by COMPANY. In general this has to be done during the maintenance period.

14.12 All openings in or damage to the fence or enclosures shall be repaired by installing new fencing of quality which shall be at least equal to the parts damaged or removed. Provisional gates shall be removed and replaced with new fencing. All repairs to fences and enclosures shall be carried out to the complete satisfaction of COMPANY, land owner and / or tenant.

14.13 If, in the opinion of COMPANY, the sod in pasture land has been damaged by vehicles and wheel tracks are visible, the ROW shall be tilled with a disc- harrow or rotary cultivator several times. The damaged sod shall be firmly cut up and thoroughly mixed through the top-soil. In general the ROW has also to be ripped. After this procedure no

closed-in layers must be found and sufficiently loose top-soil 25 to 30cm thick must be present. The whole procedure has to be approved by COMPANY, Subsequently, the entire ROW which is part of pasture land, shall be prepared for seeding and fertilized according to the instructions of COMPANY.

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

14.15 A sapling of any plant/tree uprooted or cut during construction shall be planted along the route as per the direction of the COMPANY and in accordance with the Forest Preservation Act, 1981. The cost of sapling and its plantation shall be to CONTRACTOR'S account.

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

If during the maintenance period certain parts of the ROW are lower than the Original level, COMPANY can order CONTRACTOR to bring these parts to the original level. If the level of the ROW for clean-up is ordered by COMPANY, risk of above mentioned additional restoration shall not be to CONTRACTOR's account.

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

- spading with dragline (depth 30 – 80 cm)
- spading with dragline (depth 80 – 100 cm)
- fertilizing
- Cover with sand.

If during clean-up operations, soil shortages become apparent outside the trench, CONTRACTOR shall supplement said soil shortage using suitable materials, approved by COMPANY.
If site and / or climatic conditions should render this necessary, COMPANY shall have the right to order CONTRACTOR to suspend certain parts of the WORK related to the clean-up and postpone it to a later date.

14.17 **Soil Surplus**

If on site as a result of the work and after careful backfilling and compacting, a sub-soil surplus exists, this shall be worked up by grading and compacting below the sub-soil

top layer and as a rule this shall be done in the same plot of land. It shall not be permitted to remove the surplus from the plot concerned, unless it concerns rejected soil which has to be removed. Working up surplus soil or removal of rejected soil shall be considered to pertain to the WORK.

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

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

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

14.18 Soil Shortages.

If due to unforeseen circumstances during backfilling and compacting there isn't enough soil to fill the trench property, or to install the crown height as stipulated, CONTRACTOR shall supply the necessary backfill material.

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

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

15.0 MAINTENANCE DURING DEFECTS LIABILITY PERIOD

Defects liability Period (defined as period of liability in the CONTRACT) means the period of 12 months calculated from the date certified in the Completion Certificate.

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

CONTRACTOR shall be responsible for making good with all possible speed at his expense any defect in or damage to any portion of the Work which may appear or occur during the Defects liability Period and which arise either.

a) from any defective material (other than supplied by COMPANY), workmanship or design (other than a design made, furnished or specified by COMPANY and for which CONTRACTOR has disclaimed responsibility in writing), or

b) from any act or omission of CONTRACTOR done or omitted during the said period.

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

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

- Clean up of ROW including water courses
- Sagging or sinking of site level or pipe supports.
- Sliding of ditch banks
- Repair of fencing or removal of construction fencing.
- Repaving of pavements, repair of pavements, repair of coatingpainting.
- Realigning markers, signs.
- Leak/burst of pipe, leaking flanges, washouts.
- Short-circuit in casings.
- Construction defects such as dents, ovality, welding offsets/defects etc detected during intelligent pigging survey.
- Etc.

Company reserves the right to have the required computerized potential Logging Test

executed during the DEFECTS LIABILITY PERIOD and whenever conditions are more favorable for this job. The work shall at or as soon as practicable after the expiration of the Defects Liability Period be delivered to COMPANY in the conditions required by the CONTRACT, fair wear and tear excepted to the satisfaction of COMPANY CONTRACTOR shall finish the work, if any outstanding, at the date of completion as soon as possible after such date and shall execute all such work.

CONTENTS

CONTENTS

1. SCOPE

This specification stipulates requirements for fabrication of all types of welded joints in carbon steel piping systems covering the pipeline and its facilities, which will include the following.

- All line pipe joints of the longitudinal and circumferential buttwelded and socket welded types.
- Branch connections
- Joints in welded / fabricated piping components.
- Attachments of castings, forgings, flanges and supports to pipes.
- Attachments of smaller connections for vents/drain pipes andtoppings for instrumentation.

Note : Any approval accorded to the Contractor shall not absolve him ofhis responsibilities and guarantees.

2. APPLICABLE CODES, STANDARDS & SPECIFICATIONS

All welding works, equipment for welding, heat treatment, other auxiliary functions and the welding personnel shall meet the requirements of the latest editions of the following codes, standards and specifications as listed below.

- Code for Gas Transmission and Distribution Piping System(ASME B31.8).
- Standard for welding of Pipelines and Related Facilities (API1104).
- Specification for welding Electrodes and Filler Materials (ASMESec. II C).
- API 1105 – Boiler on construction Practicum for oil and products Pipeline.
- ASME B31.4 – Pipeline Transportation systems for liquid hydrocarbons and other liquids.
- Past 19.2 title-4g – Transportation of Natural and other gas by pipeline (Department of Transportation pipeline safety standards).
- Part 19s – Transportation of liquids by pipeline (US Department of Transportation Pipeline Safety standards).

- 0150141 – Design construction requirements for cross country hydrocarbon pipeline).
- Non Destructive examination (ASME Sec. V)

3. MATERIAL SPECIFICATIONS

- In general carbon steel is used in this specification. The details of material specifications will be given in a welding Specification Chart attached along with other project data sheets.
- The CONTRACTOR will keep a record of test certificates of all the materials for the reference of the welding engineer.

4. WELDING CONSUMABLES

The electrode shall be suitable for the welding process recommended and base metal used. Physical properties of the welds produced by an electrode recommended for the welding of a particular base metal shall not be lower than the minimum values specified for the base metal unless otherwise specified in Welding Specification Chart and shall correspond to the physical properties of the class of electrode adopted. The choice of electrode shall be made after conducting the required tests on the electrodes as per relevant standards, and shall be the sole prerogative of the COMPANY.
The welding electrodes / Filler wires supplied by the CONTRACTOR shall conform to the class specified in the welding specification chart. The materials shall be of the make approved by the COMPANY.

The CONTRACTOR shall submit batch test certificates from the electrode manufactures giving details of physical and chemical tests carried out by them for each batch of electrode to be used.

Electrode Qualification test records shall be submitted as per Annexure-I with respect to the electrodes tested by the CONTRACTOR and submitted for approval of the COMPANY.

The CONTRACTOR shall provide at his own expenses all the welding consumables necessary for the execution of the job such as electrodes, oxygen, acetylene etc. and the same shall be approved in advance by the Purchaser / Consultant.

The electrodes used shall be free from rust, oil grease, earth and other foreign matter which affect the quality of welding.

All electrodes shall be purchased in sealed containers and stored property to prevent deterioration. The electrodes removed from the containers (except cellulose coated electrodes) shall be kept in holding ovens at the temperature

recommended by the electrode manufacturer.

Ovens shall be used for low hydrogen electrodes only. Out-of-the oven time of electrodes, before they are consumed, shall not exceed the limits recommended by the electrode manufacturer. The electrodes shall be handled with care to avoid any damage to the flux covering.

Different grades of electrodes shall be stored separately. Cellulose electrodes used shall however be used as per specific recommendations of manufacturer.

4.1 Shielding Gas

The composition and purity of shielding gas when required by the welding processes other than shielded metal arc (SMAW) welding, when permitted by the COMPANY, shall have prior approval of the COMPANY. Where appropriate, gases or gas mixture of the following quality shall be used.

a) Argon complying with BS 4365

b) Carbon dioxide complying with type 1 specified in BS 4105.

c) Gas mixture that have been proved to be satisfactory as a resultof procedure approval tests.

When a gas mixture is used which has specified additions, e.g. 2% 02.5% Co_2 the variation of such addition shall not exceed + 10% of that stated Moisture content shall correspond to a dew point of – 30^0C or lower.

5. EQUIPMENT & ACCESSORIES

5.1 The CONTRACTOR shall have sufficient number of welding and cutting equipment, auxiliaries and accessories of sufficient capacities to meet the target schedule.

5.2 All the equipment for performing the heat treatment including transformers, thermocouples, pyre-meters, automatic temperature recorders with suitable calibration arrangements, etc. shall be provided by the CONTRACTOR, at his own expenses and these shall bear the approval of the COMPANY. Adequate means of measuring current and voltage shall be available.

5.3 Redoing of any work necessitated by faulty equipment or operation used by the CONTRACTOR, will be done at his own expense.

6. WELDING PROCESSES

6.1 Welding of various materials under this specification shall be carried out using Shielded Metal Arc welding process (SMAW) with the approval of the COMPANY.

6.2 The welding processes to be employed are given in the welding specification

chart. Any deviation desired by the CONTRACTOR shall be obtained through the express consent of the COMPANY.

6.3 Automatic process shall be employed only with the express approval of the COMPANY. The welding procedure adopted and consumables used shall be specifically approved.

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

7. BEVEL CLEANING AND BEVEL INSPECTION

Line pipe supplied by COMPANY shall have bevel ends as specified in the applicable specification for Line pipe attached with the Bid Package. Any modification thereto, if required by CONTRACTOR due to his special welding technique shall be carried out by the CONTRACTOR at his own cost.

Before welding, all rust and foreign matter shall be removed from the beveled ends by power operated tools. This shall be effected inside and outside and for a minimum distance of 25mm from the edge of the weld bevel. The bevels shall be thoroughly inspected at this stage. If any of the ends of the pipe joints are damaged to the extent that, in the opinion of COMPANY, satisfactory weld spacing cannot be obtained and local repair by grinding cannot be successfully done, the damaged ends shall be cut and re-beveller to the satisfaction of the COMPANY, with an approved beveling machine. Manual cutting and weld repairs of bevels is not allowed. Should laminations, split ends or inherent manufacturing defects in the pipe be discovered, the lengths of pipe containing such defects shall be removed from the line to the satisfaction of COMPANY.

Notches or laminations on pipe ends are not permitted and must be removed by cutting the pipe as a cylinder and re-beveling of pipes priorto welding.

On pipes which have been cut back, a zone extending 25mm back from the new field bevel, shall be ultrasonically tested to the requirement of the line pipe specification to ensure freedom from laminations. The new bevel shall be subjected to 100% visual and 100% dye penetrate / MPI tests. A report shall be written for all testing and records kept.

8. ALIGNMENT AND SPACING

Immediately prior to line-up CONTRACTOR shall inspect the pipe ends inside and outside for damage, dents, laminations etc. Pipe for welding shall be set up, correctly spaced, allowing for temperature changes during welding, in correct alignment and shall in no circumstance be sprung into position. Temporary attachments of any kind shall not be welded to the pipe. Welds joining the sections of the pipelines, valve installation or similar welds classified as tie-in welds shall be made in the trench. Otherwise the alignment and welding shall be made alongside the ditch with the pipe supported on skids and back pad or other

suitable means approved by COMPANY, at least 500mm above the ground, unless approved by the COMPANY in specific cases.

Seam orientation of welded pipe shall be selected to ensure that at the circumferential welds, the longitudinal welds shall be staggered in the top 90 of the pipeline, or 250mm whichever is the lesser. A longitudinal joint shall pass an appurtenance of a structural element at a minimum distance of 50mm. should a section of the line containing uncompleted welds fall from the skids, the CONTRACTOR shall immediately inform COMPANY.

Every effort shall be made to reduce misalignment by the use of the clamp and rotation of the pipes to obtain the best fit. For pipe of same nominal wall thickness off-set shall not exceed 1.6mm. The off set may be checked from outside using dial gauges. Any branch connection, sleeve, etc. shall be at lest 150mm from any other weld. The welds for fittings shall be so located that the toe of the cold dressing is permissible only in cases of slight misalignment and may only be carried out with a bronze headed hammer. Hot dressing shall not be permitted. When welding pipes of different wall thickness (as directed by COMPANY) as special transition piece shall be used. This shall have a minimum of 1:4 taper. The welds shall be subject to both ultrasonic and radiographic inspection.

The root gap shall be accurately checked and shall conform to the qualified welding procedure. The use of internal line-up clamps is mandatory for pipe diameters 10” and above. However, in some cases (tie-in welds, flanges, fittings, diameter of pipe 10” etc.) where it is impossible to use internal clamps an external line-up clamp may beused.

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

When as external line-up clamp is used, all spaces between bars or at least 60% of the first pass shall be welded before the clamp is released and the pipe remaining adequately supported on each side of the joint.

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

9. WEATHER CONDITIONS

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

10. WELDING

10.1 Root Pass

a) Root pass shall be made with electrodes / filler wires reconvened in the welding specification chart attached along with other project data sheets. The size of the electrodes used shall be as per the approved welding procedure.

b) Position or roll welding may be permitted. Separate procedures shall be submitted and qualified for up hill, down hill, vertical down and roll welding. The vertical up method of welding shall be used for the root pass of the tie-ins, special crossings, fittings and special parts, filled welds, repairs and when an external line up clamp is used. The down hill welding may be used for root run welding of tie-ins and special crossings when (a) the edges are machined or have equivalent preparation (b) line up clamps are used and the fit up is geometrically and mechanically similar to one of the ordinary line welding without misalignment or unevenness.

c) The root pass of butt joints shall be executed properly so as to achieve full penetration with complete fusion of the root edges. Weld projection inside the pipe shall not exceed 3mm wherever not specified by the applicable code.

d) Any deviation desired from the recommended welding technique and electrodes indicated in the welding specification chart shall be adopted only after obtaining express approval of the COMPANY.

e) Welding shall be continuous and uninterrupted during a pass.

f) On completion of each run, craters, welding irregularities, slag, etc. shall be removed by grinding and chiseling.

g) While the welding is in progress care shall be taken to avoid any kind of movement of the components, shocks, vibration and stresses to prevent occurrence of weld cracks.

h) Fillet welds shall be made by shielded metal are welding process irrespective of the thickness and class of piping. Electrode size shall not exceed 3.25mm diameter for socket joints. At least two passes shall be made on socket weld joint's.

i) Preening shall not be used.

10.2 Joint Completion

In case of manual welding the first pass shall be carried out by a minimum of two welders, working simultaneously and so placed as to cause minimum distortion of the pipe.

The number of welders and the allowable welding sequences shall be as those laid down in the qualified welding procedure specification. One the deposit of the first pass has been started, It must be completed as rapidly as possible, reducing interruptions to the minimum. The welding and wire speed shall be approximately same as that established in the qualified welding procedure specification.

The pipe shall always be adequately supported and must not be pumped or shaken during welding. The clamp shall be removed, as indicated in as per Speciation clause 8.0 above. Before starting the second pass, the first pass shall be cleaned and attended with rotating grinders.

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

For crack prevention a top and bottom reinforcement of at least one electrode shall be applied before lowering the pipe on the skid.

The welding speed selected shall enable production of a bead which is sufficiently thick and which shows no undercutting.

The time lapse between second and third pass shall be as stated in the procedure specification, normally not exceeding five minutes. After completion of the third of following passes, welding operations may be suspended, so allowing the joint to call down, provided that the of the weld metal deposited is equal to at least

50% of the pipe thickness of the weld metal deposited is equal to at least 50% of the pipe thickness. Upon restarting, depending on the materials, wall thickness and welding process, a preheating to at least 100°C shall be carried out. Subsequent passes up to weld completion shall be protected to avoid rapid cooling, if metrological conditions so dictate. Cleaning between passes shall be done carefully so as to reduce the possibility of inclusions.

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

The Completed weld shall be carefully brushed and cleaned and shall appear free from spatters, scales, etc.

These requirements apply not only to completed welds but also to the bare strip at least so wide so as to allow full skid examination at both ends of the pipe to allow a good ultrasonic inspection when it is required.

11. HEAT TREATMENT

11.1 Preheating

a) Preheating requirements for the various materials shall be as perthe welding specification chart.

b) Preheating shall be performed using resistance or induction / heating methods, Preheating by gas burners, utilizing acetylene or propane gas may also be carried out. Ox propane gas may be used with the permission of the COMPANY under carefulsupervision.

c) Preheating shall extend uniformly to at least three time the thickness of the joint, but not less than 50mm, on both sides of the weld.

d) Preheating temperature shall be maintained over the whole length of the joint during welding. Temperature indicating crayons or other temperature indicating devices shall be provided by the CONTRACTOR to check the temperature.

11.2 Post weld Fleet Treatment

a) Post weld heat treatment, wherever required for joints between pipes and fittings, pipe body and supports shall be carried out by the CONTRACTOR at his expense as per the relevant specifications,

applicable standards and the instructions of the COMPANY.

b) The heat treatment of welded joints shall be carried out as per the requirements laid down in ANSI B31.8 and other special requirements mentioned in welding specification chart.

c) The CONTRACTOR shall submit for the approval of the COMPANY, well before carrying out actual heat treatments the details of the post weld heat treatment procedure, as per Annexure-II attached that he proposes to adopt for each of the materials/ assembly / part involved.

d) Post weld heat treatment shall be done in a furnace or by using an electric resistance or induction heating equipment as decided by the COMPANY.

e) While carrying out local post weld heat treatment, technique of application of heat must ensure uniform temperature attainment at all points of the portion being heat treated. Care shall be taken to

ensure that width of healed band over which specified post weld heat treatment temperature is attained is at least as that specified in the relevant applicable standards / codes.

The width of the heated band centered on the weld shall at least be equal to the width of weld plus 2" (50mm). The temperature gradient shall be such that the length of the material on each side of the weld, at a temperature exceeding half the heat treatment temperature, is at least 2.5 it where is the bore radius and it is the pipe thickness at the weld.

f) Throughout the cycle of heat treatment, the portion outside the heat band shall be suitably wrapped with insulation so as to avoid any harmful temperature ordained on the exposed surface of pipe. For this purpose temperature at the exposed surface of the pipe shall not be allowed to exceed 400^0c.

g) The temperature attained by the portion under heat treatment shall be recorded by means of thermocouple pyrometers. Adequate number of thermocouples shall be attached to the pipe directly at equally spaced locations along the periphery of the pipe joint. The minimum number of thermocouples attached per joint shall be 2 up to 10" dia and 3 for 12" dia and above. However, the COMPANY can increase the required minimum number of thermocouples to be attached, if found necessary.

h) Automatic temperature recorders which have been suitably calibrated shall be employed. The calibration chart of each recorder shall be submitted to the COMPANY prior to starting the heat treatment operation and its approval shall be obtained.

i) Immediately on completion of the heat treatment, the post weld heat

treatment charts/ records along with the hardness test results on the weld joints (whenever required as per the welding specification chart) shall be submitted to COMPANY for its approval.

j) Each joint shall bear an identification number which shall be maintained in the piping sketch to be prepared by the CONTRACTOR. The joint identification number shall appear on the corresponding post weld heat treatment charts. The same identification numbers shall also be followed for identification on corresponding radiographic films. The chart containing the identification number and piping sketch shall be submitted to the COMPANY in suitable folders.

k) Vickers hardness/ Brunet hardness of the heat affected zone as well as of the weld metal, after heat treatment shall be measured using a suitable hardness tester and shall not exceed the maximum hardness specified in the welding specification chart. The weld joint shall be subjected to reheat treatment, when hardness measured exceeds the specified limit, at the CONTRACTOR's own expense.

l) The CONTRACTOR shall arrange for the hardness testing and shall maintain the records of all the joints tested. These records shall be checked by the COMPANY.

12 INSPECTION AND TESTING

12.1 General

a) The COMPANY's Inspector shall have free access to all concerned areas, where the actual work is being performed. The CONTRACTOR shall be also provide the COMPANY's inspector all means and facilities necessary to carry out inspection.

b) The COMPANY is entitled to depute its own inspector to the shop or field where pre –fabrication and erection of pipelines are being done, with (but not limited to) the following objectives :-

i. To check the conformance to relevant standards / specifications and suitability of various welding equipment and be welding performance.

ii. To supervise the welding procedures qualification.

iii. To supervise the welder's performance qualification.

iv. To carry out visual / NDT examination of the weldings.

v. To check whether shop / field welding is being executed is in conformity with the relevant specification and codes of practice followed in pipe construction.

c) CONTRACTOR shall intimate sufficiently in advance the commencement of qualification tests, welding works and acceptance tests, to enable the COMPANY's inspector to be present to supervise the same.

12.2 Welding Procedure Qualification

a) Welding procedure qualification shall be carried out in accordance with the relevant requirements of API 1104 latest edition or other applicable codes and other job requirements by the CONTRACTOR at his expense. The CONTRACTOR shall submit the welding procedure specification chart format as per Annexure- III (attached) immediately after the receipt of the order.

b) COMPANY'S inspector will review, check and approve the welding procedure submitted and shall release the procedure for procedure qualification tests. The procedure qualification test shall be carried out by the CONTRACTOR under field conditions at his own expense. A complete set of test results in format as per Annexure-III (attached) shall be submitted to the COMPANY's Inspector for approval immediately after completing the procedure qualification test and at least 2 weeks before the commencement of actual work. Standard test as specified in the code shall be carried out in all cases. In addition to these, tests, other tests like radiography, macro / micro examination, hardness tests, dye penetrate examination, charphy V-notch etc. shall be carried out on specimens. It shall be the responsibility of the CONTRACTOR to carry out all the tests required to the satisfaction of the COMPANY's Inspector. The destructive testing of welded joints shall be as per Clause 14.0.

12.3 Welder's Qualification

a) Welders shall be qualified in accordance with the API 1104 and other applicable specifications by the CONTACTOR at his expense. His qualification shall include toughness testing requirements as applicable for the line pipe. The butt weld test pieces of the qualification test shall meet the radiographic test requirements specified in Clause 12.5 and 16.0 of this specification. The welder qualification shall be –done only on project plant pipe. The COMPANY's Inspector shall witness the test and certify the qualification of each welder separately. Only those welders who have been approved by the COMPANY's Inspector shall be employed for welding. CONTRACTOR shall submit the welder qualification test reports in the standard format as shown in Annexure-IV and obtain express approval, before commencement of the work. It shall be the responsibility of CONTRACTOR to carry out qualification tests of welders.

b) The welders shall always have in their possession the identification card as shown in Annexure-V and shall produce it on demand by the COMPANY's Inspector. It shall be the responsibility of the CONTRACTOR to issue the identity cards after it has been duly certified

by the COMPANY.

c) No welder shall be permitted to work without the possession of identity cards.

d) If a welder is found to perform a type of welding or in a position for which he is not qualified, he shall be debarred from doing any further work. All welds performed by an unqualified welder shall be cut and redone by a qualified welder at the expense of the CONTRACTOR.

12.4 Visual Inspection

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

12.5 Non Destructive Examination

The non destructive examination shall mainly consist of examination using x-ray, Gamma-ray radiography as detailed in Clause 16.0 Radiographic examination of one hundred percent (100%) girth welds will be required by the COMPANY. In case of radiography is not possible due to safety reasons, weld shall be examined by using ultra sonic techniques. Prior Approval shall be taken from SGL.

For 150# Rating Pipeline, welds shall meet the standards of acceptability as set forth in API 1104. However for higher class rating pipeline welds shall meet the standards of acceptability as set forth in API 1104 and as well as the requirements laid in subsequent paragraphs.

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

The COMPANY will review all the radiographs of welds and inform the CONTRACTOR regarding acceptable welds. The decision of the COMPANY shall be final binding in the regard.

I Any length of inadequate penetration of the root bead as defined by API 1104 is not acceptable except that root concavity is allowed as per API 1104.

II Any amount of incomplete fusion at the root of the joint as detailed in Para 6.3.4 of API 1104 sixteenth edition May, 1983 (Ref. Fig. 13) is considered unacceptable.

III Unprepared burn through areas are unacceptable. IV No

root crack shall be permitted.

All requirements mentioned in the specification shall be arranged and executed by the CONTRACTOR through his own resources. In addition, for pipes with wall thickness 9.5mm and above, ultrasonic inspection is required in the following cases as per clause 15.0 of this specification.

a) On the first 100 welded joints corresponding to each automatic (GTAW / GMAW) welding procedure used.

b) When 20mm or more are cut from the pipe end as supplied, the ends shall be ultrasonically inspected for an additional length of 20mm to assure no lamination exist.

c) When welds are repaired.

d) When in the opinion of COMPANY, ultrasonic inspection is required to confirm or clarify defects indicated by radiography.

e) When automatic procedure is used at least 10 cm on each weld shall be ultrasonically inspected at COMPANY's discretion.

In addition, ultrasonic inspection may be required for certain critical welding of the pipeline (i.e. tie-ins, welding of valves, flanges) randomly selected at COMPANY's discretion. All fillet and groove welds other than the radiography shall by subjected to dye penetrate / MP inspection. The non destructive test system used for inspecting welds must be approved by the COMPANY.

Weld quality is judged on the basis of the acceptability criteria mentioned below.

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

In addition to the API-1104 requirements, the welds containing cracks including crater cracks regardless of size of location is unacceptable.

1. Any length of inadequate penetration of the root bead as defined by API-1104 is not acceptable except that root concavity is allowed as per API-1104.

2. Any amount of incomplete fusion at the root of the joint as detailed in API – 1104 is considered unacceptable.

3. Unprepared burns through areas are unacceptable.

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

12.6 Destructive Testing

The COMPANY has the authority to order the cutting or upto 0.1% of the total number of welds completed for destructive testing at no extra cost of COMPANY. The destructive testing of weld joints shall be made as per Clause 14.0.

In addition, welds already cut out for defects for any reason may also be subjected to destructive testing. The sampling and the re-execution of welds shall be carried out by the CONTRACTOR at his own expense. If the results are unsatisfactory, welding operations shall be suspended and may not be restarted until the causes have been identified and the CONTRACTOR has adopted measures which guarantee acceptable results. If it is necessary in the COMPANY's opinion the procedure shall be re-qualified. The weld joint represented by unsatisfactory welds shall stand unless investigation proves otherwise.

13 REPAIR OF WELDS

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

Welds having defects shall be removed or repaired in accordance with API 1104 or ASME Boiler and Pressure Vessel (BPV) code section IX as applicable.

A separate welding procedure specification sheet shall be formulated and qualified by CONTRACTOR for repair welds simulating the proposed repair to be carried out. Separate procedures are required to be qualified for (a) thorough thickness repair (b) external repair and (c) internal repair. Welders shall be qualified in advance for repairs and in accordance with "Qualification and Procedures of Welders".. The root pass, for repairs opening the root, shall be done by the vertical up technique. The procedure shall be proven by satisfactory procedure tests to API 1104 including the special requirement of the specification, and shall also be subject to metallographic examination, hardness surveys and Charpy tests to determine the effects of repair welding onthe associated structure.

Root sealing or single pass repair deposit shall not be allowed. Internalroot defects shall be ground thoroughly and welded with a minimum oftwo passes. However, while grinding for repairs, care shall be taken toensure that no grinding marks are made on the pipe surface anywhere. The repair shall be subjected, as a minimum requirement to the sametesting and inspection requirements as the original weld. The re-radiography of repaired weld shall be limited to 6" weld length on eitheredge of the repaired area. A 100% ultrasonic test shall be done at therepaired area externally. Any repaired area that is wide, irregular ofrough shall be rejected and full cut out shall be done.

The repair weldingshall have a minimum preheat of 100^0C and shall be preheated for atleast 150mm on either side of repair only low hydrogen electrodes shallbe used for repair of Welds.

Repairs are limited to a maximum of 30% of the weld length. Welds not meeting the specification after one repair shall be cut out depending upon the extent of repair. A report of all repairs shall be maintained by CONTRACTOR.

13.2 Limitations on Repairs

Only One attempt at repair of any region is permitted. Repairs are limited to a maximum of 30% of the weld length measuring over cap. Welds containing cracks shall be cut out and rebevelled to make a joint.

13.3 **Weld Rejected by Accumulation of Defects**.

Where a weld is rejected by the accumulation of defect clause, as defined by API 1104 and this specification, repairs within these limitations are permitted. Defects in the filling and capping passes shall be repaired preferentially.

13.4 Acceptance criteria for welding procedure qualification & their testing, welder qualification & their testing and non-destructive examination of welded joints shall be as per API-1104 (Latest Edition).

13.5 Same Criteria as mentioned above shall also be applicable for aboveground piping system.

14. DESTRUCTIVE TESTING OF WELDED JOINT – BUTT WELDS

Preparation

Having passed the visual and the non – destructive – inspection the testweld shall be subject to mechanical test.

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

Weld specimens shall be taken from the positions as per approved WPS for this reason it is necessary to take the previous non-destructive tests into account. The minimum number of tests to be carried out is given in Table-1 of this specification

The tests shall be carried out in laboratories approved by the COMPANY. The specimens shall be prepared in accordance with the figures given in the paragraphs which refer to the individual tests.

Tensile strength

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

14.2.1 **Method**

The test shall be carried out in accordance with ISO : 375

Table-1

Type and Number of Test Specimens for Procedure Qualification Test & production Welds

Pipe size. Out side Diameter-Inches	Number of Specimens									
	Tensile API	Tensile ISO	Nick Break	Root Bend	Face Bend	Side Bend	Macro Bend	Hardness	Impact	Total
Wall Thickness- 1/2 inch (12.7mm) and under										
Under 2-3/8	0	0	2	2	0	0	0	0	0	4
2- 3/8 to 4- ½ Incl.	0	0	2	2	0	0	0	0	0	4
Over 4- ½ less than 12.75	2	0	2	2	2	0	2	2	12	24
12 – ¾ and over	2	2	4	4	4	0	2	2	24	44
Wall Thickness – Over ½ Inch (12.7mm)										
4 – ½ and smaller	0	2	0	0	0	2	0	0	0	4
Over 4 – ½ Less than 12- ¾	2	0	2	2	2	0	2	2	12	24
12 – ¾ and over	2	2	4	0	0	8	2	2	24	44

14.3 Nick – Break Test

14.3.1 Preparation

Specimens for Nick-break test with notched thus worked can break in the base metal, instead of in the fusion zone; therefore an alternative test piece may be used after authorization by the COMPANY with a notch cut in the reinforcement of outside weld bead to a maximum depth of 1.5m measured from the surface of the weld bead.

14.4 Macroscopic Inspection

14.4.1 Preparation

Specimens shall be taken from the positions as Indicated in the approved WPS and shall be prepared in accordance with ASTM E2 and E3.

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

14.4.2 Method

Specimens shall be carefully examined under the microscope, with a magnification of at lest 25 times (25:1). The COMPANY may ask for amacrograph with 5 times (5:1) magnification for DOCUMENTATION purposes.

14.4.3 Requirements

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

14.5 Hardness Test

14.5.1 Preparation

The prepared macro section is to be used for hardness testing using the Vickers method with 10kg load Indentations are to be made along traverses each approximately 1mm below the surface on both sides ofthe weld.

In the weld metal a minimum of 6 indentations equally spaced along the traverses are to be made. The HAZ indentations are to be made along the traverses for approximately 0.5 mm each into unaffected materials, and starting as close to the fusion line as possible.

One indentation on each side of the weld along each traverse is to be made on parent metal Refer Fig. 3 The indentations are to be made in the adjacent regions as well on the opposite sides of the macro section along the specified traverses.

14.5.2 Method

The test shall be carried out in accordance with Recommendation ISO R81, Vickers hardness, using a laboratory type machine controlled as pre-recommendation ISO R 146 and using a diamond pyramid penetrate set at 2.37 red (136^0) with a load of 10 Kg.

14.5.3 Requirements

Hardness value shall not exceed the limit specified in welding Specification chart. In case of a single reading having a slightly (+10 HV) higher value than the specified limit, further indentations shall be made to check if the high value was an isolated case.

All the hardness values contained from the heat affected zone shall not exceed 100 HV with respect to the average hardness of the values obtained for the base metal. If these additional tests give hardness within the specification limit the slightly higher value may be accepted.

14.6 Charpy – V – Notch Impact Test

14.6.1 Specimens shall be taken from the position as per approved WPS. The test specimens will be prepared in accordance with ASTM-370 Charpy V- notch Specimens shall have dimensions as given in Fig. 3 of this specification.

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

Sl. No.	Nominal Wall Thickness in mm.	Test Specimen width mm
1.	Over 12	10
2.	Over 9.5 and up to 12	7.5
3.	From 7 up to 9.5	5
4.	Less than 7	2.5

14.6.2 Test Method

The test shall be carried out as indicated in ASTM-370 “Beam impact test V-notch”.

Test pieces shall be immersed in a thermostatic bath and maintained at the test temperature for at least 15 minutes. They shall then be placed in the testing machine and broken within 5 seconds of their removal from the bath. The test temperature shall be as mentioned in Special conditions of the Contract.

14.6.3 Requirements (Note-1)

The impact energy shall be :

Sl No.	Test Specimen	Average of three Specimens (Note-2)	Minimum Single Value (Note-1)
	In mm	Joules (Min.)	Joules
1.	10.0	27.0	22.0
2.	7.5	21.5	17.0
3.	5.0	18.5	15.0
4.	2.5	10.00	8.0

Note :

1) Only one value is permitted to be lower than average value up to the value specified.

2) These value are specified for resistance to brittle fracture only. Where additional requirements are specified in project data sheet. (Ex. Pipeline materials with arrest properties i.e. a higher upper shelf charpy V-energy for resistance against propagating ductile fractures) the same shall be followed.

14.7 Bend Test Requirements

The Bend test Specimens shall be made and tested as per the requirements of API 1104 Sixteenth Edition May 1983 except that the dimensions of the Jig for guided bend test Fig. 5 para 2.6 API 1104 shall be modified as follows

Radius of the Plunger 'A' : 2t

Radius of the die 'B' : 3t + 1.6mm

Radius of the die 'C' : 50.8mm

The acceptance criterion on shall however be as per para 2.643 and2.653 of API 1104 Eighteenth edition May 1994.

Note : t = thickness of specimen.

15. ULTRASONIC INSPECTION

In addition to the radiographic inspection, ultrasonic inspection is required as per conditions listed in paragraph 12.5 of this specification. This section concerns manual ultrasonic inspection. However ultrasonic by automatics equipment may be used if approved by the COMPANY.

15.1 Equipment and Operators

The CONTRACTOR who carries out the ultrasonic inspection shall have sufficient qualified personnel equipment and instruments at his disposal to be able to affect the tests without hindering or delaying the pipeline assembly operations.

The operators shall be fully qualified as per a recognized standard (ASME Sec.V or equivalent) and they shall have as minimum level it. The operators shall be able to :

- Calibrate the equipment;
- Perform an operational test under production conditions;
- Interpret the screen picture;
- Evaluate the size and location of reflectors
- Interpret the type of defects detected.

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

The CONTRACTOR appointed to carry out ultrasonic inspection shall supply all the instruments necessary for their execution on site.

15.2 Specification for Ultrasonic Inspection Procedure Qualification

Before work beqins, the CONTRACTOR shall present a specification describing the proposed U.T. procedure qualification.

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

- Type of U.T. equipment used.
- Type and dimensions of transducers
- Frequency range
- Details for calibration
- Coupling medium
- Inspection technique
- Record details
- Reference to the welding procedure where it is intended to adoptthe specification.
- Temperature range of the joints to be inspected.

15.3 Qualification of Ultrasonic Inspection Procedure

The ultrasonic Inspection procedure shall be approved by the COMPANY. Before inspection beings, the COMPANY may require the qualification test of the ultrasonic inspection procedure. This specification test consists in testing (under normal operation conditions) some CONTRACTOR welds made according to the same production procedure, where there are typical defects the test intends to detect.
This test shall be conducted in the presence of the COMPANY.

15.4 Test Procedure

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

The surface with which the probes comes into contact shall be free of metal spatter, dirt, iron oxide, and scales of any type; therefore it shall be necessary to clean a strip at least 50mm wide on both sides of the weld with steel wire brushes and anyhow the cleaned strip must be atleast wide enough to allow full skip examination.
If, during the test, echoes of doubtful origin appear, it shall be necessary to inspect a convenient area on the pipe surface, close to the weld, with a straight beam transducer in order to check whether any manufacturing defects are present which could have interfered with the ultrasonic beam.

By way of an example, the equipment shall include but not be limited to the following:

- Ultrasonic equipment and coupling medium
- Sample sections for calibration of instruments.
- Equipment for cleaning of surface to be examined.
- Rules calibrated in centimeters for exact location of the position of defects.

The characteristics of the above – listed instruments and equipment shall guarantee.

a) that the required standards of the inspection procedure, as previously established and approved by the COMPANY, are satisfied.

b) Continuous operation

All the instruments and equipment shall be approved by the COMPANY before being used. The COMPANY has the authority to reject any item which is considered unsuitable. The decision of the COMPANY is final. The CONTRACTOR appointed to carry out ultrasonic inspections shall also ensure the operational efficiency and maintenance of the instruments and equipment,

and shall immediately substitute any item rejected by theCOMPANY.

All the instruments and equipment necessary for carrying out ultrasonic inspection on site shall satisfy the requirements laid down by the public boards of institutions which regulate ‘safety at work’.

15.5 Ultrasonic Instruments.

The Ultrasonic Instruments shall satisfy the following..

- Be pulse type, able to generate, receive and display, on the screen a cathode ray tube (CRT) pulse at frequencies between 1 and 6 MHz. The useful part of the CRT screen shall be at lest 70mm wide and at least 50mm high.
- Shall have variable amplification, with steps of 1 or 2 dB over a range of at lest 60dB.
- The regulation control shall be accurate to within +1 db and this accuracy shall be certified by the instrument manufacturer.
- May be powered by a battery or an electric generator. In the first case, the autonomy of operation (endurance) of the instrument shall be sufficient to carry on working without frequent interruptions, and the instruments shall be equipped with an automatic switch which switches it off when the battery runs down; in the second case there must be a voltage stabilizing device with a tolerance of +2 Volts.

15.6 Probes

The probes used shall have dimensions, frequencies, and a refraction angle suited to the type of steel, the diameter, the thickness of the pipe and to the joint design.

15.7 Reference Sample Pieces

The efficiency of the equipment used, the effective refraction angle of the probe, and the beam output point, shall be checked using a V_1 and V_2 sample block, IIW type or calibration block ASTM E-428.

For the calibration of runs and the regulation of detection sensitivity during the test, a calibration piece shall be used. This piece shall be taken from the production material, and will be least 150mm long (measured in the direction of the axis), and at least 50mm wide (measured in the direction of the circumference) (see Fig. 4 of this specification).

In the middle of the inside and the outside surface of the calibration piece a groove shall be made. The groove will have a rectangular cross section, a flat bottom and the following dimensions.

- Depth : 1 ± 0.1mm
- Breadth (measured parallel to the 150mm side) : 1 ± 01mm
- Length (measured parallel to the 50mm side) not less than 30mm

In addition, the calibration piece shall have a hole, 2mm in diameter, passing

through its thickness and positioned so that during calibration the echoes returning from the two grooves do not interfere with those returning the hole.

15.8 Calibration

For a precise check of the sound paths necessary for a full inspection of the weld joint, the probe shall be moved (half skip and full skip distance) until internal and external notches on the test piece are detected (See Fig. 5 of this specification).

The relevant defect limits the path lengths on the time base. The calibration of reference sensitivity is obtained by utilizing the through – drilled test hole in the thickness of the reference block to draw the distance – amplitude correction curve relevant to the test probe.

Calibration shall be carried out according to the following procedure ; place its internal vertex until the maximum height of echo is displayed on the screen; this echo is adjusted to 80% of full screen height by means of the sensitivity adjuster set in dB. Without varying the amplification, the probe placed at full skip distance from the hole is moved to detect the external vertex of the hole until the maximum height of echo is obtained. The straight line connecting the peaks of the two echoes obtained by the above procedure, represents 100% reference level, while the one connecting the two points at half height of the same echoes represents “50% reference level”.

The two straight lines shall be marked on the screen with a pen. Calibration shall be repeated each time tests are re-started; at intervals not longer than 30 minutes during normal operations; each time the conditions fixed in advance are altered. This calibration is applicable provided that the crystal of the probe is 8 x 9mm size. Should this size of the crystal be different, the value of the sensitivity obtained from the calibration by a crystal of a different, the value of the sensitivity obtained from the calibration by a crystal of a different size shall be brought to the value of sensitivity obtained from the calibration by a 8 x 9 mm crystal. The sensitivities of the two different size probes shall be compared through the echoes obtained on the notch of the test piece with the probe position at half skip of the distance.

15.9 Regulation of Amplification During Production Testing

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

15.10 Qualification of Ultrasonic Testing Operators

Before the inspection begins or during the same inspection, the COMPANY may require a qualification test for the ultrasonic equipment operators.

15.11 Evaluation of Indications Given by Ultrasonic Tests

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

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

15.12 Other Equipment

The use of rules calibrated in centimeters, attached if possible to the probe, for the precise location of the position of welding defects, is recommended. Defect location is effected by measuring the projection distance between the probe output and the reflecting surface.
The operators carrying out the tests shall have besides the probing instrument, tools for cleaning the pipe surface (files, brushes, etc.) as well as, the coupling liquid or pasts appropriate for the temperature of the section to be examined.

16. RADIOGRAPHY

16.1 Scope

This covers the radiographic inspection of all types of welded joints ofthe main pipeline.

The welded joints shall include the following :-

I Full girth welds on the mainline construction including doublejointing of pipe, if adopted.

II Welds for installation of block valves, insulation joints and other appurtenances and tie-ins.

III Welds at scraper launching and receiving barrels.

Iv Terminal Piping

16.2 Applicable Standards

This specification shall apply in conjunction with the following (all latest

editions).

I API 1104, Standard for welding Pipelines and Related facilities.

II ANSI B31.8, Code for Gas Transmission and Distribution Piping Systems

III ANSI B31.4 Code for Liquid Petroleum Transportation Piping Systems.

IV ASTM E94, Recommended practice for Radiographic Testing.

V ASTM E142, Standard Method for Controlling Quality of Radiographic Testing.

VI The American Society for Non-destructive Testing. Recommended Practice No. SNT – TC – 1A Supplement A.

16.3 Procedure

16.3.1 The radiographic examination procedure to be adopted shall be submitted by the CONTRACTOR as per Annexure – VI.

16.3.2 The procedure of radiographic examination shall be qualified to the entire satisfaction of COMPANY prior to use. It shall include but not be limited to the following requirements:

I Lead foil intensifying screens, at the rear of the film shall be used for all exposures.

II Type 2 and 3 films as per ASTM E-94 shall be used.

III A densitometer shall be used to determine film density. The transmitted film density shall be 2.0 and 3.5 throughout the weld. The unexposed base density of the film shall not exceed 0.30.

IV Radiographic identification system and documentation for radiographic interpretation reports and their recording system.

16.3.3 The CONTRACTOR shall qualify each procedure in the presence of the COMPANY prior to use.

16.3.4 The procedure of radiographic examination shall produce radiographs of sufficient density, clarity and contrast so that defects in the weld or in the pile adjacent to the weld, and the outline and holes of the penetrameter are clearly discernible.

16.3.5 All the girth welds of mainline shall be subjected to 100% radiographic examination. The CONTRACTOR shall furnish all the radiographs to the COMPANY, immediately after processing them, together with the corresponding interpretation reports on approved format. The details of the radiographs all

along with the joint identification number shall be duly entered in a register and signed by the CONTRACTOR and submitted to the COMPANY for approval.

16.3.6 When the radiation source and the film are both on the outside of the weld and located diametrically opposite each other, the maximum acceptable length of film for each exposure shall not exceed the values given in Table-4 of API 1104. The minimum film overlap, in such cases, shall be 40mm. The ellipse exposure technique may be used on nominal pipe sizes of 2 inch and smaller provided that the source of film distance used is a minimum of 12 inch.

16.3.7 Three copies of each acceptable radiographic procedure (as per Annexure-VI) and three copies of radiographic qualification records shall be supplied to COMPANY. One set of the qualifying radiographs on the job shall be kept by the CONTRACTOR's authorized representative to be sued as a standard for the quality of production radiographs during the job. The other two sets shall be retained by COMPANY for its permanent record.

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

16.3.9 The CONTRACTOR shall, on a daily basis, record for each radiograph (1) radiograph's number, (2) welder's number (3) approximate chainage of weld location, (4) whether or not the welds meet the specified acceptance standards and (5) the nature and approximate location of unacceptable defects observed. It must be possible to relate back to a particular butt weld and welder on piping drawing and pipe line alignment drawing.

16.3.10 Each day's production of processed radiographs shall be properly packaged separately, identified by at least the (1) date, (2) radiographic Unit, (3) job locations, (4) starting and ending progress survey stations and (5) shall include original and three copies of the daily radiographic record. The package shall be submitted to the COMPANY daily when possible, but in no event later than non of the following day.

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

16.3.12 The CONTRACTOR, If found necessary, may modify the procedure of radiographic examination suiting to the local conditions prevailing. This shall, however, be subject to the approval of the COMPANY.

16.3.13 COMPANY shall have free access to all the CONTRACTOR's work facilities in the field.

16.3.14 Any approval granted by the COMPANY shall not relieve the CONTRATOR of his responsibilities and guarantees.

16.4 Radiation Sources

16.4.1 Radiographic examination shall be carried out using x –radiations, Radiographic examination by Gamma rays may be allowed, at the discretion of the COMPANY, in case of inaccessible joints. Radiography by Gamma – Ray for tie-in joints shall be acceptable provided D4 AGFA film or equivalent is used and the required sensitivity obtained.

16.4.2 Whenever possible, pipeline welds will be inspected by placing the radiation source inside the pipe, on the pipeline axis, with a radiation of 6.28 rad. (360^0C).

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

40mm at the ends of each film shall be required to ensure that the first and last location increment numbers are common to successive films and to establish that no part of a weld has been omitted.

16.5 Level of Quality

The quality level of Radiographic sensitivity requited for radiographic inspection shall be at least equivalent to the values in Fig. 6.

16.6 Penetrameters

The image quality indicator (abbreviation: IQI) shall be used for the qualification of the welding procedure and during normal line production. Radiographic sensitivity shall be measured with the wire image quality indicator (Penetrameters). The Penetrameters shall be selected according to DIN54109 or ISO1027. For radiographs made with the source on the outside, a penetrameter shall be placed on each side of the film with the smaller wire of the penetrameter turned towards the end of the film with the smaller wire of the penetrameter turned towards the end of the film it self. When a completed weld is radio graphed in a single exposure using a source inside the piping, four penetrameters approximately equally spaced around the circumference shall be used. During the procedure qualification, IQI shall be placed both on the source side and on the film side. The sensitivity obtained with IQI on the source side shall not be less than the values shown in Fig. 6 of this specification.

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

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

16.7 Film Identification Markers

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

16.8 Protection and care of film

16.8.1 All unexposed films shall be protected and stored property as per the requirements of API 1104 standard and ASTM E. 94.

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

16.9 Re-radiography

16.9.1 The weld joints shall be re-radiographed in case of unsatisfactory quality of the radiographs, at the expense of the CONTRACTOR.

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

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

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

16.10 Qualification of Radiographers

16.10.1 Pipeline radiographers shall be qualified in accordance with the requirement of API 1104 and to the full satisfaction of COMPANY.

16.10.2 Certificate of all the radiographers, qualified as per ASNT-TC-1A Levor-2 above, shall be furnished by the CONTRACTOR to the COMPANY before a radiographer will be permitted to perform production radiography. The certificate record shall include.

I Background and Exprerience Record.II

Training Course Record.

III Technical Examination Record.

IV Doctor's report on radiographer's 0aecurer 0-1 acquity eye test. V

Date of qualification

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

16.11 Preservation of Radiographs.

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

16.11.2 All radiographs shall become property of the COMPANY.

16.12 Equipment and Accessories.

16.12.1 CONTRACTOR shall make necessary arrangement at his own expense, for providing the radiographic equipment, radiographic film and all the accessories for carrying out the radiographic examination for satisfactory and timely completion of the job.

16.12.2 For carrying out the mainline radiographic examination the CONTRACTOR shall be equipped with suitable mobile / stationary type dark rooms.

16.13 Radiation Protection

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

16.13.2 The protection and monitoring shall comply with local regulations.

16.13.3 In view of visual hazards in the handling of Radioactive source of material, CONTRACTOR shall be solely responsible for complying with all rules and regulation set forth by Atomic Energy Commission or any other Government agency of India in this regard and COMPANY shall not be responsible and shall be kept indemnified by the CONTRACTOR for default (s) responsible and shall be kept indemnified by the CONTRACTOR for default (s) whatever nature by the CONTRATOR, Safety equipment as considered adequate by the COMPANY for all necessary personnel shall be made available for use and maintained for immediate and proper used by the CONTRACTOR.

16.14 Display of Safety Instructions

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

16.15 Enforcement of Safety Regulations

16.15.1 To ensure effective enforcement of the rules and regulations relating to safety precautions, the arrangement made by CONTRACTOR shall be open to inspection by COMPANY or its representatives.

16.16 First Aid and Industrial Injuries.

16.16.1 CONTRACTOR shall maintain first aid facilities for its employees and sub-contractors.

16.16.2 CONTRACTOR shall make outside arrangements for ambulance service and for treatment of industrial injuries. Names of those providing these services shall be furnished to COMPANY prior to start of work and their telephone no. shall be posted prominently in CONTRACTOR'S field office.

16.16.3 All critical industrial injuries shall be reported promptly to the COMPANY and a copy of CONTRACTOR'S report covering each personal injury requiring the attention of physician shall be furnished to the COMPANY.

16.17 No. Exemption

16.17.1 Notwithstanding the above there is nothing in these to exempt the CONTRACTOR from the operation of any other act or rules in force.

ANNEXURE-I

ELECTRODE QUALIFICATION TEST RECORD

A. Tested at (Site name) Date :

Manufacturer's Name :
Brand Name :
Batch Number & Size Tested :
Classification & Code :
Intended for Welding in Positions :In
combination with (if any) :
Code of Reference :
(used for testing)
Special requirements
:

B. All weld Tensile Test :

Base Material used :
Pre-heat temp :
Postweld Heat Treatment Details:
Visual Examination :
Radiographic Examination Results :
Tensile Test Results
:

Sl. No.	Identification No.	U.T.S.	Yield Point	Elongation
1.				
2.				

ANNEXURE-I

Sheet 2 of 3

C. Impact Test Results :

Test Temperature : Notch in :

Type of Specimens : Size of Specimens :

(Charpy)

Sl. No.	**Specimen No.**	**Impact Valve**	**Average**
1.			
2.			
3.			
4.			
5.			
6.			

D. Chemical Analysis Result

Electrode Size used :

Batch No. :

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

E **Fillet weld Test Results :**

Welding Positions :

Base Materials :

Size of Electrode used :

Visual Inspection Results : 1)

2)

ANNEXURE-I
Sheet 3 of 3

Fracture Test Results:

Remarks :

F. **Other Test Results:**

1. Transverse Tensile Test :

In combination with :

Base Material Used :

Position of Welding :

Preheat Temperature :

Post Weld Heat Treatment :

Radiography :

Identification No.	U.T.S.	Fracture in	Remarks

2. Guided Bend Test

Position	ID No.	Root, Face or Side Bend	Remarks
1.			
2.			
3.			
4.			
5.			

Any other Tests :

ANNEXURE-II

STRESS RELIFE 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. (C) :

Method of Temp :

Measurement :

Atmosphere Control :

3. Heat Treatment Cycle Details :

Changing Temp. C :

Rate of Heating, C / Hr. :

ANNEXURE-II

Sheet 2 of 2

Soaking Temp. C

Soaking time, Hrs. Rate

of Cooling, C / Hr.Mode

of Cooling

4. Other Details, if any.

Notes :

The following documents shall be furnished along with the specifications :

i. Material Test Certificates

ii. Assembly / Part Drawing.

ANNEXURE-III

Sheet 1 of 3

WELDING PROCEDURE QUALIFICATION TEST RECORD

Example of record form for welding procedure approval test :

Project / Contract		Contractor	
Pipe and Coating Material			
Process			
Outside DiameterPipe			
Thickness			
Joint Design (Sketch Attached)			
Make and type of filler Metal	Diameter	Current	Volts
Root Second RunOther Runs			
Other Electrical Characteristics	a c/d. c	Electrode +ve / - ve	

Shielding Gas	:	
Type of mixture Flow	:	
Shielding Flux	:	
Position	:	

Direction of Welding	:	
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	:

ANNEXURE-III
Sheet 2 of 3

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 commencementAnd
completion or weld

Type of line-up clamp

Removal of clamp after run :

Lowering off after run :
Cleaning
Preheating
Minimum temperature ^{0}C Ambient Temperature ^{o}C
Type of heater to be used

Interpass temperature

Minimum ^{o}C Maximum ^{o}C

Post weld heat treatment

Speed of travelTest

Results

State acceptable non-acceptable
(with reasons) or give numerical resultsNon –

destructive test :

Visual
Radiograph

ANNEXURE-III

Sheet 3 of 3

Destructive Tests 1 2 3 4

Transverse tensile
Tensile strength (with units)

Fracture location Test
temperature Macro –
examinationFillet weld
fracture

Hardness Survey :-

Type Load Location of hardness measurement (Sketch)

Hardness rang :

Parent 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 result e.g. chemical analysis, micro – examination, CTODtests, bend tests etc.

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

InspectorDate

:

ANNEXURE-IV

Sheet 1 of 1

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
Direction of travel	Root : Vertical Up / Vertical Down	Fill and cap: Vertical up Vertical down

Reason for failureVisual

Non-destructive testing
Butt joint
Fillet weld
Number of attempts
Comments

ANNEXURE-V

Sheet 1 of 1

WELDERS INDENTIFICATION CARD

Name	:	
Identification	:	Photograph
Date of Testing	:	
Valid Until	:	
Welding Position	:	
Material	:	
Diameter	:	
Wall Thickness	:	
Type of Welding	:	
Consumables	:	

ANNEXURE-VI
Sheet 1 of 1

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 or 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.

CONTENTS

FIGURES

TABLES

1. SCOPE

1.1 This specification covers the minimum requirements of supply, works and operation to be performed by CONTRACTOR for hydrostatic testing of cross-country steel pipelines transporting hydrocarbons in liquid or gaseous phase under high pressure. This specification does not cover the requirements of drying/precommissioning of the tested pipelines. This specification shall be read in conjunction with the conditions of all specifications and documents included in the CONTRACT between COMPANY and CONTRACTOR.

2.0 REFERENCE CODES, STANDARDS AND SPECIFICATIONS

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

a) ANISI B 31.8 Gas Transmission and Distribution Piping Systems
b) ANSI B 31.4 Liquid Petroleum Transportation Piping system
c) API RP 1110 Pressure Testing of Liquid Petroleum Pipelines
d) ASME Sec. VIII Div.1 Boiler & Pressure Vessel Code.
e) OISD 141 Design & construction requirements for cross-country hydrocarbon pipeline.

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

2.3 For the purpose of this specification the following definitions shallhold.
- the words “shall” and ‘Must” are mandatory.
- The words ‘Should’, ‘May’, and ’Will’ are non-mandatory, advisory or recommended.

3.0 GENERAL

3.1 Hydrostatic test shall be performed on the entire length of thepipeline. Hydrostatic test shall be performed in accordance with

approved Hydrostatic Test diagrams for each test section. Themaximum length of each test section shall not exceed 25 kms.

3.2 For pipeline section which in COMPANY's opinion, once installed would require an inordinate amount of effort for repair in case of a leak, a provisional pre-tested shall be conducted, However, after installation, such pretested sections shall be tested again alongwith the entire pipeline.

3.3 Hydrostatic 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. Hydrostatic test shall include those sections which have been previously tested, viz Rail/ road crossing, major water crossings including test on banks and in place after installation, and scraper traps at the terminals CONTRACTOR shall perform all works required for hydrostatic testing after obtaining prior written approval from the COMPANY.

3.4 The pipeline shall be tested in accordance with the requirements of the latest edition of ANSI B 31.8 or ANSI B.31.4, OISD 141 as applicable, and requirements laid down in this specification.

4 HYDROSTATIC TEST PROCEDURE MANUAL

CONTRACTOR shall prepare for COMPANY'S approval a hydrostatic test procedure manual. The procedure shall strictly comply with the requirements of this specification and shall be submitted to COMPANY for approval well in advance. The procedure manual shall include all temporary materials & equipment, but not be limited to the following items.

a) For the systems to be tested a diagram indicating all fittings, vents, valves, temporary connections, relevant elevations and ratings. The diagram shall also indicate injection locations and intake and discharge lines.

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

c) Filling and flushing procedures, including a complete description of all proposed equipment and instruments (including spares) their location and set-up.

d) The type and sequence of pigs and the pig tracking systems for cleaning and removal of air pockets. Pig inspection procedures, including procedure to be followed in case the calliper pig indicates damage.

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

f) Pressure testing procedure including a complete description of all proposed equipment and instruments (including spares) their location and set-up and proposed system for observation and recording of data during the pressure test.

g) Procedure for detection and location of leaks.

h) Procedure for dewatering the pipeline section(s) after testing, including a complete description of all proposed equipment and instruments, (including spares) their location and set-up, the type and sequence of pigs and the pig tracking system along with the pig specifications.

i) Forms for recording the test data.

5 TEST DURATION AND PRESSURE

5.1 The duration of hydrostatic test shall be a minimum of 24 hours after stabilization and the test pressure shall be as indicated in the approved hydrostatic test diagram.

5.2 Unless specified otherwise in the CONTRACT, the maximum base pressure shall not be higher than the one resulting in a hoop stress corresponding to 90% of SMYS of pipe material based on the minimum wall thickness in the test section and minimum test pressure shall not be lower than the one resulting in a hoop stress corresponding to 85% of SMYS of pipe material based on the minimum wall thickness in the test section.

5.3 All buried steel pipelines and mains shall be pressure tested after installation using water as a test medium. Minimum test pressure shall be equal to 1.4 times *Maximum Allowable Operating Pressure.*

6 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 the following :

a) Pigs for filling, cleaning and gauging including.

- Cleaning pigs with spring loaded steel wire brushes except for internal coated pipes. In this case pigs to be provided with nylon / polyurethane brushes.
- Four cup batching pigs.
- Caliper pigs with gauge plate diameter equal to 95% of the heavy wall pipe in the pipe sections. Gauging pig fitted with gauge plate.

The CONTRACTOR shall provide sufficient number of pigs including spares.

b) Fill pumps : The CONTRACTOR shall determine the type andnumber of fill pumps in order to guarantee the following.
Differential head 20% greater than the maximum required.Flow rate : 400m3 min. 200m3 max.
If single pump is used, a standby unit must be available.

c) 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.

d) 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.

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

f) Bourdon pressure gauges of suitable pressure range and accuracy.

g) Dead weight testers with an accuracy of 0.01 bar measuring in increments of 0.05 bar provided with a calibration certificate not older than one month.

h) Two 48 hours recording pressure gauges tested with charts and ink gauges tested with dead weight tester prior to use. These shall be installed alp the test heads.

i) Pressure recording charts.

j) Two temperature recorders for fill water.

k) Thermocouples for measuring the pipe wall temperature.

l) Two laboratory thermometers 0*C to 60*C range, accuracy + 0.1 degree to be used in their no wells.

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

n) Injection facilities to inject additives into the test medium in the required proportions.

o) 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.

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

The test heads shall be sized in conformity with ASME specification Section VIII, Division 2 with particular reference to Appendices 4 and 5.

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

- 1 thermocouple at about 500 m distance from the pumping head.
- 1 thermocouple every 2500 m of the pipe the spacing may be increased to maximum 5000m depending on the terrain and nature of sub-soil along the alignment of section.
- 1 thermocouple at about 500 m distance from the terminalhead.

7 PROCEDURES

7.1 Equipment and/or parts which need not or must not be subjected to the test pressure must be disconnected or separated from the pipeline to be tested.

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

The pipeline test shall exclude long segments of line exposed to atmospheric conditions, viz Aerial lengths on piers, suspension bridges, etc, which shall be tested separately.

7.3 The test medium shall be soft non-aggressive water furnished by the CONTRACTOR. The water to be used shall be filtered, shall not be contaminated, and free from sand or silt. CONTRACTOR shall submit laboratory test reports of water used for testing. The possible use of sea water shall be subject to its degree of cleanliness, the possibility of obtaining a pre determined salinity neutralization and the use of corrosion inhibitors, this at the sole discretion of COMPANY, CONTRACTOR shall provide COMPANY approved corrosion inhibitors, oxygen scavengers and bactericides to be added to the test water. The CONTRACTOR shall furnish and install all temporary piping which may be necessary to connect from source of water to its pumps and manifolds/ tankage.

7.4 Before filling operation the CONTRACTOR shall clean the pipeline by air driven pigs provided with spring loaded bushes and chisets to remove all mill scale rust/ sand from the inside of pipe section. For

this purpose temporary header for air cleaning shall be attached to the pipeline. The number of pig runs is depending upon the cleaning results and shall be determined by the COMPANY at site.

7.5 After cleaning the pipeline by using air and acceptance by cmpany, gauging shall be carried out by using gauging pig. The gauge plate diameter shall be equal to 95% of inside diameter of the heaviest wall pipe in the test section. While computing the ID of heaviest wall pipe, pipe manufacturing tolerance shall not be considered. A 10 mm thick minimum plate shall be used for making gauge plate.

After receipt of gauging pig at the other end, the gauge plate shall be inspected in the presence of Company representative. A deformed, bent or severally nicked plate or damaged pig shall be evidence of gauging pig run failure and the same is not acceptable to company. In such cases the Contractor shall repair and rectify the line and repeal the gauging pig run to the satisfaction and approval of the Company Representative. Any obstruction and/or faults such as dents, buckles, flat spots, etc. analyzed and noted during gauging pig run shall be located and any necessary repair work shall be performed to rectify the same to the satisfaction of the Company. A written approval shall be obtained from Company regarding successful completion of gauging pig run.

After acceptance of gauging operation, air header shall be cut and removed protested test headers loaded with three numbers of four cup batching pigs shall be welded to test Section. Un-inhibited water equal to 10% of the volume of test section shall be introduced in front of the first pig. The first pig shall be launched by introducing about 1.5 km un-inhibited water. Then the second pig shall be launched by pumping the inhibited water till the second pig is received at the other end. The thermal stabilization and pressurization can now the started".

7.6 Thermal Stabilization

After a check has been made to confirm if the pressure has attained at least 1 bar(g) on the highest section, 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 4 hour-intervals. Thermal stabilization shall be considered to have been achieved when a difference not higher than 1*C is attained between the average values of the last two readings. Thermal stabilization completion shall be approved by COMPANY.

7.7 Pressurization

Pressurization shall be performed in the presence of COMPANY at moderate and constant rate not exceeding 2bars/min. One pressure recording gauge shall be installed in parallel with the dead weight tester. Volume required to reach the test pressure shall be recorded periodically throughout the pressurization as follows:

- each 5 bar increments up to 80% of test pressure asrecorded by the dead weight tester,
- each 2 bar increment between 80% to 90% of test pressureas recorded by the dead weight tester,
- each 0.2 bar increment between 90% of test pressure to fulltest pressure as recorded by the dead weight tester.

The pressurizing shall be cycled according to the followingsequence.

a) Pressurize to 50% of test pressure, hold pressure for 1 hour.
b) Drop pressure to static head of test section at test head.
c) Pressurize to 75% of test pressure, hold pressure for 1 hour.
d) Drop pressure to static head of test section at the test head.
e) 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.

In case, during the hold pressure periods indicated above, a decrease in pressure is observed, the operations shall not be repealed more than twice, after which the line shall not be considered capable of test, until the CONTRACTOR has isolated and eliminated the cause for the lack of water tightness.

7.8 Air Volume Calculation

In order to check the presence of air in the pipeline, two separate consecutive pressures lowering of 0.5 bar shall be carried out.
For calculation of air in the pipeline the second pressure lowering shall be used, and the relevant drained water shall be accurately measured (V1). This amount measured shall be compared to the theoretical amount (Vp) corresponding to the pressure lowering that has been carried out, by using the procedure outlined in clause
12.1 of this specification.

If no air is present in the length under test

$$\frac{V1}{Vp} = 1$$

In order that the above ratio is acceptable, it shall not differ from 1 by more than 2% (i.e. 1.02).

If the air found in the pipeline is within the above established tolerance, then the pressurizing can continue. If the ration V1. / Vp exceeds 1.02 the hydrostatic testing cannot go on and additional pig passages shall be performed to remove the air pockets.

The test shall be repeated as per the above procedure until above estimated tolerances are satisfied. The pressurizing can then continue, to reach the value of test pressure.

7.9 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 the testing period the following measurements shall be recorded:

- Every one hour pressure measurements form 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.

8 ACCEPTANCE

8.1 The hydrostatic test shall be considered as passed if pressure has kept a constant value throughout the test duration, except for change due to temperature effects such change shall be evaluated as described under clause 12.2 of this specification.

The pressure change value as a function of temperature change shall be algebraically added to the pressure value as read on the meters. The pressure value thus adjusted shall be compared with the initial value and ***the test shall be considered as acceptable if the difference is less than or equal to 0.19 bar.*** In case of doubt the testing period shall be extended by 24 hours.

8.2 It test section fails to maintain the specified test pressure after isolation, 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 circumferential welds the method of repair shall be determined by the COMPANY. CONTRACTOR shall comply with instructions of the COMPANY whether to replace a section of the line pipe that includes the line leak or whether to repair the circumferential weld. This repair should however meet the requirements of ' Specification for Welding Pipelines and Related Facilities'. Where failure 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.

8.3 The cost of repairs or replacements, followed by refilling and depressurizing the line, due to poor workmanship, shall be borne by the CONTRACTOR. In the event of leaks or failures resulting form faulty COMPANY furnished materials, CONTRACTOR shall be reimbursed for furnishing all labour, equipment, materials, except those materials furnished by the COMPANY, and transportation necessary to repair and repressurize the section of the pipeline to the pressure at the time of

recognition of leak or line failure. CONTRACTOR shall be entitled for compensation as per the provisions of the CONTRACT. All work of reinstalling line pipe, to replace pipe failures shall be done in accordance with the relevant specification included in the CONTRACT.

8.4 CONTRACTOR shall haul and stockpile all damaged and defective pipes to storage locations designated by the COMPANY All cracks and splice resulting from failures shall be coated with an application of grease to preserve the

characteristics of failures from corrosion. Joint of failed pipes shall be marked with paint with a tag indicating failure details, date and location of failure and pressure at which failure occurred.

9 TERMINATION

After the positive results of testing and collection of all data the test shall be terminated upon written approval given by the COMPANY.

9.1 CONTRACTOR shall dewater the tested line as per the following requirement after test acceptance.

The dewatering shall be carried out by using four cup pigs and foam pigs driven by compressed air. The detailed dewatering procedure shall be developed by the CONTRACTOR in such a way as to provide adequate control of pigs during dewatering. Pigs and equipment required for dewatering the line shall be furnished by CONTROCTOR and shall be approved in advance by the COMPANY. Four cup pigs shall first be passed through the line to displace the water. Foam pigs shall then be passed in order to complete the line dewatering. CONTRACTOR shall use a number of foam pigs, each in different colours / numbered for this purpose. The line shall be considered dewatered when a negligible amount of water is flushed out by the last foam pig and approval is givenby the COMPANY.

9.2 During dewatering, care shall be taken to properly dispose the discharging water in order to avoid pollution, damages to fields under cultivation and/or existing structures and interference with the traffic. Before start of dewatering and disposal of hydrotest water, a procedure for treatment of inhibited water to prevent pollution shall be submitted by contractor to owner/consultant for review and approval.

9.3 Upon completion of the testing and dewatering operation, any provisional traps for pigs and all other temporary installation relating to the test shall be removed. Subsequently the individual sections of the line already tested shall be joined in accordance with the requirements of relevantspecifications issued for the purpose.

10 TEST REPORT

A complete report signed by CONTRACTOR and the COMPANY shallbe submitted upon completion of the hydrostatic test for each test section.

This report shall contain as a minimum

- the cleaning, flushing, filling and testing procedures used,
- schematic layout of cleaning, filling and testing facilities,
- instrument calibration certificates;
- a profile of the pipeline that shows the test sites, all instrument and injection connections;
- pipe filling logs and records,
- additive specification, required concentration and additive injection records;
- pig specifications;

- pig inspection records including photographs of the damages;
- records of gauging pig survey and photographs;
- pressurization and stabilization records;
- pressure and temperature recording charts with appropriate information inscribed thereon;
- temperature data along the pipeline;
- dead weight tester logs and recording;
- air volume calculations;
- pressure change due to temperature change calculations;
- environmental data;
- depressurization logs and records;
- dewatering procedure and schematic layout of relevant facilities;

Further the temperature measurement shall be taken;

- During the filling operation.
- During the thermal stabilization stage.
- During the hydrostatic test.

The thermocouple's sensitivity shall enable temperature readings with anaccuracy of + 0.2*C

b) Water temperature shall also be measured on the pump delivery by means of a recording thermometer (temperature recorder) throughout the filling stage.

The recording thermometer shall have the following features;

Accuracy	± 1% of the scale range
Scale	– 10* to 40*C
Recording	Continuous on tape or disk, diagram within 100mm Feed : 20mm/h for tape diagrams, 7.5%/h for disk diagrams.

c) Ground temperature shall be taken by measuring pipe temperatureat the thermocouple prior to starting the filling operation.

d) Environmental temperature shall be recorded from the beginning of pressurization to the end of the test by means of a recording thermometer featuring the following characteristics;

Accuracy	± 1% of the scale range
Scale	- 0* to ± 60*C
Recording	Continuous on tape or disk, diagram width 100mm Feed 20mm/h for tape diagrams, 7.5*/h for disk diagrams.

- dewatering logs and records:
- records and photograph of all leaks.

11.0 MEASUREMENTS

11.1 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, as per clause 12.1 of this specification, use shall be made of the geometrical volume of the sectionin question.

11.2 Pressure Measurement

Pressure shall be measured with a dead weight tester with an accuracy of 0.01 bar that shall permit readings of at least 0.05 bar.

During the test the pressure shall be recorded by means of a pressurerecorder featuring the following specifications :

Accuracy	:	+ 0.1% of the full-scale value
Recording	:	continuous on tape or disk, graph width 100mm
Feed	:	20mm/h for tape diagrams, 7.5/h for diskdiagrams
Recording	:	to be such as to record pressure between 50% and 90% of the diagram width.

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

A pressure gauge tested with dead weight tester shall be connected inparallel to the dead weight tester at the test head.

11.3 Temperature Measurements

Water temperature shall be taken at every 2 hours through the thermocouple that have been installed on the pipe wall along the section under test on the pipe wall.

12 CALCULATIONS

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

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

$$Vp = (0.884\ r\ i/t + A) \times 10^6 \times V1 \times P \times K^t$$

Where

V= computed water amount required to raise by P the pressure in the section to be tested (m^3)

Vt= geometrical volume of the section (m^3)P=

Pressure rise (bar)

ri= 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 106

(Refer water compressibility factor vs pressure and temperature chart) For temperature above 30*C the values may be extrapolated.

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

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

$$P = \frac{B}{0.884\ r\ I\ /\ t + A}$$

Where,

P = pressure change resulting from a temperature change (bar)

T = algebraically 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 water at the pressure and temperature as measured at the end ofthe test and that of steel (c-1) × 10

(Refer table – 1)

A = Isothermal compressibility value of water as estimated at the pressure and temperature values obtained at the end of test (bar-1) × 10 6 (refer Figure 1)

R I = nominal inner radius of the pipe (mm)

For Hydrostats tester

Before foresting of the pipeline section the above mentioned sections shall be pre-tested for 6 hours duration to ensure.

No leakage :

During :

Pipeline shall be dried up to deas point of 8*C dryingprocedure shall be submitted by contractor to company's Representative for approval.

t = nominal thickness of pipe (mm).

14.0 PRECAUTIONS DURING THE TEST

In addition to all that has been expressly described in the procedures for carrying out that tests, the following additional requirements shall be complied with:

13.1 Provision shall be made for the installation of no – admittance signs to unauthorized personnel from the roads to the R.O.W. Relevant Warning Signs shall be displayed at the test area.

13.2 Proper communication facilities shall also be arranged for during testing. The test area shall be properly cordons to prevent anyaccident.

13.3 A proper Emergency Response Plan shall be in place and emergency contact number of relevant agencies should be visible

13.4 Signs stating "PIPE UNDER TEST – KEEP OFF "with local language translation shall be placed where the pipeline is uncovered, and particularly where the provisional traps and stations are located. Such areas shall be suitably fenced in such a way as to prevent access of unauthorized personnel. No unauthorized personnel shall be closer than 40 m to the pipeline or equipment under test.

13.5 Provisional scraper traps shall be installed in compliance with methods and suitable locations so that their rupture cannot cause any injuries to the personnel or third parties.

13.6 The test station shall be placed in such a location as to prevent it from being affected by a catastrophic failure in the test head.

13.7 Once dewatering is over, the sectionalizing valves and other and other valve assemblies tested previously shall be installed at locations shown in the drawings and in accordance with the procedures contained in the relevant specifications. All thermocouple installed in the pipeline shall be removed and damaged corrosion coating shall be repaired using COMPANY approved materials and procedure.

15.0 PRESERVATION OF PIPELINE

When so stated in the CONTRACT, to preserve / conserve the pipeline for a specified duration CONTRACTOR shall completely fill the pipeline with water, with sufficient quantity of corrosion inhibitors depending upon quality of water and the period of conservation at a pressure to be agreed upon with the COMPANY at a later stage. CONTRACTOR shall obtain necessary approval from the COMPANY of the procedure and the type and quantity of the inhibitors used before commencement of the work.

CONTENTS

1.0 SCOPE

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

The provisions of this specification are not applicable for pipeline crossing water courses, which are specifically designated as "Major Water Courses" in the CONTRACT.

1.2 This specification shall be road in conjunction with conditions of all specifications and documents included in the CONTRACT between COMPANY and CONTRACTOR.

For the purpose of this specification the following definitions shall hold :

- The words " Shall " and "Must" are mandatory
- The words "Should, "May" and "Will" are non – mandatory, advisory recommended

2.0 GENERAL

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

Highways, main – roads and railroads and their verges and banks of water crossings are not allowed to be used loading unloading or stacking of materials and / or equipment. For secondary roads, such loading/ unloading is permitted only after prior approval from the concerned

authorities CONTRACTOR is not allowed to close or divert roads or water courses without prior approval from the COMPANY and the concerned authorities. CONTRACTOR shall never unnecessarily hamper the users of the roads, railroads, buried services and/ or water courses. The water flow shall not be obstructed in any way

2.2 COMPANY reserves the right to demand for individual crossings from the CONTRACTOR a separate detailed report for approval, containing :

- Time schedule
- Working method with equipment
- Test procedure
- Manpower deployment
- Calculations of temporary works
- Soil investigations, etc.

Such works shall be without any extra cost to COMPANY.

2.3 Pipeline crossings for road, railroad canals and rivers etc., shall be hydrostatically pre-tested ex – situ, prior to joint coating, whenever,

- Crossing is executed by boring ;
- Crossing is installed in casing pipe ;
- River crossing pipes which are to be continuously concrete weight coated (to be tested prior to concrete coating);
- Whenever in COMPANY"S opinion the repair of pipeline at crossing in case of a leak during final hydrostatic testing would require inordinate amount of effort and/ or time :
- Whenever pre-testing is insisted upon by the Authorities having jurisdiction over the utility crossed.

The section of the pipeline for the crossings shall be tested as a single string. Unless specified otherwise in the CONTRACT, the test pressure shall be the one resulting in a hoop stress corresponding to 90% of SMYS of pipe material. Test pressure shall be retained in the pipeline for minimum period of 6 hours. Test section shall be visually examined for leaks / defects, etc.

3.0 ROAD AND RAILROAD CROSSINGS

3.1 The work under crossings shall include necessary clearing, grading and trenching to required depths and widths welding of casing (when required) and carrier pipes, coating lowering – in backfilling clean – up restoration to the original condition and further strengthening and protective work testing, installation of assemblies, insulators and seals, and temporary work such as sheet pilling bridges etc.

The work shall be carried out in accordance with the approved drawing and job standards as directed by COMPANY and to the satisfaction of COMPANY and the authorities having jurisdiction over the facility crosses. The work carried out for road and railroad crossings shall meet the minimum requirements of APL RP 1102 latest edition.

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

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

3.2 Boring / jacking of carrier pipes for crossings is allowed only if the pipes for boring/ jacking are provided with a suitable corrosion coating and CONTRACTOR remains liable for the suitability of the pipe and weld-coating of carrier pipes to be bored and for which coating and method of application are anyhow to be authorized by COMPANY.

Before start of the boring/ jacking CONTRACTOR shall execute a soil investigation and determine the ground water table. Based on these investigations CONTRACTOR shall prepare a construction drawing and submit to COMPANY for approval including time schedule and soil investigation report. The CONTRACTOR shall submit for approval of COMPANY the method of boring / trench less to be carried out, depending on the nature of soil conditions, nature of crossing local requirements etc.

During the execution of boring the ground water over the length of the boring shall be lowered up to at least 0.50 M below bottom of the pipeline. This water table is to be regularly inspected and maintained by CONTRACTOR and reported to COMPANY. To safeguard the stability of the bore pit, CONTRACTOR shall, if necessary in COMPANY'S opinion use a closed sheet piling which shall extend at least over 50% of the length in undisturbed soil. The length of the boring shall be in

accordance with the length of the ROW of the crossing (road, railroad, etc.) with minimum 0.6 m extra on either side.

If the soil conditions and groundwater for a particular boring give reasons for this, CONTRACTOR is entitled to suggest to COMPANY for a relaxation of one or more of the following requirements as defined here forth :

- Soil investigation
- Lowering of groundwater table
- Sheet piling
- Length of boring etc.

In approaches to the crossing, CONTRACTOR shall eliminate unnecessary bending of pipe by conforming to the contour of the ground by gradually deepening the ditch at such approaches as directed by the COMPANY

3.3 The bottom of the trench and / or the pit at least twelve (12) meters at the approach to each end of a casing shall be graded and if necessary backfilled with clean sand and compacted unto at least 95% Proctor density to an elevation that will provide sufficient and continuous support to the pipeline so that the pipeline remains correctly aligned at the casing ends during and after backfilling.

3.4 The diameter of the hole for bored section shall have a hole diameter as close as practicable to the outside diameter of the carrier or casing pipe. If excessive void or too large hole results, or if it is necessary, in the opinion of COMPANY, to abandon the bored hole, prompt remedial measures such as filling the hole with suitable material shall be taken to the entire satisfaction of the COMPANY and Authorities having jurisdiction thereof at no extra cost to COMPANY. Equipment used for installation of casing pipe shall be of the type approved by COMPANY.

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

At the front of the pipe there may be a cutting ring which may be 12 mm larger than the outside diameter for the pipe or casing. A lubricating pipe can also be used in jacking the nipples of which shall not protrude from the cutting edge. Said lubricating pipe shall not be fixed to the pipe casing. When jacking Only biologically degradable lubricants shall be used (E.D. WRC Med lube or an emulsion of betonies)

Removal of soil form the pipeline during jacking shall be done mechanically by means of a standard, locked auger, which has to be safeguarded against jacking ahead of the pipe.

During jacking the progress of the pipe to be jacked and the cutting capacity of the auger shall be mutually adjusted by regulation the speed of the auger; to prevent the road from bulging (rpm too low) or cave – ins (rpm too high). In any case on more soil shall be removed than the volume of the pipe. The auger drive shall be provided with a clutch.

If the jacking fails the casing shall not be withdrawn. It shall be filled with sand and plugged at either end.

Casing at crossings, when provided to meet statutory requirements, shall be designed in accordance with API 1102. Casing pipe diameter shall be minimum two pipe sizes bigger than carrier pipe. COMPANY reserves the right to inspect certain lengths of pipes to assess damages, if any, to the corrosion coating of the carrier pipe used for boring. CONTRACTOR shall weld additional lengths of pipe and pull the required extra lengths of COMPANY'S inspection. If during inspection any defects are noticed CONTRACTOR, in consultation with COMPANY, shall carry out the remedial measures required.

3.5 While welding of the casing and vent / drain pipes, internal high or low is jot allowed. Welding of casing and vent/ drain pipes need not be radiographed however, only normal visual checks shall be carried out. Before welding, the single length of pipe shall be inspected in order to check that is no out of roundness and dents. When such defects are noticed, there must be completely removed before joining the pipes. If these defects cannot be repaired, the defective section shall be cut out.

3.6 In the case of crossing where excavation has authorized, the welding for the casing pipe and for a continuous section of the pipeline corresponding to the expected length shall be carried out in the proximity of the crossing. Casing must be laid immediately after the trenching. Casing pipe must be laid with a single gradient in order to allow for an easy insertion and, if necessary at a future date, to allow for the removal or replacement of the

pipeline, leaving the casing undisturbed.

3.7 The assemble of vent units as approved by COMPANY shall be carried out by direct insertion and welding to the ends of the casing pipe before introducing the carrier pipe. The operation of assembling and extending the vent pipe shall be carried out in such a way that there is no contact with the carrier pipe. The painting / coating of the vent pipes shall be applied before backfilling as per relevant specifications.

3.8 The casing pipe shall be considered ready for installation of the carrier pipe after careful inspection and internal cleaning with the removal of soil, mud, stones and other foreign materials.

3.9 Insulators, as approved by COMPANY, shall be securely fastened to the pipe with all bolts and fixtures firmly tightened. The number of insulators and spacing shall be as shown in the drawings or at 2.5 m intervals (whichever is more stringent). At the end of both sides of the casing, a double set of insulators shall be installed.

3.10 Care must be taken in pushing or pulling carrier pipe into the casing so that the pipe is aligned correctly in the casing and that the pushing or pulling force is evenly and constantly applied to avoid damages to the insulators. A nose piece having a diameter equal to that of the pipe shall be welded on the front and back end of the carrier pipe to facilitate installation of the carrier pipe properly in the casing and to keep it dry and clean.

3.11 After installation of the carrier pipe section, the casing and the appurtenances, but prior to making tie-in welds and backfilling, an electrical test shall be conducted by the CONTRACTOR in the presence of the COMPANY to determine the resistance between the casing and the carrier pipe or the carrier pipe and the soil. These tests shall show at test a resistance of 100 k-ohm/m2. After backfilling and compaction, additional tests shall be conducted to determine if the casing is electrically shorted to the pipe. If the installation is found to be shorted, CONTRACTOR shall make the necessary corrections and repairs at his cost, until a test to the satisfaction of the COMPANY is obtained.

4.0 CROSSINGS OF BURIED SERVISES

4.1 The pipeline under construction may pass above or below the existing buried facilities such as pipeline, cables, etc. Type of crossing shall be such that a minimum depth of cover as required in the drawings and specifications are guaranteed. The minimum clearance required between pipeline and the existing facility shall be 500 mm

4.2 Whenever buried services in the ROW are to be crossed by CONTRACTOR, he shall safeguard the buried facilities and the required precautions shall be taken as approved by Owner of the buried services and by COMPANY.

4.3 For buried services to be crossed by boring / jacking the relevant provisions of Section 3.0 shall apply.

5.0 MINOR WATER COURSE CROSSINGS

5.1 Minor water crossings are crossings of ditches canals, water courses, rivers, streams etc, whether the bed(s) contain(s) water or not, and not being specified as 'Major Water Crossings' in the CONTRACT.

5.2 For minor water crossings a standard drawing or a separate detailed approved drawing for individual crossing shall be applicable, and all further specifications are applicable.

5.3 Whenever minor water crossings in the ROW are to be crossed, CONTRACTOR shall install / temporary bridges to facilitate movement.

5.4 In crossings of water courses with either moderate flow rate or of torrential nature with marked and unpredictable flooding, an adequate survey shall be carrier out before starting the work with the object of determining what precautions are necessary and the most favorable period for executing the work.

5.5 In case of crossings of water courses for which no special methods of laying are required, a pipe section of a size as per the approved drawings shall be assembled and subsequently laid. Bends shall be of cold field type.

Wherever required by COMPANY CONTRACTOR shall before start of construction execute a soil investigation. Based of this soil investigation he shall prepare construction drawings, work method and time schedule for approval of COMPANY as well as concerned local agencies.

The depth of the existing bottom of a minor water course crossing shall be determined in relation to the adjacent stable ground level by taking the average of four measurements. Measurements shall be taken with a gauge and with dimensions 60 × 60 mm and having a flat bottom. The minimum force to be exerted shall be 360 N (36 kgf)

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

5.7 For crossings beneath the bed of water courses, the pipe section shall be made in such a way that it conforms to the existing or future bed as indicated in the approved drawings. In crossings for which an individual drawing has not been prepared the minimum cover of the pipeline shall not be less than that indicated in the standard drawings for a similar type of crossing

5.8 Whenever the crossing requires a straight section of pipe between the lower bends coinciding with the river bed, this section shall be laid at a single horizontal level.

5.9 For crossings of ditches canals, banked channels, etc by boring the pipe section shall be prepared laid and tested in accordance with the applicable clauses of Section 3.0 of this specification.

5.10 The CONTRACTOR shall arrange temporary installation of diversions as may be necessary to ensure the entire satisfaction of the concerned Local Authorities as well as the COMPANY.

5.11 Banks and trenches of minor water crossings shall be backfilled with soil which it to be approved by COMPANY and shall be thoroughly compacted to prevent soil and bank erosion as per the drawings and standards to the satisfaction of authorities having jurisdication thereof and the COMPANY. Whenever boulders, rock, gravel and other hard objects are encountered, they shall not be placed directly on the pipe. Sufficient earth, sand or selected and approved backfill material shall be backfilled initially around and over the pipe to provide a protective padding or cushion extending to a minimum thickness of 30 centimeters around the pipe before backfilling remainder of the trench with excavated or other material as per approved drawings and standards.

After the trench has been backfilled and during the clean up work, the minor water crossing shall be cleaned at least across the whole of the ROW.

When directed by the COMPANY, CONTRACTOR shall stabilise and restore the bank of the water crossings with materials to be supplied by him as follows.

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

The GI wire shall be made from steel having tensile strength of 400 N/mm2 and with a minimum elongation at failure of 10%. The minimum zinc coating of 200 gm2 shall be applied on single / double twisted wire.

The length of the above protection shall equal to the actual bank excavation edge including damage and extending 2 m on either sides. The width of this protection on the slope shall be determined by the following:

- 2m plus the highest water level (recoverable) or upto the top of bank whichever is higher.
- Upto the bottom of the crossing or 20 m below the highest water level whichever is smaller.

Bank stabilization for certain minor water crossings shall be determined by COMPANY based on nature of crossing e.g. type of river, canal, major nallah flood control banks and other water bodies; type of soil, regulations of local authorities; and any other socio- economic consideration evaluated by the COMPANY.

5.12 The crossing of any embankments shall be carried out strictly in accordance with approved drawings.

No drilling work on embankments shall be permitted without prior written approval from the competent authorities.

CONTENTS

1. SCOPE

This Specification covers the minimum requirements of materials, equipment and installation of field joint anti-corrosion coating of buried onshore pipelines factory coated with either three layer polyethlene of fusion bonded epoxy coating, byheat shrink wraparound sleeves or by cold applied tapes conforming to 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" and the requirements of this specification. Unless modified/ replaced by this specification, all requirements of DIN EN 12068 shall remain fully applicable and 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 section of this specification shall apply to all specifications referred in this specification.

2. REFERENCE DOCUMENTS

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

a) **ASTM D-149:** Standard Test Methods of Dielectric Break- down voltage and Dielectric Strength of solid electrical insulating materials at commercial frequencies.

b) **ASTM D-257 :** Standard Test Methods for D-C Resistance for conductance of

insulating materials.

c) **ASTM D-570 :** Standard Methods of Test for Water Absorption of Plastics

d) **ISO 8502-3 :** Preparation of steel Stubstrates before Application of Plastics-Part-3-Assessment of Dust on Steel Surfaces Prepared for Painting (Pressure Sensitive Tape Method).

e) **ISO: 8503-1:** Part-1: Specification and definitions for ISO surface profile comparator for the assessment of abrasive blast cleaned surfaces.

f) **ISO: 8503-4:** Part-4 : Methods for calibration of ISO surface profile comparator and for the determination of surface profile - Stylus instrument procedure.

g) **SIS-055900:** Pictorial surface Preparation Standard for Painting Steel Surfaces.

h) **SSPC-SP 1** : Steel Structure Painting Council.

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

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

3. MATERIALS AND EQUIPMENT

3.1 Field Joint Corrosion Coating Material

Field joint anti-corrosion coating material shall be either heat shtrinktable wraparound sleeve or cold applied tape suitable for a maximum operating temerature of (+) 60˚ C (T_{max}) and shall conform to designation EN 12068- CHT 60 UV. In addition the field joint anti-corrosing coating shall comply the requirements specifiedin para 3.2 of this speciffication.

3.1.1 Heat Shrinkable Wraparound sleeve

Heat shrinkable wraparound sleeve shall consist of radiation - cross -linked thermally stabilised, ultraviolet resistant semi-rigid polyolefin backing with a uniform thickness of high shear strength thermoplastic/ copolymer hot melt adhesive. The joint coating system may consist of a solvent free epoxy primer applied to the pipe surface prior to sleeve application. The backing shall be coated with thermochrome paint which will change colour when the desired heat during shrinking is attained. The wraparound sleeve shall be supplied in pre-cut sizes to suit the diameter and the requirements of overlap.

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

Pipe size (Specified Outside Diameter)	Thickness (mm)		
	On pipe Body		On Weld Bead (Min.)
	Average	Min	
Upto 103/4” (273.1 mm)	2.0	1.8	1.6
Over 103/4” (273.1 mm) to below 20” (508.0mm)			

From 20" (508.0mm) to below 32" (813.0 mm)			
From 32" (813.0mm) and above	2.4	2.2	2.0

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

Heat shrink wraparound field coating system manufactured by M/s Tyco Adhesives - Raychem 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 manufactures. In case the contractor proposes to supply heat shrick wraparound sleeve from any other manufacturer, then the contractor shall propose only those coating systems that have been previously used in piplines of similar size and operating conditions.

3.1.2 Cold Applied Tapes

Cold applied tapes system shall comprise of primer, an inner wrap and an other wrap. The inner and outer wraps shall be asymmetic 3-ply tape with co-extruded polyethylene crrier film and butyl rubber adhesive layers on both sides. The inner layer of butyl rubber adhesive of inner wrap shall have a thickness of min.1.0mm. The inner and outer wraps are to be spirally wrapped with 55% overlap, equivalent to two layers each providing a total minimum thickness of 3.0 mm on the pipe body and 2.5mm on the weld.

The Contractor shall propose only those cold applied tape coating systems that have been previously used in pipelines of similar size and operating conditions.

3.2 Functional Requirements of Field Joint Coating

3.2.1 Properties of the PE backing shall be as follows :

Sl. No.	Property	Unit	Requirement	Test Method
a)	Tensile Strength at @+25'C	N/mm	>12	DIN EN 12068

b)	Ultimate Elongation @+25'C	%	> 250	DIN EN 12068
c)	Dielectric withstand with 1000 Volts / sec	kv	> 30	ASTM D 149
d)	Water absorption @+ 25'C for 24 hours	%	< 0.05	ASTM D 570
e)	Volume Resistivity @+25'C	Ohm-cm	> 10	ASTM D 257

3.2.2 Functional Properties of Joint Coating System (As applied)

As applied field joint coating system shall the requirements of DIN EN 12068.Table 1 and 2 corresponding to designation DIN EN 12068 - C HT 60 UV, except as modified below :

a) Cathodic Disbondment Resistance at T_{max} i.e. 60˚ C shall be 20mm when tested as per Annexure K of DIN EN 12068. Test shall be carried out (+)60˚C.

b) Peel strength shall be as follows:

Peel strength		Unit	Requirementfor Mech Resistance Class C (Minimum)	Test method as per DINEN 12068
Inner to Inner + Outer to Inner	@23^0 C	N/mm	1.5	Annexure-B
	@T_{max}	N/mm	0.3	
Outer to outer	@23^0 C	N/mm	1.5	
	@T_{max}	N/mm	0.3	
To pipe surface	@23^0 C	N/mm	3.5	Annexure-C
	@T_{max}	N/mm	0.3	
To factory coating	@23^0 C	N/mm	3.5	
	@T_{max}	N/mm	0.3	

(T_{max} shall be (+) 60^0 C)

Contractor shall obtain approval from company regarding the manufacture of the joint coating material. Complete technical details along with test certificates complying with the requirements of douse 3.2.1 and 3.2.2 shall be submitted to company for this purpose. The contractor shall furnish test certificates from an independent DIN recognized / approved laboratory for all the properties required for the specified EN designation of field joint coating and the requirements of this specification.

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

CONTRACTOR shall ensure that the coating materials supplied by are properly packed and clearly marked with the following.

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

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

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

3.6 CONTRACTOR shall provide and maintain mobile facilities which contains all necessary equipment and it's spares for cleaning repairs, inspection and tests.

3.7 CONTRACTOR shall furnish sufficient number of the following equipment and the required spares as a minimum for inspection and purpose for each crew.

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

4. APPLICATION PROCEDURE

4.1 General

4.1.1 The application procedure shall be in accordance with manufacturer's instruction and minimum requirements specified below whichever are most stringent and shall be demonstrated to and approved by the company. Manufacturer's expert shall supervise the application and shall be available at site upon request during qualification of application procedure and during construction an CONTRACTOR'S cost.

4.1.2 Operators for coating application shall be given necessary instructions and training before start of work, by the CONTRACTOR. To verify and quality the application procedures, all coating applid during the qualification test, shall be removed for destructive shall only utilize those operatours who have been approved / prequalified by the field joint coating manufacturer.

4.1.3 Oil, grease, salt shall be removed from steel surface by wiping with rags soaked with suitable solvents such as naphtha or benzene. Kerosene shall not be used for this purpose. Solvent cleaning procedure according to SSPC-SP 1 shall be followed.

4.1.4 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. During blast cleaning the pipe surface temperature shall be simultaneously more than 5^0 and more than 3^0 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 SA 21/2 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 ISOI 8503-1 and shall be calibrated prior to the start of the work in accordance with ISO: 8503-3 or ISO-8503-4. The blast cleanliness shall be checked on every joint and the roughness profile shall be checked 1 every 10 joints.

Dust girt or foreign matter shall be removed from the cleaned surface by an industrial vacuum cleaner. The dust contamination allowed shall be of a rating max 2 as per ISO: 8502-3. The frequency of checking for dust contamination shall be 1 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) > 80 % - 4 Hours

Pipes delayed beyond this point showing any visble rust stain shall be blast cleaned.

4.1.5 The field joint surface shall be inspected immediately after blast cleaning and any feature of the steel surface such as weld spatter, scabs, laminations or other imperfections considered injurious to the coating integrity made visible during blast cleaning shall be reported to the company representative and on permission from company representative

such defets shall be then re-blast cleaned if the defective area is larger than 50 mm in diameter.

4.1.6 The ends of existing pipe protective coating shall be inspected and chamfered. Unbounded portions of the coating shall be removed and then suitaby trimmed. Portions where parent coating is removed shall be throughly cleaned as specified. The adjacent chamfered areas of the line pipe coating shall be cleaned and abraded, to expose a clean uniform fresh surface of uncontaminated factory applied coating.

4.1.7 All steel joint surfaces shall be throughly exmained before the application of the coating in order to ensure the surfaces are free of oil, grease, rust, earth or any other foreign matter. All these substances shall be removed coating, to the procedures herein described.

4.1.8 Protetion coating shall be applied on the joints immediately after the completion of cleaning operation.

4.2 Application of Heat Shrink Wraparound / Sleeves

In addition to the general requirements stated above, following shall be taken into account.

4.2.1 The wrap around sleeve shall be a size such that a minimum overla of 50mm before applying is ensured (after shrinking) on both sides of the yard applied corrosing coating of pipes.

In the cases where carrier pipe is installed by direct boring/ jacking, the overlap on the mill coating for the leading edges of the joints shall be minimum 200mm. 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.

4.2.2 Before centering the wraparound sleeve, the bare steel surface shall be preheated with torch moved back and forth over the surface or by induction heating. The minimum preheat temperature shall be as

recommended by manufacturer and shall be checked by means of contact type temperature recording thermometer. Temperature indicating crayons shall not be used pre-heat temperature shall be checked on every joint. Care shall be taken to ensure that the entire circumference of the pipe is heated evenly. Temperature measuring instruments shall be calibrated immediately before the start of the works and thereafter at intervals recommended by the manufacturer of the instrument.

4.2.3 Upon pre-heating the pipe surface shall be applied with two pack epoxy primer of wet film thickness 100 microns or as per manufacture's recommendation whichever is higher, to cover the exposed bare metal of the welded fled joint and 10mm min. onto the adjacent pipe coating if recommended by the manufacture. The wet film thickness of the primer shall be checked or every joint with a wet film thickness gauge prior to installation of sleeve. Thickness gauges shall be calibrated once per shift.

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

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

The complete shrinking of the entire sleeve 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 unit the adhesive has codified.

4.3 Application procedure for corrosion protection Tapes:

4.3.1 Cold applied joint protection tapes shall be of the type which can be applied by spirally wrapping on the pipe.

4.3.2 Immediately after the completion of surface preparation the approved primer of wet film thickness 100 microns or as per manufacture's recommendation whichever is higher to cover the exposed bare metal of the welded field joint and 10mm min. onto the adjacent pipe coating if recommended by the manufacture. Any dirt on the primed surface shall be removed. If the primer is damaged, the damaged aired shall be cleaned and re-primed.

4.3.3 Approximately 100mm of tape interleaving paper shall be peeled back and tape shall be applied with the adhesive side to the pipe. Whilst continuously removing the interleaving paper, the tape shall be spirally applied to provide a minimum of 55% overlap. Stuffiest tension shall be applied to ensure good conformity, avoiding air pockets and also continuously smooth out as the wrapping proceeds. The wrapping shall start and finish to give a minimum of 50mm overlap on to the adjoining yard applied coating. Outer wrap shall be applied in similar method.

4.4 Pre-Qualification of Field Joint Coating System

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

- Surface preparation cleanliness, roughness profile and dust contamination.
- Pre-heat temperature (as applicable)
- Primer thickness
- As applied coating thickness
- Holiday detection
- Peel test at (+) 230^{a}C & (+) 60^{0} C on pipe surface & factory applied coating and at over laps (as applicable). If required to achieve the temperature of (+) 60^{0} C, suitable thermal blanket may be used.
- Visual appearance and void after installation on the body, are adjoining the weld and area adjoining the factory applied coating. (To establish voids adjoining the weld and factory coating a strip of 50mm wide and 200mm long shall be stripped and examined.)

Company Representative shall witness the tests and inspection. Regular application of field coating shall commence only upon successful completion of the pre-qualification testing.

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

5. INSPECTION & TESTING

5.1 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 adhesionat 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.

5.2 Holiday Inspection

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.

The entire surface of the joint section 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 50^0 C. The holiday detector used shall be checked and calibrated daily with an accurate DC voltmeter. The detector eletrode shall be in direct contact with the surface of coating to be inspected.

No filed joint shall be covered or lowered in the trench until it has been approved by the COMPANY.

5.3 As-applied coating Thickness.

Coating thickness shall be checked by non-destructed methods for each field joint. Average thickness of the as-applied coating on pipe body shall be established based on measurement at min. eight locations i.e. four measurement on either the minimum thickness on the girth weld, four measurement shall be taken 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 measurement at any location on the five joint coating, whenever doubt arises.

5.4 Peel Strength Testing

5.4.1 One out of every 50 joint coatings or joint coating out of every day's production whichever is stringent shall be tested to establish the pell strength on steel and factory applied coating. Contractor shall carry out such testing in the presence of company Representative.

5.4.2 From each test sleeve selected as above, one or more stips of size 25mmx 200mm 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 (+) 23^0 C or (+) 60^0 C whichever is feasible.This test shall be conducted between wrapping & metal and mill coating &between layers at overlap with joint coating (wherever applicable). Afterremoval of strip, the bulk of adhesive shall remain adhered to the pipeshowing no bare metal, otherwise, test shall be considered failed. Theadhesive layer that remains on the pipe surface shall generally be free ofvoids resulting from air or gas inclusion. In case the peel strength test at a

different temperature than that specified in warranted due to the ambient site conditions, then the peel strength shall comply the recommendation of the manufactuer. Manufactuer shall be asked to furnish peel stength values corresponding to various expected temperatures, prior to start of the works.

5.4.3 If the sleeve does not meet the requirements of clause 5.4.2 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 5.4.1 if either or both of the adjacent two sleeves do not meet the requirements of clasue 5.4.2, the field joint shall be stopped.

5.4.4 Company representative reserve the right of 100 % removal of sleeves if he is not convinced that the requirements of clause 5.4.2 are achieved.

6. Repairs

6.1 If a field joint is detected to be unacceptable after testing as per section 5.0 of this specification the contractor shall, at his own cost:

- Determine the cause of the faulty results of the filed coating.
- Mobilise the expert of manufactuer, if required.
- Test to be complete satisfaction of the COMPANY, alreadycompleted field coatings.
- Stop field coating until remedial measures are taken against thecauses of such faults, to the entire satisfaction of the company.

6.2 CONTRACTOR shall replace all joint found or expected to be unacceptable as per section 5.0 of this specification.

6.3 CONTRACTOR shall, at his owen cost repair all areas where the coatinghas been removed for testing by COMAPNY.

6.4 After the coating work on welded joints, fittings and repairs to the coating have been completed the coating as a whole shall be tested with a spark- tester before lowering or jacking the pipeline.

6.5 COMPANY shall entitled to check the coating on buried piplines or parts of pipelines with equipment such as the "Pearson meter" and the resistance meter. If the coating defects are established, the contractor shall be responsible for excavations at such points repair the coating, spark testing and back filling the excavations without extra charge.

7. Documentation

7.1 Prior to procurement of coating materials, contractor shall furnish thefollowing information for qualification of the manufacturer and material:

i. complete information as per clause 5.2, DIN EN 12068 along with descriptive technical catalogues.
ii. Test certficates and result of previously conducted tests, for all properties listed in clause 3.2 of this specification.
iii. Reference list of previous supplies, in last 5 years, of the similar material temperature, year of supply, project name, contact person and feed back on performance.

Once the Company's approval has been given, any change in material or manufactuer shall be notified to company, whose approval in writing of all changes shall be obtained before the materials are manufactured.

7.2 Prior to shipment of materials from the manufacturer's works. Contractorshall furnish the following documents:

i. Test certificates / result as per manufactuter's Quality Controlprocedure for each batch of materils.
ii. Specific application instructions with pictorial illustrations.
iii. Specific storage and handling instructions.

7.3 All documents shall be in English language only.

CONTENTS

1.0 SCOPE :

This specification covers the minimum requirement of material and equipment, installation procedure and inspection of repair of damaged polyethylene coatings on steel pipes.

1.1 The repair shall be carried out using repair patch made of radiation cross linked polyolefin backing, coated on the inside with semi – crystalline thermoplastic Adhesive and filler mastic.

2.0 MATERIAL AND EQUIPMENT

2.1 CONTRACTOR shall supply all, equipment and manpower required for a skillful and adequate application in the field in accordance with the specification.

2.2 The repair material shall be :

- Repair patch shall be cross linked polyolefin with semi – crystalline thermoplastic adhesive (PERP patch make of RAYCHEM or equivalent).
- Filler mastic : PERPFILLER make of RAYCHEM or equivalent.

2.3 The material shall not be older than their period of validity at the time of Application by CONTRACTOR. Deteriorated / decomposed materials shall not be used.

2.4 Material shall be stored in sheltered storages in the manufacture's original packing and away from direct sunlight and in accordance with manufacture's recommendations.

3.0 APPLICATION PROCEDURE

Application procedure shall be as per manufacture's recommendations and as per the following guidelines (ref. Fig : 1)

Preparation : Remove coating from damaged area with knife, scraper or power brush. Scrap off the damaged area and adjacent coating to remove oil, grease, ruse dirt and moisture.

Preheating : Preheat the exposed bare metal surface to about 60 C and adjacent pipe coating to about 47 C with a torch moved back and forth over the surface.

Application of the Filler : Plastic filler shall be applied to all exposed metal surface. The mastic is heated and smoothed down with a paint scraper to cover all bare metal in a manner such that allentrapped air is removed.

Application of repair tape : Cut a patch from the tape in a manner such that it extends 50 mm beyond the damaged area, position it over the damaged area heat until the temperature sensitive paint on the outside of the patch changes colour. It shall be smoothed down to confirm with the contour of lap, and shall be freed of anyair bubbles or wrinkles.

For cosmetic type of defects such as minor gauging tearing scratches which do not indicate holiday during holiday inspection following procedure shall be adopted:

The defect area shall be roughened to remove loose polyethylene coating oil grease, dirt etc.

This shall be followed by application of repair patch as describedabove

4.0 INSPECTION, TEST

A visual inspection shall be carried out for the following

- Mastic extrusion on the patch shall be examined.
- There shall be no sign of punctures or pin holes or bend failure. The external appearance of the patch shall be smooth, free from dimples, air entrapment or void formation.
- The entire repair patch shall have changed colour uniformly.

5.0 HOLIDAY INSPECTION

The holiday detector used shall be checked and calibrated easily with an accurate D.C. Voltmeter. The detector electrode shall be in direct contact with the surface of coating to be inspected.

The entire surface of the repaired section shall be inspected by means of a full circle holiday detector approved by company set to a DC Voltage of at least 25 KV. Inspection of repaired patch shall be conducted only after it has cooled below 50 C.

No repaired point shall be covered or lowered in the trench until it has been approved by the COMPANY.

CONTENTS

ANNEXURES

1.0 SCOPE

This specification establishes the Healthy, Safety and Environment (HSE) management requirement to be compiled with by the Contractors during construction.
Requirement stipulated in this specification shall supplement the requirement of HSE management given in relevant Act (s) / legislations. General Condition of Contract (GCC) Special Condition of Contract (SCC) and Job Specifications. Where different documents stipulate different requirements, the most stringent shall be adopted.

2.0 REFERENCES

This document should be read in conjunction with following :

- General Conditions of Contract (GCC)
- Special Conditions of Contract (SCC)
- Job Specification
- Relevant IS Codes (refer Annexure-A)
- Reporting Formats (refer Annexure-B)

3.0 REQUIREMENT OF HEALTH, SAFETY & ENVIRONMENT (HSE) MANAGEMENT SYSTEM TO BE COMPLETED BY BIDDERS.

3.1 Management Responsibility

3.1.1 The Contract Should have a document HSE policy to cover commitment of the organization to ensure health, safety and environment aspects in their line of operations.

3.1.2 The HSE management system of the Contractor shall cover HSE requirement including but not limited to what specified under clause 1.0 & 2.0 mentioned above.

3.1.3 Contractor shall be fully responsible for planning and implementing HSE requirement to the satisfaction of the company. Contractor as a minimum requirement shall designate / deploy the following to co- ordinate the above :

No. of workers deployed		
Up to 250	-	Designate one safety supervisor who will guide the workers from

		time to time, as well as lmpart training, basic guidelines at lest weakly once.
	Above 250 & upto 500	Deploy one qualified and experienced safety Engineer / Officer who will guide the workers from time to time as well as impart basic guideline & training at least Weakly once.
	Above 500 (for every 500 or less)	One additional safety engineer/ Officer whose function will be as mentioned above.

Contractor shall indemnify and hold harmless SGL & their representative's from any and all liabilities arising out of non fulfillment of HSE requirements.

3.1.4 The Contractor shall promote and develop consciousness for Healthy, Safety and Environment among all personnel working for the Contractor. Regular awareness programs and fabrication shop/work site meeting shall be arranged on HSE activities to cover hazards involved in various operations during construction.

3.1.5 The Contractor shall ensure that the Health, Safety and Environment (HSE) requirements are clearly understood & faithfully implemented at all levels, at each and every site / work place.

3.1.6 Arrange suitable first aid measure such as First Aid Box, trained personnel to give First Aid, Stand by Ambulance or Vehicle and install fire protection measures such as: adequate number of steel buckets with sand and water and adequate fire extinguishers to the satisfaction of SGL.

3.1.7 The Contractor shall evolve a comprehensive planned and documented system for implementation and monitoring of the HSE requirements. This shall submitted to SGL for approval well in advance, prior to start work. The monitoring for implementation shall be done by regular inspection and compliance to the observations thereof. The Contractor work site / Office. However,

compliance of HSE requirement shall be the sole responsibility of the Contractor. Any review / approval by SGL shall not absolve the Contractor of his responsibility / liability in relation to all HSE requirements.

3.1.8 Non-Conformance on HSE by the Contractor (including his Sub-contractors) as brought out during review / audit by SGL representative shall be resolved forthwith by Contractor, Compliance report shall be possibility submitted to SGL at the earliest.

3.1.9 The Contractor shall ensure participation of his Resident Engineer/ Site-in – Charge in the Safety Committee/HSE Committee meetings arranged by SGL. The compliance of any observation shall be arranged urgently. Contractor shall assist SGL to achieve the targets set by them on HSE during the project implementation.

3.1.10 The Contractor shall adhere consistently to all provisions of HSE requirements. In case of non-compliance or continuous failure in implementation of any of HSE provisions; SGL may impose stoppage of work without any Cost & time implication to Owner and / or impose a suitable penalty for non-compliance with a notice of suitable period, upto a cumulative limit of 1.0% (one percent) of Contract value with a ceiling of Rs. 10 Lakhs. This penalty shall be in addition to all other penalties specified else where in the contract. The decision of imposing stoppage of work, its extent & monitory penalty shall rest with SGL & binding on the Contractor.

3.1.11 All fatal accidents and other personnel accidents shall be investigated by a team of Contractor's senior personnel for root cause and recommend corrective and preventive actions. Findings shall document and suitable actions taken to avoid recurrences shall be communicated to SGL. SGL shall have the liberty to independently investigate such occurrence and Contractor shall extend all necessary help and co-operation in this regard.

3.2 House Keeping

3.2.1 Contractor shall ensure that a high degree of house keeping is maintained and shall ensure the followings :

a) All surplus earth and debris are removed / disposed off from the working site to identified location (s)

b) Unused / Surplus Cables Steel items and steel scrap lying scattered at different places within the working areas are removed to identified location (s).

c) All wooden scrap, empty wooden cable drums and other combustible packing materials shall be removed from work place to identified location(s).

d) Roads shall be kept clear and materials like pipes, steel, sand, boulders, concrete chips and bricks, etc. shall not be allowed in the roads to obstruct free movement of men & machineries.

e) Fabricated steel structural's, pipes & piping materials shall be stacked properly for erection.

f) Water logging on road shall not be allowed.

g) No parking of trucks / trolleys, cranes and trailors etc. shall be allowed on of roads, which may obstruct the traffic movements.

h) Utmost care shall be taken to ensure over all cleanliness and proper up keep of the working areas.

i) Trucks carrying sand, earth and pulverized materials etc. shall be covered while moving within the plant areas.

3.3 Healthy, Safety and Environment

a) The Contractor shall provide safe means of access to any working place including provision of suitable and sufficient scaffolding at various stages during all operations of the work for the safety of his workmen, and SGL. Contractor shall ensure deployment of appropriate equipment and appliances for adequate safety and healthy of the workmen and protection of surrounding areas.

b) The Contractor shall ensure that all their staff workers including their sub-Contractor (s) shall wear Safety Helmet and Safety shoes. Contractor shall also ensure use of safety belt, protective goggles, gloves etc. by the personnel as per jobs requirements. All these gadgets shall conform too relevant IS specification equivalent.

c) Contractor shall ensure that a proper Safety Net System shall be used at appropriate locations. The safety net shall be located not more than 30 feet (9.0 metrs) below the working surface at site to arrest or to reduce the consequences of possible fall of persons working at different heights.

d) Contractor shall ensure that flash back arrester shall used while using gas Cylinders at site. Cylinders shall be mounted on trollys.

e) The Contractor shall assign to his workmen, tasks commensurate with their qualification, experience and state of health for driving of vehicles, handing and erections of materials and equipment's. All lifting equipments shall be tested certified for its capacity before use. Adequate and suitable lighting at every work place and approach there to shall be provided by the contractor before starting the actual work / operation at night.

f) Hazardous and / or toxic material such as solvent coating or thinners shall be stored in appropriate containers.

g) All hazardous materials shall be labeled with the name of the materials, the hazards associated with its use and necessary precautions to be taken.

h) Contractor shall ensure that during the performance of the work all hazards to the health of personnel have been identified assessed and eliminated.

i) Chemical spills shall be contained & cleaned up immediately to prevent further contamination.

j) All personnel exposed to physical agents such as ionizing or non-ionizing radiation ultraviolet rays or similar other physical agents shall be provided with adequate shielding or protection commensurate with type of exposure involved.

k) Where contract or exposure of hazardous materials could exceed limits or could otherwise have harmful affects, appropriate personal protective equipment's such as gloves, goggles, aprons, chemical resistant clothing and respirator shall be used.

l) Contractor shall ensure the following facilities at work sites :
   I) A Crèche where 10 or more female workers arehaving children below the age of 6 years.
   II) Reasonable Canteen facilities are made available at appropriate location depending up on site conditions.

m) Suitable facilities for toilet, drinking water, proper lighting shall be provided at site and labor camps, commensurate with applicable Laws/ Legislation.

n) Contractor shall ensure storage and utilization methodology of material that are not detrimental to the environment. Wherever required Contractor shall ensure that only the environment friendly material are selected.

o) All person deployed at site shall be knowledgeable for and comply with the environmental laws, rules & regulation relating to the hazardous materials substance and wastes. Contractor shall not dump, release or otherwise discharge or dispose off any such materials without the authorization of SGL.

4.0 DETAILS OF HSE MANAGEMENT SYSTEM BY CONTRACTOR

4.1 On Awards of Contract.

The Contractor shall prior to start of work submit his Health. Safety sand Environment Manual of procedure and HSE Plans for Approval by SGL. The Contractor shall participate in the pre-start meeting with SGL to finalize HSE plans including the following.

- Job procedure to be followed by Contractor for activitiescovering Handling of equipment's Scaffolding, Electric

Installation, Describing the risks involved, actions to be takenand methodology for monitoring each.

- Organizations structure along with responsibility and authority records / reports etc. on HSE activities.

4.2 During job execution

4.2.1 Implement approved Health, Safety and Environment management procedure including but not limited to as brought our under para 3.0 Contractor shall also ensure to:

- Arrange workmen compensation insurance, registration under ESI Act, third party liability insurance etc. as applicable.
- Arrange all HSE permits before start of activates (as applicable) like her work, confined space, work at heights, storage of Chemicals/ explosives materials and its used and implement all precautions mentioned therein.
- Submit timely the completed check list on HSE activities, Monthly HSE report, accident report, investigation report, etc. as per SGL only in case of his absence from site, a seconds senior most person shall be nominated by him in advance and communicated to SGL.
- Display at site office and work locations caution boards, list of hospitals for emergency services available.
- Provided posters, banners, for safe working to promote safety consciousness.
- Carryout audits / inspection at sub Contractor work as per approved HSE documents & submit the reports for SGL review.
- Assist in HSW audits by SGL and submit compliance report.
- Generate & submit HSE records / reports as per HSE Plan.
- Appraise SGL on HSE activities at site.

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.

2 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	Remark	Action
HOUSEKEEPING				
Waste containers provided and sued				
Sanitary facilities adequate and Clean				
Passageways and Walkways Clear				
General neatness of working areas				
Proper Material Storage				
Wooden Boards properly stacked & nails removed				
Cords, leads out of walk and traffic ways				
Scraps removed from the work site				
Other				
PERSONNEL PROTECTIVE EQUIPMENT				
Doggies : 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				
Openings properly covered or barricaded				
Excavations shored				
Excavations barricaded				
Overnight lighting provided				
Other				

MONTHLY CHECKLIST CUM COMPLIANCE REPORT REGARDING HSE (2/6)

WELDING/CUTTING				
Valid hot work permit				
Flashback arrester provided for cylinders				
Power cable not crossing the welding cable				
Adequate ear thing 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 + 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				
Outinggers used				
Singh/barricades provided				
Signals observed and understood				
Qulified opretors				
Other				
MACHINERY, TOOLS AND EQUIPMENT				
Proper instruction T				
Saftey devices				
Proper cords				
Inspections and maintenance				
Other				
VEHICLE AND TRAFFIC				
Rules and regulations observed				
Inspection and mantinance				
Licensed drivers				
Other				

MONTHLY CHECKLIST CUM COMPLIANCE REPORT REGARDING HSE (4/6)

Item	Yes	No	Remark	Action
TEMPORARY FACILITIES				
Emergency instruction posted				
Fire extinguishers provided				
Fire-aid equipment				
Secured against storm damage				
General nemeses				
In accordance with electrical requirements				
Other				
FIRE PREVENTION				
Personnel instructed				
Fire extinguishers checked				
No smoking in prohibited areas				
Hydrants clear				
Other				
ELECTRICAL				
Proper wiring & earthing				
ELCB's provided				
Ground fault circuit interrupters				
Protection against damage				
Prevention of tripping hazards				
Proper electrical cable joints				
Light poles secured				
Clear way to power distribution board				
Proper rating of fuses				

MONTHLY CHECKLIST CUM COMPLIANCE REPORT REGARDING HSE (5/6)

Item	Yes	No	Remark	Action
HANDLING AND STORAGE OF MATERIALS				
Properly stored or stacked				
Passageways clear				
Other				
FLAMMABLE GASES AND LIQUIDS				
Containers clearly identified				
Proper storage				
Fire extinguish HSE rs nearby				
Other				
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 hydro testing disposed off as per agreed proceeding				
Lubricant Waste/Engine oils properly disposed.				
Waste from Canteen office, sanitation etc. disposed properly				
Disposal of surplus earth, stripping materials, Oily rags and combustible materials done properly.				
Screen belt protection				

MONTHLY CHECKLIST CUM COMPLIANCE REPORT REGARDING HSE (Conted… 6/6)

Item	Yes	No	Remark	Action
HEALTH CHECKS				
Hygienic conditions at labour camps OL				
Availability of First Aid facilities				
Proper sanitation at site, officer 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

ANNEXURE-B
Format-3

3.0 ACCIDENT REPORT

(To be submitted by Contractor after every accident within 2 hours of accident)

Report No. :
Date :

Name of Site :
Contractor :

NAME OF THE INJURED …….
FATHER'S NAME …….
SUB-CONTRACTOR M/S. …….
DATE & TIME OF ACCIDENT ……..
LOCATION ……..

BRIEF DESCRIPTION OF ACCIDENT

CAUSE OF ACCIDENT

NATURE OF INJURY / DAMAGE

MEDICAL AID PROVIDED / ACTIONS TAKEN

INTIMATION TO LOCAL AUTHORITIES

DATE : SIGNATURE OF CONTRACTOR WITH SEAL

To. : Owner 1 Copy
RCM/SITE-IN-CHARGE, MECON 1 Copy

ANNEXURE-B
Format-4

4.0 SUPPLEMENTARY ACCIDENT & INVESTIGATION 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 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, MECON 1 Copy

5.0 MONTHLY Health, Safety & Environment (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	Cumulatx
Total Strength (Staff-Workmen)		
Number of HSE meeting organized at site		
Number of HSE awareness programmes Conducted at site		
Whether workmen compensation policy taken	Y/N	
Whether workmen compensation	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 : SIGNATURE OF CONTRACTOR WITH SEAL

To. : Owner 1 Copy
RCM/SITE-IN-CHARGE, SGL 1 Copy

CONTENTS

1 SCOPE

1.1 This specification covers the minimum requirements for supply, fabrication and erection of pipeline markers to be installed by CONTRACTOR at various locations along the route of a cross – county pipeline

1.2 This specification shall be read in conjunction with the conditions of all specification and documents in the CONTRACT between COMPANY and CONTRACTOR

2 REFERENCE CODES

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

API RP 1109 : Recommended practice for marking liquid petroleum pipeline facilities

3 GENERAL

3.1 CONTRACTOR shall supply fabricate and install the pipeline marked along the pipeline route. The locations of markers as indicated in the approved drawings shall be treated for guidance purposes only and the exact location of the markers shall be based on AS BUILT drainage and as directed by COMPANY.

3.2 The pipeline markers shall be fabricated and installed in accordance with the COMPANY standard drawings included herein. Before start of fabrication of the markers, CONTRACTOR shall prepare and submit for COMPANY'S approval the detailed scheme for the marker plates as applicable for the project.

3.3 The pipeline markers shall be installed, as far as possible at locations such that to cause no hindrance to the regular use of the land or to the traffic.

1.0 AERIAL MARKERS

Aerial markers shall in general in installed along the pipeline at every five (5) kilometres intervals and at places specified by COMPANY. ReferCOMPANY Standard Drawing No SGL/TS/08/10A for details

2.0 KILOMETRE MARKERS

Kilometer marker shall in general be installed along the pipeline between the aerial markers at every one (1) kilometre interval. Markers shall indicate cumulative distance in kilometers from the reference station as directed by COMAPANY. A kilometre marker is not required in the relative length between its location and any pipeline warning sign is less than 200 metres. Refer COMPANY Standard Drawings.

3.0 PIPELINE WARNING SIGN

Pipeline Earning sign shall in general be installed at

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

A marker shall be marked in bold and legible local language and Hindi /English with at least the following:

- Name of CGD Network Operating Company
- Contact Telephone Number to report emergency.

- Location Area Code
- Warning - "High Pressure Gas Line, Dial before Digging" etc

4.0 ROW BOUNDARY MARKERS

Right – of - Way boundary markers shall be fabricated and installed along entire network as per the drawing at every 100 meters in urban area and 200 meters within industrial parks. These shall be installed on either side of the pipeline alignment to define the ROW boundary limits. These shall also be installed at pipeline turning points to maintain the continuity of the ROW limits. Refer COMPANY Standard Drawings.

5.0 DIRECTION MARKERS

Direction markers as shown in COMPANY Standard Drawing Shall be installed to identify the significant turning points of the pipeline during aerial traverse. One direction marker shall be installed at each turning point., in addition, two more direction markers shall be installed along the pipeline alignment, one on either side of the turning point at 200m from the turning point.

6.0 NAVIGABLE WATERWAY PIPELINE CROSSING WARNING SIGN

The Navigable Waterway Pipeline Crossing Warning Sign shall be fabricated in accordance with COMPANY Standard Drawing No. Such Warning sign shall be installed one on each bank of navigable water courses at the pipeline crossing location, in lieu of the pipeline Warning sign described in clause 6.0 of this specification.

CONTENTS

1. SCOPE

This specification covers the general requirements for Inspection, flushingand testing of piping systems.

Flushing and testing of all piping system shall be witnessed by theEngineer-in-charge / PMC/ TPIA.

2. INSPECTION

During various stage and after completion fabrication and erection, thepiping system shall be inspected by the Engineer-in-charge to ensure that

- Proper piping material been used.
- Piping has been erected as per drawings and the instruction of the engineer-in charge.
- All supports have been installed correctly.
- Test preparations motioned in this specification have been carriedout.

3. FLUSHING

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

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

In line instruments like control valves, orifice plates, rot meters, safety valves and other instruments like them wells which may interfere with flushing shall not be include I m the flushing circuit.

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

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

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

Care shall be taken during flushing so as not to damage/ spoil work of other agencies. Precautions shall also be taken to prevent entry of water/

foreign matter into equipment, electric motors, instruments, electrical installations etc. in the vicinity of lines being flushed.

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

Dropping of valves, specials distance pieces, online instruments and any other piping part before flushing. The flanges to disengage for this purpose shall be envisaged by the contractor and approved by the Engineer-in-charge. These flanges shall be provided with temporary gaskets at the time of flushing.

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

Records in triplicate shall be prepared and submitted by the contractor for each piping system for the flushing done in the proforma in exhibit

4. Testing

4.1 Extent of testing

With the exclusion of instrumentation. Piping system fabricated or assembled in the filed shal be tested irrespective of whether or not they have been pressure tested prior to site welding of fabrication.

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

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

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

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

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

Control valves shall not be included in the test system. Where by-passes are provided test shall be performed through the by-pass end/or necessary spool shall be used in place of the control valve.
-Pressure gauges which are of the finished system, but cannot withstand test pressure shall not be installed until the system has been tested. Where piping systems to be tested are directly connected at the battery

limits to piping for which the responsibility teast with other agencies, the piping to be tested shall be isolated from such piping by physical disconnection such as valves or blinds.

4.2 General Requirement/ Test preparation for Testing

Test shall be carried out with permanent gaskets installed unless specified otherwise or instructed by the Engineer0in-charge.
No pressure test shall be carried out against close valve unless approved by the Engineer-in-charge.

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

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

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

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

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

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

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

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

Provide blind on valve flanges and test the upstream and downstream of the line separately and remove the blind after testing. All these flanges, temporary gaskets shall be provided during testing and shall be replaced by permanent gaskets subsequently. For check valves in lines- 1-1/2” and below, flapper or seat shall be removed during testing (if possible). After completion of testing the flopper/ seat shall be refitted.

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

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

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

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

4.3 Testing modes, test pressure and test pressure gauges

4.3.1 Testing Modes

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

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

4.3.2 Test Pressure

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

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

Test pressure required as per line list.

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

4.3.3 Test Pressure Gauge

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

Prior to the start of any test or periodically during the field test programmes, all test gauges shall be cailbrated using a standard dead weight gauge tester or other suitable approved testing apparatus. Any gauge having an incorrect zero reading or error of more than _ 2% of full

scale range shall be discarded. The Engineer-in-charge shall check theaccuracy of master pressure gauge used for calibration.

4.4 Testing pressure

4.4.1 Hydrostatic Test

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

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

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

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

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

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

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

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

4.4.2 Air Test

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

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

All other activities shall be same as per hydrotesting procedure (Specified above).

4.5 Completion of Testing

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

All vents and drains shall be opened before the system is to be drained and shall remain open till all draining is complete, so as to prevent

formation of vacuum in the system. After draining lines/ systems shall be dried by air.

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

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

4.6 Test Records

Records in triplicate shall be prepared and submited by the contractor for each piping system, for the pressure test done in the proforma as given in Exhibit ‘F’.

CONTANTS

1.0 Scope

This specification covers the requirements of various piping materils used in piping/ pipeline system handling natural gas and associate utilitties in the pipeline.

2.0 Codes and Standards

2.1 Pipeline and terminal facilities envisaged as a part of this project shall be designed and Engineered primarily in accordance with the provision of ASME B 31-8 Gas Transmission and Distribution piping system 1995 edition.

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

2.3 For sake of bravity, the intials of the society to which the codes are referred are omitted in the specification, for example, B16.5 is a code referring to ANSI/ ASME, A 105 is a code referring to ASTM.

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

3.0 Material Specification

Piping material specifications are classified for the general purpose of selection of material for the class of services. The maximum design pressure and design temperature together with the fluid in line governs the selection of material specification. Deviation of materials from class specifications may occurred due to specific design condition. These deviations are permissible if they are equal or better than the individual class requirements.

4.0 Class Designation Code

The piping class designation consist of three digits numbering system made upof letter, number, letter e.g.A1A, B1A, D1A, etc as follows:

First letter indicates ANSI class rating e.g.A-

Class 150

B-Class 300

C-Class 600

The middle number indicates differences in the specification within the samerating and material.

The last letter indicates type of material e.g.A-

Carbon steel

5.0 Pipeline

The material for line pipe shall be as per the requirements of specification asindicated in table- I.

6.0 Piping

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

6.2 Pipe dimension shall be in accordance with ANSI B 36'.10 for carbon steel pipes and ANSI B 36.19 for stainless steel pipes.

6.3 All pipe threads shall conform to American Standard taper as per ANSI B 1.20.1 NPT, unless otherwise specified.

6.4 For butt weld end, bevel shall be in accordance to ANSI B 16.25/ API 5L as applicable.

7.0 FITTINGS

7.1 Fully killed carbon steel shall be used in the manufacture of fittings.

7.2 Threaded joints, if used shall conform to American standard taper as per ANSI 1.20.1 NPT.

7.3 Dimension of socket weld/ screwed fitting shall conform to ASME B 16.11.

7.4 Bore of socket welded fittings shall suit old. OF Pipe and its thickness.

7.5 Dimensions of butt welded carbon steel fitting upto size 18" NB shall conform to ASME B 16.9/ MSS-SP-75 as applicable.

7.6 Butt welding ends shall conform to ANSI B 16.25/ API 5L. in case of difference in thickness of matching ends, requirements of ASME B 31.8 shall apply.

7.7 Intergrally reinforced forged branch fitting such as sockolet, threadolet, weldolet, nippolet etc. shall be as per MSS-SP-97. Fittings not covered in ASME B 16.9 and MSS-SP-97, shall conform to manufactuer's standard.

8.0 Bends

8.1 Unless otherwise specified for terminal piping, the elbow of radius R = 1.5 D shall only be used.

8.2 For pipeline cold field bends with radius R = 40D (Where D is pipe 0. D) for 18" NB shall be used. Limited used of long radius bends (R=6D) may be permitted for reason of space constraints.

9.0 Flanges

9.1 Flange rating shall be same as ANSI class rating unless otherwise specified.

9.2 Dimensions pf flanges shall be in accordance with ANSI B 16.5 for sizes up to 18" NB.

9.3 Neck Of Weld Neck (WN) flanges to suit pipe bore and thickness.

9.4 Bore of Socket Welded (SW) flanges shall suit pipe O.D. and its thickenss.

9.5 Threads for screwed flanges if used shall conform ti American Standard taper as per ANSI B 1.20 1 NPT.

9.6 Sizes for blind flanges shall be indicated by nominal pipe sizes.

9.7 Carbon,Steel flanges faces shall have serrated finish or smooth finish as indicated in the material specification. Flanges faces shall have serrated finish to 250-500 microinches AARH as per ANSI B 16.5 for ANSI class 150# and smooth finish to 125-200 micronches AARH as per MSS-SP-6 for ANSI class 300# & 600 #.

9.8 Butt welding ends of WN flanges shall conform to ANSI B 16.25

9.9 Spectacle blind/ spacer & blinds for sizes upto and including sizes 18" NB shall be in accordance with API standard 590/ SGL standard. Spectacle blind shall be used for sizes upto 8" NB and for 10" & above spacer & blind shall be used.

9.10 Two jack screws 180° apart shall be provided for all spectacle blind assemblies. The jack screws shall be as per SGL'S standard, attached with this specification.

10.0 GASKETS

10.1 Spiral wound metallic gaskets shall conform to B 16.20 and shall be provided with compressed asbestos filler. All spiral wound gaskets shall be privided with carbon steel centering ring. Gasket thickness shall be as indicated in piping material specification for the acpplicable piping class.

10.2 Non metallic compressed asbestos gaskets for flanged pipe joints shall conform to B16.21 unless specified otherwise, asbestos material shall conform to IS 2712 Gr. 0/1. Gasket thickness shall be as indicated in piping material specification for the applicable piping class.

11.0 Bolting

11.1 Nuts for stud bolts shall be American standard hexagonal heavy. Series and double chamfered.

11.2 Dimension and tolerances for stud bolts and nuts shall be as per ANSI B 18.2.1 and 18.2.2 with full threading to ANSI B 1.1 Class 2A thread for bolts and class 2Bfor nuts. Diameter and length of stud bolts shall be as per ANSI B 16.5 with full threading.

11.3 Threads for nuts shall as per ANSI B 1.1, as follows : Nuts

for stud dia 1/4" TO 1"	:	UNC-2B
Nuts for stud bolts dia 11/8" to 31/4	:	8UN-2B

11.4 Threads for stud bolts shall be as per ANSI B 1.1, as follows.Studs

bolts dia 1/4" to 1"	:	UNC- 2A
Stud bolts dia 11/8" to 31/4"	:	8UN-2A

11.5 Heads of jack screws shall be heavy hexagonal type. Jack screw end shall berounded. Stud bolts shall be fully threaded with two hexagonal nuts.

Table : 1

MAIN LINE PIPE MATERIAL

Line pipe material and thickness shall be indicated in mainline SOR.

Table : 2

INDEX OF PIPING MATERIAL SPECIFICATIONS

Piping Class	Service	Design pressure	Design Temp. ^0C	C.A.in mm.	Basic Material	Design Code
AIA (150 #)	Natural Gas	19.0	65	1.5	APL 5L	ASME B 31.8
BIA (150#)	Natural Gas	49	65	1.5	API 5L	ASME B 31.8
DIA (150#)	Natural Gas	92	65	1.5	API 5L	ASME B 31.8

12.0 Thread Sealant

12.1 Threaded joints shall be made with 1" wide PTEF jointing tape.

13.0 VALVES

13.1 All valves installed above ground within the terminal of sizes 2" and above shall have flanged ends. Valves of size less than 2" shall have socket welded ends except for ball valves.

13.2 Flange dimensions and face finish of flanged end valves shall confirm to clause 9.0 of this specification.

13.3 Butt welding ends of butt welded valves shall confirm to ANSI B 16.25

13.4 Face to face and end to end dimensions shall confirm to applicable standards.

13.5 Buried valves on mainline shall be provided with stem extension, sealant, vent/ drain & shall have butt welded ends.

13.6 Sectionlising valves (block valves) installed on the main pipeline shall have butt welded ends and shall be full bore to allow smooth passage of cleaning pigs as well as intelligent pigs.

13.7 Unless specified otherwise. Valves shall confirm to the following standards.

Screwed/ Socket welded / flanged end valves (1 1/2" and below)

Ball valves	-	BS 5351
Plug Valves	-	BS5353
Check Valves	-	BS 5352
Globe Valves	-	BS 5352
Gate Valves	-	API 602

Flanged/ Butt weld end valves (2" and above)

Ball Valves	-	API 6D
Plug Valves	-	API 6D
Check Valves	-	BS 1868
Globe Valves	-	BS 1873
Gate Valves	-	API600

13.8 Valve operators shall be as indicated below, unless specified otherwise in theP&ID.

a) Gate and globe valves

i) For ANSI Class 150 and 300 - Hand wheel operated for size < 12"NG

Gear operated for size >14" NG.

ii) For ANSI class 600 - Hand wheel operated for siz < 10" NB
Gear operated for size >12" NB.

b) Ball and plug valves

i) For ANSI class 150, 300, 600 - Wrench operated for size < 4" NB.
Gear operated for size < 6" NB.

14. Quick opening end closure

Quick opening end closure to be installed on scraper traps shall be equipped with safety locking in compliance with setion VII, division 1, UG- 35 (b) of ASME bolier and pressure vessel code.

15. Hydro testing vents and drains

High point vents and low point drains required for the purpose of hydro testing shall be of size 0.75" and consist of sockolet, gate valve, flange & bling flange.

CONTENTS

1.0 SCOPE

1.1 This specification covers the minimum requirements of various records reports and drawings for all aspects of pipeline construction to be prepared by Contractor and submitted to the Company at intervals as described in this specification and as directed by Company.

1.2 All document required to prepared and submitted by contractor as per this specification shall be in addition to the various reports, records, methodology statement, calculation drawing etc to be submitted by the Contractor for Company's record review or approval as per the requirements of all other specification included in the Contract between the Company and Contractor.

1.3 This specification shall be read in conjunction with the conditions of all specifications and document included in the Contract between Company and Contractor.

2.0 RECORDS

Contractor shall submit daily, weekly monthly and after completion to the Company, various records and reports for company's documentation purpose during and immediately after the construction. This shall as minimum include, but not limited to the following :

2.1 Daily

- Separate progress reports of all crews
- Daily welding results and repairs
- Actual weather conditions

- Application for deviations, if any
- Accidents
- Darnages
- Activities required from Company
- Materials Receipts
- Urgently required materials

2.2 Weekly

- Up – to date list of confirmed site instruction issued by company
- Materials 'taken over'
- Material defects and repairs
- Outstanding activities of Company
- List of installed markers, chainage
- Required approval from Company
- Progress planned
- Reports of manning of all crews equipment and plant
- Report of equipment and plant
- Report of accidents
- Report of damages
- Report of acquired release, permits

- Priced variations
- Required materials for next month

2.3 Monthly

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

2.4 Further Contractor shall supply (for approval if required to theCompany with documents such as but not limited :

- Organogram for construction work.
- Bio-date of key personnel (including foremen)
- (Revised) list of address of personnel in particular of medicalstaff, safety and security offers.
- (Revised) list of approved coaters.
- (Revised) list of approved sub – contractors.
- Time schedule.
- Acquired permits and/ or approvals from Authorities, if any.
- Minutes of meeting with Company with comments, if any.
- Material certificates, material receipt.
- Guarantee from vendors and sub – contractor.
- Calculations, Temporary work bouyance, blasting.
- Drawings issued by contractor.
- Vendors drawings.

- As- built of route maps alignment sheets details drawingsand isometric drawing
- Procedure such as surveying stacking fencing
- Welding procedure qualification record, radiographic procedure qualification welder qualification.
- Coating procedure
- Installation of crossings.
- Hydrostatic testing
- Blasting.
- Radiographic report alongwith original radiographs
- Pipe and welding book
- **Reports**
  - Material tests (coating, welding painting)
  - Computerised Potential Logging Test
  - Water Samples
  - Cleaning, Pigging Report before Hydrostatic Test
  - Hydrostatic Test
  - Calibration Test
  - Blasting Trials
  - Equipment certificate (dead weight tester, instruments vessels equipment)
  - Manuals
  - Major water crossings
  - Waste disposal
  - Disposal of water after hydrostatic test.

2.5 Contractor shall submit to company colour photographs of various construcation activities / operations at regular intervals. Size

number and frequency of the photographs shall be mutually agreed upon at a leter stage. Also Contractor shall make video recordings of all operations right from the start of construction till the completion of the work, covering to the extent as instructed by company and submit to Company. Upon completion of the work contractor and submit edited master tape plus six copies of video recording in VHS formats or any format ordered by the Company. The duration of Video recording shall be of ½ hour and shall coverall aspects of the job.

3.0 AS – BUILT DRAWINGS AND PIPE BOOK

3.1 General

Contractor shall prepare "as – built" drawings of all by or on behalf of Company issued drawing and of all Contractor work drawings including vendor drawing, such as but not limited to :

For Pipeline Section :

- Route Maps
- Alignment Sheets
- Detail Drawing (road, railway, minor water crossings, major water crossings, valley crossings)
- Isometric drawings of installations
- Special installation

Further Contractor shall prepare a pipe Weld Book

If required by the Company, Contractor shall update the diskettes for drawings issued for construcation of the job.

3.2 "As – Built" Drawings

Contractor shall prepare a complete set of "as-built" drawings. From the start of construction, contractor shall on daily basis process any changes in two sets drawings. Deleted [parts shall be indicated in red new parts in blue, remarks in green and unchanged parts in yellow. Said drawings shall be kept at site and be available to company at all times. Contractor shall prepare "as-built" drawings based on these data. On completion of the work one revised film trensparency of all drawing made "as-built" by contractor containing the "as-built" information shall be handed over to Company as well as one complete set of CD ROM/ Floppy diskettes as specified by Company.

Contractor shall prepare and submit a specimen of the layout of the drawing for Company's approval.

The required measurement for "as-built" drawing shall executed by Contractor by experienced qualified surveyors.

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

- Horizontal location of pipeline with regard to deviations and permanent Grid Pillars.
- Vertical Level with regard to Mean Sea Level of pipeline and grade.
- Location and type of bends, fittings etc. and grades, points of intersection.
- Change of wall thickness materials.
- Location and details of valves, insulating flanges, fencing.
- Location and details of crossing pipes, vents.
- Location and type of coating.

- Location and type of weighting anchoring.
- Location and type of markers.
- Location of further appurtenance (pig-Signallers)
- Location of ROU and of pipeline with respect to ROU.
- Type of soil
- Type of rock
- Type of blasting and ripping.
- Sand padding.
- Type of road pavement.
- Details of bank protection, number of insulators seals. Contractor shall also prepare isometric drawing of all installation(facilitates) etc. for which the data as mentioned in or required forthe pipe and Welding Book can be identified and these drawingscan also be used for material accounting.

3.3 Nameplates of Equipment

All permanent equipment supplied and installed by Contractor shall be provided with plates by Contractor: All texts shall be submitted to Company for approval before plates may be manufactured.

3.4 Pipe Book

Every page of the pipe and Welding Book shall mention :

- Date relevant to the project and section there of.
- Sequential number.
- Length brought forward (for pipes and other materials).
- Length bring forward (for pipes and other materials). Alignment sheet number and atleast the location thereon of twowelds on every page of the pipe Book.

Further,

- Diameter of pipeline
- Length of each pipe
- Wall thickness
- Pipe number
- Heat number certificate number
- Cut and re-numbered pipe ends
- Coating type
- Date of stringing
- Date of welding
- Direction of working
- Heat treatment
- Equipment used for radiography
- Limits of water crossings
- Test pressure and date of test.

In order to achieve this, Contractor shall identify all pipe elements. Sampleformat of pipe Book shall be submitted for Company approval

3.5 As- Built Documents

Contractor shall prepare all documents in the prescribed format as indicated below. In addition to the three hard copies, three copies of final documents shall also be submitted in electronic media i.e. CD ROM / floppy diskettes.

Software used for the preparation of these documents shall be as follows :

Type document		Software
a)	Reports / Documents	MS Office
b)	Drawing	Auto CAD

For the purpose of preparation as as-built drawing, Contractor shall update the "Issued for construction " drawings issued by the Company. It

shall be Contractor responsibility to covert the drawings furnished by the Company in hard copy into CAD drawings including scanning, digitizing and converting the drawing s into a suitable format compatible with the Auto CAD and above. As-Built drawings shall be prepared only on AutoCAD drawings.

CONTENTS

1.0 INTRODUCTION

This specification covers the minimum technical requirements for pre-commissioning and commissioning of gas pipeline, including pre-commissioning activities such as pre-commissioning checks, flushing of terminal piping, dewatering, swabbing and nitrogen purging

2.0 GENERAL

The scope of work for testing and commissioning including pre-commissioning activities shall include, but not limited to the manpower, machinery & equipment, detailed procedures, materials and consumables, communications etc. to perform the work satisfactorily.

Contractor shall prepare detailed procedures for flushing of terminal piping, dewatering, swabbing, inertisation and commissioning of the pipeline, covering all aspects of work for company's approval. This shall include, but not limited to, the sequence and description of all operations, data on materials, equipment, instruments, consumables, communications systems, necessary calculations, detailed time schedule and organization chart.

The Contractor shall be responsible for demonstrating the successful completion of all the activities i.e. flushing of terminal piping, dewatering, swabbing, inertisation and commissioning of the pipeline. All necessary work to perform the job successfully including necessary modifications required shall be the responsibility of the Contractor.

Contractor shall design and supply all temporary line connections, valves, instruments, etc. as required during the various operations.

In the event of any detail which is not fully addressed, it is warranted by Contractor that work shall be performed in accordance with company's specification and the best recognized practices in the on-shore pipeline industry.

3.0 THE WORK

The work to be performed by the Contractor shall consist of the following activities.

Pre-commissioning : Entire pipeline project shall be checked with respect to latest P&ID's and other design specification.

Dewatering : Removal of hydrotest water from the entire pipeline network system.

Swabbing : Reducing the amount of remaining water in the main pipeline system which is left behind after completion of the dewatering operations to make the pipeline free of water.

Inertisation : Intertising the entire pipeline with nitrogen.

Commissioning : Charging the entire pipeline network with the product and achieving normal operating conditions of the Pipeline.

4.0 PER-COMMISSIONING CHECKS

4.1 The pre-commissioning checks shall be carried out of for the pipeline to ascertain the pipeline system has been mechanically completed in all respects. These checks shall cover the main pipeline including distribution network system and Sectionalizing valve stations. The pre-commissioning checks shall include the following:

i) System Checks

The entire facilities shall be checked against the latest P&ID's and other design specification code

ii) Checking of Field Instruments

All the field instruments like control valves, sectionalizing valves, transmitters, solenoid valves, shut down switches, alarms etc. shall be checked physically and also for their intended application by simulating the operating conditions. It will also include checking of different meters, gauges action of shutdown valves etc. as applicable.

iii) Survey of the Pipelines

This shall be performed to confirm that proper fittings/supports, route markets, fencing around SV Stations etc.have been installed along the pipeline

iv) Checking of Communications System

This is to check that there is proper communications with adequate back-up power to ensure uninterrupted communication

v) Checking of Electrical Distribution System

This is to check that instrument controls and interlocks are functional as per the normal operating conditions.

vi) Checking of instruments, Controls & Interlocks

This is to check that instrument controls and interlocks are functional as per the normal operating conditions.

vii) Checking of Utilities

This is to check that utilities like power, nitrogen, UPS system instrument air, etc. are available prior to startup.

viii) Any other checks are may be considered necessary.

4.2 DEWATERING

4.2.1 General

During the dewatering operation the major quantity of hydrotest water shall be removed from the main pipeline and distribution network. It is the responsibility of the Contractor to develop suitable dewatering procedure and submit for Company's approval.

The disposal of the water shall be performed such that no harm is done to the environment.

4.2.2 Operational Requirements

The dewatering operation shall consist of number of dewatering pig runs when air is used as propellant for pig trains.

Bi-directional cup pigs shall be used and will be suitable for traversing the entire length of the pipeline/ pipe segment being dewatered. Contractor shall ensure that all the pigs are designed to prevent damage to the pipeline internal coating, if any.

The Contractor shall propose the minimum speed and the back pressure of the pigs in order that continuous operation will be performed without the pig getting struck. Contractor shall submit all the calculations regarding this procedure and a contingency plan for implementation in case the pigs get struck.

Contractor shall provide a suitable compressor for oil-free air with sufficient capacity and pressure.

Upon arrival of the pigs at the receiving end the Contractor in the presence of Company's representative shall remove the pigs without delay.

4.2.3 Acceptance Criteria

Before proceeding to the next stage of the inertisation operation Contractor shall ensure that bulk of the water has been removed from the pipeline. Contractor shall specify when the dewatering phase if finished and shall obtain approval of the company before proceeding to the next inertisation phase.

4.3 Swabbing

4.3.1 General

The swabbing operation is meant to reduce the remaining water in the pipeline into touch dry condition.

Swabbing operation shall be carried out to ensure that there is no free water left inside the pipeline. This is done by driving number of swabbing pigs so that the weight increase in pig before and after the swabbing operation is not more then 25%. The Contractor shall submit the detailed procedure along with the duration of the swabbing operation and obtain approval of the company before starting the operation.

4.3.2 Acceptance Criteria

The Contractor shall ensure that the swabbing operation is considered to be completed when it is established that there is no free water left in the pipeline and the pipeline has achieved a touch dry condition. This shall be subject to company's approval.

4.4 Inertisation

During the inertisation operation, the air left in the pipeline shall be replaced by nitrogen before admitting the product natural gas that the pipeline will ultimately carry.

The inertisation operation shall as soon as possible after the swabbing operation has been completed and approved by the company. Contractor shall submit the detailed purging procedure for approval for the company prior to its implementation.

Nitrogen needed for inertisation of the pipeline, shall be provide by the Contractor. The maximum allowable oxygen content inside the pipeline shall be less than 1 % by volume.

Multiple separation pigs with nitrogen slugs in between shall be used for pipeline commissioning. At least three batches of nitrogen separated by four separation pigs shall be used for inertisation of the pipeline during charging of gas in it. The combined nitrogen column length to be used for inertisation should be at least 5% of the total pipeline length.

4.4.1 Safety Review before start of commissioning

A pre-startup safety review shall be carried out of the pipeline system before permitting entry of natural gas into the new facility. Owner/ Owner's representative shall also participate in the pre-startup safety review.

4.5 COMMISSIONING

4.5.1 General

Commissioning of pipeline shall be considered completed when the line is charged with product natural gas at operating pressure and the total system operated at normal operating parameters for a minimum period of 72 hours with all the instruments, controls and interlocks working satisfactorily at normal operating conditions. Contractor shall submit a detailed commissioning procedure for company's approval.

5.0 DOCUMENTATION

Contractor shall submit for approval of the company the complete description, detailed procedure and time schedule of all the dewatering, swabbing, purging and commissioning operations, as applicable

Documents shall also contain al procedures and safety plans to be followed while carrying out the activities.

Upon successful completion of the work, Contractor shall prepare a final report of the work which shall include necessary charts, diagrams, graphs, calculations, recordings, daily logs, measurements, details of the operation, etc. Report shall also include all certificates of calibration of instruments required together with records of calibration performed at site prior to the start of any operation.

5.1 Spares and Consumables

Supply of spares, tools and consumables for start-up & commissioning

5.2 Safety

- Appropriate Work Permit should be issued based on the kind of activity.
- Fire fighting equipments should be available during commissioning.
- Proper communication facilities should also be arranged.
- Follow the safety practice during execution of pre-commissioning/commissioning works as detailed in the scope of work. Maintain and follow all safety practices equivalent or better than those being practiced for the pipeline during pre-commissioning and commissioning.

CONTENTS

1.0 INTRODUCTION

This specification establishes the Quality Assurance Requirements to be met by the Sub-contractors (including turnkey Contractors) and their sub-vendors

In case of any conflict between this specification and other provisions of the contract/ purchase order, the same shall be brought to the notice of SGL, at the stage of bidding and shall be resolved with SGL, prior to the placement of order.

2.0 DEFINITION

Bidder

For the purpose of this specification, the word "Bidder" means the person(s) firm, company or organization who is under the process of being contracted by SGL/ Owner for delivery of some products (including service). The word is considered synonymous to supplier, contractor or vendor.

Correction

Action taken to eliminate the detected non-conformity.

Refers to repair, rework or adjustment and relates to the disposition of an existing non-conformity.

Corrective Action

Action taken to eliminate the causes of an existing non-conformity, defect or other undesirable situation in order to prevent recurrence.

Preventive Action

Action taken to eliminate the causes of a potential non-conformity, defect or other undesirable situation in order to prevent recurrence.

Process

Set of inter-related resources and activities which transform inputs into outputs.

Special Process

Processes requiring pre-qualification of their process capability.

3.0 CONTRACTORS SCOPE OF WORK

3.1 Prior to award of contract

The bidder shall understand scope of work, drawings, specifications and standards etc., attached to the tender/enquiry document, before he makes an offer.

The bidder shall submit milestone chart showing the time required for each milestone activity and linkages between different milestone activities alongwith overall time period required to complete the entire scope of work.

The bidder shall develop and submit manpower and resource deployment chart.

The bidder shall submit, along with the bid, a manual or equivalent document describing / indicating / addressing various control/check points for the purpose of quality assurance and the responsibilities of various functions responsible for quality assurance.

3.2 After the award of contract

The bidder shall submit the schedule for submission of following documents in the kick-off meeting or within two weeks of the placement of order, whichever is earlier.

- Detailed Bar Chart
- Quality plan for all activities, required to be done by the bidder, to accomplish offered scope of work.
- Inspection and test plans, covering various control aspects.
- Job procedures as required by SGL / SGL'S PMC.
- Procurement schedule for items to be supplied by contractor covering inspection of the same.

Various documents submitted by the bidder shall be finalized in consultation with SGL / SGL'S PMC. Here it shall be presumed that ones a bidder has made an offer, he has understood the requirements given in this specification and agrees to comply with them totality unless otherwise categorically so indicted during pre-

award stage through agreed deviation / exception request. All Quality Assurance Plan (QAP) documents shall be reviewed by concerned functional groups of SGL / SGL'S PMC and the bidder shall be required to incorporate all comments within the framework of this specification at this stage of the contract. It is also obligatory on the part of the bidder that obtains approval on every Quality Assurance Plan (QAP) documents, before he starts using a particular document for delivery of contracted scope of work. Participation of SGL / SGL'S PMC in review/ approval of quality plan/ QAP documents does not absolve the contractor of his contractual obligations towards specified and intended use of the product (or service) provided/ to be provided by him under the contract.

3.3 During job execution

During job execution, the bidder shall fully comply with all quality document submitted and finalized/ agreed against the requirements of this specification. Approval of SGL / SGL'S PMC on all these documents shall be sought before start of work.

Bidder shall produce sufficient quality records on controlled/ agreed forms such that requirements give in this specification are objectively/ demonstrable.

Bidder shall facilitate SGL / SGL'S PMC during quality/ technical audits at his works/sites.

Bidder shall discharge all responsibilities towards enforcement of this specification on all his sub-contractors for any part of the scope which is sub-contracted.

4.0 QUALITY ASSURANCE SYSTEM REQUIREMENTS

4.1 The bidder shall nominate an overall in-charge of the contract titled as "Project Manager" for the scope of work agreed contract. The name of this person shall be duly intimated to SGL / SGL'S PMC including all subsequent changes, if any. SGL / SGL'S PMC shall correspond only with the project manager of the bidder on all matters of the project. The manager of the bidder shall be responsible for co-ordination and management of activities with bidder's organization and all sub-vendors appointed by the bidder.

After award of work, the bidder may review augmentation of man review augment of manpower and resource deployment chart (submitted earlier), detail it out, if so consented by SGL / SGL'S PMC and resubmit the same as "issued for effective implementation of the project".

4.2 The Bidder shall plan the contract scope of work on quality plan format such that no major variation is expected during delivery of contract scope of work. These quality plans shall be made on enclosed format complete in all respect. The quality plan shall be assumed to be detailing bidder's understanding and planning for the contract/ offered scope of work. The bidder shall plan the type of resources including various work methodology which he agrees to utilize for delivery of contract scope of work.

4.3 The bidder is required to review the contract at all appropriate stages to evaluate his capabilities with respect to timely and quality completion of all activities pertaining with respect to timely and quality completion of all activities pertaining to contracted scope of work and shall report for constraints, if any to SGL / SGL'S PMC.

4.4 The design activities, if any, performed during delivery of contract scope of work shall be so controlled that the outputs is reliable enough. It is expected that during development of design, the bidder shall take recourse to detailed checking, inter departmental reviews and documented verification methods.

4.5 For all documents which the bidder is likely to utilize for delivery of contract scope of work, a system must exist which assures that latest/ required version(s) of the document(s) is available at all location/point of use.

4.6 In case the bidder decides to sub-contract any part/full of the contract scope of work (without prejudice to main Contractual condition), the bidder shall:

- Evaluate the technical and their products and/ or service before awarding them with the sub-contracted scope of work. Selection of a sub-contractor should meet SGL / SGL'S PMC approval in documented form.

- Requirement of this specification shall be enforced on sub-contracted agency also. The bidder shall choose sub-contractor based on their capability to meet requirements of this specification also.

Note: It may so happen that, in a given situation, a sub-contractor may not have a system meeting the requirements of this specification. In all such eventualities, bidder may lend his system to sub-contractor for the contract such that sub-contractor effectively meets the requirements of this specification. In all such cases SGL / SGL'S PMC shall be duly informed.

4.7 Bidder shall establish adequate methodology such that the materials supplied by SGL / SGL'S PMC shall be adequately preserved, handled and made use of for the purpose for which they are provide.

4.8 All output delivered against contract scope of work shall be suitably identified in such a manner that either through identification or some other means, sufficient traceability is maintained which permits effective resolution of any problem reported in the outputs.

4.9 Critical activities shall be identified and the bidder is required to have documented methodologies. Which he is going to utilize for carrying out such activities under the contract scope of work. Wherever it is difficult to fully inspect or verify the output (special process), bidder shall pre-quality, the performers and methodologies.

4.10 All inspections carried out by the bidder's surveillance/inspection staff shall be conformity to quality plans and/ or inspection and test plans. All inspection results shall be duly documented on controlled/ agreed forms such that results can be co-related to specific product that was inspected / tested.

4.11 All inspection, measuring & test equipments (IMTEs) shall be duly calibrated as per National/ International standards/ codes and only calibrated and certified IMTEs shall be utilized for delivery of contract scope of work.

4.12 All outputs/ products delivered against contract scope of work shall be duly marked such that their inspection status is clearly evident during all stages/ period of the contract.

4.13 All non-conformities (NCs) found by the contractor's inspection/surveillance staff shall be duly recorded, including their disposal action. The deficiencies observed during stage of product, shall be implemented by the bidder for all repetitive NCs, including deficiencies.

4.14 All deficiencies noticed by SGL / SGL'S PMC shall be recorded on a controlled form. Such deficiencies shall be analysed by the bidder and effective and appropriate correction, corrective and preventive actions shall be implemented. Bidder shall intimate SGL / SGL'S PMC of all such corrective and preventive action implemented by him.

4.15 Bidder shall establish appropriate methodologies for safe and effective handling, storage, preservation of various materials/ inputs encountered during delivery of contract scope of work.

4.16 Bidder shall prepare sufficient records for various processes carried out by him for delivery of contract scope of work such that requirements of this specification are objectively demonstrable. In case SGL / SGL'S PMC finds that enough objective evidence/ recording is not available for any particular process, bidder shall be obliged to make additional records so as to provide sufficient objective evidence. The decision of SGL / SGL'S PMC shall be final and binding on such issues.

4.17 The bidder shall arrange internal quality audits at quarterly intervals, to independently assess the conformance by various performers to the requirements of this specification. The findings of such assessment shall be duly recorded and a copy shall be sent to SGL / SGL'S PMC for review.

4.18 For all special processes, bidder shall deploy only qualified performers. Wherever SGL observes any deficiency, the bidder shall arrange the adequate training to the performer(s) before any further delivery of work.

SPECIFICATION FOR INSTALLATION OF POLYETHYLENE PIPES – EXECUTION OF WORKS

TABLE OF CONTENTS

1. INTRODUCTION

This specification defines the requirements which shall meet for the Installation of polyethylene pipes for natural gas distribution. Deviations from this specification are only permitted if they have been explicitly permitted by the Company due to local circumstances and subject to the required precautions being taken.

2. DEFINITIONS

2.1. PRESSURE

Pressure referred to in this document is measured above atmospheric in bar.
1 barg = 1000 mbar above atmospheric pressure. (barg = bar gauge)

2.2. LP - LOW PRESSURE

Pipelines with a normal operating pressure not greater than 1 barg.

2.3. MP - MEDIUM PRESSURE

Pipelines with a service pressure greater than 1 barg but not greater than 19.8 barg.

MP A: pipelines with a maximum operating pressure between 1 barg and 5 barg.

MP B: pipelines with a maximum operating pressure between 5 barg and 19.8 barg.

2.4. LCL - LOWER CONFIDENCE LIMIT

A quantity, expressed in megapascals (MPa), representing the material stress which Corresponds to the reliability limit of 97.5% of the specified long term hydrostatic strength (LTHS) for a period of 50 years, calculated according to ISO9080.2.

2.5. MRS - MINIMUM REQUIRED STRENGTH

MRS 10: standardized class of compounds for which the LCL is equal to 10.

2.6. PE 100

Standard designation for PE compounds in class MRS 10.

For such PE compounds, the long-term hydrostatic strength – calculated and classified according to the standardised method (ISO 9080 and ISO 12162) for a temperature of 0°C, a period of 50 years and a reliability of 97.5 % – must be at least 10 MPa.

2.7. SDR

The number *d/e* giving the ratio of the nominal diameter *d* in relation to the nominal wall thickness *e*.

2.8 OD - NOMINAL OUTSIDE DIAMETER

Nominal outside diameter of the plastic pipe or fitting (also referred to as *d*)

3. MATERIALS

3.1. NATURE OF THE MATERIALS

The pipes and fittings (T-pieces, elbows, reductions etc.) which form part of the gas pipelines are made of polyethylene. The pipes used satisfy standard IS:14885:2001, ISO- 4437 and SGL technical specifications. They are made of polyethylene with classification of MRS 10 (PE 100). Pipes and fittings can be supplied in two different wall thickness standardized according to the SDR series SDR11 or SDR17.6. The correct material to be chosen with respect to raw material, MRS, SDR, color, packaging and marking is laid down by the Company and may vary according to the circumstances. The Contractor will if necessary adapt his welding technology according to the choice referred to above. Only electro-fusion welded joints are permitted as a standard. Exceptions to this require the express permission of the Company. Fittings made of other materials shall be in accordance with the standard concerned for use in gas pipelines.

3.2. MATERIALS MADE AVAILABLE BY THE COMPANY

Unless otherwise specified, the materials stated below are made available to the Contractor by the Company at its warehouses.

3.2.1. The usual PE 100 pipes are summarized in the table in Annex 1.

3.2.2. The PE valves.

3.2.3. 32 mm HDPE ducts for OFC cable.

3.2.4. Materials to be supplied by the Contractor:

All materials which are not mentioned in section 3.2. are supplied by the Contractor and shall be included in the unit prices offered in the Tender. If they do not meet the quality requirements or other criteria in connection with the expert execution of the work or the provisions of the specifications, the Company is entitled to reject the materials supplied by the Contractor - even after they have been installed – and to require their proper replacement.

4. EARTHWORKS

4.1. ADDITIONAL PROVISIONS

4.1.1. Laying depth

This is the vertical distance between the top tangent of the pipeline and the top level of the expertly repaired road surface. At a crossing with railways, this is the vertical distance between the top tangent of the pipeline and the lowest rail foot. If the pipeline is in a sleeve, the lying depth is determined with respect to the top tangent of this sleeve.

4.1.2. Cover

Unless otherwise stated, the following covers apply to the various pressure classes:

Minimum Cover Requirements for Pipelines	
Location	**Min. Cover (Mtr.)**
Normal / Rocky terrain	1.0
Minor river / unlined canal / nala crossings, tidal areas and other watercourses.	1.5
Major river crossings	2.5
Rivers with rocky bed	1.5
Lined canals / drains / nalas etc..	1.5
Drainages ditches at roadway and railrods	1.0
Rocky areas	1.0
Cased / uncased road crossings	1.2
Cased railroad crossings	1.7

The minimum cover may be greater than as mentioned above as may be required by Government/ Public authorities under jurisdictions. The contractor shall perform such work without extra compensation, according to the requirement of concern authorities. If these minimum depths cannot be respected, special measures will be taken on the instructions of the Company.

4.13 Mutual Spacing

- If the underground pipeline is laid in the vicinity of other underground works, a distance of 0.3 m must exist at the intersections or 0.3 m in the case of parallel running between the most adjacent parts of the two installations. Wherever possible, these distances are increased, in particular in the vicinity of large engineering structures, in order to limit as far as possible for each installation the risks associated with carrying out work on a nearby installation.
- As far as practical, a minimum separation of the Three Meters should be maintained between the Steel Pipeline or main and footing of Transmission Power. A clearance sufficiently large to avoid Electrical fault current interference shall be maintained between the pipeline and the grounding facilities of electrical Transmission line.
- Clear distance between new Steel PL or main running parallel to existing pipeline should be minimum 5 Mtrs when heavy conventional construction equipment is expected to be utilized. This distance may be reduced after careful assessment of construction Methodologies, to three Meters, provided it does not result in unsafe conditions during construction. Existing pipeline should be clearly marked on the ground during the construction. Bi-language (Local language and Hindi / English) caution sign should be installed while working in such areas.
- While laying more than one new Hydrocarbon pipelines or main in the same trench, clear separation of minimum 500mm shall be maintained between adjacent pipelines.
- No Steel pipeline or main should be located within three meters of any habitable dwelling or any industrial building unless it is provided with at least 300mm of cover over and above minimum cover specified above table above or special protective measures such as concrete slab, steel casing are provided.

If the minimum distances stipulated in this section cannot be complied with or if the nature of the products transported in the other underground pipelines necessitates (such as Oil pipelines or Water & Sewerage pipeline, Electric line etc), the Contractor shall take special precautions as per the instruction guided by the Owner Representative/ PMC/TPI . These precautions comprise in each case doubling the distances or interposing an additional adjusted isolating screen which can consist of a rubber mat laid double, 5 mm in thickness (quality in accordance with the specification). The screen must be secured to the pipe in an efficient way to prevent displacements. In the event of two pipelines crossing, the screen will have a minimum length of 0.5 m. It should be ensured that these distances are not achieved by twisting or treating incorrectly one of the underground pipelines.

4.14 Trench adjustments

The Contractor carries out the necessary trench widening and trench deepening at no extra cost at the following places:

- on the fusion joints where these are made in the trench;
- at the places where destructive or non-destructive testing has to be performed;
- wherever necessary because of the local circumstances and the execution of work.

4.2. EXCAVATION AND BACKFILLING OF TRENCHES

Local codes of practice are to be followed among others:

- Technical requirements for Laying of New Major Services within the Road Rou limit.
- Code of Practice for Road-Opening Works.
- Code of Practice for temporary Traffic Controls.

5 HANDLING OF PIPES AND COMPONENTS BEFORE AND DURING LAYING

5.1 HANDLING OF PIPES OR PIPELINES

5.1.1 It is compulsory:

- To take the necessary precautions to prevent damage during the loading, transportation, unloading and various other operations involving the handling of pipes and fittings;
- To stack the pipes on a flat surface and to support and clamp them sufficiently during transport;
- To organize the movement of the pipes so that the pipe or the ends of it do not drag across the ground.

5.1.2. It is prohibited:

- To roll pipes across the ground or the road surface;
- To lift up or move pipes or pipelines with cables, chains or other hard or squeezing ropes;

- To bring the pipes into contact with a naked flame, oil or bituminous products.

5.2. ACTIONS PRIOR TO FUSION

The pipes and fittings are carefully checked immediately prior to fusion.

Internal check:

For the presence of foreign objects (such as tools, earth, stones etc.), which must then be removed carefully.

The Company might require that a suitable brush be drawn through every pipe.

External check:

For any damage, however slight.

In the case of damage deeper than 1 mm or 10% of the pipe thickness, whichever is lesser, the damaged part should be removed.

5.3 PIPE ARRANGEMENT DURING FUSION

Lengths can be fused together, depending on the local circumstances, above or alongside the trench. The actions for laying the pipeline in 5.1 and 5.2 apply to installing the pipeline sections fused together in the trench.

5.4 TEMPORARY SEALING OF PIPELINE ENDS

5.4.1. Every pipeline which is temporarily left alongside or above the trench shall always be protected against the penetration of water, dust or any objects by mean of plugs or caps. Special attention shall be made to these plugs while lowering the pipeline in the trench. The plugs or caps are designed in such a way that they can not enter the pipeline and can be easily removed.

A necessary number of plugs or caps, matched to the various diameters of the pipelines to be laid, should always be available.

5.4.2. Ends of pipelines temporarily left behind in the trench must be sealed in such a way that it is impossible for water or mud to penetrate, even if the trench runs completely under water. Suitable plugs or caps can be used for this purpose.

5.4.3. The presence of water or dirt in the pipeline is regarded as a serious fault of the contractor. In such cases the Company will oblige the Contractor to clean the pipeline, at his own expense, with a pipe cleaner until all the water and dirt have been removed.

5.5. ACTIONS BEFORE LAYING IN THE TRENCH

Immediately before a pipe or a fused section of pipeline is left in the trench, the Contractor shall:

5.5.1. Inspect the condition of the bottom of the trench thoroughly again, work away the unevenness's where necessary and remove all earth, stone or other objects which have meanwhile dropped into the trench.

5.5.2. Carry out a last careful check on the good condition of the pipelines.

5.6. CROSSINGS OF ROADS AND ENGINEERING STRUCTURES

Crossings of roads and engineering structures shall be designed as to minimizing the number of joints.

5.7. INSTALLATION IN THE TRENCH

All necessary precautions must be taken in order to avoid pipe damage during installation. The Company must be notified of any damage. Any damage to the fusion weld leads to rejection; the weld must then be cut out and done again.

5.8. UNCOILING AND INSTALLATION OF COILED PIPES

- General
- The tensile force on the pipe must be as low as possible
- The rotational speed of the reel during uncoiling must be kept under control.
- The pipe must be uncoiled along the lower edge of the reel, at a tangent to the turns. This prevents the spiral effect, which makes correct installation impossible.

- The outer surface of the pipe is examined during uncoiling. Grooves more than 1 mm deep, kinks in the pipe wall, the inclusion of foreign objects or any other visible deviation are reported to the Company. The latter will decide whether the section of pipe concerned is to be removed.

- Rollers must be laid on the bottom of the trench across the complete length of the route; their number is chosen such that the pipe cannot scrape across the ground at any time; they are also installed in order to prevent twisting of the pipe against obstacles; the same happens in elbows, the radius of curvature of which is greater than 20 times the diameter of the pipe.

- Manual towing

- If the trench can be opened over its entire length, and no obstacles are present, the pipe may be uncoiled directly in the trench. The reel is placed for this purpose on an uncoiling truck, which travels slowly along the trench.
- If obstacles block the trench in the part where the pipe has to be laid, the uncoiling truck remains in position and the pipe is pushed over the obstacles manually. The pipe must be supported by sufficient people so that it is laid down and not dragged.

- Mechanical towing

- The winch for towing must have been approved by the Company.

- It must allow gradual towing so that the pipe is uncoiled regularly and without shocks; the maximum permitted uncoiling rate is 15 m/minute.

- It must be equipped with a dynamometer and be provided with an adjustable force limiter which automatically stops the towing as soon as the maximum selected tensile force has been reached. The Company may require a recent calibration report on the dynamometer before towing is started; this report must have been certified up by a recognized inspection body.
- It must also be provided with a device for measuring the tensile rate and a recording device which prints out the tensile force exerted on the pipe during installation as a function of the pipe
- length. This graph, on which the designation of the section of pipeline is indicated, is handed over to the Company.

- The tensile force which is exerted on the pipe must be kept as low as possible; it may in no case exceed the values shown below:

The values given are based on the following formula:

$$F = \frac{\sigma n \pi de2}{3SDR}$$

σn = nominal wall tension in the PE pipe (+ 15 N/mm2)
π = 3.14
de = nominal diameter of the PE pipe
SDR = SDR series of the pipe (see definitions)

SDR = SDR series of the pipe (see definitions) The adjustable force limiter may be replaced by the assembly described below:

when the towing cable is attached to the PE pipe:

A metal cap is placed over the pipe; this cap is provided with two holes 29 mm in diameter, 180 degrees apart. After the cap has been pushed over the pipe, two holes 28 mm in diameter, also 180 degrees apart, are drilled in the pipe wall at a distance from the edge of *c* mm. A bolt with a nut is secured through these, so that the cap is firmly connected to the pipe. The dimension c is chosen such that in the event of excessive tensile force this part of the pipe cracks and thus detaches the PE pipe from the cap. The last 0.3 m of the pipe end to which the towing cable has been attached must be cut off afterwards.

6. FUSION WORK, FUSION JOINTS

6.1. COMPETENCE REQUIREMENTS FOR FUSION OPERATORS

All fusion operators must have satisfied both the draft International Standard ISO/DIS/19480 "training and assessment of fusions operators" drawn up by the "Fusion Operators" working group ISO TC I38/SC4 and the Company's acceptance procedure, after a training course which comprises at least the following parts:

- Generalities on polyethylene pipelines for Gas.

- Butt fusion technology and/or electrofusion technology has been attended.

A certificate is issued by the Company, which is valid for one year. The certificate or the recognition does not affect the liability of the Contractor in the event of accidents or damage caused by the fusion operator concerned.

The certificate must be extended annually subject to an evaluation of the person concerned. This evaluation takes place with the fusion equipment of the person concerned. The qualification must relate to the technology applied (butt and/or electro fusion). Each recognized fusion operator shall be in the possession of identification markers, with which he identifies the weld carried out by him on the pipe, next to the weld.

Each recognized fusion operator shall be in the possession of an operator's badge designed in a form of a bar code card as specified in the standard ISO 12176-3.

6.2. EXECUTION OF THE FUSION WORK

- PE pipelines are generally assembled by the electro fusion technique.

6.2.1. Fusion equipment

All fusion equipment used must be presented to the Company for approval. It must additionally satisfy:

- For electrofusion machines: As per the ISO Standard 12176-2 and the Company specification, if any;

Without the written agreement of the Company, only polyvalent equipment which allows fusion voltages in the range from 8 to 48 V and for which the fusion procedures can be entered using a bar code reader and/or magnetic card reader may be used.

The fusion machines must comply with all the applicable safety regulations.

The Company reserves the right to have a technical inspection. All equipment must be subjected to an annual inspection by the contractor/manufacturer.

Every item of equipment subjected to such inspection will be provided with a mark or certificate.

The testing body will apply a green sticker to every approved machine and/or part, and a red sticker to rejected items. Electrofusion machines are marked by the manufacturer either externally or in the electronic memory which is clarified by the welding reports. If a fusion machine or other item of equipment does not meet the requirements, the Company may require that this part be repaired or replaced.

6.2.2. Other auxiliary equipment

All other equipment used in producing the welds, such as current generators, re-rounding clamps, aligning clamps, scrapers, degreasing product etc. must be approved by the Company.
The degreasing products must be processed at the site in their original packing unless express agreement has been obtained from the Company.

The Contractor must have sufficient tents or shelters available at the site of the work so that in unfavorable weather conditions the fusion can be continued under cover.

6.2.3. Preparation of the pipe

- Ovalisation on the external diameter must not exceed 2% for straight and 6% for coiled pipes. If this is not the case, the Company will assess whether the pipes may be welded.
- 5 cm is sawn off from the pipe ends (flow).
- The effect of weather conditions must be minimized in order to ensure the fusion temperature and avoid moisture and dust in the fusion zone.
- Electrofusion can be made down to -10°C. Fusion may only be performed outside these limits with the express agreement of the Company.

6.3. BUTT FUSION

Butt fusion are not allowed in any case.

6.4. ELECTRO FUSION

The inner wall of the electro fusion fittings is provided with an electric resistor. When a suitable energy source is applied, this resistor heats up the PE and softens the mass of both surfaces, resulting in a fusion pressure build up. In order to ensure that this fusion pressure is built up, it is thus necessary to secure the smooth ends of the pipe and fitting properly with respect to the coupler.

6.4.1. Preparation procedure

6.4.1.1. Pipes and fittings with smooth fusion end(s)

- The pipes must be cut off cleanly and at 90° angles; a PE pipe cutter or a hand saw is used for this purpose (in the case of the hand saw, the pipe is clamped in a pipe tensioner which also serves as a guide for the saw).
- The pipe end is deburred.
- indicate the insert depth (half the coupler length)
- The pipe or fitting surface is treated as follows:
- cleaning of the pipe ends over a sufficient length;
- remove the oxidation layer with a suitable tool and/or scraper knife; a minimum of 0.15 mm material is removed; scraping must be done beyond the marking of the inserting depth;
- re-round the end of the pipe, using re-rounding clamps;
- Clean the fusion surface using non-fluffing paper, soaked in a degreasing, volatile product; ***this product must be approved by the Company prior to the commencement of the works***.
- leave to dry completely; if necessary, in cold weather, dry using a hot air generator.
- Designate the insert depth **again** with marks.
- In the case of saddles, scrape over a length greater than or equal to the width of the saddle + 4 cm.

6.4.1.2. Electrofusion fittings

- Do not remove the fittings from their packaging until just before use.
- Careful examination of : internal condition of the wiring

- cleanness and condition of the connectors
- presence of bar code and magnetic card.
- Carefully examine and clean the the internal surface of the fittings by using no fluffing paper soaked in a degreasing, volatile product.
- Leave to dry completely, particularly between the resistor wire; if necessary dry using the hot air generator.

6.4.2. Electrofusion procedure

6.4.2.1. Insertion

Ensure when inserting that:

- the insert depth is correct (to be checked using mark line)
- the terminals of the resistor are readily accessible
- the resistor wire is not damaged.

The coupler is pushed by hand over the pipe or fitting, if necessary using a suitable tool or a rubber hammer. If necessary, in the case of pipes on reels or coils, the pipe is hold straight with a suitable tool or a straight piece of pipe of 1 m is welded onto the pipe end, in order to avoid the curvature of the pipe at the site of the joint. If several fittings have to be joined, these are first joined to each other; the couplers are then welded. To avoid exerting any forces on the fusion zone, the pipes are re-rounded and all the pieces to be welded are firmly clamped using a suitable tool throughout the welding cycle and until the electrofusion fitting has cooled completely (**minimum cooling time = 30minutes or as per manufacture instruction**).

Particular inserting machines can be used as a clamping tool. For the fusion of saddles, two round-pressing clamps are placed at + 10 mm on either side of the saddle.

6.4.2.2. Fusion

The fusion cycle comprises at least the following phases:

- examination of the continuity of the electric circuit
- examination of the regulation of the device
- examination of the fusion time; it must be within the limits specified by the manufacturer of the electrofusion fitting
- marking of the fused fitting to indicate that the fusion has been carried out.If the fusion cycle is interrupted for one or other reason (for example a power failure, detachment of a terminal etc..), the same fitting may be fused a second time, on condition that the fusion cycle is only started after this fitting has cooled completely. Every such case must be reported directly to the Company with the location of the fusion concerned.

6.4.3. Checking of the electrofusion procedure

- Checking of the fusion method

The checking comprises:

- preparation of the pipes and fittings to be welded
- insertion
- clamping during fusion
- use of the fusion machine and follow-up of the fusion cycle
- Checking of the fusion
- Each fusion is marked with the code of the welder and subjected to a visual examination (fusion indicators or ejected material)
- The Company reserves the right to carry out a destructive test per site and per welder.

If the conditions in which the fusion was carried out cause doubt to arise on the good quality of the fusions, the Company can carry out destructive testing at any time.

The following destructive tests can be performed:

- Tensile tests:
  The tensile test is carried out on a welded coupler, which is cut out of the pipeline; a pipe end with a minimum length of 0.5 m is cut out on either side of the coupler.
- Peel-off:
  The peel-off test is carried out on a welded coupler which is cut out of the pipeline; a pipe end with a minimum length of 0.2 m is cut out on either side of the coupler. The pipe and the coupler are cut through in the longitudinal direction in the workshop. The pipe is pressed flat at either edge of the coupler, until the internal walls of the pipe come into contact with each other. The parting line must not show a brittle break pattern. The test described above can be

replaced by the peel-decohesion test described in the ISO standard 13954 (Latest Edition) [TC138/SC5/WG12 N219], performed in a laboratory.

6.5 FOLLOW-UP OF THE FUSION INSPECTION

6.5.1. By the Contractor

The Contractor shall notify immediately the Company of any default of fusion. The Company reserves the right, at its expense, to search for defaults. The defaults that have not been notified shall be considered as a breach of contract. The fusion joints concerned shall be located and replaced at the expense of the Contractor.

6.5.2. By the Company

The Company has the right to have all fusions removed which provide reason for rejection according to one of the methods of inspection mentioned. If an unacceptable fusion to be attributed to a procedural error is found, the following procedure should be followed:

- Two arbitrarily chosen fusions (by the same welder) are tested.
- If one of these two fusions is unacceptable, all the fusions (by the same welder) of the same day are cut out and fully tested.
- If another two unacceptable welds are found, this welder will not be allowed to do anymore welding until he has received further training. A pipe layer/fusion operator may be re-trained up to two times. If poor work then still follows, he will be completely excluded from working as a PE fusion operator.

6.6. REPAIR OF THE FUSIONS

All fusions declared to be unacceptable must be replaced, at the expense of the Contractor, by welding a new piece into the pipeline. This work will be performed by a certified fusion operator and all the fusions will be examined again.

6.7. COST OF FUSION CHECKING AND REPAIRS

All the costs resulting from defects in fusion joints, the supplementary checks and all repairs at at the expense of the Contractor.

6.8. CHANGE IN DIRECTION OF THE PIPELINE

Changes in direction with a radius greater than 20 OD can be absorbed by the flexibility of the pipes. The changes of direction must never be absorbed in the fusions. Changes in direction with a radius of less than 20 OD will be made with fittings intended for the purpose.

7. TESTS

7.1. GENERAL PROVISIONS

All materials and devices for performing the leakage tests are supplied by the Contractor.
All fittings used in carrying out the tests must be suitable for a pressure which is at least equal to the test pressure and must be rigidly secured. In addition, the necessary action must be taken so that if a fitting nevertheless fails, the parts flying off do not cause injury. A record will be drawn up of these tests. This is signed by the Company and the Contractor.

7.1.1. A soundness test must be performed on the complete pipeline (+ a mechanical resistance test on MP pipelines).

7.1.2. The soundness test is performed with compressed air or inert gas. Adding odorizing or corrosive products is prohibited.

7.1.3. Using couplings or pre-screwed joints of good quality, the supply line is provided with:

- a valve made for a pressure of 10 bar for LP and MP lines;
- a dial pressure gauge of the “Bourdon” type or equivalent, of accuracy class 1 and with the necessary scale range or a recording pressure gauge with the same accuracy. The scale divisions must be applied with at least one per tenth of a bar (nine gradations between each bar gradation). The pressure gauge is branched between the valve mentioned and the pipeline to be tested. The Company has the right to check the pressure gauge(s) for accuracy at any time and to require immediate replacement of a defective or incorrect pressure gauge.

Checking of the zero position of the pressure gauge is carried out by the Company before the pipeline is pressurized.

7.1.4. Before the pipeline is pressurised, it is examined again whether:

- all the fusion joints have cooled down sufficiently;
- all non-fusion joints and fittings are properly screwed on and are provided with the necessary seals;
- The pipeline is properly fixed, among other things by backfilling at the required places (in no event on the joints which must be tested) so that the pipelines do not undergo any dangerous displacements or changes of direction due to the internal pressure;
- Personnel have moved out of the vicinity of the trench. During the test, only staff responsible for detecting any leaks may enter the trench close to the pipeline, but in no case behind the plugs.

7.1.5. All foam products should be halogen-free (non-corrosive, e.g. Trisilon) and approved by the Company.

7.1.6. The joints between the new pipeline and existing pipeline are tested by soaping at service pressure.

7.2. EXECUTION OF THE TESTS

7.2.1. MP pipelines

Before being put into service, the polyethylene pipelines are subjected to:

A mechanical resistance and soundness test. The PE pipelines are subjected to a test pressure of 7.5 bar for MD for at least 6 hours from the time when this pressure is reached and has been stabilized. The pressure gauge must measure an unchanged pressure during the tightness test.
All pressures for MP tests must be recorded and the diagrams handed over to the Company after the test. In the event of doubt over whether an unchanged pressure is maintained, the Company can have an additional tightness test performed at 50 mbar with a water manometer.

For venting and any repair required, see 7.2.2.

7.2.2. LP pipelines Before they are commissioned, the polyethylene pipelines are subjected to a pressure of 1 bar for at least 1 hour, counting from the time at which this pressure is reached after stabilization.

The following techniques are possible for checking tightness:

- If possible, all joints are carefully checked with a suitable foaming agent one by one over their whole circumference for bubble formation. Each joint must be accessible and visible all round and over a sufficient space. The joints which are in the trench must be properly dug free all round. Wherever possible, a clear-image mirror with a sufficient surface area must be used in order to discover even the smallest bubble formation with certainty underneath the joints.

- In other cases the tightness is checked as a function of the volume of the installation by suitable techniques approved by the Company. A chart record is required. The pressure gauge must measure an unchanged pressure during the tightness test. In case of doubt, the delegate of the Company may require a recording pressure gauge or have an additional tightness test carried out at 50 mbar with a water manometer (see7.2.3.). After all the joints have been checked, the compressed air is vented. Suitable Precautions must be taken for this purpose to prevent the air escaping when venting takes place from causing soil, stones or other objects to fly. In addition, all bystanders shall move at a safe distance from the pipeline and the trench.

If the laid pipeline is shorter than 100 m and all the joints and welds can be examined with a suitable foaming agent for bubble formation, the above test can be replaced by a tightness test at gas distribution pressure. The leaks found at mechanical joints are immediately repaired, while leaking fusion joints are expertly replaced. The tightness test is afterwards repeated as stipulated above.

7.2.3. Tightness test at 50 mbar with water manometer or pressure gauge recorder. The test may only start after the temperature and the pressure in the pipeline have stabilized and lasts at least one hour. Any variation in pressure which does not stabilize is reported to the Company for assessment. If a repair is required, the tightness test is repeated according to all the above stipulations, the repaired joints being checked again.

Testing of the pipelines – Summary

LP MP

1. Mechanical resistance (1)
2. Soundness (2)

- Foaming product
- Manometer - mains services

if L<100m , foaming product

- Water manometer at 50 mbar (3)
3. Non-destructive test
- visual
- US or radiographic
4. Destructive
AIR or inert gas
1 bar (1h)
1 bar (1h)
1 bar (1h)
distribution pressure
1 hour
100%
random sampling
random sampling
AIR or inert gas
7.5 barg (24 hours)
1 hour100%random sampling

(1) checking by soaping or using pressure gauge, depending on the case;

(2) this test may be optionally stipulated.

Remarks:

- If no single test duration is mentioned, the pressure is maintained for the time necessary for soaping;
- the times indicated are minimum values.

8. CATHODIC PROTECTION

If during work on the polyethylene pipelines, steel gas pipes are locally used or if any change occurs in the cathodic protection of existing steel gas pipes, the special specifications for steel pipes can be consulted in the section headed “Preparation of the grid in connection with the use of cathodic protection”.

9. SPECIAL WORKS

9.1. TRENCHLESS CROSSINGS

The following must be carried out strictly and without exception:

1) The internal diameter of the sleeve must be at least 100 mm greater than that of the pipeline (for pipelines up to diameter 200 mm).
2) Insulating support collars supplied by the Company are fitted on the section of pipeline placed in the sleeve. The maximum distance between support collars is 2.5 m. The first and last support collars are fitted no more than 0.5 m from the ends of the sleeve.
3) The extremities of the sleeve are sealed against the pipeline by specially designed rubber bushes which are connected by clamping brackets around the pipeline and the sleeve.
4) The sleeves for jacking are fibre-cement pipes or steel pipes.
5) In a road where electricity cables are present and where it is necessary to drill through, the cables lying in the path of the drilling must be completely exposed before starting to drill.

9.2. PROTECTION WITH SLEEVES

At those places where the buried pipeline requires special protection, it is also possible to use sleeves.
The Company stipulates when and which sleeve is used.

9.3. COUPLING OF NEW PIPELINES TO EXISTING ONES

The practical instructions for installing the new pipeline at the coupling to the existing network are laid down on the spot. The Contractor will contact the Company for this purpose at the appropriate time. The coupling to the existing network is generally carried out by the Company.
However, this work can also be allocated to the Contractor who carries it out under the instructions and supervision of the Company. Unless otherwise agreed with the Company, this coupling takes place immediately after the tests have been completed. The earthworks and repaving works are to be carried out by the Contractor.

9.4. INSTALLATION OF VALVES
The installation of valves comprises:

1. The necessary trench adjustments where the valve is installed;
2. The installation of a stabilised footing (100 kg cement to 1 m^3 sand) with a thickness of 10 cm for the support of the valve;
3. The welding or connection of the valve in the pipeline;
4. The insulating coating of metallic parts in the worked zone;

5. The isolation of the spindle at the correct length and the installation of the protective pipe;
6. The installation at the correct desired height, above each valve, of the hatch and cover made available by the Company, on a concrete footing.

9.5. INSTALLATION OF PURGING LINES

Purging lines are installed at the places designated by the Company, such as:

- before and after each valve;
- at the end of the pipelines.

The installation of the purging lines comprises:

1) The necessary trench adjustments at the site of the purging line;
2) The construction of the purging line according to the Company's plan with materials made available by the Company;
3) The isolating coating of the purging line where appropriate according to the Company's instructions;
3) The installation at the desired height of the hatch and cover made available by the Company, on a concrete footing.

9.6. CLEANING OF THE PIPELINE

After testing, it may be required that a brush or a plug (scraper) is pushed through the pipeline. This is done until all foreign objects have been removed from the pipeline. If water has also entered during cleaning, it is rinsed where appropriate with methanol, provided agreement has been obtained from the Company.

9.7. SPECIFIC SAFETY MEASURES

9.7.1. General

Always check that THERE IS NO FIRE OR SOURCE OF HEAT in the immediate vicinity of the excavation (smoking, welding equipment, generator sets, halogen lamps, wall radiators etc.).
Make sure that you can always leave the excavation quickly and easily. Install the FIRE EXTINGUISHER IN THE IMMEDIATE VICINITY of the excavation.

9.7.2. Static electricity

Gas might escape in certain works. This outflow of gas can generate static electricity on the PE pipeline. Any contact of the pipe or fittings can cause discharge, with the striking of an arc. This arc can cause the gas to ignite.

That is why it is necessary to take always the following safety measures:

- Earth the PE pipeline beforehand by winding a wet cotton strip in a spiral around the pipeline. Connect the cotton strip to earth throughout the duration of the work in which gas is released.

This is done to avoid discharges of static electricity causing fire in the trench.

9.7.3. Outflow of gas

While work is being carried out at gas pressure, LIMIT ANY ESCAPES OF GAS TO AN ABSOLUTE MINIMUM

ANNEX 1
LIST OF COMMON PIPES

d mm	e mm	SDR	Length m	Total length of packing - m	Number of pipes	Weight kg/m
32	3.0	11	50 or 100			0.28
63	4.8	11	50 or 100	100		1.05
90	5.2	17.6	50 or 100	100		1.39
110	6.3	17.6	16	688		2.08
160	9.1	17.6	16	272		4.35
200	11.4	17.6	16	224		6.79