

- ❖ OISD Standards & CCE Norms
- ❖ API Model code of safe practices
- ❖ GAIL Safety Standards
- ❖ All statutory, state, local requirements and norms
[All latest available editions only.]

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

- Statutory Regulations and norms
- This Specification
- Codes & Standards, Recommended practices

2. CORROSION SURVEY DATA

Corrosion Survey Data collected already from site [pipeline ROW & Anodebed locations] viz: **Soil Resistivity, Soil Chemical analysis for chemical and microbial loading** is enclosed:

- i. Soil Chemical Analysis - As per Annexure-1.
- ii. Soil Resistivity - As per Annexure-2.

However, verification of its veracity and Adequacy shall be the entire responsibility of the CP contractor.

In addition the CP contractor shall have to generate/collect additional Data from site such as:

The CP contractor shall carry out a site survey along pipeline ROW and at proposed Anode bed locations, in order to verify design data, prior to the final design of the [TCP], [PCP] system. The site survey shall generally include the following:

General information [Topographic] of terrain along which the pipeline is to be routed.

Measurement of soil resistivity [ρ] along ROW and at Anode bed plots. Each selected Anode bed plot shall be sub-divided into sub-plots. Size of the sub-plots shall depend upon investigation of soil resistivity upto requisite depth. Each of these sub-plots shall be investigated individually. Sufficient observations at each of these plots shall be recoded as recommended hereunder:

- 1) Soil Resistivity at every 2 Kms along ROW to be carried out at 1,2,3 M depths. Wherever, abrupt changes are observed additional readings to be recorded in between.
- 2) Soil Resistivity at Anode-bed plots to be recorded at 1,3,5,7M for shallow Anode beds and 1,3,5,7,10,15,20,25,30,35,40... M for Deep well Anode beds.



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Chemical Analysis of Soil / Water samples collected from two depths [1.0M] and [2.0M] of pipeline ROW at every 5 Kms. and at each intersection of a grid from sub-plots for each anode beds location. The air dried soil samples to be quartered, coned and aqueous extract prepared for chemical and microbial analysis of following:

| S. No. | Sample from Locations Kms. | 0 | 0 | 5 | 5 | | |
|--------|--|---|---|---|---|--|--|
| 1 | Depth in M | 1 | 3 | 1 | 3 | | |
| 2 | pH | | | | | | |
| 3 | Redox Potential V | | | | | | |
| 4 | Total Dissolved Solids ppm | | | | | | |
| 5 | Chloride ppm | | | | | | |
| 6 | Sulphate ppm | | | | | | |
| 7 | Sulphide ppm | | | | | | |
| 8 | Carbonate ppm | | | | | | |
| 9 | Bi-carbonate ppm | | | | | | |
| 10 | Nitrate ppm | | | | | | |
| 11 | Nitrite ppm | | | | | | |
| 12 | Phosphate ppm | | | | | | |
| 13 | Sodium ppm | | | | | | |
| 14 | Potassium ppm | | | | | | |
| 15 | Calcium ppm | | | | | | |
| 16 | Magnesium ppm | | | | | | |
| 17 | Sulphate Reducing Bacteria (SRB) Counts | | | | | | |



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This data to be used for calculating soil/water corrosivity based on which and clause 5.1 of this specification, the protective current density and Anode material shall be selected/decided.

Stray Current Survey:

Survey for investigating possible sources of stray currents along ROW so that requisite Mitigative measures are included in the CP design. The CP contractor carrying out CP Interference survey due to DC current will have to get necessary permissions from other utilities such as underground pipelines of ONGC, IOCL, HPCL, BPCL, GAIL, etc., over ground water pipeline running parallel on concrete pedestal, and DC rail traction etc. so that composite studies for interference detection are done and recommended Mitigative measures are installed. At the time of handing over the interference free system to owners (GAIL), the contractor will hand over these permissions of other utility owners, for further needful by GAIL.

Where a site survey is not possible the C P contractor shall ensure that requisite data is available for him to fulfil requirements of the work order.

Survey for knowing the location of **Existing Cathodic Protection system** to maintain appropriate clearance between the existing and upcoming C P Systems. CP contractor, prior to CP Design for, shall carry out extensive site surveys and attenuation calculations and data collection, from pipeline ROW and proposed Anode bed locations. Likely interfering elements along ROW, survey for sources of stray currents likely to cause interference, and shall base the CP System Design on this Data collected from site.

Ground Water Table Data to be collected either from GSI [Geological Survey of India] by CP contractor or measured at site to ensure Anode bed location in appropriate perennially moist environment round the year throughout service life.

In addition contractor shall have to collect/ generate additional Data as required for completeness of the C P job for GAIL as follows:

3.0 ADDITIONAL DATA TO BE COLLECTED

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

- i. Route and types of foreign service/pipeline in and around or crossing the right of way (including those existing and those which are likely to come up during contract execution or any abandoned pipelines).

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- ii. Diameter, wall thickness, pressure, pipeline coating against corrosion, soil cover used in case of pipelines.
- iii. Details of the existing pipeline Cathodic protection systems protecting the services i.e. location, rating, type of protection, anode beds, test station locations and their connection schemes.
- iv. Graphical representation of existing structure/pipe-to-soil potential [P-S-P] records, T/R unit current/ voltage input/output ratings, present current/Potential Input/Output Data etc for the existing pipelines.
- v. Remedial measures existing on foreign pipeline/ services to prevent interaction.
- vi. Possibility of integration/ isolation of existing CP systems, which may involve negotiations with owners of other existing pipeline services.
- vii. Crossing and parallel running of electrified and non-electrified traction (along with information regarding operating voltage, type AC/DC etc.) as well as abandoned tracks near ROW having electrical continuity with the tracks in use.
- viii. Crossing or parallel running of any HT AC/DC overhead line (existing/proposed) along with details of distance from pipeline, voltage, type AC/DC, distance from pipeline of earthing of towers etc.
- ix. Voltage rating, number of cores and sheathing details of underground power cables, along ROW or in it's vicinity.
- x. Information on existing and proposed DC/AC power sources and system having earth as return path, in the vicinity of the entire pipeline route such as HV DC sub stations, fabrication yards with electric welding etc.
- xi. Any other relevant information that may be needed in designing and implementing proper protection scheme for the proposed pipeline.

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



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CP DESIGN REPORT

On completion of all field work a composite report incorporating all the results generated from site surveys for data generation and details of additional data collected and complied with in the attached Compliance Report format clause wise as above shall be furnished to owner for Approval. The report shall also contain detailed interpretation of survey results and resistivity data enclosed, probable interference prone areas etc. to form design basis for the scheme of Cathodic protection [TCP] & [PCP] system. This report shall also include various drawings prepared in connection with the above work. The soil resistivity values shall be plotted on semi-log graph sheets and in Histograms. Log mean resistivity values to be calculated and used for the Design of CP system.

The Cathodic Protection Design of [TCP] and [PCP] systems should be part of this composite Report. The Bill Of Materials [B.O.M.], Technical Specifications, Vendor list [from listed herein] etc. will be included in this Report for Approval of Owner. The Drawings for Owners Approval shall be part of this composite report.

4. CATHODIC PROTECTION DESIGN PARAMETERS

Unless expressly varied and otherwise specified in the project specifications, following parameters shall be used for design of temporary Cathodic protection [TCP] system and permanent Cathodic protection [PCP] system.

4.1 Those parts of sacrificial anode Cathodic protection [TCP] system which will be integrated with permanent CP system [PCP] such as Reference Cu-CuSO₄ electrodes, Test Lead Points, Junction Boxes, Thermit welds epoxy encapsulation, Markers, Polarization coupons etc. shall be designed based on permanent CP parameters.

4.2. PROTECTION CURRENT DENSITY

Pipelines having polyethylene coating.

| Pipeline surrounding | Protection Current density * | |
|---|---|---|
| | Temporary CP ($\mu\text{A}/\text{m}^2$) | Permanent CP ($\mu\text{A}/\text{m}^2$) |
| Normal soil | 35 | 35 |
| Marshy area | 45 | 45 |
| High resistivity area (more than 100 Ωm) | - | - |



However, the Protective Current Density to be chosen at site as per measured Environmental conditions obtained as per Detailed Chemical & Microbial Analysis and presence or absence of interfering elements in close vicinity of GAIL pipeline ROW.

Pipe to soil potential shall not be more negative than (-) 1.5V (“ON”) or (-) 1.18V (“Off”) w.r.t. Cu-CuSO₄ Reference electrode.

*Actual current density to be adopted shall be decided based upon soil/water corrosivity and other environmental conditions, proximity of foreign pipelines and structures resulting in interference. Where considered necessary for satisfactory protection of pipeline the current density shall be suitably increased by contractor with appropriate justifications.

4.3. OTHER PARAMETERS FOR DESIGN

Other parameters to be considered for [TCP] and [PCP] design:


- 4.3.1. Safety Factor for Current Density : **1.3**
- 4.3.2. Anode Utilization Factor : 0.85 for centre connected Anode
: 0.5 for Ribbon Anode
- 4.3.3. Pipeline natural potential (-) 0.45V [as measured from existing /upcoming structure in the same soil matrix].
- 4.3.4. Unless otherwise specified in project specification the design life of the TCP system shall be (2) years or till PCP commissioning whichever is earlier and that of [PCP] permanent CP shall be (40) Forty years.
- 4.3.5. Along the ROW where soil resistivity is higher than 100 Ω m temporary CP for the pipeline may not be necessary subject to Owner’s Approval.
- 4.3.6. Steel Resistivity $2.2 \times 10^{-7} \Omega \text{ M}$
- 4.3.7. Maximum Loop Resistance 1 Ω

5. CATHODIC PROTECTION DESIGN CRITERIA

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

5.1 TEMPORARY CATHODIC PROTECTION [TCP]

- 5.2. The pipe to soil potential measurements shall be between -0.95V (“On”) and -1.5V (“On”) both “On” Potentials w.r.t. Cu-CuSO₄ reference electrode. In case sulphate reducing bacteria [SRB] are present in soil the minimum protective potential shall be (-) 0.95V (“On”), the maximum remaining the same (-) 1.5V (“On”) w.r.t. Cu-CuSO₄ reference electrode. At the location of Polarization coupons, the coupon to soil potential measurement shall be between (-) 0.95 (“Off”) minimum and (-) 1.18 V(“Off) maximum w.r.t. CuCuSO₄ reference electrodes, both being “Off” potential. During [TCP] monitoring using Reed Magnetic switch “Off” potentials to be recorded.

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5.3. In rare circumstances a minimum polarisation shift of (-) 100 millivolts w.r.t. Cu-CuSO₄ reference electrode shall indicate adequate levels of cathodic protection for the pipeline.

Discretion to use any of the criteria, listed above, shall solely rest with the Owner/ Owner's representative.

5.4. A positive potential swing of >20 mV [P-S-P] shall be considered as the criteria for presence of an interaction situation requiring investigation and incorporation of suitable mitigation measures by the C P Contractor.

PERMANENT CATHODIC PROTECTION [P C P]

5.5. The pipe to soil potential measurements [PSP] shall be between (-) 0.95V ("Off") minimum and (-) 1.18V ("Off") maximum [both "Off" Potentials] w.r.t. Cu-CuSO₄ reference electrode, the maximum remaining the same (-) 1.5V ("On") w.r.t. Cu-CuSO₄ reference electrode. At the location of Polarization coupons, the coupon to soil potential measurement shall be between (-) 0.95 ("Off") minimum and (-) 1.18 V ("Off") maximum w.r.t. CuCuSO₄ reference electrodes [both being "Off" potential].

5.6. In rare circumstances a minimum polarisation shift of (-) 100 millivolts w.r.t. Cu-CuSO₄ reference electrode shall indicate adequate levels of Cathodic protection for the pipeline.

Discretion to use any of the criteria, listed above, shall solely rest with the Owner/ Owner's representative.

5.7. A positive potential swing of >20 mV [P-S-P] shall be considered as the criteria for presence of an interaction situation requiring investigation and incorporation of suitable mitigation measures by the C P Contractor.

6. SYSTEM DETAILS

6.1 Temporary Cathodic Protection [TCP]

The [TCP] system unless specified otherwise, may include the following major equipment/ sub-systems.

- Sacrificial anodes [Zn or Mg] ground beds in carbonaceous back-fill
- Test stations [TLP]
- Junction Boxes with shunts and resistors [AJB] & [CJB]
- Permanent Reference Cu-CuSO₄ Electrodes [CSE]
- Pin Brazing epoxy encapsulated




- Surge diverter/ Grounding cell at Insulation Mono – blocks, or
- Grounding cell at Insulation mono - blocks
- Solid state DC Decoupling device at A.C. Interference locations
- Earthing of Motor Operated Valve [MOV] and other Electrical equipments without disturbing CP System through Sacrificial anodes
- Polarization ER Coupons for corrosion monitoring
- Interconnecting cables
- Cable to pipe connections-Pin Brazing.
- Markers for Cable,Anode bed etc.
- CP System at Cased Railway Crossings

6.2 PERMANENT CATHODIC PROTECTION [P C P]

The [PCP] system may include the following major equipment/ sub-systems unless otherwise specified.

- Digital Power Source AC Input DC Output [TRU] with built-in Current interrupter and GPS based timer.
- Distribution Board [dB]
- MMO [LIDA Single] anodes and anode ground beds in carbonaceous back-fill
- Test stations [TLP]
- Computerized Test Stations [CTSU]
- CPPSM
- Junction Boxes with shunts and resistors [AJB] [CJB]
- Permanent Reference Cu-CuSO4 Electrodes [CSE]
- Pin Brazing for pipe to cable connection [epoxy encapsulated]
- Surge diverter/ Grounding cell across Insulation Mono - blocks
- Grounding cell at Insulation mono - blocks
- Solid state DC De-coupling device at A.C. Interference locations
- Polarization ER Coupons for Corrosion monitoring
- Interconnecting cables
- Cable to pipe connections.
- Markers [for cable route. anodebed etc.]

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- Insulating fittings

6.3 SITE CONDITIONS

The equipment will be designed for the following site conditions:

| | |
|---|--|
| Min/Max. Temperature | 0° C to 60° C |
| Design Temperature | 65° C |
| Relative Humidity | 90% |
| Height above MSL | < 1,000 M |
| Atmospheric Pollution | To withstand the site conditions, dust, vapour |
| Hazardous area classification for plant | Zone 2, Gas Group IIA, IIB |
| | Temp. Class T3 |
| Control Room/Electrical Room/ | |
| D.G.Room / Guard Room/Battery Room | Safe Area |

6.4 EQUIPMENTS

All equipment shall be new and supplied by CP contractor sourcing from approved manufacturers of repute with proven track record and approved by the owner for the supply for this project. Equipment offered shall be field proven. Equipment requiring specialised maintenance or operation shall not be acceptable hence should be avoided, as far as possible, and prototype equipment shall not be accepted. Make and construction of all the material shall be as per GAIL Vendor list and Standard specification of this document.

The detailed specification of each system and equipment shall be furnished by the contractor. However, certain minimum requirements for the major equipment are highlighted in this document.

6.4.1 Equipment Location In Hazardous / Non Hazardous Area

As far as possible equipment including Power source, test stations, anodes, junction boxes, TLP etc. shall be located in safe area. However, **all equipment located in hazardous areas shall be of flame proof type as per BIS: 2148, IEC 79 for gas groups IIA & IIB and temp. Class T3 (200° C).**All equipment to be located in Hazardous area should conform to and comply with BIS 2148 and IEC 79 (or equivalent) code requirements. All indigenous flame proof equipment should be certified by **CMRI**. All flame proof equipment of indigenous origin should also be **BIS** marked.



7. ANODE GROUND BEDS

7.1 TEMPORARY CATHODIC PROTECTION [TCP]

- 7.1.1 Along ROW where soil resistivity predominantly remains low and ranges from 0-10 Ω m Zinc (Zn) anodes shall be provided. However, at locations where soil/water pH is more than 9, Zn anodes not to be used as these get Passivated.
- 7.1.2 Along ROW where soil resistivity is predominantly higher than 10 Ω m Magnesium (Mg) anodes shall be provided.
- 7.1.3 At high resistivity area where resistivity is of the order of 50 Ω m and above Magnesium (Mg) ribbon anodes shall be provided.
- 7.1.4 Anodes shall be installed along the pipeline at suitable intervals as per pipeline protection voltage attenuation calculations and ground bed resistance/current output of anode installations.
- 7.1.5 Each electrically continuous section of pipeline shall preferably be protected totally by one type (material) of anodes [either Zn or Mg] to avoid inter-anode [Zn \leftrightarrow Mg] circulation currents. Grounding cell should also conform to this specific requirement.
- 7.1.6 The anodes shall be installed at sufficient depth to reach perennially moist soil [ascertained by ground water table data] but minimum 2M depth from grade level and shall be separated linearly from the pipe line by at least 5m and 2m for Magnesium (Mg) and Zinc (Zn) anodes respectively. The ribbon anodes should be laid at least 0.5 M away from pipe. The anode connections to pipe line shall be routed through test stations.
- 7.1.7 However, environment suitability [such as pH, excessive carbonate, bi-carbonates, sulphates, chlorides, nitrates etc. which could result in anode passivation] should be checked prior to lowering of sacrificial anodes suitability in the anodebeds. Zn should not be used if soil/water pH is over 9.
- 7.1.8 At the temporary CP anode ground bed, the leads of all the anodes shall be connected individually through Shunt and Resistor [for controlling each anode output individually] in the TLP/ junction box. The junction boxes should contain 20% extra terminals points.
- 7.1.9 For sacrificial anode ground beds which shall be integrated with permanent CP system the leads of all the anodes shall be brought up to the test station and shall be terminated individually with shunts inserted in between so that individual anode current output can be regulated & measured as required.
- 7.1.10 For Sacrificial anode CP system the Anodes shall be supplied with Tail cable [6 mm² PE PVC copper conductor single core multistrand cable] of sufficient length so as to reach Junction box, for termination, without difficulty. No joints are permissible on the cable run from anode tail to junction box.
- 7.1.11 The tail cable connection with the Iron Insert of Cable should be tightly done followed by Epoxy encapsulation so as to ensure that no Necking takes place which could result in snapping of cable connection due to spark. Anode cap of heat shrinkable PE material should be able to ensure this.

7.2. PERMANENT CATHODIC PROTECTION [P C P]

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- 7.2.1. Anodebeds To be installed at every CP Station and located at least 100 M away from pipeline ROW to ensure adequate remoteness which should also be calculated.
- 7.2.2. All [MMO] Anodes to be placed in Petroleum coke breeze, in appropriate [deep –horizontal or vertical, or semi-, deep well, deep well] configuration as per design to achieve requisite circuit resistance and protective Current output throughout the [40 years] service life. However, anode bed configuration selected should be technically justified.
- 7.2.3. The MMO anode should be supplied with sufficient length of 10 mm² XLPE PVC cable so as to run up to junction box for termination in the junction box without in-between joints. No joints are permitted in cable run from Anode tail to junction box. This cable size is minimum only and wherever necessary, for appropriate operation of the CP system, higher sized cables should be provided.
- 7.2.4. Appropriate tamping of carbonaceous backfill [petroleum coke breeze] should be done so as to ensure appropriate compaction around [MMO] anode.
- 7.2.5. Anodebed Plot: CP contractor shall acquire[for GAIL] & anode bed plot to be as per design requirement) & at least 100 M away from pipeline ROW for locating anodebed, at each Anodebed location along the pipeline ROW. CP Contractor to indicate the location of anodebeds along pipeline ROW and mark it on As-Built Drawings and handover the requisite ownership documents to GAIL at the time of Handing over of the system.

8. ANODES

❖ **SACRIFICIAL ANODES**

8.1 MAGNESIUM ANODE

The anode shall be of low voltage (-) 1.5 V type Magnesium [Mg] alloy packed in special back fill and suitable for use with three layer extruded polyethylene coating. The anode to conform to ASTM B 843 specifications such as the metallurgical composition, potential and consumption rate of anode shall be as below:

xii. Composition:

| Element | Weight |
|-------------------------|------------------|
| Manganese | 0.15 – 0.7% |
| Copper | 0.02% max. |
| Silicon | 0.10% max. |
| Zinc | 2.5 – 3.5%% max. |
| Aluminium | 5.3 – 6.7% max |
| Iron | 0.003% max |
| Nickel | 0.002% max |
| Other metallic elements | |
| - Each | 0.05% max. |



- Total 0.3% max.

Magnesium (Mg) Balance

xiii. Anode open circuit potential (-)1.5 volts. W.r.t. CSE

xiv. Anode consumption rate 7.9 kg / (A Yr) Max.

8.2 ZINC ANODE

The Zinc [Zn] anode shall conform to ASTM B 418 standard. The anode (other than ribbon anode) shall be packaged with special back fill. The metallurgical composition of anode, potential and consumption rate shall be as below:

Composition:

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

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

Anode consumption rate 11.24 kg / (A yr) Max.

8.3 Contractor shall furnish spectrographic analysis from each heat both for Zinc (Zn) and Magnesium (Mg) anodes along with electrochemical test results .CP Contractor shall mention specifically the method of Spectrography (Atomic Absorption/Emission Spectrometry/Photometrics) for Owner's Approval.

8.4 SPECIAL BACKFILL FOR SACRIFICIAL ANODES

The composition of special backfill for sacrificial anodes shall be as below:

| | |
|-----------------|-----|
| Gypsum | 75% |
| Bentonite | 20% |
| Sodium sulphate | 05% |

8.5 Some Specific Requirements for sacrificial anodes are as follows:



The anodes shall be provided with cable tail of sufficient length to reach junction box/test station [TLP] as applicable in single run without tension and without in between joints.=

8.5.1. TOLERANCE IN FABRICATION OF SACRIFICIAL ANODES

Visual Inspection shall be carried out on all the Anodes regarding surface finish, excessive shrinkage, cracks, cable joint to anode core etc.

- The anode surface shall be free from cracks (which may reduce the performance of the anode.).
- Any cracks which follow the longitudinal direction of elongated anodes shall not be acceptable.
- Small cracks in the transverse direction of elongated anodes and in anodes of other shapes may be accepted provided the cracks would not cause any mechanical failure during service of the anode considering that the combination of cracks and lack of bond to the anode core is detrimental.
- For transverse cracks the acceptable limits shall be furnished by the bidders along with the offer.
- The anode shall be free from excessive shrinkages. The following limits shall be used.

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

- The surface of the anodes shall be free from coatings and slag/ dross, inclusions etc.
- The maximum deviation from straightness shall not exceed 2%.
- The weight tolerance on individual anodes may be taken as $\pm 5\%$. The total weight of the anodes shall not have negative tolerance.
- Recommended dimensional tolerance shall be as follows:

| | |
|------------------|-------------|
| Length | $\pm 2.5\%$ |
| Width/ thickness | $\pm 5\%$ |

- One Anode per heat shall be radiographed to evaluate slags, voids, inclusion etc.
- At least 10% number of Anodes from each heat to be checked for conformity to Dimensions & Weight.
- One Anode, at least shall be Tested Destructively to check bond between Anode material and steel insert, slag, inclusion etc. Failure of one anode during the test shall make the entire anode lot liable for rejection.



FOR PERMANENT CATHODIC PROTECTION [P C P]

8.6 Mixed Metal Oxide [MMO] Anodes: LIDA SINGLE

The Permanent Cathodic Protection [PCP] system will have Mixed Metal Oxide [MMO] Strip Anodes also known as LIDA [Linear Distributed] Anodes and LIDA single. The [MMO] LIDA single anodes shall be centre connected sealed tubular type. These Anodes shall be of Noble metals [group VIII] Mixed Metal Oxide coated Titanium [having Ti substrate composition conforming to ASTM B 338 Grade I and/or Grade II]. The LIDA [MMO] anodes shall be dimensionally stable.

The characteristics of the [MMO] LIDA single anodes are as follows:

- Shape and Dimension
 - 1,000 mm \pm 5 mm long
 - 25 mm \pm 0.2 mm wide
 - 3 mm \pm 0.1 mm thick
- Weight 0.27 Kgs \pm 0.020 Kgs. Recommended Maximum

OPERATING CURRENT DENSITY

- With Carbonaceous Backfill 75 Amp / M²
- Current Output with Carbonaceous Backfill 3 Amp /M²
- Electrical Resistivity 6 x 10⁻⁵ Ω cms.
- Type of Joint Epoxy Splicing
- Contact Resistance of Anode to Cable joint 9 x 10⁻⁵ Ω {maximum}
- MMO Coating thickness \geq 6 gms/M²
- Anode Consumption Rate 1 mg/Amp. Yr.
- Type of Cable XLPE PVC 10 mm²
- Length of Cable As Required so as to reach JB
- Design Life 40 Years
- The Anodes shall be provided Bare for Deep well, and with sheet steel canisters and petroleum coke breeze for deep bed configuration
- The Anodes to be Installed at a distance of 5m (Minimum) apart and shall be **electrically remote to the pipeline [to be ascertained by calculations]**. Normally the nearest part of anode for deep horizontal/vertical type of anode beds shall not be less than 100M from the pipeline. However, the actual distance will be as per site conditions. For Deep well anode bed the first anode should be at least more than 15 M deep [as per NACE RP 0572 Standard] and the actual depth shall be as per Approved Design. However, for Deep well Anode bed also LIDA Single [MMO] anodes (& not LIDA String Anodes) shall be used.



- Anode LIDA [MMO] Single to cable [XLPE PVC 10 mm²] jointing and insulation shall be done by anode manufacturer at MMO anode fabrication shop.
- Dimension & weight of all anodes to be checked & recorded. Negative tolerance will not be acceptable.
- Routine & type test certificates of cable manufacturer to be furnished for anode lead cable as per IEC 502 – 1983 or relevant BIS code. Length and identification tag to be verified by measurement
- Each anode to cable joint shall be tested for it's electrical contact resistance & its value in Ω shall be recorded.
- First Anode to cable joint shall be subjected to accelerated ageing test & destructive test to determine pullout strength of cable to anode joint as well as effectiveness of the joint insulation.
- Manufacturer shall furnish detailed dimensioned fabrication drawing of anodes as well as details of cable connection& it's insulation sealing to owner for approval. Manufacturer of anode will commence only after this Approval from owner.
- Vendor shall furnish, for Owner's Approval, the following information
 - type & make of Heat Shrink cap & it's properties
 - procedure for making the joint
 - procedure for accelerated ageing test
 - Vendor shall submit all test reports for Owners review.

9.0 PETROLEUM COKE BREEZE

Lubricated calcined petroleum coke breeze backfill material for use with LIDA Single [MMO] Anodes in [PCP] system shall have a carbon content of 91.77% minimum and a bulk density of 74 pounds per cubic ft. Zero percent shall be retained by a screen size of 16 mesh.

The coke breeze shall have low resistance carbon lubricant added for lowering the combined resistance while developing the pumping qualities. Earth contact resistance shall be 0.1 Ω cm at 150 PSI.

BACKFILL DATA SHEET

| | |
|-----------|---------|
| Carbon | 91.770% |
| Volatiles | 00.700% |
| Ash | 02.230% |
| Sulphur | 05.850% |
| Silicon | 00.060% |
| Iron | 00.020% |
| Moisture | 00.000% |



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TYPICAL PARTICLE ANALYSIS

| Screen Size | % Retained | % Retained (Cumulative) |
|-------------|------------|-------------------------|
| 16 Mesh | 00.000 | 000.00 |
| 28 Mesh | 02.100 | 002.10 |
| 48 Mesh | 21.100 | 023.20 |
| 100 Mesh | 60.300 | 083.50 |
| 200 Mesh | 15.000 | 099.50 |
| 200+Mesh | 01.500 | 100.00 |

TYPICAL PHYSICAL ANALYSIS

| | |
|--------------|--------------|
| Bulk Density | 54 lb/cu ft. |
| Real Density | 02 gm/ml |
| Porosity | 40.8% |

- ❖ The Petroleum Coke Breeze Material shall be tested for chemical composition, bulk density, real density, particle size and resistivity, sieve analysis.

10.0 AC OPERATED AUTO/MANUAL TRANSFORMER RECTIFIER UNIT [TRU]

The TRU shall be supplied in accordance with the following specifications and Data sheets:

10.1 GENERAL DESCRIPTION

This specification covers the requirements of design, manufacture, inspection, testing and supply of Automatic Controlled Transformer Rectifier Unit for Cathodic Protection of underground structures. Reliability of equipment and ease of maintenance is of utmost importance. The workmanship shall be of highest grade and entire design and construction in accordance with the best modern practice. The C.P. Units shall be capable of continuous trouble free operation at full load rating specified. The protection devices and control components shall be of standard design and carefully chosen to meet the requirements of the sets.

All similar materials and parts of similar equipments shall be interchangeable with each other. Special care shall be exercised in the design and manufacture for aging effects, low input voltage, DC voltage fluctuations, high forward current through the rectifying elements and high temperature conditions during operation.



Apart from the derating for site conditions an additional derating of 20% shall be considered for the specific use. The components of the units shall be designed for maximum operating efficiency. The C.P. Units shall be provided with all the necessary protections required as detailed in the following pages. The C.P. Units shall have Automatic/Manual control and shall be metal clad, compact, indoor installation type, air natural cooled, dust and vermin proof systems exactly confirming to the following specifications and no deviations shall be allowed.

10.2 TECHNICAL REQUIREMENT

10.1.1 The CP Transformer Rectifier Units' scheme for protection, monitoring, control, metering and indication shall be designed to meet requirements of this specification. The control shall be achieved using thyristors and fully solid state logic only. The various features of the unit will be as per the details provided in the data sheet in this specification.

10.1.2 Transformer shall be of double wound, air cooled type with an electrostatic shield between the windings. The transformer insulation shall be Class F. The winding size shall be based on maximum current density of 1.6 Amps/sq. mm of copper conductor.

10.1.3 Rectifier shall be silicon type of approved make with adequate cooling arrangement and with moisture and humidity resistant finish. It shall be mounted on spindles or other suitable supports. It shall have configuration suitable for full wave rectification. Adequate filtering in the form of L-C filtering circuit shall be provided on output side to smoothen out the D.C. output to limit ripple content to less than 5% at rated output.


The input and output of rectifier shall be protected by fast acting fuses of suitable ratings. Lightning Arrestors/Surge Suppressors shall also be provided across D.C. output terminals and A.C. input terminals to protect the rectifier against surges. Each diode and SCR shall be provided with suitable surge suppressers.

10.2 OPERATION OF THE CP TRANSFORMER RECTIFIER UNIT

The T/R unit shall be provided with two modes of working as under. A mode selector switch shall be provided to select the desired mode of operation. Both the modes shall be independent of each other and failure of the unit in one mode shall not affect working of the unit in other mode. A brief description of these modes is given below.

A) Auto Ref. Mode

The unit will be generally working in this mode. The operation of the unit in this mode shall be controlled by a reference signal. The output D.C. voltage of the unit in this mode shall vary right from 0V to rated voltage and from 0A to rated current to maintain the reference signal within ± 20 mV of the set value under all operating conditions. The response of the unit shall be instantaneous to suppress extremely fast acting external stray currents if present. The typical reference regulation in this mode shall be within ± 20 mV under all conditions.

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Fully solid state Automatic Reference Selector logic shall be provided to select the lowest of the Three Reference Inputs automatically. Facility shall also be provided for Manual selection of any one out of the three reference inputs for control. Suitable metering arrangement shall also be provided to monitor all the three external reference signals as well as the internal reference signals independently.

In the event of failure of all the reference signals, the unit will provide alarm - "All Reference Fail" and the output of the unit shall get adjusted to a preset value, which will be operator adjustable from 0V to rated voltage.

Independent ultra fast acting electronic current limit circuit shall be provided to limit the output current of the unit in Auto mode to any value from 0 A to rated value as desired by the operator. The current limit circuit will be capable of protecting the unit even under dead short circuit across output. The unit will be capable of sustaining dead short circuit across output indefinitely without degrading or damaging any internal components in this mode.

B) Automatic Voltage-Current Control mode (AVCC mode)

This will be the second mode of operation. The working of this mode shall be totally independent of the Auto mode and failure of the unit in Auto mode shall not affect operation in this mode.


The output voltage of the unit shall be adjustable to any value from 0V to rated voltage by means of a stepless voltage setter. The set voltage shall be maintained within $\pm 0.25V$ of the set value for change in DC input voltage within specified limits and change in load from 0A to full load.

The output current of the unit shall also be adjustable to any value from 0A to rated current by means of a stepless current setter. The current shall be regulated within $\pm 0.5A$ of the set value for change in DC input voltage within specified limits and change in load from zero to the rated value. The response of both current controller and voltage controller shall be ultra fast, instantaneous type. The current limit circuit will be capable of protecting the unit even under dead short circuit across output. The unit will be capable of sustaining dead short circuit across output indefinitely without degrading or damaging any internal components in this mode.

10.3 LOCAL & REMOTE MONITORING & CONTROL

The unit will be capable of working in Local Mode of control as well as Remote mode of control. For this purpose a mode selector switch will be provided on the unit. With this switch in 'Local Mode' it will be possible to control the various parameters of the unit by means of local controls located in the unit. With this switch in 'Remote Mode' it will be possible to control the various parameters of the unit remotely thru the RTU/SCADA system.

10.3.1 Local Monitoring & Local Control

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Facility will be provided for monitoring and control of various parameters by means of controls provided on the front panel of the unit. The details of the parameters to be monitored and controlled locally are as under:

10.3.1.1 Local Monitoring

Facility will be provided for local monitoring of following:

A) Metering on Panel

- AC Input Voltage - Digital Voltmeter
- AC Input Current - Digital Ammeter
- DC Output Voltage - Digital Voltmeter
- DC Output current - Digital Ammeter
- PSP (Set & Actual) - Digital Voltmeter with 10 Meg Impedance

B) LED Indications on Panel

- AC Supply ON - LED indication
- Pipeline Underprotection - LED indication
- Pipeline Overprotection - LED indication
- Reference 1 Lowest - LED indication
- Reference 2 Lowest - LED indication
- Reference 3 Lowest - LED indication
- Reference 1 Fail - LED indication
- Reference 2 Fail - LED indication
- Reference 3 Fail - LED indication
- All Reference Fail - LED indication
- Overcurrent (Current Limit) - LED indication
- Unit Working in Auto Mode - LED indication
- Unit Working in AVCC Mode - LED indication
- Unit Working in Local Mode - LED indication
- Unit Working in Remote Mode - LED indication



10.3.1.2 Local Control

Facility will be provided for local control of following:

- O/P Voltage - By means of potentiometer on panel
- DC O/P Current - By means of potentiometer on panel
- PSP - By means of potentiometer on panel
- Selection of Auto/AVCC Mode - By means of selector switch on panel
- Start/Stop of Current Interrupter - By means of Keypad on Timer
-

10.3.2 REMOTE MONITORING & REMOTE CONTROL

The T/R unit will be suitable for Remote Monitoring & Remote Control through the RTU/SCADA system. For this purpose Programmable Logic Control system (PLC) shall be provided in the existing TR unit. The PLC shall interface all the remote control and monitoring signals of the TR with RTU/SCADA. The PLC shall be of a reputed and proven brand like Allen Bradley, Siemens, GE, Schneider, and Mitsubishi. PLC of any unknown and non-proven make will not be acceptable.

The system shall comprise of Processor, I/O system, communication sub-system, power supply and serial link communications to RTU, including 10 meters of serial interface cables along with all necessary connectors at both ends for communication to RTU. The system shall include all accessories like isolators, relays, terminals, etc as per the specifications along with software and all other necessary hardware, etc required for proper operation of the PLC system.

The design and the component used for the PLC system shall provide maximum reliability, maximum on-line performance and minimum maintenance. All items shall be field proven. No prototype item shall be supplied.

The PLC shall not be damaged due to power failure. In case of power failure the PLC shall be able to retain the control settings prior to power failure and set accordingly on resumption of power.

The system shall be modular in construction and expandable in future by adding additional modules, which shall be easily accessible for maintenance and repair. The types of modules shall be kept to minimum possible in order to have inter-changeability and low spares inventory.

The PLC shall have a very high noise immunity in order to ensure safe and reliable operation when subjected to electrical radio frequency interference and electro magnetic disturbances expected from other electrical/electronic equipment located near by and inside the TR unit panel.



The communication subsystem shall be a digital communication bus that provides reliable and high speed data transfer between the processor subsystem, I/O subsystem, PLC display, or other devices connected to the system.

10.3.2.1 SYSTEM SOFTWARE

The vendor will supply the necessary system software such as all programs for the PLC, PLC display etc. which are required to perform all the PLC functions including communication and self-diagnostics. Logic program with necessary instructions shall be recorded on compact disc (CD) and shall be delivered with the system.

The PLC system shall be rated for 24 V DC power supply voltage. The 24 V DC power supply shall be derived from 230V AC power supply for the TR unit, through a suitably rated 24 V DC Power supply module.

The PLC and the DC for power supply module for the PLC shall be mounted inside the TR Unit panel.

10.3.2.2 PARAMETERS FOR REMOTE MONITORING

Facility will be provided for remote monitoring of following:

A) Analog Signals

- DC Output Voltage - Hardwired
- DC Output current - Hardwired
- Lowest/Selected PSP - Hardwired

B) Digital Status Signals

- Pipeline Underprotection - Through PLC / RS 485
- Pipeline Overprotection - Through PLC / RS 485
- All Reference Fail - Through PLC / RS 485
- Unit Working in Auto Mode - Through PLC / RS 485
- Unit Working in AVCC Mode - Through PLC / RS 485
- Unit Working in Local Mode - Through PLC / RS 485
- Unit Working in Remote Mode - Through PLC / RS 485



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10.3.2.3 PARAMETERS FOR REMOTE CONTROL

Facility will be provided for Remote control of following:

- Setting of DC O/P Voltage - Through PLC / RS 485
- Setting of DC O/P Current - Through PLC / RS 485
- Setting of PSP - Through PLC / RS 485
- Selection of Auto/AVCC Mode - Through PLC / RS 485
- Start/Stop of Current Interrupter - Through hard wired potential free contact from RTU/SCADA

10.4 RELIABILITY AND FACTOR OF SAFETY

Due to very harsh conditions under which the units are going to operate, prime importance shall be given to ensure reliability and trouble-free operation. To take care of high transient voltages and high peak current demands adequate factor of safety shall be provided in choosing all the components. Minimum factor of safety to be provided for critical components is as under.

| Components | Factor of Safety |
|---|--|
| All wound components | : 50% additional capacity |
| Thyristor & diodes | : PIV : 1200V minimum I _{av} : At least 3 times actual max. average current at full load. |
| Passive components like switches, resistors | : 50% safety margin in current rating. |
| Overall system | : The unit shall be capable of delivering 125% rated current output at rated voltage for 1 hour. |
| Electronic Control | : The entire electronic circuitry shall be assembled on plug-in type glass epoxy PCBs. The control circuit shall be designed using the latest advanced ICs to minimize the component count. Status indicator LEDs shall be provided on each control card to indicate functioning of the card. All the control cards shall be completely sealed using protective coatings. The control circuit shall be capable of operating at elevated |



Components**Factor of Safety**

temperatures of upto 70 °C without any degradation in performance or life expectancy.

10.5 WORKING LIFE

The TR Unit shall be designed for a working life of minimum 35 years.

10.6 TECHNICAL SPECIFICATIONS AND DATA SHEET – TR Unit

- A) A. C. Input Voltage : 230V \pm 10%, 1Ph, 50 Hz \pm 5%, AC
- B) A. C. Input Current : 8.0 A (max)
- C) D. C. Power Output : 625W
- D) D. C. Output Voltage : 0 to 25V DC
- E) D. C. Output Current : 0 to 25A DC
- F) Controls : 1. Auto PSP
2. AVCC (Manual)
- G) Full load efficiency of the TR unit : Not less than 70%
- H) Power Factor at full load : Better than 0.8 Lag
- I) Insulation Level : 2 KV for 1 minute
- J) Cable entry : A.C. input, D.C. output, Ref. Cells and Alarm cables. From the bottom plate of the unit, thru suitable cable glands.
- K) Filtering circuit : L. C. Filter
- L) Ripple & Hum : Less than 5% at rated load
- M) Surge Diverters for diodes/SCRs/Transistor : Metal oxide varistors / capacitors / R-C Networks
- N) Lightning Arrestor : At both input & output side of the unit
R.M.S. Voltage Rating : 500V
R.M.S. Current Rating : 1.5KA
Type : LT 0.5 or Eqv.
- O) Protection : - 2 pole MCB in AC input for overload



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protection & Isolation.

- 2 pole MCB in DC output.

- HRC fuses in input & output.

- Glass cartridge fuses in the live line of all lamps, auxiliary power lines to control circuit.

- Built in electronic current limit and short circuit protection feature.

Current limit adjustable from 0 to rated value.

- All reference fail indication and automatic setting of O/P DC voltage to preset value.

P) Ref. Fail Safe Feature

In the event of failure of all the Reference Electrodes the unit will provide "All Reference Fail" indication and the DC O/P voltage will get adjusted to a programmable preset value.

Q) Reference Electrode
[Permanent]

: 3 Nos. Cu/CuSo4
Automatic Reference Selector Logic shall be provided to automatically select the lowest (least protected) reference signal out of three reference signals fed to the unit simultaneously.
Facility shall also be provided to select one out of three ref. Electrodes by means of a Manually operated Reference Selector switch.

R) Control element

: The DC output will be controlled using latest solid state SCRs.
These SCRs will be controlled by the commands from the control circuits.
All the electronic circuits will be assembled on plug-in type control cards.

S) Modes of operation

: Following modes of control shall be provided.
a) Auto Ref. Mode:
The operation of the unit in this mode will be fully Automatic and will be controlled by the Reference electrode feedback (PSP). The unit will automatically maintain Reference voltage or P.S.P. within $\pm 20\text{mV}$ of the set value under all conditions.
b) AVCC Mode:
This will be the second mode of operation. In this mode the unit can be operated in either constant voltage or constant current mode.



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The output voltage will be adjustable from 0 to rated value by means of stepless voltage setter potentiometer.
The output current will be adjustable from 0 to rated value by means of stepless current setter potentiometer.

- T) Voltage Setting Range in AVCC Mode (Manual) Mode : 0 to 25V
- U) Current Limit setting Range : 0 to 25A
- V) P. S. P. setting Range : -0.8V to -2.5V
- W) Ref. Regulation in Auto Mode : Better than $\pm 20\text{mV}$
- X) DC Voltage regulation in AVCC (Manual) Mode : Better than $\pm 0.25\text{V}$
- Y) Current Regulation in current limit mode : Better than $\pm 0.5\text{A}$
- Z) Indications : a) Underprotection
b) Overprotection
c) Reference cell 1 Lowest
d) Reference cell 2 Lowest
e) AVCC mode of operation
- AA) Annunciations : a) Underprotection
b) Overprotection
c) Reference cell 1 Lowest
d) Reference cell 2 Lowest
e) Reference cell 3 Lowest
f) Reference cell 1 fail
g) Reference cell 2 fail
h) Reference cell 3 fail
i) Reference cell All fail
j) Overcurrent (Current Limit Mode)
- AB) Meters/Instruments : Digital Meters as under:
AC Input Voltage : 0 to 300V AC
AC Input Current : 0 to 10A with CT
3-1/2 Digit Digital Meters as under:



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Output Voltage : 0 to 50V DC

Output Current : 0 to 50A with shunt PSP & Set PSP :
0 to + 19.99 V DC

AC) Local control Mode : Following controls will be provided in local mode from local control panel.

1. Setting of Ref. PSP through Potentiometer
2. Setting of Output Voltage through Potentiometer.
3. Setting of output current limit through Potentiometer.
4. Auto/AVCC Mode Selection
5. START/STOP of Current Interrupter

AD) Remote Monitoring and control : Following features will be provided by means of PLC and through PLC through RS 232C / RS 485 Serial Link with MODBUS RTU Protocol.
485 Serial Link

Digital Input status to RTU/SCADA.

1. Under Protection
2. Over protection
3. All Ref. Fail
4. TR unit in Auto mode
5. TR unit in AVCC mode
6. TR unit in Local mode
7. TR unit in Remote mode

Digital control signal from RTU/SCADA

1. TR unit Operation in AUTO mode
2. TR unit Operation in AVCC mode

Analog Input status to RTU/SCADA

1. Lowest/selected PSP value
2. Output DC voltage



3. Output DC current

Analog Set points from RTU/SCADA

1. Setting of PSP

2. Setting of DC output voltage

3. Setting of DC output Current

AE) Current Interruption : Current interruption facility will be provided by means of a built-in contactor & microprocessor based fully programmable and GPS enabled Synchronisable digital timer with real time clock & ON/OFF time display. The timer will have facility for adjusting the ON time & OFF time from 0 to 999 sec. by means of front panel keypad. Timer will have START, STOP & RESET facility thru local keypad or thru remote potential free contacts.

The Timer will have typical time accuracy of + 5 PPM

Facility for interconnection of an external timer shall also be provided.

A removable bypass link will be provided for bypassing the interrupter contactor contacts.

AF) Enclosure/Construction : Floor mounted Indoor type.

Fabricated from 1.5mm/2.0mm CRCA sheet.

Confirming to IP42 degree of protection.

Lockable doors shall be provided in the front and back.

AG) Cooling : Natural air cooled

AH) Painting : Baked epoxy paint/Powder Coating of shade RAL 7032 Siemens grey with proper pre-treatment and primer application as per standard Industrial Practice.

AI) Earthing : 2 Nos. M6 earthing bolts and 1 no. nickel plated copper earth bus bar shall be provided.

10.6.1 MANUFACTURER'S TECHNICAL EXPERTISE & EXPERIENCE IN THE FIELD OF CATHODIC PROTECTION RECTIFIERS



The manufacturer should be a reputed and established manufacturer of CP Rectifier & CPPSM Units and should have experience in manufacturing of C.P. rectifiers & CPPSM units of similar specifications. The manufacturer will have to submit a list of C.P. Rectifier & CPPSM installations having similar specifications executed in the past 5 years, giving present working status of various units.

10.6.2 TESTING AND INSPECTION

The Manufacturer/Contractor shall provide all the necessary facilities to carry out full performance tests on the AC operated DC Output TR Units at his works.

10.6.3 GUARANTEE

The manufacturer/Contractor will have to guarantee the successful working of the units for a period of 12 months from date of Installation & commissioning.


11 REFERENCE ELECTRODE [CuCuSO4] PERMANENT TYPE

Permanent Copper Copper sulphate reference electrodes three (3) numbers at each CP Station and one at middle of two consecutive CP Stations are to be installed for [P-S-P] Monitoring. One number CSE (Permanent type at each ER Probe to be installed.

12 TEST STATIONS [TLP]

12.1 Test stations [TLP] shall be provided along the pipeline ROW for monitoring the performance of the cathodic protection system at intervals not exceeding 1,500 meters unless otherwise specified. In addition to above, test stations of requisite type [A, B, C, D, E or Combination of any two of these Viz: DE] shall be provided at the following locations:

- a. At both sides of major road crossings
- b. At all insulating joints
- c. At vulnerable locations with drastic changes in soil resistivity.
- d. At connections of surge diverters, grounding cells and polarisation cells.
- e. At HT AC/DC overhead line crossings and selected locations where HT overhead line is in the close vicinity of the pipeline.
- f. At railway line crossings and running parallel to the pipeline.
- g. At both sides of major river crossings.
- h. At high voltage cable crossings or along routes where HV cables are running in parallel.
- i. In the vicinity of DC net works or grounding system where interference problems are suspected.

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- j. At crossings/parallel running of other pipelines/ structures.
- k. At both sides of cased crossings.
- l. At any other locations considered vulnerable/locations where interference is expected.
- m. At any other locations considered necessary by owner/ owner's representative.

Besides, every 10 Kms. Computerized Test station shall be installed for remote monitoring of the Protective Potential and Current profile.

Non Metallic [TLP] to be installed at every 1Kms. Of Salt Pan Area. For Other Areas metallic [TLP] may be provided.

- 12.2 Between the pipeline and foreign pipelines or structures that may exist in common ROW. Test stations for bonding shall be provided with shunt and resistor as a means to monitor and control current to ensure zero net flow of Current from one to the other.
- 12.1 Test stations used for sacrificial anodes shall have shunt for measurement of individual anode current, and provision of resistance to limit & control the anode current output.
- 12.2 Test station with current measuring facility shall be provided at each intermediate CP station drainage point (to measure pipeline current on any one or both side of the pipeline from drainage point), at interference prone areas, on both sides of major river crossings and at least at two additional locations along the pipeline ROW between two CP stations.
- 12.3 All test stations shall have weather proof enclosure, having degree of protection IP55 with hinged lockable shutter. Enclosure shall be made of sheet steel of at least 3 mm thickness and shall be suitable for M.S. post mounting. The test stations shall be designed with terminals required for both temporary [TCP] and permanent CP system [PCP] and shall be suitable for total life of permanent CP system.
- 12.4 The test stations shall be installed with the front of the test station facing the pipeline. The name plate of test stations shall in minimum carry following information.
 - Test station number
 - Chainage in km
 - Test station connection scheme type
 - Distance from pipeline in meters
 - Direction of product flow
- 12.5 Terminal blocks and different scheme of wiring as required shall be provided in the test station as per the test station connection scheme sketch.
- 12.6 The location of all the test stations shall be marked with their connection schemes and other relevant information on alignment sheets. A detailed test station schedule shall be prepared.
- 12.7 Computerized Test Stations [CTSUs] to be installed at pre-identified locations along pipeline ROW for Monitoring the CP System adequacy from these locations. Readers three (2) numbers at least to be supplied with two CTSUs.

13 SURGE DIVERTER, GROUNDING CELL AND POLARISATION CELL

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13.1 At the crossing or parallel run of pipeline and overhead HT line of 66 KV and above, the pipeline shall be grounded through solid state polarisation cell/device. Alternatively, grounding could also be done with galvanic anodes [grounding cells] at the discretion of the owner. The grounding shall be done at regular intervals where transmission line run parallel within 25 m of the pipeline, to ground any surges in the pipeline potential that may appear in case of faults [phase to phase or phase to ground] in overhead transmission line.

Locations along pipeline where continuous induced over-voltage due to HT line etc. is expected &/or observed during commissioning, the pipeline shall be earthed through solid state polarisation cell/device to the HT tower earth system causing the voltage induction to ground or through a separate earthing system. Alternatively the pipeline shall be grounded with galvanic anodes [Grounding cells] at the discretion of the owner.

13.2 The solid state polarisation cell/device shall be installed in a vandal proof steel housing by the contractor.

13.3 Spark gap surge diverter shall be connected across each insulating joint to protect it from high voltage surges.

Alternatively, Zinc or Magnesium grounding cell may be provided across insulating joints along ROW where the pipelines on both sides of the insulating joint are Cathodically protected and difference of protection voltage is not more than 0.4 volts.

13.3.1 Surge diverter shall be provided for the protection of insulating joints located at the ends of the pipe line/at terminals & in between. Alternatively owner on his own discretion may permit use of Magnesium (Mg)/Zinc (Zn) galvanic anodes [grounding cells] appropriately sized for protection of insulating joints. Choice between Zn & Mg anodes will depend up on the potential values on either side of the insulating joint locations. These anodes shall be sized for the specified design life of permanent cathodic protection system [PCP].

13.3.2 The total system including cable, cable termination, anodes/surge diverters shall be suitable for the anticipated fault current magnitude at the location of its installation.

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

i. **Grounding Cell**

- Type : 2 or 4 plate type
- Current rating : Suitable to pass more than 10 kA surge

ii. **Polarisation Cell**

- Type : *Solid state device*
- Current rating : The rating shall be based on actual fault current expected at site.

iii. **Surge Diverter**



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- Type : Spark gap
- Current 8/20 μ s) : 100 kA
- Spark over AC voltage :
- 50 Hz : 1 KV
- Impulse (1.2/50 μ s) : 2.2 KV

13.4 The grounding cell, surge diverter and the solid state polarisation cell/device system shall be sized for the design life of permanent CP system. The Zinc (Zn) or Magnesium (Mg) anodes meant for pipeline grounding shall also be sized for the life of the permanent CP system and the surge magnitude taking into account the current discharge from the anodes. The grounding system shall have minimum resistance to earth to restrict the pipeline voltage [PSP] as per NACE protection criteria.

14 CP AT CASED CROSSING

At all cased crossings the casing shall be coated using 2 pack epoxy, 750 micros thick, both on internal and external surface of the casing. The casing shall be protected additionally by independent [from carrier pipe protection system] sacrificial anode installations. The sacrificial anode installations shall be provided at both ends of casing. The anode installation shall be sized based on the permanent CP design parameters specified for the main pipeline.

The carrier pipe inside casing shall be protected by Zn or Mg ribbon anodes well connected to the outer surface of bottom of carrier pipe extending between hour hand positions of 4 and 8 o' clock. The anodes shall be placed at close intervals as per design calculations and sized based on the permanent CP design parameters. Casings upto 20 mts in length may not be provided additional cathodic protection to carrier pipe bottom inside casing. More than 20 mts length casing additional cathodic protection to carrier pipe bottom shall be provide.

The annulus between the casing and the carrier pipe shall be filled with graded sand/ betonite.


The HDD contractor will arrange an agency to check the coating condition of the casing pipe post erection of HDD so that requisite repairs(if required) are done to the damaged coat.

15 PAINTING

The sheet steel used for fabrication shall be thoroughly cleaned and degreased to remove mill scale, rust, grease and dirt. Fabricated structures shall be pickled and then rinsed to remove any trace of acid. The under surfaces shall be prepared by applying a coat of phosphate paint and a coat of yellow zinc chromate primer. The under surfaces shall be free from all imperfections before undertaking the finished coat. After preparation of the under surface, spray painting with two coats of final paint shall be done. The finished panel shall be dried in oven in dust free atmosphere. Panel finish shall be free from imperfections like pin holes, orange peels, run off paint etc.

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

16 CABLES

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Cables shall be annealed high conductivity, tinned, stranded copper conductor, PE insulated 650V grade, and PVC sheathed FRLS. The size of the copper conductor shall be 6 sq mm for anode cable from anode to junction box, 10 mm² from junction box to test station, 10 mm² from test station to pipeline. The size of the conductor shall be 4 mm² for potential measurement and 25 mm² for bonding, polarization cell / grounding cell and surge diverter connection purpose. The anode cable from anode to junction box shall be unarmored. The length of anode tail cable shall be sufficient enough to reach junction box (buried) in case of temporary CP anode and up to test station in case of permanent CP anodes.

17 INSTALLATION

17.1 CABLE LAYING

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

17.3 All cables inside station/plant area shall be laid at a depth of 0.75 M. Cables outside station/plant area shall be laid at a depth of 1.5 m . Cables shall be laid in sand under brick cover back filled with normal soil. Out side the station/ plant area the routes shall be marked with polyethylene cable warning mats placed at a depth of 0.9 m from the finished grade.

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

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

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

17.7 Cable root markers shall be installed overground at suitable intervals.

17.8 In no case cables shall pass from below underground pipeline. All cables shall be placed above underground pipeline and tightened with tape.

17.9 CABLE TO PIPE CONNECTIONS

All cable connections to the pipeline including charged foreign pipeline shall be made using an (owner) approved exothermic process e.g.: Pin Brazing.

The Pin Brazing to have

- | | |
|-------------------------------------|--|
| 1. extremely low Contact Resistance | ≤ 0.1 Ω. |
| 2. Low transition resistance | 7.5 to 14 μΩ per brazed joint |
| 3. High mechanical strength | Binding strength 490 N/mm ² |
| 4. Shear Strength | 245 N/mm ² |
| 5. Brazing Temperature | 650 ^o C |
| 6. Time per Braze | 2 Seconds |
| 7. Weather Effect | Suitable for all weather operation |
| 8. Life | 40 Years + 1 |



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Field Test Cable Connection through Pin Brazing to be field tested for contact resistance & Temperature etc.

18 CIVIL WORKS

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

19 TESTING AND INSPECTION AT WORKS

19.1 Owner/ Owner's representative shall visit the works during manufacture of various equipment [Anodes, Cables, Junction Boxes, Test Lead Points etc.] to assess the progress of work as well as to ascertain that only quality raw material and fabrication technology is used for the same. All necessary assistance during such inspections shall be provided by the contractor/fabricator to owner's representative.

19.2 The minimum testing, inspection requirements for all components/ equipment shall conform to the requirements as defined in the relevant codes and standards. Detailed inspection and testing procedures along with the acceptance criteria, including various stages where hold points, review etc shall be for owners inspection, shall be prepared by CONTRACTOR for Owner's approval.

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

19.4 Owner reserves the right to ask for inspection of all or any item under the contract and witness all tests and carry out inspection or authorise his representative to witness test and carry out inspection. CONTRACTOR shall notify the Owner or Owner's representative at least 20 days in advance giving exact details of tests, dates and addresses of locations where the tests would be carried out.

20 PACKING AND TRANSPORT

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

21 SYSTEM TESTING, COMMISSIONING AND INTERFERENCE MITIGATION

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21.1 SYSTEM TESTING AT SITE

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

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

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

21.5 All tools, equipment and instruments required for testing shall be provided by C P CONTRACTOR.

21.6 Generally following tests shall be carried out and recorded in perform given in subsequent clauses.

Checking: Visual inspection, comparison with drawings and specifications.

Inspection: Detailed physical inspection & Dimensions measurement

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

i. Cables

- Cable no.
- Voltage grade
- Conductor cross section
- Continuity check
- Voltage test
- Insulation resistance values between core and earth.
- All cables shall be tested by 500 V megger.

ii. Insulating Joints

Checking of insulating joint for leakage, before and after energisation of C.P.by means of insulating joint tester. Structure-to-electrolyte potential of both protected and non-protected sides of insulating joint shall be checked before and after energisation of CP system. Grounding cell/Surge diverter shall be connected thereafter.

iii. Polarisation cell

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

iv. Grounding Cell



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

v. **Surge diverter**

- Location/ identification number
- Ratings
- Check for healthiness

vi **Anode ground beds**

- Location/ test station number
- Current Output of each Anode
- Current output of the ground bed

21.7 COMMISSIONING

21.7.1 Natural pipe to soil potential [P-S-P] shall be measured at each test station [TLP] location prior to connecting anodes to pipeline. The pipe to soil potential observation shall be repeated after connecting the anodes and allowing sufficient time for polarisation. The current output of the anode installation shall also be measured to ensure that it does not exceed the output current capacity of the anodes. In case the anode output current exceeds the rated capacity it shall be controlled by insertion of resistance element in the anode circuit inside test station and the pipe to soil potential shall be rechecked for adequacy of protection. Additional anodes shall be provided where required to achieve desired level of protection [PSP].

Each anode installation shall become individually operational as above.

21.7.2 After connecting all the anode ground beds to pipe line, measurement of pipe to soil potentials shall be taken at each test station [TLP] to ensure adequate conformity to protection criteria.

21.7.3 In case of insufficient protection as per the NACE CP design criteria on any portion of the pipe line, CONTRACTOR shall carry out necessary additions/ modifications to the provided protection in consultation with the ENGINEER so that NACE criteria is met.

21.8 INTERFERENCE MITIGATION

Investigation shall be made by an expert agency with prior experience for stray current electrolysis of the pipeline. Interference due to high voltage DC lines, electric traction & installed CP System of existing underground utilities and make suitable Recommendations so that recommended D.C. Interference Mitigative measures could be installed.

The C.P. Contractor to carry out Interference due to overhead AC lines and install suitable Mitigative measures for AC Interference.

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

In case of fluctuating stray currents investigation shall be made continuously over a period of time and if required simultaneously at different locations to find out the stray current source. For long line measurements, data loggers shall preferably be used.

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

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

Between an existing pipeline & upcoming pipeline a concrete raft [size to be approved by owner as per OISD] is to be provided as a barrier. The new pipeline will pass below the existing U/G Pipeline.

Bonding with foreign pipeline/ structure as a mitigation measure shall be provided where the owner of the pipeline/ structure has no objection, otherwise alternative mitigation measure shall be provided.

Wherever bonding is provided for mitigation the bonding resistor shall be adjusted for optimum value for minimum / no interference so that no net current flows from one to the other pipeline. Galvanic anodes installed as a mitigation measure shall be sized for the life specified for permanent CP.

22 SYSTEM MONITORING

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

23.2 P-C-P system after commissioning shall be monitored by the CP contractor for One Year once a month and During this period if any deficiency/ interference in protection system is noticed the same shall be rectified / augmented by additional fixtures as required.

23 DRAWINGS AND DOCUMENTS

23.1 GENERAL

23.2 Within three weeks from the date of issue of PURCHASER ORDER, CONTRACTOR shall submit four copies of the list of all drawings/ data manuals/procedures for approval, identifying each by a number and descriptive title and giving the schedule date. This list shall be revised and extended, as

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23.3 All drawings and documents shall be in English and shall follow metric system. Number of copies of each submission shall be as per Scope of work document.

23.4 CONTRACT DRAWINGS AND DOCUMENTS

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

- a. Report on corrosion survey
- b. Basis of system design and design calculations, equipment selection criteria and sizing calculations.
- c. Bill of material, material requisitions, purchase requisitions.
- d. Quality assurance / Quality control procedures

23.6 Detailed construction drawings (including as built status)

- a. Sacrificial anode fabrication drawings
- b. Typical layout drawing for anode ground bed installation and connection.
- c. Equipment layout, cable layout and schedules.
- d. TLP & Junction Box Erection / Installation Details Drawing
- e. Permanent Cu-CuSO₄ reference electrode installation Drawing
- f. Fabrication, installation details of surge diverter, grounding cell and polarisation cell with its enclosure and housing.
- g. Cable- to-pipe joint details for charged and non charged pipelines.
- h. Incorporation of anode beds, polarisation cell, surge diverters, test stations, etc. and other relevant features of CP system-design in Pipeline alignment sheet and other related drawings.
- i. Identification of section of pipeline affected by interference, source of interference and details of interference mitigation arrangements provided. Various measurement data at all relevant test stations with and without mitigation measures provided.
- j. Detailed commissioning report including various measurement data at all test stations etc.
- k. Vendor drawings and catalogues, test certificates.
- l. Operation and maintenance manual.
- m. Miscellaneous
 - Equipment inspection and testing procedure
 - Construction, installation procedures
 - Field testing and commissioning procedures
 - Procedure for monitoring of Cathodic protection after commissioning
 - Quality control procedures.
 - Post Commissioning Testing/Monitoring Periodicity and Methodology

24 INSTRUMENTS, TOOLS AND SPARES

24.1 CONTRACTOR shall include a List of all instruments, tools and tackles necessary for proper operation and maintenance [O&M], Monitoring of complete Cathodic protection [TCP] [PCP] systems and associated equipment that are to be deployed at site, such as Corrosion Voltmeter, Multi-combination Meter, CPL Survey Data Logger, DCVG Meter, Holiday Detector, Pipe Locator, Elcometer for Coating thickness measurement, CAT survey, Soil resistivity meter etc. duly calibrated by an Owner Approved agency in last six (6) months.

24.2 CONTRACTOR shall provide number of spares and consumables being provided for proper operation and maintenance of part of Cathodic protection [TCP] system to be integrated with permanent CP system [PCP] designed on the basis of permanent CP design parameters and associated equipment, for two (2) years un-interrupted operation of the system.

25 INFORMATION REQUIRED WITH THE BID

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Bidders are advised in their own interest to provide the following information along with the bid without which the bids are liable for summary rejection.

- A. Work Experience, in detail, Project wise, giving Job content, Year, Status for client etc.
- B. List of Equipments, Tools, Tackles, etc. likely to be deployed at site
 - a. Basis and calculations for preliminary system design for Cathodic protection system [TCP] and [PCP]
 Viz: Surface Area, Protective Current Required, Anode Weight and size required/provisioned, Anode bed type, Coke Breeze/Backfill required/provisioned, Anode bed Loop Resistance, Remoteness adequacy, Surge Resistance calculated/provisioned, etc.
 - b. List of formulae with legends to be used for detailed system design calculations.
 - c. Basis of system design, design calculations, equipment selection criteria, sizing calculations along with characteristic curves for various equipment.
 - d. Preliminary bill of material [B O M] for major equipment for [TCP] and [PCP].
 - e. Details of the equipment/ material offered along with technical leaflets / related literatures/ catalogues, make, rating, type test certificates.
 - f. Dimension, weight and general arrangement drawings for each offered equipment.
 - g. List of instruments, tools and tackles offered for maintenance and operation.
 - h. List of recommended maintenance / operation spares.
 - i. Clause-wise deviations, if any, to the specifications along with justifications.
 - j. List & Credentials of Crew to be deployed at site and contractors home office.



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APPENDIX A

COMPUTERISED TEST STATION UNITS (CTSUs) FOR CATHODIC PROTECTION PERFORMANCE MONITORING

Each CTSU (Computerised Test Station Unit) is a Microprocessor based low CMOS circuitry with built in RTC, installed near a Computerised Test Station to acquire and store the complete CP System performance data available for each Test station. CTSUs are typically designed for outdoor applications and are NEMA4 protected.

Once stored, the data can be downloaded as under:

- a) By a remote computer by telephone, cellular phone or radio link/OFC.
- b) By portable handheld data reader using local communication port.

Key features of the CTSU are as under:

| | | |
|----|--|---|
| 1. | Recording Rate | To be configured from 1 reading per second to 1 reading per 365 days. |
| 2. | Battery backup | Lithium battery back up option allowing CTSU ECU to retain data for 10 years on a single charge. |
| 3. | Timing | Status input sampling time 10m sec to 2.5 m-sec. |
| 4. | Power requirement | The CTSU to be powered by 24 \pm 15% Volts DC |
| 5. | The CTSU shall be able to read and record. | PSP and current data of pipeline & foreign pipeline/pipelines upto 10,000 sets to be stored till downloaded |
| 6. | Inputs available | Minimum 10 nos. [5 inputs for PSP & 5 inputs for current.] |
| 7. | Protection against | Voltage/current surges expected along the pipeline & foreign structure. |
| 8. | Test Station Reader (TSR) | Portable type suitable for field transport & handing. Unit enclosure is weather proof, IP55. |
| 9. | Input battery for TSR | Internal rechargeable battery provided. |

To be installed at pre-identified locations



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APPENDIX-B

POST C.P. COMMISSIONING SURVEYS

1. COATING CONDUCTANCE SURVEYS

For evaluation of the electrical strength of the coating, post commissioning of the C.P. System, after one (1) Month, Coating Conductance surveys to be conducted, to serve as Reference for future comparison. Although same coating specifications are used throughout the length of the pipeline, effective electrical strength thereby it's ability to resist flow of current would reasonably vary on account of terrain, construction defects, soil resistivity along the Pipeline length.

For conducting coating conductance surveys, Potential (ΔV) & (ΔI) Current are to be measured at two consecutive "B" type Test Lead Points [TLP], w.r.t remote earth using $CuCuSO_4$ reference electrode, alternatively with current interrupter "On" & "Off" at each measurement point.

The difference of the two ΔI will be the C.P. Current being collected by this section of the pipeline. The difference of the two ΔV will be the average change in pipeline potential within the test section owing the current received from C.P. System.

The above procedure to be repeated for all "B" type TLP for evaluating coating conductance value for different sections along the pipeline. All the Data obtained is to be handed over to the owner & will form part of final Technical Documentation.

Before commencement of site surveys the survey procedure shall be got duly approved from the Owner.

2. CURRENT ATTENUATION TEST (CAT) SURVEY

Current attenuation test (Cat) survey for impressed current cathodic protection service for underground Gas pipelines. To identify of pipeline sections where coating is good and bad, To pinpoint coating defect in pipeline sections where coating is bad with Use of 'PCM'- A frame equipment, To give accurate coating defect locations for future coating repairs, To size the defects by standard method, Classify defects as Anodic or Cathodic.

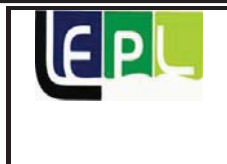
Vendor shall carryout Pipeline current mapping followed by A frame survey at pipeline sections where coating is suspected to be damaged. Vendor shall also make coating defect co-ordinates drawing for subsequent coating repairs.

The survey need to be carried out by the Instrument "Pipeline Current Mapper" or any other equivalent equipment.

The survey along the pipeline should be carried out after duly identifying the pipeline alignment using the instrument's peak and null modes of operation. The pipeline alignment should be identified using temporary markers, at defined distance intervals. This shall facilitate retracing back high current attenuation locations for PCM-'A' frame survey.

Distance of survey traverse - survey Chainage shall be accurately measured with tape for accurate demarcation of the coating fault. The same shall be re matched with Pipeline marker Chainage /TLP Chainage, at regular intervals to avoid accumulation of error of measurement.

Prior to commencement of **CAT** survey, the survey procedure to be got approved from the Owner. Only Good & Proven survey equipment and trained, experienced manpower to be used. All survey Data to be submitted to Owner as part of Technical Documentation.



3. DCVG SURVEY

Post commissioning of the C.P. System, after 30 days of Line polarization, CPL Survey will be conducted for evaluation of coating condition to serve as future Benchmark for comparative evaluation.

Any finding of coating defect in particular, where coating defects and holidays are high, have to be further established through a separate **DCVG** survey for the defective stretch delineated as above from CPL survey findings.

Prior to commencement of **DCVG** survey, the survey procedure to be got approved from the Owner. Only Good & Proven survey equipment and trained, experienced manpower to be used. All survey Data to be submitted to Owner as part of Technical Documentation.

3. COMPUTERIZED POTENTIAL LOGGING [CPL] SURVEY

Post commissioning of the C.P. System, after 30 days of Line polarization, a Computerized Potential Logging [CPL] survey will be conducted, as per procedure, already got approved by the Owner. The "On"/"Off" Potential survey. For the survey, Data Logger of repute & Current interrupter [if not available in the TRU] will be used by experienced and trained manpower. All the survey data and findings of under-protected, over-protected zones, short etc. shall be handed over to the owner as part of final technical Documentation. Suitable remediation measures to be recommended for achieving adequacy of protection throughout the pipeline length. This CPL survey Data will serve as base Data for future comparative evaluations of the Protective system adequacy.

4. A.C. /D.C. INTERFERENCE DETECTION & MITIGATION

Post commissioning of the C.P. System, after 30 days of Line polarization, an AC / DC Interference survey to detect presence (or absence) of induced AC Voltages [which in certain circumstances may be fatal] on the underground pipeline that run parallel to AC transmission systems [having voltages greater than or equal to ≥11KV] shall be carried out. Measurement of P-S-P shall be taken at every TLP of the pipeline that run parallel to overhead AC transmission lines and are within 20 M of transmission line alignment. On detection of AC induced Hazardous voltages suitable Mitigative measures such as grounding of the pipeline with Zn / Mg Grounding cell, installation of Polarization cell etc. shall be resorted to dissipate Ac induced hazardous voltages to ground in controlled manner. Type "A" TLP shall be provided at these locations having AC induced Hazardous voltages on the pipeline.

DC Interference Detection from existing CP system in close vicinity of ROW and any other DC source such as electric traction, switching yard, welding shop etc. Appropriate measures for mitigation to be recommended for installation by CP contractor.

Prior to site survey commencement, the Approval for survey procedure, from the Owner, shall be taken.

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APPENDIX-C

INTERFACING WITH SCADA

Cathodic Protection (CP) panel shall be properly interfaced with RTU through RS 485 serial link for various signals like pipeline under protection, pipeline overprotection, all reference fail, unit working in auto mode, unit working in AVCC mode, unit working in local / remote mode, setting of DC O/P voltage, setting of DC output current, setting of Pipe soil potential (PSP), setting of auto / AVCC mode. CONTRACTOR to note that SCADA vendor shall provide RS 485 serial link at the RTUs for interfacing with CP system. Hence, CONTRACTOR shall also provide RS 485 serial link (Modbus ASCII & Modbus RTU protocol which shall be user selectable). The digital and analog data shall be made available to RTU (SCADA) and it shall be mapped in the contiguous registers so that data can be fetched / written in minimum transactions.

CONTRACTOR shall furnish all details like pin configuration and signal wise MODBUS address mapping list etc. for smooth interfacing of this communication link with RTU (SCADA).

CONTRACTOR shall also furnish the details of implemented MODBUS protocol like function codes for read and write, CRC implementation, BCC implementation, register addressing methods / mapping etc. during detail engineering for serial interfaces with RTU (SCADA).

The following hardwired signals shall be taken from CP system to SCADA system (however hardwired cables shall be routed through PLC cabinet):

- PSP Value
- Impressed Voltage
- Impressed Current
- Start / Stop of Current Interrupter





GAIL INDIA LIMITED



DATA SHEET FOR CATHODIC SYSTEM

TOTAL SHEETS

04

DOCUMENT NO.:

GAIL-STD-CP-DOC-DS-001

| REV | DATE | DESCRIPTION | PREP | CHK | APPR |
|-----|----------|----------------|------|-----|------|
| 0 | 22.12.20 | ISSUED FOR BID | AS | TR | SB |

**TECHNICAL DATA SHEET
FOR
CATHODIC PROTECTION SYSTEM**

1.0 E/R Probes :

- 1.1 Make and model no. of E/R probe : -----
 1.2 Material of E/R probe : -----
 1.3 Size of the exposed area of the probe : -----
 1.4 Make and mode no. of E/R probe : -----
 reading instrument

2.0 Permanent reference electrodes :

- 2.1 Make & model no. : -----
 2.2 Design life of electrode under burial condition : ----- Years

3.0 Polarization cells :

- 3.1 Type : -----
 3.2 Make & model no. : -----
 3.3 Maximum DC leakage current at 40 degree C at
 - 1V DC across the Polarisation cell : ___ mA
 - 1.5V DC across the Polarisation cell: ___ mA
 - 2.0V DC across the Polarisation cell: ___ mA
 3.4 50 Hz AC current rating at 40o C
 - Continuous : ___ A
 - Short time : ___ KA for ___ sec
 3.5 Rated no. of operations over life time
 under maximum ratings ___ Nos.

4.0 Polarisation Coupons :

- 4.1 Exposed area of metal : -----
 4.2 Metal type : -----
 4.3 Make and model no. of reed switch : -----
 4.4 Make and model no. of
 reed switch operator
 magnet :
 4.5 Rating of reed switch :
 -Continuous current rating : ___ A DC, at _ V DC
 -Breaking current : ___ A DC, at ___ V DC



5.0 Surge Diverters :

5.1 Type : -----

5.2 Ratings : -----

5.2.1 Current, 8/20 micro second wave :

5.2.2 AC spark over voltage

-50Hz AC :

-Impulse(1.2/50 micro second) :

5.3 Make :

6.0 Cables :

6.1 Type and voltage grade :

-For anode tail cables : ___ / ___ V

-For other CP cables : ___ / ___ V

6.2 Make :

-For anode tail cables :

-For other CP cables :

7.0 Cable to pipe connection :

- For charged pipeline :

- For non charged pipeline :

-7.1 Make and model number of

- Cad weld Material :

- Pin brazing equipment :

8.0 Anode type and make :

8.1 Impressed current anodes

- Type :

- Make :

8.2. Sacrificial anodes make –

- Zinc anodes :

-Zinc ribbon anodes :

9.0 TR Unit :

9.1 CPTR unit :

9.2 CPPSM :

9.3 Test stations :

9.4 Anode junction box :

9.5 Cathode junction box :



9.6 Calcined petroleum coke breeze :

9.7 Permanent reference

electrodes -

CuCuSO₄ type :

-Ag-AgCl type :

9.8 Special Backfill for sacrificial anodes:

9.9 Make :



**QUALITY ASSURANCE PLAN FOR TEST STATIONS**

| | | | |
|----------------------------------|-------------------------|---------------|---|
| PROJECT | | | |
| OWNER | GAIL INDIA LIMITED | | |
| PROJECT NO | | DATE:- | |
| TPIA | | | |
| CONSULTANT | | | |
| CONTRACTOR | | | |
| CP CONTRACTOR | | | |
| QAP NO. | GAIL-STD-CP-DOC-QAP-001 | REV. | 0 |
| REFERENCE SPECIFICATION | | | |
| REFERENCE DESIGN DOCUMENT | | | |
| REFERENCE DATA SHEET | | | |
| REFERENCE DRAWING | | | |
| VENDOR | | | |

| DESCRIPTION / TYPE OF INSPECTION | REFERENCE DOCUMENT | FORMAT OF RECORD | INSPECTION BY | | | Remarks |
|---|-------------------------------|-------------------------|----------------------|-------------|-------------|----------------|
| | | | M | TPIA | GAIL | |
| Compliance with approved Drawing & Data sheet (Manufacturer, type &Model) | Approved Drawing & Data Sheet | Inspection Report | P | W | W | |
| Visual Inspection: 100% | Approved Drawing & Data Sheet | Inspection Report | P | W | W | |
| Dimensional Check: 25% | Approved Drawing | Inspection Report | P | W | W | |
| fitness test, terminal to body resistance. Randomly | Approved Drawing & Data Sheet | Inspection Report | P | W | W | |
| Thickness Check :25% | Approved Drawing | Inspection Report | P | W | W | |
| Terminals to TS Body | Approved Drawing & Data Sheet | Inspection Report | P | W | W | |
| Manufacturer Test Certificate (IP 55) | Approved Drawing & Data Sheet | IP 55 Test Certificate | S | R | R | |
| Document / Marking | Approved Drawing & Data Sheet | IRN | H | P | R | |

LEGEND: P-PERFORM, W-WITNESS ALL, S-SUBMITTED BY, R-REVIEWED BY, H-HOLD M-Manufacturer C-Contractor TPJA-Third Party Inspection Agency H-Hold



QUALITY ASSURANCE PLAN FOR CP CABLE



| | |
|---------------------------|--------------------------------|
| PROJECT | |
| OWNER | GAIL INDIA LIMITED |
| PROJECT NO | DATE:- |
| TPIA | |
| CONSULTANT | |
| CONTRACTOR | |
| CP CONTRACTOR | |
| QAP NO. | GAIL-STD-CP-DOC-QAP-001 REV. 0 |
| REFERENCE SPECIFICATION | |
| REFERENCE DESIGN DOCUMENT | |
| REFERENCE DATA SHEET | |
| REFERENCE DRAWING | |
| VENDOR | |

| DESCRIPTION / TYPE OF INSPECTION | REFERENCE DOCUMENT | FORMAT OF RECORD | INSPECTION BY | | | Remarks |
|--|-------------------------|-------------------|---------------|---|------|---------|
| | | | M | C | TPIA | |
| Compliance with approved Data sheet (Manufacturer, type) | Approved Data Sheet | Inspection Report | P | W | W | |
| Visual Inspection: 100% | Approved Data Sheet | Inspection Report | P | W | W | |
| Voltage Test, Conductor Cross Section, Insulation Test -100% | Approved Data Sheet | Inspection Report | P | W | W | |
| Continuity Check- Randomly | Approved Data Sheet | | | | | |
| Voltage Grade - Randomly | Technical specification | Test Report | P | W | W | |
| Type Test -100% | As per ref. Standard | Test Report | P | W | W | |
| Manufacturer Test Reports | Approved Data Sheet | Test Report | P | W | P | |
| Document / Marking | Approved Data Sheet | IRN | H | P | R | |

LEGEND: P-PERFORM, W-WITNESS ALL, S-SUBMITTED BY, H-HOLD M-Manufacturer C-Contractor TPIA-Third Party Inspection Agency H-Hold



QUALITY ASSURANCE PLAN FOR POLARISATION CELL



| PROJECT | | | | | | |
|--|-------------------------|-------------------|---------------|------|------|---------|
| OWNER | GAIL INDIA LIMITED | | | | | |
| PROJECT NO | DATE:- | | | | | |
| TPIA | | | | | | |
| CONSULTANT | | | | | | |
| CONTRACTOR | | | | | | |
| CP CONTRACTOR | | | | | | |
| QAP NO. | GAIL-STD-CP-DOC-QAP-001 | | REV. | 0 | | |
| REFERENCE SPECIFICATION | | | | | | |
| REFERENCE DESIGN DOCUMENT | | | | | | |
| REFERENCE DATA SHEET | | | | | | |
| REFERENCE DRAWING | | | | | | |
| VENDOR | | | | | | |
| DESCRIPTION / TYPE OF INSPECTION | REFERENCE DOCUMENT | FORMAT OF RECORD | INSPECTION BY | | | Remarks |
| | | | M | TPIA | GAIL | |
| Compliance with approved Drawing & Data sheet (Manufacturer, type &Model) | Inspection Report | Inspection Report | P | W/R | W/R | |
| Manufacturer Test Report | Test Certificate | Test Certificate | P | R | R | |
| Inspection Release Note | IRN | | H | P | R | |
| LEGEND: P-PERFORM, W-WITNESS ALL, S-SUBMITTED BY, R-REVIEWED BY, H-HOLD M-Manufacturer C-Contractor TPIA-Third Party Inspection Agency H-Hold | | | | | | |



| | | | |
|---|--|-------------------------|----------------------|
| <p style="text-align: center;">QUALITY ASSURANCE PLAN FOR PERMANENT REFERENCE CELL (Ag/AgCl)</p> | | | |
| PROJECT | | | |
| OWNER | GAIL INDIA LIMITED | | |
| PROJECT NO | | | DATE:- |
| TPIA | | | |
| CONSULTANT | | | |
| CONTRACTOR | | | |
| CP CONTRACTOR | | | |
| QAP NO. | GAIL-STD-CP-DOC-QAP-001 | REV. | 0 |
| REFERENCE SPECIFICATION | | | |
| REFERENCE DESIGN DOCUMENT | | | |
| REFERENCE DATA SHEET | | | |
| REFERENCE DRAWING | | | |
| VENDOR | | | |
| DESCRIPTION / TYPE OF INSPECTION | REFERENCE DOCUMENT | FORMAT OF RECORD | INSPECTION BY |
| Compliance with approved Drawing & Data sheet (Manufacturer, type & Model) | Approved Data Sheet & Drawing | Inspection Report | M TPIA GAIL |
| Visual Inspection 100% | Approved Data Sheet & Drawing/ Technical specification | | P W / R W/R |
| Manufacturer Certificates | Approved Data Sheet & Drawing | Test Certificate | P W / R W/R |
| Inspection Release Note | IRN | | Submission R R |
| <p>LEGEND: P-PERFORM, W-WITNESS ALL, S-SUBMITTED BY, R-REVIEWED BY, H-HOLD M-Manufacturer C-Contractor TPIA-Third Party Inspection Agency H-Hold</p> | | | |



**QUALITY ASSURANCE PLAN FOR COMPUTERIZED
TEST STATION UNIT**



| | | | |
|--|-------------------------------|-------------------------|--|
| PROJECT | | | |
| OWNER | GAIL INDIA LIMITED | | |
| PROJECT NO | | | DATE:- |
| TPIA | | | |
| CONSULTANT | | | |
| CONTRACTOR | | | |
| CP CONTRACTOR | | | |
| QAP NO. | GAIL-STD-CP-DOC-QAP-001 | REV. | 0 |
| REFERENCE SPECIFICATION | | | |
| REFERENCE DESIGN DOCUMENT | | | |
| REFERENCE DATA SHEET | | | |
| REFERENCE DRAWING | | | |
| VENDOR | | | |
| DESCRIPTION / TYPE OF INSPECTION | REFERENCE DOCUMENT | FORMAT OF RECORD | INSPECTION BY |
| Compliance with approved Drawing & Data sheet (Manufacturer, type & Model) | Approved Data Sheet & Drawing | Inspection Report | M C TPIA |
| Manufacturer Certificates | Approved Data Sheet & Drawing | Test Certificate | P W / R W/R Submission R R H H P |
| Inspection Release Note | IRN | | |
| LEGEND: P-PERFORM, W-WITNESS ALL, S-SUBMITTED BY, R-REVIEWED BY, H-HOLD M-Manufacturer C-Contractor TPIA-Third Party Inspection Agency H-Hold | | | |



QUALITY ASSURANCE PLAN FOR MMO ANODE

| | | | |
|--|--------------------------------|-------------------------|----------------------------------|
| PROJECT | | | |
| OWNER | GAIL INDIA LIMITED | | |
| PROJECT NO | | DATE:- | |
| TPIA | | | |
| CONSULTANT | | | |
| CONTRACTOR | | | |
| CP CONTRACTOR | | | |
| QAP NO. | GAIL-STD-CP-DOC-QAP-001 | REV. | 0 |
| REFERENCE SPECIFICATION | | | |
| REFERENCE DESIGN DOCUMENT | | | |
| REFERENCE DATA SHEET | | | |
| REFERENCE DRAWING | | | |
| VENDOR | | | |
| DESCRIPTION / TYPE OF INSPECTION | REFERENCE DOCUMENT | FORMAT OF RECORD | INSPECTION BY |
| | | | M TPIA GAIL |
| Compliance with approved Drawing & Data sheet (Manufacturer, type &Model) | Approved Data Sheet | Inspection Report | P W W |
| Dimensional Check | Approved Drawing & Data Sheet | Inspection Report | P W W |
| Electrical Test , coating consumption rate | Approved Drawing & Data Sheet | Inspection Report | P W W |
| Leak proof test (Helium Test), cable length, coating resistivity & Coating thickness | Approved Drawing & Data Sheet | Inspection Report | P W W |
| Inspection as per below attached vendor's ITP | Vendor's ITP is attached below | Inspection Report | P R R |
| Document / Marking | Approved Drawing & Data Sheet | IRN | H P R |
| LEGEND: P-PERFORM, W-WITNESS ALL, S-SUBMITTED BY, R-REVIEWED BY, H-HOLD M-Manufacturer C-Contractor TPIA-Third Party Inspection Agency H-Hold | | | |



QUALITY ASSURANCE PLAN FOR PIPE CONNECTION



| | | | |
|----------------------------------|-------------------------|---------------|---|
| PROJECT | | | |
| OWNER | GAIL INDIA LIMITED | | |
| PROJECT NO | | DATE:- | |
| TPIA | | | |
| CONSULTANT | | | |
| CONTRACTOR | | | |
| CP CONTRACTOR | | | |
| QAP NO. | GAIL-STD-CP-DOC-QAP-001 | REV. | 0 |
| REFERENCE SPECIFICATION | | | |
| REFERENCE DESIGN DOCUMENT | | | |
| REFERENCE DATA SHEET | | | |
| REFERENCE DRAWING | | | |
| VENDOR | | | |

| DESCRIPTION / TYPE OF INSPECTION | REFERENCE DOCUMENT | INSPECTION BY | | | Remarks |
|---|-------------------------------|----------------------|----------|-------------|----------------|
| | | M | C | TPIA | |
| Compliance with approved Drawing & Data sheet (Manufacturer, type &Model) | Approved Data Sheet & Drawing | P | W / R | W/R | |
| Manufacturer Certificates | Approved Data Sheet & Drawing | Submission | R | R | |

LEGEND: P-PERFORM, W-WITNESS ALL, S-SUBMITTED BY, R-REVIEWED BY, H-HOLD M-Manufacturer C-Contractor TPIA-Third Party Inspection Agency H-Hold



QAP FOR TRANSFORMER UNIT



| | | |
|--------------|-------------------------|---------------------|
| PROJECT | | |
| CLIENT | GAIL INDIA LIMITED | REV. NO.- 0 |
| PMC | | RATING AND QUANTITY |
| CONTRACTOR | | DATE:- |
| MANUFACTURER | | |
| P.O.NO. | | P.O DATE |
| QAP NO. | GAIL-STD-CP-DOC-QAP-001 | |
| REF. DOC. | | |

| Sr.No. | Item/ Component | Characteristics | Type of Check | Extent of Work | Reference Document | Acceptance Norms | Format of Record | Agency | | REMARKS |
|--------|---|---|---|--------------------------|--|---------------------------|--|--------|------|---------|
| | | | | | | | | M | TPIA | |
| 1 | BOUGHT OUT ITEMS | | | | | | | | | |
| 1 | Receiving Inspection for Fabricated | 1. Physical Check 2.Physical damage if any. 3 Verification with Manufacturer specification. | Measuring Tape Physical Test Verification of Test Certificate | 100% 1 in Lot | Approved Drawing Manufacturer specification | Incoming Test Certificate | Incoming Test Certificate | P | R | R |
| 1.2 | Receiving Inspection of Meters, PCB'S, Semiconductor & Electrical Items | 1. Dimensions, Size 2. Electrical Parameters | Functional test 2.Mechanical/Ele ctirical Measurement | sampling 10% 1 in Lot | Approved Drawing Manufacturer specification | Test Report | 1.Manufacturer Test Report 2.Incoming Test Report | P | R | R |
| 1.3 | Sub assembly- Transformer,Choke, | 1. Insulation Test 2. No Load Test | | 100% | Approved drawing | Test Certificate | Test Certificate | P | R | R |
| 1.4 | Sub assembly- Timer-Inspection & Test | 1. Visual inspection 2. Functional Test 3. Internal settings | Functional test 2.Mechanical/Ele ctirical | 100% | Approved drawing | Test Certificate | Test Certificate | P | R | R |
| 1.5 | Assembly Process | 1. Electrical wiring and tightness of all connections 2. Labeling and Marking | Measurement Visual | 100% | Approved drawing | Test Report | Test Report | P | R | R |
| 1.6 | Auxiliary device check | Verification as per BOM | Visual | 100% | Approved Drawing | Test Report | Test Report | P | R | R |
| 1.7 | Insulation Test | Insulation and High Voltage Test between primary to Earth, Secondary to Earth and/or Primary to secondary | Electrical Measurement | 100% | Approved Drawing | Test Report | Test Report | P | R | R |
| 1.8 | Sub/assembly-control card Inspection & Test | 1. Visual inspection 2. Functional Test | Functional Test | 100% | Approved Drawing | Test Report | Test Report | P | R | R |
| 1.9 | Heat Run Test | Heat run at at rated Load for at least 12/16 Hrs with Temperature measurement on all power devices and Magnetics at the end of test | Electrical Test & Inspection | 100% | 1.Approved Drawing 2.Approved Specification | Test Report | Test Report | P | R | R |



QAP FOR TRANSFORMER UNIT



| | |
|---------------------|--------------------|
| PROJECT | |
| CLIENT | GAIL INDIA LIMITED |
| PMC | |
| CONTRACTOR | |
| MANUFACTURER | |
| P.O.NO. | |
| QAP NO. | |
| REF. DOC. | |
| REV. NO.- | 0 |
| RATING AND QUANTITY | |
| DATE:- | |
| P.O DATE | |

| Sr.No. | Item/ Component | Characteristics | Type of Check | Extent of Work | Reference Document | Acceptance Norms | Format of Record | Agency | | | REMARKS | |
|-------------------|---|--|------------------------------|----------------|--|--------------------|--------------------|--------|------|------|---------|--|
| | | | | | | | | M | TPIA | GAIL | | |
| FINAL TEST | | | | | | | | | | | | |
| | | 6. Continuity (ON-OFF) | Electrical | 100% | | | | P | R | R | | |
| 2 | Functional Test of Unit | 1. Visual Inspection 2. Insulation Test 3. Operation in Manual Mode 4. Operation in AVCC & Voltage/current. 5. Regulation 6. Operation in Auto and PSP regulation 7. Ripple content in DC Output 8. Indication and alarm 9. Remote signal and Potential free contacts Converter and Timer(if any)10.HV 11. Annuciation | Inspection | 100% | 1.Approved Drawing. 2. Approved Specification. | Test Report | Test Report | P | W | W | | |
| 2.1 | Heat Run Test | 10.Efficiency/power factor Heat run at at rated Load for at least 8 Hrs with Temperature measurement on all power devices and Magnetics at the end of test | Electrical Test & Inspection | 40% | 1.Approved Drawing 2.Approved Specification | Test Report | Test Report | P | W/R | W/R | | |
| 5 | Inspection Release Note | | | | | GAIL Specification | GAIL Specification | H | P | R | | |
| 6 | Documents to be Submitted at time of Dispatch and Packing | 10.1 Warranty Certificate 10.2 Operation Manual | | | | | | P | R | R | | |

LEGEND: P-PERFORM, W-WITNESSE, S-SUBMITTED, R-REVIEW OF RECORDS, H-HOLD, M-MANUFACTURER, C-CONTRACTOR, TPIA-THIRD PARTY INSPECTION AGENCY



QUALITY ASSURANCE PLAN FOR PLAN SURGE
DIVERTER



| PROJECT | | | | | |
|---|-------------------------------|---------------|-------|------|---------|
| OWNER | GAIL INDIA LIMITED | | | | |
| PROJECT NO | | DATE:- | | | |
| TPIA | | | | | |
| CONSULTANT | | | | | |
| CONTRACTOR | | | | | |
| CP CONTRACTOR | | | | | |
| QAP NO. | GAIL-STD-CP-DOC-QAP-001 | REV. | 0 | | |
| REFERENCE SPECIFICATION | | | | | |
| REFERENCE DESIGN DOCUMENT | | | | | |
| REFERENCE DATA SHEET | | | | | |
| REFERENCE DRAWING | | | | | |
| VENDOR | | | | | |
| DESCRIPTION / TYPE OF INSPECTION | REFERENCE DOCUMENT | INSPECTION BY | | | Remarks |
| | | M | TPIA | GAIL | |
| Compliance with approved Drawing & Data sheet (Manufacturer, type & Model) | Approved Data Sheet & Drawing | P | W / R | W/R | |
| Manufacturer TEST Report | Approved Data Sheet & Drawing | P | R | R | |
| Inspection Release Note | IRN | H | P | R | |
| LEGEND: P-PERFORM, W-WITNESS ALL, S-SUBMITTED BY, R-REVIEWED BY, H-HOLD M-Manufacturer C-Contractor TPJA-Third Party Inspection Agency | | | | | |



QUALITY ASSURANCE PLAN FOR ER PROBE & ER PROBE READER



QUALITY ASSURANCE PLAN FOR PERMANENT REFERENCE CELL (Cu/CuSo4)

| | | | |
|---|-------------------------------|-------------------------|----------------------|
| PROJECT | | | |
| OWNER | GAIL INDIA LIMITED | | |
| PROJECT NO | | DATE:- | |
| TPIA | | | |
| CONSULTANT | | | |
| CONTRACTOR | | | |
| CP CONTRACTOR | | | |
| QAP NO. | GAIL-STD-CP-DOC-QAP-001 | REV. | 0 |
| REFERENCE SPECIFICATION | | | |
| REFERENCE DESIGN DOCUMENT | | | |
| REFERENCE DATA SHEET | | | |
| REFERENCE DRAWING | | | |
| VENDOR | | | |
| DESCRIPTION / TYPE OF INSPECTION | REFERENCE DOCUMENT | FORMAT OF RECORD | INSPECTION BY |
| Compliance with approved Drawing & Data sheet (Manufacturer, type & Model) | Approved Data Sheet & Drawing | Inspection Report | M C TPIA |
| Manufacturer Certificates | Approved Data Sheet & Drawing | Test Certificate | Submission R R |
| Inspection Release Notee | | IRN | H H P |
| LEGEND: P-PERFORM, W-WITNESS ALL, S-SUBMITTED BY, R-REVIEWED BY, H-HOLD M-Manufacturer C-Contractor TPIA-Third Party Inspection Agency | | | |



| QUALITY ASSURANCE PLAN FOR SACRIFICIAL ZINC ANODE | | GAIL INDIA LIMITED | | |
|--|-------------------------------|--------------------|---------------|---------|
| PROJECT | | | | |
| OWNER | GAIL INDIA LIMITED | | | |
| PROJECT NO | | DATE:- | | |
| TPIA | | | | |
| CONSULTANT | | | | |
| CONTRACTOR | | | | |
| CP CONTRACTOR | | | | |
| QAP NO. | GAIL-STD-CP-DOC-QAP-001 | REV. | 0 | |
| REFERENCE SPECIFICATION | | | | |
| REFERENCE DESIGN DOCUMENT | | | | |
| REFERENCE DATA SHEET | | | | |
| REFERENCE DRAWING | | | | |
| VENDOR | | | | |
| DESCRIPTION / TYPE OF INSPECTION | REFERENCE DOCUMENT | FORMAT OF RECORD | INSPECTION BY | Remarks |
| Compliance with approved Drawing & Data sheet (Manufacturer, type & Model) | Approved Drawing & Data Sheet | Inspection Report | M TPIA GAIL | |
| Inspection | | | | |
| a. Surface 100 %, Length \pm 2.5 %, Width/ Thickness \pm 5% | | | P W/R | |
| b. Visual : Longitudinal cracks of more than 40 mm long and 3 mm deep not acceptable | | | | |
| c. Weight tolerance: + %5 (Total weight of all anodes shall not have negative tolerance) | | | P W/R | |
| Radiographic Test | | | | |
| One anode per heat shall be subjected to radiography to evaluate cracks, voids, slack inclusion etc. | Approved Drawing & Data Sheet | Test Report | P W/R | |
| Destructive Testing | | | | |
| One anode per heat shall be subjected to destructive testing for slag inclusions, bond between anode and insert. | Approved Drawing & Data Sheet | Test Report | P R W | |



| PROJECT | | QUALITY ASSURANCE PLAN FOR SACRIFICIAL ZINC ANODE | | | |
|--|-------------------------------|---|------|------|---------|
| OWNER | | GAIL INDIA LIMITED | | | |
| PROJECT NO | | DATE:- | | | |
| TPIA | | | | | |
| CONSULTANT | | | | | |
| CONTRACTOR | | | | | |
| CP CONTRACTOR | | | | | |
| QAP NO. | | REV. 0 | | | |
| REFERENCE SPECIFICATION | | | | | |
| REFERENCE DESIGN DOCUMENT | | | | | |
| REFERENCE DATA SHEET | | | | | |
| REFERENCE DRAWING | | | | | |
| VENDOR | | | | | |
| DESCRIPTION / TYPE OF INSPECTION | REFERENCE DOCUMENT | INSPECTION BY | | | Remarks |
| | | M | TPIA | GAIL | |
| be subjected to destructive testing for slag inclusions, bond between anode and insert. | Approved Drawing & Data Sheet | P | R | R | |
| Chemical Analysis: One anode sample per heat by Spectrography Sample in the beginning for first heat, end of second heat, at the beginning of third heat and so on. | Approved Drawing & Data Sheet | P | R | R | |
| Mass per liner meter ALL | Approved Drawing & Data Sheet | P | R | W | |
| Anode to core resistance Randomly | Approved Drawing & Data Sheet | P | R | W | |
| Electrochemical Test | | | | | |
| a.)Open circuit potential shall lie within (+) 10 mV and (-) 50 mV of the guaranteed value. | Approved Drawing & Data Sheet | R | R | W | |
| b.)Consumption rate by weight loss method (consumption rate shall not be more than the specified value). | Approved Drawing & Data Sheet | Submission | R | W | |
| All the above Manufacturer Test Reports | Approved Drawing & Data Sheet | IRN | P | R | |
| Document / Marking | Approved Drawing & Data Sheet | | | | |
| LEGEND: P-PERFORM, W-WITNESS ALL, S-SUBMITTED BY, H-HOLD M-Manufacturer C-Contractor TPIA-Third Party Inspection Agency | | | | | |



**QUALITY ASSURANCE PLAN FOR CATHODE
JUNCTION BOX**





| QUALITY ASSURANCE PLAN FOR ANODE JUNCTION BOX | | | | | | |
|--|--------------------------------|-------------------|---------------|------|------|---------|
| PROJECT | | | | | | |
| OWNER | GAIL INDIA LIMITED | | | | | |
| PROJECT NO | DATE:- | | | | | |
| TPIA | | | | | | |
| CONSULTANT | | | | | | |
| CONTRACTOR | | | | | | |
| CP CONTRACTOR | | | | | | |
| QAP NO. | GAIL-STD-CP-DOC-QAP-001 REV. 0 | | | | | |
| REFERENCE SPECIFICATION | | | | | | |
| REFERENCE DESIGN DOCUMENT | | | | | | |
| REFERENCE DATA SHEET | | | | | | |
| REFERENCE DRAWING | | | | | | |
| VENDOR | | | | | | |
| DESCRIPTION / TYPE OF INSPECTION | REFERENCE DOCUMENT | FORMAT OF RECORD | INSPECTION BY | | | Remarks |
| Compliance with approved Drawing & Data sheet (Manufacturer, type &Model) | Approved Drawing & Data Sheet | Inspection Report | M | TPIA | GAIL | |
| Visual Inspection | Approved Drawing & Data Sheet | Inspection Report | P | W | W | |
| Dimensional Check, Physical verification, locking , painting | Approved Drawing & Data Sheet | Inspection Report | P | W | W | |
| Fitness Test | Approved Drawing & Data Sheet | Inspection Report | P | W | W | |
| Thickness check, Terminal to body check | Approved Drawing & Data Sheet | Inspection Report | P | W | W | |
| Manufacturer Test Certificate (IP 55) | Approved Drawing & Data Sheet | Test Certificate | P | R | R | |
| Document / Marking | Approved Drawing & Data Sheet | IRN | H | P | R | |
| LEGEND: P-PERFORM, W-WITNESS ALL, S-SUBMITTED BY, H-HOLD M-Manufacturer C-Contractor TPJA-Third Party Inspection Agency | | | | | | |



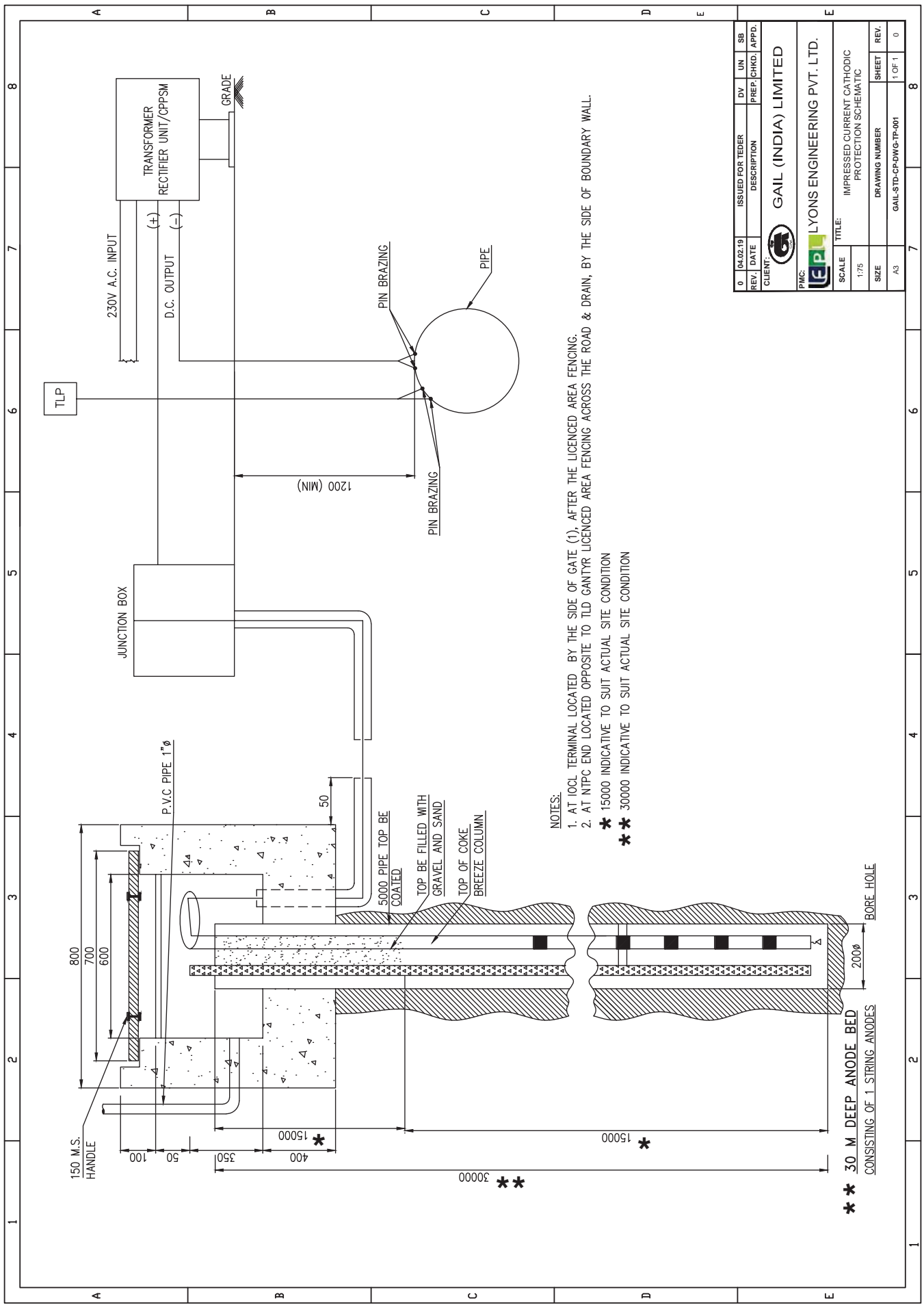
| PROJECT | | QUALITY ASSURANCE PLAN FOR SACRIFICIAL MAGNESIUM ANODE | | | | |
|--|-------------------------------|--|------|---------------|-----|---------|
| OWNER | GAIL INDIA LIMITED | | | | | |
| PROJECT NO | DATE:- | | | | | |
| TPIA | | | | | | |
| CONSULTANT | | | | | | |
| CONTRACTOR | | | | | | |
| CP CONTRACTOR | | | | | | |
| QAP NO. | GAIL-STD-CP-DOC-QAP-001 | REV. | 0 | | | |
| REFERENCE SPECIFICATION | | | | | | |
| REFERENCE DESIGN DOCUMENT | | | | | | |
| REFERENCE DATA SHEET | | | | | | |
| REFERENCE DRAWING | | | | | | |
| VENDOR | | | | | | |
| DESCRIPTION / TYPE OF INSPECTION | REFERENCE DOCUMENT | FORMAT OF RECORD | | INSPECTION BY | | Remarks |
| | | M | TPIA | GAIL | | |
| Compliance with approved Drawing & Data sheet (Manufacturer, type & Model) | Approved Drawing & Data Sheet | Inspection Report | P | W | R | |
| Inspection a. Surface 100 %, Length \pm 2.5 %, Width/ Thickness \pm 5% b. Visual : Longitudinal cracks of more than 40 mm long and 3 mm deep not acceptable c. Weight tolerance: + %5 (Total weight of all anodes shall not have negative tolerance) | Approved Drawing & Data Sheet | Inspection Report | P | W | W/R | |
| Radiographic Test One anode per heat shall be subjected to radiography to evaluate cracks, voids, slack inclusion etc. | Approved Drawing & Data Sheet | Test Report | P | W | W | |
| Destructive Testing One anode per heat shall be subjected to destructive testing for slag inclusions, bond between anode and insert. | Approved Drawing & Data Sheet | Test Report | P | R | R | |



| QUALITY ASSURANCE PLAN FOR SACRIFICIAL MAGNESIUM ANODE | | GAIL INDIA LIMITED | | DATE:- | |
|--|-------------------------------|---------------------------|-------------------------|----------------------|---------|
| PROJECT | | OWNER | GAIL INDIA LIMITED | PROJECT NO | |
| TPIA | | CONSULTANT | | CONTRACTOR | |
| CP CONTRACTOR | | QAP NO. | GAIL-STD-CP-DOC-QAP-001 | REV. | 0 |
| REFERENCE SPECIFICATION | | REFERENCE DESIGN DOCUMENT | | REFERENCE DATA SHEET | |
| REFERENCE DRAWING | | VENDOR | | FORMAT OF RECORD | |
| DESCRIPTION / TYPE OF INSPECTION | REFERENCE DOCUMENT | INSPECTION BY | | | Remarks |
| | | M | TPIA | GAIL | |
| Chemical Analysis; One anode sample per heat by Spectrography Sample in the beginning for first heat, end of second heat, at the beginning of third heat and so on. | Approved Drawing & Data Sheet | P | R | R | |
| Mass per liner meter | Approved Drawing & Data Sheet | P | R | W | |
| Anode to core resistance | Approved Drawing & Data Sheet | P | R | W | |
| Electrochemical Test One anode per heat shall be tested for a.) Open circuit potential shall lie within (+) 10 mV and (-) 50 mV of the | Approved Drawing & Data Sheet | P | R | R | |
| | Approved Drawing & Data Sheet | R | R | R | |



| QUALITY ASSURANCE PLAN FOR SACRIFICIAL MAGNESIUM ANODE | | | | | |
|---|-------------------------------|------------------|---------------|------|---------|
| PROJECT | | | | | |
| OWNER | GAIL INDIA LIMITED | | | | |
| PROJECT NO | DATE:- | | | | |
| TPIA | | | | | |
| CONSULTANT | | | | | |
| CONTRACTOR | | | | | |
| CP CONTRACTOR | | | | | |
| QAP NO. | GAIL-STD-CP-DOC-QAP-001 | | | | |
| REFERENCE SPECIFICATION | REV. 0 | | | | |
| REFERENCE DESIGN DOCUMENT | | | | | |
| REFERENCE DATA SHEET | | | | | |
| REFERENCE DRAWING | | | | | |
| VENDOR | | | | | |
| DESCRIPTION / TYPE OF INSPECTION | REFERENCE DOCUMENT | FORMAT OF RECORD | INSPECTION BY | | Remarks |
| b.)Consumption rate by weight loss method (consumption rate shall not be more than the specified value). | | | M | TPIA | GAIL |
| All the above Manufacturer Test Reports | Approved Drawing & Data Sheet | Test Report | | R | R |
| Document / Marking | Approved Drawing & Data Sheet | IRN | H | P | R |
| LEGEND: P-PERFORM, W-WITNESS ALL, S-SUBMITTED BY, R-REVIEWED BY, H-HOLD M-Manufacturer C-Contractor TPIA-Third Party Inspection Agency | | | | | |



NOTES:

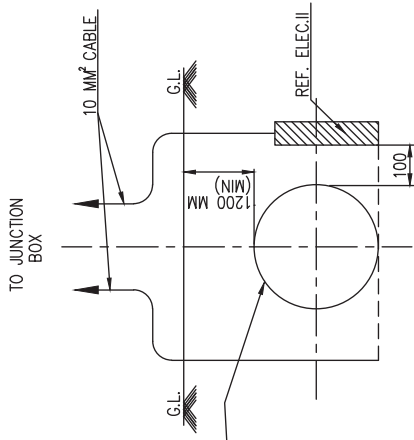
1. AT IOCL TERMINAL LOCATED BY THE SIDE OF GATE (1), AFTER THE LICENCED AREA FENCING.
 2. AT NTPC END LOCATED OPPOSITE TO TLD GANTYR LICENCED AREA FENCING ACROSS THE ROAD & DRAIN, BY THE SIDE OF BOUNDARY WALL.
- ** 15000 INDICATIVE TO SUIT ACTUAL SITE CONDITION
 ** 30000 INDICATIVE TO SUIT ACTUAL SITE CONDITION

**** 30 M DEEP ANODE BED**
 CONSISTING OF 1 STRING ANODES

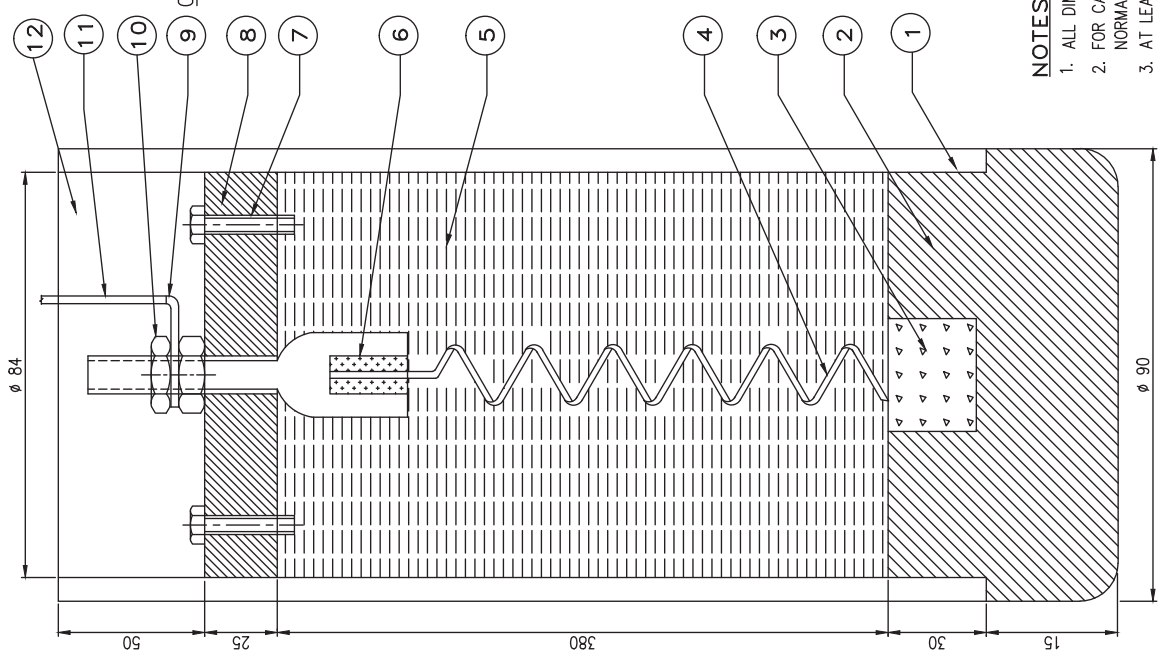
| | | | | | | |
|-------------|--|----------|-------------------|------|------|-------|
| REV. | 0 | 04.02.19 | ISSUED FOR TENDER | DV | UN | SB |
| DESCRIPTION | | | | PREP | CHKD | APPD. |
| CLIENT | GAIL (INDIA) LIMITED | | | | | |
| PINC | LYONS ENGINEERING PVT. L.TD. | | | | | |
| SCALE | TITLE: IMPRESSED CURRENT CATHODIC PROTECTION SCHEMATIC | | | | | |
| SIZE | DRAWING NUMBER | | | | | |
| A3 | GAIL-STD-CP-DWG-TP-001 | | | | | |
| SHEET | 1 OF 1 | | | | | |
| REV. | 0 | | | | | |

BILL OF MATERIAL

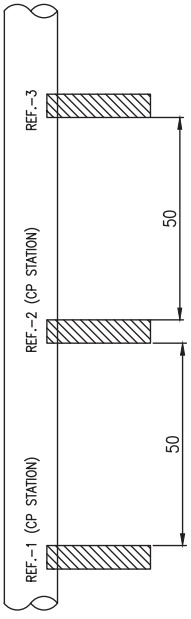
| SL. NO. | DESCRIPTION | QTY. |
|---------|--|----------|
| 1. | P.V.C PIPE 3 MM THICK | 1 NO. |
| 2. | SAG WOOD PLUG | 1 NO. |
| 3. | CUSO4 CRYSTALS | AS REQD. |
| 4. | ELECTROLYTIC COPPER SPIRAL 8 MM ϕ | 1 NO. |
| 5. | CUSO4 SATURATED SOLUTION | AS REQD. |
| 6. | BRAZED COPPER JOINT | 1 NO. |
| 7. | WATER FILLING BOLTED HOLES ϕ 8 MM | 2 NOS. |
| 8. | HYLAM BUSH | 1 NO. |
| 9. | COPPER LUG | 1 NO. |
| 10. | BOLTED CABLE CONNECTION | 1 NO. |
| 11. | CONNECTION CABLE 10 MM ² | AS REQD. |
| 12. | EPOXY FOR SEALING | AS REQD. |



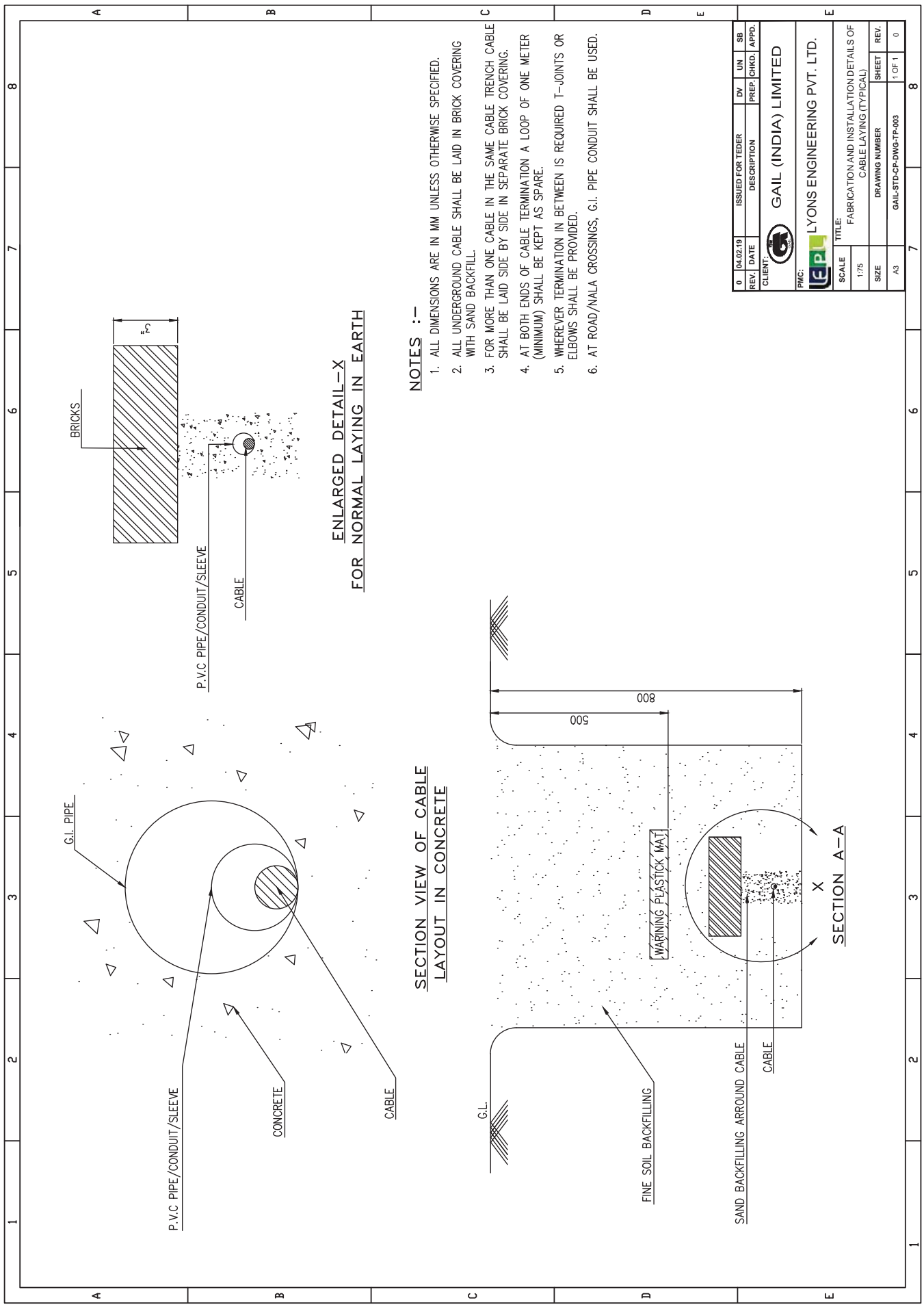
ARRANGEMENT OF TWO REFERENCE ELECTRODES ON PIPE LINE TYPICAL INSTALLATION DETAILS



- NOTES :-**
1. ALL DIMENSIONS ARE IN MM UNLESS OTHERWISE SPECIFIED.
 2. FOR CABLE TO REFERENCE CELL CONNECTION FOLLOW THE NORMAL CABLE CONNECTION PROCEDURE.
 3. AT LEAST 2 NOS REF. ELECTRODE SHOULD BE INSIDE THE C.P. STATION.



| | | | | | |
|---|----------|------------------------|-------|--------|-------|
| 0 | 04.02.19 | ISSUED FOR TENDER | DV | UN | SB |
| REV. | DATE | DESCRIPTION | PREP. | CHKD. | APPD. |
| CLIENT: GAIL (INDIA) LIMITED | | | | | |
| PMC: LYONS ENGINEERING PVT. LTD. | | | | | |
| TITLE: FABRICATION AND INSTALLATION DETAILS OF ELECTRODES PIPELINE | | | | | |
| SCALE | 1:75 | DRAWING NUMBER | | SHEET | REV. |
| SIZE | A3 | GAIL-STD-CP-DWG-TP-002 | | 1 OF 1 | 0 |



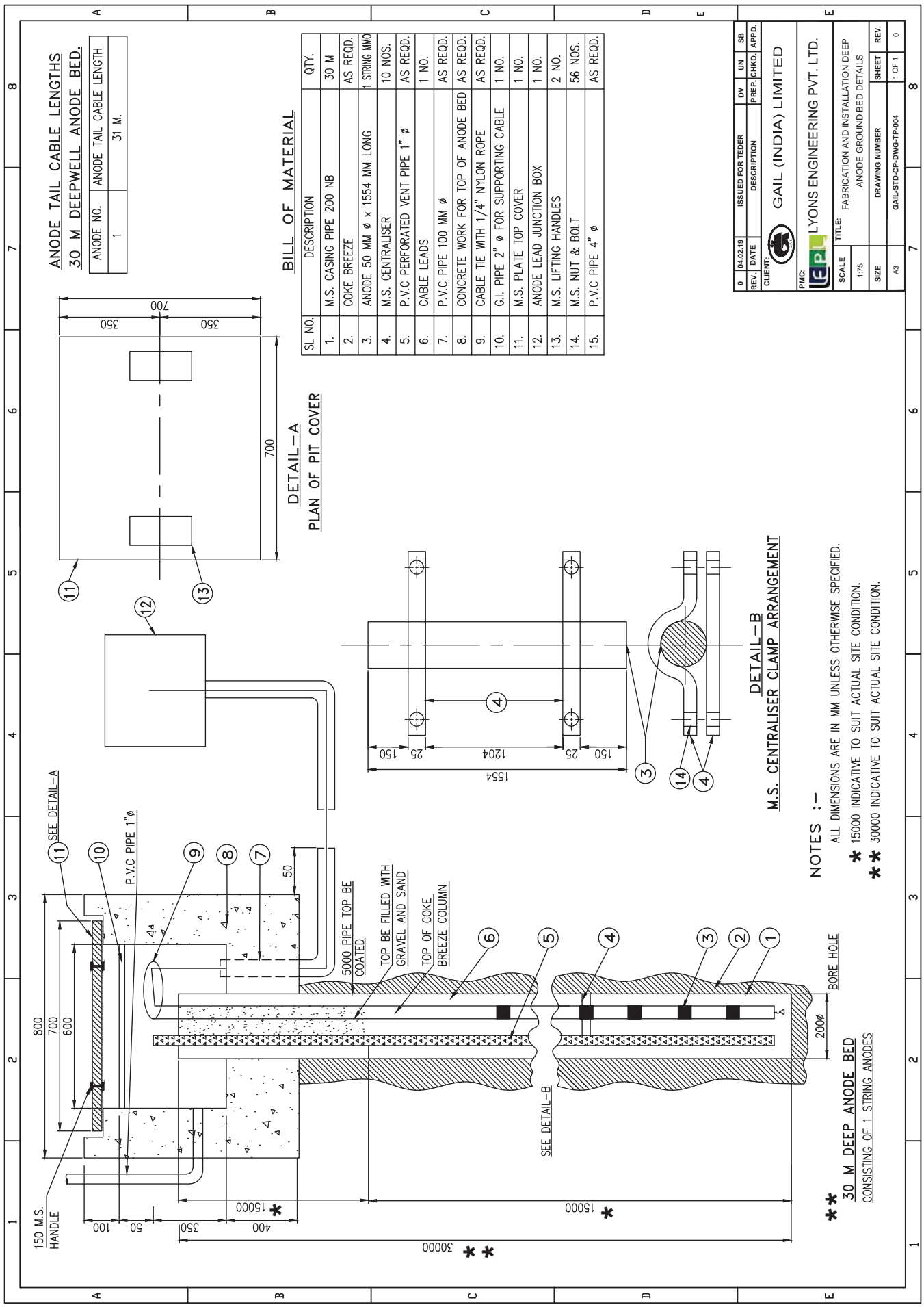
**ENLARGED DETAIL-X
FOR NORMAL LAYING IN EARTH**

**SECTION VIEW OF CABLE
LAYOUT IN CONCRETE**

NOTES :-

1. ALL DIMENSIONS ARE IN MM UNLESS OTHERWISE SPECIFIED.
2. ALL UNDERGROUND CABLE SHALL BE LAID IN BRICK COVERING WITH SAND BACKFILL.
3. FOR MORE THAN ONE CABLE IN THE SAME CABLE TRENCH CABLE SHALL BE LAID SIDE BY SIDE IN SEPARATE BRICK COVERING.
4. AT BOTH ENDS OF CABLE TERMINATION A LOOP OF ONE METER (MINIMUM) SHALL BE KEPT AS SPARE.
5. WHEREVER TERMINATION IN BETWEEN IS REQUIRED T-JOINTS OR ELBOWS SHALL BE PROVIDED.
6. AT ROAD/NALA CROSSINGS, G.I. PIPE CONDUIT SHALL BE USED.

| | | | | | |
|--|------------------------|-------------------|--------|------|-------|
| REV. 0 | DATE 04-02-19 | ISSUED FOR TENDER | DV | UN | SB |
| | | DESCRIPTION | PREP | CHKD | APPD. |
| CLIENT: GAIL (INDIA) LIMITED | | | | | |
| PMC: LYONS ENGINEERING PVT. LTD. | | | | | |
| TITLE: FABRICATION AND INSTALLATION DETAILS OF CABLE LAYING (TYPICAL) | | | | | |
| SCALE 1:75 | DRAWING NUMBER | | SHEET | | REV. |
| SIZE A3 | GAIL-STD-CP-DWG-TP-003 | | 1 OF 1 | | 0 |



ANODE TAIL CABLE LENGTHS
30 M DEEPWELL ANODE BED.

| ANODE NO. | ANODE TAIL CABLE LENGTH |
|-----------|-------------------------|
| 1 | 31 M. |

BILL OF MATERIAL

| SL NO. | DESCRIPTION | QTY. |
|--------|--|--------------|
| 1. | M.S. CASING PIPE 200 NB | 30 M |
| 2. | COKE BREEZE | AS REQD. |
| 3. | ANODE 50 MM ϕ x 1554 MM LONG | 1 STRING MMO |
| 4. | M.S. CENTRALISER | 10 NOS. |
| 5. | P.V.C PERFORATED VENT PIPE 1" ϕ | AS REQD. |
| 6. | CABLE LEADS | 1 NO. |
| 7. | P.V.C PIPE 100 MM ϕ | AS REQD. |
| 8. | CONCRETE WORK FOR TOP OF ANODE BED | AS REQD. |
| 9. | CABLE TIE WITH 1/4" NYLON ROPE | AS REQD. |
| 10. | G.I. PIPE 2" ϕ FOR SUPPORTING CABLE | 1 NO. |
| 11. | M.S. PLATE TOP COVER | 1 NO. |
| 12. | ANODE LEAD JUNCTION BOX | 1 NO. |
| 13. | M.S. LIFTING HANDLES | 2 NO. |
| 14. | M.S. NUT & BOLT | 56 NOS. |
| 15. | P.V.C PIPE 4" ϕ | AS REQD. |

| REV. | DATE | ISSUED FOR | TENDER | DV | UN | SB |
|------|----------|-------------|--------|------|------|-------|
| | | DESCRIPTION | | PREP | CHKD | APPD. |
| 0 | 04.02.19 | | | | | |

CLIENT: **GAIL (INDIA) LIMITED**

PINC: **LYONS ENGINEERING PVT. L.TD.**

| SCALE | TITLE |
|-------|--|
| 1/75 | FABRICATION AND INSTALLATION DEEP ANODE GROUND BED DETAILS |

| SIZE | DRAWING NUMBER | SHEET | REV. |
|------|------------------------|--------|------|
| A3 | GAIL-STD-CP-DWG-TP-004 | 1 OF 1 | 0 |

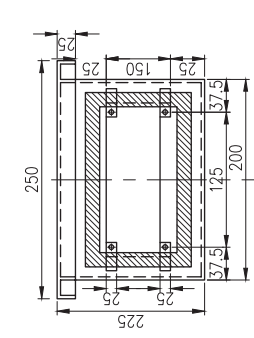
DETAIL-B
M.S. CENTRALISER CLAMP ARRANGEMENT

NOTES :-
 ALL DIMENSIONS ARE IN MM UNLESS OTHERWISE SPECIFIED.
 * 15000 INDICATIVE TO SUIT ACTUAL SITE CONDITION.
 ** 30000 INDICATIVE TO SUIT ACTUAL SITE CONDITION.

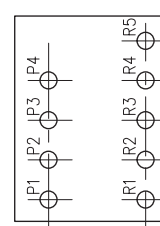
****** 30 M DEEP ANODE BED
 CONSISTING OF 1 STRING ANODES

BILL OF MATERIAL

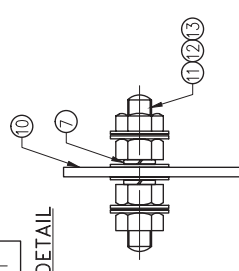
| SL. NO. | DESCRIPTION | QTY. |
|---------|---|---------|
| 1. | BOTTOM PLATE, 5TKx194 MS PLATE | 001 |
| 2. | REAR & SIDE, 2.67x217x704 MS | 001 |
| 3. | TOP, 2.67x250x300 MS | 001 |
| 4. | FRONT TOP 2.67 x190x81 MS | 001 |
| 5. | FRONT BOTTOM, 2.67x190x81 MS | 001 |
| 6. | SHUTTER 2.67x234x234 MS | 001 |
| 7. | SPRING WASHER SC. B.6 | 066 |
| 8. | CASTLE LOCK WITH MASTER KEY (3NOS. KEY) | 001 |
| 9. | HINGE FOR SHUTTER | 002 |
| 10. | TERMINAL PLATE, 8x150x150 PHENOLIGE LAM SHT. | 001 |
| 11. | BASS STUD M6x50LG (FOR TERMINALS) | 001 |
| 12. | BASS NUT M6 | 044 |
| 13. | BASS WASHER | 044 |
| 14. | MS. ANGLE 5TKx50x50x30 | 004 |
| 15. | STEEL SCREW, M6x16 | 004 |
| 16. | LATCH FOR SHUTTER | 001 |
| 17. | MS COUPLING PLATE, 5TKx130x130 MS PLATE | 001 |
| 18. | MS PIPE, 100 NB x 5.4 TKx 1275MM | 001 |
| 19. | NEOPRENE RUBBER GASKET 6 TK. | 001 SET |
| 20. | FOUNDATION PLATE 6TKx400x400 AA 10108 | 002 |
| 21. | RUBBER BUSH | 001 |
| 22. | FOUNDATION BOLT M14x125 LG WITH SPRING WASHER AND NUT | 001 |
| 23. | STIFFENER PLATE 6TKx100x100 | 001 |
| 24. | NAME PLATE ANNOUIDISED AL 0.9x120x160 | 001 |



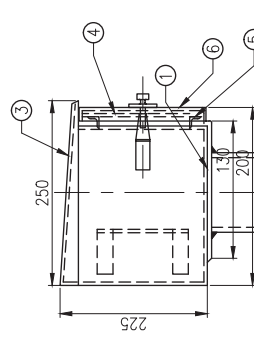
FRONT VIEW DOOR REMOVED



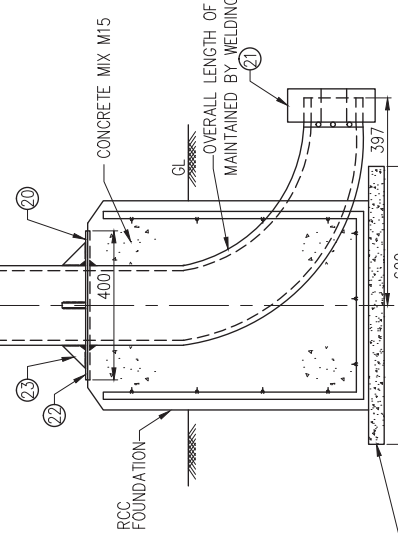
TERMINAL PLATE DETAIL



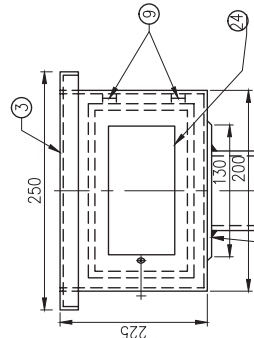
SIDE ELEVATION



FRONT ELEVATION



SIDE ELEVATION



FRONT ELEVATION

| REV. | DATE | ISSUED FOR | DESCRIPTION | DV | UN | SB |
|------|----------|------------|-------------|----|----|----|
| PREP | CHKD | APPD | | | | |
| 0 | 04.02.19 | | | | | |

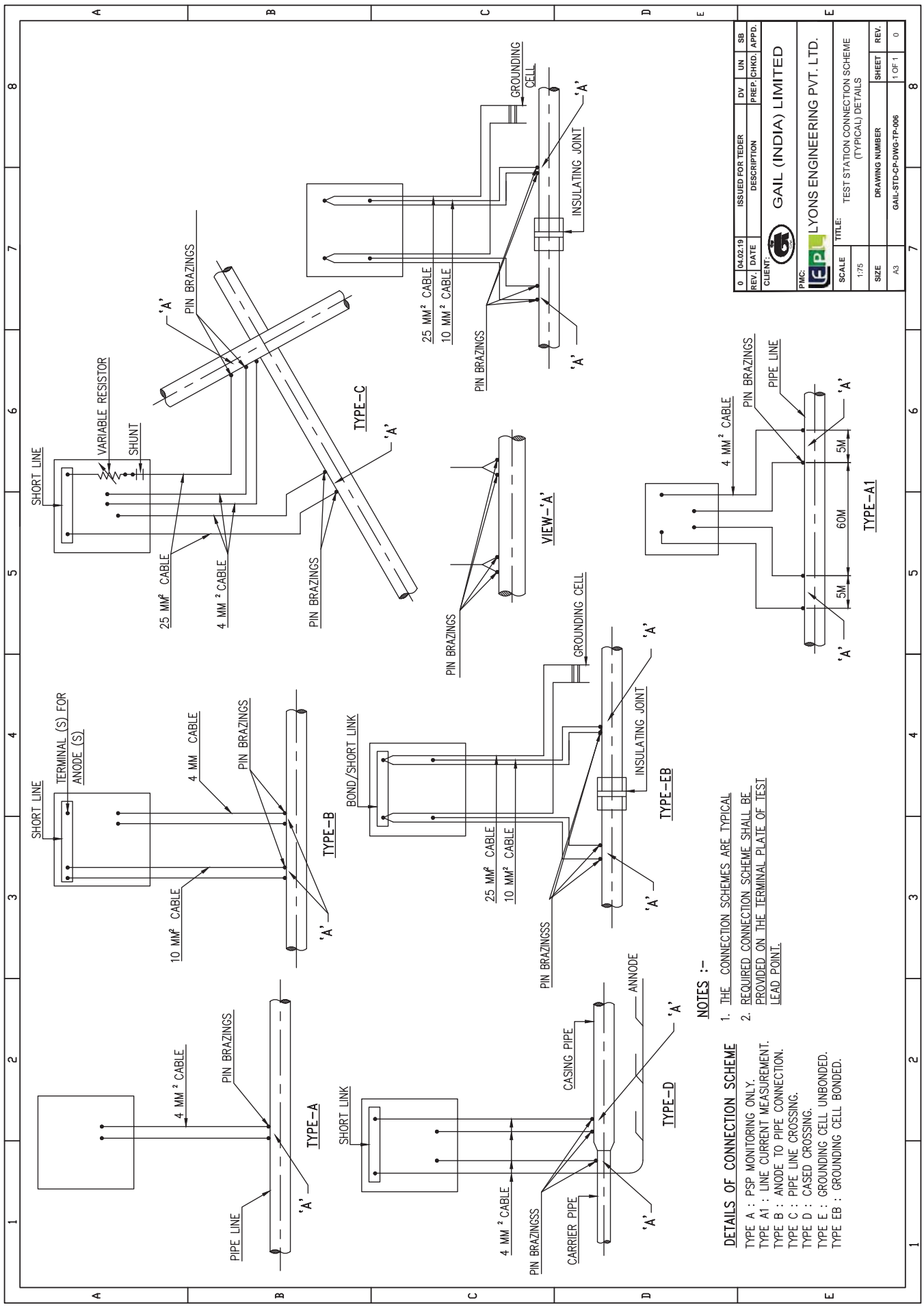
CLIENT: **GAIL (INDIA) LIMITED**

PMC: **LYONS ENGINEERING PVT. LTD.**

SCALE: 1/75

TITLE: TEST LEAD POINTS & JUNCTION BOX WITH FOUNDATION DETAILS

| SIZE | DRAWING NUMBER | SHEET | REV. |
|------|------------------------|--------|------|
| A3 | GAIL-STD-CP-DWG-TP-005 | 1 OF 1 | 0 |



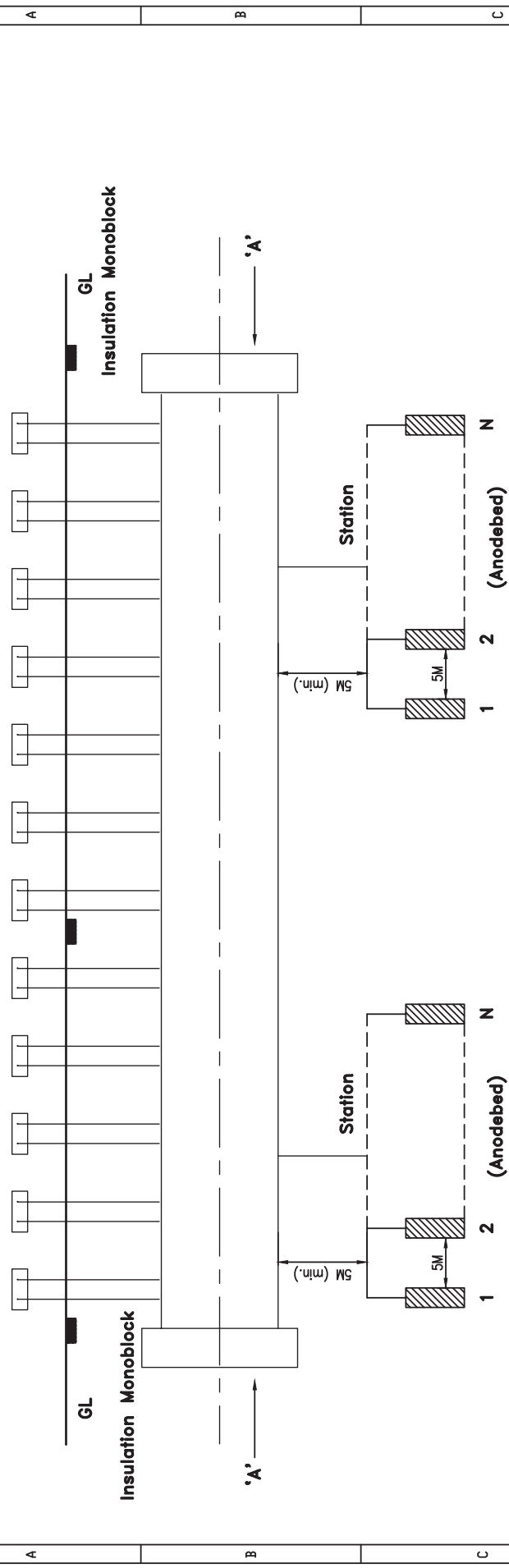
DETAILS OF CONNECTION SCHEME
 TYPE A : PSP MONITORING ONLY.
 TYPE A1 : LINE CURRENT MEASUREMENT.
 TYPE B : ANODE TO PIPE CONNECTION.
 TYPE C : PIPE LINE CROSSING.
 TYPE D : CASED CROSSING.
 TYPE E : GROUNDING CELL UNBONDED.
 TYPE EB : GROUNDING CELL BONDED.

NOTES :-

1. THE CONNECTION SCHEMES ARE TYPICAL.
2. REQUIRED CONNECTION SCHEME SHALL BE PROVIDED ON THE TERMINAL PLATE OF TEST LEAD POINT.

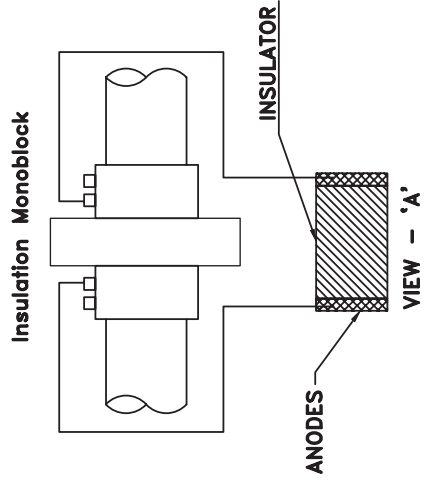
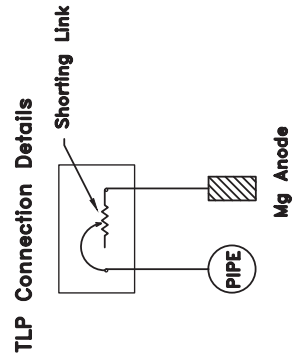
| | | | | |
|---|-------------------|----------------|------------------------|------------|
| REV. DATE | ISSUED FOR TENDER | DV | UN | SB |
| 0 | 04.02.19 | PREP | CHKD | APPD. |
| CLIENT: GAIL (INDIA) LIMITED | | | | |
| PMC: LYONS ENGINEERING PVT. L.TD. | | | | |
| TITLE: TEST STATION CONNECTION SCHEME (TYPICAL) DETAILS | | | | |
| SCALE | 1:75 | | | |
| SIZE | A3 | DRAWING NUMBER | GAIL-STD-CP-DWG-TP-008 | SHEET REV. |
| | | | | 1 OF 1 0 |

Test Lead Points (TLP) at every 1.5 Km.

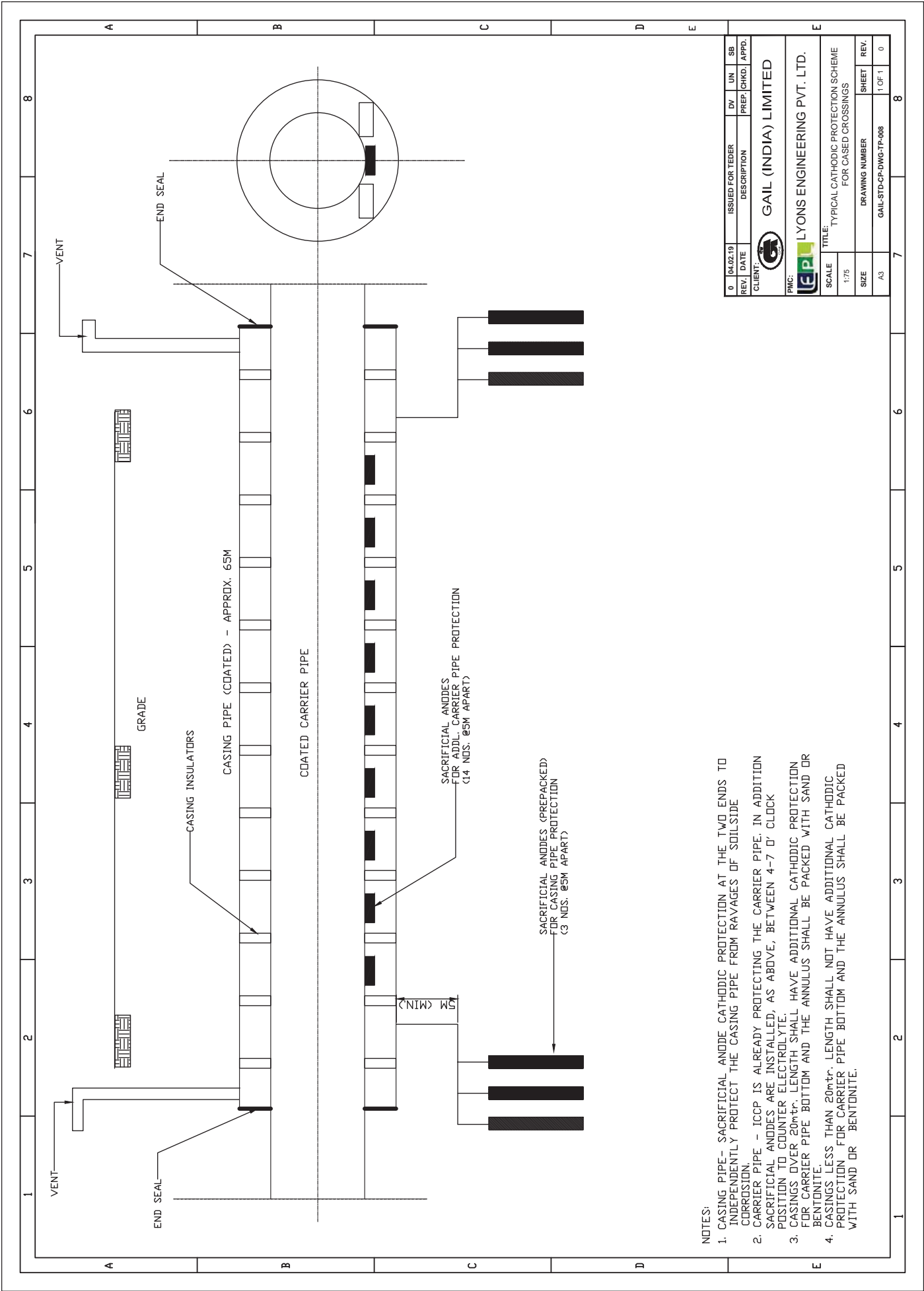


NOTE:
Mg ANODES TO BE BUNCHED TOGETHER IN ANODEBEDS AT
LOCATIONS MOST SUITED AS PER ATTENUATION CALCULATIONS.

Pre-packed Mg Anodes.



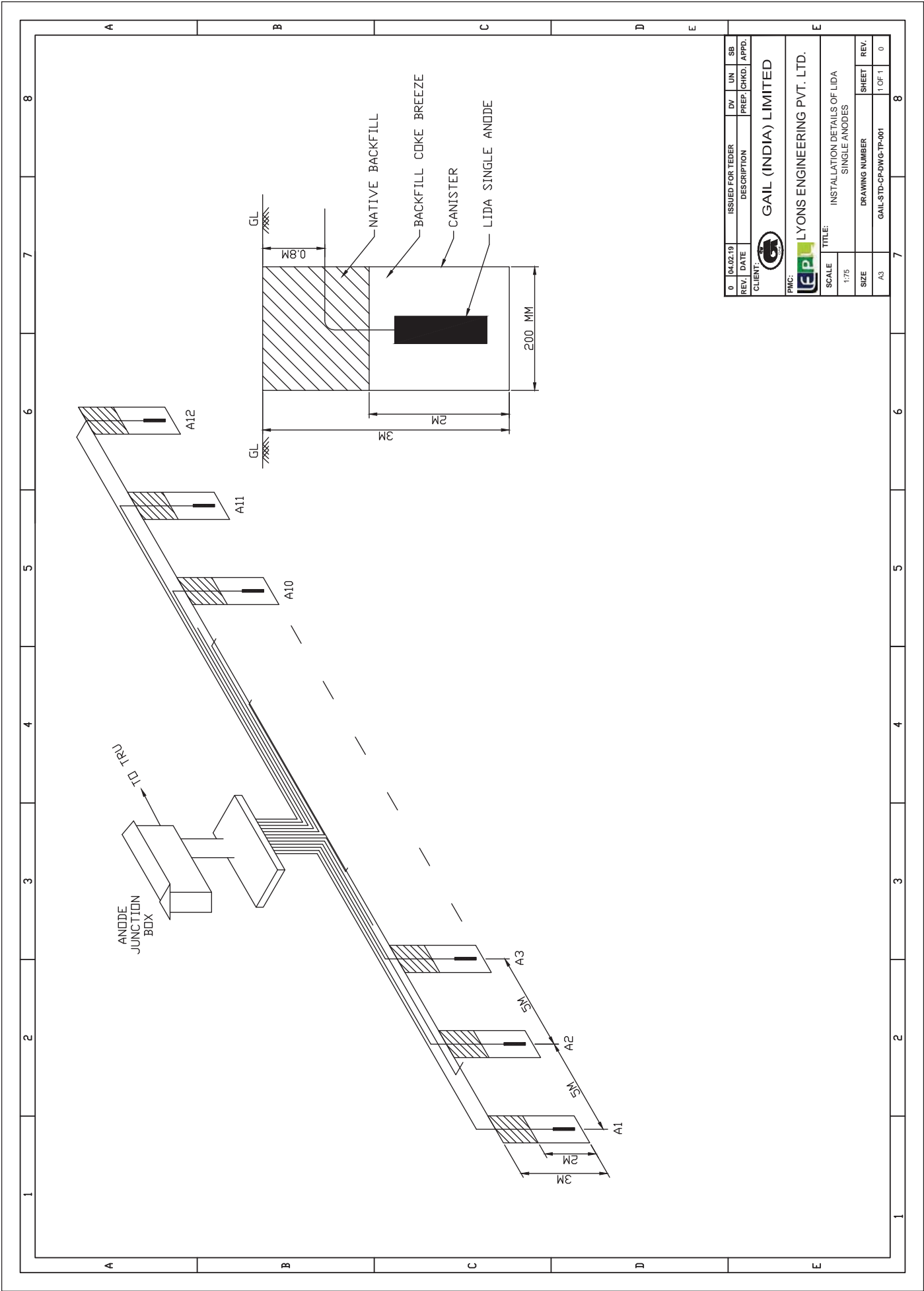
| | | | | | | |
|--|----------|----------------|------------------------|-------|-------|-------|
| REV. | DATE | ISSUED FOR | TDER | DV | UN | SB |
| 0 | 04.02.19 | DESCRIPTION | | PREP. | CHKD. | APPD. |
| CLIENT: GAIL (INDIA) LIMITED | | | | | | |
| PMO: LYONS ENGINEERING PVT. LTD. | | | | | | |
| TITLE: TEMPORARY CATHODIC PROTECTION SCHEMATIC | | | | | | |
| SCALE | 1:75 | | | | | |
| SIZE | A3 | DRAWING NUMBER | GAIL-STD-CP-DWG-TP-007 | | | |
| | | SHEET | 1 OF 1 | | | |
| | | REV. | 0 | | | |



NOTES:

1. CASING PIPE- SACRIFICIAL ANODE CATHODIC PROTECTION AT THE TWO ENDS TO INDEPENDENTLY PROTECT THE CASING PIPE FROM RAVAGES OF SOILSIDE CORROSION.
2. CARRIER PIPE - ICCP IS ALREADY PROTECTING THE CARRIER PIPE. IN ADDITION SACRIFICIAL ANODES ARE INSTALLED, AS ABOVE, BETWEEN 4-7 D' CLOCK POSITION TO COUNTER ELECTROLYTE.
3. CASINGS OVER 20mtr. LENGTH SHALL HAVE ADDITIONAL CATHODIC PROTECTION FOR CARRIER PIPE BOTTOM AND THE ANNULUS SHALL BE PACKED WITH SAND OR BENTONITE.
4. CASINGS LESS THAN 20mtr. LENGTH SHALL NOT HAVE ADDITIONAL CATHODIC PROTECTION FOR CARRIER PIPE BOTTOM AND THE ANNULUS SHALL BE PACKED WITH SAND OR BENTONITE.

| | | | | | | | | |
|---------|---|--|----------|------------------------|--------|--------|-------|-------|
| REV. | 0 | DATE | 04.02.19 | ISSUED FOR | TENDER | DV. | UN | SB |
| | | | | DESCRIPTION | | PREP. | CHKD. | APPD. |
| CLIENT: | | GAIL (INDIA) LIMITED | | | | | | |
| PMC: | | LYONS ENGINEERING PVT. LTD. | | | | | | |
| SCALE: | | TYPICAL CATHODIC PROTECTION SCHEME FOR CASED CROSSINGS | | | | | | |
| SIZE: | | A3 | | DRAWING NUMBER | | SHEET | | REV. |
| | | | | GAIL-STD-CP-DWG-TP-008 | | 1 OF 1 | | 0 |



| REV. | DATE | ISSUED FOR TENDER | DV | UN | SB |
|------|----------|-------------------|-------|-------|-------|
| 0 | 04.02.19 | | | | |
| | | DESCRIPTION | PREP. | CHKD. | APPD. |

CLIENT: **GAIL (INDIA) LIMITED**

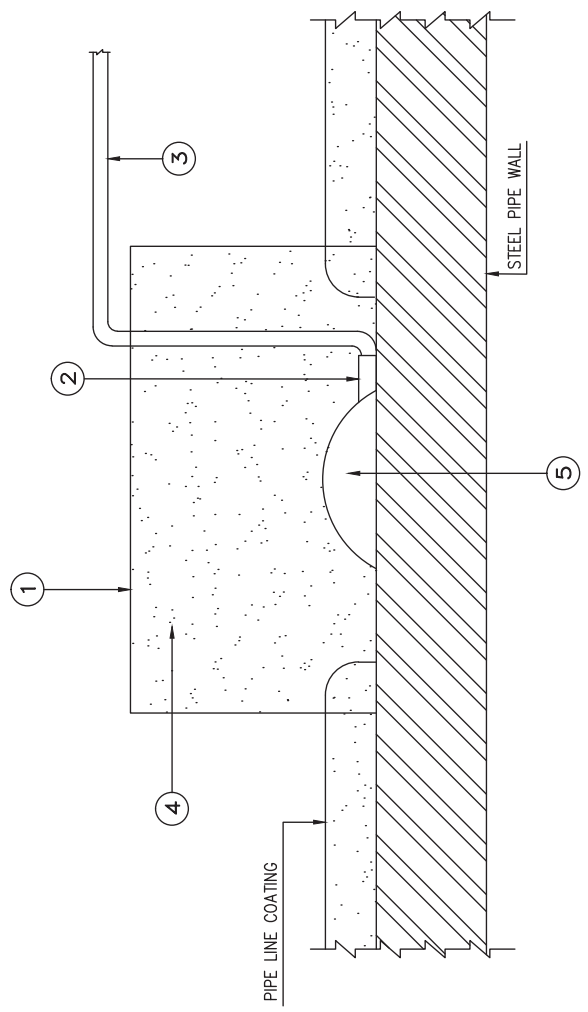
PMC: **LEPE LYONS ENGINEERING PVT. LTD.**

| TITLE: | SCALE: | DRAWING NUMBER: | SHEET: | REV.: |
|--|--------|------------------------|--------|-------|
| INSTALLATION DETAILS OF LIDA SINGLE ANODES | 1:75 | GAIL-STD-CP-DWG-TP-001 | 1 OF 1 | 0 |

BILL OF MATERIAL

| SL. NO. | DESCRIPTION | QTY. |
|---------|---------------|----------|
| 1. | P.V.C CAP | 1 NO. |
| 2. | COPPER SLEEVE | 1 NO. |
| 3. | CABLE | AS REQD. |
| 4. | EPOXY RESIN | AS REQD. |
| 5. | CAD WELD | 1 NO. |

- NOTES :-**
1. INSTRUCTION APPEARING WITH THIS DRG. ARE SUITABLE FOR Cu CABLE CONNECTIONS
 2. FOR DIFFERENT SIZES OF CABLES, MATCHING SIZES OF WELDING Moulds SHALL BE USED.
 3. FOR SEALING THE COMPLETED JOINT FILL WITH EPOXY RESIN FORMULATION ENSURING THAT EVERY METALIC PART OF THE JOINT IS COMPLETELY INSULATED.
 4. FOR EFFECTIVE SEALING, THE SIZE OF P.V.C CAP SHOULD BE SUCH THAT IT COVERS THE AREA FROM WHERE PIPE COATING HAS BEEN REMOVED AND IN ADDITION AT LEAST 15 MM OVERLAPPING THE EXISTING GOOD COATING OF THE PIPE LINE.



PROCEDURE FOR CARRYING OUT THERMIT WELDING CABLE TO PIPE JOINT

1. REMOVE PIPE COATING FROM A SPOT ON TOP OF PIPE APPROX. 15MM LARGER THAN Mould BASE.
2. CLEAN PIPE TO BRIGHT METAL FOR APPROX. 40MM PIPE SPOT.
3. REMOVE 5MM OF INSULATION FROM END OF CABLE, CRIMP 10MM LONG COPPER SLEEVE ON CABLE END.
4. POSITION COPPER SLEEVE ON CLEAN PIPE SPOT.
5. SECURE AND FASTEN CABLE ON PIPE WITH ADHESIVE TAPE AND STRAPPING BANDS.
6. PLACE Mould ON CABLE TO PIPE JOINT AND HOLD SECURELY.
7. PLACE METAL DISC IN Mould DEPOSIT WELD CHARGE ON DISC AND PLACE LID ON Mould.
8. IGNITE THE CHARGE WITH IGNITER FOR WELDING.
9. REMOVE Mould AFTER COMPLETE IGNITION OF THE CHARGE.
10. TEST THE CONNECTION BY STRIKING SEVERAL BLOWS ON THE CONNECTIONS USING A 1 Kg. HAMMER. TOP OF WELD MAY BE HAMMERED FLAT, IF DESIRED.
11. COVER THE CONNECTION WITH P.V.C CAP.
12. FILL THE P.V.C CAP WITH EPOXY MIXED HARDENER AND ALLOW TO DRY TO BECOME HARD.

| REV. | DATE | ISSUED FOR | TDER | DV | UN | SB |
|--|----------|------------|------|----|---------------------|----|
| PREP. | CHKD. | APPD. | | | | |
| 0 | 04.02.19 | | | | | |
| CLIENT: GAIL (INDIA) LIMITED | | | | | | |
| PMC: LYONS ENGINEERING PVT. LTD. | | | | | | |
| TITLE: FABRICATION AND INSTALLATION OF THERMIT WELDING CABLE TO PIPE JOINT | | | | | | |
| SCALE: 1:75 | | | | | | |
| SIZE: A3 | | | | | | |
| DRAWING NUMBER: GAIL-STD-CP-DWG-TP-010 | | | | | SHEET REV. 1 OF 1 0 | |



GAIL INDIA LIMITED

**CONSTRUCTION OF STEEL PIPELINE AND ASSOCIATED FACILITIES
FOR CGD CONNECTIVITIES**

VOLUME II OF II (TECHNICAL) – G

ELECTRICAL

E-TENDER REF : 8000017904

(BID DOCUMENT NO - 034/LEPL/GAIL/31-R0)



Lyons Engineering Pvt. Ltd.

| | | | |
|--|--|-------------------------------|---|
| PMC:  | DCI - MASTER DELIVERABLE CONTROL INDEX FOR CONSTRUCTION OF STEEL PIPELINE AND ASSOCIATED FACILITIES FOR CGD FOR M/S IOAGPL PALAKKAD, CGD TO M/S IOAGPL MALAPPURAM, CGD TO M/S IOAGPL KANNUR & CGD TO M/S GAIL GAS LIMITED DAKSHIN KANNADA | Doc No. | CLIENT:  |
| | | GAIL-ENG-GN-DOC-DL-001 | |
| | | Rev. 0 | |
| Sr. No. | Description | Document / Drawing No. | Rev. No. |
| TECHNICAL VOLUME - II OF II | | | |
| G | ELECTRICAL | | |
| 1 | Electrical Design Basis | GAIL-STD-EL-DOC-DB-001 | 0 |
| TECHNICAL SPECIFICATION FOR ELECTRICAL SYSTEM | | | |
| 2 | Technical Specification of Main Electrical Distribution board | GAIL-STD-EL-DOC-TS-002 | 0 |
| 3 | Technical Specification of Cables | GAIL-STD-EL-DOC-TS-003 | 0 |
| 4 | Technical Specification of Lighting System | GAIL-STD-EL-DOC-TS-004 | 0 |
| 5 | Technical Specification for Earthing & Lightning Protection system | GAIL-STD-EL-DOC-TS-005 | 0 |
| 6 | Technical Specification for Installation, Testing and Commissioning of Electrical Equipments. | GAIL-STD-EL-DOC-TS-006 | 0 |
| DATA SHEET FOR ELECTRICAL SYSTEM | | | |
| 7 | Data Sheet for MEDB | GAIL-STD-EL-DOC-DS-001 | 0 |
| 8 | Data Sheet for Cables | GAIL-STD-EL-DOC-DS-002 | 0 |
| QAP FOR ELECTRICAL SYSTEM | | | |
| 9 | QAP of Distribution Board | GAIL-STD-EL-DOC-QAP-001 | 0 |
| 10 | QAP of Power Cables | GAIL-STD-EL-DOC-QAP-002 | 0 |
| 11 | QAP of Lighting Panels | GAIL-STD-EL-DOC-QAP-003 | 0 |
| STANDARD / TYPICAL DRAWINGS FOR ELECTRICAL SYSTEM | | | |
| 12 | Standard Cu Plate Electrode in Test Pit | GAIL-STD-EL-DWG-TP-001 | 0 |
| 13 | Standard GI Pipe Electrode in Test Pit | GAIL-STD-EL-DWG-TP-002 | 0 |
| 14 | Typ. Installation of Power/Lighting Panel Flush mounted | GAIL-STD-EL-DWG-TP-006 | 0 |
| 15 | Typ. Installation of Directly Burried Cables | GAIL-STD-EL-DWG-TP-008 | 0 |
| 16 | Typ. Installation of Lighting Fixture at Ground Level | GAIL-STD-EL-DWG-TP-009 | 0 |
| 17 | Typ. Installation of Post Top Lantern on Gate | GAIL-STD-EL-DWG-TP-010 | 0 |
| 18 | Typ. Earthing Connection for Lighting Pole | GAIL-STD-EL-DWG-TP-011 | 0 |
| 19 | Typ. Earthing/Bonding of Pipes & Pipe Racks | GAIL-STD-EL-DWG-TP-012 | 0 |
| 20 | Typ. Earthing of Gate & Fence | GAIL-STD-EL-DWG-TP-013 | 0 |
| 21 | Typ. Earthing for Process Equipment | GAIL-STD-EL-DWG-TP-014 | 0 |
| 22 | Typ. Installation of Street Light Fixture/FLP/Div.2 Area Light Fixture | GAIL-STD-EL-DWG-TP-015 | 0 |
| 23 | Typ. Installation of Open Area Flood Light Fixture Mounted on Wall / Column | GAIL-STD-EL-DWG-TP-016 | 0 |
| 24 | Typ. Installation of Flood Light Fixtures Mounted on Pole | GAIL-STD-EL-DWG-TP-017 | 0 |



CONSTRUCTION OF STEEL PIPELINE AND
ASSOCIATED FACILITIES FOR CGD
CONNECTIVITIES



ELECTRICAL DESIGN BASIS

CLIENT JOB NO.

034

TOTAL SHEETS

17

DOCUMENT NO

GAIL

STD

EL

BD

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22.12.2020

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DESCRIPTION

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TABLE OF CONTENTS

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| 1.0 | INTRODUCTION | 3 |
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| 7.0 | EARTHING, BONDING & LIGHTNING PROTECTION SYSTEM | 10 |
| 8.0 | CABLES | 11 |
| 9.0 | UPS SYSTEM..... | 13 |



CONSTRUCTION OF STEEL PIPELINE AND ASSOCIATED FACILITIES FOR CGD CONNECTIVITIES

1.0 INTRODUCTION

The Electrical design basis broadly outlines the minimum requirements for the design, selection, sizing and installation of the electrical equipments and associated systems of the cross country gas pipeline & terminals.

The electrical system shall be designed to ensure:

- Main Power Distribution System
- Substation design philosophy i.e. trenches, clearances, thickness, RCC, materials and entries
- Safety to personnel and equipments.
- Reliability of service.
- Minimum fire risk.
- Ease of maintenance and convenience of operation.
- Adequate provision for future expansion and modification.
- Maximum interchangeability of equipments.
- Automatic protection of all electrical equipments through selective relaying system.
- Fail safe features.
- Hook-up provisions with existing facilities, wherever required.
- Adequate provision for future expansion and modification.

- 1.1 GAIL is currently implementing Laying of buried pipeline API 5L grade X42 (or higher) from Proposed tap-off point to proposed metering skid with TCP/PCP.

2.0 CODES AND STANDARDS

Electrical equipment and system design, manufacture, testing, installation and commissioning will comply with all latest applicable standards, regulations and codes.

| | |
|----------------------|---|
| BIS | Bureau of Indian Standards |
| CMRI | Central Mines Research institute |
| IEEE | Institute of Electrical & Electronics Engineers |
| IER | The Indian Electricity Rules |
| IEA | The Indian Electricity Act. |
| API | American Petroleum Institute |
| OISD | OIL Industry Safety Directorate. |
| DGMS | Director General of Mines Safety |
| NEC | National Electric Code |
| IEC | International Electromechanical Commission |
| NEMA | National Electrical Manufacturers Association |
| NACE, CCE, BS, PNGRB | |

3.0 OPERATING REQUIREMENTS

- 3.1 The electrical equipment and material shall be in accordance with the LEPL Technical

| | | | |
|--|--------------------------------|------------------------|------------|
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Specifications, BIS and suitable for the following power supply system and site conditions.

3.2 Site Conditions:

The equipment shall be designed for the following site conditions.

| | |
|---|--|
| Max / Min. Temperature | 60°C /4°C |
| Design Temperature | 55°C |
| Relative Humidity Max / Min. | 90%/ 41% |
| Altitude above Sea level | Less than 1000 Meters. |
| Atmospheric condition | Tropicalised to withstand the Site condition, dust, vapour etc. |
| Hazardous Area classification for Plant | Zone-1 or Zone-2, Gas group IIA, IIB. Temp class T3 |
| Electrical Room/Control Room / Guard Room/Battery room | Safe area(If applicable) |

3.3 Power Source:

It is presumed that all the stations have Grid Power as Main Power Supply and UPS/Solar power supply as emergency / critical Power Source (to feed the Instrumentation Critical Loads etc).(if applicable)

3.4 Power System Design:

The distribution system shall be designed in accordance with project specification taking into account all possible factors affecting the choice of the system to be adopted such as required continuity of supply, flexibility of operation, operational costs and reliability of supply from available Power sources, total load and the concentration of individual loads.

3.5 Capacity of Electrical System:

All the components of the electrical system shall be sized to suit the maximum load, under the most severe operating conditions. Accordingly, the maximum simultaneous consumption of power required by continuously operating loads shall be considered and an additional margin shall be taken into account for intermittent service loads, if any. The amount of electrical power consumed by each process unit shall be calculated for its operation at the design capacity.

Total Running load of a Station = 100% of Continuous Load + 50% of the Intermittent Load + 20% of the Stand-by Load.

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3.6 Protection and Metering Schemes:

The protective system shall be selected and coordinated to ensure the following:

- i) Protection of equipment against damage which can occur due to internal or external short circuits or atmospheric discharges.
- ii) Uninterrupted operation of those parts of the system, which are not affected by the fault.
- iii) Personnel and plant safety.

Metering shall be provided to keep a record of power consumption and supervision of all concerned parameters like current, voltage, power, frequency, power factor etc.

3.7 Power Supply Voltage:

| | |
|--|-----------------|
| Voltage | 415V \pm 10% |
| Frequency | 50 Hz \pm 5% |
| Combined voltage & frequency variation | \pm 10% |
| Phase & Wire | 3 Ph, N & 4W |
| Fault level | 25 KA for 1 Sec |
| Neutral Earthing | Solidly earthed |

- Voltage selection is based upon economic considerations, taking the following factors into account:
 - a. Size and location of loads.
 - b. Provision of future extension.
 - c. Short-circuit level.
 - d. Availability of switchgear with suitable current rating and rupturing capacity.
- Possibility of keeping the number of different voltage levels to a minimum.

3.8 Control Supply Voltage:

| | |
|--|-----------------|
| Voltage | 230V \pm 10% |
| Frequency | 50 Hz \pm 5% |
| Combined voltage & frequency variation | \pm 10% |
| Phase & Wire | 1 Ph, N & 2W |
| Fault level | 10 KA for 1 Sec |

Any other control supply voltage will be arranged by the contractor as per equipment requirement. Lighting, small power, etc.: 415 / 240 V, 50Hz; 24 V





CONSTRUCTION OF STEEL PIPELINE AND ASSOCIATED FACILITIES FOR CGD CONNECTIVITIES

3.9 Electrical Control:

Digital and analogue monitoring and control signals as required for Solar Electric Power Source, Normal power source, CP system shall be provided in various electrical equipment for connection to SCADA system.

3.10 LV Switchgear / Switchboard:

Switchgear and associated equipment fed from generators and transformers(existing) shall have rating at least equal to the rating of respective generators and transformers feeding it, under any circuit configuration. Generator incomer shall be rated w.r.t. maximum power output of the generator set over entire operating temperature range.

Bus tie circuit breakers shall have same rating as the incomer.

All other switchgears / switchboards not directly fed from generator and transformers shall have rating at least equal to the maximum demand under any circuit configuration plus a provision for 25% future load growth. Incomers of these switchgears / switchboards shall be designed to cater to the complete load including 25% margin for future load growth.

Spare outgoing feeders shall be provided in all MV switchgears / switchboards as indicated in SLD. For other switchboards at least one number of each type of outgoing feeder or 20% of same feeder type.

3.11 Equipment Clearance:

The control building shall be sized to maintain adequate clearances between equipment for ease of maintenance. The following minimum clearances around various electrical equipment shall be maintained:

| Sl. No. | LOCATION | CLEARANCE |
|---------|---|---|
| a) | Front clearance for MV switch boards/ all other panels | Minimum 1500 mm |
| b) | Rear clearance for panels having maintenance access from front only | Minimum 750 mm |
| c) | Rear clearance for panels having maintenance access from rear | 1000 mm |
| d) | Side clearance between two switch boards or nearest obstruction | 1000 mm after considering space for future panels |
| e) | All around clearance for transformers | 1000 mm |
| f) | Battery rack to wall clearance for <ul style="list-style-type: none"> - Single row, single/double tier - Double row, single tier - Double row, double tier | 100mm 100mm 750mm |



CONSTRUCTION OF STEEL PIPELINE AND ASSOCIATED FACILITIES FOR CGD CONNECTIVITIES

| | | |
|----|--|-------------------------|
| g) | Battery rack to rack clearance | 100 mm or ≥ 750 mm |
| h) | Front clearance for wall mounted equipment | 750mm |
| i) | Front clearance for operation station / annunciation / control panel | 2000 mm |

4.0 AREA CLASSIFICATION AND EQUIPMENT SELECTION

- 4.1 Classification of hazardous area will be in accordance with API 500 /IS-5572 and OISD: 113(2001)-Classification of area for Electrical Installation at hydrocarbon processing and handling facilities whichever is stringent.
- 4.2 Following factors will be considered for proper selection of electrical equipment for use in hazardous areas:
- Area Classification - Zone-1, Zone-2
 - Gas Group - IIA and IIB
 - Temperature Classification - T3
- 4.3 All electrical equipment for hazardous area shall be certified by CMRI or equivalent independent testing agency.
- 4.4 Approval certificate from Chief Controller of Explosives (CCOE) is mandatory for all electronic / electrical instruments / equipment to be installed in India, irrespective of country of origin.

4.5

| S.No. | Adequate Type of Protection | Area Classification | Description (Symbol) |
|-------|-----------------------------|---|-------------------------------|
| 1 | Zone 0 | * Intrinsic safe category | "ia" |
| | | * Other electrical apparatus, specifically designed for zone 0 | "ia", "s" |
| 2 | Zone 1 | * Any type of protection adequate for zone 0 (not preferred) | |
| | | * Flameproof enclosure | |
| | | * Intrinsic safe category | "ib" |
| | | * Oil immersion (see note 2) | |
| | | * Pressurization (see table 2) | |
| | | * Sand filling | |
| 3 | Zone 2 | * Other electrical apparatus specifically designed for zone 1 | "d", "ib", "o", "P", "q", "s" |
| | | * Any type of protection adequate for zone 0 or zone 1 (not preferred). | |
| | | * Increased safety (see note 1) | |
| | | * Non sparking apparatus (see note 1) | "e", "n" |

Notes:

1. For all outdoor installations, including the apparatus with type of protection "e" and type of protection "n", the degree of protection shall be in accordance with section 6.
2. Oil-immersed apparatus may be used only in case its security will not be impaired by tilting or vibration of the apparatus.



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5.0 LIGHTING SYSTEM

5.1 Illumination level in the plant area for calculation of lighting fixtures are as follows:

| | |
|-----------------|---------|
| Control room | 500 Lux |
| Electrical room | 150 Lux |
| Office room | 300 Lux |
| Process area | 50 Lux |
| Battery room | 100 lux |
| Other rooms | 100 lux |
| Road area | 20 lux |
| Open area | 10 Lux |

| | |
|----------------------|----------------------------------|
| Utilization factor | As per manufacturer's catalogue |
| Maintenance factor - | 0.6 for outdoor / 0.7 for indoor |

5.2 Type of Lighting Fixtures :

| | |
|--|--|
| Battery Room | 2x26 W LED Decorative Flame Proof Surface Mounted Fixtures |
| Control room | 2x36 W LED Decorative Recess mounted Fixtures |
| Local area Near the field Instrument in Process area | 250 W HPMV FLP well glass fixtures or Equivalent LED FLP Light Fixture |
| Electrical room | 2x36 W LED decorative surface mounted Fixtures |
| Guard Room/Store room | 2x26 W LED Decorative Recess mounted Fixtures |
| Toilet/ Veranda | 1x26 W LED Recess mounted Fixtures |
| Gate Light | 1x26 W LED Gate Top mounted Fixtures |
| Process area | 250 W HPMV FLP well glass fixtures or Equivalent LED FLP Light Fixture |
| Road | 250 W HPMV or Equivalent LED Street Light Fixtures |
| Outdoor Area | 2x250 W HPMV Flood Light Fixtures. |

5.5 All cables (Power & control) shall be armoured only including Lighting Cables.

5.6 All type of Battery should be accommodated in battery room only.





CONSTRUCTION OF STEEL PIPELINE AND ASSOCIATED FACILITIES FOR CGD CONNECTIVITIES

5.7 2 nos. 450mm dia exhaust fan shall be provided in Battery Room and Electrical Room, 1 no. 300 mm dia Exhaust fan shall be provided in store/Toilet. Blade shall be FRP type. Exhaust fan in battery room shall be flameproof type.

5.8 1200 mm sweep Ceiling fan shall be provided in Electrical Room, Store Room & Guard Room.

6.0 ENCLOSURE PROTECTION OF EQUIPMENT

6.1 Weather Protection

The electrical equipment installed indoor / outdoor shall have the following enclosure protection:

IP for all station – Indoor control room – IP-42,
Indoor Switchgear Room – IP-52
Outdoor – Ex-d
Flood Light, Street Light – IP-55
Other Outdoor-IP-55

The above enclosure protection shall be in accordance with the Indian standard.

6.2 Safety enclosures in hazardous areas

The types of enclosures that shall be used in the plants are the following:

Flame proof (Ex-d)
Pressurized Electrical Equipment – Ex-p

6.3 Key Single-Line Diagram shall define the power distribution system, showing voltage levels, fault level of the bus, bus current rating, frequency, power supply sources, emergency distribution systems and system earthing methods, as well as protection and metering aspects of state electricity board. The document will be set up based on preliminary load data available at the start of the activity and the power distribution philosophy.

7.0 EARTHING SYSTEM :

7.1 All non – current carrying metal enclosures shall be bonded for earth continuity to the main earth Grid/earth bus.

7.2 The minimum of two earth studs must be provided on the skid base, diagonally Opposite to each other, for connection to the main plant earth system.

7.3 No. of earth pits shall be provided as per IS : 3043. All earthing materials shall be supplied as per Technical Specification.

- i) 600 x 600 x 3 mm thick copper plate earth electrodes for UPS, RTU, Telecom, Instrument Control Panel, metering panel.
- ii) 65 mm dia X 3000 mm (L) GI Pipe electrode for other





CONSTRUCTION OF STEEL PIPELINE AND ASSOCIATED FACILITIES FOR CGD CONNECTIVITIES

7.4 All equipment earthing shall be carried out as per IS : 3043, Minimum size of earth conductor to be used shall be as given below:

| <u>Equipment</u> | <u>Conductor size</u> |
|--|--|
| Main Grid & equipment such as main Electrical Distribution Board etc | 50 X 6 mm GI Flat |
| Switch Socket DB, UPS, DB, Lighting DB | 25 x 6 mm GI flat / 16 sq. mm GI rope |
| Motors up to 15 KW Other equipment | 2.5 sq mm Copper PVC Wire 2.5 sq mm Copper PVC Wire |
| Mechanical equipment / Vessels, tanks, Pipe/cable racks, structure, fencing | 50 X 6 mm GI Flat |
| UPS, Telecom, RTU | 10 Sq. mm Cu cable |
| Field Instruments | 2.5 sq mm copper PVC Wire |

10 sq. mm Cu armoured cable shall be used for Cu plate electrode interconnection of two earth pits

7.5 Earthing electrode shall be GI pipe/ copper plate.

- Minimum 2 Nos. Copper Plate Electrodes will be provided for RTU/SCADA/Control Panel equipment at new station.
- Minimum 2 Nos. Copper Plate Electrodes will be provided for Telecommunication System at new station.
- Minimum 2 Nos. Copper Plate Electrodes will be provided for UPS system at new station.
- GI pipe electrodes for new stations will be provided as per IS-3043 and as per site requirement, (2nos for neutral earthing of transformer as applicable ,4 Nos. near building & 2 nos. for process area and 2 nos. separate earthing for lightning protection system). All these earth electrodes will be interconnected.
- Minimum 2 Nos GI pipe electrodes for Earthing fence for Customer End and Existing station.
- Minimum 2 Nos Cu electrodes for Earthing of Metering skid at Customer End station.

7.7 A board of 250 X 250 mm, 3mm thick GI plate shall be provided adjacent to all earth pits. Board shall display earth pit number, date of testing, test values & next due date, as per guide line of CEA.

8.0 CABLES

Cables shall be supplied as per Technical Specification. Scope shall cover Design, manufacturing, testing at works, laying and commissioning at site.



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8.1 Power Cable

- 1 Stranded Annealed Copper Conductor up to 16 mm²
- 2 Stranded Aluminium Conductor from 16 mm² and above
- 3 XLPE insulation
- 4 Inner and outer Sheath will be extruded
- 5 Inner sheath will be ST2
- 6 Steel strip/wire armoured
- 7 Outer sheath of cable will be FRLS PVC, ST2 Type
- 8 Voltage grade- 1100 V
- 9 IS 7098, IS: 5831

8.2 Control Cable

- Stranded Annealed Copper Conductor 2.5 sq mm
- PVC insulation type A.
- Inner and outer Sheath will be extruded
- Inner sheath and outer sheath will be ST1
- Steel strip/wire armoured
- Outer sheath of cable will be FRLS PVC, ST1 type
- Voltage grade - 1100 V
- IS-1554 Part I, IS: 5831

8.3 Lighting Cable/Wire in conduit

- 4 core 6 mm² stranded Copper will be used from outdoor lighting DB to junction box on the lighting poles.
- 3 core 2.5 sq. mm stranded copper cable (YWY) will be used from junction box on the lighting pole to lighting fixture. .

8.5 Voltage Drops

The maximum voltage drops in any feeder of the electrical system under steady state conditions at full load shall be within the limits as stated follows:

- Cable between transformer secondary and MV Switchboard/PCC/PMCC - 0.5%
- Cable between MV Switchboard/PCC/PMCC and motors - 5%





CONSTRUCTION OF STEEL PIPELINE AND ASSOCIATED FACILITIES FOR CGD CONNECTIVITIES

| | |
|--|-------------|
| - Cable between MV Switchboard /Auxiliary Switchboard and Lighting Panel / Power Panel | - 1 to 1.5% |
| - Circuit between lighting panels and lighting points | - 3% |
| - UPS outgoing circuit | - 5% |
| - Cable between Switchboard and motor during starting maximum | - 15% |





GAIL INDIA LIMITED

TECHNICAL SPECIFICATION OF MAIN ELECTRICAL DISTRIBUTION BOARD (MEDB)


(Doc. No. GAIL-STD-EL-DOC-TS-002)

| Rev | Date | Purpose | Prepared By | Checked By | Approved By |
|-----|------------|--------------------|----------------|---------------|----------------|
| 0 | 29.01.2019 | Issued As Standard | RKS | SB | SB |



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1.0 Scope

This specification covers the requirement of design, fabrication, testing, packing and supply of Medium voltage fixed type distribution board in single front execution required for receipt, control and distribution of power to various medium voltage consumers of the package equipment.

2.0 CODES AND STANDARDS


2.1 The equipment shall comply with the requirements of latest revision of following standards issued by BIS unless otherwise specified.

| | |
|-----------|---|
| IS: 772 | AC Electricity Meters |
| IS: 1248 | Direct acting electrical indicating instruments |
| IS: 2705 | Current transformers |
| IS: 2824 | Method for determining the comparative tracking index of solid Insulating materials under moist conditions |
| IS: 3156 | Voltage transformers |
| IS: 3231 | Electrical relays for power systems protection. |
| IS: 3618 | Phosphate treatment of iron and steel for protection against corrosion. |
| IS: 5082 | Material data for aluminium bus bars. |
| IS: 5578 | Guide for marking of insulated conductor. |
| IS: 6005 | Code of practice of Phosphating of iron and steel. |
| IS: 8623 | Factory built assemblies of switchgear and control gear for voltages upto and including 1000 V A C and 1200 V DC. Part -II particular requirements for bus bar trucking systems (bus ways). |
| IS: 11353 | Guide for uniform system marking and identification of conductors and apparatus terminals. |
| IS: 13703 | Low voltage fuses. |
| IS: 13947 | LV Switchgear and control gear. (Part-1 to Part-5) |

2.2 In case of imported equipment standards of the country of origin shall be applicable if these standards are equivalent or stringent than the applicable Indian standards.

2.3 The equipment shall also conform to the provisions of Indian Electricity rules and other statutory regulations currently in force in the country.

2.4 In case Indian standards are not available for any equipment, standards issued by IEC/BS / VDE/ IEEE/ NEMA or equivalent agency shall be applicable.

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- 2.5 In case of any contradiction between various referred standards / specifications / data sheet and statutory regulations the following order of priority shall govern:
- Statutory regulations
 - Data sheets
 - Job specification
 - This specification
 - Codes and standards

3.0 GENERAL REQUIREMENTS

- 3.1 The offered equipment shall be brand new with state of art technology and proven field track record. No prototype equipment shall be offered.
- 3.2 Vendor shall ensure availability of spare parts and maintenance support services for the offered equipment at least for 15 years from the date of supply.
- 3.3 Vendor shall give a notice of at least one-year to the end user of equipment and LEPL before phasing out the product/spares to enable the end user for placement of order for spares and services.


4.0 SITE CONDITIONS

- 4.1 The switchboards shall be suitable for installation and satisfactory operation in a pressurized substation or in substation with restricted natural air ventilation in tropical, humid and corrosive atmospheres. The switchboards shall be designed to operate under specified site conditions. If not specifically mentioned a design ambient temperature of 50° C and altitude not exceeding 1000 meters above mean sea level shall be considered.
- 4.2 All the equipment described in this specification is intended for continuous duty at the Specified ratings under the specified ambient conditions unless indicated otherwise.


5.0 DESIGN AND FABRICATION REQUIREMENTS

Medium voltage distribution board shall meet the requirements of medium voltage distribution board data sheet, and following requirements of this specification in addition to the general requirements as per latest editions of applicable Indian standards.

- 5.1 The distribution board shall be free standing, suitable for wall/floor mounting, with complete front access for operation and maintenance. The distribution board shall be fixed type in single front execution, assembled in single line up, metal enclosed, fully compartmentalised, totally segregated compartments for feeders, cables and bus bar, dust and vermin proof suitable for indoor installation.
- 5.2 Distribution board enclosure shall provide a degree of protection not less than IP-42 as per applicable IS.
- 5.3 The switchgear shall be assembled out of vertical panels of uniform height not exceeding 2450 mm. The maximum height of the operating handle/switches shall not exceed 1900 mm and the minimum height not below 300 mm.
- 5.4 The distribution board shall be designed to ensure maximum safety during operation, inspection, and connection of cables, relocation of outgoing circuits and maintenance


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- with the energized bus bar system and without taking any special precautions. The switchgear shall permit maximum interchangeability and shall be extensible on either side.
- 5.5 The distribution board shall be sheet steel clad with the frame fabricated out of 2mm cold rolled sheet steel and doors/covers out of 1.6mm cold rolled sheet steel, having heavy duty integral base frame for each vertical panel.
 - 5.6 All hardware shall be corrosion resistant. All joints and connections of the panel members shall be made of galvanised, zinc passivated or cadmium plated high quality steel bolts, nuts and washers, secured against loosening.
 - 5.7 All openings, covers and doors shall be provided with neoprene gaskets around the perimeter to make the distribution board dust and vermin proof. Suitable lifting hooks shall be provided and each shipping section for ease of lifting of switchboard.
 - 5.8 All metal surfaces shall be thoroughly cleaned, degreased to remove mill scale, rust, grease and dirt. Fabricated structure shall be pickled and then rinsed to remove any trace of acid. The under coat shall be prepared by applying a coat of phosphate paint and a coat of yellow zinc chromate primer. The distribution board shall be powder coated. Pre-treatment of the distribution board shall be done by 7 tank process before powder coating. The final paint shade shall be as per manufacturer standard unless specified otherwise.
 - 5.9 The distribution board shall be suitable for bottom cable entry unless specified otherwise and shall be provided with removable gland plates unless otherwise specified. The distribution board shall have a separate cable alley for each vertical panel with cable tying arrangement. The width shall be sufficient to accommodate the required number of cables. However, in any case it shall not be less than 200mm width. The cable alley shall be provided with a suitable hinged door. Required number of single compression nickel plated brass cable glands and tinned copper compression type lugs for all power and control cables shall be included in the vendor's scope of supply.
 - 5.10 The distribution board shall comprise of incoming load break switch/MCCB/Switch Fuse Unit Panel, Contactor, outgoing switch fuse/MCCB, MCB/ contactors feeders, motor starter feeders, control supply transformers, both power and auxiliary/control bus bars, cable termination compartment etc. All these shall be housed in independent compartments separated from each other by metallic barrier.
 - 5.11 Main horizontal bus bars shall be provided at the top in separate compartment. Vertical bus bars required for connection between main bus bars and outgoing feeders shall be in separate vertical chamber. One set of vertical bus bars can be provided for feeding outgoing feeders in two panels on either side of the vertical bus bar.
 - 5.12 All components including bus bars and cable termination shall be accessible only from the front side for repair and maintenance.
 - 5.13 Each outgoing feeder shall be in multitier arrangement having minimum height of individual module as defined in distribution board data sheet. All feeders shall be of modular design with height in multiple of standard unit size.
 - 5.14 Number and rating of feeders shall be as per package vendor's electrical load list/single

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line diagram. The components rating and type for various types of outgoing feeders such as motor feeders shall be selected based on package requirement and shown in data sheets.


- 5.15 All auxiliary devices for control, indication, measurement and protection except the bimetallic relays shall be mounted on the front side of the respective compartment. Components requiring frequent inspection during operation shall be easily accessible.
- 5.16 Each vertical panel shall be provided with anti condensation heater rated for 240VAC supply, provided with a switch fuse and thermostat having variable setting range of 30-70° C. Adequate space shall be provided for termination of incoming and outgoing cables.
- 5.17 Main bus bars shall be of high conductivity Electrical Grade aluminum having uniform current rating throughout their length. Horizontal and vertical bus bars shall be sized depending upon the maximum expected current and to limit the specified maximum operating temperature at specified design ambient temperature. Bus bar shall be designed to withstand thermal and mechanical stress due to short circuit current.
- 5.18 The maximum operating temperature of bus bars including joints at the maximum design temperature inside the panel shall not exceed 95°C under normal operating conditions.
- 5.19 Minimum clearance between live parts, between live parts/neutral to ground shall be 19 mm.
- 5.20 Adequately sized auxiliary copper bus bars running horizontally in a separate enclosure shall be provided for space heaters, control supply and metering requirements. Necessary tee-off connections shall be used for distributing auxiliary supply to each vertical panel.
- 5.21 All horizontal and vertical bus bars shall be insulated with heat shrink PVC sleeves of 1100 V grade and removable shrouds shall be provided for joints. All bus bars shall be prominently marked with Red; Yellow and Blue colour rings for easy phase identification at regular interval and at every power tap off point and designed to withstand specified short circuit currents for one second.
- 5.22 Copper earth bus of 30x6 mm size for fault level upto 31.5 KA and 50x6 mm² size for fault level above 31.5 KA shall be provided throughout the length of the distribution board with provision for interconnection to earthing grid at two ends. All non-current carrying metallic parts of the mounted equipment shall be earthed. Doors and movable parts shall be earthed using flexible copper connections.
- 5.23 Inside the distribution boards, the wiring for power, control, signaling protection and instrument circuits shall be done with PVC insulated copper conductors having 660/1100 V grade insulation.
- 5.24 For modules rated above 100 Amp. Preferably copper strip connection shall be used. Minimum size of control wire shall be 1.5 mm² coppers for circuits having fuse rating 10 Amp. or less. For higher fuse rating control circuits, min. 2.5 mm² copper conductor shall be used. Each wire shall be identified at both ends by self-sticking wire marker tapes or PVC ferrules. Transparent shrouds shall be used on outgoing power terminals.

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- 5.25 Clamp type terminals shall be acceptable for wires upto 10 mm² size, for conductors larger than 10mm² bolt type terminals with crimping lugs shall be provided. Each wire shall be terminated at a separate terminal. A minimum of 10% spare terminal shall be provided on each terminal block. Shorting links shall be provided for all CT terminals.
- 5.26 All motor starting shall be DOL type unless otherwise specified. 240 V AC control supply for motor starters shall be derived from a common 415/240 V adequately sized transformer for each bus section.
- 5.27 Components of the similar modules of same sizes shall be identically located and wired. Control supply change over switch shall be provided in case the distribution board is with two bus-sections. Identical modules shall be designed such that these can be interchanged in case of emergency.

6.0 EQUIPMENT SPECIFICATION

- 6.1 The number of modules in the panel shall not exceed six for motor starter feeders and eight for switch fuse/MCB/MCCB feeders. The minimum size of module shall be 300 mm and 200 mm for starter and switch fuse feeders. The incomer and bus coupler module sizes for ratings upto 400 A shall be half the panel size. For higher ratings they shall be housed in single panel.
The module door shall be so interlocked that it shall not be possible to open the door with switch/MCCB in closed position. Defeat interlock facility shall be provided.
- 6.2 All fuses shall be non-deteriorating HRC cartridge, pressure fitting link type.
- 6.3 The contactors shall be air break type having AC-3 duty rating as per package requirement. All contactors shall be provided with 2 NO + 2 NC potential free spare auxiliary contacts wired to the terminal block for owner use.
- 6.4 Thermal overload relays shall be three elements; positive acting ambient temperature compensated type with adjustable setting range and built in protection feature against single phasing. Bimetal relays shall be manually reset type with the reset push button provided on the cubicle door.
- 6.5 Current transformers for metering shall have an accuracy class 1.0 and instrument safety factor less than 5. However accuracy class of 3.0 is acceptable for ammeters only for outgoing feeders. Protective current transformers shall have an accuracy class 5P and an accuracy limit factor greater than 10.
- 6.6 All measuring AC instruments shall be moving iron, flush mounting type and of 96 x 96 mm and 72 mm x 72 mm square pattern instruments for incomer and outgoing feeders respectively. Accuracy class shall be 1.0 for KW/KWH meter and 1.0 for ammeter and voltmeter. Ammeters for motor feeders shall have a non-linear compressed scale at the end to indicate motor starting current and red mark for the normal current.
- 6.7 All selector switches shall be rotary back-connected types having a cam operated contact mechanism with knob type handle. Ammeter selector switch shall have make before break feature on its contacts.
- 6.8 Indicating lamps shall be suitable for 6.0 V A C, complete with built in 240/6V

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transformers. Lamps shall be provided with translucent covers to diffuse light. Alternately clustered LED type indicating light with minimum 8mm-diameter size shall be considered. The following indicating colours shall be used.

| | | |
|-------------------|---|-------|
| Close/on | : | Red |
| Open/off | : | Green |
| Fault trip | : | Amber |
| Control supply on | : | White |

Push button colours shall be as follows:

| | | |
|----------------------|---|--------------------|
| Stop/ open/emergency | : | Red |
| Start/close | : | Green |
| Reset/test | : | Yellow/Black/White |

'Stop' push buttons for motor control feeders shall have stay put feature.

All motor starter feeders shall have Stop and Reset push buttons and On and Trip indication lamps.

- 6.9 A centrally located engraved nameplate shall be provided for the switchboard. Each module shall have engraved *nameplate-bearing data* as per approved drawings. Name plate or *polyester* adhesive stickers shall be provided for each equipment mounted on the switchboard. Identification tags shall be provided inside the panels matching with those shown on circuit diagram. Special warning labels shall be provided on removable covers or doors giving access to cable terminals and bus bars.
- 6.10 At least 20% spare feeders of each rating of outgoing feeders subject to a minimum of one feeder of each rating shall be provided in the switchboard.
- 6.11 Sizing and selection for components of Distribution board shall be submitted to PMC/Owner for review/approval.

7.0 INSPECTION, TESTING AND ACCEPTANCE

- 7.1 In addition to the expediting/inspection activities being undertaken by the package vendor, distribution board shall be subject to inspection by LEPL/Owner or by an agency authorised by the owner. All necessary information concerning the supply shall be furnished to LEPL/Owners inspectors. Two weeks notice shall be given to LEPL/owner for witnessing the final testing of the complete assembly to ensure satisfactory operation of all components.
- 7.2 Tests shall be carried out at the manufacturer works under his supervision and at his cost.
- 7.3 All routine tests as specified by the applicable standards and codes shall be conducted. Type tests certificates of a recognized testing organization shall be furnished with the bids. The vendor shall also submit the guaranteed technical particulars with the bids. Type test certificates shall not be older than 5 years.
- 7.4 In addition, specified tests shall be conducted to check mechanical and electrical


operation and the control wiring to specification and schematic drawings.

- 7.5 Acceptance tests shall be as follows:
 - 7.5.1 A general visual check shall be carried out. This shall cover measurement of overall dimensions, location, number, and type of devices and their ratings as per bill of materials, terminal blocks, location and connection of terminals.
 - 7.5.2 Manual and electrical operation of switches, contactors, relays etc. under various conditions of supply voltage.
 - 7.5.3 Insulation resistance of the main and auxiliary circuit shall be checked.
 - 7.5.4 Operation check for every control function as per the schematic diagram by manually simulating the actual operating conditions.
 - 7.5.5 Primary injection test to check winding of current transformers, ammeter, ammeter selector switch and correctness of wiring connection between them.
 - 7.5.6 Relays shall preferably be tested with secondary injection test equipment.
- 7.6 For equipment bought from other sub-suppliers certified test reports of tests carried out at the manufacturer's works shall be submitted. Normally all routine tests as specified in the relevant standards shall be conducted by the sub-supplier at his works. In addition type test if specified shall be additionally carried out and witnessed by the owner at CPRI/approved testing authority.

8.0 PACKING AND DESPATCH

All the equipment shall be divided in to several shipping sections for protection and ease of handling during transportation. The equipment shall be properly packed for transportation by ship/rail or trailer. The panels shall be wrapped in polyethylene sheets before being placed in wooden crates /cases to prevent damage to the finish. Crates /cases shall have skid bottoms for handling. Special precaution notations such as Fragile, This side up, center of gravity, weight, Owner's particulars, Purchase number etc. shall be clearly marked on the package together with other details as per purchase order. The equipment may be stored outdoors for long periods before installation. The packing should be suitable for outdoor storage in areas with heavy rains and high ambient temperature unless otherwise agreed.

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GAIL INDIA LIMITED


TECHNICAL SPECIFICATION OF CABLES
(Doc. No. GAIL-STD-EL-DOC-TS-003)

| Rev | Date | Purpose | Prepared By | Checked By | Approved By |
|-----|------------|--------------------|-------------|------------|-------------|
| 0 | 29.01.2019 | Issued As Standard | RKS | SB | SB |



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1.0 SCOPE

This specification along with data sheets covers requirements for design, manufacture, testing at works and supply of Flame Retardant Low Smoke (FRLS) PVC cables and cable terminating accessories for medium voltage systems.


2.0 STANDARDS

2.1 The cables and cables j ointing & terminating accessories shall comply with the latest edition of the following standards as applicable:

| | |
|---------------------------|--|
| IS: 1554 [Part-I] | PVC insulated (heavy duty) electric cables. |
| IS: 7098 | Cross-linked polyethylene insulated PVC sheathed. |
| IS: 8130 | Conductors for insulated electric cables and flexible cords. |
| IS: 5831 | PVC insulation and sheath of electric cables. |
| IS: 3975 | Mild steel wires, strips and tapes for armouring of cables. |
| 10810(Part 41) | Methods of test for cables: Mass of zinc coating on steel armour. |
| IS: 209 | Specification for zinc. |
| IS: 3961(Pt-2) | Recommended current ratings for cables: Part - 2 PVC Insulated and PVC sheathed heavy-duty cables. |
| IS: 10418 | Drums for electric cables. |
| IS: 10462 (Pt-I) | Fictitious calculation method for determination of Dimensions of protective coverings of cables: Part - I Electrometric and thermoplastic insulated cables |
| IS: 10810 (Pt-58) | Oxygen Index test. |
| IS: 10810 (Pt 61) | Flame Retardant test. |
| IS: 10810 (Pt 62) | Fire resistance test for bunched cables. |
| IEC: 60332-3 | Tests on electric cables under fire conditions. |
| IEC: 60502 | Extruded solid dielectric insulated power cables for rated Voltages from 1 kV.up to 30 kV. |
| IEC: 60540 & 60540A | Test methods for insulation and sheaths of electric Cables. |
| ASTM: D2863 | Standard method of test for flammability of plastics using oxygen index method. |
| ICEA S-61-402 NEMA-WC5 | Thermoplastic insulated wire and cable for transmission and distribution of electrical energy. |
| ICEA S-66-524 NEMA-WC7 | Cross-linked thermosetting polyethylene insulated wire and cable for transmission and distribution of electrical energy. |
| SP: 30 (BIS) | Special Publication – National Electrical Code. |
| IS: 10810 (Part 43) | Method of Test for cables; Part 43 Insulation resistance. |
| IS: 10810 (Part 45) | Method of Test for cables: Part 45 High voltage test. |
| OISD 147 | Inspection and safe practice during electrical installation |
| OISD 173 | Fire prevention and protection system for electrical installation |

2.2 In addition to the above it shall be ensured that the installation conforms to the requirements of the following as applicable:


- a. Indian Electricity Act and Rules.
- b. Regulations laid down by CEA/Electrical Inspectorate.
- c. Regulations laid down by CCE/DGMS (as applicable).
- d. The petroleum rules (Ministry of Industry Government of India).

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- e. Any other regulations laid down by central/state/local authorities and Insurance agencies.
- 2.3 The cables and accessories shall also conform to the provisions of Indian Electricity Rules and other statutory regulations, as applicable.
- 2.4 In case of any contradiction between various referred standard/ specification/data sheet and statutory regulations, the following order of priority shall govern:
- Statutory Regulations
Data Sheets
Job Specifications
This Specification
Codes and Standards

3.0 GENERAL CONSTRUCTION

- 3.1 The cables shall be suitable for laying in trays, trenches, ducts, and conduits and for underground-buried installation with uncontrolled backfill and possibility of flooding by water and chemicals.
- 3.2 Outer sheath of all PVC cables shall be black in colour and the minimum value of oxygen index shall be 29 at $27 \pm 2^\circ$ C. In addition suitable chemicals shall be added into the PVC compound of the outer sheath to protect the cable against rodent and termite attack.
- 3.3 All cables covered in this specification shall be Flame Retardant Low Smoke (FRLS) unless specified otherwise in the data sheet. The outer sheath of PVC and XLPE cables shall possess flame propagation properties meeting requirements as per IS-10810 (Part-62) category AF.
- 3.4 Sequential marking of the length of the cable in metres shall be provided on the outer sheath at every one metre. The embossing / engraving shall be legible and indelible.
- 3.5 The overall diameter of the cables shall be strictly as per the values declared by the manufacturer in the technical information subject to a maximum tolerance of ± 2 mm up to overall diameter of 60mm and ± 3 mm for beyond 60mm.
- 3.6 PVC / Rubber end caps shall be supplied free of cost for each drum with a minimum of eight per thousand metre length. In addition, ends of the cables shall be properly sealed with caps to avoid ingress of water during transportation and storage.
- 3.7 The cables used in installations under the jurisdiction of Director General of Mines and Safety (DGMS) shall be of copper conductor only, and shall have valid DGMS approvals for the specified locations. The word "Mining Cable" shall be embossed / engraved on the cable outer sheath as per the applicable Indian Standards
- 3.8 PVC cables
- 3.8.1 All power/control cables for use on medium voltage systems shall be heavy-duty type, 650/1100 V grade with aluminium / copper conductor, PVC insulated, inner-sheathed, armoured and overall PVC sheathed unless specified otherwise in data sheet.
- 3.8.2 The conductors shall be solid for conductor of nominal area up to and including 6mm^2 and stranded beyond 6mm^2 . Conductors of nominal area less than 16mm^2 shall be circular only. Conductors of nominal area 16mm^2 and above may be circular or shaped as per IS 8130. Cables with reduced neutral conductor shall have sizes as per Table I of IS 1554 (Part-I).

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- 3.8.3 The core insulation shall be with PVC compound applied over the conductor by extrusion and shall conform to the requirements of type 'A' compound as per IS: 5831. The thickness of insulation and the tolerance on thickness of insulation shall be as per Table 2 of IS: 1554 (Part-I). Control cables having 6 cores and above shall be identified with prominent and indelible Arabic numerals on the outer surface of the insulation. Colour of the numbers shall contrast with the colour of insulation with a spacing of maximum 50 mm between two consecutive numbers. Colour coding for cables up to 5 cores shall be as per Indian standard.
- 3.8.4 The inner sheath shall be applied over the laid-up cores by extrusion and shall be of PVC conforming to the requirements of Type ST-1 PVC compound as per IS: 5831. The minimum thickness of inner sheath shall be as per IS: 1554 (Part-I). Single core cables shall have no inner sheath.
- 3.8.5 If armouring is specified for multicore cables in the data sheet, the same shall be by single round galvanised steel wires where the calculated diameter below armouring does not exceed 13 mm and by galvanised steel strips where this dimension is greater than 13 mm. Requirement and methods of tests for armour material and uniformity of galvanisation shall be as per IS - 3975 and IS -10810 (Part 41). The dimensions of Armour shall be as per method (b) of IS - 1554 (Part -1). If armouring is specified for single core cables in the data sheet, the same shall be with H4 grade hard drawn aluminium round wire of 2.5 mm diameter.
- 3.8.6 The outer sheath for the cables shall be applied by extrusion and shall be of PVC compound conforming to the requirements of type ST-1 compound as per IS: 5831. The minimum and average thickness of outer sheath for unarmoured cables and minimum thickness of outer sheath for armoured cables shall be as per IS: 1554 (Part -1).
- 3.8.7 If heat resisting PVC cables are specified in the data sheet, the following shall be the requirements: It shall be possible to continuously operate the cable at a maximum conductor temperature of 85° C. PVC compounds used for HR PVC cables shall be as follows:
- Conductor insulation - Type C
 - Inner sheath - Type ST 2
 - Outer sheath - Type ST 2

3.9 Control Cables:

Control cables shall be 1100 Volt Grade, 2.5 mm² copper conductor PVC insulated PVC sheathed FRLS, single wire armored with an overall PVC sheath, as per IS: 1554 pt. I. All cables shall be of armored type only.


3.10 XLPE Cables

Power cables for 3.3 kV system shall be with Aluminium conductor, XLPE insulated (unearthed grade), screened, sheathed, armoured and overall PVC sheathed.

The construction of the conductors shall be stranded and compacted circular for all cables.

The cables shall be provided with both conductor screening and insulation screening. The conductors shall be provided with non-metallic extruded semi-conducting shielding.

The core insulation shall be with cross-linked polyethylene unfilled insulating compound. It shall be free from void and shall withstand all mechanical and thermal stresses under steady state and transient operating conditions.

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The insulation shielding shall consist of non-metallic extruded semi-conducting compound in combination with a non-magnetic metallic screening of copper. The insulation screen shall be strippable without application of heat. The copper screen shall be capable of carrying the single line to ground fault current of 1 kA for a duration of one (1) second.

The conductor screen XLPE insulation and insulation screen shall all be extruded in one operation by "Triple Extrusion" process to ensure perfect bonding between the layers. The core identification shall be colored strips or by printed numerals.

The inner sheath shall be applied over the laid up cores by extrusion and shall conform to the requirements of Type ST2 compound of IS:5831. The extruded inner sheath shall be of uniform thickness of size not less than 0.7 mm for all sizes of cables.

For multicore cables, the armouring shall be by galvanized steel strips armouring for single core cables shall be with hard-down aluminium round wire of 2.5 mm diameter.

The outer sheath for the cables shall be supplied by extrusion over the armouring and shall be of PVC compound conforming to the requirements of Type ST2 compound of IS: 5831. To protect cable against rodent and termite attack, suitable chemicals shall be added into the PVC compound of the outer sheath.

3.11 Cable Sizing:

Following factors to be considered for cable sizing:

- (i) Continuous current
- (ii) Fault current
- (iii) Voltage drop (Running & Motor starting)

4.0 CABLE ACCESSORIES

4.1 The termination and straight through jointing kits for use on the systems shall be suitable for the type of cables offered as per this specification.

4.2 The accessories shall be supplied in kit form. Each component of the kit shall carry the manufacturer's mark of origin.

4.3 The kit shall include all stress grading, insulating and sealing materials apart from conductor fittings and consumable items. An installation instruction sheet shall also be included in each kit.


4.4 The contents of the accessories kit including all consumable shall be suitable for storage without deterioration at a temperature of 45° C, with shelf life extending to more than 5 years ..

4.5 Terminating kits

The terminating kits shall be suitable for termination of the cables to an indoor switchgear or to a weatherproof cable box of an outdoor mounted transformer / motor. For outdoor terminations, weather shields / sealing ends and any other accessories required shall also form part of the kit. The terminating kits shall be from one of the makes / types mentioned in the data sheet.

4.6 Jointing kits

The straight through jointing kits shall be suitable for installation on overhead trays, concrete lined trenches, and ducts and for underground burial with uncontrolled backfill and possibility of flooding by water and chemicals. These shall have protection against any mechanical damage and suitably designed to be protected against rodent and termite attack. The inner sheath similar to that provided for cables shall be provided as part of straight through joint. The jointing kits shall be from one of the makes / types

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mentioned in the data sheet.

5.0 INSPECTION, TESTING AND ACCEPTANCE

The cables shall be tested and inspected at the manufacturer's works. All the materials employed in the manufacture of the cable shall be subjected, both before and after manufacture, to examination, testing and approval by LEPL / owner. Manufacturer shall furnish all necessary information concerning the supply to LEPL / owner's inspectors. The inspector shall have free access to the manufacturer's works for the purpose of inspecting the process of manufacture in all its stages and he will have the power to reject any material, which appears to him to be of unsuitable description or of unsatisfactory quality. The vendor shall give at least 2 weeks advance notice to the purchaser, regarding the date of testing to enable him or his representative to witness the tests.

5.1 Cables

- 5.1.1 After completion of manufacture of cables and prior to despatch, the cables shall be subjected to type, routine, acceptance and special tests as detailed below. LEPL/Owner reserves the right to witness all tests with sufficient advance notice from vendor. The test reports for all cables shall be got approved from the Engineer before despatch of the cables.
- 5.1.2 All routine tests, acceptance tests, type tests and additional type tests for improved fire performance shall be carried out as listed in IS: 1554 (Part-I), and IS: 7098 (Part-2) on PVC and XLPE insulated cables respectively.
- 5.1.3 The test requirements for PVC insulation and sheath of cables shall be as per latest revision of IS: 5831
- 5.1.4 Test for Resistance to Ultra Violet Radiation: This test shall be carried out as per DIN 53387 or ASTM-G-53 on outer sheath. The retention value of tensile strength and ultimate elongation after the test shall be minimum 60 % of tensile strength and ultimate elongation before the test. Test certificates with respect to this test (not older than one year) from recognised testing laboratory to be furnished for review by LEPL before despatch clearance of cables. In case test certificates are not available, test is to be conducted by vendor at his own cost in any recognised test laboratory or in house testing laboratory, before despatch clearance of cables. Sampling for this test is to be done randomly once for each order, provided outer sheath remains same.
- 5.1.5 Acceptance tests as per IS-15 54 (Part-I) and IS -7098 (Part-2) and the following special tests to be performed on the cables as per sampling plan. These tests are required to be witnessed by LEPL /owner before despatch of cables.
- a. Accelerated water absorption test for insulation as per NEMA - WC - 5. (For PVC insulated cables) and as per NEMA WC - 7 (for XLPE insulated cables). Test certificates with respect to this test (not older than one year) from recognised testing laboratory to be furnished for review by LEPL before despatch clearance of cables. In case test certificates are not available, test is to be conducted by vendor at his own cost in any recognized test laboratory or in house testing laboratory, before despatch clearance of cables. Sampling for this test is to be done randomly once for each order, provided type of insulation remains same.
 - b. Dielectric Retention Test: The dielectric strength of the cable insulation tested in accordance with NEMA WC - 5 at $75 \pm 1^{\circ} \text{C}$ shall not be less than 50 % of the original dielectric strength. (For PVC insulated cables). Test certificates with respect to this test (not older than one year) from recognised testing laboratory to be furnished for review by LEPL before despatch clearance of cables. In case test certificates are not available, test is to be conducted by vendor at his own cost in any recognized test laboratory or in house testing laboratory, before despatch clearance of cables. Sampling for this test is to be done randomly and once for each order.
 - c. Oxygen Index Test: The test shall be carried out as per ASTM D2863 or applicable Indian Standard specifications. Sampling to be done for every offered lot/size as per sampling plan.

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- d. Flammability Test: The test shall be carried out on finished cable as per IS - 10810 (part 61 & 62). Sampling for these tests is to be done randomly once for each order, provided outer sheath remains same. The acceptance criteria for tests conducted shall be as under:
 Part-61- The cable meets the requirement if there is no visible damage on the test specimen within 300 mm from its upper end.
 Part-62- The maximum extent of the charred portion measured on the test sample should not have reached a height exceeding 2.5 m above the bottom edge of the burner at the front of the ladder.
- e. Test for rodent and termite repulsion property: The vendors shall furnish the test details to analyse the property by chemical method. Sampling to be done for every offered lot / size as per sampling plan.

5.2 Cable Accessories

Type tests should have been carried out to prove the general qualities and design of a given type of termination / jointing system as per IS-13573. The type test certificates from independent testing laboratory shall be submitted before despatch.

6. MISCELLANEOUS MATERIAL SPECIFICATIONS

All materials and hardwares to be supplied by the contractor shall be new, unused and of best quality and shall conform to the latest specifications of Bureau of Indian Standards.

6.1 Cable Trays:

These shall be ladder type trays either prefabricated hot dip galvanized sheet steel trays or site fabricated angle iron painted trays as specifications of Bureau of Indian Standards.

6.1.1 Pre-fabricated hot dipped galvanized trays

The cable trays shall comply to the requirements specified in LEPL installation std.

6.1.2 Site fabricated angle iron trays


Angle iron cable trays shall be fabricated from standard rolled angle iron sections of size 75x75x8 for runners for supporting spans limited to 3000 mm. Cross support shall be 25 x 6 mm MS flat for tray width upto 500 mm and 32 x 6 mm flat for tray of more than 500 mm wide and spacing between two cross supports shall not exceed 250 mm.

- 6.1.3 Vertical supports for both the prefabricated and site fabricated type trays shall be fabricated out of ISMC 100 and horizontal supports shall be with 65 x 65 x 6 mm angle iron sections. Outer most tier of all vertical cable trays shall be covered with GI sheet for protection against physical damage to cables.

Cable racks and trays shall be covered by removable top covers on upper most tier allowing adequate ventilation in following cases where :

- Mechanical damage of cables is likely to occur during maintenance in the plant.
- Oil or spillage of chemicals can be expected.
- Protection from exposure to sun is required.

GI cover sheet shall allow adequate ventilation to the cables and shall be in standard length of 3000 mm, flanged on both sides for fixing on cable tray. Covers shall be complete with required GI hardwares.

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6.2 Cable Glands:

Cable glands shall be of nickel plated brass double compression type suitable for outdoor termination. For indoor protected location single compression glands may also be considered selectively, cable glands for the flameproof equipments located in zone-1 and zone-2 areas shall be of flameproof type and suitable for the Hazardous location. They shall be CMRS tested/certified.

6.3 Connectors:

Power cable terminations shall be made with crimped type tinned copper solderless lugs which shall be suitable for the cable size mentioned in cable schedule.

6.4 Ferrules:

Ferrules shall be of approved type and of size to suit core size mentioned and shall be employed to designate the various cores of control cable by the terminal numbers to which the cores are connected, for ease of identification.

7. CABLE LAYING

7.1 General

Cable installation shall include power, control, lighting etc. cables. These shall be laid in trenches/ cable trays as detailed in the cable layout drawings. Cable routing given on the cable layout drawings shall be checked in the field so as to avoid interference with structures, heat sources, drains, piping, airconditioning duct etc. Any change in routing shall be done to suit the field conditions wherever deemed necessary, after obtaining approval of Engineer-in-charge.

7.1.1 LT power and control cables shall be separated from each other by adequate spacing or by running through independent pipes, trenches or cables trays, as shown on layout drawings/installation standards. Details of cable routes and cable spacing not shown in detail on these drawing shall be determined by the contractor and approved by the engineer in-charge.


When single core cables are laid in flat formation, the individual cable fixing clamps and spacers shall be of non-magnetic material. As a general practice, the sheath of single core cables shall be earthed at one point to keep sheath at earth potential unless otherwise stated. Single core cables, when laid in trefoil formation shall be braced by suitable clamps at a distance, not exceeding 3 meters along the cable routing.

The Telephone, Communication and Fire alarm cables shall run on instrument trays/ducts/ trenches in the units. Wherever these are not available, cables shall be taken in a separate trench/tray with a min. spacing of 600 mm from power and control cables but in any case such separation shall not be less than 300 mm.

Telephone, fire alarm and plant communication cables shall be directly buried in road berm area, (unless otherwise specified in cable layout drawings) .. These cables shall cross power cables preferably at right angles. Street lighting cables shall be laid on the other side of road berm area

7.1.2 The lengths indicated in the cables schedule are only approximate. The contractor shall ascertain the exact length of cable for a particular feeder by measuring at site. All cable routes shall be carefully measured. Before the start of cable laying, the contractor shall prepare cable drum schedule and get that approved by Engineer-in -charge to minimize/avoid straight through joints and then the cables cut to the required lengths, leaving sufficient lengths for the terminations of the cable at both ends. The various cable lengths cut from the cable reels shall be carefully selected to prevent undue wastage of cables. Extra loop length shall be given for feeder cables where required as per the directions of Engineer-in-charge to meet contingencies

Cables shall be laid in directly buried trench or in RCC trench (underground trench) or in cable tray along pipe sleeves as shown on cable layout drawings.

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7.1.3 Cables shall be neatly arranged in the trenches / trays in such a manner that criss-crossing is avoided and final take off to the motor / switchgear is facilitated. Arrangement of cables within the trenches / trays shall be in line with cable layout drawings. Cable routing between cable trench and equipment/motors shall be taken through GI pipe sleeves of adequate size. Pipe sleeves shall be laid at an angle of maximum 45° to the trench wall. Bending radii of pipes shall not be less than 8D. It is to be ensured that both the ends of GI pipe sleeves shall be sealed with approved weather proof sealing plastic compound after cabling. In places where it is not possible, cables shall be laid in smaller branch trenches.

7.1.4 All cables shall be identified close to their termination point by cable tag numbers as per cable schedule. Cable tag numbers shall be punched on aluminium straps (2mm thick, 20 mm wide and of enough length) securely fastened to the cable and wrapped around it.

Each underground cable shall be provided with cable tags of lead securely fastened every 30 m of its underground length with at least one tag at each end before the cable enters/leaves the ground. In unpaved areas, cable trenches shall be identified by means of cable markers as per installation drawing. The cable markers shall be placed at location of changes in the direction of cables and at intervals of not more than 30 m and also at cable straight through joint locations.

7.1.5 All temporary ends of cables must be protected against dirt and moisture to prevent damage to the insulation. For this purpose, ends of cables shall be taped with an approved PVC end cap or rubber insulating tape.

7.1.6 Each row of cables shall be laid in place and before covering with sand. All wall openings/pipe sleeves shall be effectively sealed after installation of cables to avoid seepage of water inside building/lined trench. Every cable shall be given an insulation test in presence of Engineer-in-charge/Owner before filling the cable trench with sand. Any cable which is found defective shall be replaced.

7.1.7 Where cables pass through foundation walls, the necessary openings shall be provided in advance for the same by another agency. However, should it become necessary to cut holes in existing structures for example floor slab etc., the electrical contractor shall determine their location and obtain approval of the Engineer-in-charge before carrying out the same.

7.1.8 Cables for road crossings shall be taken through ERC (Electrical Road Crossing) as shown in the cable layout drawings.

At road crossing and other places where cables enter pipe sleeves adequate bed of sand shall be given so that the cables do not slack and get damaged by pipe ends.

7.1.9 Wherever cable trench crosses storm water, waste water channel/drain, cables shall be taken through PVC/RCC pipes. Where cables are required to cross drains of depth more than 1200 mm, cables shall be taken over the drain on cable trays supported suitably using ISMC 150/200 sections.


7.1.10 Ends of cables leaving trench shall be coiled & capped and provided with protective cover till such time the final termination to the equipment is completed.

7.2 Cables laid direct in ground

Cables shall be laid underground in excavated cable trenches where specified in cable layout drawings. Trenches shall be of sufficient depth and width for accommodation of all cables. Cables shall be properly spaced and arranged with a view of heat dissipation and economy of design. Maximum number of cable layers in trench shall be preferably limited to 5 layers.

Minimum depth of cable trench shall be 750 mm for LT Cables. The depth and the width of the trench shall vary depending upon the number of layers of cables as per LEPL installation Standards

Cables shall be laid in buried trenches at depth as shown in the cable layout drawings. It is to be insured by the contractor that the bottom of buried trenches shall be cleared of all rocks, stones and sharp objects before cables are placed. The trench bottom shall be filled with a layer of sand. This sand shall be leveled and cables laid over it. These cables shall be covered with 150 mm of sand on top of the largest diameter

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cable and sand shall be lightly compacted. A flat protective covering of 75 mm thick second class red bricks shall then be laid and the remainder of the trench shall then be back -filled with soil, rammed and leveled.

7.3 Cables laid in concrete trench

Cables shall be laid in 3 or 4 tiers in concrete trench as shown on layout drawings. Concrete cables trenches shall be filled with sand in hazardous area to avoid accumulation of hazardous gases and oil. RCC covers of trenches shall be effectively sealed to avoid ingress of chemical and oil in process area. Removal of concrete covers where required for the purpose of cable laying and reinstating them in their proper position after cables are laid shall be done by electrical contractor.

All wall openings/pipe sleeves shall be effectively sealed after installation of cables to avoid seepage of water


7.4 Above ground cables

- 7.4.1 Cables installed above grade shall be run in cable trays, clamped on walls, ceiling or structures and shall be run parallel or at right angles to beams, walls or columns. Cable routing shall be planned to be away from heat sources such as hot piping, gas, water, oil drainage piping, air-conditioning duct etc. Each cable tray shall contain only one layer of cables as far as possible for power cables. However control cables may be laid in double layer in the cable trays.
- 7.4.2 Individual cable or small group of cables (upto 3 to 4 cables) which run along structures / walls etc. shall be clamped by means of 16 SWG GI saddles on 25 x 6 mm saddle bars. Alternatively small group of cables can be taken through 100/150 mm slotted channel tray / ISMC 100. Cables shall be supported so as to prevent sagging. In general, distance between supports shall be approximately 300 mm for cables upto 25 mm diameter and maximum 450 mm for cables larger than 25 mm dia. to prevent the sagging of cables.
- 7.4.3 Cable laid on supporting angle in cable trenches, structures, columns and vertical run of cable trays shall be suitably clamped by means of G.I. saddles / clamps, whereas cables in horizontal run of cable trays shall be tied by means of nylon cords. Distance between supporting angles shall not exceed 600 mm.
- 7.4.4 All cable trays (other than galvanised trays) and supporting steel structures shall be painted before laying of cables. The under surfaces shall be properly degreased, derusted, descaled and cleaned. The painting shall be done with one coat of redoxide zinc chromate primer. Final painting shall be done with two coats of approved bituminous aluminium paint unless otherwise specified.
- 7.4.5 Where cables rise from trench to motor, lighting panel, control station, junction box etc., they shall be taken in GI pipe for mechanical protection upto a minimum of 300 mm above grade. Cable ends shall be carefully pulled through conduit to prevent damage to cable.
- 7.4.6 All G.I. Pipes shall be laid as per layout drawings and site conditions. Before fabrication of various profiles of pipes by hydraulically operated bending machine (which is to be arranged by the contractor) all the burrs from the pipes shall be removed. GI Pipes having bends shall be buried in soil/concrete in such a way that the bend shall be totally concealed. For G.I. pipes buried in soil, bitumen coating shall be applied on the buried lengths, Installation of G.I. pipes shall be undertaken well before paving is completed and necessary coordination with paving agency shall be the responsibility of Electrical Contractor.

Following guide shall be used for sizing of G.I. pipe.

- | | | |
|----|------------------------------|---|
| a) | 1 cable in a pipe | - 53% of pipe cross-sectional area occupied by cables. |
| b) | 2 cables in a pipe | - 31% of pipe cross-sectional area occupied by cables. |
| c) | 3 cables in a pipe | - 43 % of pipe cross-sectional area occupied by cables. |
| d) | 4 and above cables in a pipe | - 40 % of pipe cross-sectional area occupied by cables. |

- 7.4.7 After the cables are installed and all testing is complete, conduit ends above grade shall be plugged with a suitable weatherproof plastic compound/bitumen/suitable sealing compound. Alternatively rubber bushes

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shall be employed for the purpose of sealing.

8. TERMINATIONS


- 8.1 PVC / XLPE cables up to 1100V grade shall be terminated at the equipment by means of compression type cables glands suitable for the cable size. They shall have a screwed nipple with conduit electrical threads and check nut. The cables shall be identified close to their termination points at both the ends of cable(cable numbers shall be punched on aluminium straps 2 mm thick and securely fastened to the cable, wrapped around it) and also along the route at recommended intervals, by cable tag numbers.

All cable entries for outdoor termination shall be preferably through bottom. Outdoor cable termination through top of equipment shall not be permitted.

- 8.2 Power cables cores wherever colour coding is not available shall be identified with red, yellow and blue PVC tapes. Where copper to aluminium connections are made, necessary bimetallic washers shall be used.
- 8.3 In case of control cables, all cores shall be identified at both ends by their terminal numbers by means of PVC ferrules suitable for core size. Wire numbers shall be as per schematic/ wiring/inter-connection diagram. All unused spare cores of control cables shall be neatly bunched and ferruled with cable tag at both ends, for future use.

For trip circuit identification additional red ferrules shall be used only in the particular cores of control cables at the termination points in the Switchgear/ Control panels and Control Switches.

- 8.4 Contractor shall drill holes for fixing glands wherever necessary. Gland plate shall be of non-magnetic material/ aluminium sheet in case of single core cables. All unused cable entries on equipment/panels shall be plugged/sealed.
- 8.5 The cable shall be terminated at electrical equipment/switchboards through glands of proper size. The individual cores shall then be dressed and taken along the cables ways or shall be fixed to the panels with polyethylene straps. The cable glanding shall be done as per manufacturers instructions. Cable armour shall not be exposed after termination is complete. In case of termination of cables at the bottom of a panel over a cable trench having no access from the bottom close fit holes shall be drilled in the gland plate for all the cables in one line, then gland plate shall be split in two parts along the centre line of holes. After fixing bottom plate, uncovered cable holes/gaps shall be sealed with cold setting compound.
- 8.6 Crimping of lugs to cable leads shall be done by hand crimping / hydraulically operated tool as per requirement. Insulation of the leads shall be removed before crimping. Conductor surface shall be cleaned and shall not be left open. Suitable conducting jelly shall be applied on the conductor lead. Lugs shall enclose all strands of cable core. Cutting of strands shall not be allowed.
- 8.7 The contractor shall bring to the notice of Engineer-in-charge any mismatch in cable glands, lugs provided with the equipment vis-a-vis to the cable size indicated in cable schedule for taking corrective action.
- 8.8 The cable joints in power and control cables shall be avoided as far as possible. In case a joint is unavoidable, the following shall be insured:
- The number of joints shall be restricted to minimum as far as possible.
 - The location of joints shall be identified with permanent markers.
 - No joints shall be allowed in hazardous areas without the approval of Engineer-in-charge.
- The jointing and termination of medium voltage power cables shall be carried out by trained personnel only. Jointing and termination of high voltage cables shall be done by skilled and experienced joiner duly approved by Engineer-in-charge. Only type tested termination kits of approved make shall be used.
- 8.9 No unauthorised repairs, modifications shall be carried out on the hazardous area equipment terminal boxes and junction boxes. Damaged enclosures of hazardous area equipment shall be brought to the notice of Engineer-in-charge by contractor. After termination is complete, all the bolts, nuts, hardware of terminal box shall be properly placed in its position and tightened.

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8.10 Where required, cable sealing boxes intended to be used with the apparatus shall be filled with solid setting type bituminous compound unless otherwise specified.

9. TESTING AND COMMISSIONING

9.1 Field testing and commissioning of electrical installation shall be carried out as per LEPL specification.

9.2 Before energizing, the insulation resistance of every circuit shall be measured from phase to phase, phase to neutral and from phase/ neutral to earth.

9.3 Where terminations are required in circuits rated above 650 volts, insulation resistance of each length of cable shall be measured before terminating. After completion of terminations measurements shall be repeated.

9.4 The insulation resistance of directly buried cables shall be measured before cable trenches are backfilled. Measurements shall be repeated after back filling.

For cables upto 1.1 kV grade 1000 V Megger shall be used.

9.5 All checks and tests shall be made as per LEPL standard test performa available with site engineer.

9.6 Cable schedule, cable layout drawings, Interconnection drawings shall be marked by contractor's 'AS BUILT STATUS' and two sets of copies shall be submitted to LEPL/Owner.

10. PACKING AND DESPATCH

10.1 Cables shall be despatched in non-returnable wooden or steel drums of suitable barrel diameter, securely battened, with the take-off end fully protected against mechanical damage. The wood used for construction of the drum shall be properly seasoned, sound and free from defects. Wood preservatives shall be applied to the entire drum. Ferrous parts used shall be treated with a suitable rust preventive finish or coating to avoid rusting during transit or storage.

10.2 On the flange of the drum, necessary information such as project title, manufacturer's name, type, size, voltage grade of cable, length of cable in metres, drum no., cable code, BIS certification mark, gross weight etc. shall be printed. An arrow shall be printed on the drum with suitable instructions to show the direction of rotation of the drum.

10.3 Unless otherwise specified, Cables shall be supplied in drum lengths as follows:

LT Cables

| | |
|---|-------|
| Multicore Power cables upto 6 mm ² | 1000m |
| Multicore Power cables from 10mm ² up to 300 mm ² | 500m |
| Single Core Power cables upto 630 mm ² | 1000m |
| Control cables upto 61 cores | 1000m |

A tolerance of ±3 % shall be permissible for each drum. However, overall tolerance on each size of cable shall be limited to ± 2%. Offers with short / non-standard lengths are liable for rejection. If non-standard drum lengths are specified in the data sheet, the same shall be supplied.



GAIL INDIA LIMITED

TECHNICAL SPECIFICATION OF LIGHTING SYSTEM


(Doc. No. GAIL-STD-EL-DOC-TS-004)

| Rev | Date | Purpose | Prepared By | Checked By | Approved By |
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| 0 | 29.01.2019 | Issued As Standard | RKS | SB | SB |



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1.0 SCOPE

This specification defines the requirements for the supply of equipment, materials, installation, testing and commissioning of the lighting system (lighting fixtures, lighting power distribution etc.).

2.0 CODES AND STANDARDS

- 2.1 The work shall be carried out in the best workmanlike manner, in conformity with this specification LEPL Installation Standards, and the relevant specifications/codes of practice of the Bureau of Indian Standards.
- 2.2 In addition to the above it shall be ensured that the installation conforms to the requirements of the following as applicable:

- a. The applicable Indian standards are listed below but are not limited to:
IS : 732 - Code for practice for electrical wiring installations (3 parts).
IS : 2148 - Specification for flameproof enclosures of electrical apparatus.
IS : 3043 - Code of Practice for Earthing.
IS : 5571 - Guide for Selection of Electrical equipments for Hazardous areas.
IS : 5572 - Classification of Hazardous areas(other than mines) having flammable gases and vapours for electrical installation.
Listed above Indian standards have priority over than than standards:

INTERNATIONAL STANDARDS :

IEC 60079 : Electrical apparatus for explosive gas atmosphere.
IEC 60269 : Low Voltage fuses.
IEC 60364 : Low Voltage electrical installations.
IEC 60439 : Low Voltage switchgear and control gear assemblies.
IEC 60445 : Basic and safety principles of Man Machine interface, marking and identification-identification of equipment terminals and conductor terminals.
IEC 60529 : Degree of protection provided by enclosures.
IEC 60664 : Insulation coordination of equipment with in low voltage systems.
IEC 60947 : Low voltage switchgear and control gear.

The minimum enclosures protection according to IEC 60529 shall be :

For indoor use (External) : IP 52
For indoor use (Internal) : IP 42
For Outdoor use (External) : IP 54(with canopy)
Internal : IP 42


- b. Regulations laid down by CEA/Electrical Inspectorate.
c. Regulations laid down by CCE/DGMS (as applicable).
d. The petroleum rules (Ministry of Industry Government of India).
e. Any other regulations laid down by central/state/local authorities and Insurance agencies.

3.0 EQUIPMENT SPECIFICATIONS

All materials, fittings and appliances to be supplied by the contractor shall be new, unused and of the best quality and shall conform to the specifications given hereunder. These shall be manufactured in accordance with the latest revision of the specifications of Bureau of Indian Standards/International standards. In the absence of any specifications for a particular item, contractor shall bring material samples along with proven track record to site and get the same approved by Engineer-in-Charge/Owner before installation.

3.1 Lighting and Power panels

- 3.1.1 Lighting and Power panels (general purpose panels for safe area) shall be made of 1.6mm thick sheet steel and shall be dust and vermin proof. All metal surfaces shall be cleaned free of rust, given a coat of red-oxide primer and finished with two coats of epoxy based paint of shade RAL-7032. Panels shall be indoor/outdoor type as specified. Indoor type panels shall have IP42 degree of protection and shall be suitable for surface or flush mounting on wall surface as specified. Lighting and power panels located outdoor shall be IP55 weather protected and shall also preferably have integral canopy for additional weather protection. The canopy shall be made of 2mm thick galvanized sheet steel or FRP where these are separate from the equipment.

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- 3.1.2 Lighting and Power panels shall have TPN incoming feeder and single phase outgoing feeders. Lighting circuit feeders shall be rated for 10 amps and power circuit feeders shall have current rating of 16Amps. in power panels for window Air conditioning units, power circuit feeder shall be rated for 20 amps. Panels shall be equipped with phase and neutral bus bars of required current carrying capacity. The outgoing feeders shall be provided with single pole miniature circuit breakers (MCBs) for safe areas and double pole MCBs for hazardous areas. The incomer shall be with MCB and ELCB unit unless otherwise specified. Miniature circuit breakers shall be mounted in such a way that the operating levers project outside the front bakelite cover plates for ease of operation. A hinged door to cover the operating knobs shall be provided. In addition, a circuit diagram indicating incomer details and outgoing details viz. Circuit number, circuit rating, load connected and details of the load shall be pasted inside the panel. Also a laminated copy of the diagram shall be provided inside the panel in a suitably, designed pocket. Two external earthing studs for connection to the plant earthing grid shall be provided on the panel. Further, the panel shall be provided with an earth bus bar with terminal studs for connection to the third core of each outgoing circuit. Each circuit phase and neutral shall be given ferrule numbers. Complete wiring inside the panel, shall be neatly bunched with PVC tape and button. Sufficient terminals shall be provided in the terminal block so as to ensure that not more than one wire (core) is connected to a terminal. The panel shall have knock out holes or removable gland plate for the entry of incoming and outgoing conduits or cables. The panels shall be complete with requisite number of cable glands as specified.
- 3.1.3 The Main distribution board (MDB) where used, shall be made of 2mm thick sheet steel panel, dust and vermin proof similar in construction to Lighting and Power panels but with TPN MCB incoming and TPN outgoing (MCB with ELCB units and MCB without ELCB unit as applicable) of required numbers as specified.
- 3.1.4 All MCBs shall be of M9 category as per IS 8828 and sensitivity of ELCBs shall be 100 mA unless otherwise specified.
- 3.1.5 Wherever the size of incoming cable to lighting, power panels/MDB is more than 35 sq. mm a suitable cable adapter box shall be provided and attached to the panel. The incoming cable leads shall be connected to terminal block (bolted type terminals) of required size. This terminal block shall be connected to TPN incomer unit through separate PVC insulated copper conductor wires/bus bars. Sufficient space shall be provided (200 to 250mm) between gland plate and the bottom of terminal block for easy termination.

3.2 Lighting fixtures

The types, makes and catalogue numbers of various types of industrial lighting fixtures shall be as given in Fixture schedule job data sheet. HPMV /HPSV lighting fixtures shall be complete with ballast, starters and capacitor, as required. Control gears shall be integral or non-integral as specified in lighting layout drawings. Unless otherwise specified, all fixtures shall be supplied complete with lamps. Ballast for fixture shall be copper wound or electronic type. The fixtures shall be of high power factor type i.e. at least 0.9 or more.


3.3 Switches

Switches, manufactured in accordance with IS: 13947 shall be used for non hazardous areas. Switches in areas where concealed wiring has been adopted, shall be flush mounting piano type unless otherwise specified. For surface conduit wiring, piano type switches in surface mounted box shall be provided. Industrial Type switches (Weather protected) shall be used for outdoor areas.

3.4 Receptacles

Three pin type 5A/15A receptacles manufactured in accordance with IS: 1293 shall be used for non hazardous areas. The receptacles and the controlling ON/OFF switch shall be mounted in the same enclosure box but these shall be in separate units to facilitate replacement by parts. Flush mounting type receptacles shall be used in areas where concealed wiring has been adopted and surface type shall be used in other areas. For exhaust fans and wall mounted air circulators, socket and switch enclosures shall be separate. In buildings such as sub-station, D.G. shed, Workshop, maintenance shop etc. industrial type metal clad socket outlets and plugs shall be provided. These sockets shall be supplied complete with plugs.

3.5 Outlet Boxes

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The outlet boxes used as point outlets shall be prefabricated type 65mm deep junction boxes. Outlet boxes custom fabricated for sockets, switches, fixtures and fan regulators etc. shall be made of M.S. Sheet having minimum thickness of 1.6mm. Outlet boxes shall be galvanized after fabrication. These shall be complete with terminal block suitable for connection of wires up to 4 sq. mm. Front cover plate shall be of 3mm thick bakelite / PE sheet. The colour shall suit the shade of the walls or shall be white if the shade of the walls is not finalised. The sheet shall extend at least 2 mm on all sides of outlet box. Cover plate shall be fixed by cadmium plated brass screws and cup washers. Outlet boxes shall be provided with adequate number of knock outs on all the sides for ease of wiring either with conduits or without conduits.

3.6 Conduit and Accessories

Conduits for Electrical installations shall conform to IS: 9537. The type of conduit (steel/GI/PVC) shall be as specified on drawing. Black enameled steel or GI conduit shall be of 1.6mm thick and the minimum wall thickness of PVC conduit shall be 2 mm. Generally PVC conduits shall be used in concealed wiring and for surface wiring GI conduit (in plant buildings) and black enamelled steel conduit (in non plant buildings) shall be used.

3.7 Lighting Poles

Lighting poles shall be fabricated (as per LEPL installation standards) from ERW steel tubular pipes of specified section, with joints, swaged together when hot and bevelled on outside edges. Poles shall be coated with bituminous preservative solution on the ground portion of the outside surface. Remainder of the outside surface shall be given one coat of red oxide primer and finished with two coats of aluminium paint. The pole shall have, a marshalling box/ junction box near the bottom to contain HRC fuses/ MCB, a neutral link, an earth stud and terminal block.

3.8 Lighting Mast


- 3.8.1 Lighting masts (Lattice tower) where used, shall be fabricated as per LEPL Standard. They shall be complete with 2 nos. MS flats provided at the base plate for connection to the plant earthing grid. A ladder, platform, handrail, a weather protected TPN switch (at 1500mm from ground level) and a weather protected distribution board fabricated out of sheet steel shall be provided at the top of mast. The TPN Switch and the distribution board shall also have a canopy for additional weather protection. The TPN switch shall be suitable for looping one more lighting mast from the same incoming power supply. The distribution board shall have TP&N busbars of 30 Amps. rating and 12 Nos. outgoing circuits each with a 6A single pole MCB. The distribution board shall have cable entries from bottom. Necessary space provision and suitable mounting arrangement shall be made on top of the tower for mounting of ballast (choke) and condensers for all the circuits and the lighting fixtures. The masts shall be given one coat of red oxide primer and two coats of aluminium paint. Distribution board shall be fabricated out of 2mm thick sheet steel and shall be painted with two coats of enamel over a base coat of red oxide.

3.9 Wires

Wires shall be FRLS PVC insulated and shall be of 660/1100 Volts grade as per IS:694. Conductor shall be of stranded copper and size shall be minimum 2.5 Sq. mm for lighting, 4.0 Sq. mm for 15A power socket circuits and 6 sq. mm for split A/C power socket circuits. Red/Yellow/blue wires for phases, black wire for neutral and green wire for earth shall be used (size of earth wire shall be same as for phase and neutral size). Wire size for air conditioning circuit feeders shall be as indicated in the panel schedule.

3.10 Ceiling fan/ Exhaust fan

Ceiling fans shall be of 1200mm sweep unless otherwise specified with double ball bearing and regulator. The suspension down rod shall be sturdy mild steel rod of adequate diameter and of minimum length of 300mm with shakles suspension arrangement as per IS. For exhaust fans, the sweep dia. and air CFM shall be as specified in job specification. Exhaust fans for battery room shall be FLP type.

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3.11 Decorative switches and sockets

Decorative lighting switches and sockets where specified, shall be modular in design. All these items shall fit into the same frame with overall standard dimensions. Frames shall be suitable for surface and flush mounting in brick / concrete wall. The frames shall be suitable for conduit entry from all the sides. Switches and sockets shall match colors of the frame and cover plates to obtain a combination which shall match decor of the interiors of Control Room, Administrative buildings, offices rooms etc.

4.0 LIGHTING SYSTEM

4.1 General

- 4.1.1 The lighting fixtures in the plant shall be fed from lighting panel. All outdoor lighting shall be group controlled manually or through synchronous timer or photocell. Lighting wiring between panel and lighting fixtures shall be done with FRLS PVC insulated 3-core (phase, neutral and earth) copper conductor armoured cable for hazardous areas. Wiring in the building shall be done by means of 3-core copper conductor PVC insulated FRLS un-armoured cables, or FRLS PVC insulated copper conductor wires in conduit/Metsec channel as specified. All joints of conductors in Switch boards/JBs Fittings shall be made only by means of approved mechanical connectors (nylon/PVC connectors). Bare twisted joints shall not be permitted anywhere in the wiring system.
- 4.1.2 The lighting layouts furnished by owner will indicate approximate locations of lighting fixtures. The electrical contractor shall determine, with approval of Engineer-in-Charge, the exact locations of each fixture in order to avoid interference with piping or other mechanical equipment and also with a view to obtain as much uniform illumination as practicable, and to avoid objectionable shadows. Conduits shall be laid out by the contractor to suit field conditions and as per directions of the Engineer-in-Charge.-
- 4.1.3 On walkways, platforms and other outdoor area, lighting fixtures shall be located nearer to landing of stairs or ladders, gauges, flowmeters, panel boards and other equipment to provide proper illumination.
- 4.1.4 The minimum height of any lighting fixture shall be preferably not less than 2.5 meters above the floor level.
- 4.1.5 All outdoor cable terminations to outdoor junction boxes, panels, socket outlets etc. shall be through bottom or from side. Top entries for cables shall be avoided to avoid water entry. All cable glands for outdoor terminations shall be double compression type and the gland shall be covered with PVC or rubber boot shroud. All unused cable entries shall be plugged with suitable blanking plugs.
- 4.1.6 Mounting height of equipment shall be as under:-
- | | | |
|-----------------------------|---|---|
| Top of Switch Box | : | 1200mm from FFL (Finished floor level) |
| Top of Lighting/power Panel | : | 1800 mm from FFL. |
| 5/15 Amp. Receptacle | : | 300 mm FFL unless otherwise specified (1200 mm for process areas and industrial sheds) |
| Lighting fixture | : | As indicated in layout drawing |
| Exhaust fan | : | In the cutout provided /as indicated in Layout drawings. |
- 4.1.7 Fixtures shall be firmly supported from the structures. Support clamps etc. may be bolted or welded to the existing steel work or metal inserts. In case of concrete structures, where metal inserts are not available, fixtures shall be suspended from concrete surfaces with the help of anchor fasteners. In such cases special care shall be taken to see that anchoring is firm. In places where ceiling fans are provided, lighting fixtures shall be suspended below the level of fan to avoid shadow effect.
- 4.1.8 Circuit cables in a group shall be cleated to structure by using galvanised strip clamps or cable run in cable trays wherever trays are available. Spacers and cleats shall be of required size to accommodate the cables. All hardware shall be galvanised or zinc passivated. Underground lighting cables (in paved areas) shall be taken

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in suitable G.I. sleeves buried at a minimum depth of 300mm from FFL. GI pipe sleeves shall be extended to 300mm above FFL. Exact termination/layout of G.I. pipes (for protection of cables) shall be decided at site as per site convenience in consultation with Engineer-in-charge.

- 4.1.9 Wiring for all outlet sockets shall be done with 3 cores of equal sizes for phase, neutral and earth. The terminals of switch sockets shall be suitable to receive the size of wire specified.
- 4.1.10 All lighting fixtures shall be provided with terminal block with required terminals suitable for connection of wire up to 2.5 sq. mm copper conductor.
- 4.1.11 The cable shall be straightened after unwinding it from the drum. All cables be clamped/laid in straight run without any sag and kink.
- 4.1.12 For location where fan points are shown, fan hooks with junction box shall be provided during concreting.

Where fan hooks and J.Bs. are provided separately JB shall be located within a distance of 300mm from hook for mounting of ceiling rose.

- 4.1.13 Industrial type plug sockets with 20A MCB or rating as per job specification shall be provided at a height of 500mm from FFL for window AC units.

Socket outlets and plugs for installation in Sub-station building, DG shed, workshop, maintenance shop etc. shall be of industrial metal clad type.

- 4.1.14 Wiring for exhaust fans shall be terminated in receptacles as specified in layout drawing and the connection from receptacle to the exhaust fan shall be by means of a flexible cord equivalent in size to the main run of wires. Switch for exhaust fan shall be located in a separate switch board along with other switches.

4.2 Conduit System


- 4.2.1 Surface or concealed conduit system of wiring shall be adopted, as specified in the drawings. Required number of pull boxes shall be used at intervals to facilitate easy drawing of wires. Separate conduit shall be run for lighting and power circuits. Further, conduits for Normal lighting/ Emergency lighting /DC critical lighting shall be separate. Conduit layout shall be decided at site as per site conditions. Drop conduits for switch boards shall be decided by contractor as per wall locations shown in Architectural drawings. All exposed run of conduits on surface, shall be vertical or horizontal.

- 4.2.2 Only threaded type conduit fittings shall be used for metallic conduit system. Pin grip type or clamp type fittings are not acceptable. Conduit ends shall be free from sharp edges or burrs. The ends of all conduits shall be reamed and neatly bushed.

Conduit shall be of minimum 25mm dia. Maximum number of wires permissible in a conduit shall be seven/nine for wire size of 2.5 sqmm/1.5 sqmm. respectively.

- 4.2.3 The exposed outer surface of the conduit pipes, including all accessories forming part of the conduit system, shall be adequately protected against rusting. In all cases, bare threaded portion of conduit pipe shall not be exposed unless such bare threaded portion is treated with anti corrosive preservative or covered with approved plastic compound.
- 4.2.4 Conduit connection to outlet boxes shall be by means of screwed hubs or check nuts on either side. Where concealed wiring is done, junction boxes (65mm deep) shall be used so as to rest on shuttering properly. Conduits shall be laid above reinforcement. All conduit connections shall be properly screwed and Junction box covers shall be properly fitted so as to avoid entry of concrete slurry.
- 4.2.5 Conduit pipes shall be fixed by 1.6mm thick G.I. saddles on 3mm thick G.I. saddle bars of required width in an approved manner at intervals of not more than 50cms for straight run. At places near junction boxes, bends, or similar fittings, saddle and bars shall be provided on either side.

- 4.2.6 Where concealed wiring is to be adopted, conduits shall be laid in time before concreting of the slab. Pull wire (GI or steel) shall be provided inside conduit for the ease of wire pulling. The contractor shall coordinate his

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work with other agencies involved in the civil works in such a way, that the work of the other agencies is not hampered or delayed. Vertical conduit runs shall be made in wall before plastering is done so as to avoid chasing. Where chases are made for conduit run contractor shall fill these chases or any other openings made by them after completing the work and patch the surface. During installation, care shall be taken to see that proper covers are provided to prevent rusting of conduits. Locations of all point outlets, junction boxes shall be marked with brick powder or sand so that these are easily identified after shuttering removal. As built conduit layout drawing shall be submitted by contractor after completion of the work.

4.2.7 All bends and other accessories shall be of the same material as that of conduit and shall have the same protective coatings. All junction boxes shall be MS chromium plated.

4.2.8 After erection, the entire surface conduit system shall be tested, for mechanical and electrical continuity and shall be permanently connected to earth by means of approved type of earthing clamps.

4.3 Hazardous Area

4.3.1 Wiring in hazardous area shall be done by using minimum 2.5mm² copper conductor FRLS, PVC armoured cable. Circuit wiring feeding hazardous areas shall be controlled by two pole switches/MCBs (for phase as well as neutral isolation).

4.3.2 Correct type of lighting equipment (fixtures and JBs) with regard to hazardous protection as specified in the drawing, shall be installed for the areas classified as Zone I, Zone 2 etc.

4.3.3 The terminations in the junction boxes and the lighting fittings shall be done avoiding possibility of loose connections due to vibrations. After the terminations are made the cover of the junction boxes and the lighting fittings shall be closed properly with all bolts and hardware in correct position, retaining its explosion and weather protections. In fixtures having double cable entries, both the entries shall be used for looping in and looping out connection, thus minimising the use of a separate junction box. Wherever separate control gear boxes (C.G. box) are provided looping in and looping out connections shall be through CG box, thus avoiding the use of a additional junction box. All unused cable entries shall be sealed with suitable plugs.


4.3.4 Circuit cables shall be firmly cleated in a group along columns/ beam/ladders/side channels/platform using 1.6mm thick GI saddles on 25x3 mm GI saddle bar at intervals of 400mm to 500mm for straight run and on either side close to bending and at both termination ends as per the directions of Engineer-in-charge. Where required 3 or more of cables may be taken in slotted channel tray after getting the approval of Engineer-in-charge. Cables shall not be routed along hand rails.

Where fire proofing column/structures are encountered, all cabling shall be taken in GI pipes of required size and both ends shall be sealed, well before fire proofing is done. Similarly equipment such as lighting fixture, control gear box, lighting power panels, field call stations, junction boxes etc. shall be installed on a suitable steel mounting frame/distance bracket, thereby avoiding direct contact with the concrete used for fire proofing.

4.3.5 Cable glands for terminating cable on flameproof equipment shall be of double compression FLP type. Any material/equipment specified to be supplied by contractor for installation in hazardous areas, shall be tested by CMRI and duly approved by C.C.E. Nagpur or DGMS Dhanbad or any other applicable statutory authority. All indigenous FLP equipment shall also have valid BIS license as required by statutory authorities.

OUTDOOR FLAME PROOF SOLAR LIGHT TECHNICAL SPECIFICATION:

This Flame proof CFL light is powered by a 14.8 volt Li-Poly battery that is recharged by a 12 watt solar panel. This solar panel charged, flame proof light can be configured to turn on and off only when there is motion. This sensor switches the light off when there is no movement detected and light output mode when movement is detected. Light output comes from a 11 watt CFL lamp that produces 900 lumens. The light can be configured to automatically switch on when ambient light levels drop below 30 lux, which is typically at sunset. The light runs for 15 hours when the battery is fully charged. Charging time for the Li-Poly battery is 5 hours when exposed to direct sunlight. Indirect sunlight will extend the charge time.

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As with all solar powered equipment, charging time is affected by the amount of available ambient light. When ambient light levels drop below a certain level, such as on cloudy days, the unit will not recharge as quickly. Mounting options include ceiling, wall and pendant mounting for the lamp fixture and flat surface or round/square pole mounting such as on utility poles or structure supports for the solar panel.

Technical Specifications:

- Operation:** Automatic Class 1 Div 1 -Groups C, D
- Solar Panel Dimensions:** W-11 3/8" L-15 3/4" D-1" Class 1 Div 2 -Groups A, B, C, D
- Lamp Dimensions:** 7.44"-Diameter, 11.1" Height Class 2, Division 2, Groups F, G
- Panel Watts:** 12 Watt
- Lamp Watts:** 11 T6 Temperature Rating
- Charging Time:** 5 Hours -55 C to 85 C Operating Temp
- Lumens:** 900 Suitable for Marine Environments
- Runtime:** 15 Hours
- Lamp Mounting:** Wall, ceiling or pendant
- Panel Mounting:** Flat Surface / Round/Square Pole Contact us for special requirements
- Battery:** Li-Poly 14.8 Volt
- Charging Time:** 5 Hours
- Wiring:** 30 feet
- Lamp Wiring Hub:** 3/4" Threaded
- Lamp Temp Rating:** T6 - All Voltage and Temperature Ranges

4.4 Building Lighting

- 4.4.1 The type of wiring system shall comprise surface/concealed conduit system or cable wiring as specified on layout drawings.
- 4.4.2 Mounting details of fixtures shall be indicated on the drawings. If specified on the drawings, a group of fluorescent lighting fixtures which are to be mounted end to end, shall be fixed to mild steel cold rolled sections of 50mm x 50mm and of 1.2mm thick (Metsec channel). The entire assembly shall be fixed to the ceiling with necessary number of supports which may be by means of steel conduit or chromium plated chain link as required. The 'Metsec' Channel shall run continuous in suitable sections from one end to other end of wall. The complete channel shall be spray painted, with approved colour as per the directions of Engineer-in-Charge. All wires inside channel shall be neatly bunched by nylon tape & buttons.
- 4.4.3 Wiring in areas above false ceiling shall be done in Surface Conduit (25mm dia GI conduit) suitably clamped to the true ceiling. Vertical drops from true ceiling for panels, switches, receptacles etc. shall be taken in 25mm dia PVC conduit concealed in walls up to switchboards/panels. Lighting fixtures shall be supported from true ceiling. Exact location of fixtures shall be finalized in co-ordination with air-conditioning duct diffuser layout, panels layout and false ceiling grid layout. To facilitate easy maintenance 'Looping back system' of wiring shall be followed throughout. Accordingly supply tapplings and other interconnections including for earthing are made only at fixture connector blocks or at switch boards. Required number of junction boxes shall be used at intervals for wire pulling and inspection.
- 4.4.4 All wires in conduit shall be colour coded as specified. Each circuit shall have independent phase neutral and earth wire. However when group of circuits are run in a single conduit the earth wire can be common.
- 4.4.5 Building conduit lighting system of wiring where measurement is done on point wiring basis generally consists of two parts. The first part is the circuit wiring which includes the work necessary from lighting panel up to switch box and from switch box to another switch box .. The second part is the point wiring which shall include the work necessary from tapping point in the switch box upto various fixtures or fan outlets/ceiling roses.
- 4.4.6 In no case, two different sources or two different phases of supply shall be combined in one switchboard.
- 4.4.7 Switches for light fixtures/exhaust fans in battery room shall be provided outside the Battery room.

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4.5 Street Lighting

- 4.5.1 Street lighting poles to be located on road side shall be installed at a minimum distance of 300mm from the edge of the walkway of the road. Size of wires from marshalling box / Junction box upto fixture shall be min. 2.5mm², copper conductor PVC insulated FRLS.
- 4.5.2 Each pole shall be earthed at two points by connecting to the plant earth grid as shown on Installation standards.
- 4.5.3 Street lighting fixture shall be mounted on steel tubular poles as per standard drawings. The foundation for the street lighting poles will be made by electrical contractor. Street lighting poles shall be supplied with a base plate.
- 4.5.4 The poles shall be numbered as per the drawings/ directions of Engineer in-charge.

OUTDOOR SOLAR LIGHT TECHNICAL SPECIFICATION:

| | |
|------------------------|--|
| PV Module | 74 Wp under STC |
| Battery | Lead acid Tubular Flooded or Tubular GEL / VRLA , 12V- 75 AH @ C/10 |
| Light Source | Compact Fluorescent Lamp of 11 Watt |
| Light Out put | 900±5 % lumens. |
| Mounting of light | Minimum 4 metre pole mounted |
| Electronics Efficiency | Minimum 85% total |
| Inverter | Quasi sine wave or sine wave type |
| Duty Cycle | Dusk to dawn |
| Autonomy | 3 days or Minimum 42 operating hours per permissible discharge |

The Outdoor Solar Lighting System shall be make of TATA BP Solar make MV8 model system.


TECHNICAL DETAILS

PV MODULE

- (i) Indigenously manufactured PV module should be used.
- (ii) The PV module should have crystalline silicon solar cells and must have a certificate of testing conforming to IEC 61215 Edition II / BIS 14286 from an NA BL or IECQ accredited Laboratory.

4.6 Mast Lighting

- 4.6.1 The lattice structure masts shall be installed on concrete foundations with the base plate bolted on to the anchor bolts. The lattice structure shall be painted with a coat of primer and two coats of aluminium paint, the second coat to be given just before handing over to the owner. The masts shall be numbered as per drawings. The masts shall be connected to the plant earth grid at two points
- 4.6.2 The main feeder upto the distribution board of lighting mast shall be through PVC insulated FRLS armoured cable of size as specified in the respective drawing. Wiring from Distribution Board to each flood-light fixture shall be by means of a 3-core 2.5sqmm, copper conductor PVC insulated FRLS armoured cable. All the cables shall be neatly clamped to the structure at intervals not exceeding 25 cms.
- 4.6.3 Alternatively the flood light high mast shall comply to LEPL specification.
- 4.6.4 Exact orientation of flood lighting fixtures shall be decided at site to achieve optimum utility of these fixtures.

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5.0 TESTING AND COMMISSIONING

5.1 Lighting installation shall be tested and commissioned by installation contractor as per LEPL specifications. Pre-commissioning checks and tests, shall include but not be limited to the following:

- a) The insulation resistance of each circuit without the lamps (load) being in place shall be measured and it should not be less than 500,000 ohms. (Between phases, phases to neutral, phase/neutral to Earth).
- b) Current and voltage of all the phases shall be measured at the lighting panel bus bars with all the circuits switched on with lamps. If required load shall be balanced on the three phases.
- c) The earth continuity for all socket outlets shall be checked. A fixed relative position of the phase and neutral connections inside the socket shall be established for all sockets.
- d) After inserting all the lamps and switching on all the circuits, minimum and maximum illumination level shall be measured in the area and recorded.
- e) It shall be ensured that switch provided for ON/OFF control of point (light/fan/socket) is only on LIVE side.
- f) Operation of ELCB's shall be checked.
- g) Contractor shall duty fill in all the above test results and submit the test reports to Engineer-in-Charge in triplicate.

5.2 All lighting layout drawings shall be marked by contractor for 'AS BUILT STATUS' and two sets of copies shall be submitted to LEPL.

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TECHNICAL SPECIFICATION FOR EARTHING (Doc. No. GAIL-STD-EL-DOC-TS-005)

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- 5.0 INSTALLATION OF EARTH ELECTRODE
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1.0 SCOPE

This specification defines the requirements for the supply of earthing materials and installation of the earthing systems.

2.0 CODES AND STANDARDS

- 2.1.1 The work shall be carried out in the best workman like manner / conformity with this specifications, LEPL installation Standards, layout drawings, the latest edition of relevant specifications, codes of practice of Bureau of Indian Standards and OISD Standards listed below:

| | |
|--------------|--|
| SP: 30 (BIS) | Special Publication – National Electrical Code |
| IS: 2309 | Protection of buildings and allied structures against lightning. |
| IS: 3043 | Code of practice for earthing |
| IS: 7689 | Guide for control of undesirable static electricity. |
| OISD 110 | Recommended practices on static electricity |
| OISD 147 | Inspection and safe practice during electrical installation. |

- 2.2 In addition to the above it shall be ensured that the installation conforms to the requirements of the following as applicable:


- Indian Electricity Act and Rules.
- Regulations laid down by CEA/Electrical Inspectorate.
- Regulations laid down by CCE/DGMS (as applicable).
- The petroleum rules (Ministry of Industry Government of India).
- Any other regulations laid by central/state/local authorities and Insurance agencies.

3.0 MATERIAL SPECIFICATIONS

- 3.1 All materials and hardwares to be supplied by the contractor shall be new, unused and of best quality and shall conform to the specifications given here under and to latest specifications of Bureau of Indian Standards. Contractor shall bring material samples to site and get it approved by Engineer-in-charge before installation.
- 3.2 The main grid conductor shall be hot dip galvanized G.I. strip or PVC insulated aluminum conductor/copper conductor. Sizes for main conductors shall be marked on the drawings. Thickness of hot dip galvanizing shall not be less than 75 microns. Earth electrodes shall be as per LEPL's standard drawing.

4.0 EARTHING NETWORK

- 4.1 This consists of main earth conductor (grid conductor) forming a closed ring network with required number of earth electrodes connected to it to provide a common earth for electrical devices and metallic structures. From each earth electrode two distinct connections shall be made to the main earth conductor. The earth plates shall be used for taking multiple earth connections to two or more equipment.
- 4.2 The earth conductor shall be laid along cable trays/cable trench/pipe racks as indicated on the earthing layout drawing. Where lined cable trenches and shall be firmly cleated to the sidewall of concrete trenches using GI clamps at interval of 400 mm to 500 mm and near to the termination end. The earthing conductor shall run along one of the cable trays along a cable route. The earthing conductor shall be suitably cleated and electrically bonded to all the other cable trays on the same cable route at a regular interval of 25 to 30 meter. The earthing for equipment shall be tapped from the main earth conductor and not from cable tray support structure. Earth conductor when laid underground shall be at a depth of 500 mm below finished grade level.
- 4.3 Joints and tapping in the main earth loop shall be made in such a way that reliable and good electrical connections are permanently ensured. All joints below grade shall be welded and shall be suitably protected by giving two coats of bitumen and covering with Hessian tape. Earth strip laid above ground shall be welded across straight through joints and joints shall be suitably protected by giving

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two coats of bitumen to avoid oxidation and insulation film formation of the strip surface. When two earth strips are to be jointed by means of welding, lap welding with an overlapping of strip equivalent to double the width of the strip and all four sides shall be continuously welded. All joints at tapping above ground shall be by means of connector/lugs. A minimum of two bolts of adequate size shall be used for this purpose. Earthing strip joints at earth plate and equipment shall be through GI bolts, nut etc.

- 4.4 Neutral point of DG set and Incoming transformer of Local Electricity Board shall be Solidly earthed by two separate dedicated earth pit.

5.0 INSTALLATION OF EARTH ELECTRODE :

- 5.1 Earth electrodes shall be installed as shown in the earthing layout drawing and in accordance with the standard drawings and IS:3043. Their location shall be marked to enable accurate location by permanent markers.
- 5.2 All earth electrodes shall preferably be driven to a sufficient depth to reach permanently moist soil. Electrodes shall preferably be situated in a soil which has a fine texture and which is packed by watering and ramming as tightly as possible. Wherever practicable, the soil shall be dug up, all lumps broken and stones removed from the immediate vicinity of the electrodes. Earth pit with all accessories shall be provided as per drawings.
- 5.3 All earth electrodes shall be tested for earth resistance by means of standard earth test meter. The tests shall take place in dry months, preferably after a protracted dry spell.
- 5.4 The electrodes shall have a clean surface, not covered by paint, enamel, grease or other materials of poor conductivity.
- 5.5 Earth electrodes shall be located avoiding interference with road, building foundation, column etc.
- 5.6 The disconnect facility shall be provided for individual earth pits to check their earth resistance periodically.
- 5.6 The distinct No. shall be provided on all earth electrode as per approved drawing. Earth resistance, date shall be marked on a plate above grade level.

6.0 CONNECTION

The earth system connections shall generally cover the following:


- Equipment earthing for personnel safety.
- System neutral earthing
- Static and lightning protection

- 6.1 The following shall be earthed.

- System neutral.
- Current and potential transformer secondary neutral
- Metallic non-current carrying parts of all electrical apparatus such as transformers, switchboards, bus ducts, motors, neutral earthing resistors, capacitors, UPS, battery charger panels, welding receptacles, power sockets, lighting/power panels, control stations, lighting fixtures etc.
- Steel structures/columns, rail loading platforms etc.
- Cable trays and racks, lighting mast and poles
- Storage tanks, spheres, vessels, columns and all other process equipment.
- Fence and Gate for electrical equipment (e.g. transformer, yard etc.)
- Cable shields and Armour
- Flexible earth provision for Wagon, Truck
- Shield wire

Conductor size for branch connection to various equipment shall be as per LEPL Installation Standards unless otherwise stated on earthing layout drawings.

- 6.2 All process pipelines shall be bonded and earthed at the entry and exist points of battery limit of hazardous area.


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- 6.3 Steel pipe racks in the process units and offsite area shall be earthed at every 24 meters.
- 6.4 Equipment/street light pole etc. located remote from main earth network may be earthed by means of individual earth electrode and earth conductor unless otherwise stated in job specifications.
- 6.5 **LIGHTNING PROTECTION** shall be provided for the equipment, structures and buildings as shown on layout drawing. An independent earthing network shall be provided for lightning protection. Lightning protection system shall generally comprise lightning finials (air terminals), roof conductors, down conductors, test links, and earth electrodes. The number, types, materials and sizes shall be in accordance with the drawings. Air terminals shall be mounted on top of buildings or structure as required. All air terminals shall be inter-connected with roof conductors, pipes, hand rails or any other metallic projection above the roofs shall also be bonded to the roof conductors. Down conductors from air terminals or from roof conductors shall be routed as directly as possible to the test links on earth buses, with minimum bends. All provisions regarding connections of conductors for equipment earthing system shall also apply to lightning protection system. In corrosive atmospheres, plumbing metal for corrosion protection shall cover lightning finials or air terminals.
- 6.6 The main earthing network shall be used for earthing of equipment to protect against static electricity.
- 6.7 All medium and high voltage equipment (above 250V) shall be earthed by two separate from the electrical earthing system.
- 6.8 Plant instrument system clean earthing, UPS system clean/safety earth shall be separate from the electrical earthing system.
- 6.9 All paint, scale and enamel shall be removed from the contact surface before the earthing connections are made.
- 6.10 All earthing connections for equipment earthing shall be preferably from the earth plate mounted above ground wherever provided.

Equipment foundation bolts shall not be used for earthing connection.
- 6.11 Earth connections shall be made through compression type cable lugs/by welded lugs.
- 6.12 All hardware used for earthing installation shall be hot dip galvanized or zinc passivated. Spring washers shall be used for all earthing connections and all connections adequately locked against loosening.
- 6.13 Lighting fixtures and receptacles shall be earthed through the extra core provided in the lighting circuit/cable for this purpose.
- 6.14 The reinforcements of sub-station building and the sub-station floor shall be connected to main earth grid.

7.0 TESTING AND COMMISSIONING

- 7.1 Earthing systems/connections shall be tested as follows:
- 7.2 Resistance of individual earth electrodes shall be measured after disconnection it from the grid by using standard earth test meggar.
- 7.3 Earthing resistance of the grid shall be measured after connecting all the earth electrodes to the grid. The resistance value of an earth grid to the general mass of earth shall be as follows:
 - Earthing resistance of the grid shall be measured after connecting all the electrodes to the grid. The resistance between any point on the metallic earth grid and the general mass of earth shall not m exceed 1 ohm.

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- For lightning protection, the value of 5 ohms as earth resistance shall be desirable, but in no case it shall be more than 10 ohms.

7.4 The resistance to earth shall be measured typically at the following points:

- a) At each electrical system earth or system neutral earth.
- b) At each earth provided for structure lightning protections.
- c) At one point on earthing system used to earth electrical equipment enclosures.
- d) At one point on earthing system used to earth wiring system, enclosures, such as metal conduits and cable sheaths or Armour.
- e) At one point on fence enclosing electrical equipment.


7.5 All earthing layout drawings shall be marked by contractor for 'AS BUILT STATUS' and two sets of copies shall be submitted to LEPL/Owner.

8.0 TEST PROFORMA

The Contractor shall fill up the Test Report after the completion of the tests and shall submit it to the LEPL/Owner duly signed for his approval and acceptance.

INSTALLATION TESTING REPORT - EARTHING INSTALLATION

- 1.0 Earthing System Data
 - 1.1 Type of Electrodes
 - 1.2 Total number of electrodes
 - 1.3 Main earth grid size
 - 1.4 Material
- 2.0 General Checks (Tick if it is in order
Otherwise give details)
 - 2.1 Construction of earth pits and
Installation of ground electrodes as
per layout drawing
 - 2.2 Size of earth conduct for various
Equipment as per layout drawing
 - 2.3 Minimum distance kept between
Two electrodes
 - 2.4 Welding at the joints are properly made:
- 3.0 Tests
 - 3.1 Measured earth resistance of each
electrode in Ohms
 - No.1
 - No.2
 - No.3
 - No.4
 - No.5
 - 3.2 Measurement of earth grid resistance
(with all electrode connected to grid) :
 - a) At each electrical system or
System neutral earth
 - b) At one point on each earthing
System used to earth electrical
Equipment enclosure.

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9. EQUIPMENT EARTHING SCHEDULE

| TYPE OF EQUIPMENT | EARTH CONDUCTOR SIZE (SEE NOTE-1) |
|--|---|
| MOTOR UPTO 3.7 KW | 8 SWG SOLID G.I. WIRE |
| MOTORS FROM 5.5 KW & WELDING RECEPTACLES | 10 MM (3/8") DIA G.I. WIRE ROPE |
| BUILDING COLUMNS | 50x 6 MM G.I. STRIP |
| STORAGE TANKS (VERTICAL & HORIZONTAL) | 50x 6 MM G.I. STRIP |
| LOADING RACKS | 50x 6 MM G.I. STRIP |
| VESSELS & HEAT EXCHANGERS | 50x 6 MM G.I. STRIP |
| SMALL EQUIPMENT & INSTRUMENTS | 8 SWG SOLID G.I. WIRE |
| LIGHTING, POWER & INSTRUMENT PANELS | 10 MM (3/8") DIA G.I. WIRE ROPE |
| MAIN EARTH BUS/ MV & TRANSFORMER | AS SPECIFIED |
| TELECOM/ SCADA / INSTRUMENT | SEPARATE Cu STRIP OF 25x5MM OR 25 SQ.MM INSTULATED FLEXIBLE Cu CABLE (GREEN COLOUR) |
| PUSH BUTTON STATIONS | 8 SWG SOLID G.I. WIRE |
| STREET LIGHT POLES | 10 MM (3/8") DIA G.I. WIRE ROPE |
| LIGHTING TRANSFORMER | 16 MM (5/8") DIA G.I. WIRE ROPE |
| PIPE RACK | 50x6 MM G.I. STRIP |
| BONDING OF PIPE | 25 SQ.MM INSTULATED FLEXIBLE CU. CABLE (GREEN COLOUR) |
| LIGHTNING PROTECTION | 20x3 MM G.I. STRIP |

NOTE:-

- EARTH CONNECTIONS TO INDIVIDUAL EQUIPMENT FROM NEAREST EARTH PLATE/ GRID MAY ALSO BE DONE ALTERNATIVELY USING ALUMINIUM/ COPPER CONDUCTOR PVC INSULATED CORE OF SIZE NOT LESS THAN HALF THE CROSS-SECTION OF RESPECTIVE POWER CABLE TO EQUIPMENT (MOTOR, PANEL ETC.). CONNECTIONS SHALL BE MADE USING CRIMP TYPE OF LUGS.
- GREEN COLOR SLEEVING (ABOUT 50MM LENGTH) SHALL BE PROVIDED AT BOTH ENDS TO DENOTE EARTHING.

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TECHNICAL SPECIFICATION FOR INSTALLATION, TESTING, COMMISSIONING OF ELECTRICAL EQUIPMENTS


(Doc. No. GAIL-STD-EL-DOC-TS-006)

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16.2. Q.A. INVOLVEMENT

16.3. TEST SHEETS


17. ACCEPTANCE OF INSTALLATION

APPENDIX 1 - LIST OF CODES, STANDARDS & STATUTORY REGULATIONS

APPENDIX 2 – CABLE

1. TESTING AND ELECTRICAL MEASUREMENTS OF CABLE INSTALLATIONS


1.1. INSULATION RESISTANCE TEST ON NEWLY INSTALLED CABLES BEFORE

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JOINTING

1.2. TEST RESULT OF COMPLETE CABLE –INSTALLATION

2. CABLE INSTALLATION PLAN

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1.0 GENERAL**1.1. SCOPE**

This specification covers the technical requirements for equipment, materials and installation methods, testing and commissioning of electrical system which will generally include the following:

- 1) Power Distribution Boards/Power Control Centers
- 2) Lighting Installation, including Lighting Distribution Boards, Lighting Fittings & Socket Outlets
- 3) Wiring for Power, Control, Lighting
- 4) Earthing of Electrical Equipment, & Lightning Protection
- 5) Emergency Power AMF D.G. Set
- 6) Batteries & Associated Equipment

Basic and detailed engineering including sizing and selection of electrical/CP system equipment / switch boards / cables / lighting and other materials required within the battery limit of each stations and terminals shall be performed by the detail engineering contractor. These shall include, but not limited to the following:

- a. Power distribution diagram
- b. Load calculation
- c. Transformer sizing calculation
- d. DG sizing calculation
- e. UPS sizing calculation along with associated back-up Ni-Cd battery bank
- f. Calculation for lighting system, earthing and lightning protection system, voltage drop etc
- g. Sizing of all power & control cables
- h. Preparation of cabling, lighting, earthing, lightning protection, equipment layout including other associated documents such as cable schedule, lighting/power panel schedule, cable interconnection diagrams for terminals and Sv station.
- i. Preparation of area classification drawings as per IS:5572, IEC:60079 and Petroleum rules for Terminals and SV station.

1.2. CODES, STANDARDS AND STATUTORY REGULATIONS


All equipment, materials and construction shall be in accordance with the latest issues of ISS, Indian Electricity rules, fire insurance regulations, factory act and regulation.

1.3. RELATED DOCUMENTS

This specification is to be read in conjunction with the other Bid document, which will include General Conditions of contract, Special Conditions of Contract, Specific Requirements and Schedule of Quantities and Rates. The scope of work shall be defined in Schedule of Quantities & Rates. In case of conflict between this Specification and Specific Requirement, the latter shall govern.

GENERAL INFORMATION :

1. INSPECTION ORGANISATION : The following recommendations will apply to all installations:
 - a) Inspection shall be carried out and witnessed by suitably trained persons.
 - b) All inspections shall be reported to the electrical department/Senior Electrical Engineer.
 - c) Inspection shall as far as practicable, be independent of maintenance, construction and

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- operation activities.
- d) Wherever possible, an authorized inspector shall be appointed to be responsible for all inspecting activities, including scheduling, documentation and reporting.

2. GENERAL INSPECTION :

- a) Electrical installations and equipment, which have been completed and are ready for Operation shall be subject to certain take over procedures, which shall have been agreed before the pre-commissioning stage.
- b) Inspection will give evidence of sub standard or in adequate items at an early stage, thus avoiding delays in commissioning progress.
- c) Systematic performance of the take over inspection procedures will facilitate the collection of accurate as-built information, essential for the completion of the equipment record system, refer to section 4 for details of requirements.

3. TESTING ACTIVITIES :

- a) Prior to commissioning, the electrical installations and equipment shall be subject to a comprehensive test procedure as detailed in section 5. all test results shall be reported on the inspection forms(data sheets), section 22.

4. SAFETY ASPECTS :

- a) All inspecting and testing activities shall be carried out in accordance with the procedures in section 3 to 5 and the recommendations included in the vendor specifications for each item of electrical equipment.
- b) For activities in hazardous areas the following additional recommendations shall be adhered to :
Electrical equipment shall not be opened until it has been isolated/discharge and the voltage shall not be restored until the enclosure has been completely re-closed. Testing in hazardous areas may be carried out, provided that areas where sparking is likely to occur, are proven to be gas free and the appropriate safety / fire permits.

2.0 DESIGN

2.1. EQUIPMENT & MATERIALS

Equipments supplied by the Contractor shall conform to the Owner's/Owner's Representatives 'Particular Specifications' for such equipment. These specifications may also be detailed in the documents. Materials not specifically described shall be of the best quality, complying with applicable codes, standards or current Owner's representative practice.

2.2. DOCUMENTS


These shall include but not limited to the following:

Calculations:- Earthing, Lightning Protection, Lighting, CP(TCP/PCP), Cable sizing, Load list, schedule, SLD, UPS Sizing, Servo Stabiliser sizing, DG sizing, Heat loss etc.

These shall include but not limited to the following:

Layouts:- Equipment, Indoor/Outdoor earthing, Indoor/Outdoor lighting, Indoor/Outdoor cable layout, hazardous area classification, CP cable layout etc and other if any.

Bill of materials

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2.3. APPROVAL OF DRAWINGS

- 2.3.1. All design calculations & drawings prepared by the Contractor shall be submitted to the Owner/ Owner's representative for comments/approval, before they are finalised. The number of copies to be furnished by the Contractor shall be indicated in the "Drawing & documents".
- 2.3.2. The Contractor shall be responsible for obtaining approvals of drawings and installation from statutory Authorities and Electrical Inspector.

3.0 EQUIPMENT & MATERIALS

3.1. GENERAL


- 3.1.1 All equipment and materials supplied by the Contractor shall be suitable in all respects for the type of environment in which these are to be used.
- 3.1.2. All equipment shall be of robust construction. The enclosures of equipment installed indoors shall be dust and damp proof. Equipments installed outdoors shall have weather proof enclosures.
- 3.1.3. For equipment installed outdoors, particular attention should be paid to the following:
 - a) Fixing holes shall not be provided through the enclosure of casing of any component. External mounting lugs with fixing holes shall be provided.
 - b) Removable covers and cable entries at the top of the equipment shall be avoided as far as possible.
 - c) Gaskets shall be secured to the main parts of the enclosure, in such a way, that they need not be detached during normal installation and maintenance. Gasket material shall be non-deteriorating and shall not deform or set with age. Where hinged doors are provided, the door fasteners shall be designed to ensure uniform pressure at all points on the gasket, when the door is closed.
- 3.1.4. Equipment used in hazardous areas shall be certified by a competent authority as suitable for use in such areas. The enclosures and other requirements shall be in accordance with the ISS.
- 3.1.5. All equipment and materials supplied by the Contractor shall be inspected & approved by Owner/Owner's representative regarding its quality, conformity with specifications and standards and suitability for site conditions.
- 3.1.6. The Contractor shall furnish required number of copies of test certificates from manufacturers for the equipment.

3.2. CABLE & CONDUIT ENTRIES

Tapped entries shall be provided on equipments, for conduits and cables as far as possible. If tapped entries cannot be provided on the enclosure, conduit or cable glands terminated at the enclosure shall be effectively bonded to the same by means of an earthing or bonding washer.

3.3. EARTHING TERMINALS/EARTH BUS

All metal work of the enclosures and non-current carrying metallic parts of the equipment shall be effectively bonded to one another and connected to two external earth terminals provided on the

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enclosure. In equipments, such as Power Control Centres or Distribution board an earth bus running along the entire length of the board should be provided in place of earth terminals, to which the bonding of internal components shall be carried out, the earth bus in turn shall be connected to the main earthing system by 2 separate and distinct connections.

3.4. EQUIPMENT AND MATERIALS SUPPLIED BY THE CONTRACTOR

All equipment and materials required for the complete electrical installation shall be supplied by the Contractor.

3.5. CABLE

3.5.1. The types of cables used in the installations shall generally be as given below. If any Other special types of cables are required to be used, details of the types will be given in the Bid documents.

3.5.1.1 XLPE insulated with XLPE/rubber inner sheath armoured unarmoured and with overall XLPE sheath with aluminum or copper conductors.

3.5.1.2 Multicore flexible cables, with stranded copper conductors, rubber / XLPE insulated, with or without pliable armour and with an overall XLPE / Rubber Sheath.

3.5.1.3 Single core XLPE insulated cables with copper/aluminium conductors.

3.5.2 Cable Terminations and Cable Joints

3.5.2.1 Heavy duty XLPE cables, upto 1.1. KV grade (armoured & unarmoured) shall be terminated by means of a compression type cable gland. In hazardous areas or for outdoor installation, cable glands with two seals, one on outer sheath and one on the inner sheath, shall be used. In safe and indoor areas, cable glands, with only one seal on outer sheath may be used. In case of glands for armoured cables, armour earthing cone or washers shall be incorporated in the gland.

3.5.2.2 Cable Glands used in Division 2 hazardous areas shall be flameproof type.


3.5. CONDUITS & CONDUIT ACCESSORIES

Heavy gauge, screwed, rigid steel/XLPE conduits shall comply with IS : 9537. Steel conduit may be black enamelled or galvanised as specified in the Bid documents and drawings. XLPE conduit may be black or grey as specified.

All conduit fittings and accessories shall be of cast iron/malleable iron, Provided with screwed entries, and of robust construction. Only large round junction boxes (min. dia. 80 mm) shall be used in the installation. Large round and adaptable rectangular junction boxes, shall have external fixing lugs. Two external and internal earthing terminals complete with hardware shall be provided on the steel junction boxes. Terminal blocks of adequate rating and number shall be provided in the junction boxes for looping.

All conduits and accessories shall be black enamelled or galvanised as specified in the BOQ.

3.6. STRUCTURAL STEEL

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All structural steel such as channels, angles, flats, plates, etc. used in the installation shall be new and of best quality, conforming to relevant Indian Standards.

3.8. CARE OF EQUIPMENT AND MATERIALS

3.8.1 Storage and Care prior to Erection

The contractor shall be entirely responsible for the safe storage and care of equipment and materials during execution of the contract.

3.8.2. Care of Equipment After Erection

The Contractor shall be responsible for the care and maintenance of all electrical equipment, after installations is completed and until the Certificate of Acceptance of Electrical installation is signed by the Owner.

The Contractor shall ensure that the proper enclosure of equipment is maintained at all times and that access doors or covers are opened only when necessary to work upon the equipment. All unused cable or conduit entries shall be effectively sealed.

The Contractor shall bring to the attention of the Owner / Owner's representative, in writing, any damage which may occur to electrical equipment after installation and shall also notify the Owner's representative of any abuse of electrical equipment which might cause damage.

4.0 CIVIL WORK

4.1. GENERAL

All major Civil Work such as foundation for electrical equipment, sub-stations or switch room buildings shall generally be carried by contractor's civil team. However, minor civil works such as grouting of equipment foundation bolts, breaking and remaking of floor walls, etc. is included in the scope of Contractor's electrical team.

Excavation & backfilling of trenches for directly buried cables, earth electrodes, installation of street lighting poles (including concrete foundation for poles) is included in Contractor's scope of work. Provisions of hume pipes for road crossings may also be included in the scope of Contractor's work.

5.0 INSTALLATION OF POWER CONTROL CENTRE & DISTRIBUTION BOARD

5.1. GENERAL

The Contractor shall carry out a preliminary inspection of the equipment to ensure that the switchgear to be installed is in a satisfactory condition.


5.2. INSTALLATION

The Contractor shall place the switchgear correctly on the bases or foundation prepared for the same. If the switchgear consists of a switchboard with number of panels bolted together, he will place all sections of the switchboard correctly, align them and bolt the

sections together to form one continuous switchboard. The switchgear shall then be secured to the foundation by means of nuts and bolts or foundation bolts grouted in the base. The Contractor shall also make inter-section bus/wiring connections.

The Contractor shall clean all parts of the switchgear, plug and socket contacts, auxiliary switches, etc. Conducting petroleum jelly shall be applied to all electrical contact surfaces.

The Contractor shall lubricate all moving parts of the Circuit Breaker mechanism with recommended lubricants, and ensure satisfactory mechanical operation. Alignment of drawout type circuit breakers or switches shall be checked, for horizontal and/or vertical movements and its correctness shall be ensured. Operation of all mechanical inter locks shall also be checked.

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The Contractor shall generally check all internal wiring of the switchgear for its accuracy as per Vendor's wiring diagram. Satisfactory operation of all controls and protection circuits, relays, meters & electrical interlocks shall also be checked. Relay settings and adjustments, if any, shall also be carried out by the Contractor.

The insulation resistance of switchgear shall be tested with a 500 megger.
The Contractor shall carry out the high voltage tests on the switchgear.
The Contractor shall also carry out Primary and Secondary injection test and check the calibration of relays and meters.

5.3 Equipment Clearance

| Sl. No. | LOCATION | CLEARANCE |
|---------|---|---|
| a) | Front clearance between two L.T Panels | 2000mm, (minimum 1500mm). |
| b) | Rear clearance between H.T Panel, L.T Panel and wall | Less than 200mm or more than 750mm (if double front it should be 1500mm). |
| c) | Front clearance between H.T and L.T Panel. | 2500 mm or as per vendor recommendation. |
| d) | Side clearance between H.T and L.T Panel or Two HT/LT Panels | Less than 200mm or more than 750mm |
| e) | Front clearance between two H.T Panels. | 3000 mm or as per vendor recommendation. |
| f) | Battery rack to wall clearance for <ul style="list-style-type: none"> - Single row, single/double tier - Double row, single tier - Double row, double tier | 100mm 100mm 750mm |
| g) | Battery rack to rack clearance | Less than 200mm or more than 750mm. |
| h) | Front clearance for wall mounted equipment | 750mm |
| i) | Rear clearance for panels from rear(MV) | 1000 mm |


6.0 INSTALLATION OF POWER & LIGHTING DISTRIBUTION BOARD

6.1. PRELIMINARY INSPECTION

The Contractor shall carry out a preliminary inspection of the equipment before installation to ensure that the equipment is in a satisfactory condition.

6.2. INSTALLATION AND COMMISSIONING

The installation of factory built distribution boards shall be carried out generally in the same manner as for Power Control Centre and Distribution board.

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In case of wall/structure mounted distribution boards, the Contractor shall fabricate and install the structural steel framework suitable for mounting the various distribution boards. The Contractor may have to prepare drawing showing the proposed general arrangement, of the structural frame which shall be to the approval of the Owner's representative. The fabrication and installation of the framework shall be recommended only after the approval of drawing. Various items for the distribution board shall be mounted in accordance with the approved drawings.

After completion of the installation of distribution boards, internal/interconnecting wiring shall be checked for correctness. Insulation resistance of wiring and equipment shall be tested with a 500 Volts megger. Operations of all equipment shall also be checked for correct functioning.

7.0 MOTORS

7.1. GENERAL

Motor shall generally be installed by others, along with the driven equipment. The Contractor may, however, be asked to install motors in specific instances.

7.2. COMMISSIONING OF MOTORS

The Contractor, shall however, check all the motors installed, carry out the tests required and commission the motors. The work will include the following:

- a) Check rotor for free movement.
- b) Check end play in bearings.
- c) Check for mechanical defects, if any, by visual inspection.
- d) Inspect bearings to ensure they are greased.
- e) Inspect bearings to ensure they are greased.
- f) Check conduit entries on terminal boxes, block unused entries.
- g) Carry out insulation test with an appropriate megger.

8.0 WIRING WITH CABLES

8.1. GENERAL


This specification covers installation, termination and connection of various types of single-core or multicore cables.

8.2. INSTALLATION OF CABLES

Cable routes and mode of installation shall generally be as shown in the Cable Tray layout drawings. When these are not indicated on the drawings, the Contractor shall determine the same and get them approved from the Owner's representative before commencing the work.

For multiple runs of cables, separation between individual cables shall be provided, when so indicated, to meet the following conditions:

- a) Spacing between power cables to suit the rating factors applied in the cable installation design.
- b) Separation between cables for high voltage service and medium or low voltage service.
- c) Separation between certain types of cables for instrument service and other cables.
- d) Separation between duplicate feeders run along the same route, to prevent damage to one feeder when the other feeder becomes faulty.

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Segregation and separation distance for instrument, communication, F&G, control, medium voltage and high voltage cable shall be minimum 300mm.

8.2.1. Identification tags indicating cable designation, shall be affixed to each cable at ends and at an interval not exceeding 15 meters or at the location where cables change direction or elevation. Cable tags shall be made of stainless steel Aluminium suitable for site and installation conditions. Cable designation shall be embossed in the tags.

8.2.2. Mode of Installation

Modes of installation of cables shall generally be as given below:

- a) Directly buried in the ground.
- b) Installed in built-up trenches in ground, floors, etc.
- c) On cable trays run overhead along pipe/cable racks, or supported on structures, masonry etc.
- d) Cables run along structural steelwork or masonry, supported by suitable saddles, cleats, hangers, etc.

8.2.3. Directly Buried Cables

Trenches shall be excavated along the routes indicated in the drawings and/or approved by the Owner / Owner's representative. They shall be straight and excavated uniformly to a depth shown on the drawings or approved by the Owner / Owner's representative.

After excavation, the floor of the trenches shall be firmed and a bedding of sifted soil or clean sand with a well distributed grain size shall be prepared. The thickness of the compacted bedding shall not be less than 75 mm.

Proper equipment, such as stands for supporting cable drums and rollers for drawing cables shall be used for laying cables in trenches. Cables shall be laid without kinks and utmost care shall be taken in handling them.

After laying the cables, they shall be covered with sifted soil or clean sand well compacted, upto 150 mm above the top of cables. The cables shall be covered by bricks for cable protection at top and both side.


After placing of bricks tiles, the trenches shall be backfilled completely with riddled soil. Large stones shall not be backfilled. The backfill shall be well rammed and compacted.

At road crossings or at specified locations, cables shall be laid in hume pipes or any other type of pipes specified. After drawing the cables, the ends of pipes shall be sealed adequately with wooden plugs or any other approved means, to prevent ingress of soil or dirt into the pipes and ducts.

When directly buried cables enter the buildings, the openings made in walls shall also be adequately sealed to prevent ingress of soil or sub-soil water into the building. Bituminous or suitable type of XLPE compound shall be used for this purpose.

Approved type of cable markers shall be fixed along the cable routes at a distance not exceeding 15 metres along straight routes, and also where cable loops or cable joints are located. The position of cable markers and cable identification tags shall coincide.

When cables are laid in multiple tiers, space between individual tier shall be filled and compacted with sifted soil or sand. Spacing between tiers shall be as specified in the drawings or as approved by the Owner's representative. Protective cable bricks shall be laid above the topmost tier only.

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8.2.4 Cables in Built-up Trenches

Built-up trenches for cables may be provided in outdoor plant areas, buildings, switchrooms, etc. Cables run in trenches shall unless otherwise specified, be installed in sand, in layers.

Each layer of cables shall be laid on a compacted and consolidated bed of clean sand having well distributed grain sizes (silver sand). Each layer of cables shall be covered by a well compacted clean sand upto 75 mm above the top of cables. Next layer of cables will be laid on this and bed. On completion of laying of cables, the whole trench shall be completely sand filled and well compacted. The trenches shall then be covered by anyone of the following methods in accordance with Bid documents.

- a) Fitted with RCC covers (preferably coloured red) and sealed.
- b) Screeded over with red coloured lean concrete to finished payment level.
- c) Fitted with removable steel chequered plate, covers, generally in sub-stations, switch-rooms, control rooms and similar indoor locations.
- d) Fitted with specially designed covers at road crossings or similar locations subjected to heavy traffic.

Cables emerging from trenches for final runs to items of equipment shall be protected by steel pipes upto a height of 200 mm above the finished floor/pavement level. Pipes shall be fixed onto the trench wall and where they pass through the trench cover, shall be sealed with bitumastic compound.

All openings in trenches for ducts, cable entry into buildings, etc. shall be sealed adequately with bitumastic compound or lean concrete.

Where specifically called for in Bid documents, the trenches in non-hazardous indoor areas, such as control rooms, switchrooms, etc., need not be sand filled. Cables may be supported in trenches by means of hangers, cleats, cable trays, etc.

8.2.5 Cables on Walls, Structure or Cable Trays

Cables shall be run on walls, structure or laid on cable trays, as required. Only approved type of cable supports or fixings such as cleats, saddles, hangers or straps shall be used.

8.2.5.1. **Instrument layout drawings**


Cables shall be secured by means of saddle bars and saddles. Minimum clear facing between walls or steelwork and cables shall be 6 mm (1/4"). The type of saddles used shall be as shown in the drawings or subject to the approval of the Owner 1 Owner's representative.

8.2.5.2. **Cables Supported on Cable Trays**

Cables shall be secured to the cable trays by means of single fixing type of saddles or adjustable cable saddles, made of approved material, when run on horizontal or vertical cable trays.

8.2.5.3. **Spacing of Cable Supports**

Maximum horizontal and vertical spacing of cable supports shall not exceed 750 mm (30") and 500 mm (20") respectively. When cables are run on cable trays, they shall be securely supported on each rung of the cable tray.

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8.2.6. Cable Trays

Cable trays shall be one of the following types or as specified in the Bid document:

- a) Site fabricated ladder type cable trays from M.S. Channels, angles, flats as per cable tray details depending on the weight of cables required to be supported on cable trays and maximum cable tray supporting distance. The construction of these cable trays shall be all welded type.
- b) Shop fabricated, heavy pattern, perforated, steel cable tray galvanised or painted as specified in the Bid documents. The cable trays shall be in standard length sections and such fabricated bends or tees shall be used. Individual sections shall be securely bolted together.
- c) Shop fabricated XLPE/FRP cable trays.

Cable trays supports and tray design shall be based on the loading of cable trays. Generally, the design, shall be such that cable trays supports spacing will be 2 metres or more.

8.3. TERMINATION AND CONNECTION OF CABLES

The earthing drawings shall show the requirements of earth cabling up to the earthing systems.

8.3.1 Heavy Duty L T XLPE/XLPE Cables

Heavy duty L T XLPE/XLPE Cables, armoured or unarmoured shall be terminated with double compression type cable glands .

When armoured cables are used, the armour shall be prepared in a manner suitable for the type of cable glands. Armour shall be securely clamped and bonded to the body of the gland. Armour shall be properly cleaned and petroleum conducting jelly applied to the armour as well as clamping surfaces. When specifically called for and in hazardous areas, cable glands shall be further sealed with cold setting XLPE compound.

When cable glands are fixed onto a sheet metal enclosure, with a slip hole, a bonding/earthing washer and a heavy check-out shall be used to ensure effective bonding of the cable gland with the enclosure.

8.3.2 Prevention of Strain at Terminations


Special attention shall be given to ensure that the cable is adequately supported so that there is no strain on the termination or connection of conductors.

Particularly when cables are terminated at equipments which are subject to vibrations, strain relief clamps shall be provided where the support for the cable is derived from the equipment so as to prevent relative displacement of the support with respect to the termination.

8.3.3 Connection of Cable Cores/Conductors.

8.3.3.1. All cable cores or conductors shall be connected to the equipment terminals by means of approved type of connectors. Conductors of small sizes may be directly connected to equipment terminals, without using special connectors. The sizes of directly connected conductors will depend on the type of terminals provided. Connections of larger cables or cables connected to motors shall be made, generally with crimping type cable lugs, unless best quality, approved type, mechanical connectors are used.

8.3.3.2. Conductors shall be thoroughly cleaned and smeared with conducting petroleum jelly

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before they are connected directly or with mechanical connectors, particularly when bi-metallic connections, such as aluminium and copper or brass are made. Materials used for mechanical connectors shall also be of suitable type when bi-metallic connections are involved.

Mechanical connectors or equipment terminals shall be of pressure clamp type (not pinching type), when aluminium conductors are to be connected.

8.3.3.3. Core identification ferrules or coloured XLPE adhesive tapes shall be provided for all multi-core cables at the point of connection. Generally, red, yellow and blue coloured tapes may be used for identification of cores in power circuits, ferrules or numbered tapes shall be used for identification of control cable cores.

9.0 CONDUIT WIRING

9.1. GENERAL

This section covers installation of exposed and concealed conduit wiring. Concealed conduit wiring may be installed above false ceiling or behind panels, etc. or may be embedded in ceiling, walls, columns, or floor.

9.2. CONDUIT INSTALLATION

9.2.1. Surface Conduit Installation

When conduits for exposed or concealed wiring are installed on surface, the complete routing shall be marked on the surfaces. The installation shall be carried out only after approval of the routing by the Owner's representative. Conduit installation shall be carried out accurately and neatly, with conduit runs truly vertical or horizontal. Conduits shall be threaded to close tolerances and burr removed from the ends after threading. All screwed connections shall ensure that at least five threads are engaged and electrical continuity maintained.


Conduits shall be supported with saddles at a spacing of 1200 mm maximum for conduits upto 1" size and 1800 mm maximum for larger sizes. Saddles shall also be provided at both ends of fittings, equipment, devices, junction boxes, bends or offsets, within 200 mm maximum. Minimum clearance between conduits and surface shall be 6 mm. Saddles shall be of cast/malleable iron, cast aluminium or any other approved material, and galvanised painted or cadmium plated.

9.2.2. Embedded Conduit Installation

Conduit installation may be embedded in RCC structures or brick work.

The installation in RCC structures shall be carried out after the form work and reinforcement work is complete, but before concreting. Concreting, will be done only after completion of the conduit installation and its approval by the Owner's representative. Conduits laid in concrete shall have minimum 50 mm cover upto the finished surface and shall preferably be laid behind the reinforcement. Conduits shall be securely fixed to prevent their movement during concreting.

Installation in brickwork will require chases to be made in brickwork, sufficiently deep to provide adequate cover for the conduits. Conduits shall be securely fixed to the brickwork and chases made good.

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In this type of conduit installation, a galvanised fish wire shall be drawn in conduits.

All embedded accessories such as junction boxes, switchboxes, etc. shall be mounted such that they will be flush with the finished surfaces including plaster. All joints in the installation shall be tight and covers properly gasketted and fixed to prevent ingress of concrete slurry, water or dust.

9.3. CONDUIT WIRING

Conduit wiring shall generally be carried out with single core XLPE insulated cables/wires.

The Conduit installation shall be complete in all respects before the cables are drawn in conduits. All conduit runs shall be thoroughly cleaned of dust, moisture, etc. by blowing compressed air or by any other suitable means. An approved lubricating compound (such as soap stone powder, lux flakes or talc) shall be applied to the insulated cables before they are drawn in conduits. The cables shall be neatly bunched together to prevent kinks or twisting.

9.4. SUPPLY AND POINT WIRING

Each point wiring shall comprise the following :

Supply and installation of 1" / 1 1/4" heavy duty M.S. / XLPE conduits with MS/XLPE accessories such as 90° bends, inspection tees etc. as required - supply and pulling of 2 nos. 3/22 XLPE insulated stranded copper single core wires of 440V grade and one number 14 SWG copper wire outside conduit for earthing. It shall also include supply and installation of multi-way large round junction boxes with Dome/Flat covers and four way, 15A terminal block. For suspending of fluorescent lighting fitting dome cover junction box shall be used.

Supply, Fabrication and Fixing of hardware such as Clamp, Saddles, Bolts, Nuts, Framework, etc. as required. 14 gauge bare copper earthing wire shall be run within conduits for earthing of fittings, junction boxes, switch/single phase socket outlet enclosures.

Earthing shall be done at single point.

Wiring from LDB to lighting fittings exhaust fans single phase outlets, shall be carried out with 3/22, YY cables through 1" / 1 1/4" heavy duty M.S. / XLPE conduits.


Junction boxes shall be fixed on brackets, fabricated from 25 x 3 mm MS flat. Such brackets shall be fixed to the ceiling/wall by means of anchor bolts/nylon raw plugs and screws. Each equipment such as lighting fittings, switches, junction boxes, socket outlets, exhaust fans, etc. shall be earthed internally by the third core of the 3 x 2.5 mm YWY cable used.

9.5. MEASUREMENT OF POINT WIRING

Wiring from DB.'s / switchboard to the first lighting fitting through the circuit switch shall be considered as one point. Wiring from the first fitting to the next fitting in the same circuit shall be considered as half point. Wiring to the exhaust fan shall be considered as one point. For measurement of switch socket point wiring, wiring from D.S. / switchboard upto first socket outlet through ckt. Switch shall be considered as one point. Subsequent wiring to nest socket outlet shall be considered as half point. Supply and installation of light fitting, fans, exhaust fans, socket outlets shall be covered under separate item rate.

If a separate circuit is tapped from the same lighting circuit, it shall be treated as half point.

If a socket is located very near to a Distribution Board, it will be considered as half point. Otherwise this shall be considered as an independent point.

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Quoted rate of point wiring is applicable for any length of conduit emanating from LOB to first fig subsequent point also.

10.0 EARTHING AND LIGHTNING PROTECTION

10.1. GENERAL

This section covers installation of earthing system for electrical equipment, static earthing and for lightning protection. Installation of earthing system for an electrical equipment and static earthing shall be carried out in accordance with IS : 3043 - ' CODE OF PRACTICE FOR EARTHING' and IS : 7689 - 'GUIDE FOR CONTROL OF UNDESIRABLE STATIC EARTHING' respectively. Earthing system for lightning protection shall be in accordance with IS : 2309 - 'CODE OF PRACTICE FOR THE PROTECTION OF BUILDINGS AND ALLIED STRUCTURES AGAINST LIGHTNING'.

Generally, a common earthing system shall be provided for equipment earthing and static earthing. The earthing system for lightning protection shall be separate and may be interconnected with the former, unless otherwise specified in the drawings/specific requirement.

10.2. EARTH ELECTRODES

Earth electrodes shall generally consist of copper or G.I. plates buried in ground or copper coated steel rods or cast-iron pipes driven in ground. The type of electrodes shall be specified in the Bid documents. The method of installation of earth electrode shall be in accordance with the drawings or in accordance with IS : 3043, when the drawings are not furnished.

10.3. MAIN EARTH CONDUCTORS

Main earth conductors shall be copper or G.I. flats or stranded copper / aluminium conductors with or without XLPE sheath as specified in the Bid documents. They shall be connected, at one end, to the earth electrode and to the earth bus or test-link at the other end. All connections below ground shall be made by bolting or riveting and brazing or welding. Sizes of main earth conductors shall be as per drawings or as specified. All connections to the test-link or earth bus shall be securely bolted. Contact surfaces shall be tinned and suitably protected with Petroleum Conducting Jelly to prevent corrosion. All connections below ground shall be protected as per IS : 3043.


10.4. EARTH SYSTEMS AND EQUIPMENT EARTHING

Main Earth Loops or Earthing Ring Mains shall originate from the earth bus or test links. Equipments shall be connected to the main earth loops by means of earth conductors.

All electrical equipment viz. Power centres, motors, control stations, switches lighting fittings and other electrical apparatus shall be connected to the main earth loop by means of two separate and distinct, external earth conductors. The material, type and size of the earth conductors will be as shown in the drawings or as specified.

Two earth terminals will, generally, be provided on most of the electrical equipment. However, if these are not provided, the Contractor shall provide the same, by drilling and tapping the equipment suitably and supply necessary hardware. The entire conduit installation, cable sheaths and cable armour shall also be bonded to earth at both ends.

It must be ensured that the conduit installations maintain electrical continuity throughout its entire length. Conduits shall be effectively bonded together at each joint, such as couplings, junction boxes, draw boxes or any other accessories and equipments. Where conduits and screwed cable glands are terminated at equipment enclosures with slipholes,

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earthing/bonding washer shall be used to maintain electrical continuity.

Process equipment and piping requiring static earthing shall also be earthed in a similar manner.

Steel structures for buildings, steel platforms, staircases, ladders, handrails shall also be bonded to the main earth loops by means of two separate and distinct earth conductors at two points which are as remote as possible.

All earth connections with solid or stranded conductors shall be made by means of soldered/crimping cable lugs. Connections with copper or G.I. flats shall be directly bolted type. All hardware used shall be galvanised steel, brass or passivated to prevent corrosion. Spring washer or lock-washers shall be used to make all connections secure and vibration-proof. All contact surfaces shall be thoroughly cleaned and coated with conducting petroleum jelly to prevent corrosion. Copper tapes shall be tinned at contact surfaces.

Main earth conductors from earth bus or test-link to the Earth Electrode shall be coated with bitumastic to reduce straddle potential.

10.5. LIGHTNING PROTECTION

Lightning protection system shall generally comprise lightning finials (air terminals), roof conductors, down conductors, test links and earth electrodes: The number, types, materials and sizes shall be in accordance with the drawings.

Air terminals shall be mounted on top of buildings or structure as shown in the drawings. All air terminals shall be inter-connected with roof conductors, pipes, hand rails or any other metallic projection above the roofs shall also be bonded to the roof conductors. Down conductors from air terminals or from roof conductors shall be routed as directly as possible to the test links on earth buses, with minimum bends.

All provisions regarding connections of conductors for equipment earthing system shall also apply to lightning protection system.

In corrosive atmospheres, lightning finials or air terminals shall be covered by plumbing metal fore corrosion protection.

11.0 ELECTRICAL INSTALLATION IN HAZARDOUS AREAS

11.1. GENERAL


Electrical installation in hazardous areas as defined in IS : 5571 shall be carried out with utmost care and special precautions shall be taken to ensure operational safety.

All personnel, especially supervisory staff, working on such installations shall be fully conversant with the applicable National Standards and Codes of Practice and shall have previous experience of such work.

11.2. EQUIPMENT AND MATERIALS

Electrical equipment and materials used in the installation shall conform to the relevant Standards and shall be certified (by a competent authority) suitable for use in Division 1 or Division 2 hazardous areas, as the case may be.

No modifications shall be made in any certified equipment or material used in the installation which will impair its effectiveness and invalidate the certificate.

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All certified equipments shall be inspected before their use for any damaged or deteriorated condition which will render the equipment unsafe. Such equipments shall not be used in the installation.

When any equipment is dismantled for the purpose of installation, care shall be taken to prevent damage to vulnerable parts such as screw threads, conduits threads, machines surfaces, etc. If the equipment is to remain dismantled for a prolonged period, machined surfaces, screw threads, etc. shall be protected against corrosion by means of grease, oil, petroleum jelly or any suitable corrosion inhibitor. These shall, however, be cleaned thoroughly before re-assembly.

All hardware used for mounting shall be hot dip galvanised or plated to prevent corrosion. All bolted connections shall be made secure and vibration proof by means of locknuts, lock washers, etc.

11.3. WIRING

All wiring in Division 1 hazardous areas shall be carried out with armoured cables or with solid drawn seamless conduits. In Division 2 areas, ERW conduit may be used.

Termination of cables shall be made with certified or approved cable glands boxes shall be effectively sealed. All conductors connections shall be made with soldered/crimping cable lugs, or approved mechanical connectors. It must be ensured that all connections shall be made secure and vibration-proof, by means of locknuts, lock-washers, etc. Prevention of strain at terminations is of utmost importance.

11.4. EARTHING

All provisions for earthing apply with much greater force regarding effective bonding of electrical equipment, cable armour, conduit installation, process equipments and process piping (requiring static earthing) to the earthing system.

Special attention shall be paid to the following :


- a) Adequate support for earth conductors throughout for protection against breakage.
- b) Secure and vibration proof earth connections, protected suitably against corrosion.
- c) Continuity of conduit installation or process piping when static earthing is required, by means of conduit bonds.

11.5. MISCELLANEOUS

All openings between hazardous and non-hazardous areas for cable and conduits shall be properly sealed by approved means. In case of conduit wiring, conduit stopper boxes shall be used in conduit runs at the junction of hazardous and non-hazardous areas or at terminations of conduit runs at any equipment such as motors, starters, push buttons, etc. Stopper boxes at the junction of hazardous and non-hazardous areas, shall be located at the boundary between the 2 areas.

11.6. STEEL WORK

11.6.1. All steel work carried out by the Contractor for equipment and cable supports such as cable trays, brackets, hangers, saddles, etc. shall be of the best workmanship. Only certified

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welders shall be employed for welding. All bolted connections shall be made secure and vibration proof by means of spring washers or lock washers or lock nuts. Fixing or grouting of steel-work in floor, ceilings or walls shall be carried out with approved foundation bolts or fasteners.

11.6.2. Finished steel work shall be thoroughly cleaned by wire-brushing or sand blasting etc. All scales and rust shall be removed. The steel work shall be then painted with 2 coats of approved primer such as red oxide or red lead and shall be finished with 2 further coats of approved paint.

11.6.3. When atmospheric conditions are highly corrosive, chemical works type paints may be specified. In such cases, special primers and paints shall be used for adequate protection from corrosion.

12.0 INSPECTION, TESTS AND COMMISSIONING OF ELECTRICAL EQUIPMENT AND INSTALLATION

12.1. GENERAL

This Section covers the requirements of inspection and tests to be carried out on equipment and installation as well as commissioning of electrical installation. Inspection and tests shall be carried out jointly by the Contractor, Owner & Owner's Representative.

12.2. INSPECTION

Inspection shall be carried out to ensure that the complete installation is carried out in accordance with drawings and complies with the requirements laid down by Indian Electricity Rules, Regulations for the Electrical Equipment of Building by Insurance Association of India (Fire Section), Indian Standard Specifications & Codes of practice, Electrical Inspector, Explosive Inspector and any other statutory regulations. And

competent authorities. The complete installation shall be subject to the approval of any or all of the competent authorities and the Owner / Owner's representative.


12.3. TESTS

The tests specified below shall be carried out on the electrical equipment and installation before commissioning the same. The tests shall be performed by or under the direct supervision of a competent person, qualified to carry out the tests. All tests shall be carried out in the presence of the Authorised Representative of the Owner.

The installation shall not be accepted by the Owner unless it has been approved by the competent authorities, and the authorised representative of the Owner and/or the Owner's representative.

All test results shall be recorded on prescribed ' ELECTRICAL TEST REPORTS ' duly signed by the person conducting the test and by the authorised representative of the Owner and/or the Owner's representative, if tests are witnessed.

In case the installation is found to be not in conformity with the requirements or the test results indicate defective materials or workmanship, the same will have to be rectified to the complete satisfaction of the Owner/Owner's representative and tested again.

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DETAILS OF TESTS

• POWER CONTROL CENTRE WITH ACB


- a) Check proper mechanical operation of circuit breakers including alignment of trolleys in case of draw-out type circuit breakers, smooth operation of all mechanical parts, lubrication, mechanical interlocks etc.
- b) Check contact alignment and wipe, proper sequence of closing and opening of main and arcing contacts.
- c) Check electrical relays, instruments and controls for correct wiring.
- d) Insulation test on bus bars - phase to phase and phase to ground. This test will be carried out with circuit breakers in service position, but contacts remaining open.
- e) Insulation test on relays and control wiring including current and potential transformers and wiring of CT & PT secondary.
- f) Insulation test on circuit breakers in withdrawn position - phase to phase and phase to ground with contacts closed.
- g) Adjust correct settings of relays and/or direct acting trips - as specified.
- h) Operation Test - Energise only control circuits and carry out closing and tripping operations (where AC supply derived from main supply is used for operation, the switchgear bus may be energised). Check operations of electrical interlocks. Check tripping of circuit breakers by manual operations of protective relay contacts. Check operations of mechanical closing and tripping devices. Check lockout conditions for closing of circuit breakers by simulating the required conditions. Check control, indications, sequence interlocks and alarms.
- i) Polarity and connections of instrument transformers - Check for correctness of CT & PT connections provided. Check electrical continuity of secondary circuits with ELV tester.
- j) Adjust spacing of arcing horn/rod gaps, if provided.
- k) Check operation of instruments, meters, relays and tripping of circuit breakers by primary/secondary injections as specified.
- l) Check continuity of power circuits and earth continuity of all non current carrying metallic parts with a low voltage (6 volts or less) continuity tester.
- m) Carry out HV test on power and control circuits, if specifically called for.

• SWITCHGEARS, POWER CONTROL CENTRES (POWER DISTRIBUTION BOARDS), UPS, ETC.

- a) Check equipment, internal wiring, smooth mechanical operation, interlocks, etc.
- b) Check continuity of power circuits and earth continuity of all non current carrying metallic parts with a low voltage continuity tester.
- c) Insulation test for power & control circuits between phases, between phases and neutral and between phase/neutral and ground.
- d) Check operation by energising control circuits (without energising power circuits) for correct functioning. Simulate external controls and interlocks for the same. Note chatter or humming of Contractor and rectify, if necessary.
- e) Check fuse relay and relay.
- f) Carry out HV test on power & control circuits, if specifically called for in Bid documents.
- g) Polarity and connections of instrument transformers - check for correctness of CT & PT connections provided. Check electrical continuity of secondary circuits with ELV tester.

• MOTORS

- a) Check equipment for free movement of rotor, and play, lubrication, and for any other mechanical defects.
- b) Insulation test of motors.

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- c) Check electrical continuity with ELV tester.
- d) No load running of motor noting down no load current and voltages in all three phases.

• CABLES

- a) Insulation Test - between phases, between each phase and neutral and between each phase/neutral and ground Ref. Appendix - II).
- b) In case of lighting wiring, insulation test shall be carried out on lighting feeders with branch circuits open. Branch circuits shall be tested separately with lampholders, plug receptacles and lighting fittings in position, but without lamps. In case of lighting circuits with lamp ballasts and glow starters insulation resistance may be measured between phase and ground only.
- c) In case of directly buried cables, insulation resistance of cables shall be measured before and after the back-filling.
- d) Test all receptacles for correct phase sequence .

• EARTHING SYSTEM

- a) Measure earth resistance of each electrode separately. If a number of earth electrodes are interconnected with one another, combined earth resistance shall also be measured. The earth resistance of each electrode and/or a group of electrodes shall not exceed the values specified.
- b) Continuity test for earth continuity conductors with ELV tester

• BATTERY

- a) Visual inspection of all components.
- b) Capacity test as per I.S.

13.0 INSTRUMENTS & TOOLS

13.1. GENERAL

This section covers the instruments, tools & plant which will normally be required to carry out the electrical installation including testing and commissioning and which shall be made available as and when required by the Contractor. Meters used for tests shall be of proven accuracy and to the satisfaction of the Owner's representative.

13.2. TOOLS AND PLANT

13.2.1. Hand Tools


Screw drivers, pliers, cutters, spanners, hacksaw, hammers, rawl punches, etc.

13.2.2. Power Driven Tools & Equipment

Drilling, grinding, cutting machines, hammers, arc welding set, oxy-acetylene welding and cutting set and welding accessories.

13.3. INSTRUMENTS

- A. Instruments to be always available at Site.
 - a) Insulation resistance tester (Megger) rated 500 volts.
 - b) Multi-meter of a reputed made.
 - c) Clip-on ammeter/voltmeter (tong tester)
 - d) Phase sequence indicator.
 - e) Extra low voltage continuity tester (6 volts or less).

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- B. Instruments to be made available as and when required.
 - a) Insulation resistance tester (Megger) rated 500/100/2500/5000 volts.
 - b) Earth resistance tester with all accessories.
 - c) High voltage testing set.
 - d) Relay testing equipment.

14.0 LABOUR, SUPERVISION, COORDINATION AND PROGRESS, LICENCE, STATUTORY APPROVAL

14.1. SUPERVISORY LICENCE

The Contractor shall possess a valid contractor's licence for the state in which site is located and shall ensure its validity during the duration of the contract. The Contractor shall furnish authenticated copies of certificates to the Owner for himself and his workmen before commencement of work.

14.2. LABOUR

The Contractor shall employ adequate number of supervisors to control the labour force and to carry out the work as per schedule. Supervisory staff shall also possess the minimum qualifications stipulated by statutory and competent authorities.

14.3. SUPERVISION

The Contractor shall employ adequate number of supervisors to control the labour force and to carry out the work as per schedule. Supervisory staff shall also possess the minimum qualifications stipulated by statutory and competent authorities.

14.4. COORDINATION

The Contractor shall coordinate his work with that of other agencies, so that the work can proceed smoothly and without hindrance to all concerned.

14.5. PROGRESS

The Contractor shall submit periodic Progress Reports to the Owner's representative. The period of report shall be determined by the Owner's representative. The Progress Report shall indicate planned progress as per programme and physical progress. The format in which the reports are to be submitted shall be decided by the Owner's representative.

14.6. STATUTORY APPROVAL

The Contractor shall be totally responsible for obtaining statutory approval from the electrical inspector or any other statutory authority for the entire installation carried out by him unless otherwise specified and agreed. Necessary test reports shall be submitted by him to electrical inspector. This will be an integral part of the contract and shall not be paid for separately. However, fees payable to statutory authorities shall be borne by Owner.

14.7. EXTRA ITEMS

Extra items of work pertaining to the electrical installation may have to be carried out by the Contractor whenever required. The contractor shall submit to the Owner the invoices covering unit rate or lumpsum price for such extra items. Such invoices shall be complete with documents of authorisation and work approval and necessary break up for the cost.


15.0 RECONCILIATION

After completion of installation and commissioning work, Contractor has to reconcile all the materials such as steel and cables issued free to him by the Owner. Only 3% will be allowed as wastage for reconciliation and cut piece above 1 M length shall be considered accountable.

16.0 QUALITY ASSURANCE-- QUALITY CONTROL

16.1. QUALITY ASSURANCE (Q.A.)

Quality Assurance (Q.A.) shall be furnished by contractor for Owner's / Consultant

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- approval.
- 16.2. Q.A. INVOLVEMENT
Q.A. involvement will commence at the instigation of the project and follow through to final acceptance of each and every system and item of equipment, thus ensuring total conformity to the Owner's requirements.
- 16.3. TEST SHEETS
The Contractor shall provide the necessary 'Test Sheets' for recording the results of his electrical acceptance tests.
- 16.3.1. The full set of forms shall be submitted to the Owner's representative for his approval prior to the implementation of the acceptance testing programme.
- 16.3.2. The tests which the Contractor must perform, as a minimum requirement, shall be those described in clause 13.0 of this specification in the order indicated and shall be made in accordance with the equipment and/or systems Standards and Regulations quoted by the Owner's representative in the Bid documents and any tests required by the particular equipment/system manufacturer.
- 16.3.3. Test values acceptable to the Owner's representative shall be those laid down in the indicated standards and specifications by the Owner's representative, together with any values quoted in the Bid documents. Any discrepancy in the acceptable test values discovered by the Contractor shall be resolved by the Owner's representative, whose interpretation shall be final. No equipment shall be set to work unless tests on its associated circuits have been found satisfactory.

17.0 ACCEPTANCE OF INSTALLATION

On completion of the work the Owner's representative, together with a representative of the Owner and the Contractor, will carry out an Inspection of the Installation. The Owner's representative will issue a completed copy of the Owner's Acceptance of Electrical Installation to the Contractor as confirmation that the work has been accepted, subject to any matters noted on the form being attended to.

APPENDIX 1 - LIST OF CODES, STANDARDS & STATUTORY REGULATIONS

Spare capacity is depending on the type of equipment and is defined in the following table.

| | |
|-----------|--|
| IS: 732 | Code of Practice for Electrical Wiring Installations. |
| IS: 1646 | Code of Practice for Fire Safety of Buildings (General) Electrical Installation. |
| IS: 3043 | Code of Practice for Earthing. |
| IS: 2309 | Code of Practice for the Protection of Buildings & Allied Structures against Lightning. |
| IS: 7689 | Guide for control of undesirable static electricity. |
| IS: 900 | Code of Practice for Installation and Maintenance of Induction Motors. |
| IS: 10118 | Code of Practice for Selection, Installation and Maintenance of Switch gear and Parts I to IV control gear |
| IS: 5571 | Guide for Selection of Electrical Equipment for Hazardous Areas. |
| IS: 5572 | Classification of Hazardous Areas of Electrical Installation. |
| IS: 5216 | Safety Procedure and Practice in Electrical work. |
| - | Regulations for the Electrical Equipment of Buildings - The Institution of Electrical Owner's representatives. |
| - | Indian Electricity Rules. |
| - | Fire Insurance Regulations |
| - | Factory Act & Regulations |
| - | National Building Code (ISI Publication) |
| - | National Electrical Code (ISI Publication) |
| - | Tariff Advisory Committee Regulation |

APPENDIX 2 – CABLE

1. TESTING AND ELECTRICAL MEASUREMENTS OF CABLE INSTALLATIONS

1.1. INSULATION RESISTANCE TEST ON NEWLY INSTALLED CABLES BEFORE

JOINTING.

All new cables should be tested for insulation resistance before jointing. After satisfactory results are obtained cable jointing and termination work should commence. It should be noted here that insulation resistance test gives only approximate insulation resistance and the test is meant to reveal gross insulation fault(s). A fairly low insulation resistance reading compared to the values obtained at factory testing should not be a cause of worry since the insulation resistance varies greatly with parameters such as length and temperature. This is particularly more pronounced in the case of XLPE cables. The voltage rating of the insulation resistance tester for cables of different voltage grades should be chosen from the following table:

| Voltage Grade of Cable | Voltage Rating of IR Tester |
|------------------------|-----------------------------|
| 1.1 Kv | 500 V |
| 3.3kV | 1000 V |
| 6.6kV | 1000 V kV |
| 11 | 1000V |
| 22 | kV 2.5 kV (see Note) |
| 33 | kV 2.5 kV (see Note) |

NOTE - For long feeders, motorized insulation resistance tester should be used.

- 1.1.1. More accurate insulation resistance values can be measured only by a portable resistance measuring bridge.

1.2. TEST RESULT OF COMPLETE CABLE -INSTALLATION

The test of completed installation may be measured and entered into record book for comparison purposes during service life of cable installation and during fault location.

1.2.1. Insulation Resistance

Insulation resistance is measured by a suitable bridge. In non-screened cables, the insulation resistance of each core is measured against all the other cores and armour/metal sheath connected to earth. With screened construction the insulation resistance of each core is measured against all the other cores and the metal screen connected to earth.

1.2.2. Conductor Resistance (dc)

- 1.2.2.1. *The resistance of conductor is measured by a suitable bridge. For this purpose conductors at other end are looped together with connecting bond of at least same effective electrical cross-section as conductor. The contact resistance is kept to a minimum by proper clamped or bolted connections. With properly installed and jointed cables, values thus measured and corrected to 20°C, are in general agreement with values given in test certificates.*

- 1.2.2.2. *The measured loop resistance is converted to ohms per km per conductor as :*

$$1) \quad R_t = \frac{R}{2L}$$

where


R = measured loop resistance in ohms at temperature, t°C;

Rt= measured resistance per conductor at t°C in ohms; and

L= length of cable (not the loop) in km.

The ambient temperature at the time of measurement to be recorded and the conductor resistance to be corrected to 20°C by the following formula:

$$3) \quad R_{20} = \frac{R_t}{\quad} \quad \text{ohm/km at } 20^\circ\text{C}$$

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4) $(1 + \alpha)(t - 20)$

where

R₂₀ = conductor de resistance at 20°C in ohm/km;

t= ambient temperature during measurement in °C ; and

L= temperature coefficient of resistance

(3.93 x 10.3 ohms/°C for aluminium).


2. CABLE INSTALLATION PLAN

2.1.1. On completion of laying, terminating and jointing of the cables, a plan should be prepared, which should contain the following details of the installation:

- a) type of cables, cross-section area, rated voltage. Details of construction, cable number and drum number;
- b) Year and month of laying;
- c) Actual length between joint-to-joint or ends
- d) Location of cables and joints in relation to certain fixed reference points, for example, buildings, hydrant, boundary stones, etc.;
- e) Name of the jointer who carried the jointing work;
- f) Date of making joint; and
- g) Results of original electrical measurements and testing on cable installation.

2.1.2. All subsequent changed in the cable plan should also be entered.

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GAIL INDIA LIMITED



**DATA SHEET FOR MAIN ELECTRICAL
DISTRIBUTION BOARD (MEDB)**

TOTAL SHEETS

07

DOCUMENT NO

GAIL-STD-EL-DOC-DS-001

| REV | DATE | DESCRIPTION | PREP | CHK | APPR |
|-----|----------|----------------|------|-----|------|
| 0 | 30.01.19 | ISSUED FOR BID | RKS | SB | SB |

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- 1.0 GENERAL
- 2.0 BUS BAR
- 3.0 CURRENT TRANSFORMER
- 4.0 POTENTIAL TRANSFORMER
- 5.0 SWITCHES
- 6.0 FUSES
- 7.0 RELAYS
- 8.0 INSTRUMENT METERS
- 9.0 MOULDED CASE CIRCUIT BREAKER
- 10.0 CIRCUIT BREAKERS
- 11.0 CONTACTOR



**DATA SHEET FOR MAIN
ELECTRICAL DISTRIBUTION
BOARD (MEDB)**

Document No.

Rev

GAIL-STD-EL-DOC-DS-001

0

SHEET 2 of 7

(TECHNICAL DATA SHEET)

TECHINICAL DATA SHEET (To be furnished by Vendor)

1.0 GENERAL

- 1.1 Design ambient, Humidity, altitude (Site Conditions) :
- 1.2 Supply system Voltage :
- 1.3 Rated Current :
- 1.4 Symmetrical Short Circuit capacity/ Switchgear Fault Rating :
- 1.5 Power frequency withstand voltage :
- 1.6 Short circuit Making/ Breaking Capacity :
- 1.7 Supply system Earthing :
- 1.8 Cable entry (Incoming & Outgoing) :
- 1.9 Earth Bus bar – Material, Rating, Size etc :
- 1.10 Control supply voltage :
- 1.11 Withdrawable - Draw out type / Fixed :
- 1.12 Lifting arrangement :

- 1.13 Make :
- 1.14 IP Class of enclosure :
- 1.15 Type :
- 1.16 Thickness of sheet steel :
- 1.17 Treatment :
- 1.18 Painting :
- 1.19 Overall dimension :
 - L
 - B
 - H
- 1.20 Space heater rating of each panel :
- 1.21 Weight of the MEDB :

2.0 BUS BAR

- 2.1 Material
- 2.2 Size
 - a) Horizontal bus bar :
 - b) Vertical bus bar :
 - c) Ground :
- 2.3 Minimum Clearance
 - a) Between phases :



**DATA SHEET FOR MAIN
ELECTRICAL DISTRIBUTION
BOARD (MEDB)**

Document No.

Rev

GAIL-STD-EL-DOC-DS-001

0

SHEET 3 of 7

- b) Between phase and earth :
- 2.4 Minimum creep age distances :
- 2.5 Current rating :
- a) Continuous :
- b) Short time for 1 second :
- 2.6 Temp. rise over ambient :
- a) Supports :
- b) Material :
- c) Make :
- d) BIL :
- 2.7 a) Supports :
- b) Materials :
- c) Make :
- d) Voltage :
- e) BIL :
- 2.8 Bus bar insulation :
- 2.9 Bus bar phase identification mark :

3. CURRENT TRANSFORMER (CT)

- 3.1 Make :
- 3.2 Type of primary winding :
- 3.3 Ratio :
- 3.4 Rated Burden :
- 3.5 Accuracy class :

4.0 POTENTIAL TRANSFORMER (PT)

- 4.1 Make
- 4.2 Type of primary winding
- 4.3 Ratio
- 4.4 Rated burden
- 4.5 Accuracy class



**DATA SHEET FOR MAIN
ELECTRICAL DISTRIBUTION
BOARD (MEDB)**

Document No.

Rev

GAIL-STD-EL-DOC-DS-001

0

SHEET 4 of 7

5.0 SWITCHES

- 5.1 Rated voltage
- 5.2 Rated thermal current
- 5.3 Duty

6.0 FUSES

- 6.1 Make
- 6.2 Type of HRC fuse
- 6.3 Rated voltage

7.0 RELAYS

- 7.1 Application
- 7.2 Make

8.0 INSTRUMENT AND METERS

- 8.1 Application
- 8.2 Make
- 8.3 Maker's type
- 8.4 Ref. Standard
- 8.5 Operating principle
- 8.6 Rated voltage/current
- 8.7 Burden at rated voltage/current
- 8.8 Operating range
- 8.9 Scale range

9.0 MOULDED CASE CIRCUIT BREAKER (MCCB)

- 9.1 Make



**DATA SHEET FOR MAIN
ELECTRICAL DISTRIBUTION
BOARD (MEDB)**

Document No.

Rev

GAIL-STD-EL-DOC-DS-001

0

SHEET 5 of 7

- 9.2 Rated Voltage
- 9.3 Rated Thermal current
- 9.4 Short Circuit Capacity

10.0 CIRCUIT BREAKERS

- 10.1 Make
- 10.2 Short circuit capacity
- 10.3 Short circuit category
- 10.4 Type of medium
- 10.5 Rated voltage
- 10.6 Maximum operating voltage
- 10.7 Frequency
- 10.8 No. of poles
- 10.9 Rated operating duty
- 10.10 Current rating
 - a) Continuous
 - b) Short circuit Rating
- 10.11 Type of closing mechanism
- 10.12 Type of tripping mechanism
- 10.13 Anti pumping features
- 10.14 Details of spring charged motor
 - a) Motor
 - b) Rating
 - c) Insulation
 - d) Duty
- 10.15 Control Voltage with range
 - a) Closing
 - b) Tripping
 - c) Alarm and Indication



**DATA SHEET FOR MAIN
ELECTRICAL DISTRIBUTION
BOARD (MEDB)**

Document No.

Rev

GAIL-STD-EL-DOC-DS-001

0

SHEET 6 of 7

10.16 Power / Current required for

- a) Closing
- b) Tripping

11.0 CONTACTOR

11.1 Make

11.2 Rated Voltage

11.3 Rated Thermal current

11.4 Short circuit capacity

* * * * *



**DATA SHEET FOR MAIN
ELECTRICAL DISTRIBUTION
BOARD (MEDB)**

Document No.

Rev

GAIL-STD-EL-DOC-DS-001

0

SHEET 7 of 7



GAIL INDIA LIMITED



DATA SHEET FOR POWER & CONTROL
CABLES

TOTAL SHEETS

04

DOCUMENT NO

GAIL-STD-EL-DOC-DS-002

| REV | DATE | DESCRIPTION | PREP | CHK | APPR |
|-----|----------|----------------|------|-----|------|
| A | 30.01.19 | ISSUED FOR BID | RKS | SB | SB |

TECHNICAL DATA SHEET

TECHNICAL DATA SHEET (To be furnished by Vendor)

1. Name of the manufacturer
2. Voltage Grade
3. Type of cable
4. Standard Referred
5. Conductor
 - a. Material grade
 - b. No. of cores
 - c. Max allowable temperature (running & Short circuit)
 - d. Approx. Diameter
 - e. Normal cross sectional area
 - f. Shape of the conductor
 - g. Max. D.C. resistance at 20 Deg. C.
 - h. Number of stands
6. **Insulation**
 - a. Type and material of Insulation
 - b. Thickness of insulation
 - c. Colour Scheme/Core Identification
 - d. Extruded
7. **Inner-Sheath**
 - a. Material
 - b. Minimum Thickness
 - c. Extruded
 - d. Approximate dia over inner sheath



**DATA SHEET FOR POWER &
CONTROL CABLES**

Document No.

Rev

GAIL-STD-EL-DOC-DS-002

0

SHEET 2 of 4

8. **Armour**
 - a. Type
 - b. Material
 - c. Nominal Thickness
 - d. Diameter

9. **Outer Sheath**
 - a. Material
 - b. Minimum Thickness
 - c. Extruded

10. **Approximate overall diameter.**

11. **Normal drum length**
12. **AC resistance of the conductor at maximum operating Temperature**

13. **Approximate Reactance and Capacitance of Cable per phase at 50Hz.**

14. **Current Rating**
 - a. In ground
 - b. In air
 - c. Maximum conductor temperature during continuous Operation
 - d. Maximum conductor temperature during short Circuit
 - e. Short circuit rating



DATA SHEET FOR POWER & CONTROL CABLES

Document No.

Rev

GAIL-STD-EL-DOC-DS-002

0

SHEET 3 of 4

f. Maximum permissible bending radius

15. Standard Drum Length/Size/Material

16. FRLS properties

17. Embossing on Outer sheath

* * * * *



**DATA SHEET FOR POWER &
CONTROL CABLES**

Document No.

Rev

GAIL-STD-EL-DOC-DS-002

0

SHEET 4 of 4



GAIL INDIA LIMITED
QUALITY ASSURANCE PLAN (QAP)
PANELS & DISTRIBUTION BOARDS



| DOC. No: GAIL-STD-EL-DOC-QAP-001 | | | | | | | | | | |
|------------------------------------|--|---------------------------|---------------|------------------|-----------------------------|-----------------------------|-----------------------------|-----|------------|---|
| QAP for Panels/Distribution Boards | | | | | | | | | | |
| SL. No. | Component/Operation | Class | Type of Check | Quantum of Check | Reference Doc | Acceptance Norms | MANU. | TPI | Inspection | |
| 1 | Raw Material Inspection Cubicle | | | | | | | | | |
| | | 1. Material | B | Visual | 100% | IS 513 | IS 513 | P | R | R |
| | | 2. Adhesion | B | Visual | 100% | No peeling | No peeling | P | R | R |
| | | 3. Coating Thickness | B | Physical | One per lot | 60 Microns | 60 Microns | P | R | R |
| 1.1 | 4. Overall Quality & Correctness | B | Visual | 100% | As per Drawing | As per Drawing | P | R | R | |
| | | 1. Dimension & size | B | Physical | One per lot | IS 694 / IS 732 | IS 694 / IS 732 | P | R | R |
| | | 2. Routine Test | B | Physical | One per lot | IS 694 / IS 732 | IS 694 / IS 732 | P | R | R |
| | | 1. Dimension | B | Visual | One per lot | IS 5082 | IS 5082 | P | R | R |
| 1.2 | Wire | B | Electrical | One per lot | IS 5082 | IS 5082 | P | R | R | |
| | | 2. Conductivity | B | Test Report | One per lot | IS 5082 | IS 5082 | P | R | R |
| | | 3. Material grade | A | Visual | 100% | IS 13947 / IEC 60947 | IS 13947 / IEC 60947 | P | R | R |
| | | 1. Physical Check | B | Visual | 100% | IS 13947 / IEC 60947 | IS 13947 / IEC 60947 | P | R | R |
| 1.3 | ACBs, MCB's, Switches, Fuse connectours, O/L Relays, Timers, MCB's, Terminal Blocks, Control Indicating & Measuring instruments, CT, PT, Control Transformer & Protection Relays etc | B | Visual | 100% | IS 13947 / IEC 60947 | IS 13947 / IEC 60947 | P | R | R | |
| | | 2. Type & Rating | B | Visual | 100% | IS 13947 / IEC 60947 | IS 13947 / IEC 60947 | P | R | R |
| | | 3. Make | B | Visual | 100% | IS 13947 / IEC 60947 | IS 13947 / IEC 60947 | P | R | R |
| | | 4. Coil Voltage | B | Electrical | 100% | IS 13947 / IEC 60947 | IS 13947 / IEC 60947 | P | R | R |
| | | 5. Operation | B | Electrical | 100% | IS 13947 / IEC 60947 | IS 13947 / IEC 60947 | P | R | R |
| | | 6. Continuity (On/Off) | B | Electrical | 100% | IS 13947 / IEC 60947 | IS 13947 / IEC 60947 | P | R | R |
| | | 7. Test Certificate | A | Records | 100% | IS 13947 / IEC 60947 | IS 13947 / IEC 60947 | P | R | R |
| 1.4 | Push Buttons, SFU, Indicating Lamps, Fuses etc | B | Visual | 100% | IS 13947 / Fuse - IEC 60269 | IS 13947 / Fuse - IEC 60269 | P | R | R | |
| | | 1. Physical Check | B | Visual | 100% | IS 13947 / Fuse - IEC 60269 | IS 13947 / Fuse - IEC 60269 | P | R | R |
| | | 2. Type & Rating | B | Visual | 100% | IS 13947 / Fuse - IEC 60269 | IS 13947 / Fuse - IEC 60269 | P | R | R |
| | | 3. Operation | B | Electrical | 10% | IS 13947 / Fuse - IEC 60269 | IS 13947 / Fuse - IEC 60269 | P | R | R |
| 1.5 | Paint | B | Electrical | 10% | IS 5 | IS 5 | P | R | R | |
| | | 4. Continuity (On/Off) | B | Visual | Sample | IS 5 | IS 5 | P | R | R |
| | | 1. Shade | B | Visual | Sample | IS 5 | IS 5 | P | R | R |
| | | 2. Finish | B | Visual | Sample | IS 5 | IS 5 | P | R | R |
| 1.6 | Name Plate | A | Visual | 100% | | | P | R | R | |
| | | Resistance Screw or rivet | A | Visual | 100% | | | P | R | R |
| 2 | In Process Inspection Cubicle | | | | | | | | | |
| | | 1. Dimension | B | Physical | 100% | IS 513 | IS 513 | P | R | R |
| | | 2. Mounting Facility | B | Visual | 100% | As per Drawing | As per Drawing | P | R | R |
| | | 3. Cable Glandring Plate | B | Visual | 100% | As per Drawing | As per Drawing | P | R | R |
| | | 4. Degreasing | C | Visual | 100% | IS 6005 | IS 6005 | P | R | R |
| | | 5. Derusting | C | Visual | 100% | IS 6005 | IS 6005 | P | R | R |
| | | 6. Deburring | C | Visual | 100% | No Burrs | No Burrs | P | R | R |
| | | 7. Phosphatising | C | Physical | 100% | IS 6005 | IS 6005 | P | R | R |
| 2.1 | | C | Visual | 100% | IS 6005 | IS 6005 | P | R | R | |
| | | 8. Passivation | C | Visual | 100% | IS 6005 | IS 6005 | P | R | R |

date -29.01.2019



GAIL INDIA LIMITED
QUALITY ASSURANCE PLAN (QAP)
PANELS & DISTRIBUTION BOARDS



| Item No. | Item Description | Material | Quantity | Unit | Inspection Point | Acceptance Criteria | Reference | Remarks |
|----------|------------------|---|----------|------|------------------|-------------------------|----------------------------|---------|
| 2.2 | Busbaring | 1. Material (Al/Cu) | 100% | B | Visual | IS 5082 | IS 5082 | R |
| | | 2. Size (Thickness/Width) | 100% | B | Physical | IS 5082 | IS 5082 | R |
| | | 3. Busbar Tightening | 100% | B | Physical | As per specified Torque | As per specified Torque | R |
| | | 4. Phase to Phase Clearance | 100% | B | Physical | >25mm | >25mm | R |
| | | 5. Phase to Earth Clearance | 100% | B | Physical | >19mm | >19mm | R |
| | | 6. Spacer between parallel busbars | 100% | B | Visual | Equal to Busbar size | Equal to Busbar size | R |
| | | 7. Check for Burrs | 100% | B | Visual | No Burrs | | R |
| | | 8. Finish Uniformity | 100% | B | Visual | | | R |
| 2.3 | Wiring | 1. Size of wire | 100% | B | Physical | IS 694 / IS 732 | IS 694 / IS 732 | R |
| | | 2. Colour of wire | 100% | B | Visual | | | R |
| | | 3. Ferruling | 100% | B | Visual | | | R |
| | | 4. Sleeve size | 100% | B | Visual | | | R |
| | | 5. Terminals | 100% | B | Visual | | | R |
| | | 6. Wiring Layout | 100% | B | Visual | As per Drawing | As per Drawing/Requirement | R |
| | | 7. Accessibility | 100% | B | Visual | | | R |
| | | 8. Correctness of wiring | 100% | C | Electrical | | | R |
| 2.4 | Circuit checking | MCCB/MCB Closing and tripping mechanism | 100% | C | Electrical | As per Drawing | As per Drawing/Requirement | R |
| | | control circuit and interlock | 100% | C | Electrical | | | R |
| | | heater, lamp and earth leakage relay | 100% | C | Electrical | | | R |
| | | Meter and metering | 100% | C | Electrical | | | R |
| | | Remote close /trip | 100% | C | Electrical | | | R |
| | | CT/PT Check | 100% | C | Electrical | | | R |
| 2.5 | Gasket | 1. Fitment | 100% | B | Visual | As per Drawing | As per Drawing/Requirement | R |



GAIL INDIA LIMITED



DOC. No: GAIL-STD-EL-DOC-QAP-003

QUALITY ASSURANCE PLAN FOR
LIGHTINGPANEL

| SR NO | Component/ Operation | Characteristic | Class | Typeof Check | Quantumof check | Reference Document | Acceptance Norm | INSPECTION | | Remarks |
|----------|--|---|-------|-----------------|--------------------|-----------------------|--------------------|------------|----------|---------|
| | | | | | | | | Manu. | GAIL/TPI | |
| 1 | RAWMATERIAL&COMPONENT | | | | | | | | | |
| 1.1 | MS Steel Paints ElectricalWire | a) Wire/conductor b) Type c)Dimension d) Weight f) Make/TypeofMaterial | Major | Physical | 100% | Approved Drgs | ReferenceDrgs | P | R | |
| 2 | InProcess | | | | | | | | | |
| 2.1 | Machining & Finishing of enclosure | a) Machining b) Blow holes c)Entryholes/ Threading d) Mountingholes e) Earthingholes | Major | Visual | 100% | Approved Drgs | ReferenceDrgs | P | R | |
| 2.2 | Painting | a)Shade b) Colour c)Paint Type | Major | Visual | 100% | Approved Drgs | ReferenceDrgs | P | R | |

| | | | | | | | | | |
|----------|--|--|----------|-------------------------|--------|----------------------|----------------|---|-----|
| 2.3 | Assembly | a)BOM Verification | Major | Visual | 100% | Approved Drgs | Reference Drgs | P | R/W |
| 2.4 | Wiring | a) Continuity b) Megger | Major | Physical | 100% | Approved Drgs | Reference Drgs | P | R/W |
| 3 | Final Inspection | | | | | | | | |
| | | a)Visual Inspection b)Operation/Function c) IR Test d)Earthing | Critical | Physical and Electrical | Sample | As per approved Drgs | Reference Drgs | P | W |
| 4 | Document Review | | | | | | | | |
| 4.1 | Bought Out Component a)Wire b)MS Steel c)Paints | | Major | | Sample | | | P | R |
| 4.2 | - | Degree of Protection | Major | | Sample | | | P | R |
| 4.3 | IRN | | Major | | 100% | | | P | R |
| 4.4 | Packing and Dispatch | | Major | | 100% | | | P | R |
| 5 | Other point | | | | | | | | |
| 5.1 | Dimension | Check & verify with Final G A drawing | Major | | 100% | | | P | R |
| 4.2 | BOM | Check & verify with approved BOM | | | | | | | |
| 4.3 | Function test | Checked for all 1. Opening & closing of isolator indicating lamps as per approved drawing. | Major | | 100% | | | P | R |
| 4.4 | Packing and Dispatch | p | Major | | 100% | | | P | R |

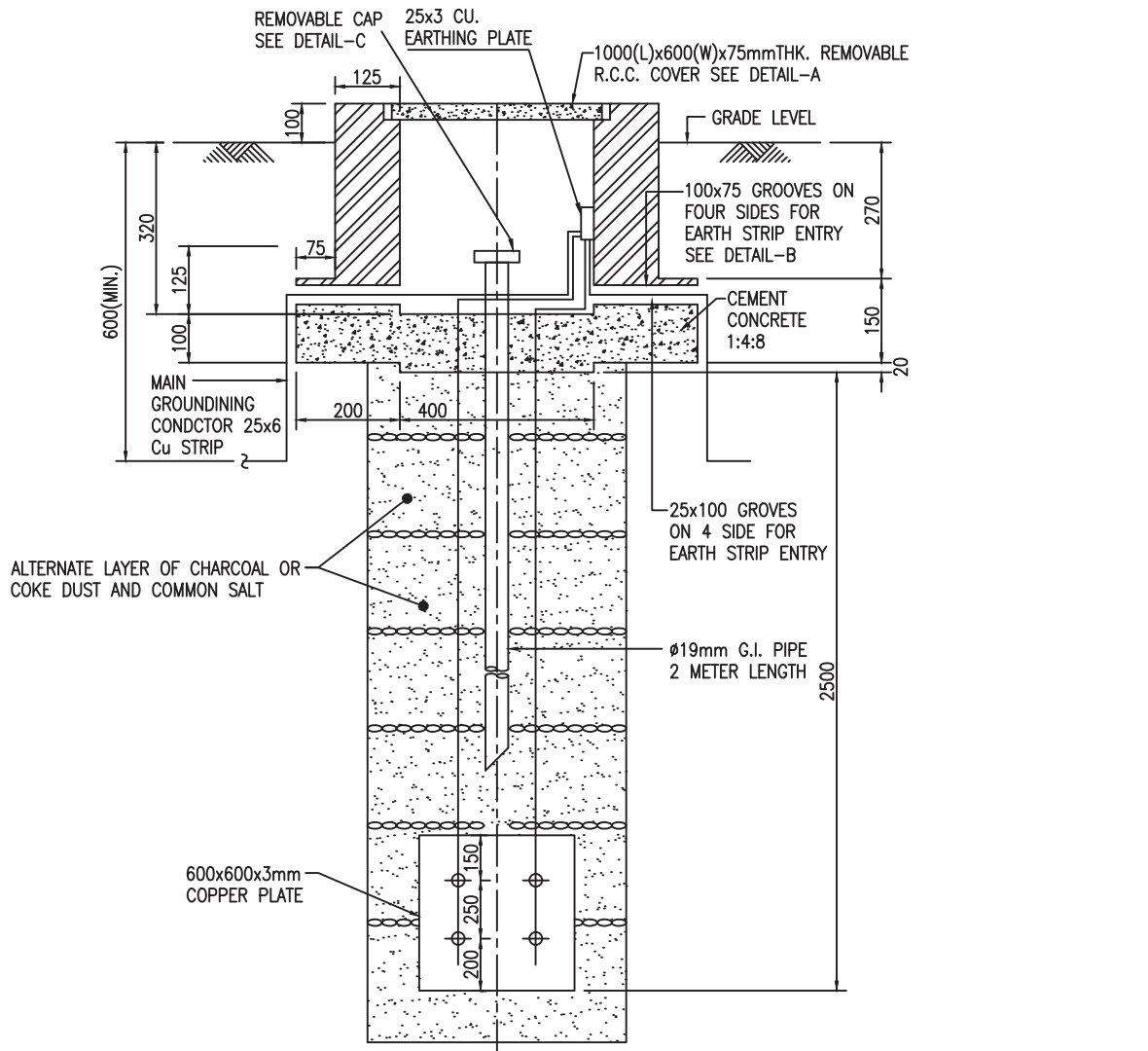
LEGEND: R: Review, W: Witness P: Perform



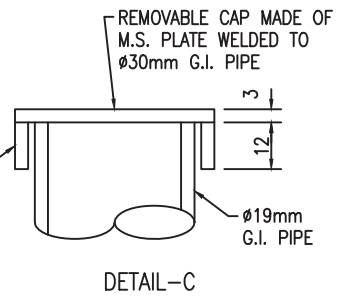
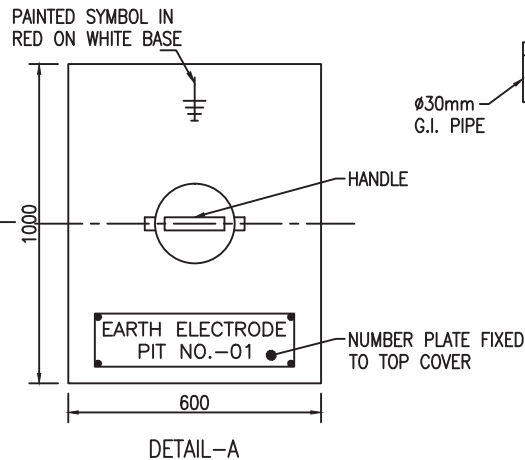
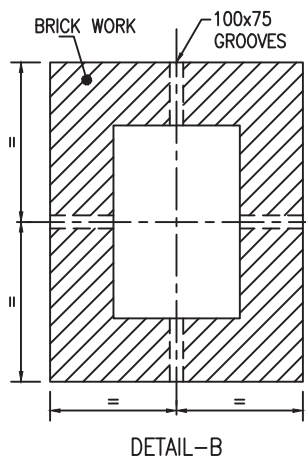
LYONS ENGINEERING PVT. LTD.
NEW DELHI

STANDARD Cu PLATE
ELECTRODE IN TEST PIT

DRAWING NO.
GAIL-STD-EL-DWG-TP-001
1 OF 1



Cu PLATE ELECTRODE WITH TREATED EARTH PIT



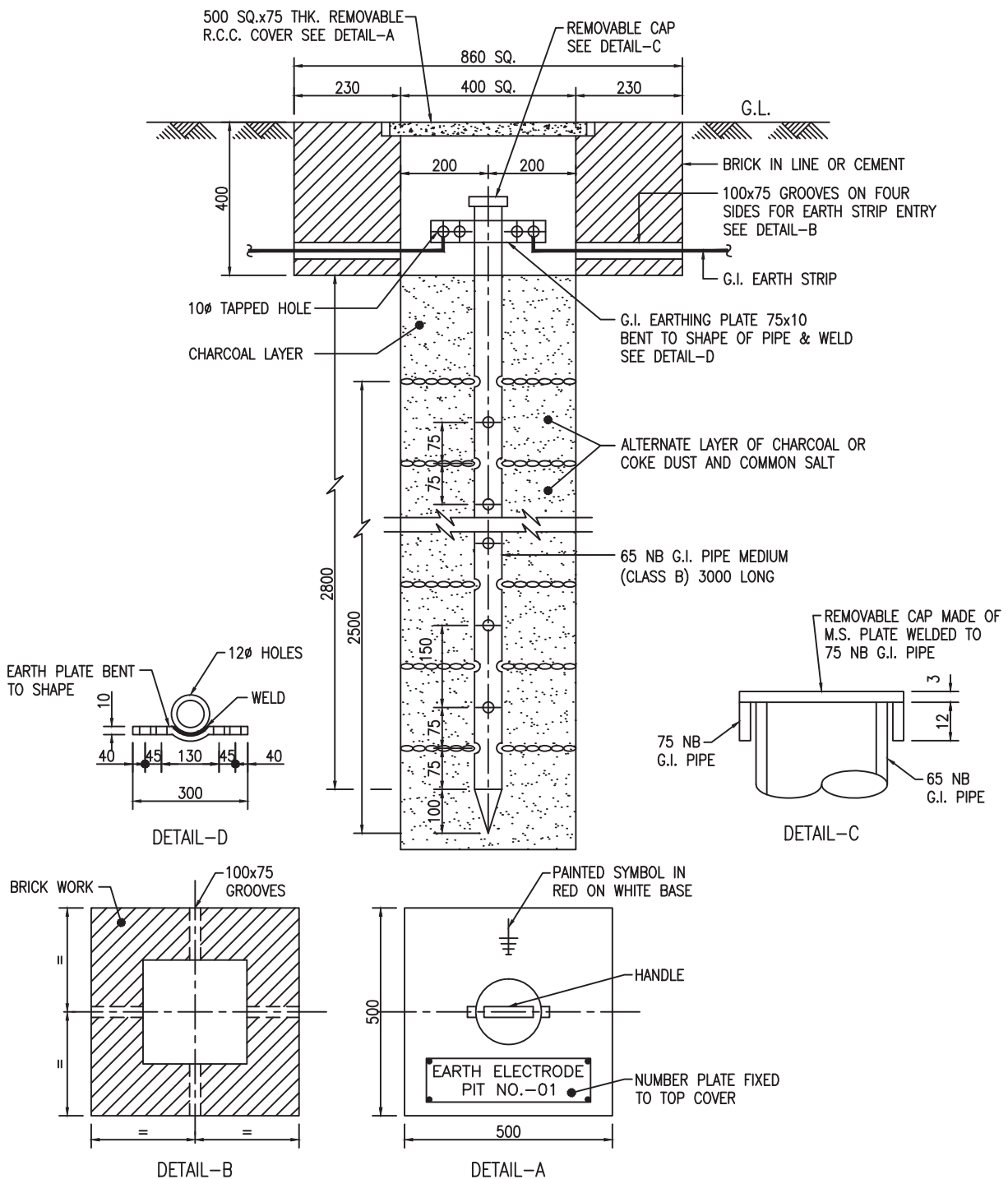
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| REV.NO. | DATE | SUBJECT OF REVISION | BY | CHECKED | APPROVED | | |



LYONS ENGINEERING PVT. LTD.
NEW DELHI

STANDARD G.I. PIPE
ELECTRODE IN TEST PIT

DRAWING NO.
GAIL-STD-EL-DWG-TP-002
1 OF 1



NOTES: -

- 1 THE PIPE ASSEMBLY SHALL BE HOT DIP GALVANISED AFTER FABRICATION.
- 2 BRICK WORK SHALL BE DONE AFTER COMPACTING THE SOIL.

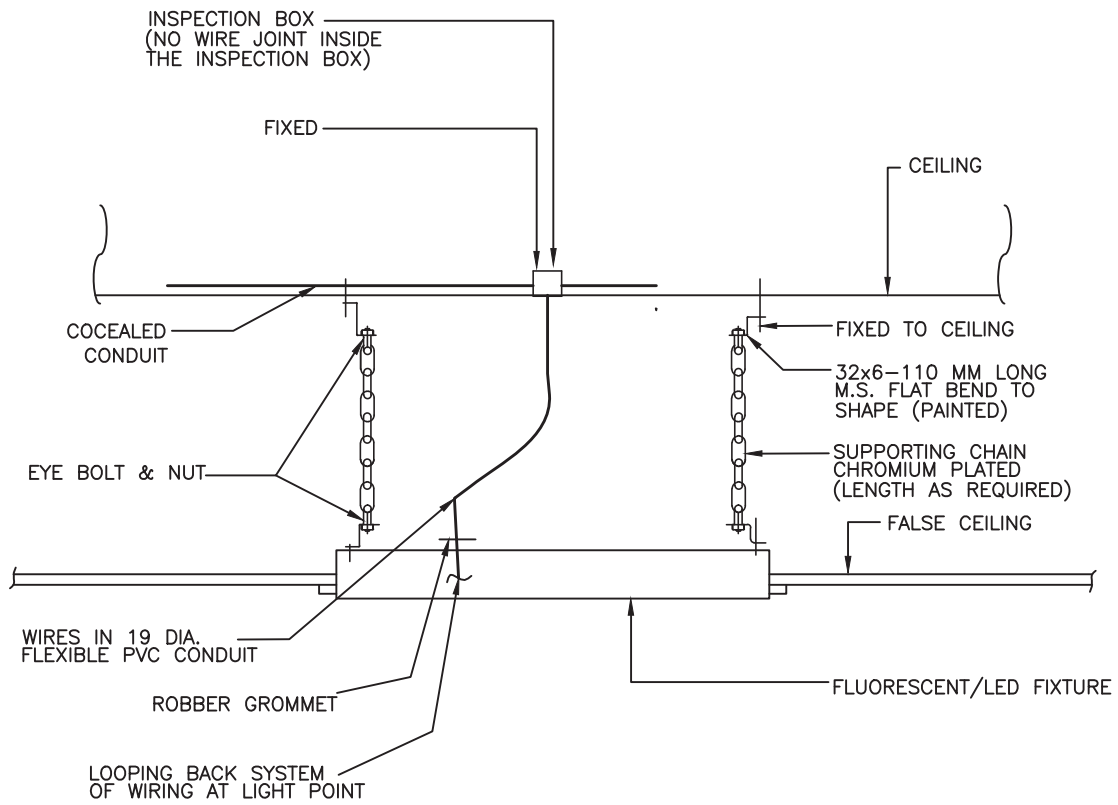
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LYONS ENGINEERING PVT. LTD.
NEW DELHI

TYP. INSTALLATION OF
FLUORESCENT/
FIXTURE ON FALSE CEILING

DRAWING NO.
GAIL-STD-EL-DWG-TP-004
1 OF 1



NOTES:-

1. ALL DIMENSIONS ARE IN MM.

| | | | | | | | | |
|---------|----------|---------------------|-----|---------|----------|--|--|--|
| | | | | | | | | |
| 0 | 04.02.19 | ISSUED FOR TENDER | D.V | U.N | S.B | | | |
| REV.NO. | DATE | SUBJECT OF REVISION | BY | CHECKED | APPROVED | | | |



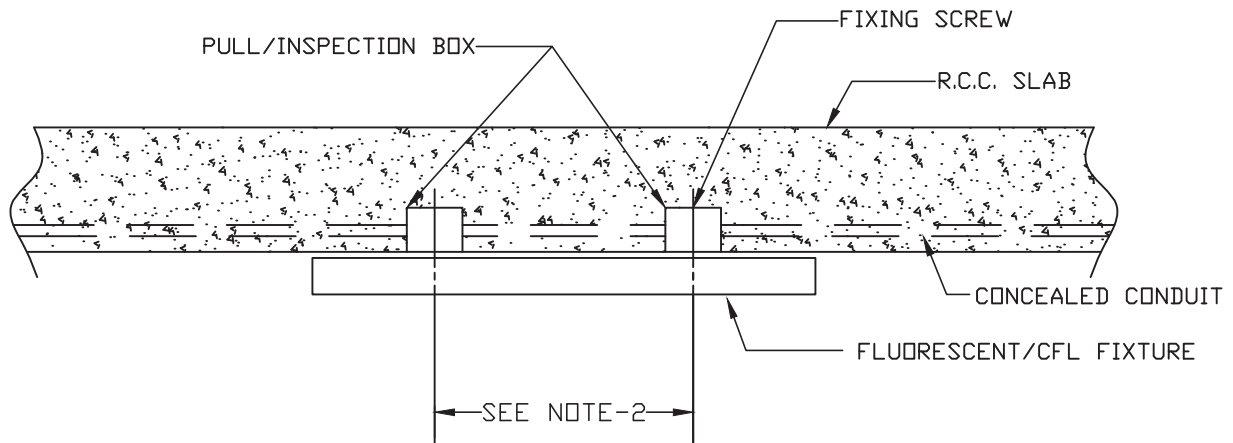
LYONS ENGINEERING PVT. LTD.
NEW DELHI

TYP. INSTALLATION OF
CEILING MOUNTING
FLOURESCENT/ CFL LIGHT FIXTURE

DRAWING NO.

GAIL-STD-EL-DWG-TP-005

1 OF 1



NOTE:-

1. ALL DIMENSIONS ARE IN MM.
2. FIXING CENTERS SHALL BE AS PER FIXTURE MANUFACTURER'S DETAILS.

| | | | | | | | | |
|---------|----------|---------------------|-----|---------|----------|--|-----|--|
| | | | | | | | | |
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| REV.NO. | DATE | SUBJECT OF REVISION | BY | CHECKED | APPROVED | | | |



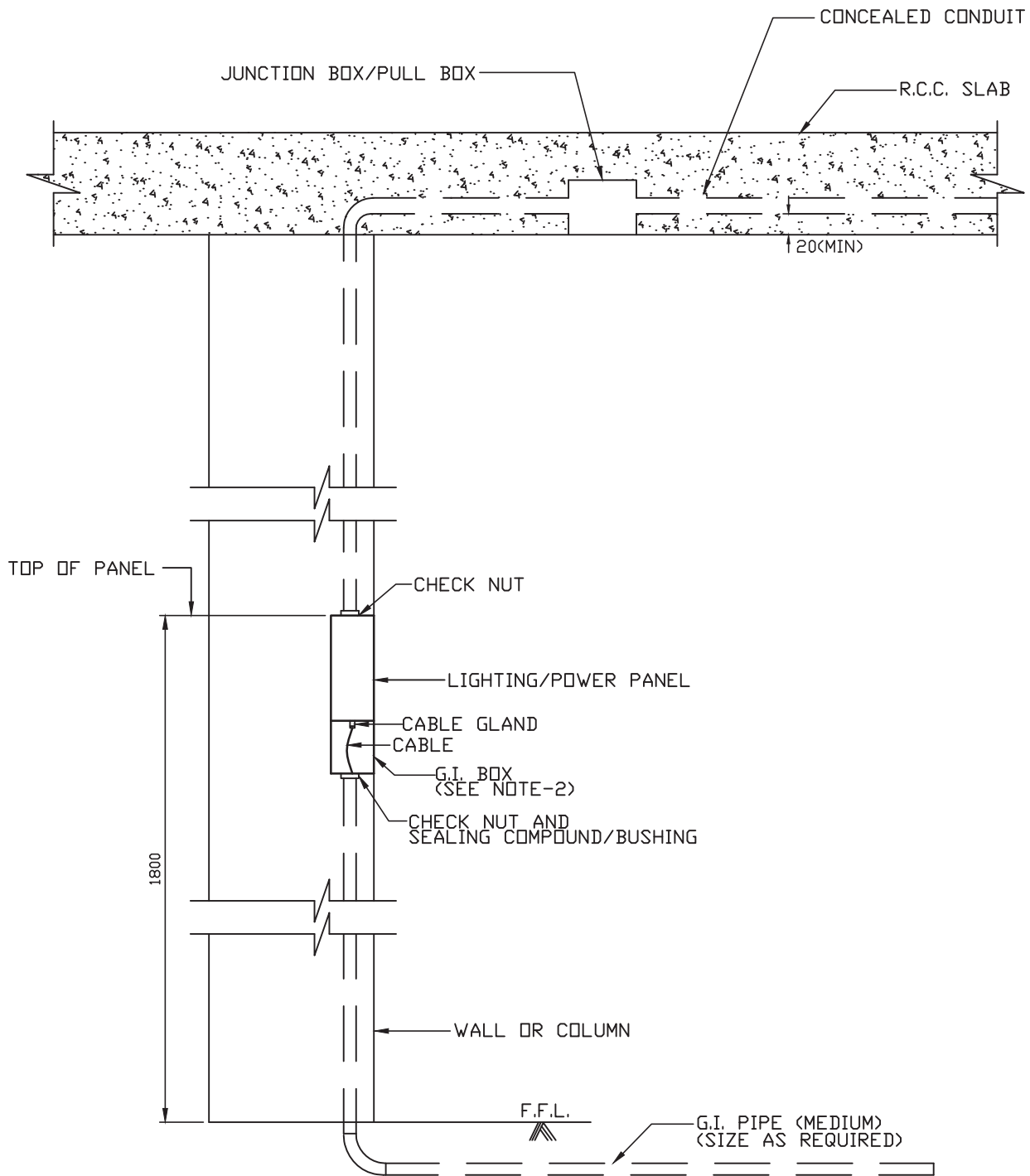
LYONS ENGINEERING PVT. LTD.
NEW DELHI

TYP. INSTALLATION OF
POWER/LIGHTING PANEL
FLUSH MOUNTED

DRAWING NO.

GAIL-STD-EL-DWG-TP-006

1 OF 1



1. ALL DIMENSIONS ARE IN MM.
2. G.I. ADAPTOR BOX OF SUITABLE SIZE WITH REMOVABLE COVER SHALL BE PROVIDED BELOW THE PANEL TO FACILITATE CABLE TERMINATION.

| | | | | | | | | |
|---------|----------|---------------------|-----|---------|----------|--|--|--|
| | | | | | | | | |
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| REV.NO. | DATE | SUBJECT OF REVISION | BY | CHECKED | APPROVED | | | |



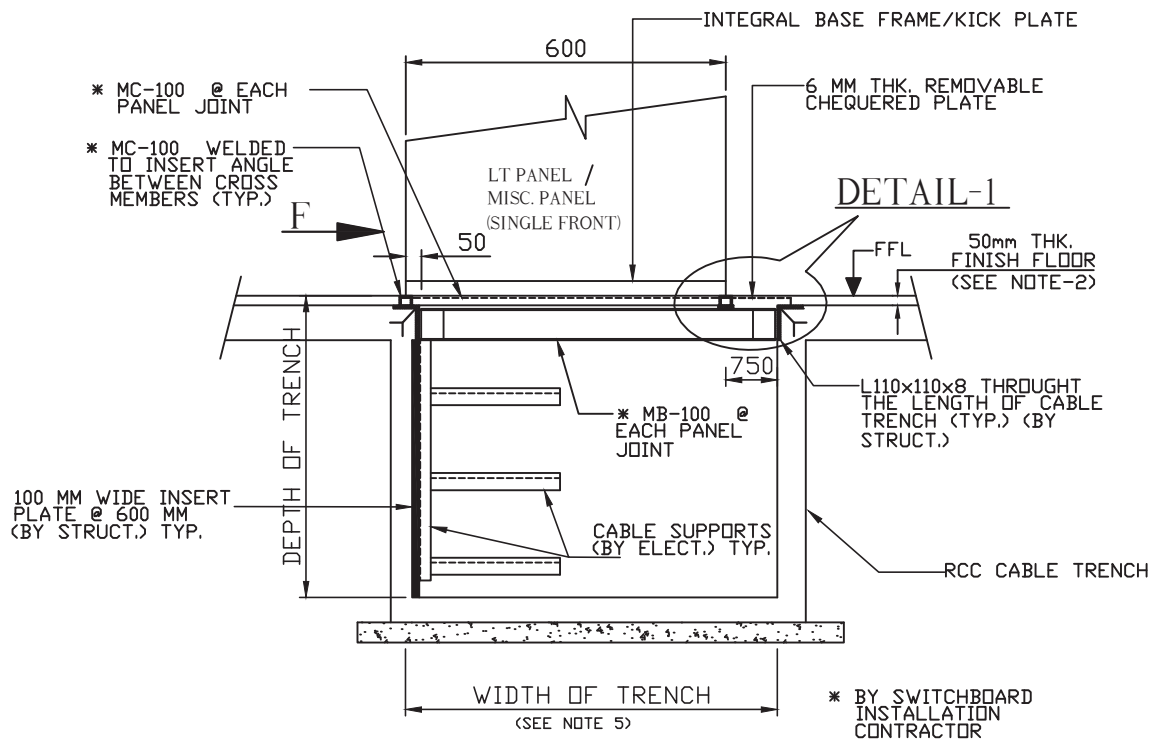
LYONS ENGINEERING PVT. LTD.
NEW DELHI

TYP. INSTALLATION OF
ELECTRICAL PANELS ON
CABLE TRENCH

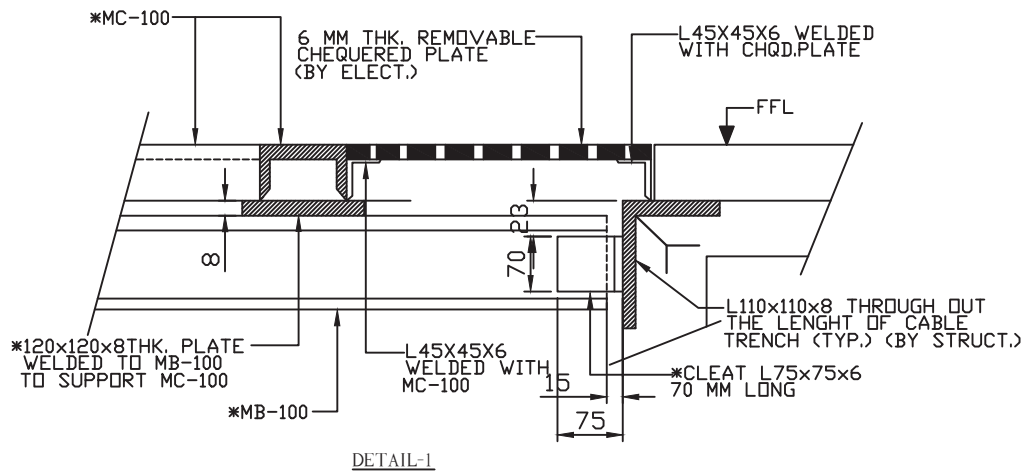
DRAWING NO.

GAIL-STD-EL-DWG-TP-007

1 OF 1



TYPICAL INSTALLATION DETAIL OF LT PANELS



1. FABRICATION, SUPPLY & INSTALLATION OF BASE FRAMES SHALL BE IN ELECT. CONTRACTOR'S SCOPE.
2. 50 THICK FFL SHALL BE DONE AFTER INSTALLATION OF BASE FRAMES BY ELECT. CONTRACTOR.
3. ALL PANELS SHALL BE TACK WELDED WITH BASE FRAME OF SWITCHBOARD.
4. UNUSED PORTION OF CUTOUTS SHALL BE COVERED WITH 6MM THICK CHEQUERED PLATES.
5. SIZE OF TRENCH TO SUIT THE DIMENSION OF PANELS SHALL BE AS PER AFC DRG. OF THE PROJECT.

| | | | | | |
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| REV.NO. | DATE | SUBJECT OF REVISION | BY | CHECKED | APPROVED |



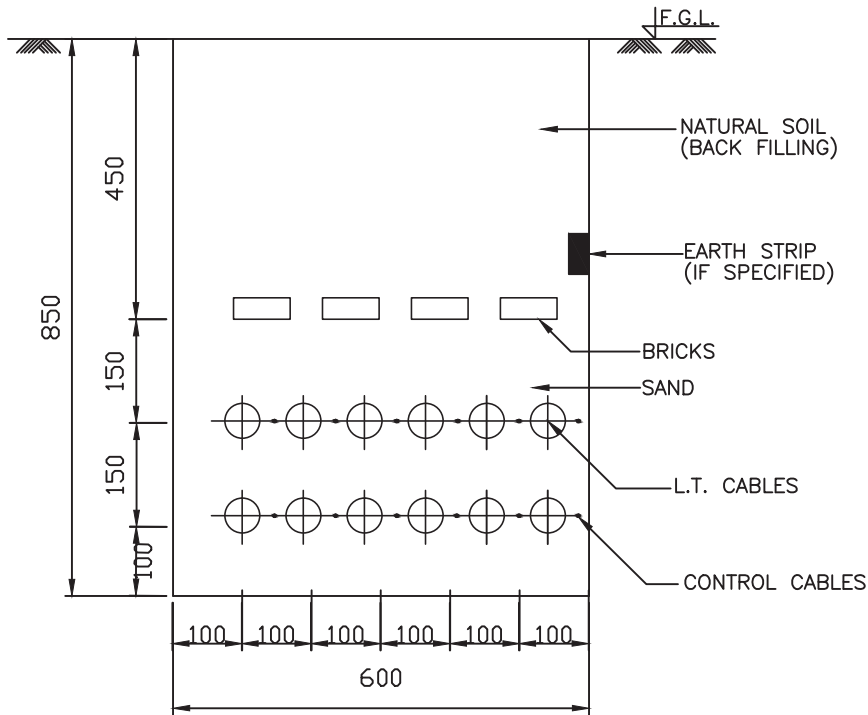
LYONS ENGINEERING PVT. LTD.
NEW DELHI

TYP. INSTALLATION OF
DIRECTLY BURRIED
CABLE

DRAWING NO.

GAIL-STD-EL-DWG-TP-008

1 OF 1



TYP. SECTION OF DIRECTLY BURRIED CABLE TRENCH

NOTES:—

1. ALL DIMENSIONS ARE IN MM.
2. PROVIDE SPACE FOR FUTURE SPARE SPACE OF AT LEAST 2 CABLES OR 15% AVERAGE SPARE SPACE FOR FUTURE EXPANSION.
3. IF FIRE ALARM AND COMMUNICATION CABLES ARE LAID IN THE SAME TRENCH A CLEARANCE OF 300 MM (MIN.) FROM POWER CABLE SHALL BE PROVIDED.

| | | | | | | | | |
|---------|----------|---------------------|-----|---------|----------|--|--|--|
| | | | | | | | | |
| 0 | 04.02.19 | ISSUED FOR TENDER | D.V | U.N | S.B | | | |
| REV.NO. | DATE | SUBJECT OF REVISION | BY | CHECKED | APPROVED | | | |



LYONS ENGINEERING PVT. LTD.
NEW DELHI

TYP. INSTALLATION OF
LIGHT FIXTURE AT
GROUND LEVEL

DRAWING NO.

GAIL-STD-EL-DWG-TP-009

1 OF 1

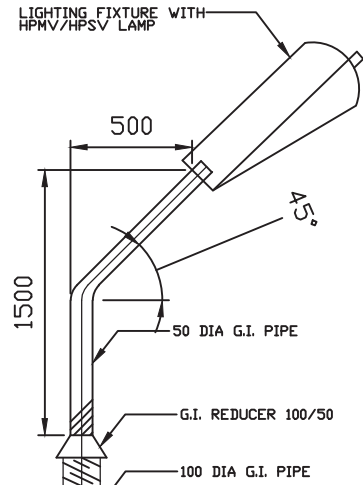
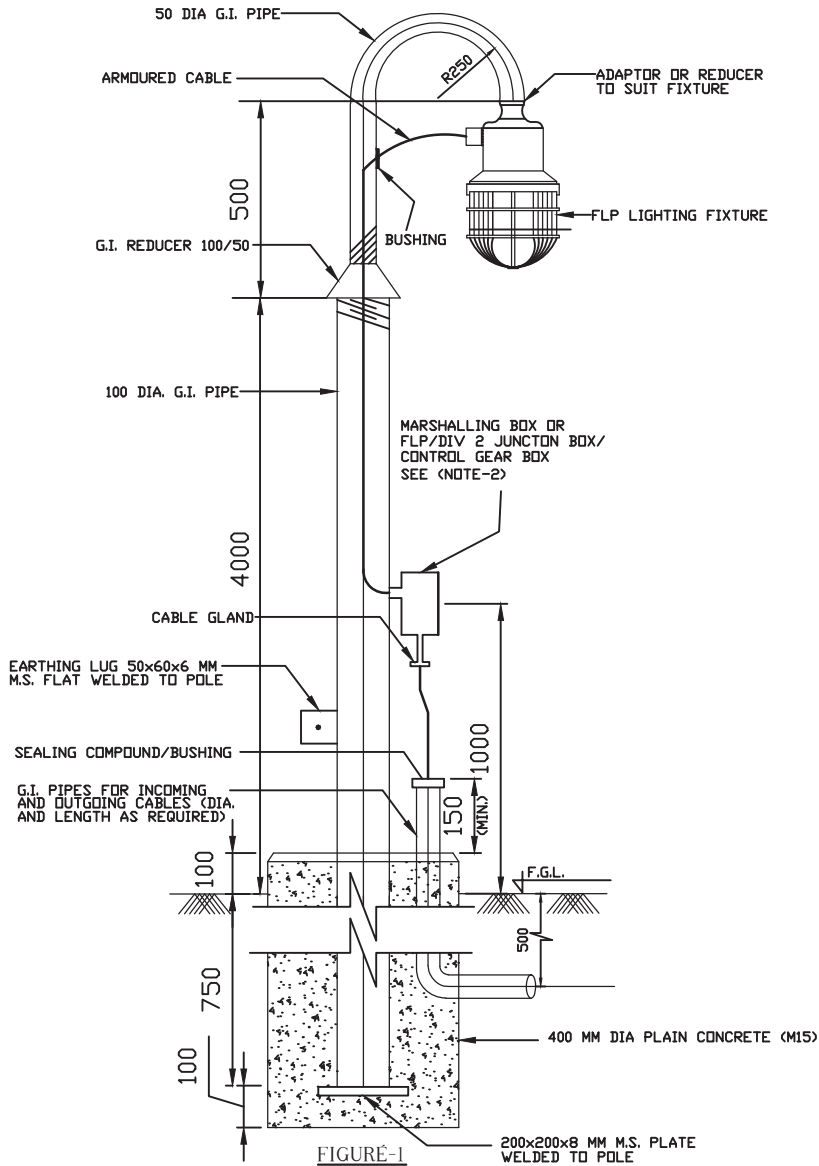


FIGURE-2

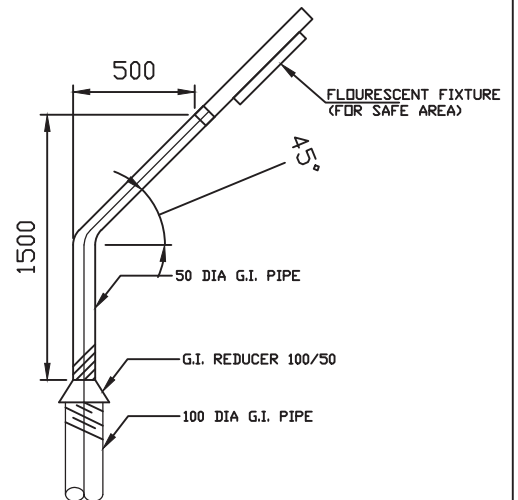


FIGURE-3

NOTES-

1. ALL DIMENSIONS ARE IN MM.
2. MARSHALLING BOX, JUNCTION BOX AND G.I. PIPES FOR CABLES SHALL BE LOCATED FACING CABLE TRENCH SIDE.
3. ALL G.I. PIPES SHALL BE MEDIUM GRADE.

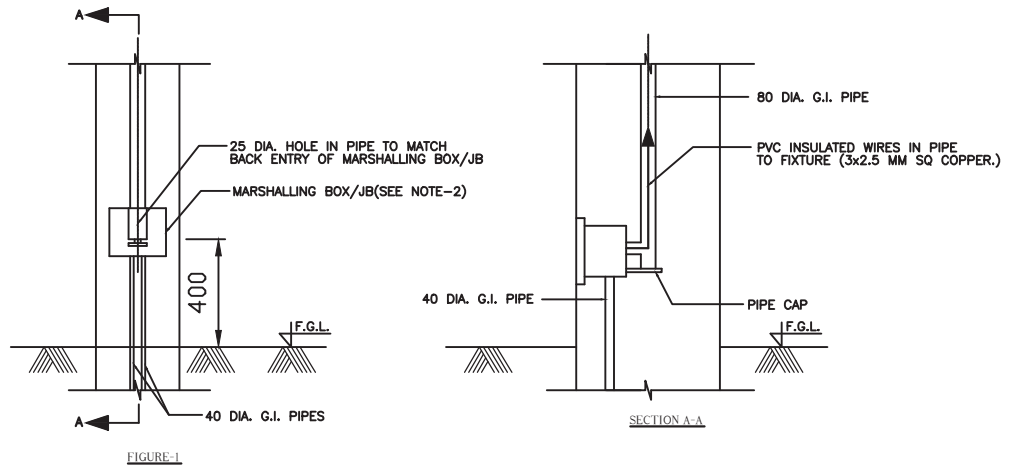
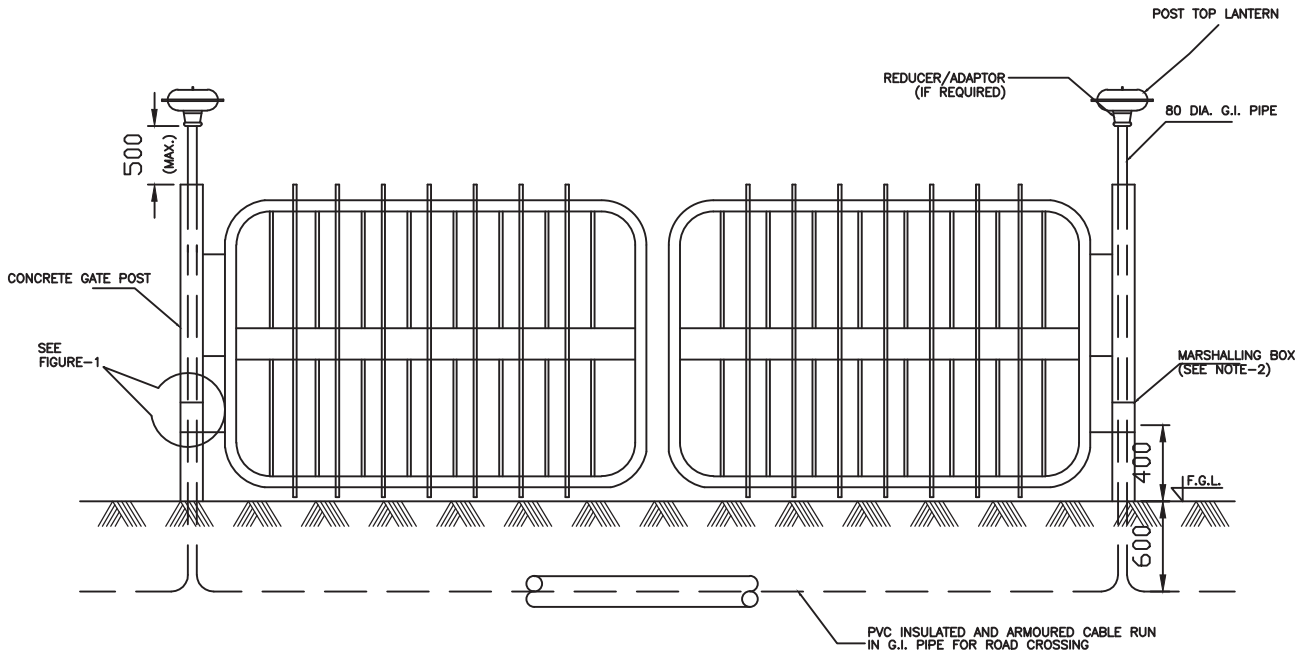
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LYONS ENGINEERING PVT. LTD.
NEW DELHI

TYP. INSTALLATION OF
POST TOP LANTERN
ON GATE

DRAWING NO.
GAIL-STD-EL-DWG-TP-010
1 OF 1



NOTES:-

1. ALL DIMENSIONS ARE IN MM.
2. USE WEATHER PROOF SINGLE PHASE JUNCTION BOX IN PLACE OF MARSHALLING BOX IF SUPPLY IS SINGLE PHASE.
3. ALL G.I. PIPES SHALL BE MEDIUM GRADE.

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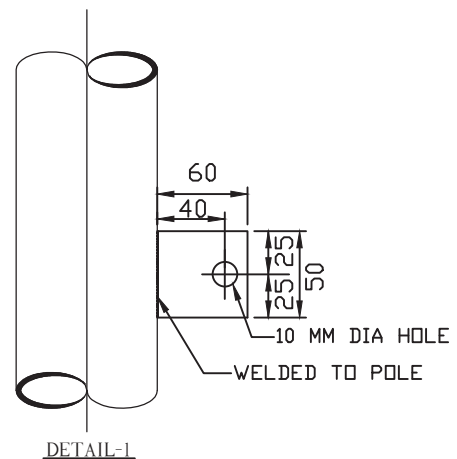
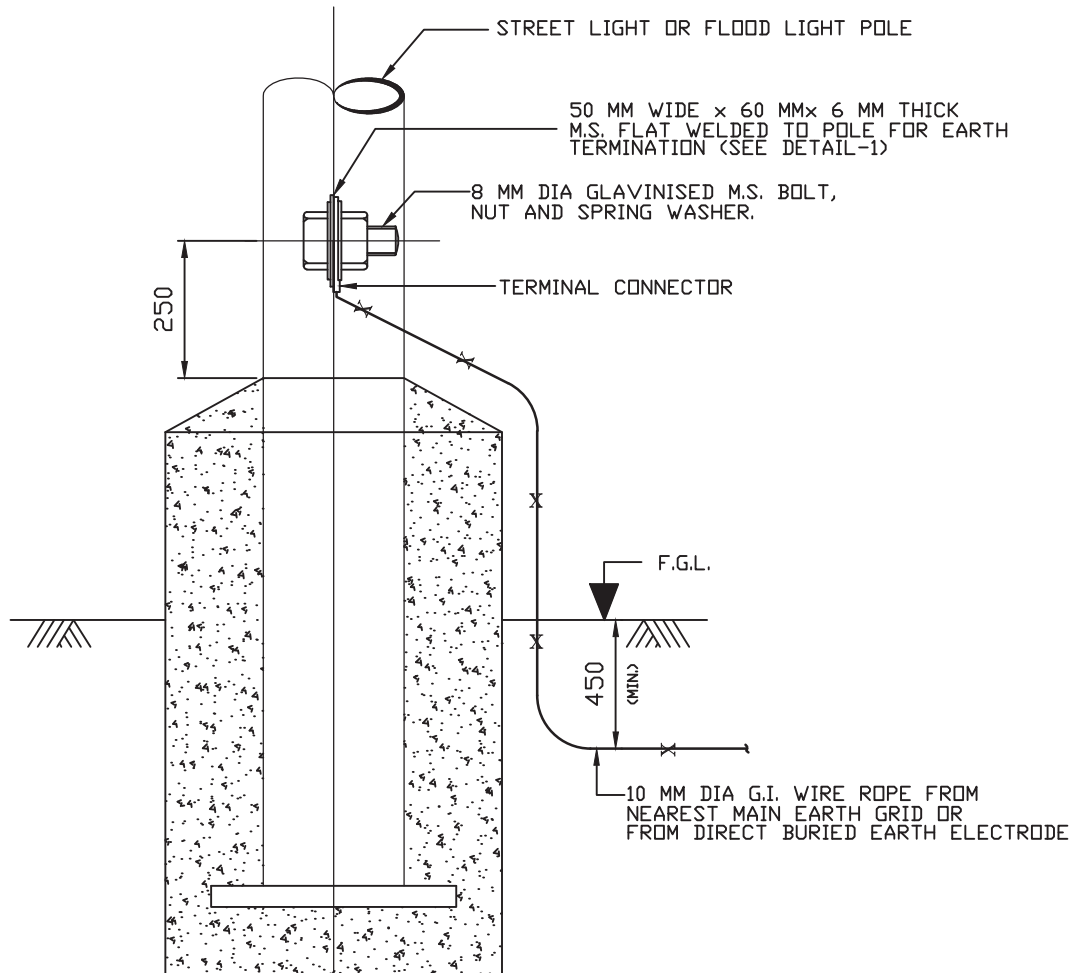
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NEW DELHI

TYP. EARTHING
CONNECTION FOR
LIGHTING POLE

DRAWING NO.

GAIL-STD-EL-DWG-TP-011

1 OF 1



NOTE-

1. USE TWO WIRE ROPES IF POLE JUNCTION BOX VOLTAGE IS 415V.

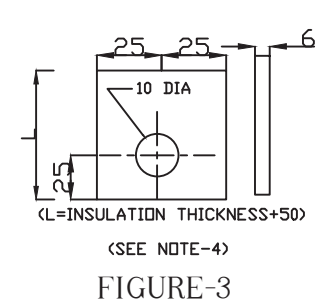
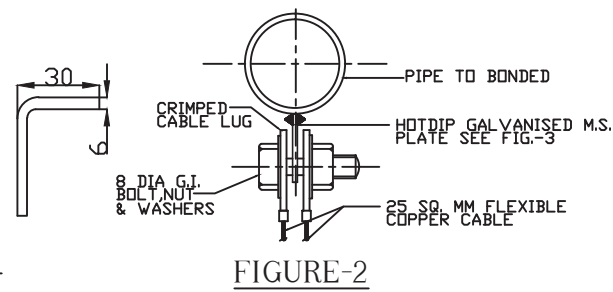
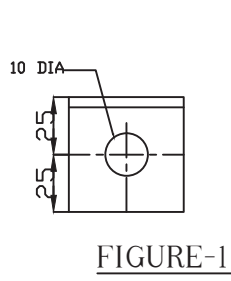
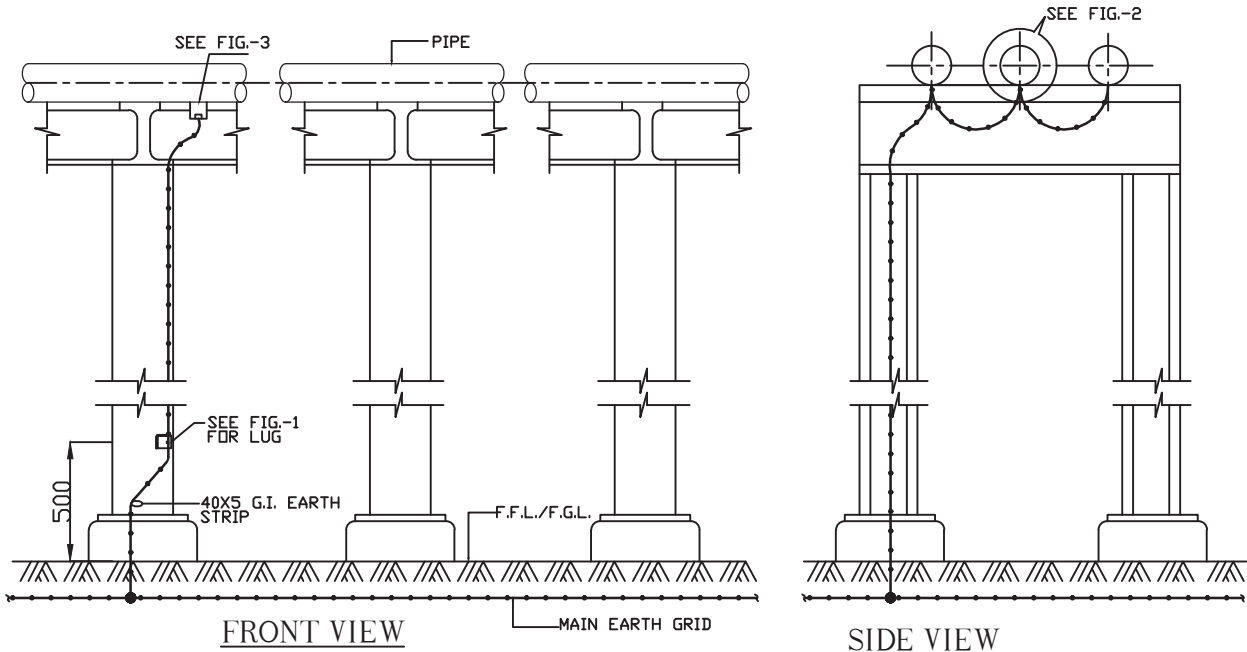
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LYONS ENGINEERING PVT. LTD.
NEW DELHI

TYP. EARTHING/ BONDING
OF
PIPES & PIPE RACKS

DRAWING NO.
GAIL-STD-EL-DWG-TP-012
1 OF 2



NOTES:-

1. UNLESS OTHERWISE MENTIONED, THE PIPELINE SHALL BE BONDED & EARTHED ONLY AT THE ENTRY & EXIT POINTS OF BATTERY LIMIT.
2. SUPPLY OF FLEXIBLE Cu CABLE, LUGS, BOLTS, NUTS & WASHERS ETC. & MAKING CONNECTIONS SHALL BE DONE BY ELECTRICAL CONTRACTOR.
3. STEEL PIPE RACKS IN THE PROCESS AREA & OFFSITE AREA SHALL BE EARTHED AT MAX. SPACING OF 24 MTRS.
4. HOT DIP G.I. STRIP AS PER FIG-3 SHALL BE PROVIDED BY THE PIPING CONTRACTOR BEFORE HYDROTESTING OF LINES.

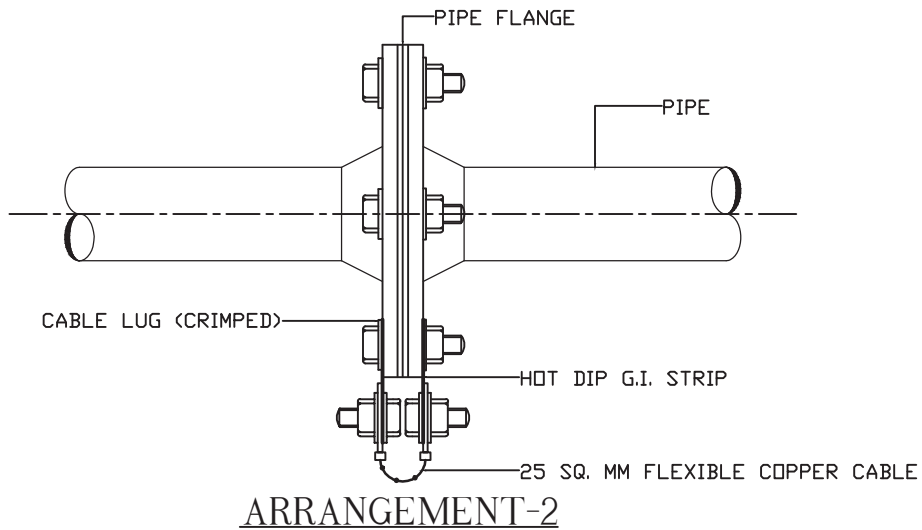
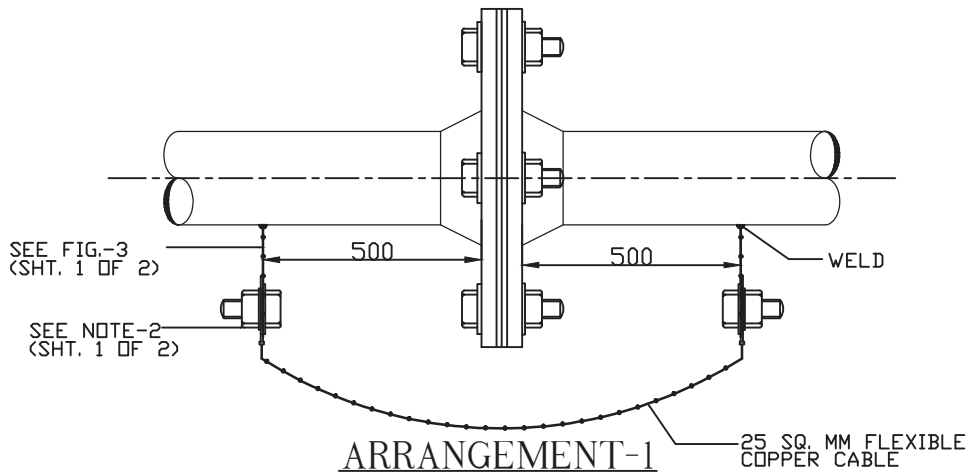
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| REV.NO. | DATE | SUBJECT OF REVISION | BY | CHECKED | APPROVED |



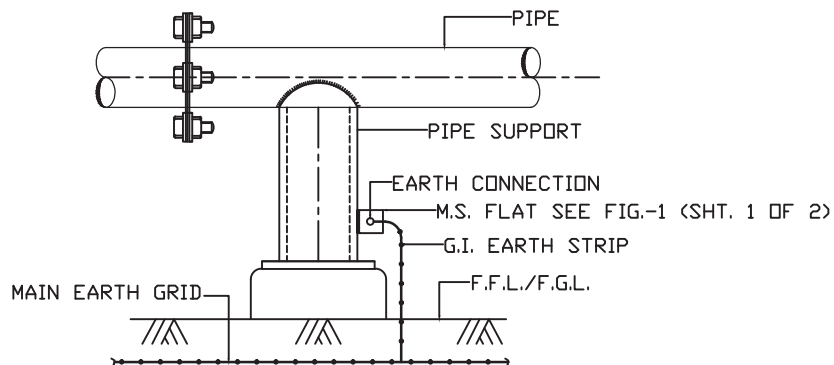
LYONS ENGINEERING PVT. LTD.
NEW DELHI

TYP. EARTHING/ BONDING
OF
PIPES & PIPE RACKS

DRAWING NO.
GAIL-STD-EL-DWG-TP-012
2 OF 2



(APPLICABLE WHERE G.I. STRIP ARE NOT AVAILABLE AS PER ARRANGEMENT-1)



(APPLICABLE WHEREVER PIPE SUPPORTS ARE ON BOTH SIDES OF FLANGES / VALVES ETC.)

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LYONS ENGINEERING PVT. LTD.
NEW DELHI

TYP. EARTHING OF
GATE & FENCE

DRAWING NO.

GAIL-STD-EL-DWG-TP-013

1 OF 1

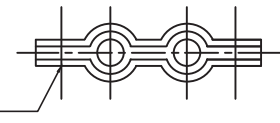
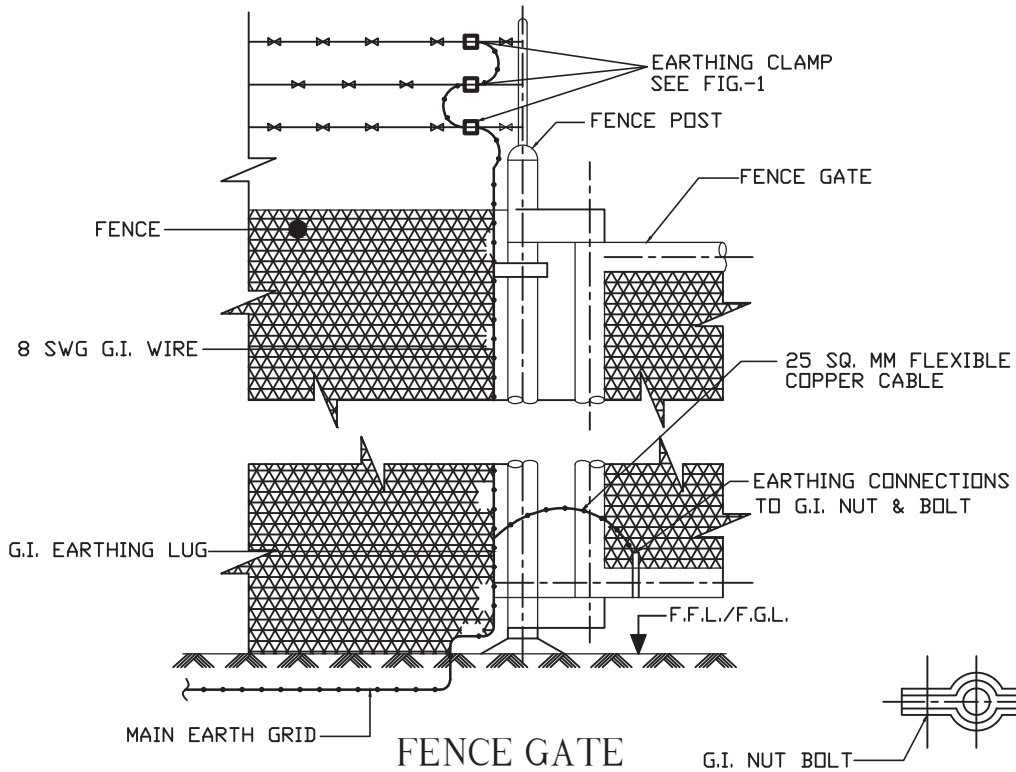


FIGURE-1

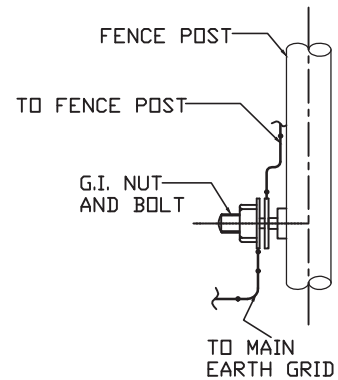
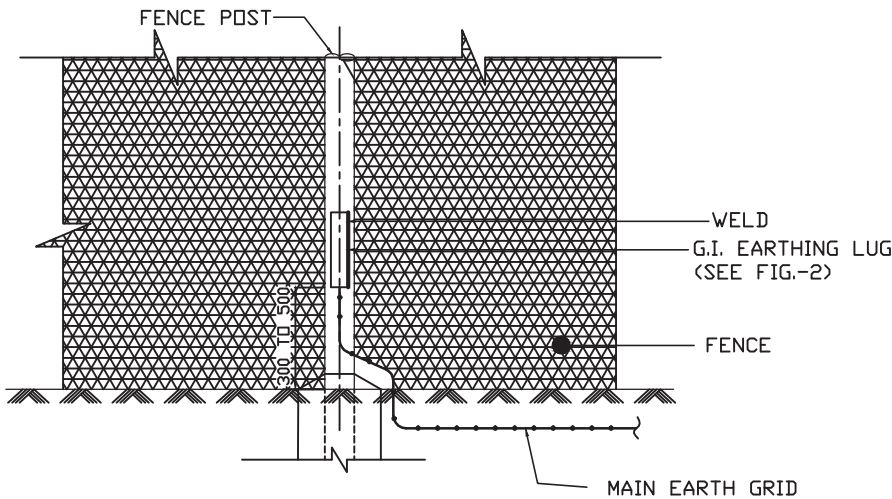


FIGURE-2

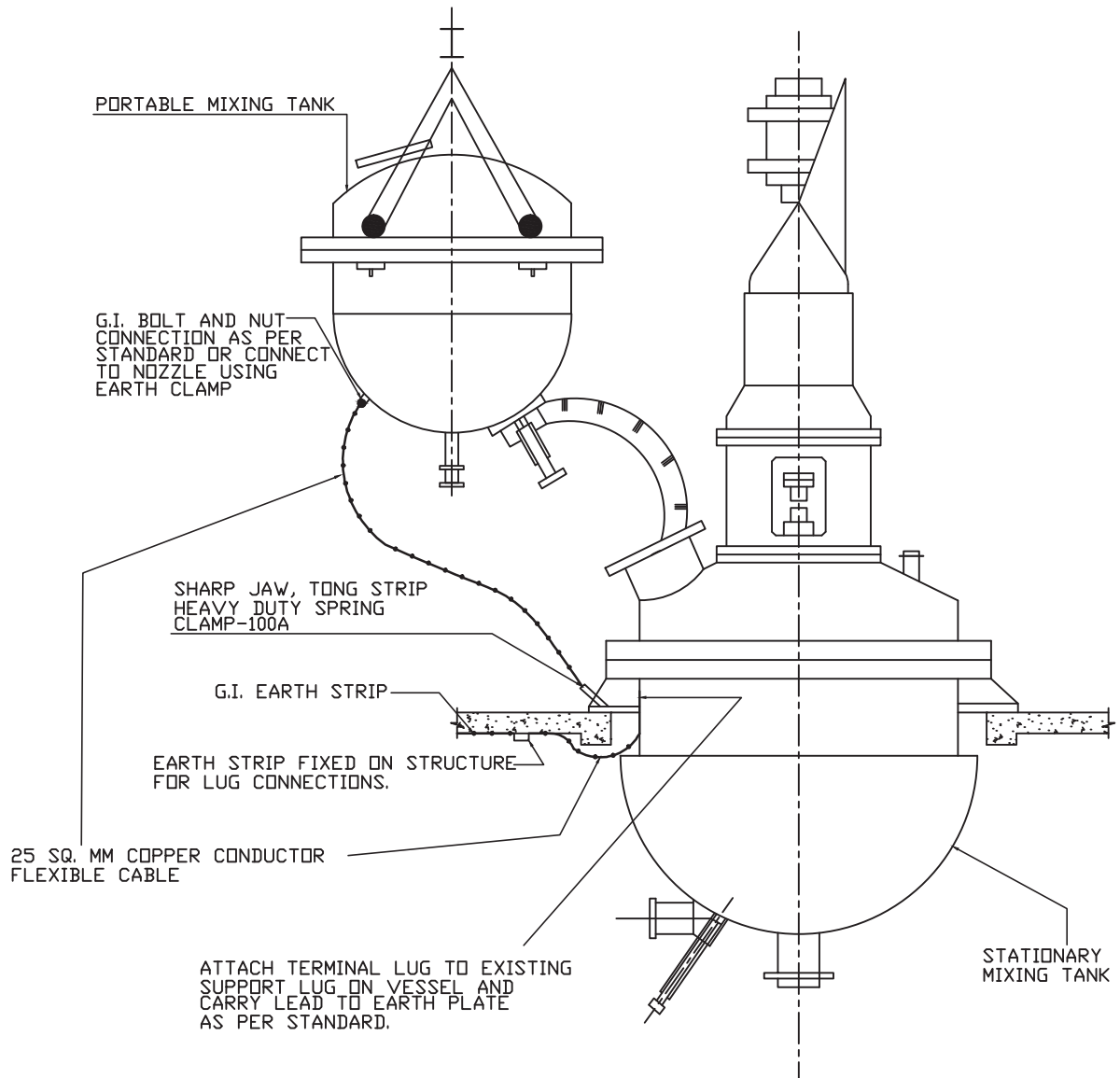
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LYONS ENGINEERING PVT. LTD.
NEW DELHI

TYP. EARTHING FOR
PROCESSING EQUIPMENT

DRAWING NO.
GAIL-STD-EL-DWG-TP-014
1 OF 1



NOTES:-

1. ALL PROCESSING EQUIPMENT SUCH AS MIXTURES, CHURNS, AUTOCLAVES, COLUMNS, CENTRIFUGES, FILTERS, PRESS PUMPS ETC. SHALL BE EARTHED, IF THESE ARE NOT IN DIRECT CONTACT WITH PROPERLY EARTH STEEL MEMBERS.
2. ALL TEMPORARY EARTH CONNECTIONS SHALL BE MADE BEFORE OPENING THE VESSEL.

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GAIL INDIA LIMITED

**CONSTRUCTION OF STEEL PIPELINE AND ASSOCIATED FACILITIES
FOR CGD CONNECTIVITIES**

VOLUME II OF II (TECHNICAL) – H



INSTRUMENTATION



E-TENDER REF : 8000017904

(BID DOCUMENT NO - 034/LEPL/GAIL/31-R0)



Lyons Engineering Pvt. Ltd.

| | | | |
|--|--|-------------------------------|---|
| PMC:  | DCI - MASTER DELIVERABLE CONTROL INDEX FOR CONSTRUCTION OF STEEL PIPELINE AND ASSOCIATED FACILITIES FOR CGD FOR M/S IOAGPL PALAKKAD, CGD TO M/S IOAGPL MALAPPURAM, CGD TO M/S IOAGPL KANNUR & CGD TO M/S GAIL GAS LIMITED DAKSHIN KANNADA | Doc No. | CLIENT:  |
| | | GAIL-ENG-GN-DOC-DL-001 | |
| | | Rev. 0 | |
| Sr. No. | Description | Document / Drawing No. | Rev. No. |
| TECHNICAL VOLUME - II OF II | | | |
| H | INSTRUMENTATION | | |
| 1 | Instrumentation Design Basis | GAIL-STD-IN-DOC-DB-001 | 0 |
| STANDARD SPECIFICATION FOR INSTRUMENTS | | | |
| 2 | Standard specification for Pressure Gauges. | GAIL-STD-IN-DOC-TS-001 | 0 |
| 3 | Standard specification for Pressure Safety Valves. | GAIL-STD-IN-DOC-TS-002 | 0 |
| 4 | Standard specifications for Electronic Transmitters | GAIL-STD-IN-DOC-TS-003 | 0 |
| 5 | Standard specification for RTDs and thermowell | GAIL-STD-IN-DOC-TS-004 | 0 |
| 6 | Standard specifications for Instrument cables. | GAIL-STD-IN-DOC-TS-005 | 0 |
| 7 | Standard specifications for Junction Boxes and cable Glands. | GAIL-STD-IN-DOC-TS-006 | 0 |
| 8 | Standard specifications for instrument tube fittings | GAIL-STD-IN-DOC-TS-007 | 0 |
| 9 | Standard specifications for instrument tubing | GAIL-STD-IN-DOC-TS-008 | 0 |
| 10 | Standard Specification for Instrument Valve & Manifold | GAIL-STD-IN-DOC-TS-009 | 0 |
| 11 | Standard specifications for Fire & Gas Detection System | GAIL-STD-IN-DOC-TS-011 | 0 |
| 12 | Standard specifications for control Panels | GAIL-STD-IN-DOC-TS-012 | 0 |
| 13 | Standard specifications for Pig Signalers | GAIL-STD-IN-DOC-TS-013 | 0 |
| DATASHEET FOR INSTRUMENT | | | |
| 14 | Datasheet for Pressure Transmitter | GAIL-STD-IN-DOC-DS-001 | 0 |
| 15 | Datasheet for Temperature Transmitter | GAIL-STD-IN-DOC-DS-002 | 0 |
| 16 | Datasheet for Temperature Element (RTD) with Thermowell | GAIL-STD-IN-DOC-DS-003 | 0 |
| 17 | Datasheet for Gas Detector | GAIL-STD-IN-DOC-DS-004 | 0 |
| 18 | Datasheet for Pressure Gauges | GAIL-STD-IN-DOC-DS-005 | 0 |
| 19 | Datasheet for Temperature Gauges | GAIL-STD-IN-DOC-DS-006 | 0 |
| 20 | Datasheet for Pressure Safety Valve | GAIL-STD-IN-DOC-DS-007 | 0 |
| 21 | Datasheet for Scrapper/Pig Signaller/detector- Intrusive Type | GAIL-STD-IN-DOC-DS-008 | 0 |
| 22 | Datasheet for GOOV | GAIL-STD-IN-DOC-DS-009 | 0 |
| QAP FOR INSTRUMENT | | | |
| 23 | QAP for Temperature Transmitters | GAIL-STD-IN-DOC-QAP-001 | 0 |

|  PMC: DCI - MASTER DELIVERABLE CONTROL INDEX FOR CONSTRUCTION OF STEEL PIPELINE AND ASSOCIATED FACILITIES FOR CGD FOR M/S IOAGPL PALAKKAD, CGD TO M/S IOAGPL MALAPPURAM, CGD TO M/S IOAGPL KANNUR & CGD TO M/S GAIL GAS LIMITED DAKSHIN KANNADA | Doc No. | | CLIENT:  |
|---|--|-------------------------------|---|
| | GAIL-ENG-GN-DOC-DL-001 | | |
| | Rev. 0 | | |
| Sr. No. | Description | Document / Drawing No. | Rev. No. |
| 24 | QAP for RTDs and Thermowells | GAIL-STD-IN-DOC-QAP-002 | 0 |
| 25 | QAP for Pressure Transmitters | GAIL-STD-IN-DOC-QAP-003 | 0 |
| 26 | QAP for Pressure Gauges | GAIL-STD-IN-DOC-QAP-004 | 0 |
| 27 | QAP for Temperature Gauges | GAIL-STD-IN-DOC-QAP-005 | 0 |
| 28 | QAP for Instrument Cables | GAIL-STD-IN-DOC-QAP-006 | 0 |
| 29 | QAP for Pressure Safety Valves | GAIL-STD-IN-DOC-QAP-007 | 0 |
| 30 | QAP for Pig Signaller | GAIL-STD-IN-DOC-QAP-008 | 0 |
| 31 | QAP for GAS detector | GAIL-STD-IN-DOC-QAP-009 | 0 |
| 32 | QAP for Gas over Oil Actuators | GAIL-STD-IN-DOC-QAP-010 | 0 |
| STANDARD TYPICAL DRAWING | | | |
| 33 | Instrument Connection on Vessels, Standpipes and Tanks | STD-ENG-IN-DWG-TP-001 | 0 |
| 34 | Drain for Single Line | STD-ENG-IN-DWG-TP-002 | 0 |
| 35 | Pressure Instrument Installation Scope of Work | STD-ENG-IN-DWG-TP-003 | 0 |
| 36 | Flow Meter Installation Scope of Work | STD-ENG-IN-DWG-TP-004 | 0 |
| 37 | Thermowell Installation Scope of Work | STD-ENG-IN-DWG-TP-005 | 0 |
| 38 | Instrument Connection on Vessel, Standpipes and Tanks | STD-ENG-IN-DWG-TP-006 | 0 |
| 39 | Meter Runs – Piping Connections D – D/2 Taps | STD-ENG-IN-DWG-TP-007 | 0 |
| 40 | Meter Runs – Piping Connections Pipe (2 ½ D – 8d) Taps | STD-ENG-IN-DWG-TP-008 | 0 |
| 41 | Thermowell | STD-ENG-IN-DWG-TP-009 | 0 |
| 42 | Thermocouple / RTD Assembly With Thermowell | STD-ENG-IN-DWG-TP-010 | 0 |
| 43 | Symbol for Instrument Location Drawings | STD-ENG-IN-DWG-TP-011 | 0 |
| 44 | Instrument Support Single Instrument | STD-ENG-IN-DWG-TP-012 | 0 |
| 45 | Instrument Support Two Instruments | STD-ENG-IN-DWG-TP-013 | 0 |
| 46 | Support Details for Junction Boxes | STD-ENG-IN-DWG-TP-014 | 0 |
| 47 | Fabricated Canopy for Instruments | STD-ENG-IN-DWG-TP-015 | 0 |
| 48 | Perforated Tray Supports and Cables Clamping Details | STD-ENG-IN-DWG-TP-016 | 0 |
| 49 | Pressure Gauge Liquid / Gas Service | STD-ENG-IN-DWG-TP-017 | 0 |
| 50 | Purge for Instrument Single Line | STD-ENG-IN-DWG-TP-018 | 0 |
| 51 | Purge for Instrument Double Line | STD-ENG-IN-DWG-TP-019 | 0 |



GAIL INDIA LIMITED

INSTRUMENTATION DESIGN BASIS

GAIL-STD-IN-DOC-DB-001


| | | | | | | |
|------------|-------------|----------------|--------------------|-------------------|--------------------|---|
| | | | | | |  |
| 0 | 22.12.2020 | Issued for Bid | RKS | SR | TR | |
| Rev | Date | Purpose | Prepared By | Checked By | Approved By | |

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1.0 INTRODUCTION

GAIL (India) Limited, the largest state-owned natural gas processing and distribution company and the youngest Maharatna company. GAIL is the nodal agency for transportation and supply of Natural Gas to various potential customers. The receipt of gas from the sources and its transportation and distribution is intended to be by means of a high-pressure trunk transmission gas grid from the gas receiving point to various customer stations.

- a) In order to supply gas to IOAGPL Palakkad, GAIL is laying 4" NB Pipeline & Piping to connect IOAGPL Palakkad inside plot / Receiving Terminal including metering skid (as per indicative plot plan / P&ID and Schematic attached elsewhere). Work shall include all the interconnecting piping, civil, electrical, instrumentation works at Customer End and Hook-up.
- b) In order to supply gas to IOAGPL Malappuram, GAIL is laying 4" NB Pipeline & Piping to connect IOAGPL Malappuram inside plot / Receiving Terminal including metering skid (as per indicative plot plan / P&ID and Schematic attached elsewhere). Work shall include the balance work for interconnecting piping, civil, electrical, instrumentation works at Customer End and Hook-up.
- c) In order to supply gas to IOAGPL Kannur, GAIL is laying 4" NB Pipeline & Piping to connect IOAGPL Kannur inside plot / Receiving Terminal including metering skid (as per indicative plot plan / P&ID and Schematic attached elsewhere). Work shall include all the interconnecting piping, civil, electrical, instrumentation works at Customer End and Hook-up.
- d) In order to supply gas to Gail Gas Ltd., Dakshin Kannada, GAIL is laying 4" NB Piping to connect Gail Gas Ltd., Dakshin Kannada inside plot / Receiving Terminal including Metering skid (as per indicative plot plan / P&ID and Schematic attached elsewhere). Work shall include all the interconnecting piping, civil, electrical, instrumentation works at Customer End and Hook-up.

■ SITE PARAMETERS FOR DESIGN:

The system shall be designed to conform following design conditions:

- Ambient Temperature - Maximum 60°C & Minimum -20°C
- Relative Humidity - 100%
- Altitude Above Sea Level - Less ≤ 1,000M
- Atmospheric Pollution - Tropicalized to withstand the site Conditions, dust, vapour etc.
- Hazardous Area Classification - Zone1 & 2, Gas Gr.IIA & IIB; Temperature Class T3
- Battery, TRU room - Safe Area

For Proposed pipeline system, please refer Pipeline Schematic Diagram.

2.0 APPLICABLE CODES , STANDARDS, ABBREVIATIONS AND DEFINITIONS

2.1 Precedence of Codes, Standards and Specifications

It is the main responsibility of EPC CONTRACTOR to inform the COMPANY of any deviations from or exceptions to the listed specifications, codes, and standards. COMPANY will take non-listing or

| | | | |
|---|-------------------------------------|-------------------------|-------------|
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| | | SHEET 3 of 28 | |

non-specification of exception or deviation by EPC CONTRACTOR in the bid proposal document, as being in full compliance with the specifications, codes, and standards listed. If there is a conflict between the various codes, standards, specifications and the attached drawings, the most stringent requirement shall be govern. EPC CONTRACTOR shall seek COMPANY'S final interpretation of any conflicts prior to the execution of work. Rework of engineering and relevant scope arising out of underestimation shall be done at no additional cost to the COMPANY.

As a minimum, all equipment shall be designed, manufactured, and delivered in accordance with the relevant section of the national/international Codes, Standards, and Regulations as listed below. The latest editions of Codes, Standards including all addenda, supplements, or revisions current at time of order placement, as issued by the following authorities shall apply:

- British Standard Institution (BS)
- International Electrotechnical Commission (IEC)
- The Institute of Petroleum (IP)
- Institute of Electrical Engineers (IEE)
- IP Codes of Practice
- American Petroleum Institute (API)
- Instrument Society of America (ISA)
- Oil Industry Safety Directorate (OISD)
- National Fire Protection Association (NFPA)
- Petroleum & Natural Gas Regulation Board (PNGRB)

2.2 International Codes and Standards

The design shall in general comply with the applicable sections of the latest editions of the applicable engineering codes and standards listed below:

| Document Number | Document Title |
|----------------------|--|
| AGA 3 | Orifice Metering of Natural Gas |
| AGA 7 | Measuring of Gas by Turbine Meter |
| AGA 8 | Compressibility and Super-compressibility for Natural Gas |
| AGA 9 | Measuring of Gas by Multipath Ultrasonic Meter |
| AGA ANSI B109.3 | Rotary Type Gas Displacement Meter |
| ANSI / ASME PTC 19.3 | ASME Performance Test Codes Supplement on Instruments and Apparatus Part 3 – Temperature Measurement |
| ANSI MC 96.1 | Temperature Measurement Thermocouple |

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|-----------------------------------|---|
| ANSI/ISA-75.05.01-2000 (R2005) | Control Valve Terminology |
| ANSI / FCI 70.2 | Control Valve Seat Leakage |
| ANSI / ISA 75.01 | Flow Equations for Sizing Control Valves |
| ANSI / ISA 5.1 | Instrumentation Symbols and Identification |
| ANSI B 16.5 | Pipe Flanges and Flanged Fittings |
| ANSI B16.10 | Face to face dimensions and End to End Dimensions of valves |
| API 14 C | Analysis, Design, Installation, and Testing of Basic Surface Safety Systems for Offshore Production Platforms |
| API 607 | Fire Test for Soft Seat Quarter Turn Valves |
| API 6D | Pipeline Valves |
| API 6FA | Specification for Fire Test for valves |
| API MPMS | Sizing, Selection and Installation of Pressure-Relieving Devices |
| API RP 500 | Recommended Practices for Classification of location for electrical installations at petroleum facilities as class 1, DIV 1&2 |
| API RP 520, Part I | Sizing, Selection of Pressure Relieving Devices in Refineries, Installation |
| API RP 520, Part II | Installation of Pressure Relieving Devices In Refineries, Installation |
| API RP 521 | Pressure-Relieving and De-Pressuring Systems |
| API RP 526 | Flanged Steel Safety-Relief Valves |
| API RP 527 | Commercial Seat Tightness of Safety Relief Valves with Metal to Metal Seats |
| API RP 551 | Process Measurement Instrumentation |
| API RP 552 | Transmission System |
| API RP 553 | Refinery Control Valves |
| API RP 554 | Process Instrument and Control |
| API RP 555 | Recommended Practices for Process Analyzer |

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|  | INSTRUMENTATION DESIGN BASIS | Document No. | Rev. |
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|----------------|---|
| ASME B 16.31 | Non-Ferrous Pipe Flanges |
| ASME PTC 19.3 | Temperature Measurement Instruments and Apparatus |
| ASME A213 | Seamless Ferritic and Austenitic Alloy Steel Tubes |
| ASME B 2.1 | NPT Pipe Threads |
| ASTM A269 | Seamless or welded austenitic Stainless Steel Tubing for General Service. |
| ATEX 94/9/EC | Equipment Intended for use in Potentially Explosive Atmospheres |
| BS 6739 | Code of Practice for Instrumentation in Process Control Systems: Installation Design and Practice |
| BS 1904 | Industrial Platinum Resistance Thermometer Sensors |
| BS 5555 | SI Units |
| BS 6174 | Differential Pressure Transmitters with Electrical Output |
| BS EN 50020 | Electrical apparatus for potentially Explosive atmosphere intrinsic safety 'I' |
| BS-5308-Part 1 | Instrumentation cables. Specification for polyethylene insulated cables |
| BS-5308-Part 2 | Instrumentation cables. Specification for PVC insulated cables |
| BS-EN-60751 | Industrial Platinum Resistance Thermometer Sensors |
| BS-EN-837-1 | Bourdon Tube Pressure and Vacuum Gauges |
| EN 50288 | Instrumentation Cables – Specification for PVC Insulated Cables |
| IEC 61000 | Electromagnetic Compatibility |
| IEC 61158 | Digital data communications for measurement and control, field bus for use in industrial control system |
| IEC 61131 | Programmable Logic Controllers – Part 2 and 3 |
| IEC 61831 | On line analyzer systems Guide to design and installation |
| IEC 60079 | Electrical Apparatus for Explosive Gas Atmospheres. |
| IEC 60529 | Classification of Degrees of Protection Provided by |

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| | Enclosures (IP code) |
| IEC 60331 | Fire Resisting Characteristics of Electrical Cables |
| IEC 60332 | Test on Electrical Cables under Fire Conditions |
| IEC 60529 | Degrees of Protection Provided by Enclosures (IP Code) |
| IEC 60540 | Test Method for Insulation and Sheaths of Electrical Cables and Cords |
| IEC 60605-1 | Equipment Reliability Testing |
| IEC- 60793-1 | Optic Fibers, Part 1 Generic Specification |
| IEC-61804-3 – 2010 | Function Blocks (FB) for Process Control: Electronic device description Language |
| IEC 61508 | Functional Safety: Safety Related Systems |
| IEC 61511-1 | Functional Safety: Safety Instrumented Systems for the Process |
| IEC 62453 | Field Device Tool (FDT) Interface Specification |
| IEC-1024-1 | Protection against Lighting |
| IEC-60227-1 | PVC cables of rated voltage up to and including 450/750 V – General requirements |
| IEEE-C37.90.1 | Surge Withstanding Capability Standard |
| ISA RP 12.06.01 | Instrument Wiring Methods for Hazardous (Classified) Locations Instrumentation – Part 1: Intrinsic safety |
| ISA S 5.4 | Instrument Loop Diagram |
| ISA-5.5 | Graphic symbols for process displays |
| ISA-7.0.01 | Quality standard for instrument air |
| ISA S5.1 | Instrument Symbols and Identification |
| ISA S5.4 | Instrument Loop Diagrams |
| ISA RP42.00.01-2001 | Nomenclature for Instrument Tube Fittings |

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| IS 1239 | Mild Steel Tubes, Tubular and other Wrought Steel Fittings |
| IS 2148 | Flame Proof Enclosures for Electrical Apparatus |
| IS 5571 | Guide for Selection and Installation of Electrical Equipment for Hazardous Areas (Other than Mines) |
| IS 5831 | PVC Insulation and Sheath of Electric Cables |
| T4S | Technical Standards and Specifications including Safety Standards for Natural Gas Pipeline PNGRB Notification G.S.R. 808 € |
| ISO 5167 Part 1 – 4 | Measurement of Fluid Flow by means of Pressure Differential 2003 Devices |
| ISO 5168 | Measurement of Fluid Flow: Estimation of Uncertainty of Flow- Rate Measurement. |
| NEMA VE1 | Metal Cable Tray Systems |
| NEMA ICS4 | Terminal Block for Industrial Use |
| NEMA ICS6 | Enclosure for industrial Control and system |
| NFPA 2001 | Clean Agent Fire Extinguishing System |
| NFPA 72 | National Fire Alarm Code |
| NFPA 12 | Standard for Carbon Dioxide Extinguishing System |

The list above is indicative. Any other International and Indian standards, if necessary, can also be referred by bidder during the execution of the job, without diluting the basic requirements, however with prior information to Owner/ Owner's Representative. In any case bidder must furnish a list of codes and standards other than those specified in this document, which shall be followed during engineering.

2.3 Abbreviations:

| | | |
|------|---|--|
| ANSI | : | American National Standards Institute |
| API | : | American Petroleum Institute |
| AGA | : | American Gas Association |
| ASME | : | American Society Of Mechanical Engineers |
| DG | : | Diesel Generator |
| DIN | : | Deutsches Institute For Normung |
| ER | : | Electrical Resistance |

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|--------|---|--|
| HOV | : | Hydraulic actuated Manually Operated Valves |
| HDD | : | Horizontal Directional Drilling |
| HDPE | : | High Density Poly Ethylene |
| LF2 | : | Lead Free #2 |
| LCP | : | Local Control Panel |
| LMC | : | Last Mile Connectivity |
| MCR | : | Master Control Room |
| MMI | : | Man Machine Interface |
| MMSCMD | : | Million Metric Standard Cubic Meter per Day |
| OFC | : | Optical Fiber Cable |
| OISD | : | Oil Industry Safety Directorate |
| PCP | : | Permanent Cathodic Protection |
| PESO | : | Petroleum and Explosives Safety Organization |
| PSP | : | Pipe to Soil Potential |
| PSV | : | Pressure Safety Valve |
| PNGRB | : | Petroleum and Natural Gas Regulatory Board |
| RLNG | : | Re-gasified Liquefied Natural Gas |
| RTU | : | Remote Telemetric Unit |
| SCADA | : | Supervisory Control and Data Acquisition |
| SMART | : | Self-Monitoring and Reporting Technology |
| STM | : | Synchronous Transmission Module |
| IP | : | Intermediate Pigging Station |
| TOP | : | Tap Off Point |
| TR | : | Transformer Rectifier |
| UPS | : | Uninterrupted Power Supply |

2.4 Definitions:

| | | |
|------------------------|---|--|
| COMPANY | : | The party that initiates the projects and ultimately pays for it design and construction, GAIL India Limited |
| CONSULTANT | : | The party which carries out FEED, detailed engineering and owner's Engineer |
| SUPPLIER/VENDOR | : | The party which manufactures or supplies the equipments and services to perform the duties specified by the Contractor EPC |
| CONTRACTOR | : | Refer Instrumentation Scope of work (doc. No. GAIL-ENG-IN-DOC-SW-001) |

3.0 DESIGN CRITERIA

3.1 GENERAL

All Instrumentation and Control and Monitoring systems shall be in accordance with this specification and as defined in the P&I Diagrams.

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All Instrumentation and Control Systems shall be designed for continuous operation in the given site conditions with the following design criteria:

- Ease of operation and maintenance;
- Suitability for applicable environmental condition;
- Suitability for operation in the designated classification of hazardous areas;
- State of art proven technology and instrumentation;
- Safety to operating and maintenance personnel;
- Safety to connected equipment;
- Safe starting and shutdown of the plant under all conditions;
- High Redundancy with high reliability (high MTBF and low MTTR) and no single point of failure;
- Minimum cost of ownership.

3.2 Quality Assurance

Procurement & Construction CONTRACTOR, CONSULTANT, SUPPLIER and VENDOR of equipment shall operate a Quality Assurance system. This system shall be based on the principles of ISO 9001 or equivalent. The quality system may be subject to auditing and monitoring by the COMPANY or his representative.

3.3 Reliability and Maintenance

High reliability of instrumentation is of paramount importance and therefore only existing field proven instrumentation, which is readily available and used widely in similar applications, shall be considered. Selection of instrumentation systems and equipment shall take account of the projects overall requirements for high availability. Importance shall be given to reducing the maintenance frequency and duration.

3.4 Operation and Design Life

The instrumentation and control equipment shall be designed to operate in the site environmental conditions continuously. The life time of the plant is envisaged to be 25 years. However, optimum design life expectancy of an instrument shall be 10 years and spare parts availability shall be for 10 years after cease of production. The life time expectancy of control equipment such as controllers, modules is expected to be 20 years with the availability of spares for 10 years after discontinuation of product.

The maintenance/replacement schedule shall be planned accordingly in order to maintain the instruments/control equipment for the duration of the plant life time.

3.5 Hazardous Area Classification

Field equipment and instruments shall be certified for use in designated areas when installed in hazardous area classified zones as per IEC 60079 and IS 5571.

Hazardous area classification shall be Zone 1, Gr. IIA/B, temperature Class T3. All field instruments shall be EEx „ia“ type, Whereas F&G equipment such as detectors, beacons and hooters shall be

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EEx "d" type. All junction boxes shall be EEx „d" type and all cable glands shall be EEx „d" certified.

Instruments shall be certified by an internationally recognized organization (statutory body in the country of origin) such as BASEEFA, PTB, FM, CSA, UL etc. for operation in hazardous area classification. Instruments shall also meet the relevant requirements of ATEX directive 94/9/EC and shall carry the ATEX marking as a minimum. Calibration /carrier gas cylinders for gas chromatographs shall be PESO approved

3.6 Ingress Protection

All field mounted equipment, junction boxes, etc. including entries and blanking plugs shall have an environmental protection rating of min. IP65 to BS EN 60529. Indoor located equipment shall be to min. IP42.

3.7 Electromagnetic Compatibility

Individually supplied instruments should conform to the intent of IEC 61000 and carry a CE/UL/CSA conformity mark.

In view of the highly corrosive (Saline) ambient conditions, all instrument internal and external parts which are not inherently corrosion resistant by choice of instrument and construction material shall be prepared and finished by suitable protective coating and paint finish.

All equipment shall also be able to withstand these conditions during shipment, storage and installation prior to commissioning.

3.8 Special Tools

The SUPPLIER/VENDOR of the main equipment shall provide tools, and any other specialist items, required to operate and maintain any instrument or system.

3.9 Instrument Air Supply

Instrument air headers with suitable tap-offs shall be provided by piping near the instrument air consumers such as control valves, emergency shutdown valves. Instrument tubing shall be used for further connection to the valves. Air filter regulator shall be provided at each consumer. Instrument air supply shall be provided from existing IA supply network at site.

3.10 Nameplates

All instruments, junction boxes, cabinets, panels and ancillary equipment should be provided with a manufacturer's engraved corrosion resistant nameplate, permanently attached with stainless steel screws or rivets. In addition, instruments shall be provided with SS304 tag number plates and junction boxes shall be provided with traffolyte service labels.

3.11 Instrument Selection:

Instruments and instrumentation systems of proven reliability and latest technology shall be used. Selection of instrumentation shall be made from the approved Instrument Supplier Lists. Any exception has to be justified and is subject to approval by the CONSULTANT & CLIENT.

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3.12 Tagging:

All instruments and instrumentation equipment shall be permanently identified by tags, labels and/or nameplates. Use of adhesive tapes shall not be allowed.

3.13 RF Immunity:

All instruments and control systems shall be immune from the effects of any R.F. interference that may occur at the plant location in accordance with IEC 801 "Electromagnetic compatibility for industrial-process measurement and control equipment". Equipment to be installed inside the control room shall be in compliance with the European Community directive requirements, denoted by the "CE mark". This compliance shall extend to each relevant item.

4.0 TYPE OF INSTRUMENT PROTECTION (AS APPLICABLE)

| Instrument | Explosion proof | Intrinsically safe | Increased Safety | Others |
|---------------------|---------------------------|--------------------|-----------------------|--------|
| Field Switches | | √ | | |
| 2-wire Transmitters | | √ | | |
| Solenoid Valves | | √ | | |
| Proximity Switches | | √ | | |
| Junction Box | √ (For Non-IS signals) | | √ (For IS signals) | |
| Cable Gland | √ (For Non-IS signals) | | √ (For IS signals) | |
| F&G Devices | √ | √ | √ | |

Generally, Weather Protection Type for Field Instruments and junction boxes shall be minimum IP-65.

All intrinsically safe instruments shall be provided with isolator barriers in control panel.

5.0 CERTIFICATION REQUIREMENT

All instrumentation items used in hazardous areas shall be certified as indicated above, by international agencies like UL, FM or BASEEFA. As a minimum all the field instruments shall be suitable for the use in **Zone 1, Gr. IIA/B, Temperature Class T3**.

Instruments shall be certified EEx'ia', EEx'ib' (Intrinsic Safety), EEx'e' (Increased Safety) or EExd (Explosion Proof) to suit the area classification. Area classification drawings shall be prepared by Consultant. All electrical and instrumentations Items shall be Certified for use in Hazardous areas wherever applicable including PESO (CCOE) approval.

6.0 UNITS OF MEASUREMENT:

The units of measure used will be those of the SI system in particular

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| Parameter description | Unit of Measure |
|------------------------------|---|
| Differential Pressure | bar |
| Flow Rate | MMSCMD |
| Density | kg/m ³ |
| Duty | kJ/hr, GJ/ hr |
| Energy | kJ |
| Gas Flow @ STP | Sm ³ /h, MSm ³ /h |
| Length | mm, m, km |
| Power | kW |
| Pressure | bar (g) |
| Specific Heat | kJ/kg °C |
| Temperature | °C |
| Thermal Conductivity | W/m °k |
| Transfer Rate | kW/m ² °C |
| Velocity | m/sec. |
| HC & Toxic Gas Concentration | ppM / Mol% |
| Viscosity | cP (centipoises) |

Standard Temperature and Pressure conditions (STP) are defined at 15 °C and 1.01325 atm.

- **CANOPY:** FRP of minimum, thickness of canopy should be 4mm (min.). FRP shall be UV Protected.

7.0 UTILITY REQUIREMENT (As Applicable):

7.1 ELECTRONIC INSTRUMENTS

7.1.1 Power Supply requirement

| | | |
|-----------------|---|------------------------|
| Transmitters | : | 24 V, DC |
| Solenoid valves | : | 24 V, DC |
| RTU Panel | : | 24 V DC, 50 Hz, - UPS, |
| F&G Panel | : | 24 V DC, 50 Hz, - UPS, |

7.1.2 Signal transmission : 4-20 mA DC, 2 wire

7.1.3 Switching : DPDT / SPDT dry contacts

Normal : Close



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Alarm/ Shutdown : Open

7.1.4 All valves requiring Power supplies shall be directly powered from the Instrumentation Panel & controlled locally from field and remotely from SCADA. There shall be no interface with electrical except for the main power supplies.

7.1.5 One UPS power feeder and one NON-UPS power feeder (for non –critical loads such as panel light, fan etc.) shall be provided for RTU panel by contractor. Distribution to panel instruments and field instruments shall be provided within the control panel. Power to field instrumentation shall be from RTU panel.

7.1.6 Instrument Earthing System Philosophy

Three separate earthing systems shall be provided:

- Electrical Safety Earth – Bonded to the Electrical Earth pit and utilized for electrical safety of metal enclosures and chassis on all instruments and electrical components.
- Instrument Clean Earth – Insulated from the Electrical Earth pit and other metal work, utilized for instrument cable screens and bonded to the main Instrumentation earthing system at a single point.
- Intrinsically Safe Earth – Insulated from the Electrical Earth pit and other metal work, utilized for termination of IS zener barrier earth connections and bonced to the main Instrumentation earthing system at a single point.

8.0 PROCESS AND ELECTRICAL CONNECTION:

8.1 PROCESS CONNECTIONS

| Instrument | Process Connection Size | | | Instrument Connection |
|--|-------------------------|---------------|---------------|-----------------------|
| | Vessel | Piping | Tank | |
| Pressure Gauge | 2” RF flg | 3/4” NPT | 2” RF flg | ½” threaded |
| Pressure Transmitter | 2” RF flg | 3/4” NPT | 2” RF flg | ½” threaded |
| DP Transmitter | 2” RF flg | 1” NPT | 2” RF flg | ½” threaded |
| Radar | 4” RF flg | -- | 4” RF flg | 4” RF flg |
| Level Transmitter (Radar Type/Displacer) | 2” RF flg | 2” RF flg | 2” RF flg | 4” RF flg |
| Level Gauge (Magnetic) | 2” RF flg | -- | 2” RF flg | -- |
| Thermowell | 1 1/2” RF flg | 1 1/2” RF flg | 1 1/2” RF flg | 1 1/2” RF flg |

9.0 MATERIAL SELECTION PHILOSOPHY

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9.1 MATERIAL OF CONSTRUCTION

The material of construction of the wetted parts and the body of all the individual instruments / equipment shall be suitable to the process fluid / conditions and the site ambient conditions.

All materials and equipment furnished shall be new and unused, of current manufacture and the highest grade and quality available for the required service, and free of defects.

Process wetted parts shall be suitable for process fluid and conditions. Body / trim materials shall be selected based on the applicable pipe class as per Piping Material Specification. Wetted parts material shall be SS316 as a minimum. Tubing and tube / pipe fittings used to hook up instruments to piping / vessel shall be SS316. Material of construction of enclosures and junction boxes shall be cast aluminum (LM6/LM25).

Galvanic compatibility between dissimilar materials is to be ensured to prevent corrosion due to galvanic action.

10.0 INSTRUMENTATION

GENERAL

All electronic transmitters shall be, "Smart" type with "HART" protocol. Transmitter output shall be 4~20mA, two wire loop powered at 24VDC from the system it is connected to. Smart sensors connected to safety systems shall be write-protected to prevent unintentional modification from a remote location.

All transmitters shall be supplied with integral LCD digital indicators scaled in engineering units; however, scale for level transmitters shall be 0 to 100% of instrument span.

Separate dedicated instruments shall be used for shutdown and process control & monitoring. Shutdown initiating devices shall only be used for shutdown functions.

Low power signals (i.e. RTD / thermocouple) shall be converted in field to 4-20 mA by means of remote mounted transmitters.

Gas chromatograph shall preferably have retractable type of probes inserted into pipelines for ease of maintenance.

Field instrument design and selection shall suit process and environmental conditions as well as hazardous area classification requirements.

All electronic / electric instruments shall have 2 Nos. ½" NPT cable entries. Suitable nickel plated brass adapters shall be provided if the cable entry on the instrument is other than NPT threads. Spare cable entries shall be plugged with certified nickel plated brass plugs.

10.1 PRESSURE INSTRUMENTS

GENERAL

- a) Process connections for pressure instruments shall normally be ½" NPT and process interface shall consist of 2" ball valves with double isolation
- b) Static pressure sensing connections on horizontal lines are normally made at the top

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- c) Impulse connection between primary process taps and pressure instruments shall generally be ½" OD SS316L seamless tubing. The tubing wall thickness shall be determined by pressure and temperature design limits of the process for that particular installation. As a minimum wall thickness for impulse tubing shall be 0.065". All tube fittings shall be of compression type with double ferrule, Swagelok or Parker only.
- d) Two valve manifolds shall be provided for pressure instruments installations. Valve Manifolds shall have MOC SS316 as Valve and seat material shall be determined by the process requirement.
- e) All pressure instruments shall be suitably mounted so as to minimize the length of impulse lines.
- f) Local Gauges shall be provided for field monitoring & control purpose. All instrument ranges shall be selected such that the normal operating point is between 35% and 75% of the instruments total range.

1. PRESSURE GAUGES

- a) Gauges shall be bourdon tube type.
- b) Pressure gauge; accuracy shall be ± 1.0% of full range and over range protection shall be 130%.
- c) Dial size shall be 150 mm and cases shall be stainless steel screw on or bayonet bezel type. Blow out disc and solid front protection shall be provided and gauges shall be orientated such that they vent safely.
- d) All pressure gauges shall be liquid filled type. It is widely known that vibration, pulsation and pressure spikes are the most common causes of poor performance and failure in pressure gauges.
- e) Gauge windows shall be constructed from safety pattern/toughened glass.
- f) Bourdon tube material shall be type 316 Stainless steel,
- g) Over-range protection shall be 1.3 times the maximum scale range. Where a gauge is subject to greater pressure, a gauge protector shall be used.
- h) On pulsating service, a snubber shall be fitted in the input connection. Syphon shall be fitted to pressure gauges on steam or hot condensable gas services.
- i) To facilitate pressure gauge removal and alignment, gauges shall be connected to the piping by means of gauge adapter and not directly into valves.

2. PRESSURE TRANSMITTER

- a) Pressure transmitter shall be electronic SMART type, two wire, loop powered at 24VDC with 4-20 mA output and integral digital indicator meter in engineering units.

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Transmitters shall have HART protocol for digital communication.

- b) Material of construction for wetted parts shall be SS 316 as a minimum.
- c) Pressure transmitters shall have minimum accuracy +/- 0.075% of the calibrated span.
- d) Transmitters shall have independent external screws for zero and span adjustment.
- e) Pressure transmitters shall be installed as close as practical to the primary taps shall not require seal or condensate chambers unless the fluid contains sediment or is corrosive. Transmitters shall be installed in accessible places.

10.2 TEMPERATURE INSTRUMENTS

1 THERMOWELLS

- a) Temperature measuring instruments shall be provided with thermowell. The process connection size of thermowell shall be 2" Butt Welded. Minimum line size for thermowell connection shall be 4". For lower size line, same shall be expanded to 4".
- b) The thermowell shall be constructed from drilled bar stock SS 316 material. Thermowell shall have a sufficient internal bore to properly accommodate the devices placed in the bore.
- c) Thermowell to be fabricated as per standard drawing for thermowell (Annexure-2)
- d) All thermowells shall be stress analysed for velocity conditions. Calculation shall be done as per ASME PTC 19.3 TW-2016 code. 100% radiography shall be conducted for all fabricated thermowells.
- e) Test wells shall be furnished with a permanently attached plug and chain. The bore shall be 10 mm to allow for the insertion of a glass stem mercury or ethyl alcohol test thermometer.
- f) All thermowells shall be of welded type only.

2 Resistance Temperature Detectors (RTDs)

- Sensor - Pt 100 RTD
- Type - 4 Wire, Duplex

3 TEMPERATURE TRANSMITTERS

- a) The sensor shall be RTD PT-100, 4-wire, Duplex type system. The transmitter shall be remote yoke mounted "SMART" type, two wire loop powered at 24V DC with 4-20 mA output with digital output indicator meter. Transmitters shall have HART protocol for digital communication. The 4-20 mA output signal must be directly proportional and linear to temperature. The RTD shall be class A type.
- b) The range shall be selected so that the normal operating temperature shall fall in the middle third of the span.

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- c) Temperature transmitters shall have a built-in linearization function to produce an output linear to temperature range.
- d) Transmitters shall have independent external screws for zero and span adjustment.
- e) The accuracy of the transmitter shall be minimum ± 0.15 % of range.

11.0 GAS OVER OIL ACTUATORS (GOOV)

Actuator shall be double acting piston design to enable quarter turn operation of the valve. The design pressure of the actuator shall be suitable to the pipe design to ensure trouble free operation of the actuator.

Actuator torque shall be 1.25 times the valve torque required at full rated differential pressure of valve. The actuator shall be suitable for operation using gas supply from upstream and downstream of the valve. Tapping for gas supply shall be provided on upstream and downstream piping of the valve.

Pneumatic cylinder storing gas with non-return valve shall be provided for emergency operation of valve. The gas tank (storage) shall cater at least 2 open / close cycles of valve operation. Both storage and accumulator cylinders shall be provided with relief valve and gauges and shall be designed as per ASME Sec VII.

Each actuator shall be provided with open / close limit switches, remote / local switch and differential pressure switch. A local actuator panel shall be provided to enable opening and closing of valve under local mode. Solenoid valves shall be 3 way with manual reset facility. Independent solenoids shall be provided for open and close conditions.

Tubing and tube fittings shall be minimum SS316. Local panel shall be die-cast aluminum and Ex"d certified. All signals from GOOV to control system shall be potential free.

Accessories:

- Valve Position Switch

All block valves shall be supplied with limit switches for valve position indications. Two separate limit switches are required, one for "closed" position and one for "open" position. Each limit switch shall be proximity type with NAMUR design.

The switch enclosure shall be copper free cast aluminium/AISI 316, weather proof IP-65 minimum and it shall be intrinsic safe suitable to hazardous area classification.

- Solenoid Valve

The solenoid valve shall be double acting type. The body and internals shall be of SS316. Valve shall be made leak proof with 'O' ring seals. The Solenoid valve shall be weatherproof to minimum IP-65 and intrinsic safe type, suitable to hazardous area classification. The power supply shall be 24 VDC.

- Differential Pressure Switch

The differential pressure switch shall be of electric type. The switch enclosure shall be copper free cast aluminium, weather proof to minimum IP 65 & it shall be intrinsic safe

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suitable to hazardous area classification.

- Local /Remote Selector switch the L/R switch shall be provided on the valve actuator for local operation from the valve or remote operation from the local control panel or SCADA.
- Actuator Sizing
The actuators shall be sized for maximum differential pressure across the valve body at the minimum medium supply pressure. The breakaway, run and end torque values of each actuator shall be carefully designed to ensure no damage to the valve stem will occur.

12.0 CONTROL VALVE

The control valve shall be self – contained totally enclosed unit, complete with actuator, electro-pneumatic positioner, filter regulator and accessories, which are required for automatic and manual operation of the valve. The control valve shall be designed for throttling operation of the valve to meet the process requirements.

Vendor shall select control valve as per the process conditions. The possible effects of erosion, cavitation and noise shall be considered in the valve selection procedure. Maximum permissible limit for noise generated by control valves shall be 85 dBA or less, as measured at a distance of 1 meter from the valve for any flow condition.

Control valve selection shall be done in accordance the necessary valve of the characteristics and to ISA S75.01, standard with regard to Flow equations for sizing of control valves. Equal percentage and linear trim are two of the main characteristic which is generally applicable to the process requirement.

Globe valves (linear motion, rotary / eccentric plug or rotary / segmented ball) shall be preferred for general service where precise flow control is required apart from low allowable pressure drop conditions and shall be cage guided expect in dirty or abrasive services.

The calculated Cv value shall be in accordance with ISA S75.01, Flow Equations for Sizing Control valves or the Vendor`s proprietary sizing program.

Control valves shall be sized for a minimum wide open capacity of 110 percent of maximum flow. The selected valve should normally be 80 to 90 percent open at maximum flow. The selected valve shall be no less than 10 percent open at minimum flow, or shall be within the Vendor's minimum throttling Cv recommendation.

Control valve actuators shall be pneumatic, spring return type, diaphragm or piston type. Spring shall be corrosion resistant, cadmium plated or equal.

The pneumatic actuator shall be suitable for instrument air and shall function properly under the minimum, normal and maximum instrument air supply pressures. The minimum instrument air pressure required for the actuator shall be 4 barg.

Actuators shall be sized for operation under maximum shutoff pressure drop across the valve with minimum instrument air pressure to the actuator.

The Vendor shall be responsible for the mechanical compatibility and provision of

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mechanical coupling between the valve and actuator. Valve to actuator mating and alignment shall be in accordance with ISO 5210 and ISO 5211.

Actuators shall be fully compatible with the valve with regard to torque/thrust figures, inertial stresses on the valve stem and mechanical stresses on the valve top.

Control valve shall be supplied duly fitted with electro-pneumatic positioner for all services except on / off control. Valve positioner supplied shall be "smart" type, 4 – 20 mA output, two wire loop powered unit with HART capability and integral LCD display. The device shall provide self-diagnostics as well as control valve diagnostics.

Positioner output action shall be direct. The valve positioner shall have sufficient capacity in both directions for pressuring and venting the actuator to prevent response time limitations. The positioner shall have a weatherproof enclosure with a minimum degree of protection of IP 65 in accordance with IEC 60529.

13.0 PRESSURE SAFETY VALVES (PSV)

Pressure safety valves (PSV) shall be direct acting, spring loaded; full nozzle / full lift, adjustable blow down high capacity type.

PSV shall have flanged end connections, enclosed spring, bolted bonnet, screwed cap, and full one-piece nozzle. Flanges shall be in accordance with ANSI B16.5 requirements.

Flanges shall be integral part of the body. Weld-on flanges shall not be allowed. Bodies and flanges shall be of the same material. Inlet flange shall be of sufficient rating to withstand the reaction force of the PSV.

PSV sizing shall be carried out based on API RP 520 Part 1. Orifice letter designation shall be in accordance with API STD 526. For blocked discharge case, overpressure shall be 10% above the set pressure. For fire relieving case overpressure shall be 21% above the set pressure.

All wetted parts of PSV shall be SS316. Safety valves shall be provided with test gags and manual test lever. Springs of safety valves shall be selected as per process conditions.

14.0 CONTROL PANEL

- Control panel shall be constructed from 2 mm thick CRCA sheet metal. However, thickness of panel front shall be 3 mm and thickness of cable gland plate shall be 3 mm.
- Panel shall be with a minimum protection of IP 42.
- Control panel shall have bottom cable entries.
- Power distribution shall be provided with in the panel for all field instruments, panel mounted instruments, annunciator, lamps, Relays, Active Barriers,etc.
- All the ferruling in the panels for the internal and field wiring shall be strictly cross Ferruled.
- The colour of the control panel shall be as per RAL 7032 / latest addition of RAL, same as that of existing control panels in order to have consistency or else as instructed by OWNER.

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- Control panel shall be fabricated as per standard specification for Control Panel, except that semi-graphic panels are not required.
- One spare trim of each type of valve, 20% spare with minimum of one (01) number of each type of instruments, relays, active barriers, all hardwares inside the panel etc. shall be provided on each panel.

15.0 GAS DETECTION SYSTEM (GDS)

Hydrocarbon Gas Detectors which are to be installed at field shall be Open Path and Point detector. Gas Detectors shall be 3-wire type and triad cable shall be used for connecting to control room. Gas Detector shall operate through 24VDC power supply and shall be explosion proof. Gas detector body shall be of die cast aluminium with epoxy coating and shall be weather proof to IP-65. Gas Detector shall have 4-20 mA HART output.

Point gas detection system will be Infrared Type.

The low and high gas concentrations and a failure/default state will be detected and signaled by the control unit. The three signals will be sent to the SCADA System located in the Control Room.

Hydrocarbon Gas detector portable IR type shall be provided where specified.

Also, Hydrocarbon Gas detector Open Path and Point IR Type detector shall be provided at stations shown in respective P&IDs to monitor leakage due to failure of prone equipment part, accessories, valves and pipes depending upon wind direction gas density. However, exact quantity will be decided at the time of detail engineering.

Gas detector shall flash alarm light in local and panel at 20% LEL and flash alarm light and sound alarm hooter in local & panel at 40% LEL.

OPEN PATH GAS DETECTION SYSTEM:

Standard Specification: AC (FP) Part – II, FA 1948 & GSR 1963, OISD

The system comprise TWO sets of Open path IR Gas detectors located in the process area. The entire Open Path Detectors are connected to a Control Panel. The control Panel for open path detection system is located in the main control room which will receive and transmit the required signals to the Detectors located in the field. All the Transmitters & Receivers of the open path detectors are connected to the Control Panel by the means of 6 P Armoured FLP Cable. From Transmitter and Receiver the continuous monitoring will be there and if the gas leaks in the field respective loop will be indicated in the front panel.

ENVIROMENTAL CONDITIONS & GENERAL REQUIREMENTS:

- All the field equipments shall be suitable for IP 65 and should be for outdoor application.
- Flame proof equipment should be installed in the process area.
- Area classification for Hazardous area shall be Zone – 2, Group –IIA, II B, & Temperature class shall be T3.
- All Electronic circuits used in the system shall be resistant from the effects of any RF interference.

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- Contacts used in intrinsically safe circuit must be gold plated.

CONTROL PANEL FOR OPEN PATH DETECTORS:

The control Panel for the open path detectors Gas module is an electronic control unit designed to operate Gas detector head. Control Card and Controller for Gas Detection system shall be of OEM make only. Its Function is to:

- Supply the detector Head with a stabilized voltage and current.
- To receive the signal from the Detector Head and process it.
- To visually display the concentration of gas present at the Detector Head.
- To initiate alarms at pre-set levels of gas concentration.

The module contains comprehensive fault monitoring facilities and circuits that allows remote display and control of its state. The unit is powered by 24 V DC supply and a switch mode regulator for the detector Head supply such that the voltage at the Head can be maintained accurately at the value required by the sensor (typically 2.0 volts) with up to 40 ohms loop conductor resistance between Detector Head and module.

The three wire interconnection between the module and the Detector Head is monitored by the fault detection circuits for any combination of short circuit or open circuit. Under normal conditions a fault relay is energized and when fault is detected this relay then de- energises. Fault conditions exist whenever the front panel function switch is in any position other than NORM. The input signal from the Detector is amplified accordingly the % LEL will be displayed in the front panel. Also the same amplified signal is compared in two separate comparator circuits against pre-set level to provide the ALARM 1 & ALARM 2 control signals.

Detected Gases: Simultaneous detection of C 1 –C 8 flammable gases. Other Features –

- Long – range gas detection up to 140 m
- High sensitivity and fast response to hydrocarbon gases.
- Compatible with extreme and harsh environments.
- Solar blind and immune to industrial environments.
- Withstands extreme vibration conditions.
- Interfaces with most commonly used control panels.
- Standards 4 – 20m A and Dry Contacts Relays.
- RS –485 Output for PC communications.
- Network for a maximum of 64.
- Simple installation , alignment, and calibration
- Explosion – proof enclosure.
- Cenelec and UL approved

Power Supply:

- 230VAC as a main Supply.
- 24V DC as a standby Supply.

Input Signals:

- Open path detectors
- Point Gas Detectors

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Output Signals:

- Signals to PLC / SCADA system located in the Control Room.

Critical alarms from the GDS such as confirmed gas detection alarm, panel fault alarm shall be hardwired to the RTU / GAIL SCADA as a minimum.

16.0 FIRE ALARM CONTROL PANEL (FACP)

Terminal buildings shall be equipped with Fire Alarm Control Panels (FACP) along with smoke detectors and manual call points (MCP) to initiate alarm on fire detection for safety of personnel and equipment in building. FACP shall be interfaced to RTU / GAIL SCADA in the terminal building.

FACP system shall be analog system compliant to NFPA 72 requirements. All buildings shall have conventional type smoke & heat detectors, hooters and beacons etc. interfaced to the FACP as required per HSE requirements.

Upon fire detection, the system shall initiate audible and visual alarms at the facility via hooters and beacons to alert personnel and initiate HSE procedures.

Critical alarms from the building FACP such as confirmed fire alarm, panel fault alarm shall be hardwired to the RTU / GAIL SCADA as a minimum.

17.0 INSTRUMENT CABLING AND WIRING

- 17.1 Only 1Pair / 2 pair / 1 Quad / 6 pair / 8 pair / 12 pair with PVC type primary insulation shall be used for instrumentation cables.
- 17.2 All cables shall be FRLS type to IEC - 60332 (Type-III, Category 'A').
- 17.3 Cables for analog signals shall have both individual pair screen and overall screen, and the pairs (or triples) shall be uniformly twisted together. Conductor size shall be 1.5mm² stranded. Cables for discrete signals shall have an overall screen, and the pairs shall be uniformly twisted together. Conductor size shall be 1.5 mm² stranded for both single pair and multipair cables.
- 17.4 Power supply cables (24V DC to solenoid valves, etc.) shall have stranded 2.5 mm² conductor size. Contractor to check the correct size depending upon length of cable and voltage drop.
- 17.5 In general, cable shall be armored type.
- 17.6 Wiring inside the control room local panels shall be 1.0 mm² copper stranded conductors with PVC insulation. Wiring shall be flame retardant & termination shall be via MCT. Panel wiring raceways and terminal blocks shall be flame retardant type (FRLS). All terminal blocks shall be with screw clamp type and shall be UL listed, 25% spare to be provided for future expansion.
- 17.7 All terminals shall be suitable for minimum 2.5mm² conductor size excepting those on main power supply distribution arrangements. The cable shields shall be grounded at one location only. Required number of junction box shall be allowed in the way of any interconnecting cable between the field instruments and the final termination point both for skid and non-skid equipment. Special signal cables shall be wired without Junction Boxes.

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18.0 JUNCTION BOX

- 18.1 Junction boxes shall be weatherproof to NEMA 4X. Junction boxes located in explosion proof circuits shall be certified explosion proof to NEMA 7 suitable for the specified area classification.
- 18.2 Material of construction of junction box shall be LM-6 cast aluminum.
- 18.3 Terminals shall be vibration proof, clip on type mounted on nickel-plated steel rails complete with end cover and clamps for each row.
- 18.4 All terminals shall be suitable for accepting minimum 2.5 sq.mm copper conductor in general. Sizing shall be done with due consideration for accessibility and maintenance.
- 18.5 Plugs shall be of Nickel plated brass.
- 18.6 Cable glands shall be double compression type for use with armored cables. They shall be of Nickel plated brass.
- 18.7 All cable glands shall be weatherproof to NEMA 4X. They shall be supplied to suit the cable dimensions. Various components like rubber ring, metallic ring, metallic cone and the outer/inner nuts etc. shall be capable of adjusting to the cable tolerances.
- 18.8 Colour shade for Junction box shall be:
- For IS JB - High build Epoxy Deep Sky Blue Shade
 - For non IS JB - Light Gray Shade Equivalent to RAL7035
- 18.9 Cable gland for hazardous area shall be Explosion proof to Exd. IIA/IIB, T3 & WP to IP 65.

19.0 OTHERS

- 19.1 All cable & tube entries to control room shall be through MCT blocks. MCT blocks shall confirm to 'SOLAS'. MCT shall have 25% spares
- 19.2 Cable trays shall be ladder type in trenches and otherwise trays shall be perforated type. Material of construction for all trays shall be GI with min. 2 mm thickness.
- 19.3 A minimum of 20% spare capacity shall be provided in terminals in junction boxes, Control panels, and multicore cables, cable entries in junction boxes, cable trays etc.
- 19.4 In general, instrument Installation shall be as per specification for instrument installation works and typical installation hook-up drawings attached elsewhere in the bid document.

20.0 GENERAL

- 20.1 In general, instrument Installation shall be as per specification for instrument installation works and typical installation hook-up drawings.
- 20.2 20% or minimum one (01) number (whichever is greater), of each type of Instruments shall be provided as mandatory spare.

21.0 TECHNICAL DESIGN DOCUMENTS:

| | | | |
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21.1 Piping and Instrumentation Diagram (P&ID)

The instrumentation symbology and presentation on the P&ID's shall be in accordance with ISA S5.1, including tag numbering.

The numbering system shall follow the project standard. A strategy of numbering, however, shall be developed during the detailed design, and approved by the COMPANY.

Instruments supplied by mechanical package equipment SUPPLIER/VENDOR shall bear tag numbers provided by the CONTRACTOR and will be part of the Instrument Index prepared by the CONTRACTOR.

21.2 Instrument Data Sheets

Instrument data sheets shall be provided for all instrument types. Data sheets shall be subdivided for each process parameter, i.e. Flow, Level, Pressure, Temperature, Control Valves, Relief Valves, Analyzers, and Miscellaneous etc.

Instrument Data Sheets shall completely identify the instrument by type and model number and shall indicate operating data such as range, capacity, action, and set-point.

21.3 Instrument Drawings

The design shall include all detailed drawings to enable purchased equipment to be installed correctly. The following design drawings are typical requirements as minimum:

- System Architecture Drawing
- Instrument Index
- IO List
- Instrument location Drawings
- Typical Installation details
- Hook up Drawings
- Instrument Cable schedule
- Instrument interconnection diagrams
- Loop drawings
- Instrument cable tray & trench layout
- Instrument earthing layout
- Thermowell wake frequency calculation
- PSV capacity, surface temperature and sizing calculation
- Any other document drawing required for the project.

Following software shall be used for this project for all instrumentation documentation / datasheets.

- Instrument Index / IO List – MS Excel
- Drawings – AutoCad
- Cable / Tubing Schedule – AutoCad / MS Excel
- Instrument JB termination – AutoCad

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ANNEXURE-1

MATERIAL SELECTION CHART FOR INSTRUMENTS

| Sr No. | Piping Class | Pressure Gauge / Pressure Switch | Thermo well |
|--------|--------------|--|-------------|
| | | Element / Socket / Gauge Saver / Snubber | |
| 1 | 6A4 | SS316 | SS316 |
| 2 | X65 | SS316 | SS316 |



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| Sr No. | Piping Class | Miniature Inst. Valve | Impulse Tube & Tube Fitting |
|--------|--------------|-----------------------|-----------------------------|
| 1 | 6A4 | SS316 | SS316 |
| 2 | X65 | SS316 | SS316 |

General Notes:

1. All Casting and welding of wetted parts shall be 100% radiographed.
2. In case of any conflict between the following documents, order of priority shall be as following:
 - a. Instrument Data Sheets
 - b. Instrument Material Selection Chart
 - c. Design Basis for Instrumentation
3. Abbreviations LTCS: Low Temperature Carbon Steel; SS: Stainless Steel
4. Contractor shall complete all these data sheets based on final selection. These shall be duly approved by the company as part of respective purchase specification.

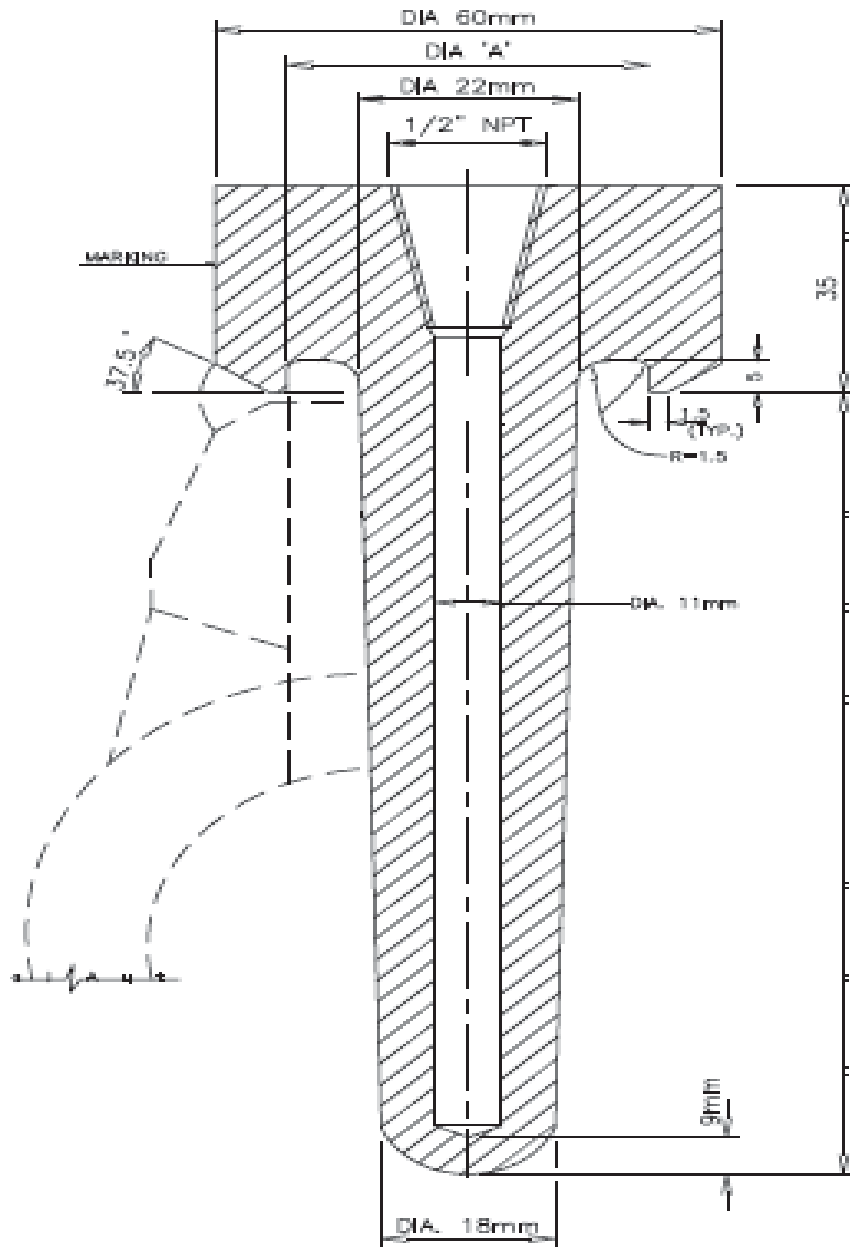


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ANNEXURE-2

**THERMOWELL
(WELDED TYPE - ABOVE GROUND)**





GAIL INDIA LIMITED

**STANDARD SPECIFICATION
FOR
PRESSURE GAUGES**

GAIL-STD-IN-DOC-TS-001

| Rev | Date | Purpose | Prepared By | Checked By | Approved By |
|-----|------------|--------------------|-------------|------------|-------------|
| 0 | 15.01.2019 | Issued As Standard | RKS | UNU | UNU |



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ANNEXURE-1: MATERIAL OF CONSTRUCTION

1.0 GENERAL

1.1 Scope

1.1.1 This specification, together with the data sheets attached herewith covers the requirements for the design, materials, nameplate marking, and inspection, testing and shipping of pressure gauges.

1.1.2 The related standards referred to herein and mentioned below shall be of the latest editions prior to the date of the purchaser's enquiry:

| | |
|-----------|---|
| ANSI/ASME | American National Standards Institution/American Society of Mechanical Engineers. |
| B 1.20.1 | Pipe Threads General Purpose (Inch) |
| B 16.5 | Pipe Flanges and Flanged Fittings NPS1/2 through NPS24 |
| B 16.20 | Metallic Gaskets for Pipe Flanges, Ring Joint, Spiral wound and Jacketed. |
| EN10204 | Inspection Documents for Metallic Products |
| IEC-60529 | Degree of Protection Provided by Enclosures (IP Code) |
| IS-3624 | Specification for Pressure and Vacuum Gauges. |


1.1.3 In the event of any conflict between this standard specification, data sheets, statutory regulations, related standards, codes etc., the following order of priority shall govern:

- a) Statutory Regulations'
- b) Datasheets
- c) Standard Specification
- d) Codes and Standards

In addition to compliance to purchaser's specifications in totality, vendor's extent of responsibility shall include the following:

- a) Purchaser's data sheets specify the type of pressure element. Unless specifically indicated otherwise, alternate type of pressure elements shall also be acceptable provided all the functional and performance requirements specified in the respective data sheets are guaranteed by the vendor.
- b) Purchaser's data sheets indicate the minimum acceptable material of construction for pressure element, movement etc. Alternate superior material of construction shall also be acceptable provided vendor assumes complete responsibility for the selected materials for their compatibility with the specified fluid and its operating conditions.

1.2 Drawing and Data


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- 1.2.1** Detailed drawings, data, catalogues and manuals required from the vendor are indicated by the purchaser in vendor data requirement sheets. The required number of reproducible, prints and soft copies shall be dispatched to the address mentioned, adhering to the time limits indicated.
- 1.2.2** Final documentation consisting of design data, installation manual, operation and maintenance manual etc., submitted by the vendor after placement of purchase, order shall include the following, as a minimum:
- a) Specification sheet for each gauges, and its accessories.
 - b) Certified drawings sheets for each gauges and its accessories, which shall provide dimensional details, internal constructional details, end connection details and materials of construction.
 - c) Copy of type test certificates.
 - d) Copy of the test certificates for all tests indicated in clause 4.0 of this specification.
 - e) Installation procedure for each gauge and its accessories.
 - f) Calibration and maintenance procedures including replacement of internal parts wherever applicable

2.0 DESIGN AND CONSTRUCTION

2.1 Pressure Elements, Gauge Movement and Socket

- 2.1.1 The pressure element shall be an elastic element like bourdon tube, bellow, diaphragm etc with material as specified in the data sheet.
- 2.1.2 In case of bourdon type of gauges, the size of the bourdon tube shall not be less than 75% of the nominal diameter of the dial size.
- 2.1.3 Gauge construction shall ensure no leakage of process fluid from the sensor elements to atmosphere and between the high pressure and low-pressure side (in case of differential pressure gauges) under normal condition.
- 2.1.4 The gauge socket shall be in one piece and shall also serve as element anchorage in case of bourdon tube type element, which shall be directly connected to the socket, without any capillary or tube in between. For other types of elements, the anchorage may be integral with the socket or connected with the socket using capillary tube with minimum bore of 3 millimetres.
- 2.1.5 Any joint in the process wetted system including joint between the element and the anchorage/socket shall be welded type only.
- 2.1.6 Unless specified otherwise, the pressure gauges shall have an over-range protection of at least 130% of maximum working pressure, as a minimum.
- 2.1.7 Data sheet indicates the minimum requirement of material of construction. Alternate materials as specified in Annexure 1 to this specification shall also be acceptable subject to meeting process conditions.

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- 2.1.8 The gauge movement material shall be of stainless steel unless specified otherwise in the data sheet. It shall be adjustable for calibration without dismantling the sensor unit. The use of link for calibration of span is not permitted. Gauges shall be provided with external zero adjustment.
- 2.1.9 Vendor shall ensure that the operating pressure falls in the middle 30% of the full working range i.e. operating pressure shall fall between 35% and 65% of the range offered.
- 2.1.10 Pressure gauges with range as 0 to 100kg/cm²g and above shall have safety type solid front case. All gauges in oxygen and chlorine service shall be thoroughly degreased using reagents like trichloro-ethylene or carbon tetrachloride. All connections shall be plugged after degreasing process in order to avoid entrance of grease or oil particles.

2.2 Cases and Dials

- 2.2.1 Unless specified otherwise, the gauges shall be weather proof to IP 65 as per IEC 60529, as a minimum.
- 2.2.2 In general, dial markings and dial colour shall be as per IS 3624. Dials of gauges in oxygen service shall additionally have the word 'OXYGEN' or 'CHLORINE' written in black and 'USE NO OIL' written in red.
- 2.2.3 The gauge dial shall be made of a suitable metallic materials so that the finished dial shall be capable of withstanding a dry heat of 85°C for 10 hours and immersion in water-at 85°C for 1 hour without cracking, blistering, warping or discolouration of the dial or paint on the dial.
- 2.2.4 The pointer stops shall be provided at both ends of the scale to restrict the pointer motion beyond 5% above the maximum of scale and less than 5% below the minimum of the scale.
- 2.2.5 The dial cover shall be made out of shatter proof glass sheet of thickness 1.5 to 3mm for gauges with dial size less than 100mm while minimum 3.0mm for gauges with dial size 100mm or greater.
- 2.2.6 All gauges shall be provided with a blow out device i.e. blow out disc of aperture not less than 25mm for gauges with dial size 100mm and above, while 20mm for gauges with dial size less than 100mm.
- 2.2.7 When safety type solid front type of gauges are specified, they shall consist of a solid partition isolating the pressure element from the dial. In such gauges the total solid partition disc area shall not be less than 75% of the cross sectional area of the inside of the case surrounding the pressure element.

2.3 Diaphragm Seals

- 2.3.1 Unless otherwise indicated in purchaser's data sheets, gauges specified with diaphragm seals shall have their diaphragms integral with the gauges.
- 2.3.2 Whenever diaphragm seal gauges are specified with capillary, the size of the capillary shall be selected to ensure response time of the gauge better than 5 seconds.

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- 2.3.3 The sealing liquid for diaphragm seal gauges shall be an inert liquid, compatible with the process fluid and its temperature. For gauges in oxygen and chlorine service, the sealing liquid shall be fluoro lube or equivalent compatible with the specified service.
- 2.3.4 For diaphragm seal pressure gauges with flanged ends, the diaphragm shall be rated for the maximum allowable pressure of the associated flange.

2.4 End Connection

- 2.4.1 Unless specified otherwise, the following shall govern;
- Threaded end connections shall be NPT as per ANSI / ASME B. 1.20.1.
 - Flanged end connection shall be as per ANSI / ASME B. 16.5
 - Ring joint flanges shall have octagonal grooves as per ANSI / ASME B16.20.
 - Flange face shall be as per clauses 6.4.4.1, 6.4.4.2 and 6.4.4.3 of ANSI / ASME B16.5.
The face finish as specified in the data sheet shall be as follows;
- | | |
|---------|-------------------|
| 125AARH | : 125 to 250 AARH |
| 63 AARH | : 32 to 63 AARH |

2.5 Performance Requirements


- 2.5.1 Unless otherwise specified, the accuracy which is inclusive of repeatability and hysteresis of pressure gauges shall meet the following performance requirements:
- Direct pressure gauge : $\pm 1\%$ of full scale
 - Chemical seal type pressure gauge : $\pm 2\%$ of full scale
 - Differential pressure gauges : $\pm 2\%$ of full scale

2.6 Accessories

- 2.6.1 Gauges shall be supplied with all accessories as specified in the data sheets pre-installed.
- 2.6.2 For flanged diaphragm seal gauges, spacer ring, isolation valve and plugs shall be provided whenever specified.
- 2.6.3 Over Range Protector (OPV)
- Whenever the maximum pressure specified in the data sheet exceeds the over range protection pressure, over range protector shall be supplied.
 - In case of pressure gauges with diaphragm seal, the over-range protector shall be installed between the seal and the gauge.
 - The material of construction of over range protector shall be same as socket material, as a material.

Snubber

- Whenever the service specified is pulsating type, snubber shall be supplied.
- The material of construction of snubber shall be same as socket material, as a minimum.

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3.0 NAME PLATE

3.1.1 Each gauge shall have a stainless steel nameplate attached firmly to it at a visible place either by riveting or screwed to the case, furnishing the following information:

- a) Tag number as per purchaser's data sheets.
- b) Vendor's name
- c) Model number and manufacturer's serial number.
- d) Range of the instrument.
- e) MAWP and maximum vacuum rating of element

4.0 INSPECTION AND TESTING

4.1 Unless otherwise specified, purchaser reserves the right to test and inspect all the items at the vendor's works inline with the inspection test plan for pressure gauges.


4.2 Vendor shall submit following test certificates and test reports for purchaser's review:

- a) Material test report as per EN10204 clause 2.2 for wetted parts like gauge socket and sensing element
- b) Type test report for enclosure.
- c) Dimensional test report for all gauges.
- d) Performance test reports for all gauges including accuracy, repeatability, over pressure and vacuum test (as applicable)
- e) Type test reports for shock test and endurance test as per IS-3624 for each type / model.
- f) Type test report for influence of temperature for each type/model.

4.3 Witness Inspection

4.3.1 All pressure gauges shall be offered for pre dispatch inspection for following as a minimum:

- a) Physical dimensions verification and workmanship.
- b) Performance test including accuracy and repeatability, on representative samples of each type/model number before and after over-pressure and vacuum test.
- c) Over-pressure and vacuum test (as applicable) shall be carried out on representative samples of each type / model number without loss of their elastic characteristics.
- d) Review of all certificates and test reports as indicated in clause 4.2 of this specification.

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- 4.3.2 In the event when the witness inspection is not carried out by purchaser, vendor shall anyway complete the tests and the test documents for the same shall be submitted to purchaser for scrutiny.

ANNEXURE-I

Material of Construction

| S.No. | Item | Specified Material of Construction | Alternate Material of Construction |
|-------|-----------------|------------------------------------|--|
| 1. | Sensing Element | SS316 | SS316L, SS316Ti |
| 2. | Socket | SS316 | SS316L, SS316Ti |
| | | SS304 | SS304L, SS316 |
| 3. | Case | SS 316 | SS316Ti, SS316L,SS |
| 4. | Capillary | SS | SS304, SS316, SS304L, SS316L, SS316Ti |
| . 5. | Diaphragm | SS316 | SS316L, SS316Ti |
| | | SS | SS 302, SS 304, SS 304L, SS316, SS316L, SS316Ti |

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GAIL INDIA LIMITED

**STANDARD SPECIFICATION
FOR
PRESSURE SAFETY VALVES**

GAIL-STD-IN-DOC-TS-002

| Rev | Date | Purpose | Prepared By | Checked By | Approved By |
|-----|------------|--------------------|-------------|------------|-------------|
| 0 | 15.01.2019 | Issued As Standard | RKS | UNU | UNU |



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1.0 GENERAL**1.1 Scope**

- 1.1.1 This specification, together with the data sheets attached herewith covers the requirements for the design, materials, fabrication, nameplate marking, inspection, testing and shipment of pressure Safety valves.
- 1.1.2 The related standards referred to herein and mentioned below shall be of the latest editions prior to the date of the purchaser's enquiry: -

ANSI/ASME **American National Standards Institute/American Society for Mechanical Engineers.**

| | |
|----------|--|
| B 1.20.1 | Pipe Threads General Purpose (Inch). |
| B 16.5 | Pipe Flanges and Flanged Fittings NPS 1/2" through JSr PS 24 |
| B 16.20 | Metalic Gasket for Pipe Flange |
| B 16.34 | Valves- Flanged, Threaded and Welding End |


ASME **American Society of Mechanical Engineers.**

| | |
|----------|--|
| Sec-VIII | Boiler and Pressure Vessels Code Section VIII 'Pressure Vessels' |
| Sec-I | Boiler and Pressure Vessels Code. Section-I 'Power Boilers' |

API **American Petroleum Institute**

| | |
|----------|---|
| API 520 | Sizing, Selection and Installation of Pressure Relieving Devices in Refineries. |
| Part I | Sizing & Selection |
| Part II | Installation |
| API 521 | Guide for Pressure Relieving and Depressurizing Systems. |
| API 526 | Flanged Steel Pressure Relief Valves |
| API 527 | Seat Tightness of Pressure Relief Valves. |
| EN 10204 | Inspection Documents For Metallic Products. |
| IBR | Indian Boiler Regulations |

- 1.1.3 In the event of any conflict between this specification, data sheets, related standards, codes etc., the following order of priority shall govern:
- Statutory Regulations
 - Data Sheets
 - Standard Specification
 - Codes and Standards
- 1.1.4 In addition to compliance to purchaser's specifications in totality, vendor's extent of responsibility shall include the following;

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- a) Technical data sheets indicate the type, size, relieving area etc. of the selected the valve. However, vendor shall be responsible to size and select the proper valve with orifice relieving area meeting the indicated operating conditions.
- b) Technical data sheets specify the minimum acceptable materials for body, bonnet, disc, nozzle, spring, bellows etc.

1.2 Drawing and Data

- 1.2.1 Detailed drawings, data, catalogues and manuals required from the vendor are indicated by the purchaser in vendor data requirement sheets.
- 1.2.2 Final documentation consisting of design data, installation manual, operation and maintenance manual etc. submitted by the vendor after placement of purchase order shall include the following as a minimum:
- Specification sheet for each pressure Safety valve and its accessories
 - Certified drawing sheets for each pressure Safety valve and accessories, which shall provide dimensional details, internal construction details, end connection details, weight and material of construction.
 - Copy of type test certificates.
 - Copy of test certificates for all the tests indicated in clause 4.0 of this specification.
 - Installation procedure for Pressure Safety valve and its accessories
 - Calibration and maintenance procedure including replacement of internals wherever applicable.

2.0 DESIGN AND CONSTRUCTION

2.1 Valve Design

- 2.1.1 The definitions of various terminologies used in purchaser's data sheets are as per clause 1.2 of API RP 520 part 1.
- 2.1.2 Unless specified otherwise, all pressure Safety valves shall be full nozzle full lift type and all Safety valves in thermal safety application shall be modified nozzle type.
- 2.1.3 For flanged pressure Safety valves, the valve inlet and outlet size, the orifice designation and corresponding relieving area shall be as per API 526.

2.2 Valve Sizing


- 2.2.1 Sizing shall be carried out using the formulae mentioned in the following standards whenever the sizing code mentioned in the purchaser's data sheets refers to these

| <u>Sizing Code</u> | <u>Standard</u> |
|--------------------|---|
| API | API RP 520 Part I API 520 Part-II API RP 521 API 526 API 527. |

- 2.2.2 Discharge Co-efficient

For all valves in gas, vapour or steam service with design code as ASME Sec VIII or ASME Section I discharge co-efficient of 0.975 as per API 520 shall be used.

- 2.2.3 For the selected orifice letter designation and inlet and outlet size of the pressure Safety valve, relieving area of the valve offered by vendor shall meet those in API-526.

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2.3 Valve Construction

2.3.1 Body

2.3.1.1 Unless otherwise mentioned, end connection details shall be as below: -

- a) Threaded end connections shall not be used.
- b) Flanged end connections shall be as per ANSI/ASME B 16.5.
- c) Flanged face finish shall be as per ANSI/ASME B 16.5. The face finish as specified in the data sheets, shall be as follows;

| | |
|---------|----------------|
| 125AARH | 125 to 200AARH |
| 63 AARH | 32 to 63 AARH |

2.3.1.2 For flanged valves, inlet and outlet sizes and ratings and centre to flange face dimensions shall be in accordance with API-526. Dimensional tolerance shall be as mentioned therein.

2.3.1.3 Body drain with a plug shall be provided as a standard feature on every pressure Safety valve.

2.3.1.4 For the pilot operated pressure safety valves, where vendor's standard model provides only semi nozzle design (i.e. the body is part of the inlet flow path), body material shall be of the same material as that of nozzle specified in purchaser's data sheets, as a minimum.

2.3.2 Trim

2.3.2.1 The term 'trim' covers all the parts of the valves exposed to and in contact with the process fluid except for the body and bonnet assembly i.e. nozzle, disc, disc holder, stem etc.

2.3.2.2 Valves shall be of the full nozzle type of design with the exception as per clause 2.3.1.4 and valves in thermal Safety application.

2.3.2.3 Wherever stellite of disc and nozzle has been specified, it stands for stellite of the seat joint and the entire disc contour, unless otherwise mentioned.

2.3.2.4 For high temperature application, the materials for the internals shall be selected to avoid galling.

2.3.2.5 Resilient seat, seals or o-rings wherever used shall be suitable for pressure and temperature conditions specified.

2.3.2.6 Gaskets wherever used shall be metallic type. Gaskets with asbestos filler or with asbestos bearing material shall not be used.

2.3.3 Bonnet and Spring

2.3.3.1 All valves shall be provided with a cap over the adjusting bolt. Cap shall be of either bolted type or screwed type as specified in the purchaser's data sheets.


2.3.3.2 Lifting lever shall be provided whenever the fluid to be relieved is steam and air or water above 65°C.

2.3.3.3 Valve spring shall be selected such that it can permit an adjustment of $\pm 5\%$ of the set pressure, as a minimum.

2.3.3.4 Carbon steel springs shall be made corrosion resistant through plating/coating as per manufacturer's standard design or as specified in the purchaser's data sheets.

2.3.3.5 The allowable tolerance in set pressures are as below:

- a) $\pm 0.14 \text{ kg/cm}^2 \text{ g}$ for set pressure upto and including $5 \text{ kg/cm}^2 \text{ g}$.

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- b) $\pm 3\%$ for set pressure above 5kg/cm² g.

2.3.3.6 Bonnet shall be of the closed type for all process applications in general. Open type bonnet shall be used only for steam and non-hazardous/non-toxic fluids. For all steam applications under design code IBR or ASME Section-I with open bonnet design, weather protection cover shall be provided.

2.3.4 Pilot Design

2.3.4.1 For pilot operated valves, the pilot design shall be of inherently fail safe.

2.3.4.2 Unless specified otherwise, pilot shall be non-flowing type.

2.3.4.3 All accessories like back flow preventer, pilot filter etc. required for proper operation of pilot operated valves as per indicated service conditions shall be included.

2.3.4.4 Material of construction of pilot shall be same as that of main valve nozzle as a minimum.

2.3.4.5 The o-ring and diaphragm material of pilot shall be suitable for the pressure and temperature conditions specified in the data sheet.

NAMEPLATE

2.4 Each pressure Safety valve shall have a stainless steel nameplate attached firmly to it at a visible place furnishing the following information: -


- a) Tag number as per purchaser's data sheet.
- b) Manufacturer's serial number and/or model number.
- c) Manufacturer's name/trade mark.
- d) Nominal flange size in inches and rating in pounds for both inlet and outlet.
- e) Orifice letter designation.
- f) Valve set pressure.
- g) Cold bench test set pressure.

2.4.1 For the above, pressures shall be marked in the same units as those followed in purchaser's data sheets.

3.0 INSPECTION AND TESTING

3.1 Vendor shall submit the following test certificates and test reports for purchaser's review:-

- a) Material test certificate as per clause 3.1B of EN10204 for each valve body and bonnet castings/forging, nozzle and as per clause 2.2 for stem, disc etc.
- b) Certificate of radiography/X-ray for valve castings as per following requirements;
 - i) 100% radiography shall be carried out for all valve castings with body rating of 600# and above or wherever specifically indicated for in the material requisition.
 - ii) Radiography procedure shall be as per ANSI B 16.34 and acceptance criteria shall be as per ANSI B 16.34 Annexure-B. Following area of pressure Safety valve shall be radiographed unless specified otherwise.
 - Inlet flange neck
 - Outlet flange neck
 - Nozzle (in case of cast construction)
 - Body/bonnet joint neck.
- c) Dimensional, hydrostatic and functional test reports for all valves as per clause 3.2 and 3.3 of this specification.

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d) Type test certificate for blow-off and closing down pressure.

3.2 Hydrostatic Test

3.2.1 Each Pressure Safety valve body shall undergo hydrostatic test as per outlet flange ANSI rating. However all the safety valves castings covered under IBR shall be tested as per IBR regulations. There shall not be any visible leakage during this test.

3.2.2 For full nozzle type of pressure Safety valve, nozzle shall undergo hydrostatic test as per inlet flange ANSI rating. For Semi nozzle design, valve Inlet shall be tested after assembly as per Inlet flange ANSI rating.

3.3 Functional Test

3.3.1 Cold bench set pressure test:

Pressure Safety valve shall be tested for opening at specified set pressure. Testing of pressure Safety valves shall be with air or nitrogen, testing of thermal Safety valves shall be with water.

3.3.2 Seat Leakage test

a) Whenever the specified set pressure is less than or equal to 420 kg/cm²g, the valve shall meet the seat tightness requirements specified in API RP-527. The maximum permissible leakage rates against various sizes shall be as specified therein. Whenever the specified set pressure exceeds 420 kg/cm²g, the vendor shall submit the leakage rates of valves for approval by the purchaser. Where bubble tightness has been specified, there shall be no leakage or bubbles of air at the specified percentage of set pressure.

b) Seat leakage test pressure shall be as per API RP 527 (determining the seat tightness of metal- and soft-seated pressure relief valves, including those of conventional, bellows, and pilot operated designs) except for valves under IBR or ASME Section-I design code. Safety valves. For these valves seat leakage shall be carried out at the following pressure;

i) Valves under IBR or ASME Section-I : 95% of Set Pressure

ii) Pilot operated Pressure Safety valves

- Upto 3.5 Kg/cm²G : 90% of set Pressure
- Above 3.5 Kg/cm²G : 95% of Set Pressure

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GAIL INDIA LIMITED

**STANDARD SPECIFICATION
FOR
ELECTRONIC TRANSMITTERS**

GAIL-STD-IN-DOC-TS-003

| Rev | Date | Purpose | Prepared By | Checked By | Approved By |
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| 0 | 15.01.2019 | Issued As Standard | RKS | UNU | UNU |



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1.0 General**1.1 Scope**

- 1.1.1 This specification, together with the data sheets attached herewith forms the requirements for the design, materials, nameplate marking, inspection, testing and shipping of electronic / pneumatic instruments.
- 1.1.2 The related standards referred to herein and mentioned below shall be of the latest editions prior to the date of the purchaser's enquiry:-

| | |
|-------------|---|
| ANSI/ASME | American National Standards Institute / American Society of Mechanical Engineers |
| B 1.20.1 | Pipe Threads General Purpose (Inch) |
| B 16.5 | Pipe Flanges and Flanged Fittings NPS½ through NPS24 |
| B 16.20 | Metallic Gaskets for Pipe Flanges, Ring Joint, Spiral wound and Jacketed. |
| BS-5760 | Reliability of System, Equipments and Components |
| EN 10204 | Inspection Documents For Metallic Products |
| IEC-60068 | Environmental Testing |
| IEC-60079 | Electrical Apparatus for Explosive Gas Atmosphere. |
| IEC-60529 | Classification of Degree of Protection Provided by Enclosures. |
| IEC-61000-4 | Electromagnetic Compatibility for Industrial Process Measurement and Control Equipment. |
| IEC-61158 | Fieldbus Standard for use in Industrial Control System |
| IEC-61158-2 | Physical layer specification and Service definition for Field bus |
| IEC 61508 | Functional Safety of Electrical/Electronic/Programmable Electronic Safety- related Systems. |
| IS-2148 | Flame Proof Enclosures of Electrical Apparatus. |
| ISA | International Society of America |
| S 7.3 | Quality Standard for Instrument Air |
| S 50.1 | Compatibility of Analog Signals for Electronic Industrial Process Instruments. |
| ITK-x.x | Interoperability Test Kit (latest version) |

- 1.1.3 In the event of any conflict between this standard specification, job specification/data sheets, Statutory regulations, related standards, codes etc. the following order of priority shall govern:
- Statutory Regulations
 - Data Sheets
 - Standard Specification
 - Codes and standards

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- 1.1.4 In addition to compliance to purchaser's specifications in totality, vendor's extent of responsibility shall include the following:
- a) Purchaser's data sheets specify the minimum acceptable material of construction of body, measuring element and accessories. Alternate superior material of construction shall also be acceptable provided vendor assumes complete responsibility for the selected materials for their compatibility with the process fluid and its operating conditions.
 - b) Selection of suitable sealant liquid for diaphragm seal instruments compatible with the process fluid and its operating temperature.


1.2 Drawing and Data

- 1.2.1 Detailed drawings, data, catalogues and manuals required from the vendor are indicated by the purchaser in vendor data requirement sheets. The required number of reproducible, prints and soft copies should be dispatched to the address mentioned, adhering to the time limits indicated.
- 1.2.2 Final documentation consisting of design data, installation manual, operation and maintenance manual, etc submitted by the vendor after placement of purchase order shall include the following, as a minimum;
- a) Specification sheet for each electronic/pneumatic instrument and their accessories.
 - b) Certified drawing for each instrument, which shall provide dimensional detail, internal construction and part list, material of construction etc.
 - c) Calculations for integral orifice
 - d) Copy of type test certificates.
 - e) Copy of the test certificates of all the tests indicated in clause 4.0 of this specification.
 - f) Installation procedure for electronic/pneumatic instrument and its accessories.
 - g) Calibration and maintenance procedures including replacement of its internal parts.

2.0 DESIGN AND CONSTRUCTION

2.1 General Requirements


- 2.1.1 The type and material of construction of electronic/pneumatic instruments shall be as specified in the purchaser's data sheet.
- 2.1.2 The range of instruments shall be selected by vendor base on the set range indicated in the purchaser's data sheet. Where no set range is indicated, vendor may select the same as per the following guidelines;
- a) The set range shall be 1.1 times the maximum process value or 1.4 times the operating process value whichever is higher rounded to the nearest ten.
 - b) The set range shall preferably be in the middle third of the selected instrument range.

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- 2.1.3 Except for instruments covered under clause 2.2.3.10 of this specification or specified otherwise in purchaser's data sheets, each instrument shall have an over-range protection of at least 130% of specified range.
- 2.1.4 Measuring element in vacuum service shall have under range protection down to full vacuum, without undergoing a change in calibration or permanent set.
- 2.1.5 Unless otherwise specified, diaphragm seal instrument shall meet the following requirements;
- a) Instruments shall have its diaphragm seal integral with the instrument and shall be supplied with adaptor flange.
 - b) When purchaser data sheets specify wafer seal type of instrument, vendor shall include supply of studs, nuts and gasket as per the materials specified in the purchaser's data sheet.
 - c) The sealant shall be an inert liquid, compatible with the process fluid and process temperature indicated in the purchaser's data sheets. In general, sealant shall be;
 - i) DC 704 or equivalent for all diaphragm seal instruments except for oxygen and chlorine.
 - ii) Fluoro-lube or equivalent for all diaphragm seal instruments in oxygen and chlorine.

The requirement of spacer ring shall be as specified in purchaser's data sheet. The material of construction of spacer ring shall be 316 Stainless Steel, as a minimum unless otherwise specified in the purchaser's data sheets.

- 2.1.6 Wherever purchaser data sheet specified integral flow transmitter, vendor shall supply complete assembly consisting of integral orifice, upstream and downstream meter runs with end flanges.
- a) Three nos. of integral orifice plates shall be supplied i.e one is installed and two are spares.
 - b) Unless otherwise specified, material of construction shall be 316 Stainless Steel for integral orifice and meter run with flanges.
- 2.1.7 The instrument enclosure shall be suitable for the area classification indicated in the purchaser's data sheets. Unless otherwise specified, the enclosure shall meet the following standards;
- Weatherproof housing IP-65 to IEC-60529.
- Flameproof housing Flameproof/ Ex (d) as per IEC-60079/IS-2148.
- Flameproof housing shall also be made weatherproof.
- 2.1.8 Unless otherwise mentioned, end connection details shall be as below:-
- a) Threaded end connections shall be to NPT as per ANSI/ASME B 1.20.1.
 - b) Flanged end connections shall be as per ANSI/ASME B 16.5.
 - c) Grooves of ring-type joint flanges shall be octagonal as per ANSI B16.20.

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- d) Flanged face finish shall be as per clauses 6.4.5.1, 6.4.5.2, and 6.4.5.3 of ANSI B 16.5. The face finish as specified in the data sheets shall be as follows: -

| | | |
|----------|---|-----------------|
| 125 AARH | : | 125 to 250 AARH |
| 63 AARH | : | 32 to 63 AARH |

- 2.1.9 All electronic / pneumatic instruments in oxygen and chlorine service shall be thoroughly degreased using reagents like trichloro-ethylene or carbon tetrachloride. End connection shall be blinded / plugged after the degreasing process in order to avoid entrance of grease or oil particles.


2.1.10 Electronic Instruments

- All instruments shall be of state-of-the-art technology and shall be in compliance with the electromagnetic compatibility requirements specified in IEC-61000-4 standard.
- Plug-in circuit boards shall be designed and manufactured such that reverse insertion or insertion of the wrong card is prevented.
- Electronic instruments shall generally operate on nominal voltage of 24 V DC and shall be protected against short circuit and reverse voltage. Transmission and output signal shall generally be 4 to 20 mA DC for analog and smart transmitters. The display of integral output meter shall be in engineering units for pressure, differential pressure and flow and 100% linear for level.
- Electronic transmitters with two-wire system shall be suitable for delivering rated current to an external loop resistance of at least 600ohm when powered with 24 V DC.
- Terminals for electrical connections shall be clearly identified, and polarity shall be permanently marked.
- Peak to peak ripple and total noise level in the analog output signal shall not exceed 0.25% of the maximum signal.
- Power supply, signal isolation, ripple and noise requirements shall generally be as per ISA-S 50.1.
- Electrical conduit entries shall have internal NPT ½” threads.

2.1.11 Pneumatic Instruments.

- All pneumatic connections shall be 1/4" NPT, unless otherwise specified.
- All threaded connections shall be internal, unless otherwise specified.
- The process input connections and pneumatic output and air supply connections etc. shall be permanently stamped on the body at a suitable place.
- Unless otherwise specified, pneumatic instruments shall operate on air supply of 1.4 kg/cm²g and shall have transmission and output signal of 0.2 to 1.0 kg/cm²g.
- Instrument air quality shall be as per ISA-S7.3 and shall be free from all corrosive, hazardous, flammable and toxic contaminants.

2.2 Transmitters

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2.2.1 Pneumatic Transmitters


- a. Pneumatic blind transmitters shall be of the force-balance type and pneumatic indicating transmitters of the motion balance type.
- b. Transmitters shall have an accuracy of 0.5 % of span.
- c. Transmitters shall be supplied with external zero and span adjustments.

2.2.2 Electronic Analog Transmitters

- a. Electronic transmitters shall be of the two-wire dc current regulating type. They shall be provided with integral output indicator. When specified, field mounted external output meters shall be provided.
- b. Electronic analog transmitters shall have an accuracy of ± 0.075 % of span.
- c. Transmitters shall be supplied with external zero and span adjustments, Flameproof transmitters shall also have their calibration adjustment from outside, without any need to remove the cover.
- d. Unless otherwise specified, the electronic transmitters shall be certified intrinsically safe.

2.2.3 Smart and Field bus based Transmitters

- 2.2.3.1 Smart and field bus based transmitters shall be two wire microprocessor based type. These shall have a non-volatile memory, storing, complete sensor characterisation and configuration data of the transmitter. All necessary signal conversions and output generation with the required protocol shall be carried out in the transmitter electronics. Integral output meter with LCD display shall be provided for all transmitters.
- 2.2.3.2 Transmitter shall also run complete diagnostic subroutines and shall provide diagnostic alarm messages for sensor as well as transmitter healthiness. Field bus based transmitter in addition shall have facility to detect plugged impulse lines, whenever specifically indicated in purchaser's data sheets. In the event of detection failure, the output shall be driven to a predefined value, which shall be field configurable.
- 2.2.3.3 The transmitters with field bus connectivity shall have built in control algorithm like proportional, proportional-integral and proportional-integral-differential.
- 2.2.3.4 Whenever specifically indicated in purchaser's data sheets, the meter electronics shall be provided with in-built lightning and power supply surges. The transient protection shall meet the requirements specified in IEC-60587.
- 2.2.3.5 The configurational data of the instruments shall be stored in a non-volatile memory such that this remains unchanged because of power fluctuations or power off condition. In case vendor standard instrument has battery backed RAM, vendor to ensure that battery drain alarm is provided as diagnostic maintenance message.
- 2.2.3.6 Accuracy of transmitters, smart as well as field bus based, shall be as follows:

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- a) For transmitter ranges of 760 mm WC and above, the accuracy shall be equal to or better than $\pm 0.075\%$ within a turndown of 1:10 of the offered span.
- b) For transmitters with ranges less than 760 mm WC the accuracy shall be equal to or better than $\pm 0.15\%$ within a turndown of 1:10 of the offered span.
- c) For all diaphragm seal transmitter with ranges 500 mm WC and above, the accuracy shall be equal to or better than $\pm 0.25\%$ within a turndown of 1:10 of the offered span.
- d) For all diaphragm seal transmitter with ranges less than 500 mm WC, the accuracy shall be equal to or better than $\pm 0.5\%$ within a turndown of 1:10 of the offered span.

The accuracy is defined as the combined effect of repeatability, linearity and hysteresis.

2.2.3.7 The stability of the transmitters shall be equal to or better than $\pm 0.1\%$ of span for a period of minimum 6 months, as a minimum.

2.2.3.8 Transmitter shall update the output at least 8 times a second unless otherwise specified.

2.2.3.9 Unless specified otherwise in purchaser's specification, transmitter response time shall be as follows:

- a) For transmitter range of 760 mm WC and above, the response time shall be equal to or 1 second. The response time of the transmitter shall be considered as the sum of dead time and 63.2% step response time of the transmitter.


2.2.3.10 Unless specified otherwise, the over-range/static pressure protection of the transmitter shall be as follows;

- a) For transmitter range between 1 kg/cm²g and 100kg, the over range/static pressure shall be 130 kg cm²g.
- b) For transmitter with ranges of 100 kg/ cm²g and above, the over-range/static pressure shall be 210 kg/cm²g or 130% of maximum range whichever is higher.
- c) For transmitter range between 0.5 kg/cm²g to 1.0 kg/ cm²g, the over pressure/static pressure shall be 70kg/cm²g.
- d) For transmitters with ranges between 1000mm WC to 5000mm WC, the over-range/static pressure shall be 35kg/cm²g.
- e) For transmitter with ranges less than 1000mm WC, over-range/static pressure shall be 1.0kg/cm²g.

2.2.3.11 In the transmitter, the 'WRITE' option shall be protected through password.

2.2.3.12 Temperature transmitters shall meet the following requirements as a minimum:

- a) Temperature transmitter shall be universal type and shall be able to accept input from resistance temperature detector (RTD) or thermocouple (T/C) of any type and range.
- b) Temperature transmitters shall be freely programmable i.e. element type and range shall be programmable without any change in hardware / software.
- c) Temperature transmitter shall be remote mounted type, in general. Head mounted transmitters shall be supplied when specifically indicated in purchaser's data sheets.

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- d) The accuracy of the temperature transmitter with RTD element shall be as follows:
- For temperature range above 350°C, the accuracy shall be equal to or better than $\pm 0.075\%$ of full scale.
 - For temperature range with ranges between 350°C to 150°C, the accuracy shall be equal to or better than $\pm 0.15\%$ of full scale.
 - For temperature range below 150°C, the accuracy shall be equal to or better than $\pm 0.2\%$ of full scale.
- e) The accuracy of temperature transmitter with cold junction compensation for Thermocouple element shall be as follows;
- For temperature above 350°C, accuracy shall be $\pm 0.25\%$ of range.
 - For temperature between 150°C to 350°C. accuracy shall be $\pm 0.5\%$ of range.

2.2.3.13 When HART protocol is specified, the following features must be ensured;


- a) It shall allow multi masters (two for example, primary and secondary) for configuration, calibration, diagnostics and maintenance. The primary could be the control system or host computer and the secondary could be the hand-held communicator.
- b) It shall be capable of implementing universal commands from either of these locations.

2.2.3.14 In addition to the requirements specified above, field bus based transmitter shall meet the following requirements;

- a) All instruments must satisfy the requirements of the field bus registration laboratory with applicable checkmark like foundation field bus, profibus PA, or as specified in the purchaser's data sheets.
- b) All instruments shall have two analog input blocks, as a minimum. In addition, when specified the transmitter shall also have PID controller block.
- c) All instruments must be interoperable and shall have valid interoperability test clearance like ITK latest version for foundation field bus or equivalent for profibus PA, as applicable.
- d) The field bus instruments shall support peer to peer communication.
- e) Field bus instruments as offered shall not be polarity sensitive.
- f) The field bus instruments in hazardous area shall be certified as per entity concept or shall be FISCO approved as per the requirements specified in the purchaser's specification.

2.3 Receivers

- a. Pneumatic/electrical cables shall be such that they permit the instrument internals to be drawn from its normal mounting position without affecting operation. Pneumatic connection points shall seal automatically upon disconnection.

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- b.. Electronic receivers shall be suitable for standard voltage inputs of 0.25 to 1.25 V, 1 to 5 V, 0 to 10 V dc. Any voltage receiver shall not alter the voltage drop across the conditioning resistor by more than $\pm 0.1\%$ of input range of maximum input voltage.
- c. Recorder pens shall be easily replaceable. Each recorder shall be supplied with chart-rolls and ink for six months continuous operation


2.4 Controllers

- i. Automatic control stations including dedicated cascade control stations shall have switches to transfer control from automatic to manual mode and vice-versa. The transfer shall be procedureless and shall not produce any bump in the process under control during such a transfer, the output signal shall not change by more than 1% of span.
- ii. Cascade control stations shall have a switch to select local or remote set point.
- iii. The control settings of the controller shall be readily adjustable from the front.
- iv. Controller action shall be easily reversible.
- v. Pneumatic automatic controller shall be easily removable, without disturbing the manual control mechanism.
- vi. Electronic controller shall be easily removable, with the aid of a service station.
- vii. Local mounted pneumatic controllers shall be supplied with gauges for air supply pressure and control signal. The gauges shall be integral with the instrument.

2.5 Accessories

2.5.1 Field HART Communicator:

- 2.5.1.1 It shall be possible to perform routine configuration, calibration, display process variable, diagnostics etc. from a hand held portable communicator, which can be connected at any location in the transmitter loop. It shall be possible to perform all the above functions online. The loop function shall remain unaffected while communication is going on between transmitter and the field communicator.
- 2.5.1.2 There should be no interruption on the output while communicating with the transmitter.
- 2.5.1.3 Field communicator shall meet the following requirements:
- a) Hand Held communicator shall be universal type and shall be compatible with all make and models of HART transmitters, Smart positioners, instruments with all engineering capability like calibration, diagnostics, configuration, inhibition of HART signal, etc.
 - b) It shall be possible to connect the communicator at any of the following locations for purpose of digital communication;
 - i) Marshalling cabinet serving the transmitter, in safe area.
 - ii) Junction box serving the transmitter, in hazardous area.

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- iii) Directly at the transmitter, in hazardous area. Plug-in type connections shall be provided with field communicator. Necessary interconnection shall be supplied by the vendor.
- c) Offered communicator shall be dust-proof, certified intrinsically safe and suitable for outdoor location. Carrying case shall be supplied with each communicator.
- d) When specified in data sheets, the software shall also be capable of configuring other makes of transmitters.
- e) They shall be battery powered with replaceable and rechargeable batteries.

2.5.2 Field Bus Tester

- I. The field bus testers shall be able to determine the ability of the field bus wiring to carry field bus signals. The field bus tester shall be capable of testing both signal and resistance of
- II. There shall not be any interruption on the output while communicating with the field bus devices.
- III. The field bus tester shall meet all the requirements as specified in clause 2.6.3 (b), (c), (d) and (e)

2.5.3 Field Bus Configurator

The field bus configurator shall be centralised device like personal computer with hardware and software for configuration and maintenance of field bus instrument.

2.5.4 Remote Output Meter


- a. Remote output meter shall be electronic with LCD display. The display shall be in actual engineering units.
- b. The indicator electronic shall be able to perform square root extraction for flow measurement.
- c. Offered indicators shall be certified Intrinsically safe, when used in hazardous area.
- d. Power supply shall be loop powered with smart transmitter, unless otherwise specified.
- e. Fieldbus based field indicator shall be able to indicate all signals available in the fieldbus segment, selectively.

2.5.5 **Remote mounted** instruments shall be supplied with mounting bracket, U-bolt and nuts suitable for mounting the instruments on a 50 mm (nominal bore) pipe stanchion (horizontal or vertical).

2.5.6 Air set

Air set, where provided, shall be a combination air filter regulator set with 5-micron filter cartridge. It shall have a 50 mm diameter pressure gauge to indicate the regulated pressure.

Each air set shall be supplied with mounting bracket and bolts with nuts for surface mounting.

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2.5.7 Battery charger

Battery charger shall be supplied with all necessary accessories and shall operate at 230V $\pm 10\%$, 50Hz ± 3 Hz, unless otherwise specified.

3.0 NAMEPLATE

3.1 Each flush panel mounted instrument shall have the following information identified in the front:-

- a) Tag number as per purchaser's data sheet.
- b) Reading coefficient, if any
- c) Pen colour, tag number-wise in the case of recorders.
- d) Each flush panel mounted instrument shall have a back nameplate permanently fixed to it at a visible place reporting the following information:
 - e) Manufacturer's serial number or model number.
 - f) Manufacturer's name/trade mark.

3.2 Surface mounted instruments need be provided with only one nameplate.

Local mounted instruments shall have a stainless steel nameplate attached firmly to it at a visible place, furnishing the following information:


- a) Tag number as per purchaser's data sheets.
- b) Manufacturer's serial number and /or model number
- c) Manufacturer's name/trade mark.
- d) Body material.
- e) Measuring element material.
- f) Range of measurement.
- g) Area classification in which the equipment can be used, this shall be to the same code as per purchaser's data sheets.

4.0 INSPECTION AND TESTING

4.1 Unless otherwise specified, purchaser reserves the right to test and inspect all the items at the vendor's works in line with the inspection test plan for electronic/pneumatic instruments.

4.2 Vendor shall submit the following test certificates and test reports for purchaser's review: -

- a) Material test report as per clause 3.1B of EN 10204 for body, flanges and spacer rings for all transmitters and diaphragm seal transmitters
- b) Material test report as per clause 2.2 of EN 10204 for sensing element
- c) Hydrostatic test report as per clause 4.3.

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- d) Functional and calibration report for each instrument including accuracy, linearity, hysteresis and repeatability.
- e) Performance test report as per clause 4.4.
- f) Response time of smart and fieldbus transmitters
- g) Capability of smart and field bus based transmitters to accept multimasters for configuration, calibration, diagnostics and maintenance.
- h) Configuration, calibration and diagnostics check through hand held configurator / field bus tester for smart and field bus based instruments.
- i) Configuration, calibration and diagnostics check through field bus configurator for field bus based instruments.
- j) Interoperability test certificate as per clause 2.2.3.14c) for fieldbus transmitters
- k) Certificate from statutory body for intrinsic safety/flameproof enclosures.
- l) Functional test report for fieldbus tester

4.3 Hydrostatic Test


- 4.3.1 All transmitters shall be hydrostatically tested at static pressure as per clause 2.2.3.10 for a period of minimum 1 minute. After this test the transmitter shall not undergo a permanent set from the original calibration.

4.4 Performance Test

- 4.4.1 All instruments shall meet the Accuracy performance characteristics stated in clause 2.2.3.6 after the instruments have been subjected to the following over-range conditions: -
- a) An air supply pressure of 2kg/cm²g for all pneumatic instruments.
 - b) Differential pressure transmitters subjected to a differential pressure in either direction equal to the manufacturer's pressure rating of the body.

4.5 Witness Inspection

- 4.5.1 Vendor shall offer all items for pre-dispatch inspection. Following tests/checks shall be carried out, as a minimum: -
- a) Physical dimensional checks and workmanship.
 - b) Hydrostatic testing as per clause 4.3 of this specification on representative sample.
 - c) Performance testing as per clause 4.4 of this specification on representative sample.
 - d) Functional and calibration check on representative samples.
 - e) Effect of power supply/air supply variation and load driving capability check on representative samples.
 - f) Response time check on representative samples for smart and fieldbus transmitters

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- g) Capability of smart and field bus based transmitters to accept multimasters for configuration, calibration, diagnostics and maintenance.
- h) Configuration, calibration and diagnostics check through hand held configurator /field bus tester for smart and field bus based instruments.
- i) Configuration, calibration and diagnostics check through field bus configurator for field bus based instruments.
- j) Review of all certificates and test reports as indicated in clause 4.2 of this specification.
 - a. Functional checks on fieldbus tester.

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GAIL INDIA LIMITED

**STANDARD SPECIFICATION
FOR
RTD AND THERMOWELLS**

GAIL-STD-IN-DOC-TS-004

| Rev | Date | Purpose | Prepared By | Checked By | Approved By |
|-----|------------|--------------------|-------------|------------|-------------|
| 0 | 15.01.2019 | Issued As Standard | RKS | UNU | UNU |



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1.0 INTRODUCTION

1.1 Scope

1.1.1 This specification, together with the data sheets attached herewith covers the requirements for the design, materials, nameplate marking, inspection, testing and shipping of thermo-couples, RTDs and thermowell.

1.1.2 The related, standards referred to herein and mentioned below shall be of the latest editions prior to the date of the purchaser's enquiry:-


| | | |
|------------------|----------|---|
| ANSI/ASME | B 16.5 | Pipe Flanges & Flanged Fittings |
| ANSI/ASME | B 16.20 | Metallic Gaskets for Pipe Flanges |
| | B 1.20.1 | Pipe Threads General Purpose (Inch) |
| | B16.34 | Valves Flanged, Threaded and Welding End |
| | Sec-VIII | Boiler & Pressure vessel code rules for construction of Pressure vessels |
| API | | American Petroleum Institute |
| RP 551 | | Recommended Practice 551 -Process Measurement Instrumentation. |
| PTC 19.3 TW 2016 | | Performance Test Code-Temperature measurement Inspection Documents For Metallic Products. |
| IEC -60079 | | Electrical Apparatus for Explosive Gas Atmosphere |
| IEC 60529 | | Degree of protection provided by enclosures (IP) |
| IEC 60751 | | Industrial platinum resistance thermometers and platinum temperature |
| IEC 60854-2 | | Thermocouple Tolerances. |
| IS-2148 | | ELECTRICAL APPARATUS FOR EXPLOSIVE GAS ATMOSPHERES-FLAMEPROOF ENCLOSURES "d" |
| IS-7358 | | Specifications for Thermocouples |
| ISA | | International Society of Automation |
| MC 96.1 | | Minerals Insulated Thermocouple |

1.1.3 In the event of any conflict between this standard specification, job specification, datasheets, statutory regulations, related standards, codes etc. the following order of priority shall govern:

- a) Statutory Regulations
- b) Data Sheets
- c) Standard Specification
- d) Codes and Standards

1.1.4 In addition to compliance to purchaser's specifications, vendor's extent of responsibility shall include the following:

- a) Data sheets indicate the minimum acceptable material of construction for sensing element, thermowell etc. Alternate superior material of construction shall also be acceptable provided vendor assumes complete responsibility for the selected materials for their compatibility with the specified fluid and its operating conditions.
- b) Vendor shall carry out the vibration analysis of thermowell as per ASME PTC 19.3 standard

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and shall provide suitable design for the thermowells wherever necessary.


2.0 DESIGN AND CONSTRUCTION

2.1 Resistance Temperature Detectors

- 2.1.1 The type of RTD shall be as specified in purchaser's data sheet. In general RTD shall be 4 wire, Class A type with platinum element having 100 ohms resistance at 0°C, selected for temperature range of (-) 200 to 650°C.
- 2.1.2 The element shall be of highly refined material of reference grade and shall have been stress relieved. RTD calibration shall be as per IEC-60751.
- 2.1.3 The wire shall be wound on a ceramic core and immobilised against strain or damage. The winding shall be of bifilar type. The leads shall be copper up to terminal block.
- 2.1.4 The element shall be within a metal sheath, in a manner which provides good thermal transfer and protection against moisture. The sheath material shall be 316 Stainless Steel, unless otherwise specified.
- 2.1.5 The RTD assemblies shall be furnished with threaded heads. The heads shall consist of a case, screwed on cover and terminal block. The RTD shall be screwed to the terminal block. Separate screw shall be provided on the terminal block for terminating the incoming cable. There shall be an extra terminal in the terminal block connected to the head for grounding the shield.
- 2.1.6 The case shall be suitable for mounting terminal blocks for single or duplex type RTD element assemblies. The connecting terminals shall be properly numbered and shall be permanently and legibly identified.
- 2.1.7 The RTD assemblies shall be spring loaded.
- 2.1.8 A heat resistant and moisture proof gasket shall be fitted between the case and cover. The head support chain (between case and cover) shall be of stainless steel.
- 2.1.9 Unless otherwise specified, the assembly shall conform to the following standards:
- a) The heads shall be weather proof to IP-65 as per IEC-60529.
 - b) In case of flame proof construction, heads shall be flame proof as per IS-60079/IS-2148 & weather proof to IP-65 as per IEC-60529/IS-13947.

2.2 Thermowells

- 2.2.1 Unless otherwise specified, the thermowell material shall be 316 Stainless Steel, as a minimum.
- 2.2.2 Thermowells with immersion length up to 500 mm shall be machined out of forged bar-stock. Built-up thermowell with welded wall construction shall be acceptable for immersion length of greater than 500 mm, unless specified otherwise in purchaser's datasheet.
- 2.2.3 Thermowell flange material and rating shall be as specified in the data sheet.
- 2.2.4 All thermowell weld joints shall be full penetration weld type only.
- 2.2.5 Thermowell immersion length shall be as specified in purchaser's data sheet. Where immersion length is not specified in purchaser's data sheet, following shall govern:

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| <u>Line Size</u> | <u>Immersion length</u> |
|------------------|-------------------------|
| Up to 6" | 280 mm |
| 8" and above | 320 mm |
| Equipments | 400 mm |

The immersion length of built-up thermowells shall be as per actual requirements.

2.2.6 Tip thickness of Thermowell shall be minimum 9 MM.

2.2.7 Unless otherwise specified, the following shall govern:

- a) Threaded end connections shall be NPT as per ANSI/ASME B 1.20.1
- b) Flanged end connections shall be to ANSI/ASME B 16.5
- c) Where ring type joint flanges shall have been specified, groove shall be suitable for octagonal rings as per ANSI/ASME B 16.20.
- d) Flange face finish shall be as per clauses 6.4.5.1, 6.4.5.2 and 6.4.5.3 to ANSI/ASME B 16.5. The face finish as specified in the datasheets, shall be as follows:

| | | |
|---------|---|----------------|
| 125AARH | : | 125 to 250AARH |
| 63 ARH | : | 32 to 63 AARH |

2.2.8 All the thermowells in oxygen and chlorine service shall be thoroughly degreased using reagents like trichloro-ethylene or carbon tetrachloride.

3.0 NAME PLATE

3.1 Thermowell

3.1.1 The following information shall be punched on the extension of the thermowell:

- a) Tag number as per purchaser's data sheets.
- b) Thermowell material as per purchaser's data sheets.
- c) Thermowell immersion length TJ'.


3.1.2 The following information shall be punched on the thermowell flange at a visible place:

- a) Nominal flange size in inches and rating in pounds.
- b) Flange material as per purchaser's data sheets.

4.0 INSPECTION AND TESTING

4.1 Vendor shall submit following test certificates and test reports for purchasers review.

- a) Material test certificate as per clause 3.2 of EN 10204 for thermowells and flanges and as per clause 2.2 for RTDs.
- b) Dimensional test report.
- c) For instruments with rating of 600# and above, certificate of radiography / X-ray for welded joints. Dye penetration test certificate shall be provided for joints where Radiograph / X-ray is not possible.
- d) Certificate for concentricity of bore.

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- e) Hydrostatic test report as per clause 4.2 of this specification.
- f) Calibration report for RTD's.
- g) Certificate from any statutory authority for explosion proof and weatherproof
- h) Construction of RTD's head as applicable.

4.2 Hydrostatic Test

4.2.1 Each thermowell made of bar stock or built-up type shall be subjected to hydrostatic test for a time period of 20 minutes at the following pressures:

- a) Inside of the well at 100 kg/cm² upto 600# flange rating and at 200 kg/cm² above 600# or up to flange rating whichever is higher
- b) Outside of the well as per ANSI flange rating.

During and after the hydrostatic test, the thermowell shall not show any leaks or rupture.

5.0 MATERIAL OF CONSTRUCTION

| SNo | Item | Specified Material of Construction |
|-----|------------|------------------------------------|
| | Thermowell | SS316 |

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GAIL INDIA LIMITED

**STANDARD SPECIFICATION
FOR
INSTRUMENT CABLES**

GAIL-STD-IN-DOC-TS-005

| Rev | Date | Purpose | Prepared By | Checked By | Approved By |
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4.0 INSPECTION AND TESTING.....8

1.0 GENERAL**1.1 Scope**

- 1.1.1 This specification, together with the data sheets attached herewith covers the requirements for design, materials, manufacturing, inspection, testing and shipping of signal cables.
- 1.1.2 Cables shall comply with latest edition of the following standards prior to the date of the purchaser's enquiry.
- | | |
|-----------------|--|
| ASTM D 2843 | Standard Test Method for Density of Smoke from the Burning or Decomposition of Plastics. |
| ASTM D 2863 | Test method for measuring the minimum oxygen concentration to support candle like combustion of plastics (oxygen index). |
| BS-5308 Part 1 | Specification for Polyethylene insulated cables. |
| BS-5308 Part 2 | Specification for PVC insulated cables. |
| IEC: 540 & 540A | Test methods for insulation and sheaths of electric Cables |
| IEC60584-3 | Extension and compensating cables - Tolerances and identification system. |
| IEC-60331 | Testing of Fire Resistant cables. |
| IEC-60332 | Tests on bunched wires and cables |
| .IEC-60092 | Electrical Installations of Cables. |
| IEC – 60574 | Test on Gases Evolved during Combustion of materials from Cables - Part 1,2. |
| IS-1554 | PVC insulated (heavy duty) electric cables-working voltage up to and including 1100 V. |
| IS-3975 | Mild steel wires, formed wires and tapes for armouring of cables. |
| IS-5831 | PVC insulation and sheath of electric cables. |
| IS-6380 | Elastomeric insulation and sheath of electric cables |
| IS-6474 | Polyethelene Insulation and sheath of electric cables |
| IS-10810 | Method of test for cables. |
| Part 40 | Method for testing uniformity of coating on zinc coated articles. |
| Part 41 | Mass of zinc coating on steel armour |
| Part 58 | Oxygen Index test |
| Part 59 | Determination of halogen acid gas evolved during combustion of polymeric material taken from cables |
| Part 61 | Flame Retardant test |
| Part 62 | Flame Retardance test for bunched cables |
| Part 63 | Smoke density of electric cables under fire conditions |
- 1.1.3 In the event of any conflict between this standard specification, data sheets, statutory regulations, related standards, codes etc., the following order of priority shall govern:

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- a) Statutory Regulations
- b) Data Sheets
- c) Standard Specification
- d) Codes and Standards


1.3 Drawings and Data

- 1.3.1 Detailed drawings, data and catalogues required from the vendor are indicated by the purchaser in the vendor data requirement sheets. The required number of reproducible, prints and soft copies should be dispatched to the address mentioned, adhering to time limits indicated.
- 1.3.2 Final documentation consisting of design and constructional data submitted by the vendor after placement of order shall include the following, as a minimum.
- a) Specification sheet for each type of cable.
 - b) Cable details giving electrical characteristics, overall diameter, diameter under armour and diameter over armour

2.0 DESIGN AND CONSTRUCTION

2.1 Constructional requirements:

- 2.1.1 Cable shall be Flame Retardant Low Smoke Type.
- 2.1.2 Voltage Class of cables shall be 1100 V.
- 2.1.3 Primary insulation for PVC insulated cables, shall be 85°C polyvinyl chloride Type C as per IS 5831. Thickness of primary insulation shall be 0.5 mm as a minimum. For PE insulated cables, primary insulation shall be of 70° C Polyethylene.
- 2.1.4 Inner sheath colour of signal cables shall be black. Outer sheath colour shall also be black except for cables used in intrinsically safe systems. The outer sheath colour for all such cables used in intrinsically safe application shall be light blue. The thickness of the sheath shall be as per IS 1554. part 1.
- 2.1.5 Inner and outer sheath of cable shall be Flame Retardant Low Smoke made of extruded PVC Type ST2 (90°C) as per IS 5831 and shall meet the following requirements:
- a) Minimum Oxygen index of PVC shall be 30 at 27 °C \pm 2°C.
 - b) Temperature index shall be over 250 °C.
 - c) Inner and Outer sheath shall meet flame retardant requirements for bunched cables as per IS 10810 (Part 62) category AF or IEC 60332 category A.
 - d) A rip cord shall be provided for inner sheath.
 - e) Outer sheath shall be suitable for protecting the cable against rodent and termite attack.

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- 2.1.6 Armour over inner sheath shall be of galvanised steel wire/flat. The dimensions of armour shall be as per IS 1554 (Part 1). Requirement and methods of tests for armour material and uniformity of galvanisation shall be as per IS 3975 and IS 10810 (Part 40) respectively.
- 2.1.7 Each pair/triad shall be shielded. Shield shall be of aluminium backed by mylar / polyester tape bonded together helically applied with metallic side down having 25% overlap on either side and 100% coverage. Minimum shield thickness shall be 0.05 mm. Drain wire shall be 0.5 mm² multi-strand bare tinned annealed copper conductor. The drain wire shall be in continuous contact with aluminium side of the shield.
- 2.1.8 Overall shield shall be of aluminium backed up by mylar/polyester tape helically applied with the metallic side down with either side having 25% overlap and 100% coverage. Minimum shield thickness shall be 0.075 mm. Drain wire shall be similar to individual pair/triad drain wire and shall be over the overall shield.
- 2.1.9 The cores of a pair triad shall be twisted with a minimum of 10 twists per metre of cable.
- 2.1.10 Sequential marking of the length of the cable in meters shall be provided on the outer sheath at every one meter. The embossing /engraving shall be legible and indelible.
- 2.1.11 Tolerance in overall diameter of cable shall be within ± 2 mm over offered value.
- 2.1.12 The cables used in installations under the jurisdiction of Director General of Mines and Safety (DGMS) shall meet all requirements of DGMS. The word "Mining Cable" shall be embossed on the cable outer sheath as per IS 1554 (Part 1).
- 2.1.13 Tinning process shall be performed over cable conductor.

2.1.14 Drum length and length tolerance

- 2.1.14.1 The length of the cables in each drum (drum length) shall be as specified in the purchaser data sheets .Where no drum length is indicated in the data sheet /material requisition, the following shall be apply:
- Drum length for single pair/ single triad cable : 500 metres
- Drum length for multi-pair/ multi- triad cable : 1000 metres
- 2.1.14.2 Actual produced drum length shall not vary by more than $\pm 5\%$ from the length indicated in purchaser's datasheet or clause 2.1.14.1 of the specification

Tolerance over the total ordered length for a type of cable shall be as follows;

- a) $\pm 5\%$ for total length less than 5 km.
- b) $\pm 2\%$ for total length more than 5 km.


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2.1.15 Specific Requirements for fire resistant cable.

- a. The cables shall have circuit integrity as per IEC 60331.
- b. Primary insulation shall be heat resisting elastomeric which can withstand temperature up to 90°C such as silicon rubber/mica glass tape/EPR (medium grade) as per IS 6380. Insulation thickness shall be 1.0mm minimum and shall confirm to IEC 60092.
- c. A wrapping of tape made of PETP (polyethylene terephthalate) /woven glass shall be provided over core insulation.
- d. Individual pair triad shall be shielded. The shield shall be aluminium backed by glass mica / PETP tape with the metallic side down helically applied with 25% overlap on either side and 100% coverage. Minimum shield thickness shall be as per IEC 60092. Drain wire shall be 0.5mm² (7/0.3mm dia). Multi-stranded bare tinned annealed copper conductor. Drain wire shall be in continuous contact with aluminium side of the shield.
- e. Inner and outer sheath shall be made of low smoke, heat resistant, oil resistant and flame retardant material with oxygen index over 30, temperature index shall be over 250°C. Acid generation shall be maximum 20% by weight as per IEC 60754. Smoke density rating not to exceed 60% as per ASTM D 2843.
- f. The thickness of the sheath shall be as per IEC 60092. Inner and outer sheath colour shall be orange. A rip cord shall be provided for inner sheath.
- g. Armour bedding over inner sheath shall be of special high oxygen index, low smoke halogen free fire resisting compound.

2.2 Electrical Characteristics

- a. Maximum DC resistance of the conductor of the finished cable shall not exceed 12.3 Ω / km at 20°C for cables with 1.5 mm² conductors and 39.7 Ω / km at 20°C for cables with 0.5 mm² conductors.
- b. Mutual Capacitance for PVC Insulated cables. The mutual capacitance of between pairs/triads or adjacent cores shall not exceed of 250 pF / metre at a frequency of 1 KHz.
- c. Mutual Capacitance for PE Insulated cables. The mutual capacitance between the pairs/triads shall not exceed of 100 pF / metre at a frequency of 1 KHz.
- d. Capacitance between any core or screen. The capacitance between any core and screen shall not exceed a maximum of 400 pF / meter at a frequency of 1 KHz.
- e. L/R ratio of adjacent core shall not exceed 40 uH / Ω .for cables with 1.5 mm² conductors and 25 micro H / Ω for cables with 0.5 mm² conductors.
- f. The drain wire resistance including shield shall not exceed 30 Ω . / km.
- g. Electrostatic noise rejection ratio of the finished cable shall be over 76 dB.

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2.3 Type I (Single pair / Triad shielded).

- a. Each core shall be 1.5 mm² made of 7 stranded annealed tinned electrolytic copper conductor. Each strand shall be 0.53 mm dia.
- b. Colour of core insulation shall be black and blue in pair and black, blue and brown in a triad.
- c. All other specifications shall be as per clauses 2.1. and 2.2 of this specification.

2.4 Type-II (Multi-pair / Multi-triad cable with individual pair / triad shield and overall shield)

- a. Conductor sizes shall be 0.5mm² made up of 7 strands of annealed tinned electrolytic copper conductor. Each strand shall be of 0.3 mm diameter. Tinned conductor copper wire.
- b. Overall twist of all pair / triads shall be as per vendor's standard.
- c. A pair of communication wire shall be provided for multipair / multitriad cables. Each wire shall be 0.5 mm² of plain annealed single or multistrand copper conductor with 0.4 mm thick 85°C PVC insulation. Insulation shall be green and red colour coded.
- d. A pair identification shall be with numbers at interval of not more than 250 mm.
- e. All other specifications shall be as per clauses 2.1. and 2.2 of this specification.

2.5 Type-III (Multi-pair / Multi-triad cable with only overall shield)

The cable shall be same as type-II cable, except that the individual pair/triad shall not have shielding.

2.6 Type-IV (Multi-pair / Multi-triad cable with individual pair shield and overall shield)

The cable shall be same as Type II, except conductor size shall be 1.5 mm² made of 7 stranded annealed tinned electrolytic copper conductor. Each strand shall be of 0.53 mm dia.


2.7 Type-V (Multi-pair / Multi-triad cable with overall shield only)

The cable shall be same as type IV except that the individual pair/triad shall not have the shielding.

2.8 Wiring Coding

The wiring shall be marked by colour code to differentiate the signal level/type according to the following table:

| Function | Wire Colour | Outer Jacket Colour |
|----------------------------|------------------------|---------------------|
| FF signals | Orange (+) / Blue (-) | Orange |
| Signals for DCS | Black (+) / White (-) | Grey |
| Signals for ESD/FGS | Black (+) / White (-) | Red |
| Intrinsically safe signals | Black (+) / White (-) | Blue |
| Thermocouple signals | Green (+) / White (-) | Green |
| AC power | Brown (Ph) / Blue (Ne) | Black |
| DC power | Red (+) / Black (-) | Black |
| Safety earth | - | Green/Yellow |

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| | | |
|------------------|---|----------------------------------|
| Instrument earth | - | Black outer, Green/Yellow sheath |
|------------------|---|----------------------------------|

3.0 NAMEPLATE

3.1 Each cable drum shall be marked with the following information at a visible place;

- a) Manufacturer's name
- b) Type and size of the cable with cable indicated in material requisition.
- c) Length of the cable in meters contained in the drum.
- d) Gross weight
- e) Drum number
- f) Direction of rotation of drum for unwinding by means of an arrow.
- g) Purchase order number.

4.0 INSPECTION AND TESTING

4.1 Unless otherwise specified purchaser reserves the right to test and inspect all the items at the vendors work in line with the inspection test plan for signal cables..

4.2 Vendor shall furnish raw material test certificates for conductor, PVC / PE etc to prove the quality and composition of the materials used for manufacturing the cable to the satisfaction of purchaser or their authorised representative during various stages of expediting and inspection.

4.3 Type test, routine test and acceptance tests shall be carried out as per relevant Indian Standard (IS), unless specified otherwise.


4.4 Type Test

4.4.1 Certificates from third party or purchaser's authorised representative for the following shall be furnished by vendor for cables similar to those being offered ;

- a) Flame retardant test on bunched cables.
- b) Electrostatic noise rejection test
- c) Fire resistance test

4.4.2 Vendor shall submit the following test certificates and test reports as per IS 10810 for each batch for purchaser's review:

- a) Physical tests for insulation and outer sheath as given below as minimum:
 - i) Tensile strength and elongation at break
 - ii) Ageing in air oven.
 - iii) Shrinkage test
 - iv) Hot deformation
 - v) Loss of mass in air oven

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- vi) Heat shock test
- vii) Thermal stability
- b) Test for armouring wires / strips.
- c) H.V. Water Immersion Tests.

4.5 Routine Tests


4.5.1 Each of the following tests shall be carried out by vendor during various stages of manufacture on each finished cable drum.

- a) Spark test as per BS 5308 Part 2.
- b) Conductor resistance
- c) High voltage test as per BS 5308 Part 2
- d) Armour resistance test (for mining cables).
- e) Mutual capacitance and capacitance between any core or screen.
- f) Inductance and L/R ratio.
- d) Annealing test (for copper)

4.6 Acceptance Tests

4.6.1 Following acceptance tests shall be carried out by vendor on representative samples taken from manufactured lot:

- a) Finished cable dimensions
- b) Conductor resistance
- c) Thickness of insulation and sheath.
- d) Tensile strength and elongation at break of insulation and sheath.
- e) Pair twisting, laying and identification.
- f) Shield overlap, drain wire resistance and continuity check.
- g) Armour resistance test (for mining cables).
- h) Uniformity of zinc coating on armour.
- i) Insulation resistance (volume resistivity) as per BS 5308 Part 2.
- j) High voltage.
- k) Test for rodent and termite repulsion.
- l) Mutual capacitance and capacitance between any core or screen
- m) Inductance and L/R ratio
- n) Oxygen and Temperature index as per ASTM D 2863.
- o) Flame retardant Test on sample cable as per IS 10810 Part 61.
- p) Acid Generation test IEC 60754 / IS 10810 Part 59 (for fire resistant cables)
- q) Smoke density test ASTM D 2843 / IS 10810 Part 63 (for fire resistant cables)

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- r) Overall finish and drum length check.
- s) Swedish Chimney test

4.7 Witness Inspection


4.7.1 Vendor shall offer all cables for pre-dispatch inspection to purchaser or their authorized representative and following test/checks shall be carried out as minimum:

- a) Acceptance tests as per clause 4.6 on representative samples.
- b) Review of all certificates and test reports as indicated in clause 4.0.

4.8 Immediately after completion of electrical tests, the ends of the cable shall be sealed to prevent ingress of moisture with suitable PVC / rubber caps.

4.9 In the event no witness inspection is carried out by purchaser, the tests shall anyway be completed by the vendor and documents for the same shall be submitted to purchaser for scrutiny.

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GAIL INDIA LIMITED

**STANDARD SPECIFICATION
FOR
JUNCTION BOXES & CABLE GLANDS**

GAIL-STD-IN-DOC-TS-006

| Rev | Date | Purpose | Prepared By | Checked By | Approved By |
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1.0 GENERAL

1.1 Scope

1.1.1 This standard specification, together with the data sheets attached herewith, covers the requirements for design, materials, nameplate marking, testing and shipping of junction boxes and cable glands which include the following types:

- a) Electrical junction boxes
- b) Pneumatic junction boxes
- c) Cable glands (whenever specified)

1.1.2 The related standards referred to herein and mentioned below shall be of the latest editions prior to the purchaser's enquiry;

ANSI/ASME American National Standards Institute / American Society of Mechanical Engineers.

B 1.20.1 Pipe Threads, General Purpose (Inch).

EN 10204 Inspection Documents For Metallic Products.

IEC-60079 Electrical Apparatus for Explosive Gas Atmosphere.

IEC-60529 Degrees of Protection Provided by Enclosures. (IP Code)

IS-5 Colours for ready mixed paints and enamels.

IS-13947 Specification for Low Voltage Switchgear and Control gear.

IS-2148 Electrical Apparatus for Explosive Gas Atmospheres - Flame proof Enclosures 'd'.

1.1.3 In the event of any conflict between this specification, data sheets, related standards, codes etc., the following order of priority shall govern:


- a) Statutory Regulations
- b) Data Sheets
- c) Standard Specification
- d) Codes and Standards

1.2 Drawings and Data

1.2.1 Detailed drawings, data, catalogues and manuals required from the vendor are indicated by the purchaser in vendor data requirement sheets. The required number of reproducible, prints and soft copies, shall be sent to the address mentioned, adhering to the time limits indicated.

1.2.2 Final documentation consisting of design data and installation manual submitted by the vendor after placement of purchase order shall include the following, as a minimum;

- a) Specification sheet for each junction box and its accessories like cable glands etc.

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- b) Certified drawing sheets for each junction box and its accessories, which shall provide dimensional details, internal constructional details (general arrangement details), and material of construction.
- c) Copy of type test certificates.
- d) Copy of test certificates for all the tests indicated in clause 4.0 of this specification.
- e) Installation procedure for junction boxes and its accessories.

2.0 DESIGN AND CONSTRUCTION

2.1 Junction Boxes

2.1.1 Junction boxes shall be either of the following type as specified in data sheets.

- a) Weather proof junction boxes.
- b) Weather proof and flameproof junction boxes.

No other type of junction boxes shall be offered / supplied unless specifically indicated otherwise.

2.1.2 Unless otherwise specified, the enclosure shall conform to the following standards:

Weatherproof housing : IP 65 to IEC-60529

Flameproof housing : Flameproof/Ex (d) as per IEC-60079.

2.1.3 Number of entries and their location shall be as per data sheets. Junction boxes with top entries shall not be offered. The size of cable entries shall be as per the cable sizes indicated in the data sheet.

2.1.4 Multi-pair junction boxes shall be provided with telephone sockets and plugs for connection of hand-powered telephone set.

2.1.5 Electrical Junction Boxes


- a) The material of construction of electrical junction boxes shall be die-cast aluminium of minimum 5 mm thick (LM-6 alloy).
- b) Weather proof junction box shall have hinged type door with neoprene gasket, which shall be fixed to the box by plated countersunk screws.
- c) Flameproof junction box shall have detachable cover, which shall be fixed to the box by means of cadmium plated triangular head/hexagonal head screws.
- d) Flameproof junction boxes for signal, alarm and control shall have the following warning engraved/integrally cast on the cover;

"Isolate power supply elsewhere before opening"

- e) Power junction boxes (junction boxes for power supply cable / distribution) shall have either the warning cast or shall have warning plate with following marking;

"Isolate power supply elsewhere before opening".

Unless otherwise indicated in the job specification, power junction boxes shall be suitable for incoming armoured power cable up to 150 sq.mm conductor size.

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- f) Terminals shall be spring loaded, vibration proof, clip-on type, mounted on nickel plated steel rails complete with end cover and clamps for each row.
- g) All terminals used in signal, alarm and control junction boxes shall be suitable for accepting minimum 2.5sq.mm copper conductor, in general.
- h) Terminal used in power junction boxes / power supply distribution box shall be suitable for accepting conductor size of 4 Sq. mm to upto 120 sq. mm. Exact requirement shall be specified in data sheet/job specification. Higher size of terminals provided when indicated. Bus bar terminals shall be provided for conductor size 50 sq.mm and above. Suitable size of lugs shall be provided to suit conductor size specified.
- i) Each junction shall have minimum of 30% spare terminal of those actually required to be utilised. Unless higher number of terminal are specified in the purchaser's data sheet, the number of terminals for various types of junction boxes shall be as follows;
- 24 Nos. for 6 pair junction box.
- 48 Nos. for 12 pair junction box
- 36 Nos. for 6 triad junction box.
- 48 Nos. for 8 triad junction box.
- j) Terminals shall be identified as per the type of input signal indicated in data sheets e.g all terminal for intrinsically safe inputs shall be blue while others shall be grey in colour.
- k) Junction boxes shall be provided with external earthing lugs.
- l) Sizing shall be done with due consideration for accessibility and maintenance in accordance with the following guidelines;
- i) 50 to 60 mm gap between terminals and sides of box parallel to terminal strip for upto 50 terminals and additional 25 mm for each additional 25 terminals.
- j) 100 to 120 mm between two terminal strips for upto 50 terminals and additional 25 mm for each additional 25 terminals.
- iii) Bottom/top of terminal shall not be less than 100 mm from bottom / top of the junction box.

2.1.6 Pneumatic Junction Boxes

- a) Pneumatic junction boxes shall be made of 3 mm thick hot rolled steel. They shall have necessary neoprene gasket between door and body. Door shall be flush with the box and shall be hinged type and provided with wing nuts.
- b) Single tube entries shall be suitable for 6 mm O.D copper tube with bulk head fittings. Multi tube bundle entry shall be suitable for the data furnished in data sheets.

2.1.7 Painting

- a) Surface shall be prepared for painting. It shall be smooth and devoid of rust and scale.

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- b) Two coats of lead-free base primer and two final coats of lead free epoxy based paint shall be applied both for interior and exterior surfaces.
- c) The colour shall be as specified in data sheets. However, following philosophy shall be followed, in general:
 - (i) Light blue for all intrinsically safe junction boxes.
 - (ii) Light grey for all others

2.2 Cable glands, Plugs and Reducers/Adaptors

- 2.2.1 Cable glands shall be supplied by vendor whenever specified.
- 2.2.2 Cable glands shall be double compression type for use with armoured cables.
- 2.2.3 The cable glands shall be of nickel plated brass, as a minimum and shall be provided with PVC shrouds.
- 2.2.4 The cable glands shall be weatherproof. Whenever specified they shall also be flameproof and certificate for the specified electrical area classification specified in the data sheets.
- 2.2.5 Cable glands shall be supplied to suit the cable dimensions indicated along with tolerances in data sheets. Various components like rubber ring, metallic ring, metallic cone and the outer / inner nuts etc. shall be capable of adjusting to the indicated tolerances of cable dimensions.
- 2.2.6 Reducers / adapters shall be supplied as per details indicated in data sheets. They shall be nickel-plated brass, as a minimum. These shall also be weatherproof and / or flame proof wherever specified and certified for the electrical area classification specified in the data sheets.
- 2.2.7 Plugs shall be provided wherever specified. They shall be of nickel-plated brass.
- 2.2.8 Plugs shall be certified flameproof when used with flameproof junction boxes.


3.0 NAME PLATE

Each junction box shall have an anodised aluminium nameplate permanently fixed to it at a visible place furnishing the following information;

- a) Tag number as per purchaser's data sheet.
- b) Manufacturer's serial number and model number.
- c) Manufacturer's name/trade mark.
- d) Stamp of certifying agency with certificate number.
- e) Electrical area classification.

4.0 INSPECTION AND TESTING

- 4.1 Unless otherwise specified, purchaser reserves the right to test and inspect all the items at the vendor's works in line with inspection test plan for junction boxes and cable glands.

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4.2 Vendor shall submit following test certificates and test reports for purchaser's review:

- a) Material test certificates as per clause 2.2 of EN 10204
- b) Pressure test on castings for flameproof junction boxes.
- c) Dimensional test report.
- d) High voltage and insulation resistance test report.
- e) Air leak test report on pneumatic junction boxes.
- f) Certificate from statutory body for suitability to install in specified hazardous area.


4.3 Witness Inspection

4.3.1 All junction boxes, cable glands and other accessories shall be offered for pre-dispatch inspection for the following, as a minimum;

- a) Physical dimensional verification and workmanship on representative samples.
- b) High voltage and Insulation resistance test on representative samples.
- c) Air leak test report on representative samples of pneumatic junction boxes.
- d) Review of all certificates and test reports as indicated in clause 4.2 of this specification.

4.3.2 In the event when witness inspection is not carried out by purchaser, the tests shall anyway be completed by the vendor and documents for the same shall be submitted for scrutiny of purchaser.

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GAIL INDIA LIMITED

**STANDARD SPECIFICATION
FOR
INSTRUMENT TUBE FITTINGS
(STAINLESS STEEL TUBE FITTINGS)**

GAIL-STD-IN-DOC-TS-007

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ANNEXURES:

ANNEXURE - 1: HYDROSTATIC TEST PRESSURES FOR INSTRUMENT TUBE FITTINGS

1.0 GENERAL**1.1 Scope**

1.1.1 This standard specification, together with the data sheets attached herewith, covers the requirements for the design, materials, inspection, testing of instrument tube fittings which includes the following types:

- a) Stainless steel compression fittings (for stainless steel tube)
- b) Brass compression fittings (for copper tube)

1.1.2 The related standards referred to herein and mentioned below shall be of the latest editions prior to the date of the purchaser's enquiry: -

ANSI/ASME American National Standards Institute/American Society of Mechanical Engineers

B 1.20.1 Pipe Threads General Purpose (Inch).

B 16.11 Forged Steel Fittings - Socket Welding and Threaded.

BS-4368 Metallic tube connectors for fluid power and general use. Specification for type test requirements

ASTM F 1387 Standard Specification for Performance of Piping and Tubing Mechanically Attached Fittings

EN 10204 Inspection Documents For Metallic Products.

IS-319 Specification for free cutting Brass Bars, Rods and Sections.

ISA International Society of Automation

RP 42.1 Nomenclature for Instrument Tube Fittings.


1.1.3 In the event of any conflict between this standard specification, data sheets, statutory regulations, related standards, codes etc., the following order of priority shall govern:

- a) Statutory Regulations
- b) Data Sheets
- c) Standard Specification
- d) Codes and Standards

2.0 DESIGN AND CONSTRUCTION**2.1 Stainless Steel Tube Fittings**

2.1.1 Nomenclature of all tube fittings shall be as per ISA RP 42.1.

2.1.2 Fittings shall be of flare less compression type having four-piece (for double compression type) construction consisting of two ferrules, nut and body or three piece (compression type) construction consisting of single ferrule, nut and body suitable for use on tubes of specified material for example stainless steel tubes conforming to ASTM A269 TP 316L with hardness in the range of HRB 70 to 79.

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- 2.1.3 All parts of the tube fittings shall be of 316 Stainless Steel unless specified otherwise.
- 2.1.4 Hardness of the ferrules shall be in the range of HRB 85-90 so as to ensure a hardness difference of the order of 5 to 10 between tube and fittings for better sealing.
- 2.1.5 Nuts and ferrules of a particular size shall be interchangeable for each type.
- 2.1.6 Spanner hold shall be metric.
- 2.1.7 Threaded ends of fittings shall be NPT as per ANSI B 1.20.1.
- 2.1.8 Specific techniques like silver plating shall be used over threading in order to avoid jamming and galling.
- 2.1.9 Ferrule finish and fitting finish shall be such that there is no abrasion/galling when the nut is tightened.
- 2.1.10 All instrument tube fittings in oxygen and chlorine service shall be thoroughly degreased using reagents like trichloro-ethylene or carbon tetrachloride. End connection shall be plugged after degreasing process in order to avoid entrance of grease or oil particles.

2.2 Copper Tube Fittings


- 2.2.1 Nomenclature of all tube fittings shall be as per ISA RP 42.1.
- 2.2.2 Fittings shall be of flare less compression type and of three-piece construction consisting of ferrule, nut
- 2.2.3 and body suitable for use on copper tubes conforming to ASTM B68 /B68M, hardness not exceeding HRB 50.
- 2.2.4 All parts shall be manufactured from brass as per IS 319 bar stock and nickel plated.
- 2.2.5 For better grip, vendor shall maintain hardness difference between tube and ferrule and indicate the same along with the offer.
Threaded ends of fittings shall be NPT as per ASME B 1.20.1
Spanner hold shall be metric.

3.0 NAMEPLATE

- 3.1 No separate nameplates are required on the fittings. However, manufacturer's name/trademark should be punched on a visible place on the body of each fitting for easy identification.

4.0 INSPECTION AND TESTING

- 4.1 Unless otherwise specified, purchaser reserves the right to test and inspect all items at vendor's works, inline with the inspection test plan for instrument tube fittings.
- 4.2 Vendor shall submit following test certificates and test reports for purchaser's review:
 - 4.2.1 Type test reports for following tests in accordance with BS-4368 Part IV:
 - a) Hydrostatic proof pressure test.

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- b) Minimum hydrostatic burst pressure test.
- c) Disassembly and reassembly test.
- d) Minimum static gas pressure (vacuum) test.
- e) Maximum static gas pressure test.
- f) Hydraulic impulse and vibration test.

4.2.2 Material test certificates as per clause 3.1 B of EN 10204.

4.2.3 Routine test reports for following tests:


- a) **Hydrostatic Test**
Instrument tube fittings shall be hydrostatically tested at ambient temperature at test pressures given in Annexure 1 of this specification. During and after the hydrostatic test, the tube fittings shall not show any leakage or rupture.
- b) **Pneumatic pressure test**
The fittings shall be tested at 7 kg/cm²g of dry air. There shall not be any visible leakage when immersed in water or coated with a leak detection solution.
- c) **Disassembly and reassembly test.**
- d) **Hardness verification:**
Hardness test shall be carried out on each rod used for machining ferrules. Vendor shall ensure that after machining, the finished ferrules shall meet the required hardness given in the specification.
- e) **Dimensional test report**

4.3 **Witness Inspection**

4.3.1 All fittings shall be offered for pre-dispatch inspection for the following as a minimum:

- a) Physical dimensional verification and workmanship on representative samples.
- b) Hydrostatic and pneumatic tests as per clause 4.2.3 of this specification on representative samples.
- c) Hardness verification as per clause 4.2.3 of this specification.
- d) Disassembly and reassembly test on representative samples.
- e) Review of all certificates and test reports as indicated in clause 4.2 of this specification.


4.3.2 In the event when no witness inspection is carried out by purchaser, vendor shall anyway complete the tests and test reports for the same shall be submitted to purchaser for scrutiny.

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ANNEXURE – 1

HYDROSTATIC TEST PRESSURES
FOR INSTRUMENT TUBE FITTINGS

| Sr. No. | Size of Tube Fittings | Material | Line Pressure Class | Max Working Pressure | Hydrostatic Test Pressure |
|---------|-----------------------|-----------------|-----------------------------------|--------------------------|---------------------------|
| 1 | 6mm and 1/2" | Stainless Steel | < or = 600# | 102 Kg/cm ² g | 153 Kg/cm ² g |
| 2 | 6mm and 1/2" | Stainless Steel | > or = 900# to < or = 1500# | 253 Kg/cm ² g | 383 Kg/cm ² g |
| 3 | 1/4" and 3/8" | Brass | > or = 900# to < or = 1500# | 53 Kg/cm ² g | 80 Kg/cm ² g |

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GAIL INDIA LIMITED

**STANDARD SPECIFICATION
FOR
INSTRUMENT TUBING (STAINLESS STEEL TUBES)**

GAIL-STD-IN-DOC-TS-008

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ANNEXURE - 1: MAXIMUM WORKING PRESSURE AND HYDROSTATIC TEST
PRESSURES FOR INSTRUMENT TUBING

1.0 GENERAL

1.1 Scope

1.1.1 This standard specification, together with the data sheets attached herewith, covers the requirements for the design, materials, inspection, testing and shipping of Instrument Tubing which includes the following types: -

- a) Stainless steel tubes
- b) Copper tubes

1.1.2 The related standards referred to herein and mentioned below shall be of the latest edition prior to the date of purchaser's enquiry;


| | |
|-----------------|---|
| ASTM | American Society for Testing and Materials. |
| A269 /A269- 15A | Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Services. |
| A632 | Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing (Small Diameter) for General Services. |
| B 251 | Specification for general requirements for wrought seamless copper and copper alloy tube. |
| B 251M | Specification for general requirements for wrought seamless copper and copper alloy tube (Metric) |
| B 68/B68M | Specification for seamless copper tube, bright annealed. |
| E 243 | Standard Practice for Electromagnetic (Eddy - Current) Examination of Copper and Copper - Alloy Tubes |
| EN 10204 | Inspection Documents for Metallic Products |

1.1.3 In the event of any conflict between this standard specification, job specification/data sheets, statutory regulations, related standards, codes etc. the following order of priority shall govern:

- a) Statutory regulations
- b) Job specification
- c) Standard specification
- d) Codes and standards

1.2 Drawings and Data

1.2.1 Detailed drawings, data, catalogues and manuals required from the vendor are indicated by the purchaser in vendor data requirement sheets. The required number of reproducible, prints and soft copies shall be dispatched to the address mentioned adhering to the time limits indicated.

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1.2.2 Final documentation consisting of design data by the contractor after placement of purchase order shall include the following as a minimum;

- a) Specification sheet for each type of tube.
- b) Copy of test certificates of all tests indicated in clause 4.0 of this specification.

2.0 DESIGN AND CONSTRUCTION

2.1 Stainless Steel Tubes

- 2.1.1 The tubes shall be 316L Stainless Steel fully annealed, seamless and cold drawn as per ASTM A 269/A269-15A.
- 2.1.2 The hardness of the tubes shall be limited to HRB 70-79. Equivalent hardness as Rockwell superficial scale (30T/15T) or Vicker's hardness scale shall also be acceptable.
- 2.1.3 Tubes shall have good surface finish and shall be free from scratches burrs etc. and suitable for bending.
- 2.1.4 Maximum working pressure shall be as per Annexure - 1 attached with this specification.
- 2.1.5 Tubes shall preferably be supplied in length of 5 to 6 metres without welding in between. Tube length less than 5 meters shall be rejected.
- 2.1.6 All tubes in oxygen and chlorine service shall be thoroughly degreased using reagents like trichloroethylene or carbon tetrachloride and tube ends shall be plugged after degreasing process in order to avoid entrance of grease or oil particles.


2.2 Copper Tubes

2.2.1 Copper Tubes (PVC Jacketed)

- a) The tube shall be soft annealed copper with 6mm OD and a wall thickness of 1.0mm as per ASTM B 68/B68 M copper No. C 12200.
- b) The tube shall be jacketed with black PVC. The jacket thickness shall be 1.6mm. The PVC jacket shall confirm to ASTM D-1047.
- c) The tube ends shall be plugged prior to transportation.
- d) The tube shall be continuous length without any brazing in between.
- e) The length of single tube shall preferably be 100 metres. However any tube length less than 70 meters shall be rejected unless specifically required otherwise in job specification.
- f) The dimensional tolerances shall be as per ASTM B 251/B251 M.

2.2.2 Bare Copper Tubes (For Steam Tracing)

- a) The tube shall be soft annealed copper with 3/8" (10mm) OD with wall thickness of 0.049" or 6mm OD with wall thickness of 1.0mm as per ASTM B68/B68 M, copper No. C12200.

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- b) The tube ends shall be plugged prior to transportation.
- c) The tube shall be continuous length without any brazing in between.
- d) The length of single tube shall preferably be 100 metres. However any tube length less than 70 meters shall be rejected unless specifically required otherwise in job specification.
- e) The dimensional tolerances shall be as per ASTM B 251/B 251M.
- f) Maximum working pressure shall be 53.0kg/cm²g at 38°C unless specified otherwise.

3.0 NAME PLATE

The following information shall be marked on the stainless steel tubes:

- a) Name of manufacturer
- b) Type and material grade of tube
- c) Tube outer diameter and wall thickness.

4.0 INSPECTION AND TESTING

4.1 Unless otherwise specified, purchaser reserves the right to test and inspect all the items at vendor's works, inline with the inspection test plan for instrument tubing.

4.2 Vendor shall submit following test certificates and test reports for purchasers review:


- a) Material test certificates as per clause 3. IB of EN 10204.
- b) Hydrostatic test for stainless steel tube and bare copper tubes as per clause 4.3 of this specification.
- c) Pneumatic test for PVC jacketed copper tubes as per clause 4.4 of this specification.
- d) Hardness / tension test for stainless steel tubes as per clause 4.5 of this specification.
- e) Ball test for copper tubes as per clause 4.6 of this specification.
- f) Eddy current examination of copper tubes as per ASTM E-243
- g) Dimensional test report.

4.3 Hydrostatic test

4.3.1 Stainless steel and bare copper tube shall be hydrostatically tested at ambient temperature at test pressures given in Annexure - 1 attached with this specification. During and after the hydraulic test, the tubes shall not show any leaks or rupture.

4.4 Pneumatic test

4.4.1 PVC jacketed copper tubes shall be tested at 7.0 kg/cm²g of dry air. During and after the test, tubes shall not show any leak or rupture.

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4.5 Hardness/Tension Test

4.5.1 All mother tubes shall be hardness tested for each heat prior to drawing for proper quality control. The hardness of the drawn tubes shall be checked by Rockwell Hardness Test. Following shall apply;

- a) For tubing less than 0.65in (1.65mm) in wall thickness, Rockwell superficial hardness test on 30T / 15T scale or Vicker's scale shall be equivalent to HRB 70 - 79.
- b) Hardness test is not required for tubes smaller than 1/4in (6.4mm) inside diameter or tubes having a wall thickness thinner than 0.020in (0.51mm). These tubes shall be tension tested in accordance with ASTM A632.

4.6 Ball Test


4.6.1 Ball test shall be carried on all copper tubes to ensure clear opening of the tube. The OD of the ball shall be minimum 1.0mm for 6.0mm OD tube and 2.0mm for 3/8" (10mm) OD tube.

4.7 Witness Inspection

4.7.1 All tubes shall be offered for pre-dispatch inspection for the following, as a minimum;

- a) Physical dimensional verification and workmanship.
- b) Hardness / tension test for stainless steel tubes.
- c) Hydrostatic and pneumatic tests on representative samples.
- d) Ball test on copper tubes on representative samples.
- e) Eddy current examination of copper tubes on representative samples.
- f) Review of all certificates and test reports as indicated in clause 4.2 of this specification.

4.7.2 In the event that the witness inspection is not carried out by purchaser, contractor shall anyway complete the tests and test reports for the same shall be submitted to purchaser for scrutiny.

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ANNEXURE - 1
MAXIMUM WORKING PRESSURE AND
HYDROSTATIC TEST PRESSURES
FOR INSTRUMENT TUBING

| Sr. No. | Size of Tube (OD) | Material | Line Pressure Class | Thickness | Maximum Working Pressure | Hydrostatic Test Pressure |
|---------|-------------------|-----------------|----------------------------------|-----------------|---------------------------|---------------------------|
| 1 | 1/2" (12mm) | Stainless Steel | < or = 600# | 0.049" (1.2mm) | 102 Kg/ cm ² g | 153 Kg/ cm ² g |
| 2 | 1/2" (12mm) | Stainless Steel | > or = 900# to < or =1500# | 0.065" (1.65mm) | 253 Kg/ cm ² g | 383 Kg/ cm ² g |
| 3 | (6mm) | Stainless Steel | < or = 600# | 1.00mm | 102Kg/cm ² g | 153 Kg/cm ² g |
| 4 | 1/4" (6mm) | Stainless Steel | > or = 900# to < or =1500# | 0.065" (1.65mm) | 253 Kg/ cm ² g | 383 Kg/cm ² g |
| 5 | 3/8" (10mm) | Copper | < or = 300# | 0.049" | 53 Kg/ cm ² g | 80 Kg/ cm ² g |
| 6 | 1/4" (6mm) | Copper | < or = 300# | 1.00mm | 53 Kg/ cm ² g | 80 Kg/ cm ² g |



GAIL INDIA LIMITED

**STANDARD SPECIFICATION
FOR
INSTRUMENT VALVE AND MANIFOLDS**

GAIL-STD-IN-DOC-TS-009

| Rev | Date | Purpose | Prepared By | Checked By | Approved By |
|-----|------------|--------------------|-------------|------------|-------------|
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1.0 GENERAL**1.1 Scope**

1.1.1 This standard specifications, together with the data sheets attached herewith, covers the requirements for the design, materials, inspection, testing and shipping of instrument valves and manifolds which includes the following types:

- a) Miniature instrument valves
- b) Instrument valve manifolds
- c) Instrument air valves

1.1.2 The related standards referred to herein and mentioned below shall be of the latest edition prior to the date of purchaser's enquiry;

ASME/ANSI American Society of Mechanical Engineers/ American National Standards Institute

B 1.20.1 Pipe threads General Purpose (Inch)

B 16.11 Forged steel fittings-socket welding and threaded.

B 16.9 Factory made Wrought Steel Butt welding fittings.

B 16.34 Valves-Flanged. Threaded and welding end.

API-598 Valve Inspection and Testing

EN 10204 Inspection Documents for Metallic Products.

MSS Manufacturers Standardization Society of the Valve and Fittings Industry.

SP99 Instrument Valves


1.1.3. In the event of any conflict between this standard specification, job specification/data sheets, statutory regulations, related standards, codes etc. the following order of priority shall govern:

- a) Statutory Regulations
- b) Data Sheets
- c) Standard Specification
- d) Codes and Standards

1.3 Drawings and Data

1.3.1 Detailed drawings, data, catalogue and manuals etc. required from the vendor is indicated by the purchaser in vendor data requirement sheets attached with material requisition. The required number of reproducible, prints and soft copies shall be dispatched to the address mentioned in the material requisition, adhering to the time limits indicated.

1.3.2 Final documentation consisting of design data, installation and maintenance manual etc. submitted by the vendor after the placement of purchase order shall include the following, as a minimum:

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- a) Specification sheet for type of instrument valve and manifold.
- b) Certified dimensional details showing internal constructional details and material of construction.
- c) Copy of type test certificates.
- d) Copy of test certificates for all the tests indicated in clause 4.0 of this specification.
- e) Installation and maintenance procedures.

2.0 DESIGN AND CONSTRUCTION

- 2.1 The instrument valves shall be of manufacturer proprietary design. However, the minimum requirements specified herein must be complied.
- 2.2 Qualification tests (hydrostatic proof and burst tests) as per MSS SP-99 shall be conducted by vendor for each design and size of valve to establish the cold working pressure (CW.P) rating.
- 2.3 For all valves and manifolds with body material of carbon steel/stainless steel, the valve trim material shall be 316 Stainless Steel, as a minimum. Whenever body material is other than that specified above, trim material should be same as body material as a minimum.
- 2.4 Unless otherwise specified, the valve packing material for all valves and manifolds shall be PTFE only. The o-ring materials wherever used shall also be of PTFE.
- 2.5 The finishing and tolerances of parts like stem, piston, stem threading etc. of the offered valves and manifolds shall be properly machined to avoid problems like galling.
- 2.6 The hand wheel material for all valves and manifolds shall be zinc/nickel plated carbon steel. Any other material, if provided as per standard vendor design, shall also be acceptable.

2.7 Instrument Valves (Miniature)

- 2.7.1 The instrument valves shall be of globe pattern needle valves forged/ bar stock with inside screwed bonnet, with back-seated blow out proof system.
- 2.7.2 Body material shall be 316 Stainless Steel unless otherwise specified.
- 2.7.3 The minimum cold working pressure (CWP) rating of the valve shall be as per Annexure 1 of this specification, unless otherwise specified.
- 2.7.4 The end connection shall be 1/2"NPTF to ANSI B 1.20.1, unless otherwise specified.
- 2.7.5 Flow direction shall be marked on the body.
- 2.7.6 The valve dimensions shall be as follows:
- a) End to end dimensions 76mm (approximately).
 - b) Height in fully open condition - 135mm maximum. These dimensions are indicative only.

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2.8 Valve Manifolds

2.8.1 3-Valve and 5-Valve manifolds:

2.8.1.1 3-Valve manifold

- a) 3-Valve manifold shall be designed for direct coupling to differential pressure transmitters having 2 bolt flanges with 54mm (2-1/8") centre-to-centre connections and 41.3mm (1 - 5/8") bolt-to-bolt distance.
- b) 3-Valve manifold shall contain two main line block valves and an equalising bypass valve. The valves shall be needle type. They shall use self-aligning 316 Stainless Steel ball seats, unless otherwise specified.

2.8.1.2 5-Valve manifold

- a) 5-Valve manifold shall be designed for direct coupling to differential pressure transmitters having 2 bolt flanges with 54mm (2-1/8") centre-to-centre connections and 41.3mm (1- 5/8") bolt-to-bolt distance.
- b) 5-Valve manifold shall contain two main line block valves and a combination double block and bleed for the bypass line. The valve shall of needle type or special ball with bleed hole.

2.8.1.3 The flanges shall be integral part of manifold block.

2.8.1.4 The material of construction shall be 316 Stainless Steel, unless otherwise specified.

2.8.1.5 The minimum cold working pressure (CWP) rating of manifolds shall be as per Annexure 1 of this specification, unless otherwise specified.

2.8.1.6 The process connection shall be 1/2"NPTF to ANSI B 1.20.1.

2.8.1.7 Wherever the manifolds are specified for stanchion mounting, these shall be supplied along with mounting accessories. The bolts and nuts shall be alloy steel as per ASTM A 193 Gr B7 and ASTM A194 Gr. 2H (Hot dip galvanised or zinc plated) respectively. Other accessories shall be zinc plated.


2.8.2 3 way 2 valve manifold for pressure gauges

2.8.2.1 The manifold shall be designed for use with pressure gauges with block and bleed valves. The manifold body shall be either straight or angle type as specified in the data sheet.

2.8.2.2 The valve shall be a needle type.

2.8.2.3 The body material shall be 316 Stainless Steel, unless otherwise specified.

2.8.2.4 The minimum cold working pressure rating of the manifold shall be as per Annexure 1 of this specification, unless otherwise specified.

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2.8.2.5 The manifold shall have the following connections:

- a) The inlet connection shall be $\frac{3}{4}$ " plain ends with a minimum of 100mm nipple extension suitable for socket weld or butt weld as per B 16.11/ BI 6.9 as specified in the job specifications
- b) The gauge connection shall be with union nut and tail piece threaded to 1/2"NPTF.
- c) The drain connection shall be W"NPTF.

2.9 Instrument Air Valves

2.9.1 Instrument Air Isolation Valves (Miniature)

- 2.9.1.1 The valves shall be full-bore ball type with forged body.
- 2.9.1.2 Body material shall be 316 Stainless Steel.
- 2.9.1.3 The minimum cold working pressure rating of instrument air isolation valves shall be as per Annexure 1 of this specification, unless specified otherwise.
- 2.9.1.4 The end connection shall be 1/2"NPTF to ANSI B 1.20.1, unless otherwise specified.
- 2.9.1.5 End to end dimensions shall be 70mm (approximately).

2.9.2 Instrument Air Needle Valves (Miniature)


- 2.9.2.1 The instrument valves shall be globe pattern-needle valves forged/bar stock with inside screwed bonnet.
- 2.9.2.2 Body material shall be 316 Stainless Steel.
- 2.9.2.3 The minimum cold working pressure of Instrument Air Needle valves shall be as per Annexure 1 of this specification, unless otherwise specified.
- 2.9.2.4 The end connection shall be 1/2" NPTF to ANSI B1.20.1, unless otherwise specified.
- 2.9.2.5 Flow direction shall be marked on the body.
- 2.9.2.6 The valve dimensions shall be as follows:
 - a) End to end dimensions - 54 mm (approximately).
 - b) Height in fully open condition - 49 mm maximum. These dimensions are tentative only.

2.10 All instrument valves in oxygen and chloride service shall be thoroughly degreased using reagents like trichloroethylene or carbon tetrachloride. End connection shall be plugged after degreasing process in order to avoid entrance of grease or oil particles.

3.0 NAME PLATE

3.1 Following information shall be punched on the body of each of these items;

- a) Material of construction to the same standards as in purchaser's data sheets.
- b) Cold working pressure of each item to the same standards as in purchaser's data sheets.

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- c) Manufacturer's identification and model number.
- d) Flow direction (if applicable)
- e) Material of construction.

4.0 INSPECTION AND TESTING

4.1 Unless otherwise specified, purchaser reserves the right to test and inspect all the items at vendor's works, inline with the inspection test plan for instrument valve and manifolds.

4.2 Vendor shall submit following test certificates and test reports for purchaser's review:

- a) Material test certificates as per clause 3. IB of EN 10204 for body and bonnet and as per clause 2.2 for other parts.
- b) Dimensional test report.
- c) Pressure test report as per clause 4.3 of this specification.
- d) Hydrostatic proof and burst tests as per MSS-SP-99 for each design and size of valve.

4.3 Pressure Test Requirements

4.3.1 Each valve and manifold shall be subjected to hydrostatic pressure test at ambient temperature for both seat and shell leakage at test pressures given in Annexure-1 of this specification. During and after the hydrostatic test there shall not be any visible leakage.

4.3.2 Pneumatic Test


Each valve and manifold shall be subjected to pneumatic test for both shell and seat leakage at 7.0 kg/cm²g with testing medium as air at ambient temperature. There shall not be any visible leakage when immersed in water or coated with a leak detection solution.

4.4 Witness Inspection

4.4.1 All valves and manifolds shall be offered for pre-dispatch inspection for following, as a minimum:

- a) Physical dimensional verification and workmanship.
- b) Pressure test as per clause 4.3 of this specification on representative samples.
- c) Review of all certificates and test reports as indicated in clause 4.2 of this specification.

4.4.2 In the event, when witness inspection is not carried out by purchaser, the tests shall anyway be completed by the vendor and documents for the same shall be submitted to purchaser for scrutiny.

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ANNEXURE-1

HYDROSTATIC TEST PRESSURES FOR INSTRUMENT VALVES AND MANIFOLDS

| SL.NO. | ITEM | LINE PRESSURE | MIN. COLD WORKING PRESSURE | HYDROSTATIC TEST PRESSURE FOR SEAT LEAKAGE | SHELL LEAKAGE TEST |
|--------|---------------------------------|-----------------------------------|----------------------------|--|-------------------------|
| 1. | Instrument Valves (Miniature) | | | | |
| A) | | < or = 600# | 102kg/cm ² g | 112kg/cm ² g | 153kg/cm ² g |
| B) | | > or = 900# to < or = 1500# | 253kg/cm ² g | 278kg/cm ² g | 383kg/cm ² g |
| 2. | Instrument Valve Manifold | | | | |
| A) | | < or = 600# | 102kg/cm ² g | 112kg/cm ² g | 153kg/cm ² g |
| B) | | > or = 900# to < or = 1500# | 253kg/cm ² g | 278kg/cm ² g | 383kg/cm ² g |
| 3. | Instrument Air Isolation Valves | < or = 300# | 27kg/cm ² g | 30kg/cm ² g | 41kg/cm ² g |
| 4. | Instrument Air Needle Valves | < or = 300# | 27kg/cm ² g | 30kg/cm ² g | 41kg/cm ² g |



GAIL INDIA LIMITED

**STANDARD SPECIFICATION
FOR
FIRE & GAS DETECTION SYSTEM**

GAIL-STD-IN-DOC-TS-011

| Rev | Date | Purpose | Prepared By | Checked By | Approved By |
|-----|------------|--------------------|-------------|------------|-------------|
| 0 | 14.01.2019 | Issued As Standard | RKS | UNU | UNU |



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1. GENERAL

1.1.1 This document defines the technical requirements for Design, engineering, Fabrication / manufacturing, assembly, testing at works, packing and supply of:

- A. Fire Detection systems
- B. Gas Detection systems

1.1.2 The related standards referred to herein and mentioned below shall be of the latest editions prior to the date of purchaser's enquiry:

| | |
|--------------------|--|
| API RP-55 | Recommended Practice for Oil and Gas Producing & Gas Processing Plant Operations Involving Hydrogen sulphide. |
| API RP-552 | Transmission Systems |
| EN-10204 | Inspection Documents for Metallic Products |
| EN-50054 | Electrical Apparatus for the Detection and Measurement of Combustible Gases - General Requirements and Test Methods. |
| EN-50057 | Performance Requirements for Group II Apparatus Indicating upto 100% LEL. |
| IEC-1000-6-3 | Electromagnetic Compatibility (EMC)-Generic Standard - Emission Standard for Residential, Commercial and Light Industrial Environments |
| IEC-60079 | Electrical Apparatus for Explosive Gas Atmosphere. |
| IEC 60331 | Testing of Fire Resisting Cables |
| IEC-60332 | Tests on bunched wires and cables. |
| IEC-60529 | Degree of protection provided by Enclosures (IP code). |
| IEC-60617 (Part12) | Graphical Symbols for Diagrams – Binary Logic Elements |
| IEC-61000-4 | Electromagnetic compatibility for Industrial Process Measurement and Control Equipment. |
| IEC-61131 | Programmable Logic controllers |
| IEC 61508 | Functional Safety of electrical/electronic/programmable electronic safety related systems |
| IEC 61511 | Functional Safety – Safety Instrumented Systems for the Process Industry Sector. |
| IS-13947 | Specification for low Voltage Switchgear and Control gear. |
| IS-2148 | Flameproof Enclosures for Electrical Apparatus for Explosive Gas Atmospheres – Flameproof Enclosures 'd'. |

1.1.3 In the event of any conflict between this standard specification, job specification/datasheets, statutory regulations, related standards, codes etc the following order of priority shall govern:

- a. Statutory Regulations

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- b. Data Sheets
- c. Standard Specifications
- d. Codes and standards

2. FIRE DETECTION SYSTEMS

2.1 SMOKE DETECTION

Smoke detectors shall be provided in control building. The detectors shall be installed in control room inside cable trenches, inside building in various rooms, electrical equipment room.

High sensitivity photo cell type (optical type) smoke detectors shall be provided.

All smoke detectors shall have self checking facility.

Each detector shall have a LED indicating the status of the detector. For smoke Detectors installed above false ceiling and in cable trenches remote indicator shall be provided in fire and gas panel.

Circuit type: 2 wire.

Open and short circuit shall be monitored by end of line resistor.

All smoke detectors shall have facility for remote reset.

Mounting type: on ceiling with base.

Alarm indication shall be LED.

2.2 HEAT DETECTORS

Heat detectors shall be provided in battery room. Rate of temp. rise type detectors shall be provided as these provide rapid response while the ambient temp. is subject to fluctuations. Quantity and installation requirements are given in data provided in this specification.

Temp set point: 85 Deg C.

Mounting: on ceiling with base.

Circuit type: 2 wire.

Alarm indication: LED.

Open and short circuit shall be monitored by end of line resistor.

All heat detectors shall be auto reset type.

2.3 Manual Call Points:

Manual Call Points (MCP) shall be positioned in such a way that they stand out against the Background i.e. they shall be clearly recognizable from a distance either by day or Night.

Manual call points shall be located;

- a) Two nos at each end outside control building
- b) Outside guard room (one no.)
- c) One no. as decided in field by Project Manager.

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Type: Break glass type.

Operation: By hammer. Hammer and chain shall be provided.

Housing material: UV resistant GRP for break glass installed outside control building IP 65.

MCPs installed outdoors in field shall be in addition be suitable for hazardous area classified

Housing colour:- Red paint two coat epoxy type.

Each manual call point shall have SS tag / label with wording "Manual alarm call station", & "Break glass to activate"

2.4 LINEAR HEAT SENSOR CABLE

- a. LHS cable shall be capable of detecting heat from a fire over entire length of cable trench and false ceiling area of control room. Cable shall be located where it will not be subject to physical damage. Normal operating state of LHS cable shall be open circuit type.
- b. The operation of system must be based on two conductors to short circuit together, and then creating an alarm condition on the Fire Alarm Panel. "switching " cable where a change in state of internal insulation - caused by temperature rise to a pre-defined level - allows a short circuit or "hot junction" to occur between two twisted tin plated copper conductors.
- c. The system shall follow principles of fire protection engineering, as well as comply applicable standard NFPA-72 / NEC 760.
- d. Alarm Temperature of the system shall be set at temperature of minimum 68 °C and response time of fire detection less than 5 second.
- e. Twisted pair copper coated steel conductors shall be covered by temperature sensitive thermoplastic or fluoropolymer insulation and protected by a jacket of thermoplastic strip braid, PVC, nylon or fluoropolymer material.
- f. LHS cable connects to Fire Alarm Panel (FCP) as a dry-contact initiative device. The maximum length of cable shall be determined by the electrical characteristic (resistance and capacitance) of the FCP initiating circuit board. FCP initiating circuit shall be installed at the end of cable.
- g. LHS cable shall be mounted at the ceiling above false ceiling of the control room. The thermal path of the LHS cable must be obstructed and maintain 1" distance from ceiling fast detection. The cable shall be adequately supported to prevent sagging; it is not necessary to tension the cable , however on straight runs it is recommended that the cable is supported every 3 feet (1m).
- h. Standard accessories like Weather tight connector, master clamp, flange clip and nylon cable tie shall be used for installation of LHS cable.
- i. In any case soldering, heat shrink tubing cannot allow during installation as well as any maintenance. Use of junction box for connecting two lengths of sensor cable will be preferable. Junction box must be weather proof.

3.0 Gas Detection system.

3.1 Open Path Gas Detectors:-

IR absorption type gas detectors shall be provided as follows:

| | | |
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2 nos detectors near each pig launcher / pig receiver
 2 nos around isolation valve in SV station.
 4 nos detectors around metering skid.

Power supply: 24 VDC.

Area classification:-Zone1,Gr IIA,IIB,T3.

Weather proof protection: IP65.

Out put :-4-20 ma DC.

Accuracy:-+/-3% full scale.

Response time:-T 95<5 secs.

Range :8 LEL meters /100 meters minimum.

Housing Material:- SS 316.

Mounting: Swivel mounting.

Lens cleaning fluid shall be supplied by contractor.

Beam blockage more than 10 secs. Shall give "BEAM BLOCKED" warning after 60 secs
 Shall give fault alarm.

Calibration Accessories. Hand held calibrator suitable for area classified with battery and charging unit, TEST FILM etc;

Tag plate :-SS 316.

3.2 Fixed Point Gas Detectors.:

IR absorption type detectors shall be provided as follows:

2 nos detectors near each pig launcher/pig receiver.
 2 nos around isolation valve in SV station
 4 nos detectors in metering skid.

Power supply: 24 V DC.

Area classification :- Zone 1,Gr. II A.IIB.T3.

Weather proof protection:-IP65.

Detection Range:-100% LEL.

Out put: 4-20 mA DC

Accuracy : +/- 3% full scale.

Response time : T90< 15 Secs.

Housing material: SS 316.

Tag plate: SS required with tag details.

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Each detector shall be equipped with facilities for site calibration and testing. The detection Range shall be adjustable between 0 and 100% LEL.

3.3 Control Card and Controller for Gas Detection System shall be of OEM make only.

4.0 Field Annunciation Devices.

Alarm Beacons / Flash Lights.

Alarm beacons shall be rotating type with a coloured lens and dual high intensity halogen Bulbs. One no. red (for fire alarm) and one no. blue (for gas alarms) shall be supplied and installed at highly visible location outside control building.

5.0 Fire Alarm / Monitoring Panel and Gas Alarm / Monitoring Panel.

Fire Alarm monitoring Panel and **separate** Gas Alarm monitoring Panel shall be supplied and installed in each control room.

This panel shall have following minimum facilities / equipment.

- a) **Gas Alarm / Monitoring Panel:** For gas detectors Single channel gas monitors shall be provided with 0-100% LEL indication (LCD) ,alarms adjustable over 100% LEL range) for low and high LEL.,AND fault alarm.(LEDs). Shall have test/acknowledge alarm, reset push buttons.

Control Card and Controller for Gas Detection System shall be of OEM make only

- b) **Fire Alarm / Monitoring Panel:** Alarm annunciator showing zone wise fire alarms, and remote indication for smoke Detectors installed above false ceiling and inside cable trenches.
- c) A horn installed above fire /gas alarm panel, and high sound level (120 DbA) installed Guard room.
- d) The panel shall be wall mounting type suitable for safe area installation.
- e) Siren with range of 1 KM shall be provided at the top of the building with acknowledge, Test and Reset provision in panel.

6.0 Portable Calibrator:

- a. Portable calibrator for fixed point detectors consisting of all accessories like volume bottles, containing known gas / mixture, a pressure regulator, a flexible hose adapter cap shall be supplied to enable field calibration of the sensors/detectors without dismantling them from the field.
- b. Calibration range shall be suitable for the sensors supplied, 0-100% LEL.
- c. Sufficient quantity of calibration gas shall be supplied to enable calibration of all the Sensors / detectors at least twice.

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7.0. Area Classification

The Hazardous area classification is Zone 1, gas Group IIA/IIB, Temp. Class T3. For Certification requirement for instruments items are as below:

For all flame proof equipment / instrument / systems, which is manufactured abroad (outside India) certification by any approving authority like BASEEFA, FM, UL, PTB, LCIE. ATEX etc shall be required. For units manufactured in India certificate from CMRI will be required.

8.0 Power Supply

Power supply available is 24V DC, Contractor to convert from this level to other levels.

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9.0 FIRE DETECTOR ALLOCATION PLAN

| Sl. no | Area Description | OSD | MHSD | Multicriteria Heat Detectors | MCP (Break Glass Unit) | LHS CABLE | Hooter | Flashlight | ZONE |
|--------|---|-----|------|------------------------------|------------------------|-----------|--------|------------|--------|
| 1 | Control room / UPS room a) above false ceiling | | 2 | | - | 1 | | | Zone-1 |
| | b) Below false ceiling | 2 | | — | | | | | Zone-2 |
| 2 | Inside cable trench in a) Control room | | | — | | 1 | | | Zone-3 |
| | b) Electrical room. | | | | | 1 | | | |
| 3 | Battery room | — | | 2 | - | | | | Zone-4 |
| 4 | Electrical Room | 1 | 1 | — | - | | | | Zone-5 |
| 5 | Manual Call points (Break Glass Unit) | — | | — | | | | | Zone-6 |
| | a) Control room | | | | 1 | | | | |
| | b) Electrical room | | | | 1 | | | | |
| | c) Store Room | | | | - | | | | |
| | d) Battery Room | | | | 1 | | | | |
| 6. | Store Room | 1 | | | | | | | Zone-7 |
| 7 | Guard Room | | | | 1 | | | | Zone-8 |
| 8 | Hooter + Flash Light | | | | | | | | Zone-9 |
| | a) Control Room | | | | | | 2 | 1 | |
| | b) Guard Room | | | | | | - | 1 | |

OSD -- Optical Smoke Detector
 MHSD – Multicriteria Heat & Smoke Detectors
 MCP – Manual Call Point

NOTES:

- Above mentioned numbers are tentative, However same shall be finalized during detail Engineering.
- Hooter / Flash lights / Beacons – Shall be different from Fire suppression system.

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GAIL INDIA LIMITED

**STANDARD SPECIFICATION
FOR
CONTROL PANEL**

GAIL-STD-IN-DOC-TS-012

| | | | | | | |
|-----|------------|--------------------|-------------|------------|-------------|--|
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| | | | | | | |
| 0 | 14.01.2019 | Issued As Standard | RKS | UNU | UNU | |
| Rev | Date | Purpose | Prepared By | Checked By | Approved By | |



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1.0 GENERAL

1.1 Pipeline and location of panels (Local control panel, fire alarm panel, gas alarm/monitoring panel, telecom interface panel).

1.2 Location of control panel and accessories: Indoor

1.3 Floor : Concrete Floor with Trench

1.4 Air conditioning :- YES

1.5 Control Panels Size : - Local control panel (Size 2100mmX1000mmX800mm)
Wall mounted Fire and gas monitoring panels, Telecom interface panel.
(Approx size 600mmX600mmX300mm)

1.6 Contractor shall provide an alarm annunciator for fire and gas alarms, in fire and gas monitoring panels.

2.0 CONTROL PANEL CONSTRUCTION

2.1 Type: Self supported, Free standing, enclosed cubicle.

2.2 Lighting: Required inside Panel with door switch

2.3 Ventilation: Required with louvers backed by wire fly screen & fan. Fan failure alarm required.

2.4 Doors: Rear double removable hinged doors with flush pull type handles & with locking arrangement.

2.5 Cable Entry: Bottom, Cable glands shall be single compression type. All unused entries are plugged.

2.6 Receptacles: Required for 230VAC UPS.

2.7 Painting: The finish should include sand blasting, grinding, chemical cleaning's finishing by suitable filler and two coats of paint. Panel colour shall be Non-glossy high strain finish. Panel colour shall be RAL 7032.

2.8 Channel Base : 100*50*6 MM, MS material

2.9 Name Plates: Front of panel instrument name plates shall be black laminated plastic white core. Name plate shall be provided on rear of panel also.

3.0 DIMENSION & MATERIAL OF CONSTRUCTION

3.1 Panel Dimension: 800(w) mm X 2100(H)mm X 800(D)mm including channel base

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- 3.2** Control Panels : 3.0 CRCA / 5.0 mm thick HRCA steel welded to frame
- 3.3** Side & Top plates : 2mm thick CRCA steel welded to frame.
- 3.4** Door of Panel: 1.6 mm thick CRCA steel. Rear side door shall be double door type. Concealed Hinges and Flush pull chrome plated handles.
- 3.5** Cable Gland Plate: 3mm thick CRCA steel
- 3.6** Anchor Bolt Size: By contractor
- 3.7** Frame: 50 mm * 50 mm * 3mm Formed section
- 3.8** Lifting Eye Bolt : Required
- 4.0** **WIRING**
- 4.1** Type : General Purpose
- 4.2** Wiring details (Power)
- 230 V AC UPS Wiring (Outside cabinet) : Min, 3* 2.5 mm² copper conductor PVC insulated armoured
- Low Voltage Inside the Cabinet: (24V DC) : Min 19 strands, 16 AWG copper conductor PVC insulated.
- 230V AC Non UPS (outside cabinet) : Min, 3* 2.5 mm² copper conductor PVC insulated armoured
- 4.3** Signal Wiring :
- External to cabinet : 1.0 mm² twin twisted, individual shielded/overall Shielded with overall drain PVC insulated, armoured.
- Inside the cabinet : Multi strand min 1.0mm² copper conductor PVC Insulated.
- Terminal Type : Screw clamp with pressure plate
- Terminal Size for signal : Suitable for min. 2.5mm² size conductor.
- Terminal size for power dist : Suitable for min 4.0 mm² size conductor and higher as per actual cable sizes.
- Terminal Block : Clip on type.
- Wiring colour code
- Power supply : Hot-Red
Neutral-Black
Earth-green
- DC Wiring : Positive-Red Negative Black
- Alarm System : White

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| | | |
|----------------------|---|------------|
| Control and shutdown | : | Yellow |
| Analog Signals(IS) | : | Light Blue |

5.0 Deleted

6.0 BULK POWER SUPPLY UNIT

| | | | |
|-----|----------|---|---|
| 6.1 | Input | : | As per Scope of Work |
| 6.2 | Output | : | 24V DC _+ 5 % or as required for instruments. |
| 6.3 | Rating | : | By Contractor |
| 6.4 | Mounting | : | DIN Rail mounted |
| 6.5 | Qty | : | 2 nos. for each Panel (Dual Redundant) |

7.0 SPECIFICATIONS FOR ACCESSORIES

7.1 ALARM ANNUNCIATOR

| | |
|------------------|-----------------------|
| No. of Window | 12 (4X3) |
| Type | Solid State |
| Mounting | Flush Panel |
| Enclosure | General Purpose IP 41 |
| Window Size | 50 mm X 60 mm |
| Make / Model No. | By Contractor |

Annunciator alarm sequence shall be as per F3A of ISA.

The design of the alarm annunciator system shall be such that transient alarms of less than 330 milliseconds duration shall be automatically rejected.

7.2 LAMPS

| | |
|----------------|--------------------|
| Type | Miniature filament |
| Rating | By Contractor |
| Voltage | 24V DC |
| Make/Model No. | By Contractor |

Lamps shall be provided with series resistor to increase life of lamp.

7.3 Push Buttons

| | |
|----------------|-----------------|
| Type | Spring return |
| Contacts | 2NO + 2NC |
| Contact Rating | 2A 24V DC |
| Make | By Contractor |
| Color | As per standard |

7.4 Selector Switch

| | |
|------|---|
| Type | As per functional switching and logic requirement |
|------|---|

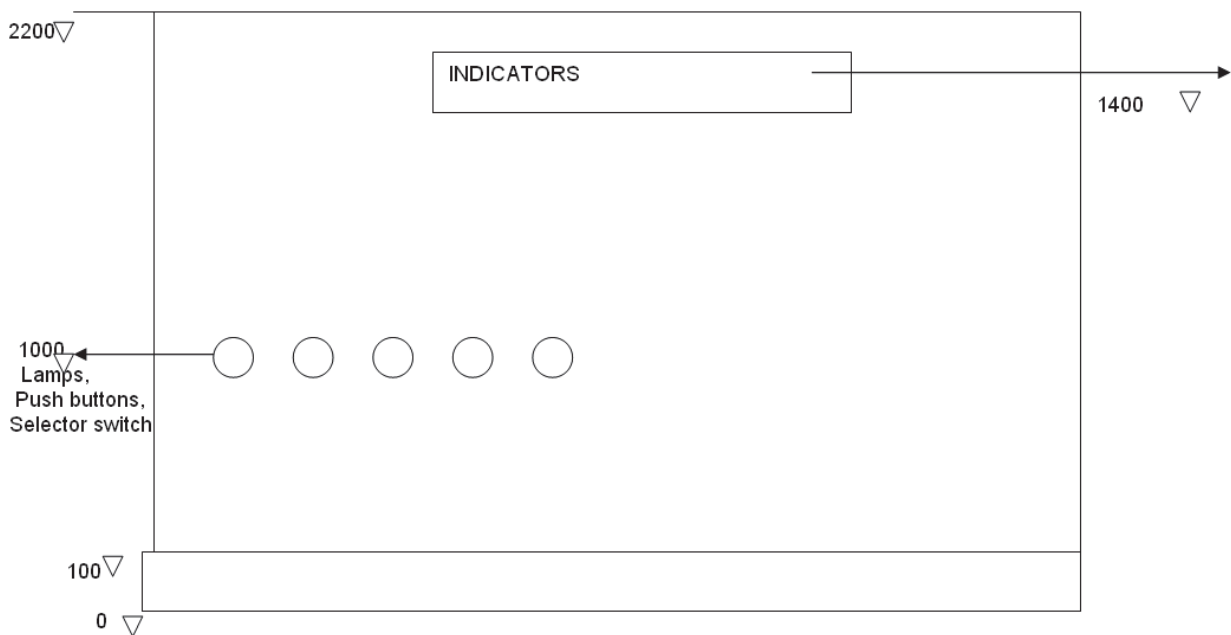
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| | |
|---------------|--|
| Specification | Silver alloy gold plated contacts with SS shaft dust covers with water proof covering and contact shall be made before break type. |
| Rating | 2A, 24V DC |
| Make | KAYCEE/Eqv. |

7.5 Relays

| | |
|--------------|------------------------|
| Type | Plug in relays |
| Contact Type | Potential free contact |
| Contact nos. | 3NO + 3NC |
| Rating | 24V DC , 5.0 AMP |
| Make | OEN/Eqv. |

7.6 SUGGESTIVE PANEL ARRANGEMENT



1. All dimensions are in mm
2. Panel front arrangement is tentative only

Panel layout shall be designed considering ease of operation. No push button or hand switch shall be located below 600 mm. Instrument Mounting heights, in general, shall be as follows:-

- a) Annunciators - 1950 mm
- b) Indicators - 1400 mm
- c) Electric push buttons / Switches, lamps etc. - 1000 mm

8.0 INDICATORS

| | | |
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| | | |
|------|---|---|
| 8.1 | Type | : Single Channel Microprocessor Based Fluorescent Display with Engineering units |
| 8.2 | Mounting | : Flush Panel |
| 8.3 | Enclosure | : General Purpose |
| 8.4 | To be used in intrinsically safe System | : With exit. Zener barrier / Isolator cum Repeater |
| 8.5 | Inputs | : 4-20 mA DC (2 wires) |
| 8.6 | Outputs | : 4-20 mA DC |
| 8.7 | Facia | : Bar graph display of PV (with digital display) |
| 8.8 | Scan time | : 500 msec. Max |
| 8.9 | A/D Convertor resolution | : 1500 steps min |
| 8.10 | D/A Convertor resolution | : 1500 steps min |
| 8.11 | Load driving capacity | : 750 ohms |
| 8.12 | Online diagnostics | : Required |
| 8.13 | Power Supply | : 24V DC |
| 8.14 | QTY | : AS Required |

Note: One number spare indicator (dual channel) shall be provided.

9.0 SIGNAL DISTRIBUTION CARDS

| | | |
|-----|------------------------------|---|
| 9.1 | Type | Dual output current isolator |
| 9.2 | Input | 4-20 mA DC |
| 9.3 | Output | Two nos 4-20m A isolated outputs as minimum |
| 9.4 | Isolation | Between input & output, Between power supply and between output and input |
| 9.5 | Accuracy | $\pm 0.1\%$ |
| 9.6 | Power Supply | 24V DC |
| 9.7 | Transmitter Power Supply | 24V DC |
| 9.8 | Output load driving capacity | 550ohms min for each output |
| 9.9 | Qty | As Required |

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10.0 ZENER BARRIERS / ISOLATORS CUM REPEATER**10.1** Type Active**10.2** Application Instrument Type

- a) 4-20 mA Analog I/P from 2 wire transmitter .
- b) RTD (4wire) Input output 4-20 mA analog O/P
- c) Limit switch (SPDT snap acting micro type) Output Pot. free contact
- d) Proximity switch (inductive type) output Pot. Free contacts
- e) solenoid valves 24V DC.

10.3 Hazardous Area Classification Zone 1 Gr IIA,IIB,T3**10.4** Approval FM/Basseefa/CSA/ATEX/CCOE/BIS/CMRI**10.5** Supply Volt 20-35V DC**10.6** Qty. As Required

ZENER BARRIERS/ISOLATORS CUM REPEATER AND SIGNAL DISTRIBUTION CARDS MAY BE COMBINED INTO ONE CARD.

10.7 MAKE MTL/P&F.**11.0 Drawings and Data**

11.1 Detailed drawings, data, catalogues and manuals required from the vendor are indicated by the purchaser in vendor data requirement sheets. The required number of prints, soft copies and reproducible shall be provided by contractor.

11.2 Basic engineering drawings required for preparation of detail panel drawings are provided in the tender.

11.3 Final documentation consisting of design data, installation manual, maintenance manual etc. submitted by the contractor after placement of purchase order shall include the following, as a minimum;

- a) Specification sheet for control panels, instruments and accessories.
- b) Certified drawings for each control panel, which shall provide following details:
 - i) Control panel front arrangement drawing showing all dimensions including bezel/cut out dimensions.
 - ii) Loop wiring drawings showing the terminal numbers of each instrument/ accessory used in the wiring.
 - iii) Ladder drawings and relay wiring drawings showing terminal numbers for interlock/shutdown.
 - iv) Power supply distribution drawings with terminal numbers, incoming/ outgoing feeder size, fuse and isolator rating etc.

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- c) Contractor shall provide test certificates for all the tests as per approved QAP.

- d) Calibration and maintenance procedure including replacement of instruments and accessories in contractor's scope, whenever it is applicable

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GAIL INDIA LIMITED

**STANDARD SPECIFICATION FOR
PIG SIGNALLERS**

GAIL-STD-IN-DOC-TS-013

| Rev | Date | Purpose | Prepared By | Checked By | Approved By |
|-----|----------|---------------------|-------------|------------|-------------|
| 0 | 14.01.19 | Issued for Standard | RKS | UNU | UNU |



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1. SCOPE

This specification covers the basic requirements for the design and manufacture testing & supply of pig signallers, used for the detection of passage of scraper and instrumented gauging pigs, to be installed in pipeline systems handling RLNG.

2. MATERIALS

2.1 All materials used in the manufacture of the main components of the pig signalers shall be as indicated in the data sheets. Other components shall be as per manufacturer's standard suitable for the service conditions indicated in data sheets which will be subject to approval by Purchaser.

3. DESIGN AND CONSTRUCTION REQUIREMENTS

3.1 Pig signallers shall be Bi-directional, Non-Intrusive, Magnetic type.

3.2 Pig signallers shall be designed to meet the requirements of pipeline diameter indicated in the data sheet.

3.3 Pig signallers shall be provided with a visual indicator to indicate the passage of pigs.

3.4 Pig signallers shall be fitted with sealed, weather-proof and explosion proof micro switch for remote signal indication. The area classification and rating of micro switch shall be as indicated in data sheet. Suitable for installation in IEC- Zone II, Gas Group-IIA & IIB, T3 hazardous area, Micro switch shall have the following rating;

2 Amp, 240 Volts, 50 Hz,
Type: SPDT,

4. INSPECTION AND TESTS

4.1 Manufacturer shall perform all inspection and tests required to supply the signallers as per the requirements of this specification.

4.2 All pig signallers shall be visually inspected.

4.3 Chemical composition & mechanical properties including hardness shall be checked for each heat of steel used.

4.4 All welds shall be non destructively examined.


4.5 Manufacturers shall perform functional tests to establish satisfactory performance of both manual and electrical indications.

5. TEST CERTIFICATES

5.1 Manufacturer shall supply the test certificates for material compliance as per the relevant Material Standards.

5.2 Certificate for hydrostatic test and functional test

5.3 Test reports on heat treatment carried out, if any.

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| Standard Specification for Pig Signalers | Doc No. | Rev |  |
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6. PAINTING, MARKING AND SHIPMENT

6.1 Exterior surface of the pig signallers shall be thoroughly cleaned, freed from rust and grease and applied with sufficient coats of corrosion resistant paint. Manufacturer shall indicate the type and corrosion resistant paint used in the drawings submitted for approval. The minimum dry film thickness shall be 300 microns.

6.2 A corrosion resistant metal tag shall be permanently attached with each unit, with the following marking:-

- i) Manufacturer's name
- ii) Serial No.
- iii) Tag No.

6.3 Each unit shall be suitably protected to avoid any damage during transit. Care shall be exercised during packing to prevent any damage to the welding ends. All machined surfaces subject to corrosion shall be well protected by a coat of grease or other suitable materials.


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GAIL INDIA LIMITED

DATASHEET FOR PRESSURE TRANSMITTER (PT)

GAIL-STD-IN-DOC-DS-001

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| | | | | | |  |
| 0 | 14.01.2019 | Issued for Bid | RKS | UNU | UNU | |
| REV | Date | Purpose of Issue | Prepared By | Checked By | Approved By | |


| CLIENT: | | | | | | | | | | |
|---|-----------------------------|--|---------|---------------------------|------------------------------|--------------------------|---|--|----------|-------------|
| QUANTITY: | | AS PER P&ID | | | | | | | | |
| | | | | | | | | | | |
| 1 | Function | Transmission & Indication | | | | Other Material | | (*) | | |
| 2 | Type | 2 Wire, Electronic smart transmitter with HART Protocol. | | | | Process Connection | | (*) | | |
| 3 | Case | Mfr. Std. | | | | Size & Rating | | (*) | | |
| 4 | Mounting | Yoke | | | | Facing & finish | | (*) | | |
| 5 | Elec. Area Class. | IEC Zone 1, Gr. II A/IB, Temp. class T3 | | | | Capillary Material | | (*) | | |
| 6 | Enclosure | WP to IP 65 as per IEC 60529 | | | | Armour Flexible | | (*) | | |
| 7 | Ex-Proof | NOTE - 3 | | | | Armour flexible material | | (*) | | |
| 8 | Power Supply | (*) | | | | Capillary Length | | (*) | | |
| 9 | Cable Entry | 1/2 " NPT(F) with SS plug | | | | 20 | Fill Fluid | Silicone Oil | | |
| 10 | Accuracy | "+/-" 0.075% or better of span (Note 1) | | | | 21 | Zero Suppression & Elevation | 100% of span | | |
| 11 | Repeatability | 40:1 or better | | | | 22 | Zero & span adjustment | Continuously adjustable externally, non interactive type | | |
| 12 | Transmitter Output | 4-20mA DC | | | | 23 | Adapter "O" ring | PTFE | | |
| 13 | Load Driving Capability | (*) | | | | 24 | Body Rating | (*) | | |
| MEASURING UNIT | | | | | MISCELLANEOUS | | | | | |
| 14 | Service | Natural Gas | | | | 25 | Over Range Protection | Yes | | |
| 15 | Element | Diaphragm | | | | 26 | Options | (*) | | |
| 16 | Body Materials | SS 316 | | | | a) | Output meter :- Yes (LCD in Engg. Unit) | | | |
| 17 | Element Materials | SS 316 L | | | | b) | Air Filler Regulator | | | |
| 18 | Process Connection | 1/2" NPT (F) thru flange adapter with plug. | | | | c) | Mounting Accessories suitable for 2" NB pipe :- Yes | | | |
| | Process Connection Location | Bottom | | | | d) | 2 Way manifold:- Yes | | | |
| 19 | Diaphragm Seat | (*) | | | | 27 | Model | (*) | | |
| | Wetted Parts Material | (*) | | | | | | | | |
| Bill of Material (BOM) | | | | | | | | | | |
| S.NO. | TAG NO. | Range (Barg) | | Operating Pressure (Barg) | Maximum Operating | | Fluid | Service | Options | |
| | | Span | Set | | Pressure (Barg) | Temperature (°C) | | | | |
| 1 | ITC-7006-PT-01001 | Note 6 | 0 ~ 150 | 60 ~ 95 | 98 | (-)20 ~ 65 | Gas | Natural Gas | a, c & d | |
| 2 | ITC-7006-PT-04001 | Note 6 | 0 ~ 150 | 10 ~ 19 | 98 | (-)20 ~ 65 | Gas | Natural Gas | a, c & d | |
| 3 | ITC-7006-PT-01002A | Note 6 | 0 ~ 150 | 10 ~ 19 | 98 | (-)20 ~ 65 | Gas | Natural Gas | a, c & d | |
| 4 | ITC-7006-PT-01002B | Note 6 | 0 ~ 150 | 10 ~ 19 | 98 | (-)20 ~ 65 | Gas | Natural Gas | a, c & d | |
| 5 | ITC-7006-PT-06001A | Note 6 | 0 ~ 150 | 10 ~ 19 | 98 | (-)20 ~ 65 | Gas | Natural Gas | a, c & d | |
| 6 | ITC-7006-PT-06001B | Note 6 | 0 ~ 150 | 10 ~ 19 | 98 | (-)20 ~ 65 | Gas | Natural Gas | a, c & d | |
| 7 | ABU-4002-PT-01001 | Note 6 | 0 ~ 150 | 60 ~ 95 | 98 | (-)20 ~ 65 | Gas | Natural Gas | a, c & d | |
| 8 | ABU-4002-PT-04001 | Note 6 | 0 ~ 150 | 04 ~ 19 | 98 | (-)20 ~ 65 | Gas | Natural Gas | a, c & d | |
| 9 | SHI-1276-PT-01001 | Note 6 | 0 ~ 150 | 75 ~ 95 | 98 | (-)20 ~ 65 | Gas | Natural Gas | a, c & d | |
| 10 | SHI-1276-PT-04001 | Note 6 | 0 ~ 150 | 10 ~ 19 | 98 | (-)20 ~ 65 | Gas | Natural Gas | a, c & d | |
| 11 | PIN-4004-PT-01001 | Note 6 | 0 ~ 150 | 60 ~ 95 | 98 | (-)20 ~ 65 | Gas | Natural Gas | a, c & d | |
| 12 | PIN-4004-PT-04001 | Note 6 | 0 ~ 150 | 10 ~ 19 | 98 | (-)20 ~ 65 | Gas | Natural Gas | a, c & d | |
| NOTES:- | | | | | | | | | | |
| | | (*) Vendor to furnish | | | | | | | | |
| | 1 | Accuracy includes the combined effect of repeatability, linearity, hysteresis etc. | | | | | | | | |
| | 2 | Operating principle of transmitters shall be capacitance / peizo resistance | | | | | | | | |
| | 3 | Transmitter shall be Intrinsically safe. | | | | | | | | |
| | 4 | Transmitters shall have Lightning Protection. | | | | | | | | |
| | 5 | Transmitter Load Resistance shall be Max 600Ω @ 24 V DC | | | | | | | | |
| | 6 | Contractor shall develop detailed datasheets with all the required information like span, make/model etc. during detailed engineering. | | | | | | | | |
| | 7 | Manifold Shall be of Swgelok or Parker Only. | | | | | | | | |
| | 8 | PESO/CCOE certificate for specified hazardous area classification is required with transmitters. | | | | | | | | |
| | 9 | 2 Nos cable entries shall be provided with one cable entry plugged with weather proof plug. | | | | | | | | |
|  | | | | | PRESSURE TRANSMITTERS | | | DOCUMENT NO. | | Rev. |
| | | | | | | | | GAIL-STD-IN-DOC-DS-001 | | 0 |
| | | | | | | | | SHEET 1 of 1 | | |



GAIL INDIA LIMITED

DATASHEET FOR TEMPERATURE TRANSMITTER (TT)

GAIL-STD-IN-DOC-DS-002

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| 0 | 14.01.2019 | Issued for Bid | RKS | UNU | UNU | | |
| REV | Date | Purpose of Issue | Prepared By | Checked By | Approved By | | Lyons Engineering Pvt. Ltd |

| | | |
|----------------------------------|----------------------------|--|
| CLIENT: | | |
| QUANTITY: AS PER P&ID | | |
| 1 | Function | Transmission & Indication |
| 2 | Type | 2 Wire, Electronic smart transmitter with HART Protocol. |
| 3 | Case | Mfr. Std. |
| 4 | Mounting | Yoke & Remote |
| 5 | Elec. Area Class. | IEC Zone 1, Gr. II A/IIB, Temp. class T3 |
| 6 | Enclosure | WP to IP 65 as per IEC 60529 / IS 2147 |
| 7 | Intrinsically Safe | Yes |
| 8 | Power Supply | 24 VDC, 2 Wire |
| 9 | Cable Entry | 1 Nos 1/2" NPTF for output signal + 1 Nos. 1/2" or 3/4" NPTF for RTD signal wire |
| 10 | Accuracy | ±0.18% or better of span |
| 11 | Self Diagnostic Facility | Yes |
| 12 | Cold Junction Compensation | (*) |
| 13 | Transmitter Output | 4-20 mA DC |
| 14 | Load Capability | (*) |
| 15 | Sensor Element | (*) |
| 16 | Calibration | As per DIN 43760 |
| 17 | Options | (*) |
| | a) | Mount. Accessories for 2" NB Pipe |
| | b) | Integral output meter |
| 18 | Model | (*) |
| 19 | Quantity | (*) |

Bill of Material (BOM)

| S.NO. | TAG NO. | Range (°C) | | Temperature (°C) | | SERVICE | OPTIONS |
|-------|--------------------|------------|--------------|------------------|--------------|-------------|---------|
| | | Adjustable | Set | Operating (Nor) | Design (Max) | | |
| 1 | ITC-7006-TT-01001 | Note 5 | (-) 20 ~ 100 | 20 | (-) 20 ~ 65 | Natural Gas | a,b |
| 2 | ITC-7006-TT-04001 | Note 5 | (-) 20 ~ 100 | 20 | (-) 20 ~ 65 | Natural Gas | a,b |
| 3 | ITC-7006-TT-01002A | Note 5 | (-) 20 ~ 100 | 20 | (-) 20 ~ 65 | Natural Gas | a,b |
| 4 | ITC-7006-TT-01002B | Note 5 | (-) 20 ~ 100 | 20 | (-) 20 ~ 65 | Natural Gas | a,b |
| 5 | ITC-7006-TT-06001A | Note 5 | (-) 20 ~ 100 | 20 | (-) 20 ~ 65 | Natural Gas | a,b |
| 6 | ITC-7006-TT-06001B | Note 5 | (-) 20 ~ 100 | 20 | (-) 20 ~ 65 | Natural Gas | a,b |
| 7 | ABU-4002-TT-01001 | Note 5 | (-) 20 ~ 100 | 20 | (-) 20 ~ 65 | Natural Gas | a,b |
| 8 | ABU-4002-TT-04001 | Note 5 | (-) 20 ~ 100 | 20 | (-) 20 ~ 65 | Natural Gas | a,b |
| 9 | SHI-1276-TT-01001 | Note 5 | (-) 20 ~ 100 | 20 | (-) 20 ~ 65 | Natural Gas | a,b |
| 10 | SHI-1276-TT-04001 | Note 5 | (-) 20 ~ 100 | 20 | (-) 20 ~ 65 | Natural Gas | a,b |
| 11 | PIN-4004-TT-01001 | Note 5 | (-) 20 ~ 100 | 20 | (-) 20 ~ 65 | Natural Gas | a,b |
| 12 | PIN-4004-TT-04001 | Note 5 | (-) 20 ~ 100 | 20 | (-) 20 ~ 65 | Natural Gas | a,b |

NOTES:-

(*) Vendor to furnish

- 1) PESO/CCOE certificate for specified hazardous area classification is required with transmitters.
- 2) Transmitters shall have Lightning Protection.
- 3) Transmitter Load Resistance shall be Max 600Ω @ 24 V DC
- 4) Temperature transmitter shall be dual compartment type.
- 5) Contractor shall develop detailed datasheets with all the required information like span, make/model etc. during detailed engineering.



TEMPERATURE TRANSMITTERS

DOCUMENT NO.

Rev.

GAIL-STD-IN-DOC-DS-002

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SHEET 1 of 1



GAIL INDIA LIMITED

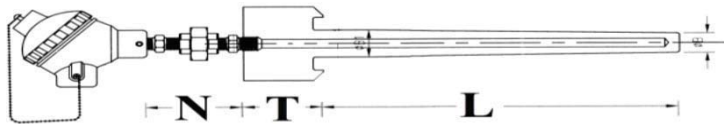
DATASHEET FOR TEMPERATURE ELEMENT (RTD) WITH THERMOWELL

GAIL-STD-IN-DOC-DS-003

| | | | | | | | |
|-----|------------|------------------|-------------|------------|-------------|---|----------------------------|
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| 0 | 14.01.2019 | Issued for Bid | RKS | UNU | UNU | | |
| REV | Date | Purpose of Issue | Prepared By | Checked By | Approved By | | Lyons Engineering Pvt. Ltd |

| | |
|-----------------------|--|
| CLIENT: | |
| QUANTITY: AS PER P&ID | |

| | | | | | | |
|----------------|------------------------------|---|------------|----------------------|--|-----|
| 1 | Assembly | As per drawing | 12 | Cable Entry | 1/2" NPT | |
| 2 | Element | 4 Wire RTD Class A type | 13 | No. of Entries | Two | |
| 3 | No. of Elements | Duplex | 14 | Enclosure Type | WP to IP 65 as per IEC 60529 / IS 2147 and Ex-Proof (IS 2148) | |
| 4 | Calibration | As per DIN 43760 / IEC 60751 | THERMOWELL | | | |
| 5 | Element Material | Pt-100, Class A | 15 | Material | SS 316 | |
| 6 | Resistance at 0 deg. Celsius | 100 Ω | 16 | Construction | Drilled bar stock upto immersion length 500 mm, otherwise fabricated | |
| 7 | Leads | Hermetically Sealed | 17 | Process Connection | 2" But-Weld | |
| 8 | Sheath | (*) | 18 | Inst. Connection | 1/2" NPT | |
| | a) | O.D. | 8 mm | 20 | Thermowell Dwg | |
| | b) | Material | SS 316 | 21 | Options | (*) |
| 9 | Nipple & Union Material | SS 316 | a) | Extra nipple extents | 150 mm | |
| 10 | No. of Wires | Four Wires | b) | | | |
| | | | c) | | | |
| HEAD | | | | | | |
| MEASURING UNIT | | | | | | |
| 11 | Head Cover Type | Screw Cap of Die Cast Aluminium with SS chain | | | | |



Bill of Material (BOM)

| S.NO. | TAG NO. | Element Length | Temperature (°C) | | Thermowell | | | Service | Options | |
|-------|--------------------|----------------|------------------|--------------|------------|-----------|-----|---------|-------------|---|
| | | | Operating (Nor) | Design (Max) | Material | Dimension | | | | |
| | | | | | | N | T | | | L |
| 1 | ITC-7006-TE-01001 | Note 1 | 20 | (-) 20 ~ 65 | SS 316L | (*) | (*) | (*) | Natural Gas | |
| 2 | ITC-7006-TE-04001 | Note 1 | 20 | (-) 20 ~ 65 | SS 316L | (*) | (*) | (*) | Natural Gas | |
| 3 | ITC-7006-TE-01002A | Note 1 | 20 | (-) 20 ~ 65 | SS 316L | (*) | (*) | (*) | Natural Gas | |
| 4 | ITC-7006-TE-01002B | Note 1 | 20 | (-) 20 ~ 65 | SS 316L | (*) | (*) | (*) | Natural Gas | |
| 5 | ITC-7006-TE-06001A | Note 1 | 20 | (-) 20 ~ 65 | SS 316L | (*) | (*) | (*) | Natural Gas | |
| 6 | ITC-7006-TE-06001B | Note 1 | 20 | (-) 20 ~ 65 | SS 316L | (*) | (*) | (*) | Natural Gas | |
| 7 | ABU-4002-TE-01001 | Note 1 | 20 | (-) 20 ~ 65 | SS 316L | (*) | (*) | (*) | Natural Gas | |
| 8 | ABU-4002-TE-04001 | Note 1 | 20 | (-) 20 ~ 65 | SS 316L | (*) | (*) | (*) | Natural Gas | |
| 9 | SHI-1276-TE-01001 | Note 1 | 20 | (-) 20 ~ 65 | SS 316L | (*) | (*) | (*) | Natural Gas | |
| 10 | SHI-1276-TE-04001 | Note 1 | 20 | (-) 20 ~ 65 | SS 316L | (*) | (*) | (*) | Natural Gas | |
| 11 | PIN-4004-TE-01001 | Note 1 | 20 | (-) 20 ~ 65 | SS 316L | (*) | (*) | (*) | Natural Gas | |
| 12 | PIN-4004-TE-04001 | Note 1 | 20 | (-) 20 ~ 65 | SS 316L | (*) | (*) | (*) | Natural Gas | |

NOTES:- (*) Vendor to furnish

- 1) Element length shall be suitable for thermowell.
- 2) Thermowell immersion length shall be selected in such a way that tip of thermowell shall preferably be at the centre of pipe to sense temperature properly.
- 3) RTD element shall be 4-wire, duplex type, Class A tolerance, Pt-100
- 4) Vendor to furnish GAD of complete assembly (TG with T/W), WFC Calculation as per the latest PTC 19.3.



RESISTANCE TEMPERATURE DETECTORS (RTD) WITH THERMOWELL

DOCUMENT NO.

Rev.

GAIL-STD-IN-DOC-DS-003

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SHEET 1 of 1



GAIL INDIA LIMITED

DATASHEET FOR GAS DETECTOR

GAIL-STD-IN-DOC-DS-004

| | | | | | |  | |
|-----|------------|------------------|-------------|------------|-------------|---|--|
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| | | | | | | | |
| 0 | 14.01.2019 | Issued for Bid | RKS | UNU | UNU | | |
| REV | Date | Purpose of Issue | Prepared By | Checked By | Approved By | Lyons Engineering Pvt. Ltd | |
| | | | | | | | |

| | | |
|----------------------------------|---------------------------------|---|
| CLIENT: | | |
| QUANTITY: AS PER P&ID | | |
| 1 | Tag Number | Refer below BOM |
| 2 | Qty. | 12 Nos. |
| 3 | Hazardous area Classification | Zone-1, Div. 1, Group IIA & IIB, T3 |
| 4 | P&ID Number | GAIL -ENG-7006-PR-DWG-PID-002/003/007/011/013 |
| 5 | Technology | IR based |
| 6 | Ambient Tempertaure | 25 ~ 30°C |
| 7 | Electrical Certification | Intrinsically Safe(Ex 'ia') or Ex 'd' |
| 8 | Protection | IP 65 as per IEC 60529 |
| 9 | Housing material | Stainless steel 316, Flameproof |
| 10 | Low Explosive Limit (LEL) | 1 (% v/v in Air) |
| 11 | Range | 0 ~ 100% LEL and Detection Range upt 15 feet. |
| 12 | Accuracy | ± 2% LEL |
| 13 | Immunity to catalytic poisoning | Required |
| 14 | Temperature compensation | Required |
| 15 | Output | 4~20 mA DC HART |
| 16 | Power supply | 24V DC |
| 17 | Type of wiring | 3-Wire |
| 18 | Cable Entry | 3/4" NPTF |
| 19 | Response time | Less than T90 < 12 sec |
| 20 | Sensor life | 5 Years |
| 21 | Self diagnostic facility | Required |
| 22 | Fail safety | Required |
| 23 | Mounting Accessories | Refer Note 2 |
| 24 | Dustguard & Splashguard | Required |
| 25 | Integral meter | Digital LED type |
| 26 | High concentration alarm | Required |
| 27 | High concentration switch | Not Required |
| 28 | Model No. | (*) |
| 29 | Make | (*) |

Bill of Material (BOM)

| S.NO. | TAG NO. | Type of Gas Detector | Remarks |
|-------|------------------------|----------------------|---------|
| 1 | ITC-7006-GDPA-01001 | Point Gas Detector | |
| 2 | ITC-7006-GDPA-01002 | Point Gas Detector | |
| 3 | ITC-7006-GDPA-01003 | Point Gas Detector | |
| 4 | ITC-7006-GDPA-01004 | Point Gas Detector | |
| 5 | 14.01.2019 | Point Gas Detector | |
| 6 | ITC-7006-GDPA-06002 | Point Gas Detector | |
| 7 | ABU-4002-GDPA-01001 | Point Gas Detector | |
| 8 | ABU-4002-GDPA-01002 | Point Gas Detector | |
| 9 | SHI-1276-GDPA-01001 | Point Gas Detector | |
| 10 | SHI-1276-GDPA-01002 | Point Gas Detector | |
| 11 | PINSHI-4004-GDPA-01001 | Point Gas Detector | |
| 12 | PINSHI-4004-GDPA-01002 | Point Gas Detector | |
| | | | |

NOTES:- (*) Vendor to furnish

- | | |
|----|--|
| 1) | Instrument shall be tested by any recognised authority like BASEEFA, FM, PTB, CMRI etc. and certified by Petroleum and Explosives Safety Organisation (PESO) / Chief Controller of Explosives (CCOE) in India. |
| 2) | Mounting Brackets shall be suitable to 2" pipe mounting. The bolts and nuts shall be alloy steel as per ASTM A193 Gr. B7 and ASTM A194 Gr. 2H (Hot dipped Galvanized or zinc Plated) respectively. Other accessories shall be zinc Plated. |
| | |
| | |



POINT GAS DETECTOR

DOCUMENT NO.


Rev.

GAIL-STD-IN-DOC-DS-004

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SHEET 1 of 3

| | | | |
|---|---------------------------------|--|---------|
| CLIENT: | | | |
| QUANTITY: AS PER P&ID | | | |
| | | | |
| 1 | Tag Number | Refer below BOM | |
| 2 | Qty. | 12 Nos. | |
| 3 | Hazardous area Classification | Zone-1, Div. 1, Group IIA & IIB, T3 | |
| 4 | P&ID Number | GAIL -ENG-7006-PR-DWG-PID-002/003/007/011/013 | |
| 5 | Ambient Tempertaure | 25 ~ 30°C | |
| 6 | Technology | IR based (Transmitter & Receiver type) | |
| 7 | Electrical Certification | Intrinsically Safe(Ex 'ia') or Ex 'd' | |
| 8 | Protection | IP 65 as per IEC 60529 | |
| 9 | Housing material | Stainless steel 316, Flameproof | |
| 10 | Low Explosive Limit (LEL) | 1 (% v/v in Air) | |
| 11 | Range | 0 ~ 100% LEL and Detection Range 5 to 100 mtrs. | |
| 12 | Accuracy | ± 2% LEL | |
| 13 | Immunity to catalytic poisoning | Required | |
| 14 | Temperature compensation | Required | |
| 15 | Output | 4~20 mA DC HART | |
| 16 | Power supply | 24V DC | |
| 17 | Type of wiring | 3-Wire | |
| 18 | Cable Entry | 3/4" NPTF | |
| 19 | Response time | Less than T90 < 5 sec | |
| 20 | Sensor life | 5 Years | |
| 21 | Self diagnostic facility | Required | |
| 22 | Fail safety | Required | |
| 23 | Mounting Accessories | Refer Note 2 | |
| 24 | Dustguard & Splashguard | Required | |
| 25 | Integral meter | Digital LED type | |
| 26 | High concentration alarm | Required | |
| 27 | High concentration switch | Not Required | |
| 28 | Model No. | (*) | |
| 29 | Make | (*) | |
| Bill of Material (BOM) | | | |
| S.NO. | TAG NO. | Type of Gas Detector | Remarks |
| 1 | ITC-7006-AE(T/R)-01001 | Open Path Gas Detector | |
| 2 | ITC-7006-AE(T/R)-01002 | Open Path Gas Detector | |
| 3 | ITC-7006-AE(T/R)-01003 | Open Path Gas Detector | |
| 4 | ITC-7006-AE(T/R)-01004 | Open Path Gas Detector | |
| 5 | 14.01.2019 | Open Path Gas Detector | |
| 6 | ITC-7006-AE(T/R)-06002 | Open Path Gas Detector | |
| 7 | ABU-4002-AE(T/R)-01001 | Open Path Gas Detector | |
| 8 | ABU-4002-AE(T/R)-01002 | Open Path Gas Detector | |
| 9 | SHI-1276-AE(T/R)-01001 | Open Path Gas Detector | |
| 10 | SHI-1276-AE(T/R)-01002 | Open Path Gas Detector | |
| 11 | PINSHI-4004-AE(T/R)-01001 | Open Path Gas Detector | |
| 12 | PINSHI-4004-AE(T/R)-01002 | Open Path Gas Detector | |
| | | | |
| NOTES:- | | (*) Vendor to furnish | |
| | 1) | Instrument shall be tested by any recognised authority like BASEEFA, FM, PTB, CMRI etc. and certified by Petroleum and Explosives Safety Organisation (PESO) / Chief Controller of Explosives (CCOE) in india. | |
| | 2) | Mounting Brackets shall be suitable to 2" pipe mounting. The bolts and nuts shall be alloy steel as per ASTM A193 Gr. B7 and ASTM A194 Gr. 2H (Hot dipped Galvanized or zinc Plated) respectively. Other accessories shall be zinc Plated. | |
| | 3) | Detector able to operate even when obscured by fog, rain, dust, snow or blowing sand. | |
| | 4) | Detector shall be based on Transmitter module & Receiver Module. | |
| | | | |
|  | | OPEN PATH GAS DETECTOR | |
| | | DOCUMENT NO. | |
| | | GAIL-STD-IN-DOC-DS-004 | |
| | | Rev. | |
| | | 0 | |
| | | SHEET 2 of 3 | |


| | | | |
|---|---|---|-------------|
| CLIENT: | | TECHNICAL DATA SHEET - IR TYPE PORTABLE GAS DETECTOR | |
| QUANTITY - AS PER REQUIREMENT | | | |
| GENERAL CHARACTERISTICS | | | |
| Sr No. | Parameter | Typical requirements | |
| GENERAL CHARACTERISTICS | | | |
| 1 | Manufacture | (*) | |
| 2 | Model | (*) | |
| 3 | Part No. | (*) | |
| 4 | Quantity | 5 Nos. | |
| DETECTOR CHARACTERISTICS | | | |
| 5 | Sensor Type | Non-Dispersive Type IR Absorption | |
| 6 | Detection Method | Diffusion Type | |
| 7 | Detector Range | 0 to 100% Vol. CH4, 0-30% vol. O2 | |
| 8 | Warm Up Time | Less than 5 Mins. | |
| 9 | Response Time | ≤ 15 Secs. | |
| 10 | Battery | Rechargeable Li-ion Type, Battery back up time is 18 hours and recharge time is < 6 hours. | |
| 11 | Display | Monochrome graphical LCD display (128 X 160) with backlighting (activated automatically in dim ambient lighting conditions when monitor is in alarm or with a button press), Automatic screen flipping. | |
| 12 | Display Readout | Real-time reading of gas concentrations; battery status; datalogging on/off; STEL, TWA, Peak, and minimum values, Various instrument status related information. | |
| 13 | Alarms | Multi-tone audible (95 db @30 cm), Vibration, Visible (flashing bright red LEDs), on-screen indication of alarm conditions and Man Down Alarm with pre-alarm. | |
| 14 | Datalogging | Continuous datalogging (six months for 5 sensors at 1-minute intervals, 24/7) or User configurable datalogging interval (from 1 to 3600 seconds). | |
| 15 | Monitoring Object | Natural Gas Leak, O2 | |
| 16 | Calibration Gas | Methane | |
| 17 | Calibration | Pre-Calibrated with Methane (Valid Calibration Certificate shall be provided). O2 (with valid calibration certificates). | |
| 18 | Self Test & Diagnostics | Fitted | |
| ENVIRONMENTAL PROTECTION | | | |
| 17 | Hazardous Area Classification | II 2G Ex ia d IIC T4 Gb | |
| 18 | Ingress Protection | IP 65 | |
| 19 | Operating Humidity | 0 to 95% RH (Non-Condensing) | |
| 20 | Operating/Ambient Temp. Range | - 20 to 50 deg C | |
| 21 | Storage Temp. Range | - 20 to 50 deg C | |
| MECHANICAL CHARACTERISTICS | | | |
| 22 | Total Weight | | |
| 23 | Dimensions | | |
| 24 | Mounting | | |
| 25 | Accessories | Travel Charger, AC Adapter, Calibration Adapter | |
| Note: (*) Vendor to furnish | | | |
| 1. Required certificates has to be submitted by Contractor. | | | |
|  | DATA SHEET - IR TYPE PORTABLE GAS DETECTOR | DOCUMENT NO. | Rev. |
| | | GAIL-STD-IN-DOC-DS-004 | 0 |
| | | SHEET 3 of 3 | |



GAIL INDIA LIMITED

DATASHEET FOR PRESSURE GAUGES (PG)

GAIL-STD-IN-DOC-DS-005

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| 0 | 14.01.2019 | Issued for Bid | RKS | UNU | UNU | | |
| REV | Date | Purpose of Issue | Prepared By | Checked By | Approved By | Lyons Engineering Pvt. Ltd | |
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| CLIENT: | | |
| QUANTITY: AS PER P&ID | | |

| | | | | |
|----|---------------------|--------------------------------------|----------------------------------|-------------------------|
| 1 | Type | Direct | Wetted Parts Material | (*) |
| 2 | Mounting | Local | Other Material | (*) |
| 3 | Dial Size | 150 mm | Process Connection | 1/2" |
| 4 | Colour | White with black inscription | Size & rating | (*) |
| 5 | Case Material | SS 316 | Facing & finish | (*) |
| 6 | Bezel Ring | Beyonnet type SS 316 | Capillary Material | (*) |
| 7 | Window Material | Shatterproof glass | Armour Flexible Material | (*) |
| 8 | Enclosure | WP to IP 65 as per IEC 60529/IS 2147 | Capillary Length | (*) |
| 9 | Pressure Element | Bourdon | Flushing/filling connection with | (*) |
| 10 | Element Material | SS 316 | 17 Over range protection | 130 % of FSD |
| 11 | Socket Material | SS 316 | 18 Blow out protection | Yes |
| 12 | Accuracy | "+/-" 1% of FSD | 19 Options | |
| 13 | Zero Adjustment | Micropointer - External Type | a) Scrubber | b) Syphon |
| 14 | Connection | 1/2" NPT(M) | c) Gauge Saver | d) Liquid filled casing |
| | Connection location | Bottom | e) Vaccum protection | f) Solid front |
| 15 | Movement | SS 316 | g) Three valve manifold | Yes (*) |
| 16 | Diaphragm Seat | Rigid | | |
| | Type | (*) | | |

Bill of Material (BOM)

| Sl. No. | Tag No. | Range (Barg) | Operating Pressure (Barg) | Maximum Service | | Fluid | Service | Options |
|---------|--------------------|--------------|---------------------------|-----------------|------------------|-------|-------------|------------|
| | | | | Pressure (Barg) | Temperature (°C) | | | |
| 1 | ITC-7006-PG-01003A | 0 ~ 160 | 10 ~ 19 | 98 | (-) 20 ~ 65°C | Gas | Natural Gas | c, d, f, g |
| 2 | ITC-7006-PG-01003B | 0 ~ 160 | 0 ~ 01 | 98 | (-) 20 ~ 65°C | Gas | Natural Gas | c, d, f, g |
| 3 | ITC-7006-PG-01002A | 0 ~ 160 | 10 ~ 19 | 98 | (-) 20 ~ 65°C | Gas | Natural Gas | c, d, f, g |
| 4 | ITC-7006-PG-06001 | 0 ~ 160 | 10 ~ 19 | 98 | (-) 20 ~ 65°C | Gas | Natural Gas | c, d, f, g |
| 5 | ITC-7006-PG-06002 | 0 ~ 160 | 10 ~ 19 | 98 | (-) 20 ~ 65°C | Gas | Natural Gas | c, d, f, g |
| 6 | ITC-7006-PG-06002A | 0 ~ 160 | 10 ~ 19 | 98 | (-) 20 ~ 65°C | Gas | Natural Gas | c, d, f, g |
| 7 | ITC-7006-PG-06002B | 0 ~ 160 | 0 ~ 01 | 98 | (-) 20 ~ 65°C | Gas | Natural Gas | c, d, f, g |
| 8 | ITC-7006-PG-09001 | 0 ~ 160 | 0 ~ 01 | 98 | (-) 20 ~ 65°C | Gas | Natural Gas | c, d, f, g |
| 9 | ITC-7006-PG-09002 | 0 ~ 160 | 0 ~ 01 | 98 | (-) 20 ~ 65°C | Gas | Natural Gas | c, d, f, g |
| 10 | MDR-4003-PG-01001 | 0 ~ 160 | 60 ~ 95 | 98 | (-) 20 ~ 65°C | Gas | Natural Gas | c, d, f, g |
| 11 | MDR-4003-PG-06001 | 0 ~ 160 | 60 ~ 95 | 98 | (-) 20 ~ 65°C | Gas | Natural Gas | c, d, f, g |
| 12 | MDR-4003-PG-06002 | 0 ~ 160 | 12 ~ 19 | 98 | (-) 20 ~ 65°C | Gas | Natural Gas | c, d, f, g |
| 13 | ABU-4002-PG-06001 | 0 ~ 100 | 04 ~ 19 | 49 | (-) 20 ~ 65°C | Gas | Natural Gas | c, d, f, g |
| 14 | ABU-4002-PG-07001 | 0 ~ 100 | 04 ~ 19 | 49 | (-) 20 ~ 65°C | Gas | Natural Gas | c, d, f, g |
| 15 | ABU-4002-PG-07002 | 0 ~ 100 | 04 ~ 19 | 49 | (-) 20 ~ 65°C | Gas | Natural Gas | c, d, f, g |
| 16 | ABU-4002-PG-13002 | 0 ~ 100 | 04 ~ 19 | 49 | (-) 20 ~ 65°C | Gas | Natural Gas | c, d, f, g |
| 17 | ABU-4002-PG-15001 | 0 ~ 100 | 04 ~ 19 | 49 | (-) 20 ~ 65°C | Gas | Natural Gas | c, d, f, g |
| 18 | ABU-4002-PG-15002 | 0 ~ 100 | 04 ~ 19 | 49 | (-) 20 ~ 65°C | Gas | Natural Gas | c, d, f, g |
| 19 | ABU-4002-PG-18001 | 0 ~ 100 | 04 ~ 19 | 49 | (-) 20 ~ 65°C | Gas | Natural Gas | c, d, f, g |

| | | | | | | | | |
|----|-------------------|---------|---------|----|---------------|-----|-------------|------------|
| 20 | ABU-4002-PG-18002 | 0 ~ 100 | 04 ~ 19 | 49 | (-) 20 ~ 65°C | Gas | Natural Gas | c, d, f, g |
| 21 | ABU-4002-PG-08001 | 0 ~ 100 | 04 ~ 19 | 49 | (-) 20 ~ 65°C | Gas | Natural Gas | c, d, f, g |
| 22 | ABU-4002-PG-08002 | 0 ~ 100 | 04 ~ 19 | 49 | (-) 20 ~ 65°C | Gas | Natural Gas | c, d, f, g |
| 23 | SHI-1276-PG-06001 | 0 ~ 160 | 10 ~ 19 | 98 | (-) 20 ~ 65°C | Gas | Natural Gas | c, d, f, g |
| 24 | SHI-1276-PG-06002 | 0 ~ 160 | 10 ~ 19 | 98 | (-) 20 ~ 65°C | Gas | Natural Gas | c, d, f, g |
| 25 | PIN-4004-PG-06001 | 0 ~ 160 | 10 ~ 19 | 98 | (-) 20 ~ 65°C | Gas | Natural Gas | c, d, f, g |
| 26 | PIN-4004-PG-06002 | 0 ~ 160 | 10 ~ 19 | 98 | (-) 20 ~ 65°C | Gas | Natural Gas | c, d, f, g |
| | | | | | | | | |


| | | | | | | | | |
|----------------|----|--|--|--|--|--|--|--|
| NOTES:- | | * Vendor to furnish | | | | | | |
| | 1) | Gauge Saver shall be provide with Low Pressure Gauges on Pig Launcher & Receiver. | | | | | | |
| | 2) | Manifold shall be of Swgelok or Parker Only. | | | | | | |
| | 3) | Contractor shall develop detailed datasheets with allthe required information like make/model etc during detailed engineering. | | | | | | |

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|  | PRESSURE GAUGE | | DOCUMENT NO. | Rev. |
| | | | GAIL-STD-IN-DOC-DS-005 | 0 |
| | | | SHEET 2 of 2 | |



GAIL INDIA LIMITED

DATASHEET FOR TEMPERATURE GAUGES (TG)
GAIL-STD-IN-DOC-DS-006

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|------------|-------------|-------------------------|--------------------|-------------------|--------------------|---|
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| 0 | 14.01.2019 | Issued for Bid | RKS | UNU | UNU | |
| REV | Date | Purpose of Issue | Prepared By | Checked By | Approved By | |


| CLIENT: | | | | | | | | | | |
|---|------------------------|---|------------------|-----------------------|---|-----------|-----|------------------------|---------|---|
| QUANTITY: AS PER P&ID | | | | | | | | | | |
| 1 | Type | Bimetallic | 17 | Extension Type | Rigid | | | | | |
| 2 | Well | Required | 18 | Bulb diameter | To suit thermowell | | | | | |
| 3 | Mounting | Local | 19 | Capillary Material | WP to IP 65 as per IEC 60529 /IS 2147 | | | | | |
| 4 | Dial Size | 150 mm | | Armour flexible | (*) | | | | | |
| 5 | Colour | White with black inscription | | Armour Material | (*) | | | | | |
| 6 | Case Material | Cast Aluminium | | Capillary Length | (*) | | | | | |
| 7 | Window Material | Shatter proof glass | 20 | Over Range protection | | | | | | |
| 8 | Conn. Location | Bottom | THERMOWELL | | | | | | | |
| 9 | Accuracy | "±" 1% of FSD | 21 | Material | SS 316 | | | | | |
| 10 | Enclosure | WP to IP 65 as per IEC 60529 / IS 13947 | 21 | Options | (*) | | | | | |
| 11 | Zero adj. screw | Required External Type | 22 | Construction | Drilled bar stock upto immersion length 500mm, otherwise fabricated | | | | | |
| BIMETAL | | | 23 | Process Connection | Welded | | | | | |
| 12 | Stem | | 24 | Gauge Connection | 1/2" NPT(F) | | | | | |
| | Type | (*) | 25 | Thermowell Dwg. | (*) | | | | | |
| | Material | (*) | 26 | Over Range protection | (*) | | | | | |
| | Size | (*) | 27 | Options | (*) | | | | | |
| 13 | Stem Diameter | (*) | a) | Liquid Filled | Yes | | | | | |
| | Filled System | (*) | b) | | | | | | | |
| 14 | SAMA class | V | c) | | | | | | | |
| | Compensation | Case | | | | | | | | |
| 15 | Bulb Type | Adjustable Union | | | | | | | | |
| | Bulb Material | SS 316 | | | | | | | | |
| 16 | Bulb Union Threaded to | 1/2" NPT(M) | | | | | | | | |
| Bill of Material (BOM) | | | | | | | | | | |
| Sl. No. | Tag No. | Range | Temperature (°C) | | Thermowell | | | Service | Options | |
| | | | Operating (Nor) | Design (Max) | Material | Dimension | | | | |
| | | | | | | N | T | | | L |
| 1 | ITC-7006-TG-09001 | (-) 20°C ~ 100°C | 20°C | (-) 20°C ~ 65°C | (*) | (*) | (*) | Natural Gas | | |
| 2 | MDR-4003-TG-06001 | (-) 20°C ~ 100°C | 20°C | (-) 20°C ~ 65°C | (*) | (*) | (*) | Natural Gas | | |
| 3 | ABU-4002-TG-06002 | (-) 20°C ~ 100°C | 20°C | (-) 20°C ~ 65°C | (*) | (*) | (*) | Natural Gas | | |
| 4 | ABU-4002-TG-07001 | (-) 20°C ~ 100°C | 20°C | (-) 20°C ~ 65°C | (*) | (*) | (*) | Natural Gas | | |
| 5 | ABU-4002-TG-15001 | (-) 20°C ~ 100°C | 20°C | (-) 20°C ~ 65°C | (*) | (*) | (*) | Natural Gas | | |
| 6 | ABU-4002-TG-18001 | (-) 20°C ~ 100°C | 20°C | (-) 20°C ~ 65°C | (*) | (*) | (*) | Natural Gas | | |
| 7 | ABU-4002-TG-08001 | (-) 20°C ~ 100°C | 20°C | (-) 20°C ~ 65°C | (*) | (*) | (*) | Natural Gas | | |
| 8 | SHI-1276-TG-06002 | (-) 20°C ~ 100°C | 20°C | (-) 20°C ~ 65°C | (*) | (*) | (*) | Natural Gas | | |
| 9 | PIN-4004-TG-06002 | (-) 20°C ~ 100°C | 20°C | (-) 20°C ~ 65°C | (*) | (*) | (*) | Natural Gas | | |
| NOTES:- | | (*) Vendor to furnish | | | | | | | | |
| | U | Immersion length | | | | | | | | |
| | T | Lagging Extension | | | | | | | | |
| | 1) | Element length shall be suitable for thermowell. | | | | | | | | |
| | 2) | U-length shall be selected in such a way that the thermowell tip shall be preferably at the centre of pipe to sense the temperature accurately. | | | | | | | | |
|  | | TEMPERATURE GAUGE | | | | | | DOCUMENT NO. | Rev. | |
| | | | | | | | | GAIL-STD-IN-DOC-DS-006 | 0 | |
| | | | | | | | | SHEET 1 of 1 | | |



GAIL INDIA LIMITED

DATASHEET FOR PRESSURE SAFETY VALVE (PSV)

GAIL-STD-IN-DOC-DS-007

| | | | | | | |
|------------|-------------|-------------------------|--------------------|-------------------|--------------------|---|
| | | | | | |  |
| 0 | 14.01.2019 | Issued for Bid | RKS | UNU | UNU | |
| REV | Date | Purpose of Issue | Prepared By | Checked By | Approved By | |

| | |
|-----------|-------------|
| CLIENT: | |
| QUANTITY: | As Per P&ID |

PSV

UNITS: Flow-> Liquid- m³/hr Gas- Sm³/hr Steam- kg/hr Pressure->Barg Temperature-> Deg C Level/Length-> mm

| | | | | | |
|--------------------|----------|-----------------------------------|------------------------|---------------------------------------|--------------------------------------|
| General | 1 | Tag No. | Quantity | ITC-7006-PSV-01001 / 06001 | 2 nos. |
| | 2 | Line No. | Schedule | X"-NG-01013-6D1-P / X"-NG-06010-6D1-P | 600# / 150# |
| | 3 | Vessel No. | | ITC-7006-PL-01001 / ITC-7006-PR-06001 | |
| | 4 | Safety / Relief | | Pressure Safety Valve | |
| Valve | 5 | Full Nozzle Full Lift/Mod. Nozzle | | Full nozzle full lift | |
| | 6 | Bonnet type | | Closed | |
| | 7 | Conv./Bellows/Pilot Operated | | Conventional | |
| | 8 | Inlet Conn. | Size & Rating | As per P&ID | |
| | 9 | | Facing & Finish | * | |
| | 10 | Outlet Conn. | Size & Rating | As per P&ID | |
| | 11 | | Facing & Finish | * | |
| | 12 | Cap Over Adj. Bolt | | Yes | |
| | 13 | | Screwed / Bolted | Bolted | |
| | 14 | Lifting Gear - Type | | | |
| | 15 | Test Gag | | Yes | |
| | 16 | Lever(Plain/Packed) | | * | |
| | Material | 18 | Body and Bonnet | | A352 Gr LCC / A 350 LF2 / A 351 CF8M |
| 19 | | Nozzle and Disc | | SS316 | |
| 20 | | Spring | | As per API 526 | |
| 21 | | Bellows | | -- | |
| 22 | | | | | |
| 23 | | | | | |
| 24 | | Resilient Seat Seal | | -- | |
| Options | 25 | | | | |
| | 26 | | | | |
| Basis | 27 | Code | | ASME / API | |
| | 28 | | | | |
| | 29 | | | | |
| Service conditions | 30 | Fluid | State | Natural Gas | Gas |
| | 31 | Corrosive Constituent | | | |
| | 32 | Required Flow Capacity | | 0.578 MMSCMD | |
| | 33 | Mol.Wt. | S.G. at Rel. Temp | 17.95 | |
| | 34 | Oper. Pressure | Normal | 10 ~ 19 | |
| | 35 | Oper. Temp. | Rel. Temp. | (-) 20 ~ 65°C | |
| | 36 | Valve Discharges to | | Atmosphere | |
| | 37 | Back Press. | Const. Or Variable | Constant | |
| | 38 | Set Pressure (Barg) | | 98 | |
| | 39 | Cold Bend Test Pressure | | | |
| | 40 | % Over Pressure | % Blow Down | 21% | As per API / ASME |
| | 41 | Cp/Cv (k) | Compressibility Factor | 1.29% | 0.97 |
| | 42 | Viscosity @ Rel. Temp. | mPas(cP) | | |
| | 43 | Vess. Wall Temp. | Surf.Area-m2 | | |
| | 44 | Max & Min Pressure (Barg) | | 10 ~ 19 | |
| | Orifice | 45 | Calculated Area cm2 | | * |
| 46 | | Sel. Area cm2 | Orifice Design | * | * |
| 47 | | No. of Valves Req'd. for capacity | | * | |
| 48 | | Tota Area - cm2 | | * | |
| 49 | | Actual Flow Capacity | | * | |
| 50 | | | | | |
| | 51 | Model No. | | * | |
| | 52 | CCOE | | Yes | |
| | 53 | Radiography | | 100% | |
| | 54 | ASME UV/NB | | Yes | |

NOTES:

- *1: Vendor to furnish
 1 At the time of approval, vendor shall furnish sizing calculation and catalogues of PSV.
 2 Test GAG Required for safety valve & Pressure Safety valve shall be fire case type.
 3 Vendor to submit Sizing sheet, Model Decodification sheet, Catalogue, Drawings and QAP for approval.



Data Sheet of Pressure Safety Valve

DOCUMENT NO.

GAIL-STD-IN-DOC-DS-007

Rev.


0



GAIL INDIA LIMITED

**DATASHEET FOR SCRAPPER/PIG SIGNALLER/DETECTOR - INTRUSIVE
TYPE**

GAIL-STD-IN-DOC-DS-008

| | | | | | |  | |
|-----|------------|------------------|-------------|------------|-------------|---|--|
| | | | | | | | |
| | | | | | | | |
| 0 | 14.01.2019 | Issued for Bid | RKS | UNU | UNU | | |
| REV | Date | Purpose of Issue | Prepared By | Checked By | Approved By | Lyons Engineering Pvt. Ltd | |
| | | | | | | | |


| CLIENT: | | | | | | | | |
|---|--|---|--|---------------------|------|--------------------------|------|---------|
| QUANTITY: AS PER P&ID | | | | | | | | |
| | | | | | | | | |
| 1 | General | Tag No. & Quantity | As per BOM below | | | | | |
| 2 | | Make | (*) | | | | | |
| 3 | | Model | (*) | | | | | |
| 4 | | Service | Outdoor,unprotected | | | | | |
| 5 | | Ambient temp. | 0°C ~55°C | | | | | |
| 6 | | Relative Humidity | 0.98 | | | | | |
| 7 | | Area Classification | Zone-2, IIA/IIIB T3 | | | | | |
| 8 | Process Condition | Process Fluid | Natural Gas | | | | | |
| 9 | | Gas Temperature (Design) | (-)20~60 (Under Ground); (-)20~65 (Above Ground) | | | | | |
| 10 | | Line gas Pressure (Design) | (*) | | | | | |
| 11 | | Multiphase Product | No | | | | | |
| 12 | Pig Details | Pig Material | Carbon Steel (*) | | | | | |
| 13 | | Pig Length | (*) | | | | | |
| 14 | | Pig Diameter (O. D.) | 95% ~ 100 % of Pipeline ID | | | | | |
| 15 | | Pig Velocity (Max.) | 8 m/Sec | | | | | |
| 16 | Sensing Element | Type | Intrusive (Bi-directional) | | | | | |
| 17 | | Mounting | On Above Ground Pipe | | | | | |
| 18 | | Detection Speed | By Vendor | | | | | |
| 19 | | Connection | Welded on Scrapper Barrel | | | | | |
| 20 | | Body Material | ASTM A 350 LF 2 | | | | | |
| 21 | | Corrosion Allowance | 1.6 mm | | | | | |
| 22 | | Internals | SS 316 or better | | | | | |
| 23 | | Type of neck | Short neck | | | | | |
| 24 | | Body enclosure | Anti-corrosive epoxy painted | | | | | |
| 25 | Switch | Enclosure type | EEx 'd', IP 65 | | | | | |
| 26 | | Electrical Entry | 1/2" NPTF(Note-3) | | | | | |
| 27 | | Signal Output | Potential free contact SPDT (2 NOS.)/ DPDT (1 NO.) | | | | | |
| 28 | | Setting | Adjustable (Factory set for Scrapper passage/detection signal) | | | | | |
| 29 | | Type | Limit switch / Proximity Switch Hermetically sealed; auto reset (restores to normal Position after actuation). Make – As per vendor list | | | | | |
| 30 | | Contact Rating | 24 VDC, 2A | | | | | |
| 31 | Response Time | (*) | | | | | | |
| 32 | Barrel Specification | Pipeline Diameter (NB) | 6" | | | | | |
| 33 | | Pipeline wall Material API 5L Gr. (PSL-2) | X-52 | | | | | |
| 34 | | Wall Thickness (mm) | 6.4 mm (Main Pipeline) | | | | | |
| 35 | | Min. Pipeline Coating Thickness (External-3 Layer Polyethylene) | Minimum 2.7 mm | | | | | |
| 36 | Others | Local Indicator | Mechanical visual (flag) with manual reset | | | | | |
| 37 | | Local Reset Buton | Black Colour, Eexd, IP65 | | | | | |
| 38 | | Ball valves for removing scraper detector for servicing | Required | | | | | |
| 39 | | Jacking bracket for removal of scraper detector | Required | | | | | |
| Bill of Material(BOM) | | | | | | | | |
| Sr. No. | Station No. | Tag No. | Line Size | Operating temp (°C) | | Line Gas pressure (barg) | | Remarks |
| | | | | Normal | Max. | Normal | Max. | |
| 1 | Existing SV - 7006 of BJPL (New Despatch Terminal | ITC-7006-XXS-01001 | ITC-7006-PL-01001 | | | | | |
| 2 | Existing SV - 7006 of BJPL (New Despatch Terminal | ITC-7006-XXS-01002 | 6"-NG-01019-XS2-P | | | | | |
| 3 | ITC Food Park - Kapurthala (New Receiving Terminal | ITC-7006-XXS-06002 | ITC-7006-PR-06001 | | | | | |
| 4 | ITC Food Park - Kapurthala (New Receiving Terminal | ITC-7006-XXS-06001 | 6"-NG-06005-XS2-P | | | | | |
| NOTES:- | | | | | | | | |
| 1 | (*) To be provided by Vendor. | | | | | | | |
| 2 | Pig Signallers shall be with isolation valve (Full Bore) for On-line repair. Valve material shall be LTCS. | | | | | | | |
| 3 | Visual Indicator with manual reset shall be provided. | | | | | | | |
| 4 | Material Compliance as per EN 10204 3.2 Certificate. | | | | | | | |
| 5 | Painting shall be suitable for Corrosive Industrial environment. | | | | | | | |
| | | | | | | | | |
|  | | DATASHEET FOR SCRAPPER/PIG SIGNALLER/DETECTOR - INTRUSIVE TYPE | | | | DOCUMENT NO. | | Rev. |
| | | | | | | GAIL-STD-IN-DOC-DS-008 | | 0 |
| SHEET 1 of 1 | | | | | | | | |



GAIL INDIA LIMITED

DATASHEET FOR GAS OVER OIL ACTUATOR VALVES (GOOV)

GAIL-STD-IN-DOC-DS-009

| | | | | | | | |
|------------|-------------|-------------------------|--------------------|-------------------|--------------------|---|-----------------------------------|
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| | | | | | | | |
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DATASHEET FOR GOOV



Doc. No. GAIL-STD-IN-DOC-DS-009

Rev. 0

Page 1 of 4

Tag No. ITC-7006-GOV-6"-0101 / 0601

| General | | ACTUATOR | | POSITION SWITCH | |
|-------------------------|--------------------------------------|--|----|---|--|
| 1 | Location Class | Confirm later | 51 | Type | Gas Over Oil Actuator, Quarter Turn Operation |
| 2 | Press. / Temp. Rating | ANSI Class 600# | 52 | Min. Pressure For Actuator Sizing | 15 barg Or Specified In PDS |
| 3 | Pipe Class | 6D1 (ASTM A333 Gr. 6) | 53 | Supply Pressure Min. / Nor. / Max. bar(g) | As per Process Parameters given in Tender |
| 4 | Design Standard | API 6D | 54 | Power Gas supply Connection | Vendor to Provide |
| 5 | Location | After Pig Launcher (ITC-7006-PL-01001) | 55 | Tubing Material | SS316L |
| 6 | Valve Type & Size | ON/OFF-Ball & 6" | 56 | Tubing Size | Vendor to Provide |
| 7 | Area Classification | Zone-1, Gr. A / B, T3-4 or Better | 57 | Filter Regulator | Required |
| 8 | P&ID No. | | 58 | Filter regulator Material \ Filter Element | SS316 / 2-5 Micron |
| 9 | Make | VTA | 59 | Valve Position Indicator | Required |
| 10 | Model | VTA | 60 | Manual Override | Required on The Actuator local Control Panel |
| 11 | Weight / Dimension | VTA | 61 | Failure Position | Stay Put |
| 12 | Body | Top entry | 62 | Painting | As per Painting Specification |
| 13 | Stem | Quarter Turn Design/Anti Blow Out | 63 | Control Panel Material | SS316 |
| 14 | Ball | Solid Ball | 64 | Logic / Tubing Components | SS316L (SWAGelok/PARKER) |
| 16 | Body Stud | Fully Threaded | 65 | Panel Enclosure Class | WP- IS 2147 to IP-66 - IEC 60529 & Flame Proof as per IS 2148 |
| 17 | Body Nuts | Two Hexagonal Nuts | 66 | Gas Storage and Hydraulic Cylinder Capacity | Min Two Open & close operations in case of loss of line pressure |
| 18 | Body Seat Ring | Renewable | 67 | Stroke Time/Response Time | Vendor to Provide for Opening & Closing @ specified Pressure |
| 19 | Type of Bore | Full Bore | 68 | Safety Factor | Actuator torque shall be minimum 1.25 times the maximum valve break torque required at full rated differential pressure of valve |
| 20 | Type of Support | Trunion Mounted | 69 | Position Switches | Required for both open and close positions |
| 21 | Body | ASTM A 350 Gr. LF2 / Equivalent | 70 | Solenoid Valves | Required Asper Attached Data sheet |
| 22 | Stem (No Casting - Single Piece) | ASTM A276 Type 410 (S 410) / A 564 Type 630 (17-4 PH) / ASTM A 479 Gr. 316 | 71 | Relief Valve | Required - Material: SS316 |
| 23 | Ball | ASTMA 182 Gr. F 316 / A 351 Gr. CF8M / A 350 Gr. LF2 + 75 Micron ENP / ASTM A 479 SS 316 | 72 | Pressure Gauge | Required - Material: SS316 |
| 24 | Stud Bolts | ASTM A 320 Gr. L7 | 73 | Differential Pressurer Switches | Required As per Attached Data sheet integral with system |
| 25 | Nuts | ASTM A 194 Gr. 4 / Gr. 7 | 74 | Adjustable Stoppers for Actuator | Required for both opening and closing |
| 26 | Body Seat Ring | ASTM A 182 Gr. F 316 / A 350 Gr. LF2 + 75 Micron ENP | 75 | Stem Extension | As per Approved P&ID's |
| 27 | Spring | Inconel X-750 | 76 | Certification | As mentioned below |
| 28 | Line Size | 6" | 77 | Gas Consumption \ Displacement | Vendor to Provide |
| 29 | Pipe Material | ASTM A 333 Gr. 6 | 78 | Oil Displacement | Vendor to Provide |
| 30 | End connection | Butt Weld | 79 | Tank Capacity | Vendor to Provide |
| 31 | Schedule of Pulp piece | ASTM A 333 Gr. 6, Sch. 80 | 80 | Oil Content | Vendor to Provide |
| 32 | End to End Dimensions | As per API 6D | 81 | Hydraulic Fluid Cleanliness | As per NAS 1638 / ISO 4406 - Latest Editions |
| FLUID PROPERTIES | | | 82 | Hand Pump | Required |
| 33 | Fluid Type / Phase | Natural Gas / Gas | 83 | Area Classification | Zone-1, Gr. II A/B, T3-T4 or Better |
| 34 | Corrosive / Erosive constituent | CO2 (0.24%) | 84 | Switch Type | Proximity Type (Nammur Certified) |
| 35 | Flow Rate: Min./Max. | 1.5 MMSCMD | 85 | Form | DPDT / SPDT |
| 36 | Pressure Drop @ Normal flow, bar (g) | 2.93 | 86 | Contact Rating | Vendor to Provide |
| 37 | Operating Pressure: Min./Max. | 19 bar (g) / | 87 | Cable Entry | 1/2" NPTF (2 Nos.) |
| 38 | Operating Temperature: Min./Max. | 20°C | 88 | Switch Quantity | Two |

| PROCESS COIL | | VALVES PC | | ENCLOSURE MATERIAL | | SS 304 or Equivalent (Mfr Std Subject to Approval) | |
|---|---------------------------------------|-------------------|--|---|--------------------|---|--|
| 39 | Design Pressure | 98 bar (g) | | 89 | Enclosure Material | WP to IP-65 | |
| 40 | Design Temperature: Min./Max. | -20°C / 65°C | | 90 | Enclosure Class | Required | |
| 41 | Density, Kg/M3: Min./Max. | | | 91 | Certification | CCOE/UL / FM / BASEEFA/ATEX or Equal | |
| 42 | Molecular Weight | 19 Kg/kmol | | 92 | Certifying Agency | | |
| 43 | Viscosity, Cp: Min./Max. | | | 93 | JUNCTION BOX (IB) | As per PTSGTS>Data Sheet of Junction Box | |
| 44 | Specific Heat Ratio, Cp/Cv: Min./Max. | | | 94 | CABLE GLAND | 1) As per PTSGTS>Data Sheet of Junction Box 2) Double Compression Type | |
| 45 | Compressibility Factor: Min./Max. | | | Certification required: | | | |
| 46 | Break to Open (BTO) | Vendor to Provide | | 1) Flame Proof / Ex. Proof Certificates, 2) Weather Proof Certificates, 3) Functional Test Reports, 4) Test Certificates for Actuator, 5) Calibration Report of Relief Valve with Serial No marked on Valve, 6) Calibration Report of Pressure Gauge with Serial No marked, 7) Blasting, Surface Preparation & Painting Report, 8) Operational, Maintenance & Installation Manual, 9) Catalogues for all the accessories. | | | |
| 47 | End to Open | Vendor to Provide | | | | | |
| 48 | Running | Vendor to Provide | | | | | |
| 49 | Break to Close | Vendor to Provide | | | | | |
| 50 | End to Close | Vendor to Provide | | | | | |
| PERFORMANCE TABLE / TORQUE DETAILS | | | | | | | |
| Documents Required: | | | | | | | |
| 1) Electrical Wiring Diagram | | | | | | | |
| 2) Interconnection Loop Diagram | | | | | | | |
| 3) Pneumatic Operating Diagram | | | | | | | |
| 4) Overall Dimension Drawing | | | | | | | |
| 5) Actuator GA Drawing | | | | | | | |
| 6) Technical Summary Table of OEM | | | | | | | |
| 7) Tank Sizing Calculation of OEM | | | | | | | |
| 8) Junction Box Details with GA Drawing | | | | | | | |
| Above mentioned details are bare minimum ther than as specified in Instrument Design Basis are also applicable | | | | | | | |
| The control logic shall enable the following: | | | | | | | |
| a) Local and remote selection in field. | | | | | | | |
| b) Maintenance / panel / SCADA selection in local panel. | | | | | | | |
| c) Logic function shall include open / close facilities. Logic may be implemented using relay logic in control panel. Panel / SCADA contacts shall be momentary, hold on contacts shall be used in logic. | | | | | | | |
| d) Remote function shall facilitate remote closure and opening of valve (without any manual intervention if all process interlocks are met). In case electrical signal to solenoid valves fail. | | | | | | | |
| e) Manual local hydraulic operation of valve, with hand pumps, in case of non availability of pneumatic (gas) operation. | | | | | | | |
| f) High differential pressure inhibit switch shall inhibit the remote operation of the valve, when differential becomes high (more than 3 bars). However it shall be possible to operate the valve locally. | | | | | | | |
| g) Close command (or open command) shall be inhibited during valve opening (or valve closing) and be made effective only after 100% opening (or closing) is achieved. | | | | | | | |
| h) Opposite movement inhibitor shall be provided. | | | | | | | |



DATASHEET FOR SOLENOID VALVES (SOV)



Doc. No. GAIL-STD-IN-DOC-DS-009

Tag No. ITC-7006-GOV-6"-XXXX/ XXXX

Rev. 0

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| | | | | |
|-----------------|----|---------------------------------|--|-----------------|
| General | 1 | Tag Numbers | XX-XSV-XXXX | |
| | 2 | Make \ Model | Vendor to provide | |
| | 3 | Quantity | Vendor to provide | |
| | 4 | Location | Mounted on Actuator Cabinet | |
| | 5 | Service | Natural Gas | |
| | 6 | Area Classification | Zone-0,1, Gr.II A/B,T3-T4 or Better,Exia | |
| | 7 | Enclosure Calss | WP to IP-66 | |
| | 8 | Certification | Required (Note-1) | |
| VALVE | 9 | Configuration (See Figure) | Vendor to provide | |
| | 10 | Body Size/ Rating | Vendor to provide | |
| | 11 | Body Material | SS316L | |
| | 12 | Process Connection | Vendor to provide | |
| | 13 | Trim Material | SS316L | |
| | 14 | Operation :Direct/Pilot | Vendor to provide | |
| | 15 | Operating Mode NC/NO/UNIVERSAL | Vendor to provide | |
| ACTUATOR | 16 | Style of Coil | Vendor to provide | |
| | 17 | Coil Voltage | 24 VDC | |
| | 18 | Coil Insulation Class | Vendor to provide | |
| | 19 | Electrical Connection | Required | |
| | 20 | Cable Entry | 1/2" NPTF | |
| | 21 | Volts | Vendor to provide | |
| | 22 | On De-Energised Condition, Port | Vendor to provide | |
| | 23 | On Energised Condition,Ports | Vendor to provide | |
| END CONNECTIONS | 24 | Manual Reset | Not Required | |
| | 25 | Process Fluid | State | Natural Gas Gas |
| | 26 | Flow | Vendor to provide | |
| | 27 | Temperature | Vendor to provide | |
| | 28 | Upstream Pressure | Vendor to provide | |
| | 29 | Down stream Pressure | Vendor to provide | |
| | 30 | Density | Vendor to provide | |
| CONFIGURATION | | | | |

Notes:

- 1) The Solenoid valves shall be intrinsically safe to specified area classification. The Certificate from a statutory body like UL /FE / BASEEFA\ATEX or equal shall be submitted along with the bid.
- 2) Flying Leads are not acceptable and shall be terminated in a termination box.
- 3) Solenoid valves shall be Operated by open/close command from SCADA system or Local Panel.
- 4) This is a Part of main line Valve/Emergency Isolation Valve Actuators and shall be supplied by main line valve Actuator Vendor.



DATASHEET FOR DIFFERENTIAL PRESSURE SWITCH (DPSH)



Doc. No. GAIL-STD-IN-DOC-DS-009

Tag No. ITC-7006-GOV-6"-XXXX/ XXXX

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Page 4 of 4

| | | | |
|----------------|----|--------------------------------|--|
| General | 1 | Tag No. | XX-PDSH-XXXX |
| | 2 | Quantity | As per latest P&ID's |
| | 3 | Service | Natural gas |
| | 4 | Type | Electric ,Differential Pressure |
| | 5 | Mounting | Surface mounted |
| | 6 | Area Classification | Zone 0, 1, GR.II A/B,T3-T4 or Better, Exia |
| | 7 | Enclosure Class | WP to IP-66 |
| | 8 | Housing Material | LM-6 Cast Aluminum |
| SWITCH | 9 | Electrical output | Contact |
| | 10 | Form | DPDT |
| | 11 | Type | Micro Switch, Hermetically Sealed |
| | 12 | Current | Vendor to provide |
| | 13 | Load Type | Inductive |
| | 14 | Conduit conn. | 1/2"NPTF |
| | 15 | No. of Entries | Two |
| | 16 | Terminal Block | Required |
| | 17 | Set Point adjustment | Internal |
| | 18 | Differential Range | Fixed |
| | 19 | Accuracy | ±1% of Span |
| | 20 | Repeatability | ±1% of Span |
| MEASURING UNIT | 21 | Hysteresis / Dead Band Details | Vendor to provide |
| | 22 | Pressure Element | Diaphragm |
| | 23 | Element Material | SS316L |
| | 24 | Process Connection | 1/2" NPTF, Bottom |
| | 25 | Over Range Protection | 150% of FSD |
| | 26 | Manifold Type | 5 Valve Manifold |
| | 27 | Manifold Material | SS316 |
| | 28 | Manifold Connection | 1/2" NPTF |
| OTHERS | 29 | Make | Vendor to provide |
| | 30 | Model no. | Vendor to provide |
| | 31 | | |

Notes:


- 1) The Switch Enclosure Shall be Weather Proof To NEMA 4X and it shall be intrinsic Safe for Zone-0,1 group II A/B and temperature class T3- T4.
- 2) Vendor shall select the suitable model for each Tag no. such that the switch differential shall be with in the following limits. The sum of the differential & repeatability (in Engg.Units) Shall be less than the difference between the set point and the normal operating pressure .In other words, it shall be ensured that at no point of time the switch shall remain in Alarm status while the process is within the normal operating range.
- 3) 5 -way valve Manifold in 316SS shall be provided for all Tags.
- 4) Differential Pressure Switches Shall withstand maximum Static/Design Pressure Without affecting calibration, 150% Full Scale Deflection or design pr. Whichever is higher.
- 5) Differential pressure Switch shall be mounted on Valve Actuator and electrical/pneumatic connections shall be shown in respective drawings.
- 6) Calibration Report.



GAIL INDIA LIMITED

QAP FOR TEMPERATURE TRANSMITTERS

GAIL-STD-IN-DOC-QAP-001

| | | | | | | |
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| REV | Date | Purpose of Issue | Prepared By | Checked By | Approved By | |



VENDOR LOGO



STANDARD QUALITY ASSURANCE PLAN FOR TEMPERATURE TRANSMITTER

CUSTOMER:- END USER:- QAP NO.:- REV.:-
 SO NO:- DATE:-
 PO NO.:-

PROJECT:-
 REF DOCUMENT:-

| Sr. No. | Component Operation | Characteristics | Class | Type of Check | Quantum of Check | Reference document | Acceptance norm | Format of Record | Vendor | Agency TPI | Client | Remarks |
|---------|---|---|---------------------------------------|--|------------------------------|---|---|--------------------------------|--------|------------|--------|---------|
| 1 | Internal test/inspection | Physical Verification of -General Finishing -Model no. & Serial no. -Tag no. -Certification -Accessories -Range -Accuracy -Calibration -Communication with HART | Major Critical | Visual Electrical | 100% 100% | Approved Datasheet / Job Specification | Approved Datasheet / Job Specification | Test and Calibration Report | P | R | R | |
| 2 | Final Test/ Inspection | Physical Verification of -Model No. Serial no -Tag No -Electrical / Conduit Entry -connection check -Accessories Check - Dimensional Check -Visual inspection -Calibration Test -Indicator Operation Check (If Meter Display) -Configuration of Range -Communication with HART configurator -Accuracy -Repeatability -Power supply variation test -Reverse Polarity Test -Load Variation Test | Major Critical Critical | Visual Electrical Electrical | 100% 100% 100% | Approved Datasheet / Job Specification | Approved Datasheet / Job Specification | COC T&C | P | W | W / R | |
| 3 | Review Documents | -Review of internal test report & MTC -Hazardous Area Classification Report - Test & Calibration Report - Certification for Compliance - CCOE certificate -Degree of protection certificate | Major | Visual | 100% | Approved Datasheet / Job Specification | Approved Datasheet / Job Specification | T&C and COC | H | R | R | |
| 4 | TPI Inspection Report & Inspection Release Note | | | | | | | | H | P | R | |

P - Performance, R - Review, W - Witness, COC - Certificate of Conformance, T&C - Test & Calibration Report, H - Hold


Notes:
 1). Material and Type shall be as per tender specification / datasheet.
 2). Acceptance Norms/ Acceptance Criteria for all the activities shall be as per specification/ data sheet/ applicable codes & standards etc.
 3). GAIL and/or his representative reserve right for inspection at any stage of manufacturing of materials as per approved QAP.
 4). All Testing & Measuring Instruments shall have valid Calibration with Calibration Certificates & Traceabilities.



GAIL INDIA LIMITED

QAP FOR RTDs AND THERMOWELLS

GAIL-STD-IN-DOC-QAP-002

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| 0 | 15.01.2019 | Issued for Bid | RKS | UNU | UNU | |
| REV | Date | Purpose of Issue | Prepared By | Checked By | Approved By | |



VENDOR LOGO



STANDARD QUALITY ASSURANCE PLAN FOR RTD AND THERMOWELLS

CUSTOMER:-
 SQ NO:-
 PO NO:-
 PROJECT:-
 REF DOCUMENT:-

END USER:-
 DATE:-
 QAP NO:-
 REV:-

| Sr. No. | Component Operation | Characteristics | Class | Type of Check | Quantum of Check | Reference Document | Acceptance Norm | Format of Record | Vendor | Agency | Client | Remarks |
|---|---------------------|---------------------------------------|------------------|---------------|------------------|--|--|--------------------------------|--------|--------|--------|---------|
| RTD ASSEMBLIES | | | | | | | | | | | | |
| 1 | RTD Assemblies | a) Accuracy test | Major | Testing | 100% | IEC751/DIN43760 As per STD | IEC751/DIN43760 As per STD | Test & Calibration Certificate | P | W | W/R | |
| | | b) IR at AMB & at 500VDC | Major | Testing | | | | Test Report | | | | |
| | | c) Hot IR at 320 Deg c & 500VDC | Major | Testing | | | | Test Report | | | | |
| | | d) N2 Test | Major | Testing | | | | Test Report | | | | |
| | | e) Response Time test | Major | Testing | | | | Test Reports | | | | |
| | | f) Dimensions/Connection | Major | Measurement | | | | Test Report | | | | |
| | | g) Weather proof test / Ex-proof Test | Major & Critical | Testing | | | | Statutory Test Certificate | | | | |
| | | THERMOWELL | | | | | | | | | | |
| 1 | Thermowell | Chemical Composition | Major | Analysis | One Sample | Approved Datasheet / Technical Specification | Approved Datasheet / Technical Specification | Material Test Certificate | P | R | R | |
| | | a) Dimensions | Major | Measurement | | | | | | | | |
| | | b) Hydro test | Major | Testing | | | | | | | | |
| | | c) Bore Concentricity test | Critical | Testing | | | | | | | | |
| | | d) Visual | Major | Observation | | | | Test Reports & Certificates | | | | |
| | | e) Workmanship/Finish | Major | Observation | | | | | | | | |
| | | f) Spec/Tagging | Major | Visual | | | | | | | | |
| | | g) Threading | Critical | Testing | | | | | | | | |
| | | h) Surface Finish | Major | Visual | | | | | | | | |
| | | 3 | | | | | | | | | | |
| TPI Inspection Reports & Inspection Release Note | | | | | | | | | | | | |
| P - Performance, R - Review, W - Witness, COC - Certificate of Conformance, T&C - Test & Calibration Report, H - Hold | | | | | | | | | | | | |


Notes:
 1). Material and Type shall be as per tender specification / datasheet.
 2). Acceptance Norms/ Acceptance Criteria for all the activities shall be as per specification/ data sheets/ applicable codes & standards etc.
 3). GAIL and/or his representative reserve right for inspection at any stage of manufacturing of materials as per approved QAP.





GAIL INDIA LIMITED

QAP FOR PRESSURE TRANSMITTERS

GAIL-STD-IN-DOC-QAP-003

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| 0 | 15.01.2019 | Issued for Bid | RKS | UNU | UNU | |
| REV | Date | Purpose of Issue | Prepared By | Checked By | Approved By | Lyons Engineering Pvt. Ltd |

|  | | VENDOR LOGO | | | |  | | | | | | | |
|---|--------------------------|---|----------|---------------|------------------|---|--|--|-----------------------------|-----|--------|---------|--|
| STANDARD QUALITY ASSURANCE PLAN FOR PRESSURE TRANSMITTER | | | | | | | | | | | | | |
| CUSTOMER:- | | END USER:- | | | QAP NO.:- | | | REV.:- | | | | | |
| SO NO:- | | DATE:- | | | | | | | | | | | |
| PO NO:- | | | | | | | | | | | | | |
| PROJECT:- | | | | | | | | | | | | | |
| REF DOCUMENT:- | | | | | | | | | | | | | |
| Sr No. | Component Operation | Characteristics | Class | Type of Check | Quantum of Check | Reference document | Acceptance norm | Format of Record | Agency | | | Remarks | |
| | | | | | | | | | Vendor | TPI | Client | | |
| 1 | Internal test/Inspection | Physical Verification -General Finish -Model no. & Serial no. -Tag no. -Certification -Accessories -Calibration -Range | Major | Visual | 100% | | | | | | | | |
| | | -Accuracy -Leak Check Process -Connection -Communication with HART | Critical | Electrical | 100% | | Approved Datasheet / Job Specification | Approved Datasheet / Job Specification | Test and Calibration Report | P | R | R | |
| 2 | Final Test/ Inspection | Physical Verification of -Model no., Serial no., -Tag no., -Process connection check -Electrical/Conduit Entry -Connection check -Accessories check | Major | Visual | 100% | Approved Datasheet / Job Specification | Approved Datasheet / Job Specification | COC | P | W | W / R | | |
| | | Calibration | Critical | Electrical | 100% | Approved Datasheet / Job Specification | Approved Datasheet / Job Specification | T&C | P | W | W / R | | |
| | | -Accuracy -Repeatability -Indicator Operation -Check(if Meter display) -Communication with Field Communicator -Power supply variation test -Reverse Polarity Test -Load Variation Test | Critical | Electrical | 100% | Approved Datasheet / Job Specification | Approved Datasheet / Job Specification | COC | P | W | W / R | | |
| 3 | Review of Documents | -Review of internal test report & MTC -Hazardous Area Classification Report -Test & Calibration Report -Certification for Compliance -CCOE certificate -Degree of protection certificate | Major | Visual | 100% | Approved Datasheet / Job Specification | Approved Datasheet / Job Specification | Test Certificate & COC | P | R | R | | |
| 4 | | TPI Inspection Report & Inspection Release Note | | | | | | | H | P | R | | |

P - Performance, R - Review, W - Witness, COC - Certificate of Conformance, T&C - Test & Calibration Report, H - Hold

Notes:


- 1). Material and Type shall be as per tender specification / datasheet.
- 2). Acceptance Norms/ Acceptance Criteria for all the activities shall be as per specification/ data sheets/ applicable codes & standards etc.
- 3).GAIL and/or his representative reserve right for inspection at any stage of manufacturing of materials as per approved QAP.



GAIL INDIA LIMITED

QAP FOR PRESSURE GAUGES

GAIL-STD-IN-DOC-QAP-004

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| Rev. | Date | Purpose of Issue | Prepared By | Checked By | Approved By | Lyons Engineering Pvt. Ltd | |
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VENDOR LOGO



STANDARD QUALITY ASSURANCE PLAN FOR PRESSURE GAUGE

CUSTOMER:- QAP NO.:- REV.:-
 SO NO.:- DATE:-
 PO NO.:-
 PROJECT:-
 REF DOCUMENT:-

| Sr. No. | Component Operation | Characteristics | Category | Type of Check | Quantum of Check | Reference Document | Acceptance Norm | Format of Plan | Agency | | | Remarks |
|---------|--------------------------|---|----------------|----------------------------------|------------------------|--|--|---|-------------|-------------|-------------|---------|
| | | | | | | | | | Vendor | TPI | Client | |
| 1 | Raw Material | a) Dimensions b) Chemical Analysis c) Dial Marking, Unique, Srl. No. D) Dial Color | MA MA MA | Mechanical Chemical Visual | 100% Sample 100% | PO approved Spec/Drg. Approved Spec/PO | PO approved Spec/Drg. Approved Spec/PO | Test Certificate Material Test Certificate Test Certificate | P P P | R R R | R R R | |
| 2 | Internal Test/Inspection | Accuracy Hystresis Repeatability | CR | Measurement | 100% | EN 837-1 | EN 837-1 | Calibration Report | P | R | R | |
| | | Over range protection | CR | Visual | 100% | EN 837-1 | EN 837-1 | Test Report | P | R | R | |
| 3 | Final Test/Inspection | Accuracy Hystresis Repeatability Dimension Visual | CR | Measurement | 100% | EN 837-1 | EN 837-1 | Calibration Report | P | W | W/R | |
| | | Over range protection | CR | Visual | 100% | EN 837-1 | EN 837-1 | Test Report | P | W | W/R | |
| 4 | Accessories | 1) Chemical Analysis | MA | Chemical | Sample | Approved Datasheet/ Drawing/Job Specification | Approved Datasheet/ Drawing/Job Specification | Material Test Certificate | P | R | R | |
| | Gauge Saver in SS 316 | 2) Dimensions | MA | Measurement | 100% | Approved Datasheet/ Drawing/Job Specification | Approved Datasheet/ Drawing/Job Specification | Test Reports/ Certificates | P | W | W / R | |
| | 2-Way Valve Manifold | 3) Leak Tightness | CR | Hydrotest | 100% | Approved Datasheet/ Drawing/Job Specification | Approved Datasheet/ Drawing/Job Specification | Test Reports/ Certificates | P | W | W/ R | |
| 3 | IRN | TPI Inspection Reports & Inspection Release Note | | | | | | | P | R | | |

Legends: P - Performance, R - Review, W - Witness, COC - Certificate of Conformance, T&C - Test & Calibration Report, H - Hold

Category: CR - Characteristics affecting safety of equipment and personnel


Notes:

- 1). Material and Type shall be as per tender specification / datasheet.
- 2). All Testing & Measuring Instruments shall have valid Calibration with Calibration Certificates & Traceabilities.
- 3). Acceptance Norms/ Acceptance Criteria for all the activities shall be as per specification/ data sheets/ applicable codes & standards etc.
- 4). GAIL and/or his representative reserve right for inspection at any stage of manufacturing of materials as per approved QAP.



GAIL INDIA LIMITED

**QAP FOR TEMPERATURE GAUGES
GAIL-STD-IN-DOC-QAP-005**

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| 0 | 15.01.2019 | Issued for Bid | RKS | UNU | UNU | |
| Rev. | Date | Purpose of Issue | Prepared By | Checked By | Approved By | |



VENDOR LOGO



QUALITY ASSURANCE PLAN FOR TEMPERATURE GAUGE WITH THERMOWELL

| Sr No. | Components & Operation | Characteristics | Class | Type of Check | Quantum of Check | Reference document | Acceptance norm | Vendor | Agency | Client |
|-------------------|---------------------------------------|---|----------|---------------------|------------------|--|--|--------|--------|--------|
| 1 | Raw Materials | | | | | | | | | |
| 1.1 | Ring | Chemical composition | Major | Chemical Analysis | 100% | As per Specification/data sheet | Approved Documents | P | R | R |
| 1.2 | Case | Chemical composition | Major | Chemical Analysis | 100% | As per Specification/data sheet | Approved Documents | P | R | R |
| 1.3 | Movement | Chemical composition | Major | Chemical Analysis | 100% | As per Specification/data sheet | Approved Documents | P | R | R |
| 1.4 | S.S. Socket | Chemical composition | Major | Chemical Analysis | 100% | As per Specification/data sheet | Approved Documents | P | R | R |
| 1.5 | Dial | Chemical composition | Major | Visual | 100% | As per Specification/data sheet | Approved Documents | P | R | R |
| 1.6 | Rubber Parts | Oil Test | Major | Oil Test | Sample | As per Relevant Std | Approved Documents | P | R | R |
| 2 | Routine & Acceptance Testa | | | | | | | | | |
| 2.1 | Thermometers | Dimensions, Connections & Mounting | | Measurement, Visual | 100% | EN 13190 Std | Approved Documents | P | R | R |
| 2.2 | Calibration Test (5 points) | Accuracy and Repeatability | | Calibration Check | 100% | Approved test procedure | Approved Documents | P | R | R |
| 2.3 | Response Time Test | Response | | | 10% | | Approved Documents | P | R | R |
| 3 | In Process Inspection | | | | | | | | | |
| 3.1 | Dimensional check | Physical Measurement | Major | Measurement | 100% | As per Relevant Std | Approved Drawings | P | R | R |
| 3.2 | Leakage test | Leak Test | Critical | Hydro test | 100% | As per Relevant Std | As per Relevant Std | P | R | R |
| 4 | Final Test Inspection | | | | | | | | | |
| 4.1 | Finish Product check for completeness | Performance check & Calibration | | | | | | P | W | W/R |
| | | a) Accuracy +/- 1% of FSD | Major | Measurement | 100% | As per Relevant Std | Approved Documents / Relevant Std | P | W | W/R |
| | | b) Repeatability | | | | | | P | W | W/R |
| | | c) Leakage | | | | | | P | W | W/R |
| 4.2 | Finished Gauge Protection | Over Range Protection | Major | 130% of FSD | 100% | | | P | W | W/R |
| 4.3 | Casing | Dimension, Enclosure Type | Major | Measurement | 100% | | | P | W | W/R |
| 4.4 | Finished Gauge | Identification, Name plate detail, appearance & Cleanliness | Minor | Visual | 100% | | | P | W | W/R |
| 5 | Review of Documents | Weather Proof Test | Major | Environmental | Type test report | IS 2147 / IEC 60529 | As per Relevant Std | P | R | R |
| THERMOWELL | | | | | | | | | | |
| 1 | Raw material of Thermowell | Chemical Composition | Major | Analysis | One Sample | Approved Datasheet / Technical Specification | Approved Datasheet / Technical Specification | P | R | R |

| | | | | | | | | | | |
|---|------------|--|--|--|------|---|---|---|---|-----|
| 2 | Thermowell | a) Dimensions b) Hydro test c) Bore Concentricity test d) Visual e) Workmanship/Finish f) Spec/Tagging g) Threading h) Surface Finish TPI Inspection Reports & Inspection Release Note | Major Major Critical Major Major Major Critical Major | Measurement Testing Testing Observation Observation Visual Testing Visual | 100% | Approved Datasheet / Drawings Applicable STD | Approved Datasheet / Drawings Applicable STD | P | W | W/R |
| 3 | | | | | | | | H | P | R |

LEGEND: R: Review, W: Witness, P: Perform, H: Hold

Notes:


- 1). Material and Type shall be as per tender specification / datasheet.
- 2). All Testing & Measuring Instruments shall have valid Calibration with Calibration Certificates & Traceabilities.
- 3). Acceptance Norms/Acceptance Criteria for all the activities shall be as per specification/ data sheets/ applicable codes & standards etc.
- 4). GAIL and/or his representative reserve right for inspection at any stage of manufacturing of materials as per approved QAP.



GAIL INDIA LIMITED

QAP FOR INSTRUMENT CABLES

GAIL-STD-IN-DOC-QAP-006

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VENDOR LOGO



QAP for Instrument Cables

CUSTOMER:-

QAP NO.:-

REV.:-

SO NO.:-

DATE:-

PO NO.:-

PROJECT:-

REF DOCUMENT:-

| | | | | | | | | | | |
|----------|---------------------------------|--|----------------------------|--|----------------------|--|--|----------------------------|----------------------------|----------------------------|
| 1.2 | Insulation & Sheathing compound | 1. Tensile & Elongation before & after ageing 2. Type of compound 3. Thermal Stability | A C C | Visual Visual Physical | One sample per batch | IS 5831/ BS 5308(P-2) Relevant Standard as per Specification ASTM-D2863 | IS 5831/ BS 5308(P-2) Relevant Standard as per Specification Min. 30% Min 250deg C | P P P | R R R | R R R |
| | FR Test for FR PVC only | 1. Oxygen Index 2. Temperature Index | C C | Enviro Enviro | | | | P P | R R | R R |
| 1.3 | Armour | 1. Surface Condition 2. Uniformity of Zinc Coating 3. Mass of zinc coating 4. Tensile strength & elongation 5. Wrapping 6. Torsion/ Winding | A C B B B B | Visual Chemical Chemical Physical Physical Physical | One sample per batch | IS 3975/ BS 5308(P-2) Relevant Standard as per Specification | IS 3975/ BS 5308(P-2) Relevant Standard as per Specification | P P P P P P | R R R R R R | R R R R R R |
| 2 | Process Inspection | | | | | | | | | |
| 2.0 | Insulated core | 1. Type of Material 2. Thickness of Insulation (Avg. Min.) | B C | Visual Physical | Each setting & | BS 5308(P-2) & Relevant | BS 5308(P-2) & | P P | R R | R R |

| | | | | | | | | | | |
|-----|--------------|--|----------------------------|--|---|--|--|---|------------|---|
| 2.6 | Armouring | 1. No. of strips/wires | B | Visual | Starting of M/c & during process | BS 5308(P-2) & Relevant Standard as per Specification | BS 5308(P-2) & Relevant Standard as per Specification | P | R | R |
| | | | | | | | | P | R | R |
| | | | | | | | | P | R | R |
| 2.5 | Conductor | 1. Make up 2. Size/Dimensions 3. DC Resistance at 20deg C | B B C | Visual Physical Electrical | 100% spools at start & end | IS 8130/ BS 5308(P-2) & Relevant Standard as per Specification | IS 8130/ BS 5308(P-2) & Relevant Standard as per Specification | P | R | R |
| | | | | | | | | P | R | R |
| | | | | | | | | P | R | R |
| 2.6 | Outer Sheath | 1. Type of PVC Compound 2. Thickness Average/Minimum 3. Dia over Outer sheath 4. Colour 5. Surface finish 6. Embossing/ Printing/Sequential Marking | C C B B B B | Physical Physical Physical Visual Visual Visual | Setting & During running of M/c | BS 5308(P-2) & Relevant Standard as per Specification | BS 5308(P-2) & Relevant Standard as per Specification | P | R | R |
| | | | | | | | | P | R | R |
| | | | | | | | | P | R | R |
| | | | | | | | | P | R | R |
| | | | | | | | | P | R | R |
| | | | | | | | | P | R | R |
| 3 | Routine Test | 1. Conductor Resistance 2. Mutual Capacitance 3. Capacitance between core & screen 4. L/R Ratio 5. HV Test a) Core to core b) Core to shield/Armour 6. Spark Test a. Core b. Sheath 7. Test for rodent & termite repulsion | B B B C | Electrical Electrical Electrical Electrical Electrical | 100% Drums 10% Drums 10% Drums 10% Drums 100% Drums | IS 8130/ BS 5308(P-2) & Relevant Standard as per Specification | IS 8130/ BS 5308(P-2) & Relevant Standard as per Specification | P | R | R |
| | | | | | | | | P | R | R |
| | | | | | | | | P | R | R |
| | | | | | | | | P | R | R |
| | | | | | | | | P | R | R |
| | | | | | | | | P | R | R |
| | | | | | | | | P | R | R |
| | | | | | | | | P | R | R |
| | | | | | | | | P | R | R |
| | | | | | | | | P | R | R |
| | | | | | | | | P | R | R |
| | | | | | | | | P | R | R |
| | | | | | | | | 4 | Final Test | |
| P | R | R | | | | | | | | |

| 5.7 | Flammability test | FRLS Tests (FR PVC Only) | C | Enviro | One sample per lot | Relevant Standard as per Specification | Relevant Standard as per Specification | P | R | R |
|-----|-------------------|--------------------------|---|--------|--------------------|--|--|---|---|---|
| | | 1. Oxygen Index | | | | ASTM 2863 | Min. 30% | P | R | R |
| | | 2. Temperature Index | | | | ASTM 2863 | Min 250deg C | P | R | R |
| | | 4. Smoke Density | | | | ASTM 2843 | ASTM 2843 | P | R | R |
| | | 5. Acid Gas Generation | | | | IEC-754-1 | IEC-754-1 | P | R | R |
| | | 6. Swedish Chimney Test | | | | As per Relevant Standard | As per Relevant Standard | P | R | R |

LEGENDS: R: Review of Docs., A: Minor, B: Major, C: Critical, W: Witness


Notes:

- 1). All Testing and Measuring Equipments / Instruments shall have valid Calibration with Calibration Certificate & their Traceabilities.
- 2). Acceptance Norms/ Acceptance Criteria for all the activities shall be as per specification/ data sheets/ applicable codes & standards etc.
- 3). GAIL and/or his representative reserve right for inspection at any stage of manufacturing of materials as per approved QAP.
- 4). All Testing & Measuring Instruments shall have valid Calibration with Calibration Certificates & Traceabilities.



GAIL INDIA LIMITED

**QAP FOR PRESSURE SAFETY VALVES
GAIL-STD-IN-DOC-QAP-007**

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| REV | Date | Purpose of Issue | Prepared By | Checked By | Approved By | |



VEDOR LOGO



QUALITY ASSURANCE PLAN FOR PRESSURE SAFETY VALVE


| Sr No. | Components & Operation | Characteristics | Class | Type of Check | Quantum of Check | Reference document | Acceptance norm | Agency | | |
|------------------------|--|---|----------|-----------------|------------------|---|---|----------|-----|--------|
| | | | | | | | | Vendor | TPI | Client |
| 1 Raw Materials | | | | | | | | | | |
| 1.1 | Incoming materials like Forgings and castings for body, Bonnet & Nozzle, Springs, Bellows etc. | i. Material Properties (Mechanical & Chemical) ii. Size iii. Rating iv. Make v. Type | Major | Visual | 100% | As per clause 3.1 of EN 10204 for each valve body & Bonnet/forging, nozzle and clause 2.2 for stem, disc etc. | Manufacturers certificate of conformity | P | R | R |
| 1.2 | Machining of components & their assembly. | Dimensions, Finish | Major | Visual/Physical | 100% | Data sheet/Standard specification/Relevant code | Data sheet/Standard specification/Relevant code | P | R | R |
| 1.3 | Internal test/Inspection | i. Radiography of valve castings | Major | Visual/Physical | 100% | ANSI B16.34 | ANSI B16.34 annex.B | P | R | R |
| | | ii. Bend test & Magnetic Particle Inspection of Body & Bonnet casting | Major | Visual/Physical | 100% | | | P | R | R |
| | | iii. Charpy V -notch impact testing (If specified) | Major | Visual/Physical | 100% | | | P | R | R |
| | | iv. Visual check, Verification of tag plate/Marking, Accessories. | Major | visual | 100% | | | P | R | R |
| | | v. Helium Leak test | Major | Physical | 100% | Data sheet/Standard specification/Relevant code | Data sheet/Standard specification/Relevant code | P | R | R |
| | | vi. Dye Penetrant test of Welds. | Major | Physical | 100% | | | P | R | R |
| | | vii. Hydrostatic test. | Major | Physical | 100% | | | P | R | R |
| | | viii. Cold bench set pressure | Major | Physical | 100% | | | P | R | R |
| | | ix. Seat Leakage test | Major | Physical | 100% | | | P | R | R |
| | | x. Valve lift test. | Major | Visual/Physical | 100% | API RP 527 | API RP 527 | P | R | R |
| | | xi. Blow down/ Reclosing pressure test | Major | Physical | 100% | | | P | R | R |
| | | xii. Capacity test | Major | Physical | 100% | | | P | R | R |
| | | xiii. Post weld Heat treatment of weld joints | Major | Physical | 100% | | | P | R | R |
| 3 | Final Inspection Test | i. Dimensional, Finish, Visual check, Verification of tag plate/Marking, Accessories. | Major | Visual/Physical | 100% | Data sheet/Standard specification/Relevant code | Data sheet/Standard specification/Relevant code | P | W | W/R |
| | | ii. Helium Leak test | Critical | | | | | Physical | P | W |
| | | iii. Dye Penetrant test of Welds. | Major | Physical | | | | P | W | W/R |
| | | iv. Hydrostatic test. | Major | Physical | | | | P | W | W/R |
| | | v. Cold bench set pressure | Major | Physical | | | | P | W | W/R |
| | | vi. Seat Leakage test | Major | Physical | | P | W | W/R | | |
| | | vii. Valve lift test. | Major | Visual/Physical | | P | W | W/R | | |
| 4 | Review of Documents | i. Review of IBR certificate & Type test report for valves under IBR regulation (If Applicable) | Critical | Visual | 100% | Data sheet/Standard specification/Relevant code | Data sheet/Standard specification/Relevant code | P | R | R |
| | | ii. PWHT report/ Radiography reports/MPI reports | Critical | Visual | 100% | Data sheet/Standard specification/Relevant code | Data sheet/Standard specification/Relevant code | P | R | R |

| | | | | | | | | | |
|---|---|----------|--------|------|---|---|---|---|---|
| | iii. Capacity test as per ASME (Type test report) | Critical | Visual | 100% | Data sheet/Standard specification/Relevant code | Data sheet/Standard specification/Relevant code | P | R | R |
| | iv. Material test certificate | Major | Visual | 100% | As per clause 3.1 of EN 10204 for each valve body & Bonnet/forging, nozzle and clause 2.2 for stem, disc etc. | Data sheet/Standard specification/Relevant code | P | R | R |
| <p>LEGENDS: R: Review of Docs W: Witness P: Perform</p> <p>Notes:</p> <p>1). Acceptance Norms/ Acceptance Criteria for all the activities shall be as per specification/ data sheets/ applicable codes & standards etc.</p> <p>2). GAIL and/or his representative reserve right for inspection at any stage of manufacturing of materials as per approved QAP.</p> <p>3). All Testing & Measuring Instruments shall have valid Calibration with Calibration Certificates & Traceabilities.</p> | | | | | | | | | |



GAIL INDIA LIMITED

**QAP FOR PIG SIGNALLER
GAIL-STD-IN-DOC-QAP-008**

| | | | | | | |
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| REV | Date | Purpose of Issue | Prepared By | Checked By | Approved By | |



VENDOR LOGO



QUALITY ASSURANCE PLAN FOR PIG SIGNALLER

CUSTOMER:- END USER:-

SO NO.:- DATE:-

PO NO.:-

PROJECT:-

REF DOCUMENT:-

REV.:-

QAP NO.:-

| Sr. No. | Stage / Activity | Characteristics | Quantum of Check | Reference documents | Acceptance norm | Format of Record | Agency | | Remarks |
|--------------------------------|--|---|--|--|--|---|--------|----------------------|---------|
| | | | | | | | Vendor | TPI | |
| A Procedures | | | | | | | | | |
| a | Hydrostatic test, NDT, PWHT, Functional test and Visibility test | Documented Procedures | 100% | Approved Datasheet / Job Specification | Approved Datasheet / Job Specification | Procedure Documents | P | R | R |
| b | Welding Procedure Specification (WPS), Procedure Qualification Record (PQR), Welders Performance Qualification (WPQ) | Qualification requirements as per ASME Sec.IX and Purchase specification | 100% | Approved Datasheet / Job Specification | Approved Datasheet / Job Specification | WPS,POR & WPQ Records | P | W / R (Refer Note-3) | R |
| B Material Inspection | | | | | | | | | |
| a | Forgings for Trigger,Weldolet, Mounting Nozzle,etc at suppliers works | i) Chemical Properties ii)Tensile/Impact/Hardness/HIC (Hydrogen Induced Cracking) & other applicable tests iii) NDT (Non Destructive Testing) - As Applicable | Approved Datasheet / Job Specification | Approved Datasheet / Job Specification | Approved Datasheet / Job Specification | Material Test Certificates / Lab Test Reports | P | Mech- W, Rest-R | R |
| b | Forgings, Gaskets, Fasteners, Visual Indicator, Limit switch, and other material after receipt at suppliers works | i) Chemical Properties ii)Tensile/Impact/Hardness/HIC (Hydrogen Induced Cracking) & other applicable tests iii) NDT (Non Destructive Testing) - As Applicable | 100% | Approved Datasheet / Job Specification | Approved Datasheet / Job Specification | Material test certificates | - | R | R |
| C In process Inspection | | | | | | | | | |
| a | Machining of Components | Visual & Dimensional | 100% | Approved Datasheet / Job Specification | Approved Datasheet / Job Specification | Suppliers Records | P | R | - |


| | | | | | | | | | |
|---|---|--|-----------|---|---|--|---|--------------------------|-----|
| b | Inspection of Welds | i) Visual ii) Applicable NDT | 100% | Approved Datasheet / Job Specification | Approved Datasheet / Job Specification | Test Reports | P | W/R (Refer Note-1) | R |
| c | Heat Treatment | Heat treatment as applicable | 100% | Approved Datasheet / Job Specification | Approved Datasheet / Job Specification | HT Chart/Record | P | R | |
| D | Final Inspection | | | | | | | | |
| a | Functional Test | Satisfactory Performance | 100% | Approved Datasheet / Job Specification | Approved Datasheet / Job Specification | Test Reports | P | W | W/R |
| b | Hydrostatic Test | Leak Check | 100% | Approved Datasheet / Job Specification | Approved Datasheet / Job Specification | Test Reports | P | W | W/R |
| c | Visual and Dimensional Inspection | Dimensions & Completeness of Assembly | 100% | Approved Datasheet / Job Specification | Approved Datasheet / Job Specification | Inspection Record | P | W | W/R |
| E | Painting | | | | | | | | |
| a | Corrosion Resistant Painting & / or Antifouling Coating (As Applicable) | i) Painting Scheme ii) Visual Check iii) Final DFT Check | 100% | Approved Datasheet / Job Specification | Approved Datasheet / Job Specification | Inspection Record | P | R | R |
| F | Documentation and IC | | | | | | | | |
| a | Final Documentation & Inspection Certificate(IC) | Issue of IC & Final document completeness certificate | As per PR | Approved Datasheet / Job Specification | Approved Datasheet / Job Specification | IC & Document completeness certificate | H | P | R |
| Legend: | | | | | | | | | |
| H- Hold (Do not proceed without approval), Random -10% (min. 1 no.) of each size and type of Bulk item, R-Review, W-Witness (Give due notice, work may proceed after scheduled date). | | | | | | | | | |
| Notes: | | | | | | | | | |
| 1). Inspection Engineer shall decide the option to be exercised for the particular stage and Suppliers | | | | | | | | | |
| 2). Forgings for Trigger, Weldolet, Mounting Nozzle, etc Shall be procured duly inspected by TPIA appointed by Supplier. | | | | | | | | | |
| 3). Witness-If New PQR / Applicable PQR is not qualified under reputed TPIA. Review-If Applicable PQR is qualified under reputed TPIA. | | | | | | | | | |
| 4) Supplier's in house procedures may be accepted in case TPIA is satisfied with adequacy of procedures to comply with Purchase Order/Specifications requirements; in case of non availability of suitable procedure s fresh procedures may be qualified under EIL witness. | | | | | | | | | |
| 5). In case of conflict between purchase specification, contract documents and QAP more stringent conditions shall be applicable. | | | | | | | | | |
| 6). This document describes generally the requirements pertaining to all types of the item. Requirements specific to PO and the item are only applicable. | | | | | | | | | |
| 7). Acceptance Norms/ Acceptance Criteria for all the activities shall be as per relevant/ job specification / Standard specification / data sheets/applicable codes & Standards etc. referred there in /Job Specification /Approved Documents. | | | | | | | | | |



GAIL INDIA LIMITED

QAP FOR GAS DETECTOR

GAIL-STD-IN-DOC-QAP-009

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| REV | Date | Purpose of Issue | Prepared By | Checked By | Approved By | Lyons Engineering Pvt. Ltd | |



VENDOR LOGO



QUALITY ASSURANCE PLAN FOR GAS DETECTOR

CUSTOMER:- END USER:- QAP NO.:- REV.:-
 SO NO.:- DATE:-
 PO NO.:-
 PROJECT:-
 REF DOCUMENT:-

| Sr No. | Components & Operation | Characteristics | Class | Type of Check | Quantum of Check | Reference document | Acceptance norm | Agency | | |
|--------|---|---|--|---|------------------------------|--|--|------------------|------------------|------------------|
| | | | | | | | | Vendor | TPI | GSPL |
| 1 | Raw Materials | | | | | | | | | |
| 1.1 | Gas detectors, Portable gas detectors & Power supply units, | i. Material Properties ii. Size iii. Rating iv. Make v. Type/Model No. | Major | Visual | 100% | Clause 2.2 of DIN 50049/BS EN-50054 & 50057 | Manufacturers certificate of conformity | P | R | R |
| 2 | In Process Inspection | | | | | | | | | |
| 2.2 | Internal test/Inspection | i. Calibration check of gas detectors including alarm. ii. General Finish & Physical Verification of -Model no. - Range - Serial no. -Tag no. - Certification label - Accessories iii. Bill of material check iv. Interface with RTU v. Checking of all power wiring for continuity. vi. Checking of all control wiring for continuity & Polarity | Critical Major Major | Electrical/Physical Visual Visual Physical / Electrical Electrical/Physical Physical Physical | 100% | BS EN-50054/BS EN-50057/Relevant Drawing | BS EN-50054/BS EN-50057 | P | R | R |
| 3 | Witness Test Inspection | i. Calibration check of gas detectors including alarm. ii. Interface with SCADA/RTU | Critical Critical | Electrical/Physical Physical | | | | P | W | W/R |
| 4 | Review of Documents | i. Statuary approval certificates (BIS or equivalent) for gas detectors, portable detectors etc. for use in specified Hazardous area. ii. Certificates from testing agencies like BASEEFA, CENELEC, CMRI, FM, PTB, CCOE/PESO or equivalent for gas detectors, portable detectors, Junction boxes etc. for use in specified Hazardous area. iii. Degree of Protection iv. Material test certificate with detailed chemical analysis (MIL certificate) | Critical Critical Critical Critical | Visual Visual Visual Visual | 100% 100% 100% 100% | IS-2148/IEC-79 IS-2148/IEC-79 IS-2147/IEC-529 Clause 2.2 of DIN 50049/BS EN-50054 & 50057 | IS-2148/IEC-79 IS-2148/IEC-79 IS-2147/IEC-530 Clause 2.2 of DIN 50049/BS EN-50054 & 50057 | P P P P | R R R R | R R R R |


LEGENDS: R: Review of Docs, W: Witness, P: Perform
 Notes:
 1). Acceptance Norms/ Acceptance Criteria for all the activities shall be as per relevant specification/ data sheets/ applicable codes & standards etc. referred there in /Job Specification /Approved Documents.







GAIL INDIA LIMITED

GAS OVER OIL ACTUATOR

GAIL-STD-IN-DOC-QAP-010

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|------------|-------------|-------------------------|--------------------|-------------------|--------------------|---|
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| 0 | 15.01.2019 | Issued for Bid | RKS | UNU | UNU | |
| REV | Date | Purpose of Issue | Prepared By | Checked By | Approved By | |

|  | | QUALITY ASSURANCE PLAN GAS OVER OIL ACTUATOR | | | | | | DOC.No. GAIL-STD-IN-DOC-QAP-010 | |  | |
|---|--|---|------------------------|------------------------|-------------------------|---------------------------|-------------------------|--|----------------------|---|--|
| | | Sr. No. | Stage /Activity | Characteristics | Quantum of Check | Reference Document | Acceptance Norms | Format Of Records | Inspection By | Remarks | |
| 1 | Procedures | -- | -- | | | | | | | | |
| 2 | Material Description | | | | | | | | | | |
| 2.1 | Incoming material like Control Valves, Solenoid Valves,Gaskets,Junction Boxes, Flow regulators, Hydraulic filters, Gas Filters, Limit Switches, Instrument tubing,Cables,Hydraulic Pumps,Limit Valves, Pressure Gauges, etc. | 1. Matreial Identification & Chemical Composition 2. Mechanical & Physical properties 3. Operational Checks 4. Caliberation Checks (As applicable) | 100% by Supplier | Refer note -6 | Refer note -5 | Material test Certificate | p | H | | | |
| 2.2 | Oil Tanks | Hydrostatic Pressure test | 100% by Sub Supplier | Refer note -6 | Refer note -5 | Material test Certificate | p | H | | | |
| 2.3 | Gas Buffer Tanks | Hydrostatic Pressure test | 100% by Sub Supplier | | | Material test Certificate | p | H | | | |
| 2.4 | Hydraulic Fluid | 1. Chemical Composition 2. Cleanliness Levels | 100% by Sub Supplier | Refer note -6 | Refer note -5 | Material test Certificate | p | H | | | |
| 3 | In Process Inspection | | | | | | | | | | |
| 3.1 | Castings of pressure Contating Parts | Radiograph test | 100% by Supplier | Refer note -6 | Refer note -5 | Supplier's test record | - | H | | | |
| 3.2 | Forgings | Ultrasonic testing | 100% by Supplier | Refer note -6 | Refer note -5 | Supplier's test record | - | H | | | |
| 3.3 | Machined Surface | Liquid Penetrent test | 100% by Supplier | Refer note -6 | Refer note -5 | Supplier's test record | - | H | | | |
| | Sealing areas within the actuator body | Magnetic particle Testing | 100% by Supplier | Refer note -6 | Refer note -5 | Supplier's test record | - | H | | | |
| | Actuator body | Pressure test for Flame proof Enclosure | 100% by Supplier | Refer note -6 | Refer note -5 | Supplier's test record | - | H | | | |
| | Complete Assembly | 1. Visual, Dimensional & BOM 2. Operation Checks | 100% by Supplier | Refer note -6 | Refer note -5 | Supplier's test record | - | H | | | |
| 4 | Final Inspection | | | | | | | | | | |

|  | | QUALITY ASSURANCE PLAN GAS OVER OIL ACTUATOR | | | | | DOC.No. GAIL-STD-IN-DOC-QAP-010 | |  | |
|---|--|---|--|--------------------|------------------|------------------------|--|----------|---|--|
| Sr. No. | Stage /Activity | Characteristics | Quantum of Check | Reference Document | Acceptance Norms | Format Of Records | Inspection By | | Remarks | |
| | | | | | | | Sub Supplier | supplier | | |
| 4.1 | Final Inspection (At Actuator Manufacturer's Works) | 1. Visual, Dimensional Checks 2. Bill of Material 2. Verification of Tag no. and Plate no. 4. Hydrostatics test at 1.5 times the actuator Design pressure for min. 2 hrs. 5. Check for Actuator torque or Thrust 6. Seal test of Hydraulic Circuits 7. Verification of opening and closing time and control of operating time 8. Actuator functional test including open close operations (at Least 5 times) Remote operation of actuator and checking of all remote feedbacks and signals, Local operation of actuator, operation of limit switches and position indicators (mechanical & Electrical) 9. Check for Emergency manual override. | 100% by Supplier and on random basis by EIL/TPIA | Refer note -6 | Refer note -5 | Supplier's test record | - | P | | |
| 4.2 | Integral Testing | Valve/Actuator assembly test at valve manufacturer's work. The following as a minimum shall be Carried out - Open/Close Operations. (at min. & Max. Pressure. -Stroke time (if applicable) -No Load test or Load operations with the min. Required feeding pressure. - Electrical and Mechanical Operation test. | 100% of each type and rating | Refer note -6 | Refer note -5 | Supplier's test record | - | P | | |
| 5 | Painting | | | | | | | | | |



QUALITY ASSURANCE PLAN GAS OVER OIL ACTUATOR

DOC.No.
GAIL-STD-IN-DOC-QAP-010



| Sr. No. | Stage /Activity | Characteristics | Quantum of Check | Reference Document | Acceptance Norms | Format Of Records | Inspection By | | Remarks |
|--|-----------------------------|--|------------------|--------------------|------------------|------------------------|---------------|----------|---------|
| | | | | | | | Sub Supplier | supplier | |
| 5.1 | Painting & Packing | 1. Visual 2. Suitable protection to prevent entry of foreign material 3. Protection against damage during transportation 4. Suitable packing for outdoor storage areas with heavy rains/high ambient temprature ubnless otherwise agreed | 100% | Refer note -6 | Refer note -5 | Supplier's test record | - | W | |
| 6 | Documentation and IC | 1. Certificate for testing agency like ATEX, CIMFR, BASEEFA, FM/UL, PTB etc. for suitability in specified hazardous area. 2. Statutory approval certificates from CCE/PESO for use in specified hazardous area. 3. Degree of protection certificate for actuator enclosure, JB, Solenoid Enclosure, Limit switches etc. 4. Flameproof Certification for cable glands, Relays, Valves etc from independent testing agency. 4. A valid BIS license for indigenous supply. 5. Operation and maintenance manual | 100% | Refer note -6 | Refer note -5 | Supplier's test record | - | R | |
| - Supplier to submit internal test reports, type test reports before offering items for inspection to TPIA. *Radiography Films shall be reviewed | | | | | | | | | |
| Legend : M : Manufacturer NA : Not Applicable C : Client (GAIL) W / R : Witness of Test & Review of Certificates & Documents as per QAP A : Approval H : Hold R : Review W : Witness RW : Random Witness | | | | | | | | | |
| Notes: 1 wherever W/R or H/W is indicated, inspection Engineer shall decide the option to be exercised for the particular stage and supplier. 2 In case of conflict between purchase specification, contract documents and ITP, more stringent conditions shall be applicable. 3 This document describes generally the requirements pertaining to all types of the items. Requirements specific to PO and the item are only applicable 4 Acceptance norms/ acceptance criteria for all the activities shall be as per relevant/job specification/standard specification/data sheets/applicable codes & standard etc. referred there in /job specification/approved documents. 5 Reference documents are relevant. Job specifications /standard specifications/data sheets/applicable codes & standards | | | | | | | | | |



LYONS ENGINEERING PVT. LTD.
NEW DELHI

INSTRUMENT CONNECTION ON VESSEL,
STANDPIPES AND TANKS

DRAWING NO.

GAIL-ENG-IN-DWG-TP-001

1 OF 4

INSTRUMENT CONNECTION ON VESSEL, STANDPIPES AND TANKS

| REV.NO. | DATE | SUBJECT OF REVISION | BY | CHECKED | APPROVED |
|---------|----------|---------------------|-----|---------|----------|
| 0 | 15.01.19 | ISSUED FOR TENDER | D.V | U.N | S.B |



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INSTRUMENT CONNECTION ON VESSEL,
STANDPIPES AND TANKS

DRAWING NO.

GAIL-ENG-IN-DWG-TP-001

2 OF 4

| S.NO. | TYPE OF INSTRUMENTS | UNCLADDED EQUIPMENTS | | CLADDED EQUIPMENTS | | INSTRUMENT CONNECTION |
|-------|--|--------------------------------|-------------------|--------------------------------|-------------------|-----------------------|
| | | EQUIPMENT/STANDPIPE CONNECTION | FIRST BLOCK VALVE | EQUIPMENT/STANDPIPE CONNECTION | FIRST BLOCK VALVE | |
| 1. | EXTERNAL DISPLACER LEVEL INSTRUMENT ON EQUIPMENT | 2" FLGD. | 2" FLGD. | 3" FLGD. | 3" FLGD. | 2" FLGD. |
| 2. | EXTERNAL DISPLACER LEVEL INSTRUMENT ON STANDPIPE | 2" FLGD. | 2" FLGD. | 2" FLGD. | 2" FLGD. | 2" FLGD. |
| 3. | EXTERNAL GUIDED WAVE LEVEL INSTRUMENT ON EQUIPMENT | 2" FLGD. | 2" FLGD. | 3" FLGD. | 3" FLGD. | 2" FLGD. |
| 4. | EXTERNAL GUIDED WAVE LEVEL INSTRUMENT ON STANDPIPE | 2" FLGD. | 2" FLGD. | 2" FLGD. | 2" FLGD. | 2" FLGD. |
| 5. | EXTERNAL MAGNETIC LEVEL INSTRUMENT/ GAUGE ON EQUIPMENT | 2" FLGD. | 2" FLGD. | 3" FLGD. | 3" FLGD. | 2" FLGD. |
| 6. | EXTERNAL MAGNETIC LEVEL INSTRUMENT/ GAUGE ON STANDPIPE | 2" FLGD. | 2" FLGD. | 2" FLGD. | 2" FLGD. | 2" FLGD. |
| 7. | EXTERNAL BALL FLOAT LEVEL INSTRUMENT ON VESSEL | 2" FLGD. | 2" FLGD. | 3" FLGD. | 3" FLGD. | 1" SW. |
| 8. | EXTERNAL BALL FLOAT LEVEL INSTRUMENT ON STANDPIPE | 1" SW/BW # | 1" SW/BW # | 1" SW/BW # | 1" SW/BW # | 1" SW |
| 9. | INTERNAL DISPLACER / FLOAT LEVEL INSTRUMENTS | 4" FLGD. | - | - | 4" FLGD. | 4" FLGD. |
| 10. | INTERNAL GUIDED WAVE LEVEL INSTRUMENT ON EQUIPMENT | 4" FLGD. | - | - | 4" FLGD. | 4" FLGD. |
| 11. | MAGNETIC LEVEL INSTRUMENT/ GAUGE (INTERNAL - TOP MOUNTED) | 4" FLGD. | - | - | 4" FLGD. | 4" FLGD. |
| 12. | LEVEL GAUGE ON VESSEL | 2" FLGD. | 2" FLGD. | 3" FLGD. | 3" FLGD. | 3/4" SCRD. |
| 13. | LEVEL GAUGE ON STANDPIPE | 3/4" SW/BW # | 3/4" SW/BW # | 3/4" SW/BW # | 3/4" SW/BW # | 3/4" SCRD. |
| 14. | SPECIAL LEVEL INSTRUMENT ON EQUIPMENT (CAPACITANCE PROBE/ULTRASONIC PROBE/R.F.PROBE) | 2" FLGD. | - | 3" FLGD. | - | 2" FLGD. |
| 15. | D.P. INSTRUMENT/ GAUGES ON VESSEL | 2" FLGD. | 2" BW/FLGD # | 3" FLGD. | 3" FLGD. | 3/4" SCRD. |
| 16. | D.P. INSTRUMENT/ GAUGES ON STANDPIPE | 3/4" SW/BW # | 3/4" SW/BW # | 3/4" SW/BW # | 3/4" SW/BW # | 1/2" SCRD. |
| 17. | DIAPHRAGM SEAL D.P.IN STRUMENT/ GAUGES ON VESSEL | | 3" FLGD. | 3" FLGD. | 3" FLGD. | 3" FLGD. |
| 18. | EXTENDED DIAPHRAGM SEAL D.P. INSTR/ GAUGE ON VESSEL | 4" FLGD.(NOTE-1) | 4" FLGD.(NOTE-1) | - | 3" FLGD. | 4" FLGD. |

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INSTRUMENT CONNECTION ON VESSEL,
STANDPIPES AND TANKS

DRAWING NO.

GAIL-ENG-IN-DWG-TP-001

3 OF 4

| S.NO. | TYPE OF INSTRUMENTS | UNCLADDED EQUIPMENTS | | CLADDED EQUIPMENTS | | INSTRUMENT CONNECTION |
|-------|---|--------------------------------|----------------------|--------------------------------|-------------------|-----------------------|
| | | EQUIPMENT/STANDPIPE CONNECTION | FIRST BLOCK VALVE | EQUIPMENT/STANDPIPE CONNECTION | FIRST BLOCK VALVE | |
| 19. | DIP TUBE LEVEL INSTRUMENT | 6" FLGD. | 1/2" SW (BY INST) | 6" FLGD. | 1/2" SW (BY INST) | 1/2" SCRD. |
| 20. | TANK LEVEL INSTRUMENT (MECHANICAL) | 1/2" FLGD. | 1/2" FLGD. (BY INST) | - | - | 1/2" SCRD. |
| 21. | TANK LEVEL INSTRUMENT (SERVO) ON ATMOSPHERIC TANKS | 6" FLGD. | - | - | - | 6" FLGD. |
| 22. | TANK LEVEL INSTRUMENT (SERVO) FOR PRESSURISED EQUIPMENT | 6" FLGD. | 6" FLGD.(BY INST) | 6" FLGD. | 6" FLGD.(BY INST) | 6" FLGD. |
| 23. | TANK LEVEL INSTRUMENT (RADAR) ON ATMOSPHERIC TANK (CLEAN SERVICE) | 8" FLGD. | - | - | - | 8" FLGD. |
| 24. | TANK LEVEL INSTRUMENT (RADAR) ON ATMOSPHERIC TANK (VISCIOUS SERVICE) | 24" FLGD. | - | - | - | 24" FLGD. |
| 25. | TANK LEVEL INSTRUMENT (RADAR) FOR PRESSURISED EQUIPMENTS | 8" FLGD. | - | 8" FLGD. | - | 8" FLGD. |
| 26. | TANK LEVEL INSTRUMENT - CAPACITANCE / ULTRASONIC/ RF TYPE ON ATMOSPHERIC TANKS/PRESSURISED EQUIPMENTS | 2" FLGD. | - | 3" FLGD. | - | 2" FLGD. |
| 27. | TANK LEVEL INSTRUMENT - TUNING FORK | 3" FLGD. | - | - | - | 3" FLGD. |
| 28. | PRESSURE INSTRUMENT/ GAUGE ON VESSEL | 2" FLGD. | 2" BW/FLGD. # | 3" FLGD. | 3" BW/FLGD. # | 1/2" SCRD. |
| 29. | PRESSURE INSTRUMENT/ GAUGE ON STANDPIPE | 3/4" SW/BW # | 3/4" SW/BW # | 3/4" SW/BW # | 3/4" SW/BW # | 1/2" SCRD. |
| 30. | CHEMICAL SEAL PRESSURE INSTRUMENT/ GAUGE ON VESSEL | 2" FLGD. | 2" FLGD. | 3" FLGD. | 3" FLGD. | 1/2" SCRD. |
| 31. | DIAPHRAGM SEAL PRESSURE INSTRUMENT /GAUGE ON VESSEL | 2" FLGD. | 2" FLGD. | 3" FLGD. | 3" FLGD. | 2" FLGD. |
| 32. | THERMOWELL ON EQUIPMENT | 2" FLGD. | - | 3" FLGD. | - | 2" FLGD./ 3" FLGD. |
| 33. | MULTI-POINT TEMPERATURE ELEMENTS FOR TANKS | 3" FLGD. | - | 3" FLGD. | - | 3" FLGD. |
| 34. | STANDPIPE (RATING UP TO 600#) | 2" FLGD. | - | 3" FLGD. | - | - |
| 35. | STANDPIPE (RATING > 600#) | 3" FLGD. | - | 3" FLGD. | - | - |

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INSTRUMENT CONNECTION ON VESSEL,
STANDPIPES AND TANKS

DRAWING NO.

GAIL-ENG-IN-DWG-TP-001

4 OF 4

NOTES:

1. O.D OF EXTENDED DIAPHRAGM OF INSTRUMENT SHALL BE SELECTED TO SUIT NOZZLE I.D OF EQUIPMENT.
2. ALL FLANGES/SW RATING SHALL BE AS PER PIPING SPECIFICATION UNLESS PROJECT SPECIFICATION REQUIRES MIN. 300#.
3. IN CASE OF DIRECT MOUNTED FLANGED INSTRUMENTS AND WHERE FLANGED TYPE FIRST ISOLATION VALVE ARE PROVIDED, BOLTING AND GASKETS SHALL BE IN PIPING SCOPE.
4. INSTALLATION OF STILL WELL OF TANK LEVEL INSTRUMENTS (SERVO, MECHANICAL AND MULTIPOINT TEMPERATURE ELEMENT) ON TANKS ARE IN TANK VENDOR SCOPE
5. FOR ANY OTHER INSTRUMENTS NOT REFERED ABOVE THE CONNECTION DETAILS SHALL BE AS PER PROJECT REQUIREMENT.
6. AS PER PIPING SPECIFICATION/PROJECT PHILOSOPHY.

| REV.NO. | DATE | SUBJECT OF REVISION | BY | CHECKED | APPROVED |
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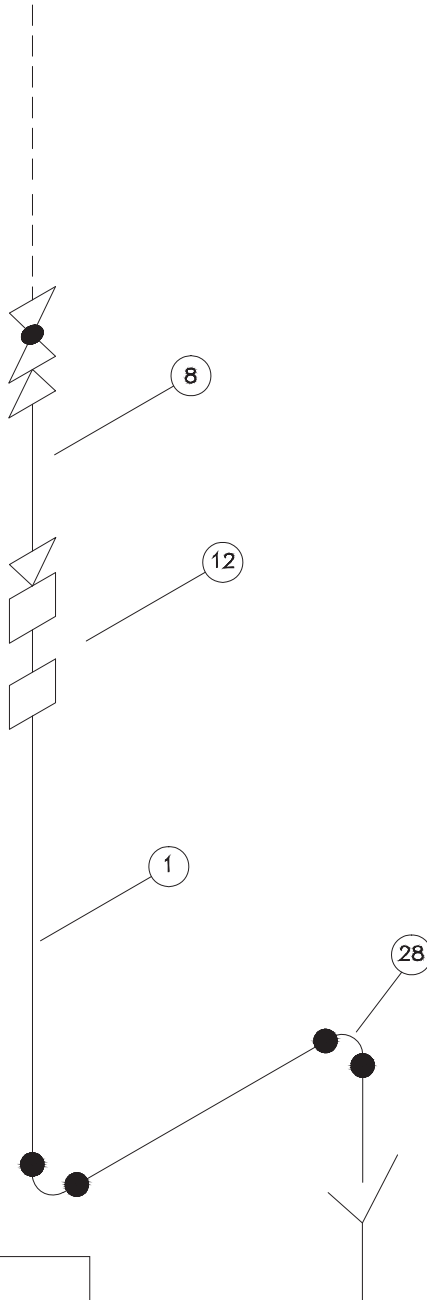
LYONS ENGINEERING PVT. LTD.
NEW DELHI

DARIN FOR SINGLE LINE

DRAWING NO.

GAIL-ENG-IN-DWG-TP-002

1 OF 1



LIST OF ITEMS

| CODE | DESCRIPTION | SIZE | ENDS | QTY. | UNIT |
|------|-------------|------|---------|------|------|
| 1 | PIPE | 1/2" | PL | A/R | m |
| 8 | NIPPLE | 1/2" | TH X TH | 1 | No |
| 12 | COUPLING | 1/2" | TH | 1 | No |
| 28 | ELBOW | 1/2" | SW | 2 | No |
| | | | | | |
| | | | | | |
| | | | | | |

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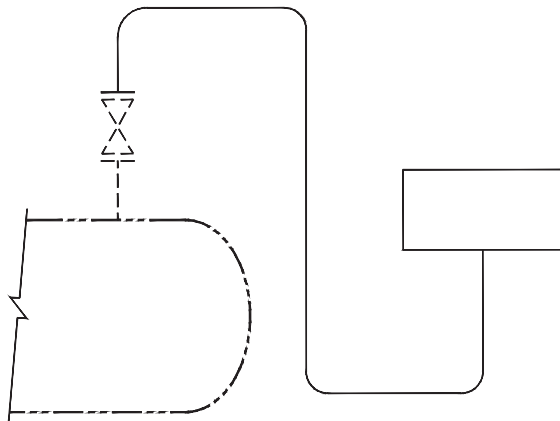
**PRESSURE INSTRUMENT
INSTALLATION
SCOPE OF WORK**

DRAWING NO.

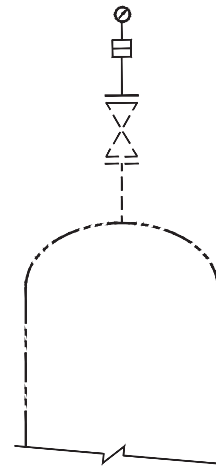
GAIL-ENG-IN-DWG-TP-003

1 OF 3

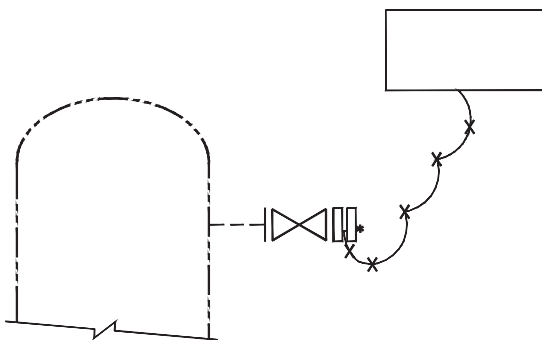
**(P-1) PRESSURE INSTRUMENT
ON VESSEL**



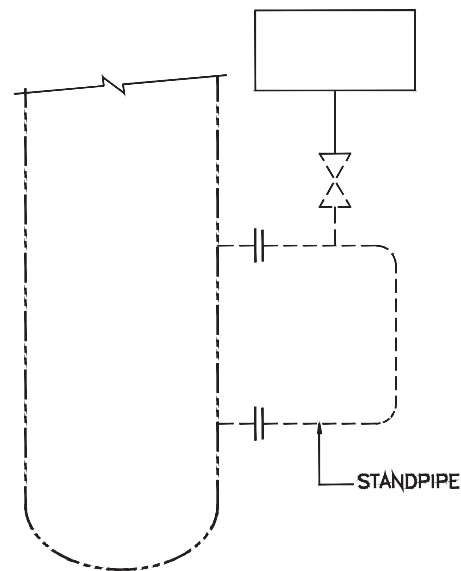
**(P-2) CHEMICAL SEAL PRESSURE
GAUGE
(SCRD.) ON VESSEL**



**(P-3) DIAPHRAGM SEAL PRESS.
INST./GAUGE
(FLGD.) ON VESSEL WITH CAPILLARY**



**(P-4) PRESSURE INSTRUMENT
ON STAND PIPE**



NOTES:

- * STUD LENGTH = STANDARD LENGTH + 3" STUD & NUTS BY INSTRUMENT GROUP
- 1. REFER STANDARD NO. SD-IC-001 FOR SIZE AND CONNECTION TYPE OF ISOLATION VALVE.

————— INSTRUMENT GROUP
 - - - - - PIPING GROUP
 - - - - - VESSEL GROUP

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| 0 | 15.01.19 | ISSUED FOR TENDER | D.V | U.N | S.B |
| REV.NO. | DATE | SUBJECT OF REVISION | BY | CHECKED | APPROVED |



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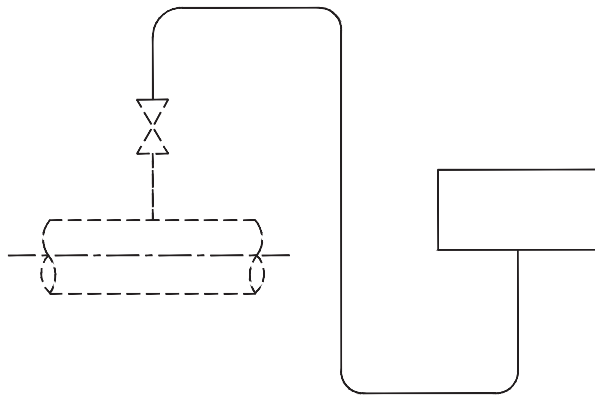
**PRESSURE INSTRUMENT
INSTALLATION
SCOPE OF WORK**

DRAWING NO.

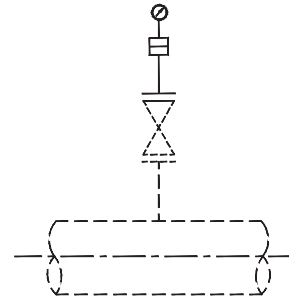
GAIL-ENG-IN-DWG-TP-003

2 OF 3

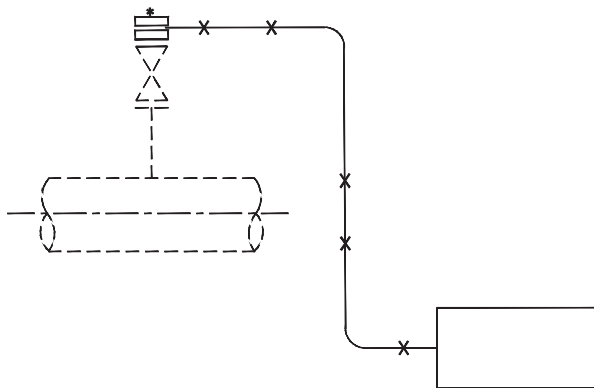
**(P-5) PRESSURE INSTRUMENT
ON PIPE**



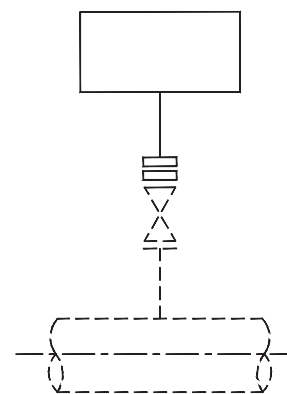
**(P-6) CHEMICAL SEAL
PRESSURE GAUGE (SCRD.) ON PIPE**



**(P-7) DIAPHRAGM SEAL PRESSURE
INST./
GAUGE ON PIPE WITH CAPILLARY**



**(P8) DIAPHRAGM SEAL PRESSURE
INST./
GAUGE (FLGD) ON PIPE**



NOTES:

* STUD LENGTH = STANDARD LENGTH + 3" STUD & NUTS BY INSTRUMENT GROUP.

1. REFER STANDARD NO. SD-IC-001.

FOR SIZE AND CONNECTION TYPE OF ISOLATION VALVE.

————— INSTRUMENT GROUP
- - - - - PIPING GROUP
- - - - -

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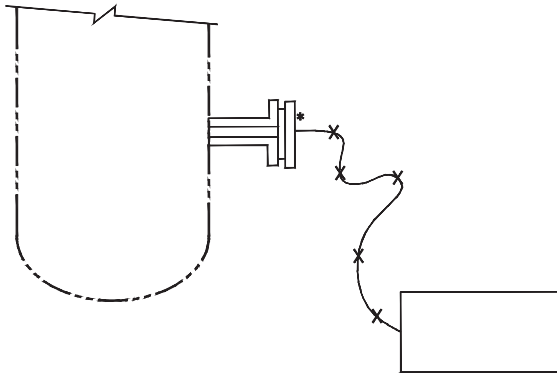
**PRESSURE INSTRUMENT
INSTALLATION
SCOPE OF WORK**

DRAWING NO.

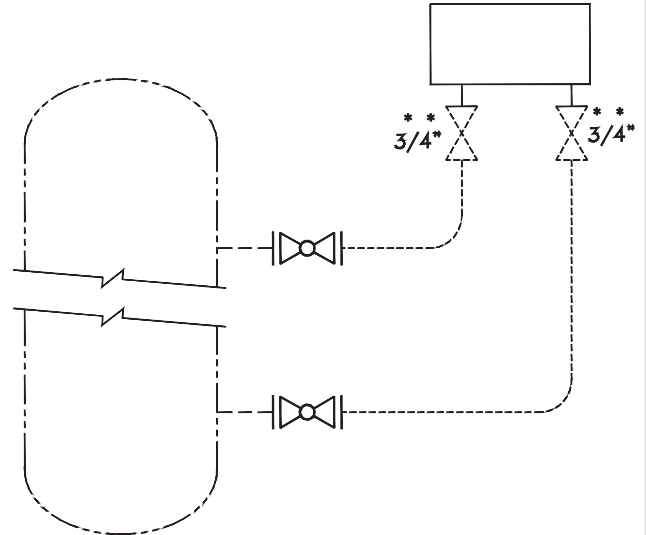
GAIL-ENG-IN-DWG-TP-003

3 OF 3

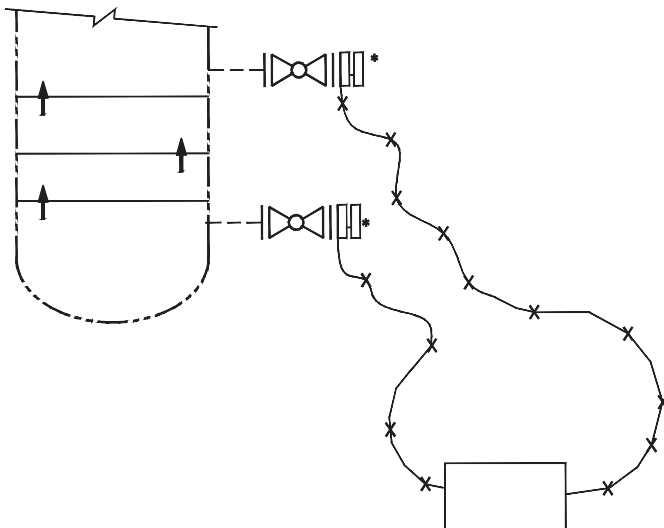
**(P-9) PRESSURE INSTRUMENT
EXTENDED DIAPHRAGM SEAL ON
VESSEL**



**(P-10) DIFFERENTIAL PRESSURE
INSTRUMENT
ACROSS COLUMN**



**(P-11) DIAPHRAGM SEAL
DP INSTRUMENT ON EQUIPMENT**



NOTES:

*STUD LENGTH = STANDARD LENGTH + 3" STUD & NUTS BY INSTRUMENT GROUP

** PROVIDE AT THE PLATFORM ABOVE THE UPPER TAP-OFF POINT.

1. REFER STANDARD NO. SD-IC-001.

FOR SIZE AND CONNECTION TYPE OF ISOLATION VALVE.

————— INSTRUMENT GROUP
- - - - - PIPING GROUP
- - - - - VESSEL GROUP

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| 0 | 15.01.19 | ISSUED FOR TENDER | D.V | U.N | S.B |
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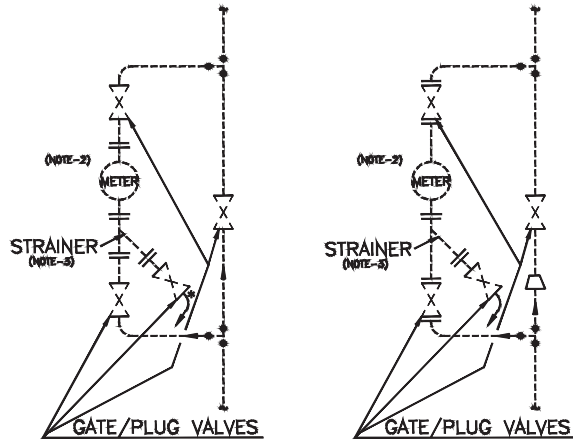
FLOW METER
INSTALLATION
SCOPE OF WORK

DRAWING NO.

GAIL-ENG-IN-DWG-TP-004

1 OF 8

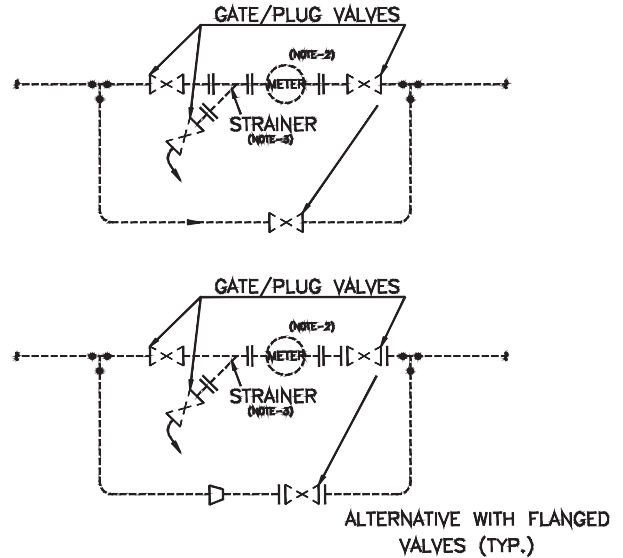
POSITIVE DISPLACEMENT METER IN
VERTICAL LINE



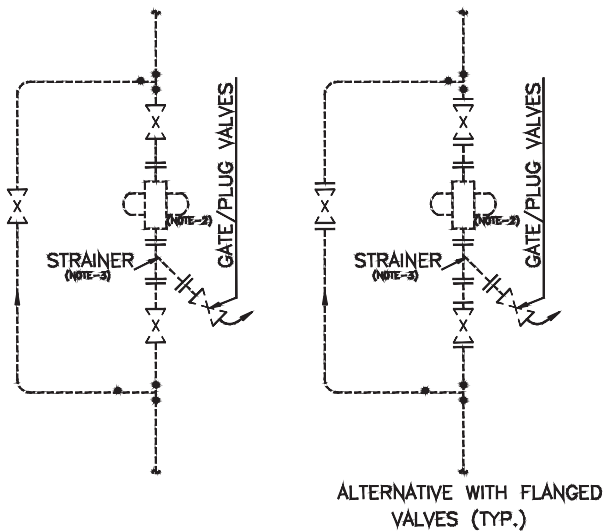
* DRAIN (TYP.)

ALTERNATIVE WITH FLANGED
VALVES (TYP.)

POSITIVE DISPLACEMENT METER IN
HORIZONTAL LINE

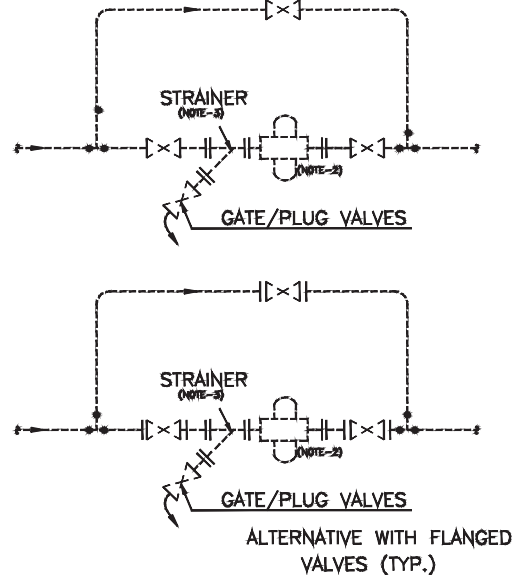


MASS FLOW METER IN VERTICAL LINE



ALTERNATIVE WITH FLANGED
VALVES (TYP.)

MASS FLOW METER IN HORIZONTAL LINE



ALTERNATIVE WITH FLANGED
VALVES (TYP.)

NOTES:

1. ENTIRE INSTALLATION SHOWN IS BY PIPING / MECHANICAL CONTRACTOR, P & ID SHALL BE REFERRED FOR FINAL SCHEME.
2. PROCUREMENT BY INSTRUMENT GROUP.
3. PROCUREMENT BY PIPING / INSTRUMENT GROUP AS PER P&ID.
4. PROCUREMENT OF OTHER ITEMS NOT COVERED IN NOTE-2 & NOTE-3 BY PIPING.

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| 0 | 15.01.19 | ISSUED FOR TENDER | D.V | U.N | S.B |
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NEW DELHI

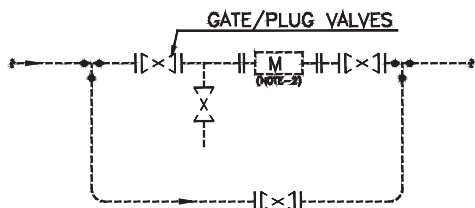
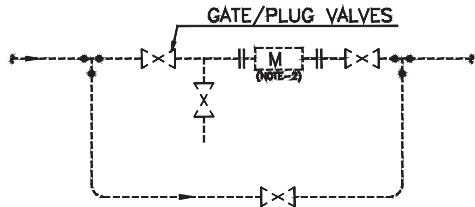
FLOW METER
INSTALLATION
SCOPE OF WORK

DRAWING NO.

GAIL-ENG-IN-DWG-TP-004

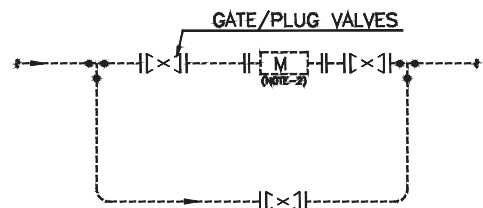
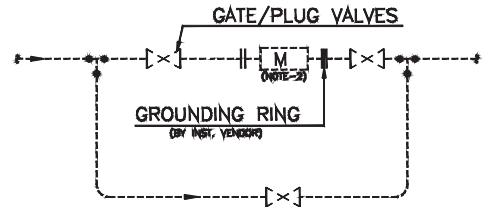
2 OF 8

MAGNETIC FLOW METER
(UNLINED PIPE)



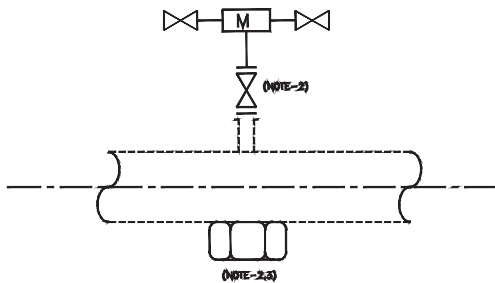
ALTERNATIVE WITH FLANGED
VALVES (TYP.)

MAGNETIC FLOW METER (LINED PIPE)

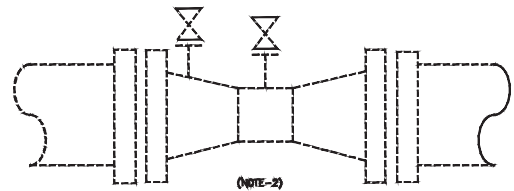


ALTERNATIVE WITH FLANGED
VALVES (TYP.)

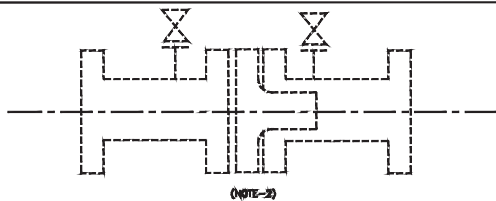
AVERAGING PITOT TUBE



VENTURI TUBE



FLOW NOZZLE



NOTES:

1. ENTIRE INSTALLATION SHOWN IS BY PIPING / MECHANICAL CONTRACTOR, P & ID SHALL BE REFERRED FOR FINAL SCHEME.
2. PROCUREMENT BY INSTRUMENT GROUP.
3. PROCUREMENT BY PIPING / INSTRUMENT GROUP AS PER P&ID.
4. PROCUREMENT OF OTHER ITEMS NOT COVERED IN NOTE-2 & NOTE-3 BY PIPING.

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| 0 | 15.01.19 | ISSUED FOR TENDER | D.V | U.N | S.B |
| REV.NO. | DATE | SUBJECT OF REVISION | BY | CHECKED | APPROVED |

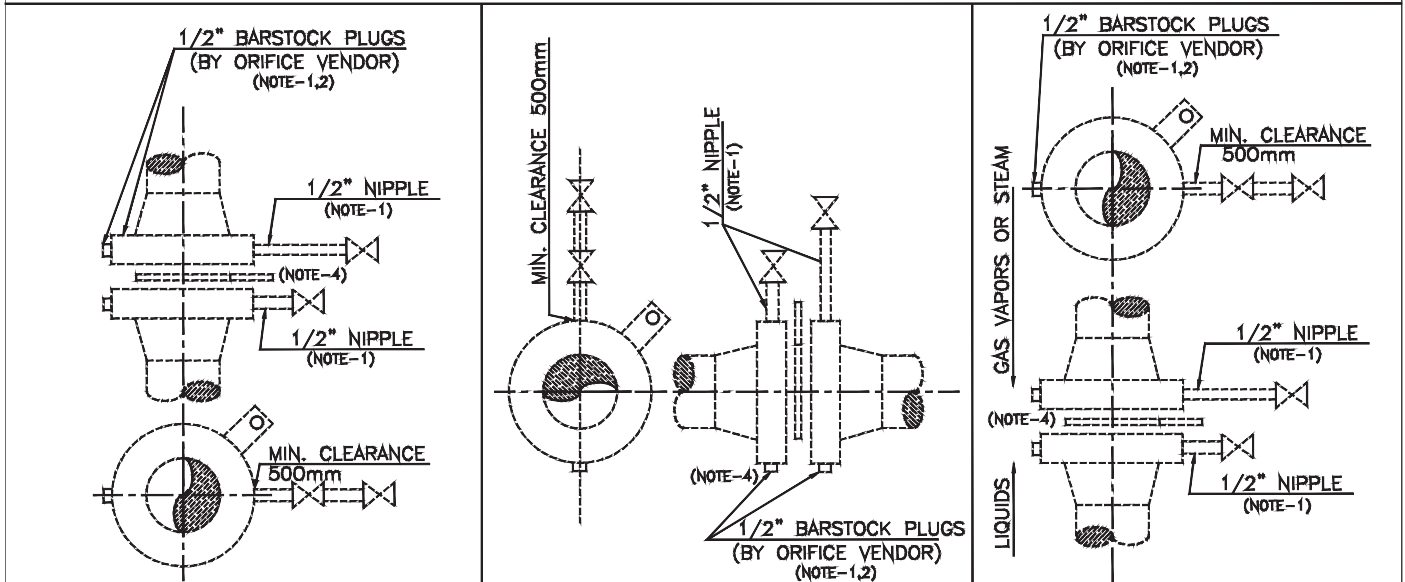


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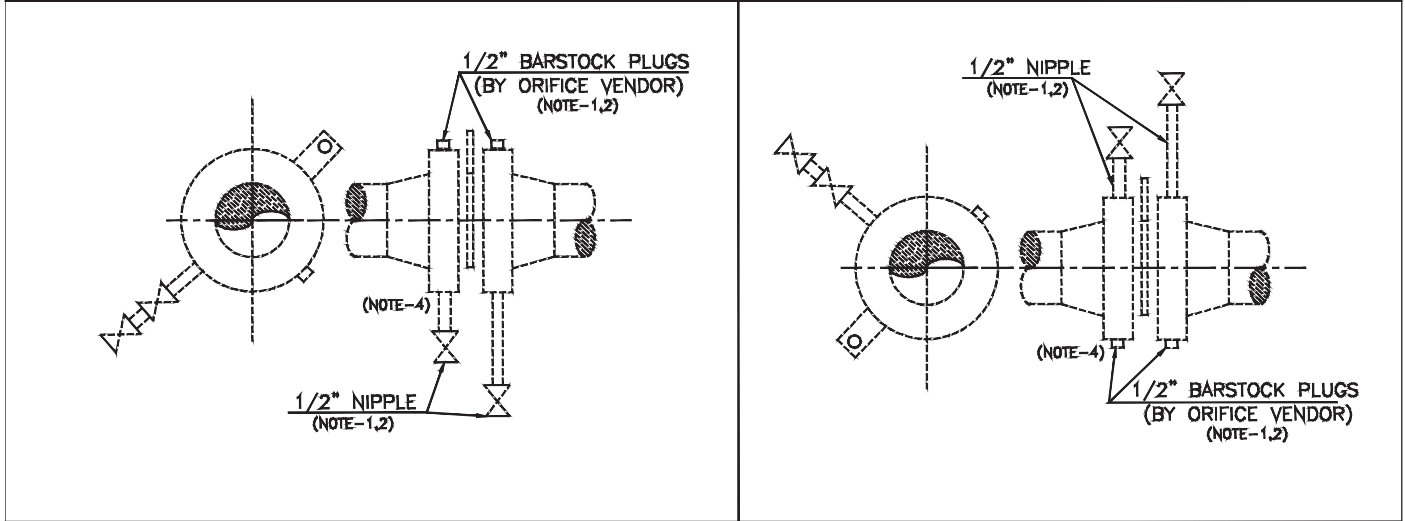
FLOW METER
INSTALLATION
SCOPE OF WORK

DRAWING NO.
GAIL-ENG-IN-DWG-TP-004
3 OF 8

ORIFICE FLANGE ASSEMBLIES – SINGLE TAPPING
(FOR RATING UPTO ASME CLASS 600)



| | | |
|---|---------------------------|-------------------------------|
| HORIZONTAL METER RUN WHEREVER REQUIRED | GAS, HORIZONTAL METER RUN | ANY FLUID, VERTICAL METER RUN |
|---|---------------------------|-------------------------------|



| | |
|---------------------------|--------------------------------|
| LIQUID LINES ON PIPE RACK | STEAM / GAS LINES ON PIPE RACK |
|---------------------------|--------------------------------|

NOTES:

1. SEAL WELDING BY PIPING GROUP.
2. ORIFICE VENDOR SHALL PROVIDE 1/2" BAR STOCK PLUG FOR SPARE TAPPING.
3. ENTIRE INSTALLATION SHOWN IS BY PIPING / MECHANICAL CONTRACTOR.
4. PROCUREMENT BY INSTRUMENT GROUP
5. PROCUREMENT OF OTHER ITEMS NOT COVERED IN NOTE-2 & NOTE-4 BY PIPING.
6. IN CASE OF PRE-FABRICATED HOOKUP, NIPPLE & ISOLATION VALVE SHALL BE SUPPLIED BY PREFAB VENDOR.

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| 0 | 15.01.19 | ISSUED FOR TENDER | D.V | U.N | S.B |
| REV.NO. | DATE | SUBJECT OF REVISION | BY | CHECKED | APPROVED |

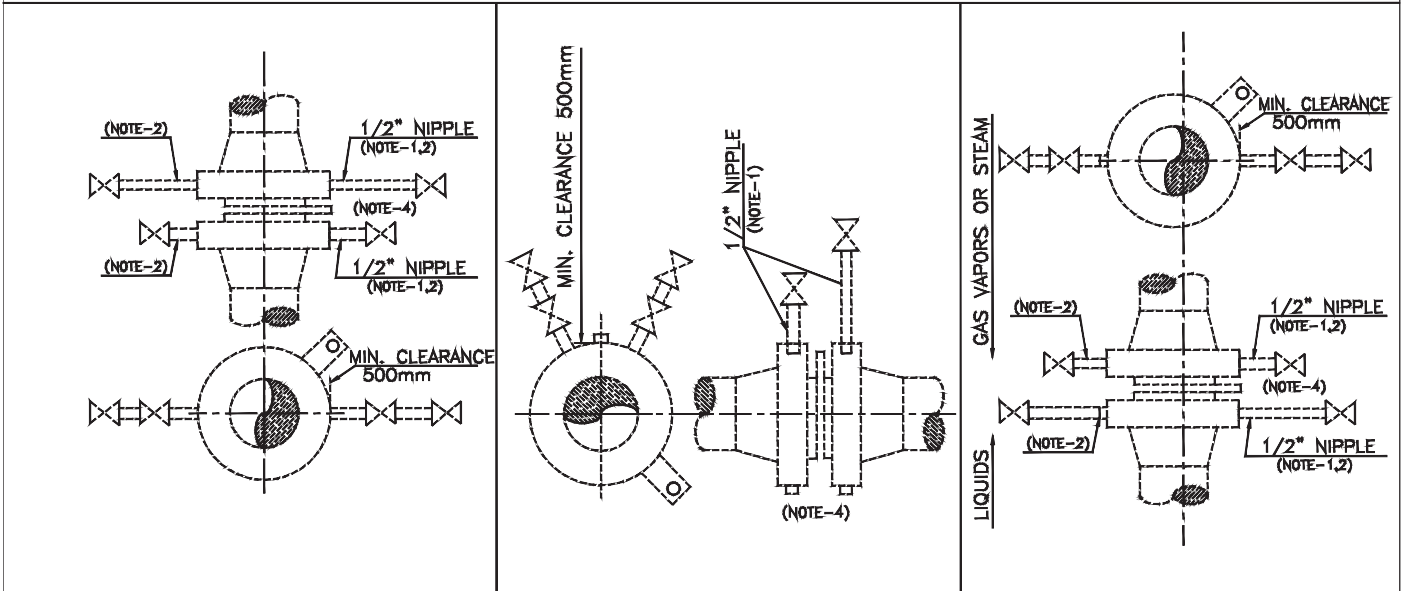


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FLOW METER
INSTALLATION
SCOPE OF WORK

DRAWING NO.
GAIL-ENG-IN-DWG-TP-004
4 OF 8

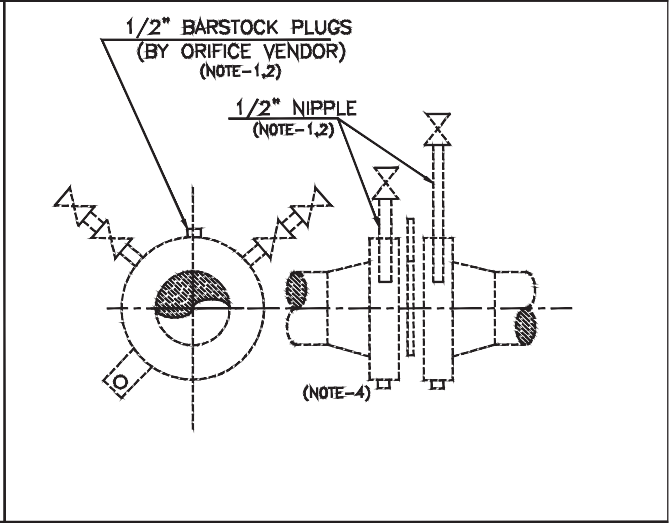
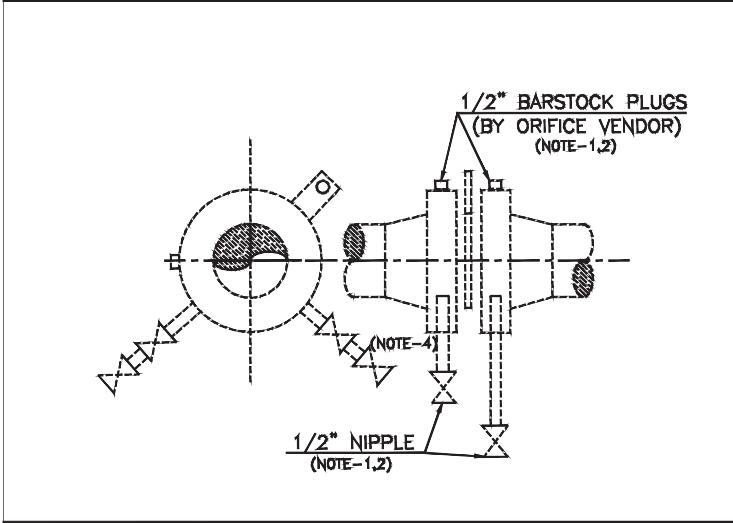
ORIFICE FLANGE ASSEMBLIES – TWO TAPPINGS
(FOR RATING UPTO ASME CLASS 600)



HORIZONTAL METER RUN
WHEREVER REQUIRED

GAS, HORIZONTAL METER RUN

ANY FLUID, VERTICAL METER RUN



LIQUID LINES ON PIPE RACK

STEAM / GAS LINES ON PIPE RACK

NOTES:

1. SEAL WELDING BY PIPING GROUP.
2. ORIFICE VENDOR SHALL PROVIDE 1/2" BAR STOCK PLUG FOR SPARE TAPPING.
3. ENTIRE INSTALLATION SHOWN IS BY PIPING / MECHANICAL CONTRACTOR.
4. PROCUREMENT BY INSTRUMENT GROUP
5. PROCUREMENT OF OTHER ITEMS NOT COVERED IN NOTE-2 & NOTE-4 BY PIPING.
6. IN CASE OF PRE-FABRICATED HOOKUP, NIPPLE & ISOLATION VALVE SHALL BE SUPPLIED BY PREFAB VENDOR.

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|---------|----------|---------------------|-----|---------|----------|
| 0 | 15.01.19 | ISSUED FOR TENDER | D.V | U.N | S.B |
| REV.NO. | DATE | SUBJECT OF REVISION | BY | CHECKED | APPROVED |

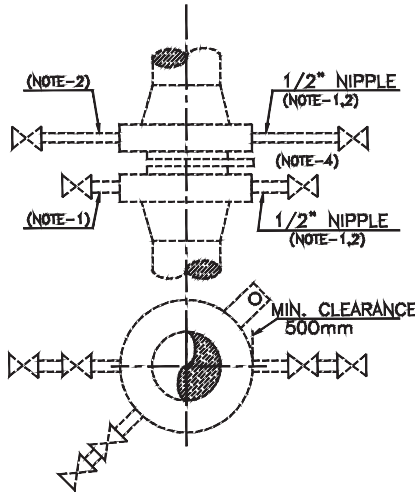


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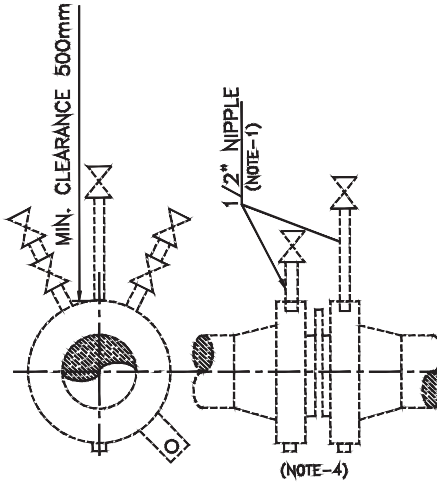
FLOW METER
INSTALLATION
SCOPE OF WORK

DRAWING NO.
GAIL-ENG-IN-DWG-TP-004
5 OF 8

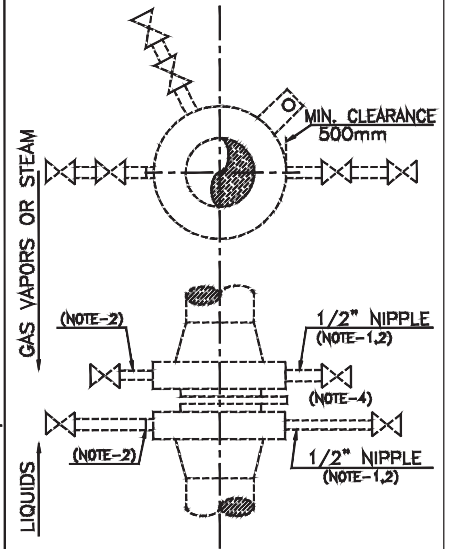
ORIFICE FLANGE ASSEMBLIES – THREE TAPPINGS
(FOR RATING UPTO ASME CLASS 600)



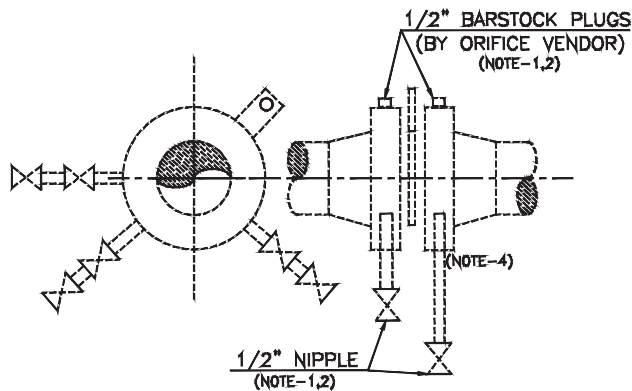
HORIZONTAL METER RUN
WHEREVER REQUIRED



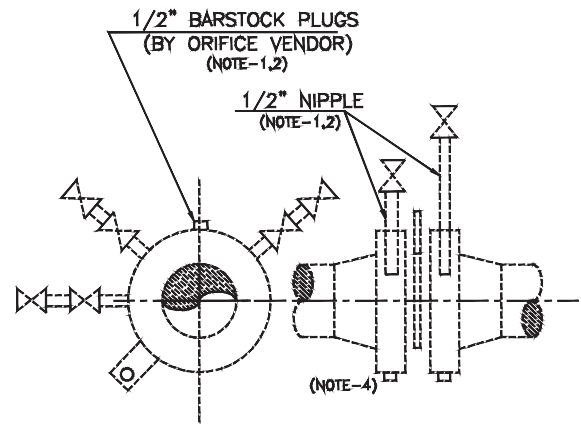
GAS, HORIZONTAL METER RUN



ANY FLUID, VERTICAL METER RUN



LIQUID LINES ON PIPE RACK



STEAM / GAS LINES ON PIPE RACK

NOTES:

1. SEAL WELDING BY PIPING GROUP.
2. ORIFICE VENDOR SHALL PROVIDE 1/2" BAR STOCK PLUG FOR SPARE TAPPING.
3. ENTIRE INSTALLATION SHOWN IS BY PIPING / MECHANICAL CONTRACTOR.
4. PROCUREMENT BY INSTRUMENT GROUP
5. PROCUREMENT OF OTHER ITEMS NOT COVERED IN NOTE-2 & NOTE-4 BY PIPING.
6. IN CASE OF PRE-FABRICATED HOOKUP, NIPPLE & ISOLATION VALVE SHALL BE SUPPLIED BY PREFAB VENDOR.

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| 0 | 15.01.19 | ISSUED FOR TENDER | D.V | U.N | S.B |
| REV.NO. | DATE | SUBJECT OF REVISION | BY | CHECKED | APPROVED |

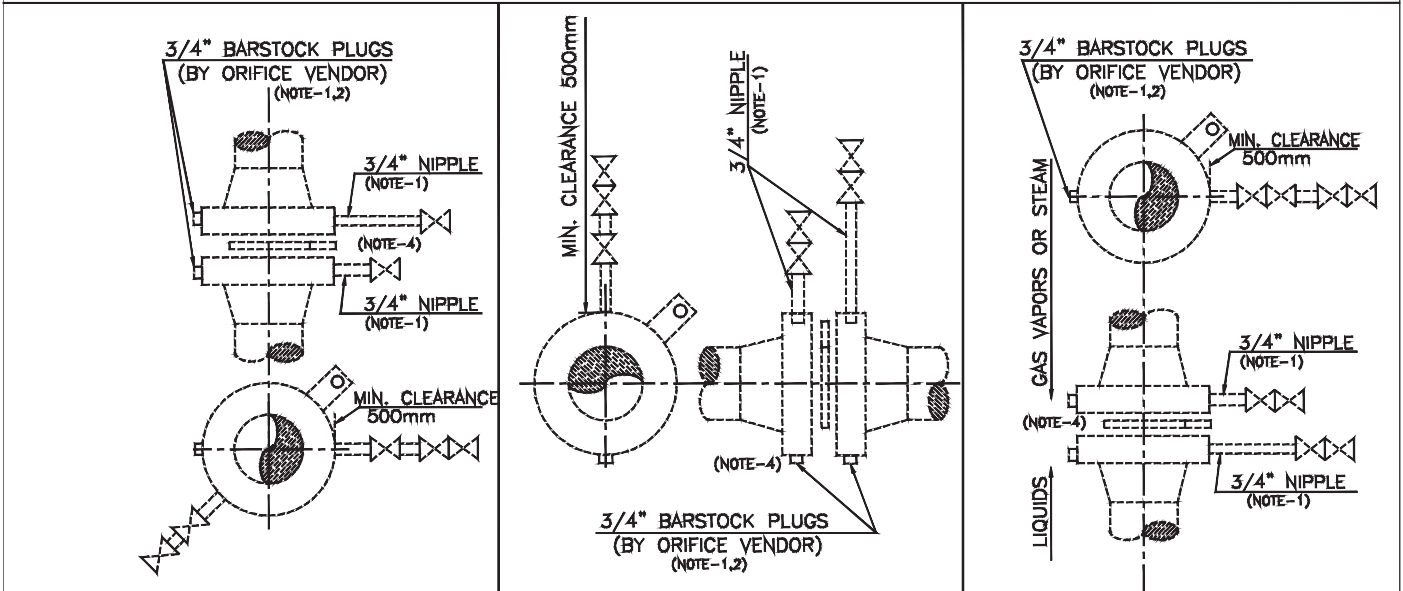


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FLOW METER
INSTALLATION
SCOPE OF WORK

DRAWING NO.
GAIL-ENG-IN-DWG-TP-004
6 OF 8

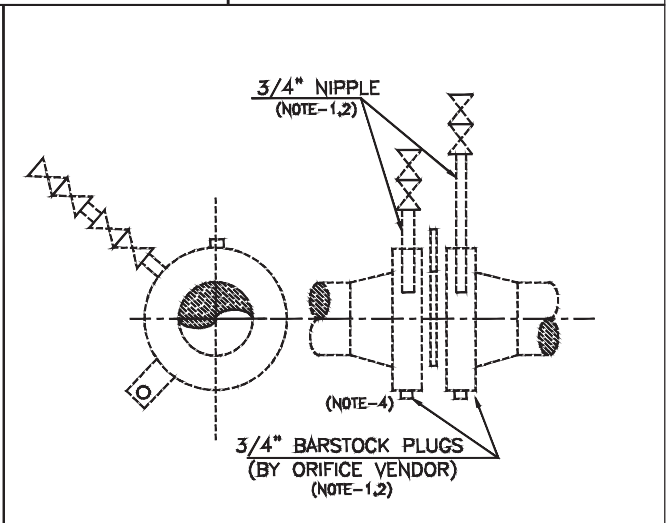
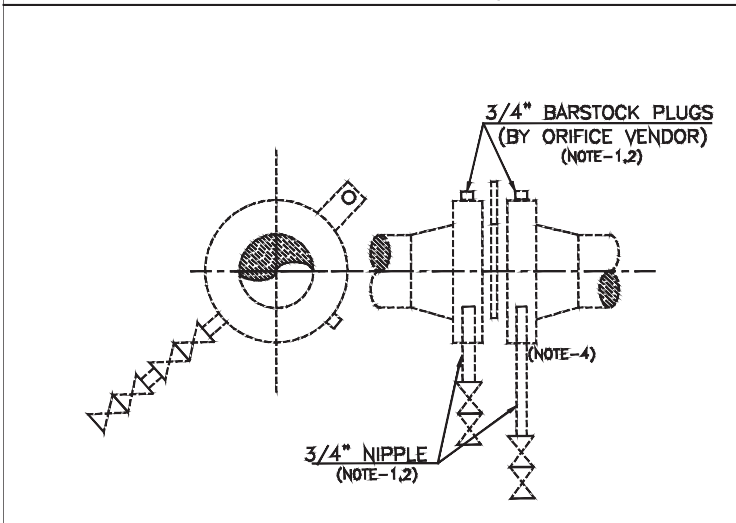
ORIFICE FLANGE ASSEMBLIES – SINGLE TAPPING
(FOR RATING ABOVE ASME CLASS 600)



HORIZONTAL METER RUN
WHEREVER REQUIRED

GAS, HORIZONTAL METER RUN

ANY FLUID, VERTICAL METER RUN



LIQUID LINES ON PIPE RACK

STEAM / GAS LINES ON PIPE RACK

NOTES:

1. SEAL WELDING BY PIPING GROUP.
2. ORIFICE VENDOR SHALL PROVIDE 1/2" BAR STOCK PLUG FOR SPARE TAPPING.
3. ENTIRE INSTALLATION SHOWN IS BY PIPING / MECHANICAL CONTRACTOR.
4. PROCUREMENT BY INSTRUMENT GROUP
5. PROCUREMENT OF OTHER ITEMS NOT COVERED IN NOTE-2 & NOTE-4 BY PIPING.
6. IN CASE OF PRE-FABRICATED HOOKUP, NIPPLE & ISOLATION VALVE SHALL BE SUPPLIED BY PREFAB VENDOR.

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| 0 | 15.01.19 | ISSUED FOR TENDER | D.V | U.N | S.B |
| REV.NO. | DATE | SUBJECT OF REVISION | BY | CHECKED | APPROVED |

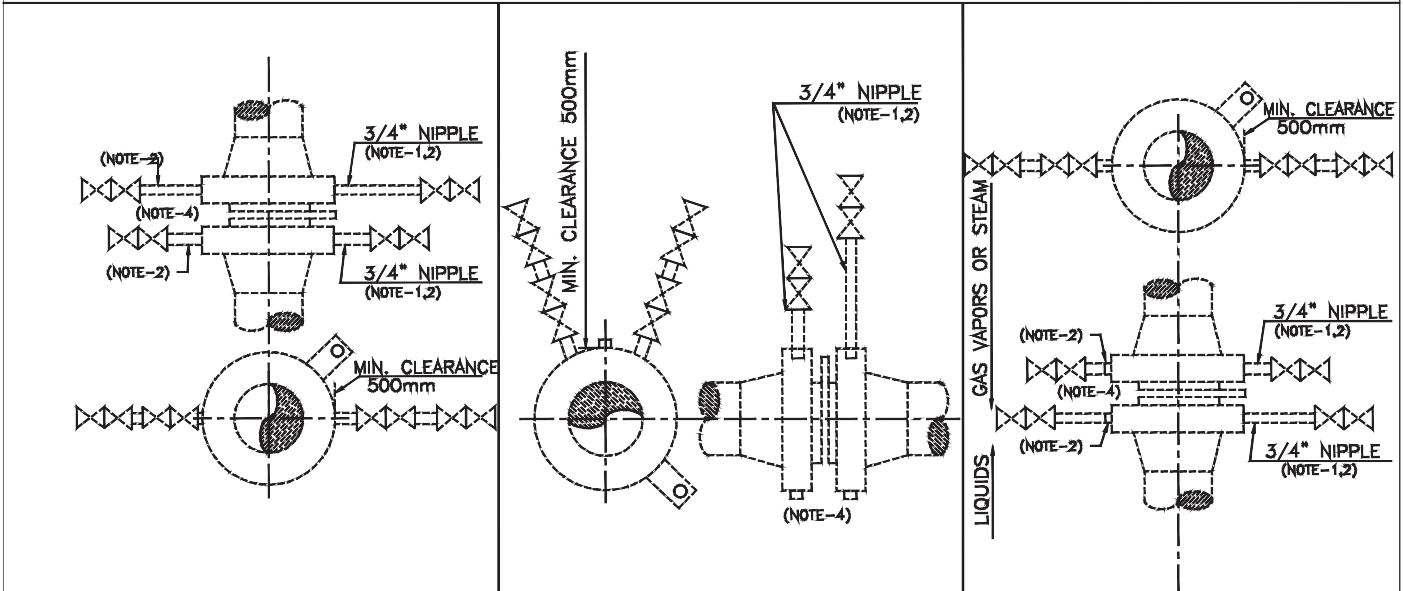


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FLOW METER
INSTALLATION
SCOPE OF WORK

DRAWING NO.
GAIL-ENG-IN-DWG-TP-004
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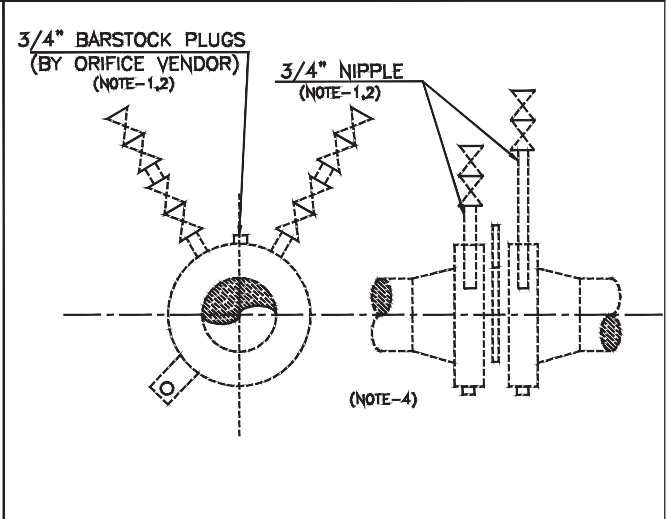
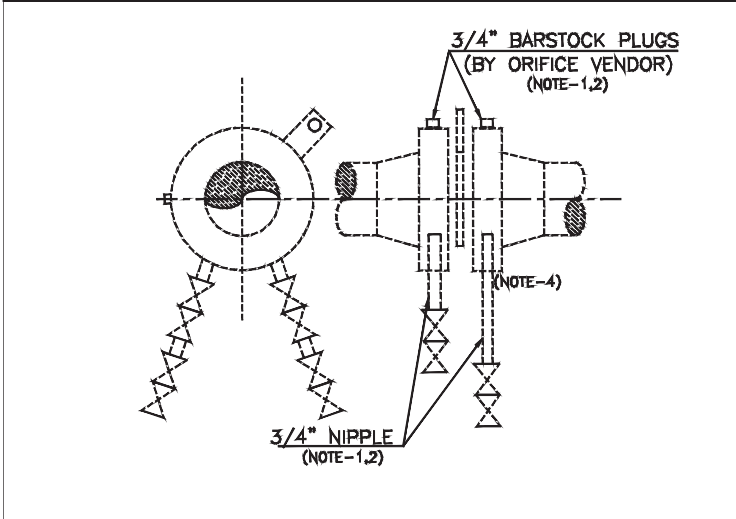
ORIFICE FLANGE ASSEMBLIES – TWO TAPPINGS
(FOR RATING ABOVE ASME CLASS 600)



HORIZONTAL METER RUN
WHEREVER REQUIRED

GAS, HORIZONTAL METER RUN

ANY FLUID, VERTICAL METER RUN



LIQUID LINES ON PIPE RACK

ANY FLUID, VERTICAL METER RUN

NOTES:

1. SEAL WELDING BY PIPING GROUP.
2. ORIFICE VENDOR SHALL PROVIDE 1/2" BAR STOCK PLUG FOR SPARE TAPPING.
3. ENTIRE INSTALLATION SHOWN IS BY PIPING / MECHANICAL CONTRACTOR.
4. PROCUREMENT BY INSTRUMENT GROUP
5. PROCUREMENT OF OTHER ITEMS NOT COVERED IN NOTE-2 & NOTE-4 BY PIPING.
6. IN CASE OF PRE-FABRICATED HOOKUP, NIPPLE & ISOLATION VALVE SHALL BE SUPPLIED BY PREFAB VENDOR.

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| 0 | 15.01.19 | ISSUED FOR TENDER | D.V | U.N | S.B |
| REV.NO. | DATE | SUBJECT OF REVISION | BY | CHECKED | APPROVED |

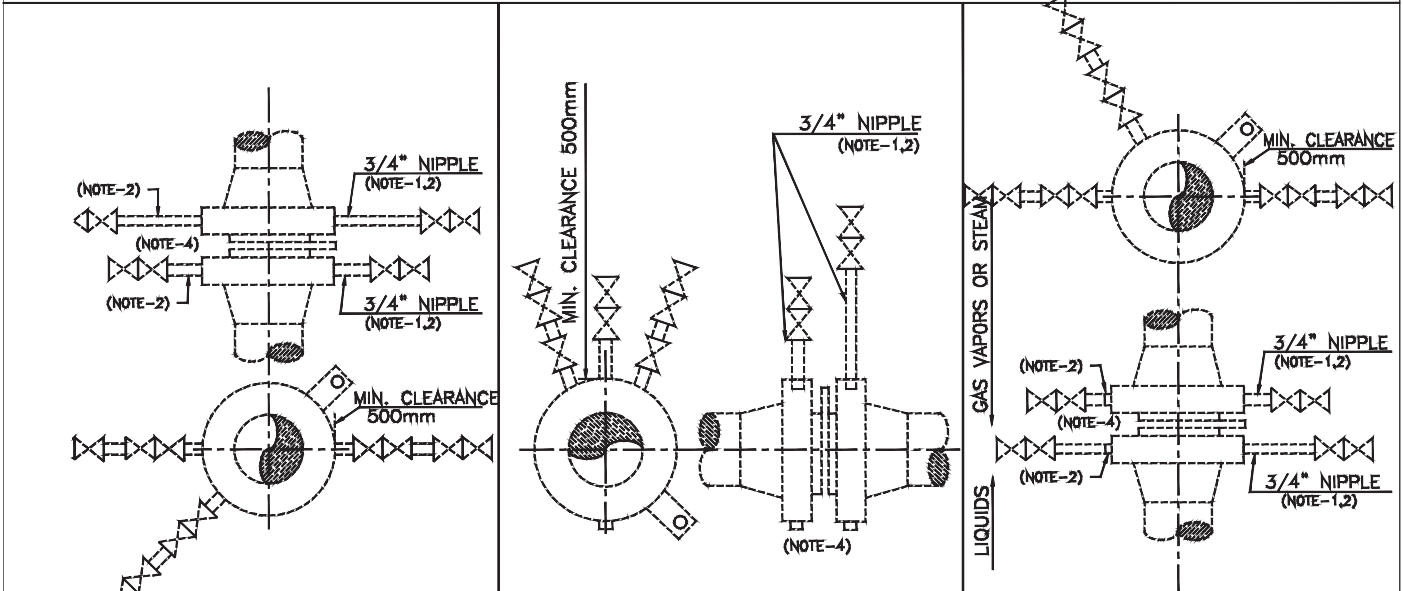


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NEW DELHI

FLOW METER
INSTALLATION
SCOPE OF WORK

DRAWING NO.
GAIL-ENG-IN-DWG-TP-004
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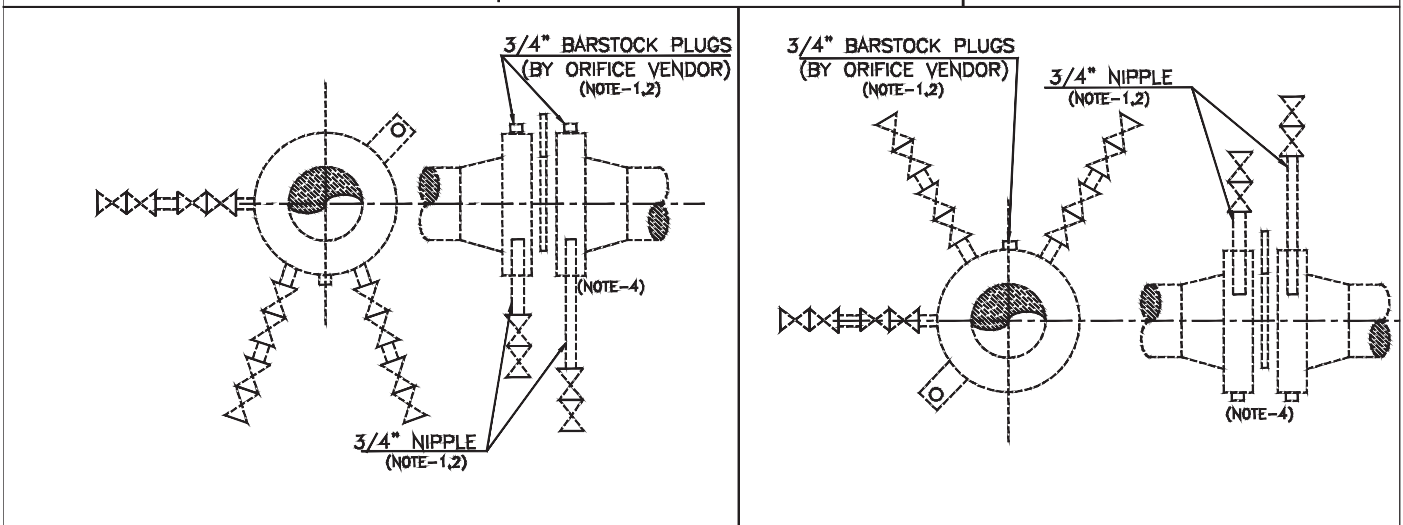
ORIFICE FLANGE ASSEMBLIES – THREE TAPPINGS
(FOR RATING ABOVE ASME CLASS 600)



HORIZONTAL METER RUN
WHEREVER REQUIRED

GAS, HORIZONTAL METER RUN

ANY FLUID, VERTICAL METER RUN



LIQUID LINES ON PIPE RACK

ANY FLUID, VERTICAL METER RUN

NOTES:

1. SEAL WELDING BY PIPING GROUP.
2. ORIFICE VENDOR SHALL PROVIDE 1/2" BAR STOCK PLUG FOR SPARE TAPPING.
3. ENTIRE INSTALLATION SHOWN IS BY PIPING / MECHANICAL CONTRACTOR.
4. PROCUREMENT BY INSTRUMENT GROUP
5. PROCUREMENT OF OTHER ITEMS NOT COVERED IN NOTE-2 & NOTE-4 BY PIPING.
6. IN CASE OF PRE-FABRICATED HOOKUP, NIPPLE & ISOLATION VALVE SHALL BE SUPPLIED BY PREFAB VENDOR.

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| 0 | 15.01.19 | ISSUED FOR TENDER | D.V | U.N | S.B |
| REV.NO. | DATE | SUBJECT OF REVISION | BY | CHECKED | APPROVED |



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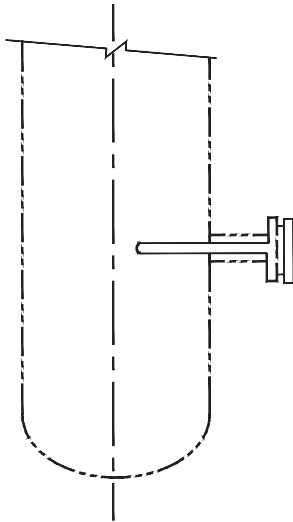
**THERMOWELL
INSTALLATION
SCOPE OF WORK**

DRAWING NO.

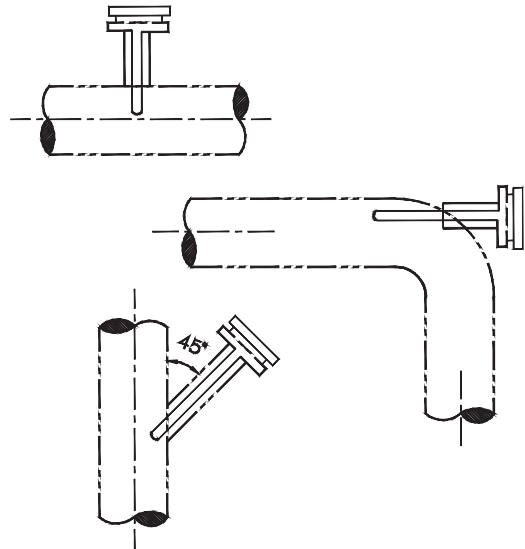
GAIL-ENG-IN-DWG-TP-005

1 OF 1

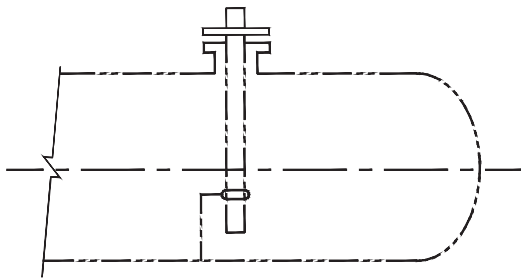
(T-1) THERMOWELL ON VESSEL



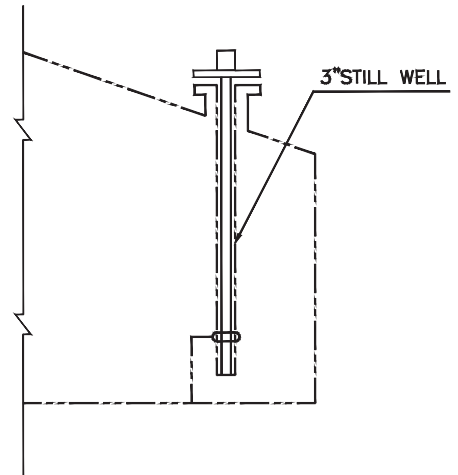
(T-2) THERMOWELL ON PIPE



(T-3) THERMOWELL ON BURRIED VESSEL



(T-4) THERMOWELL ON STORAGE TANK



NOTES:

1. REFER STANDARD NO. 7-52-0001 & 7-52-0002 FOR CONNECTION SIZE.

————— INSTRUMENT GROUP
 - - - - - PIPING GROUP
 - - - - - VESSEL GROUP

| | | | | | | | |
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LYONS ENGINEERING PVT. LTD.
NEW DELHI

INSTRUMENT CONNECTION ON VESSEL,
STANDPIPES AND TANKS

DRAWING NO.

GAIL-ENG-IN-DWG-TP-006

1 OF 1

| S.NO. | TYPE OF INSTRUMENTS | HEATER/DUCT/LINE CONNECTION | FIRST BLOCK VALVE | INSTRUMENT CONNECTION |
|-------|--|-----------------------------|-------------------|-----------------------|
| 1. | FLOW ELEMENT - AVG. PITOT TUBE (F1) | 3" FLANGED | - | 3" FLANGED (NOTE-4) |
| 2. | FLOW ELEMENT - VENTURI TUBE (F2) | 1/2" FLANGED | 1/2" FLANGED | 1/2" NPT (F) |
| 3. | FLOW ELEMENT - THERMAL MASS (F3) | 1 1/2" FLANGED | - | 1 1/2" FLANGED |
| 4. | PRESSURE INSTRUMENT (P1) | 1 1/2" FLANGED | 1 1/2" FLANGED | 1/2" NPT (F) |
| 5. | PRESSURE INSTRUMENT (COIL) (P2/P4) | 1 1/2" FLANGED | 1 1/2" FLANGED | 1/2" NPT (F) |
| 6. | DRAFT GAUGE (P3) | 1 1/2" FLANGED | - | 1/2" NPT (F) |
| 7. | TEMPERATURE INSTRUMENT (T1) | 1 1/2" FLANGED | - | 1 1/2" FLANGED |
| 8. | TEMPERATURE INSTRUMENT (COIL) (T2) | 1 1/2" FLANGED | - | 1 1/2" FLANGED |
| 9. | SKIN THERMOCOUPLE (T3) | 1" PIPE | - | - |
| 10. | FLUE GAS ANALYSER (SO _x , NO _x , O ₂ , HC,CO) (A1/A2/A4) | 4" FLANGED | - | 4" FLANGED |
| 11. | FLUE GAS ANALYSER (SPM) (A3) | 6" FLANGED | - | 6" FLANGED |

NOTES:

1. PRESSURE RATING OF FLANGE CONNECTION SHALL BE 150# FOR INSTS MOUNTED DIRECTLY ON HEATER EXCEPT TEMPERATURE INSTRUMENTS FOR WHICH FLANGE RATING SHALL BE 300#.
2. PRESSURE RATING OF FLANGE CONNECTION ON TUBE SIDE SHALL BE AS PER PIPING CLASS.
3. FOR IDENTIFICATION (F1), (P1) ETC. REFER TO STANDARDS SD-IC-001, SD-IC-002, SD-IC-013, SD-IC-014.
3. TRANSMITTER CONNECTION SHALL BE 1/2" NPT(F).

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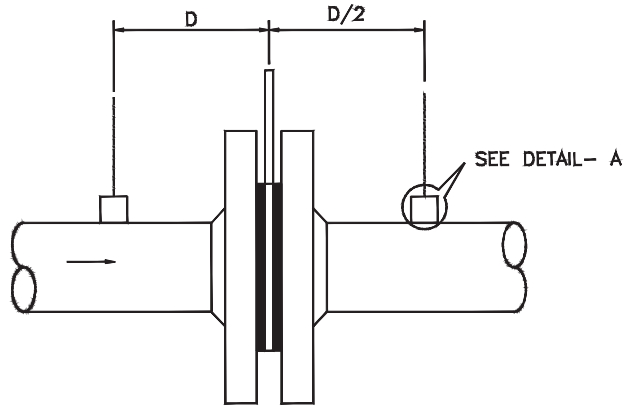
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NEW DELHI

METER RUNS-PIPING
CONNECTIONS
D - D/2 TAPS

DRAWING NO.

GAIL-ENG-IN-DWG-TP-007

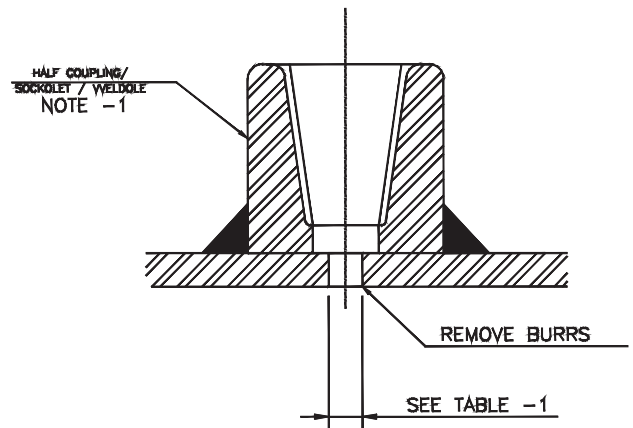
1 OF 1



D-D/2 TAPS

TABLE -1

| NOMINAL PIPE DIAMETER & RATING | MAX. DIAMETER PRESSURE TAPS |
|--------------------------------------|-----------------------------|
| 400mm (16") & ABOVE 150# / 300# | 13mm DRILL |
| 500mm (20") & ABOVE 600# | 13mm DRILL |
| 350mm (14") & ABOVE 900# | 13mm DRILL |
| 600mm (24") & ABOVE 1500# & ABOVE | 13mm DRILL |



LEGEND :-

D = PIPE I. D (INTERNAL DIAMETER)

NOTES:

- WELD 15mm (1/2") HALF COUPLING / SOCKOLET / WELDOLET TO LINE, IN ACCORDANCE WITH THE APPLICABLE PIPING SPECIFICATION, FOR RATING UPTO 600# AND 20mm (3/4") SOCKOLET / WELDOLET TO LINE, IN ACCORDANCE WITH THE APPLICABLE PIPING SPECIFICATIONS, FOR RATING ABOVE ASME CLASS 600.
- DIMENSIONS, ARE FROM FACE OF PLATE TO CENTER LINE OF TAP DRILLED HOLE, AND SHALL INCLUDE THE THICKNESS OF THE GASKET.

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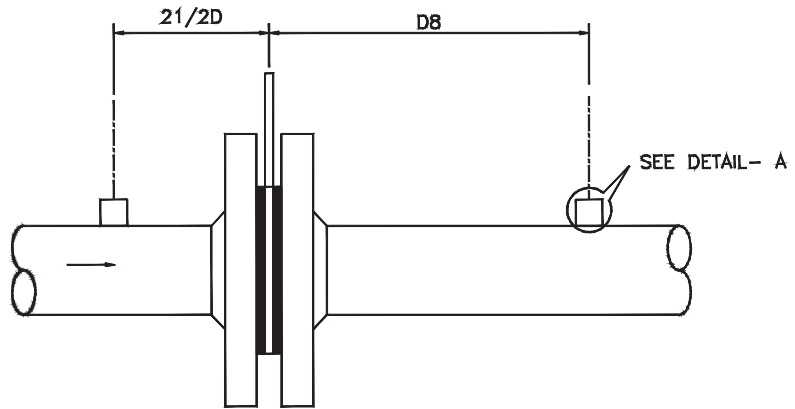
LYONS ENGINEERING PVT. LTD.
NEW DELHI

METER RUNS-PIPING
CONNECTIONS
PIPE (2 1/2 D - 8 D) TAPS

DRAWING NO.

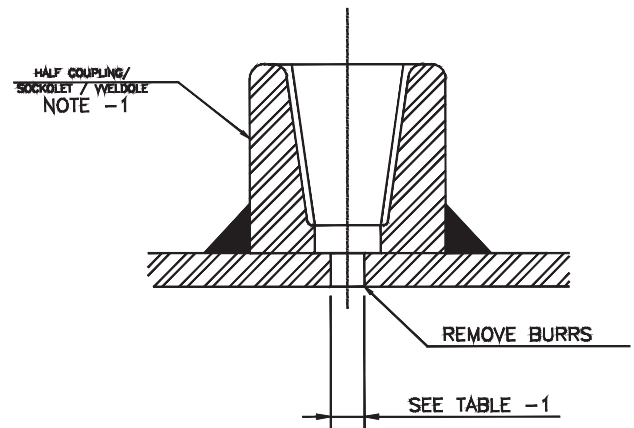
GAIL-ENG-IN-DWG-TP-008

1 OF 1



PIPE TAPS

| TABLE -1 | |
|-----------------------|-----------------------------|
| NOMINAL PIPE DIAMETER | MAX. DIAMETER PRESSURE TAPS |
| 50mm (2") | 6mm DRILL |
| 80mm (3") | 10mm DRILL |
| 100mm (4") AND ABOVE | 13mm DRILL |



LEGEND :-

D = PIPE I. D (INTERNAL DIAMETER)

NOTES:

1. WELD 15mm (1/2") HALF COUPLING / SOCKOLET / WELDOLET TO LINE, IN ACCORDANCE WITH THE APPLICABLE PIPING SPECIFICATION, FOR RATING UPTO 600# AND 20mm (3/4") SOCKOLET / WELDOLET TO LINE, IN ACCORDANCE WITH THE APPLICABLE PIPING SPECIFICATIONS, FOR RATING ABOVE ASME CLASS 600.
2. DIMENSIONS, ARE FROM FACE OF PLATE TO CENTER LINE OF TAP DRILLED HOLE, AND SHALL INCLUDE THE THICKNESS OF THE GASKET.

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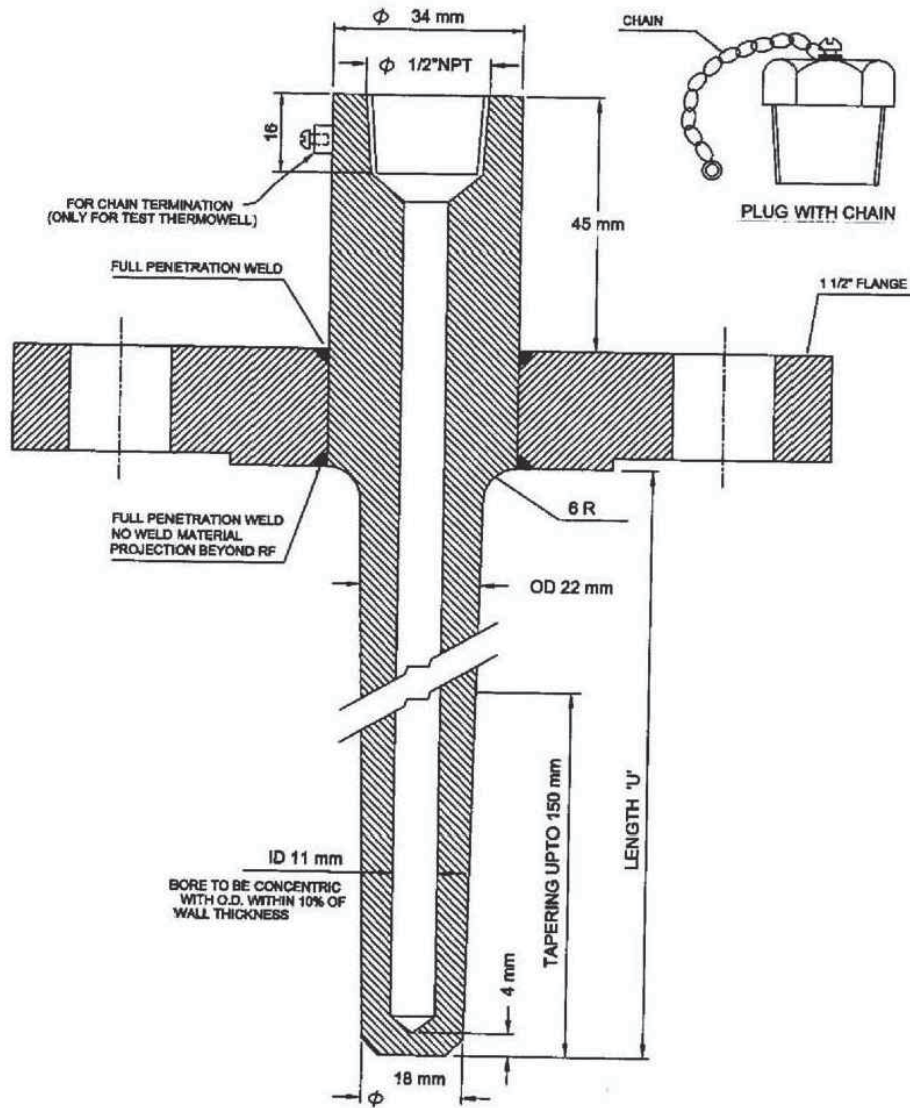
LYONS ENGINEERING PVT. LTD.
NEW DELHI

THERMOWELL

DRAWING NO.

GAIL-ENG-IN-DWG-TP-009

1 OF 3



NOTES:

1. THIS STANDARD IS APPLICABLE FOR ;
 - a).TEMPERATURE GAUGES, BEADED TEMPERATURE ELEMENTS AND DUPLEX TEMPERATURE ELEMENTS.
 - b).THERMOWELL UPTO 1500 CLASS AS PER ASME OR EQUIVALENT.
2. TYPE OF FLANGE SHALL BE RTJ FOR RATING (AS PER ASME CLASS) > 600.
3. DP TEST SHALL BE CARRIED OUT FOR ALL WELD JOINTS.
4. CHAIN AND PLUG SHALL BE APPLICABLE ONLY FOR TEST THERMOWELLS.

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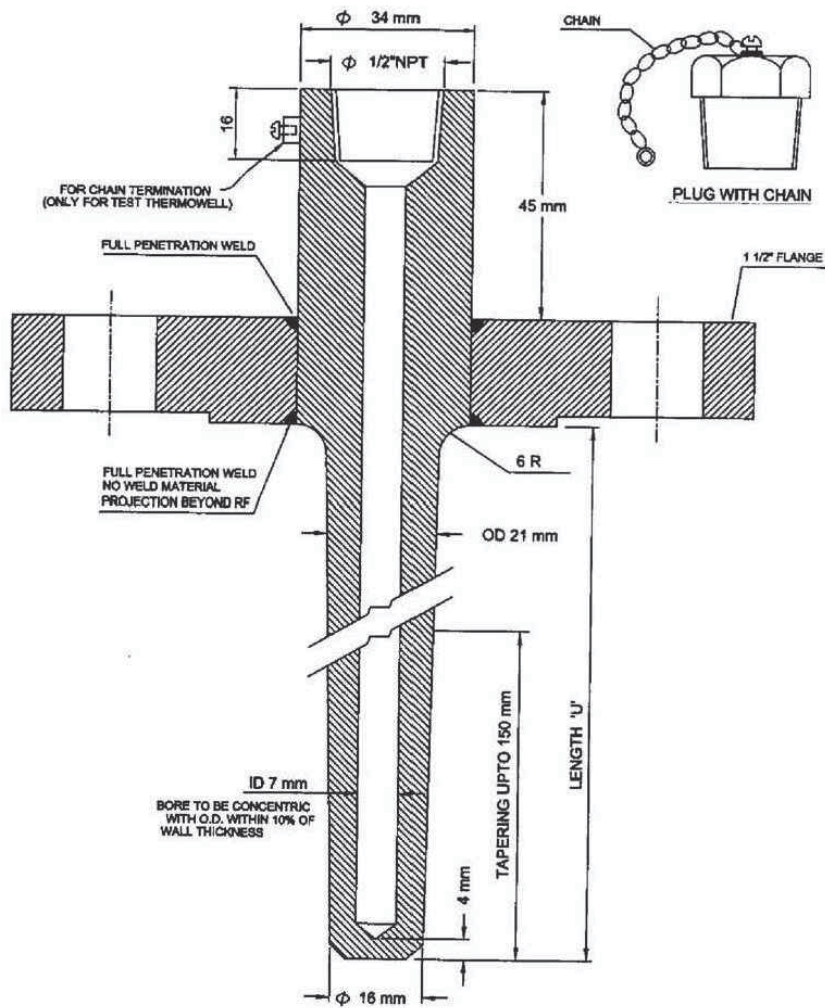
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NEW DELHI

THERMOWELL

DRAWING NO.

GAIL-ENG-IN-DWG-TP-009

2 OF 3



NOTES:

1. THIS STANDARD IS APPLICABLE FOR ;
 - a).TEMPERATURE GAUGES, BEADED TEMPERATURE ELEMENTS AND DUPLEX TEMPERATURE ELEMENTS.
 - b).THERMOWELL UPTO 1500 CLASS AS PER ASME OR EQUIVALENT.
2. TYPE OF FLANGE SHALL BE RTJ FOR RATING (AS PER ASME CLASS) > 600.
3. DP TEST SHALL BE CARRIED OUT FOR ALL WELD JOINTS.
4. CHAIN AND PLUG SHALL BE APPLICABLE ONLY FOR TEST THERMOWELLS.

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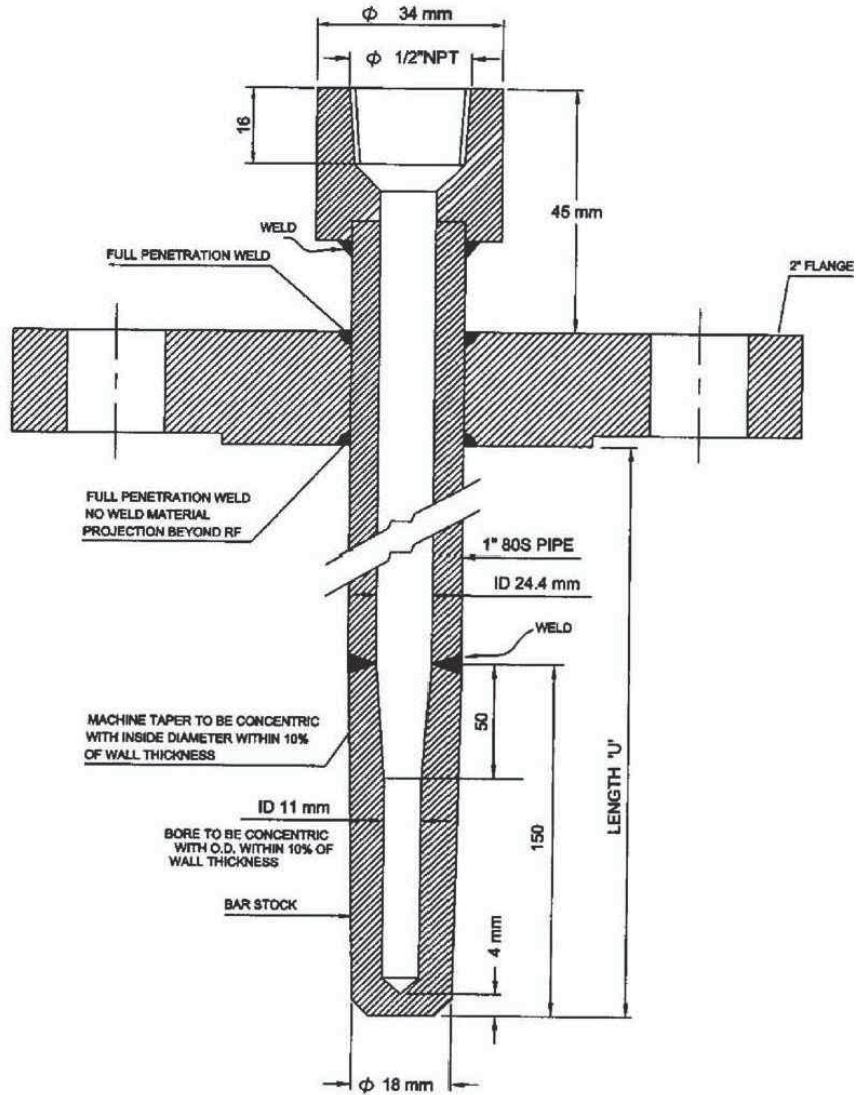
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NEW DELHI

BUILT-UP THERMOWELL

DRAWING NO.

GAIL-ENG-IN-DWG-TP-009

3 OF 3



NOTES:

1. CHAIN AND PLUG SHALL BE APPLICABLE ONLY FOR TEST THERMOWELLS.
2. TYPE OF FLANGE SHALL BE RTJ FOR RATING (AS PER ASME CLASS) > 600.

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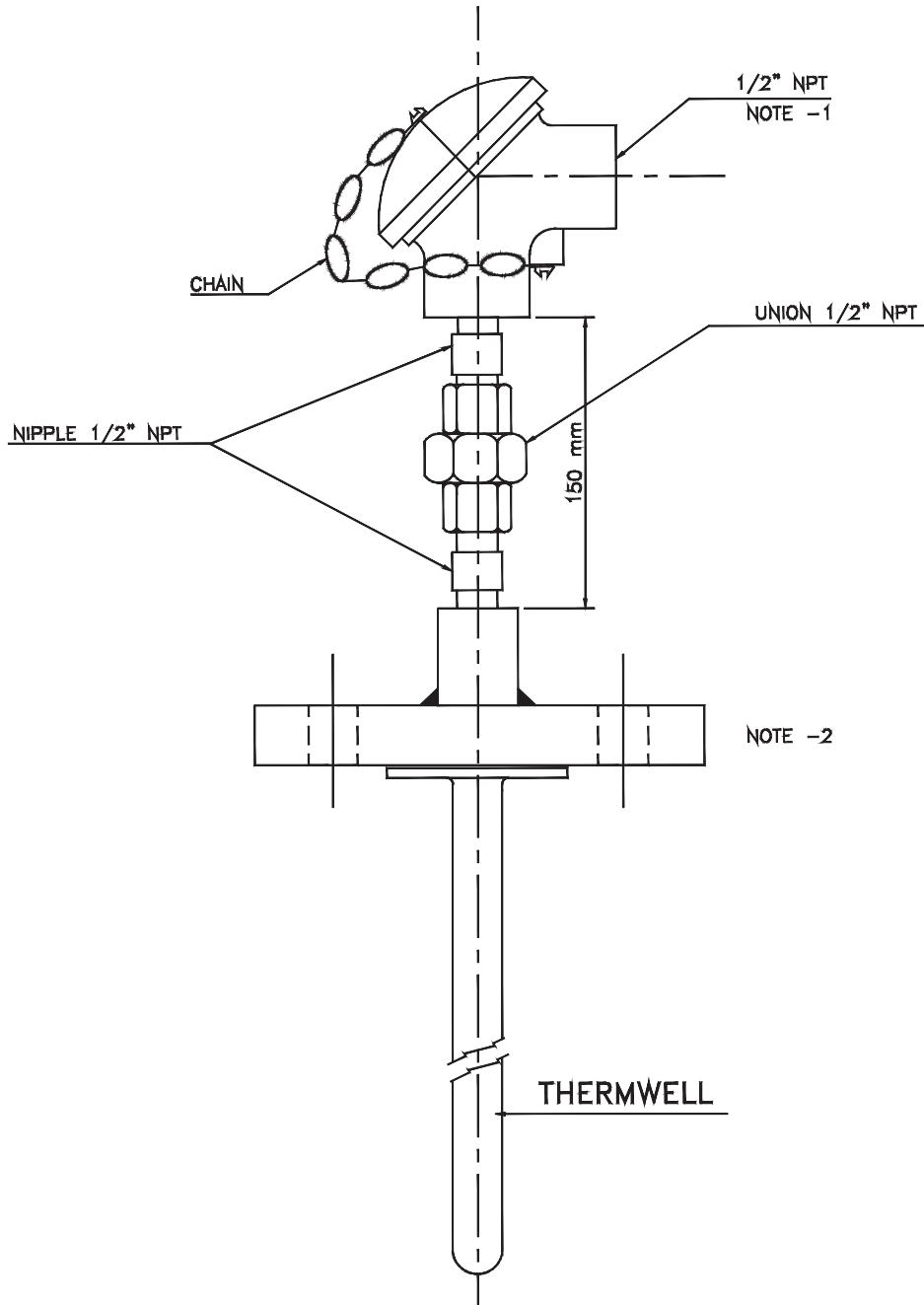
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NEW DELHI

**THERMOCOUPLE / RTD
ASSEMBLY
WITH THERMOWELL**

DRAWING NO.

GAIL-ENG-IN-DWG-TP-010

1 OF 1



NOTES:

1. IN THE CASE OF DUPLEX THERMOCOUPLE/RTD, TWO INDEPENDENT CABLE ENTRIES SHALL BE PROVIDED.
2. FLANGE TYPE, SIZE AND RATING SHALL BE AS PER DATA SHEET.

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SYMBOL FOR INSTRUMENT LOCATION DRAWINGS

DRAWING NO.

GAIL-ENG-IN-DWG-TP-011

1 OF 4

| SYMBOL | DESCRIPTION | REMARKS |
|--------|---|---------|
| | TRANSMITTER (FLOW, PRESSURE, LEVEL AND TEMPERATURE) | |
| | LEVEL TRANSMITTER (DISPLACER / GUIDED WAVE RADAR) | |
| | ANALYSER TRANSMITTER (IN CABINET) | |
| | TRANSMITTER (FILLED SYSTEM) | |
| | LOCAL INDICATOR (FI, LI, DPI) | |
| | LOCAL CONTROLLER | |
| | THERMOCOUPLE (SINGLE ELEMENT) | |
| | THERMOCOUPLE (DUPLEX ELEMENT) | |
| | THERMOCOUPLE (TRIPLEX ELEMENT) | |
| | RESISTANCE TEMPERATURE DETECTOR (SINGLE ELEMENT) | |
| | RESISTANCE TEMPERATURE DETECTOR (DUPLEX ELEMENT) | |
| | SWITCH | |
| | SWITCH (FILLED SYSTEM) | |
| | PUSH BUTTON (HAND SWITCH) | |
| | LEVEL GAUGE (TRANSPARENT TYPE) | |

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SYMBOL FOR INSTRUMENT LOCATION DRAWINGS

DRAWING NO.

GAIL-ENG-IN-DWG-TP-011

2 OF 4

| SYMBOL | DESCRIPTION | REMARKS |
|--------|--|---------|
| | HYDROCARBON GAS DETECTOR | |
| | HYDROGEN SULPHIDE DETECTOR | |
| | HYDROGEN DETECTOR | |
| | BEACON (* APPLICATION LIKE LEL / H2S / H2) | |
| | HOOTER | |
| | CCTV CAMERA | |
| | CONTROL VALVE (WITHOUT POSITIONER) | |
| | CONTROL VALVE (WITH SMART / FF POSITIONER) | |
| | CONTROL VALVE (WITH I/P CONVERTER) | |
| | SOLENOID VALVE (TWO WAY) | |
| | SOLENOID VALVE (THREE WAY) | |
| | SOLENOID VALVE (FOUR WAY) | |
| | CONTROL VALVE (WITH POS. / WITHOUT POS.) [WITH LIMIT SWITCH LOW AND HIGH] | |

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SYMBOL FOR INSTRUMENT LOCATION DRAWINGS

DRAWING NO.

GAIL-ENG-IN-DWG-TP-011

3 OF 4

| SYMBOL | DESCRIPTION | REMARKS |
|--------|-----------------------------------|---------|
| | ORIFICE (ON HORIZONTAL LINE) | |
| | ORIFICE (ON VERTICAL LINE) | |
| | TRANSMITTER (ROTAMETER) | |
| | TRANSMITTER (MAGNETIC FLOW METER) | |
| | VENTURI | |
| | AVERAGING PITOT TUBE | |
| | MASS FLOW METER | |
| | ULTRASONIC FLOW METER | |
| | FLOW NOZZLE | |
| | VORTEX FLOW METER | |

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SYMBOL FOR INSTRUMENT LOCATION DRAWINGS

DRAWING NO.

GAIL-ENG-IN-DWG-TP-011

4 OF 4

| SYMBOL | DESCRIPTION | REMARKS |
|--------|---|---------|
| | POSITIVE DISPLACEMENT METER | |
| | TURBINE METER | |
| | ANALYSER TAPPING WITH ANALYSER IN SHELTER | |
| | NUMBERING OF AN INSTRUMENT ALONG WITH JB NO. | |
| | INSTRUMENT WITH DIRECT RUN OF CABLE TO CONTROL ROOM. (WITHOUT INTERMEDIATE JUNCTION BOX) | |
| | JUNCTION BOX | |
| | INSTRUMENT DUCT | |
| | INSTRUMENT PERFORATED TRAY | |
| | INSTRUMENT LADDER TRAY | |
| | INSTRUMENT AIR HEADER WITH AIR SUPPLY TAP-OFF NO. | |
| | INSTRUMENT AIR SUPPLY DISTRIBUTION WITH MANIFOLD | |

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**INSTRUMENT SUPPORT
SINGLE INSTRUMENT**

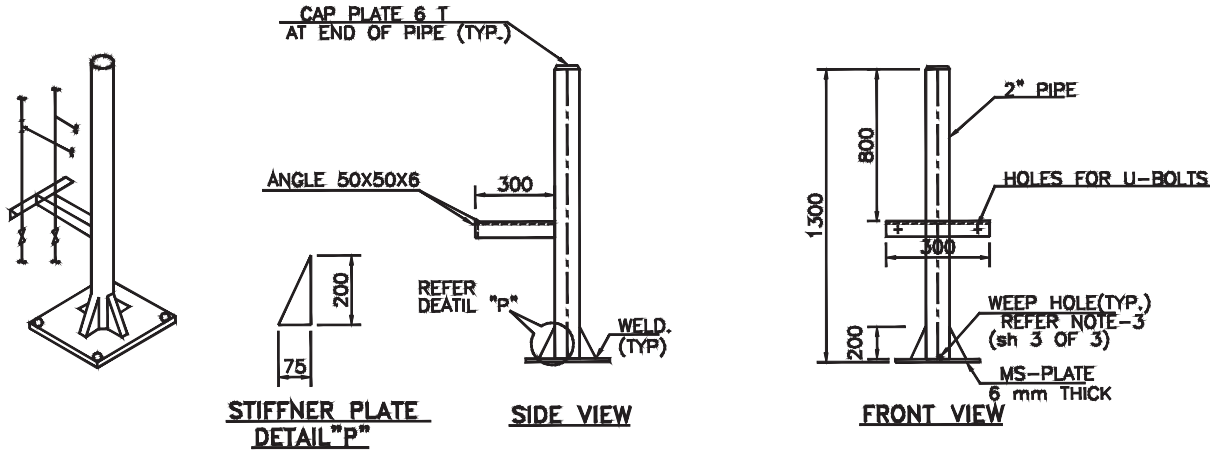
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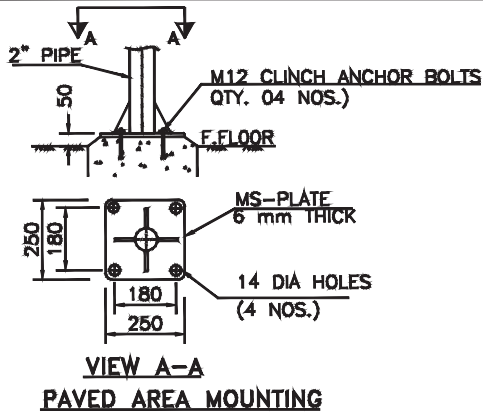
1 OF 3

TYPE 11

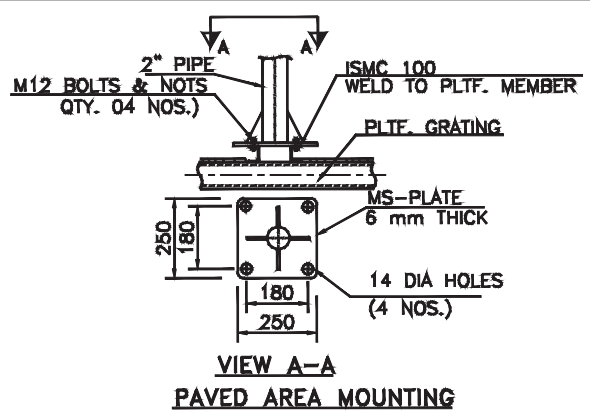
SINGLE INSTRUMENT SUPPORT - GENERAL ARRANGEMENT



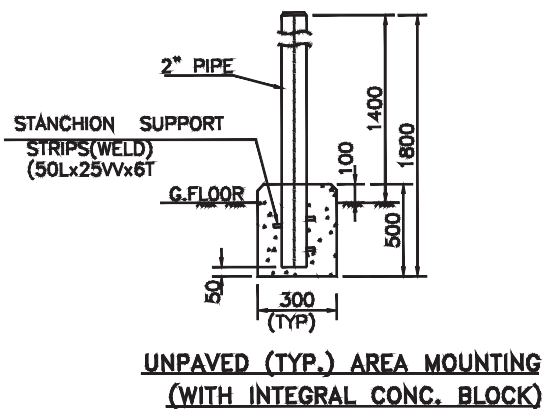
TYPE 11-1



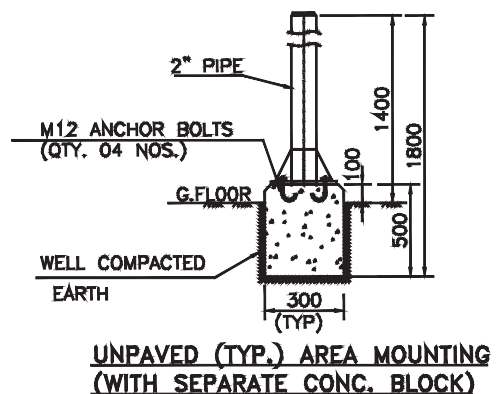
TYPE 11-2



TYPE 11-3



TYPE 11-4



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**INSTRUMENT SUPPORT
SINGLE INSTRUMENT**

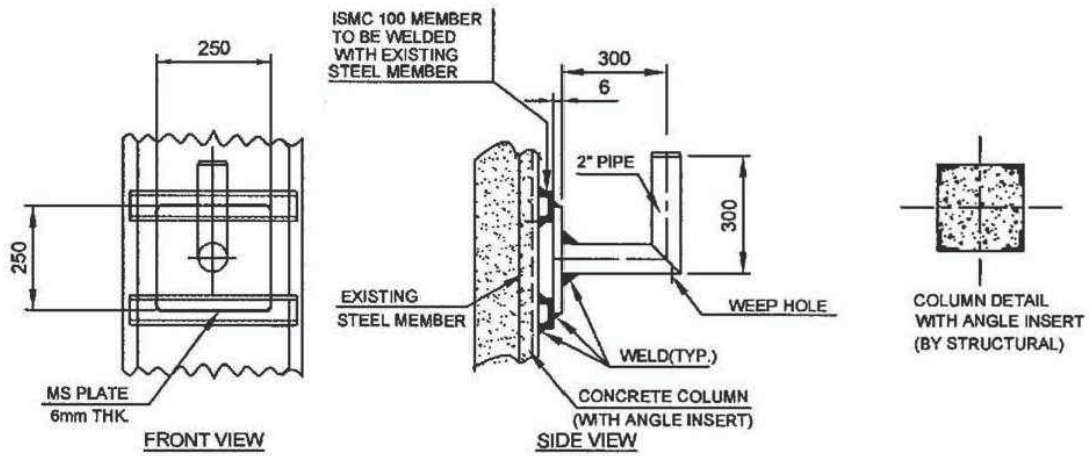
DRAWING NO.

GAIL-ENG-IN-DWG-TP-012

2 OF 3

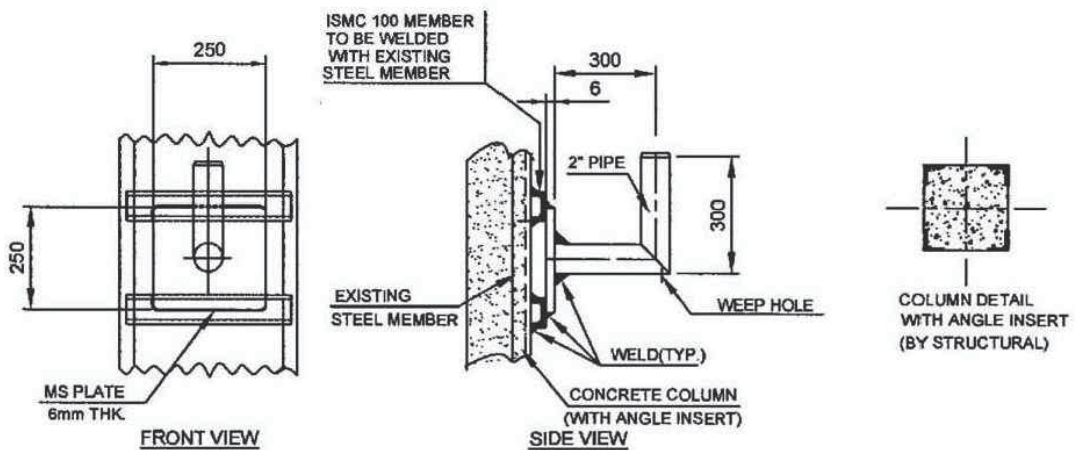
TYPE 12

CONCRETE COLUMN MOUNTING



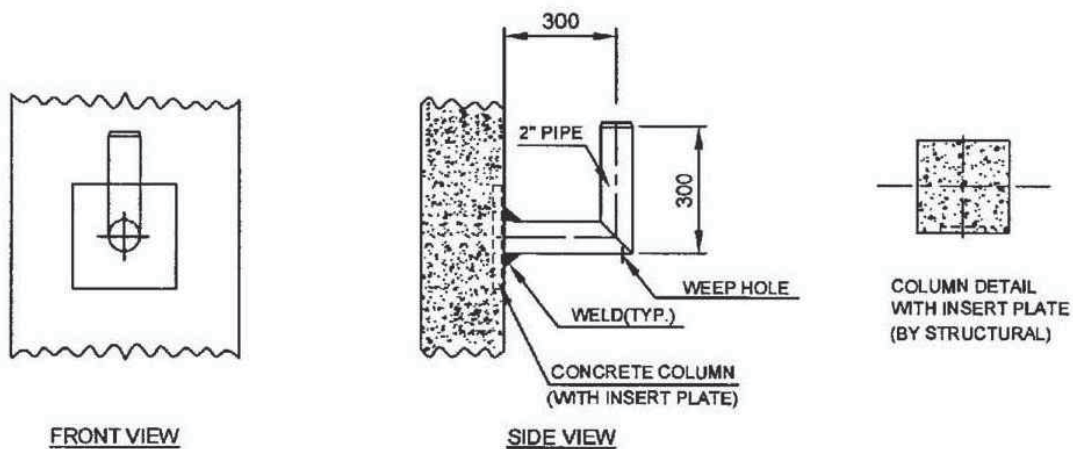
TYPE 13

CONCRETE COLUMN (WITH ANGLE INSERT) MOUNTING



TYPE-14

CONCRETE COLUMN (WITH INSERT PLATE) MOUNTING



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**INSTRUMENT SUPPORT
SINGLE INSTRUMENT**

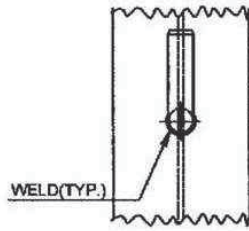
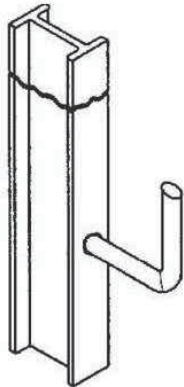
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GAIL-ENG-IN-DWG-TP-012

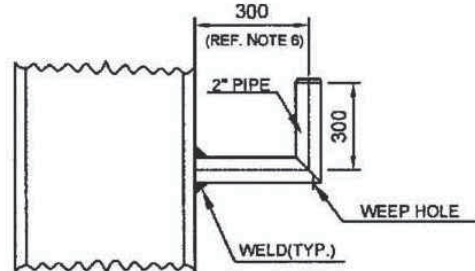
3 OF 3

TYPE 15

STEEL COLUMN MOUNTING (FLANGE FACE)



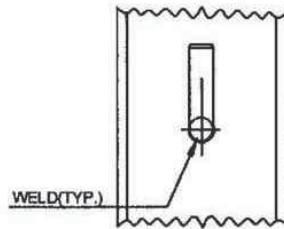
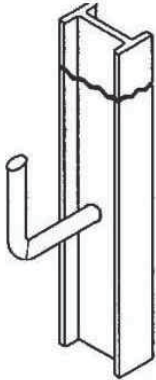
SIDE VIEW



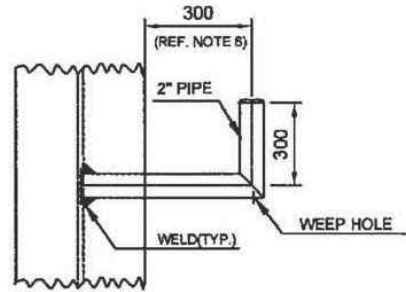
FRONT VIEW

TYPE 16

STEEL COLUMN MOUNTING (WEB FACE)



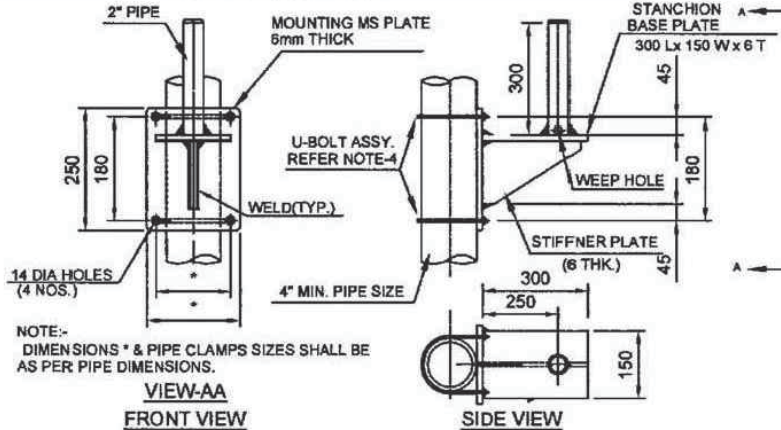
SIDE VIEW



FRONT VIEW

TYPE 17 PIPE BRACKET MOUNTING

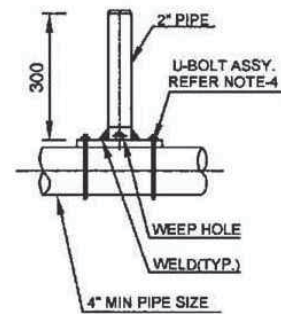
TYPE 17.1 (VERTICAL PIPE)



VIEW-AA
FRONT VIEW

SIDE VIEW

TYPE 17.2 (HORIZONTAL PIPE)



(HORIZONTAL PIPE)

NOTES:

1. ALL DIMENSIONS ARE IN M.M. UNLESS OTHERWISE SPECIFIED.
2. PIPE MATERIAL SHALL BE IS:1239 HEAVY GRADE AS A MINIMUM.
3. 6 mm DIA WEEP HOLE SHALL BE PROVIDED AT LOW POINT.
4. U-BOLT ASSEMBLY SHALL BE OF MINIMUM M12 SIZE WITH NUTS AND SPRING WASHERS.
5. ALL WELD SHALL BE 3mm FILLET WELD FULL STRENGTH
6. ADD 50mm WHERE-EVER FIRE INSULATION IS PROVIDED.
7. BOLT SHALL BE TURNED FROM M.S. ROUNDS CONFIRMING TO IS : 432 GRADE 1.
8. NUTS AND WASHERS SHALL CONFIRM TO IS : 1363 AND IS : 3138.

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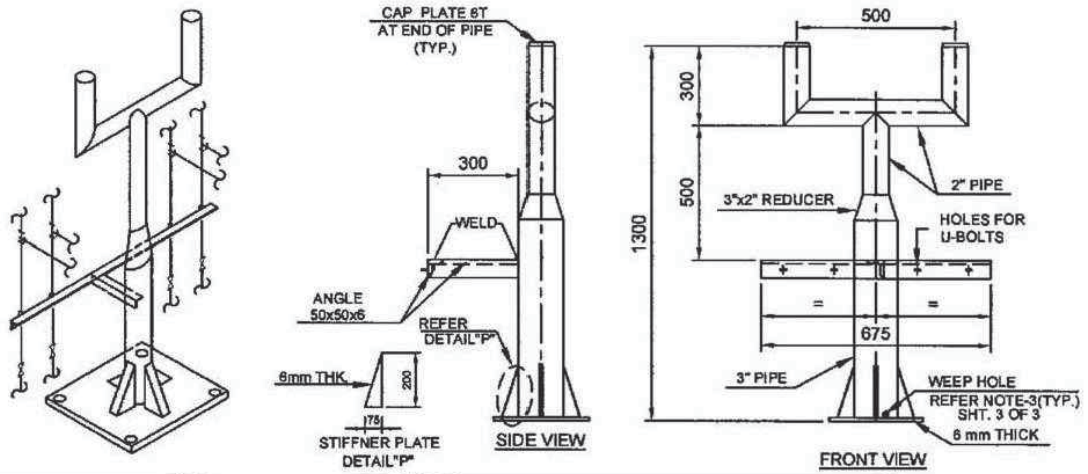
**INSTRUMENT SUPPORT
TWO INSTRUMENTS**

DRAWING NO.

GAIL-ENG-IN-DWG-TP-013

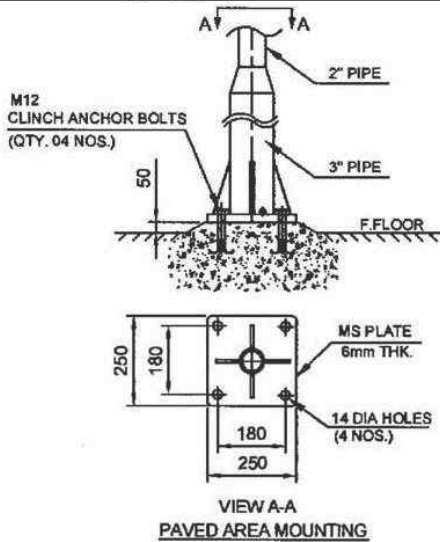
1 OF 3

TYPE 21 TWO INSTRUMENTS SUPPORT – GENERAL ARRANGEMENT

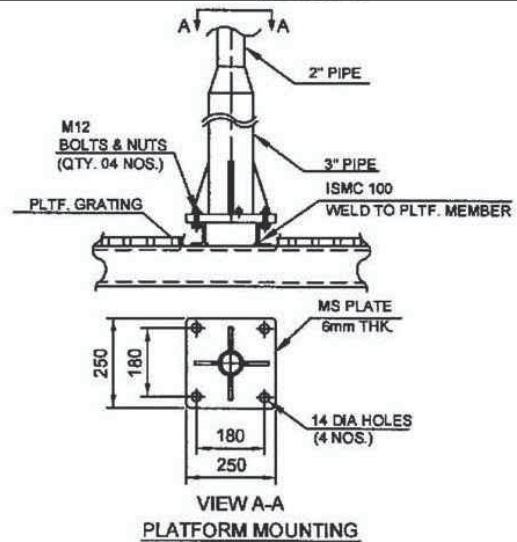


TYPE 21-1

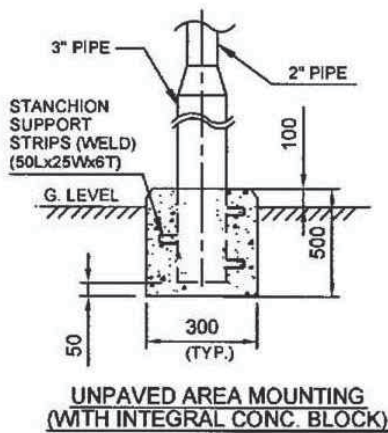
TYPE 21-2



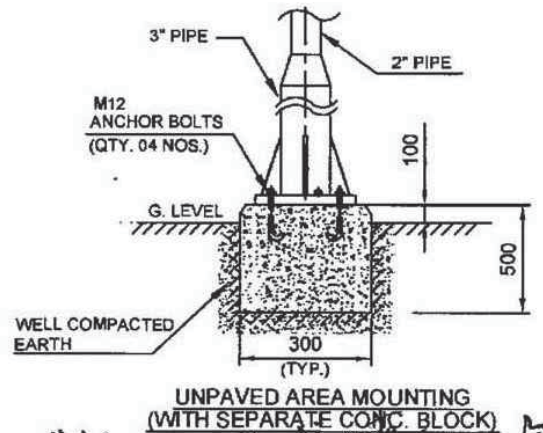
TYPE 21-3



TYPE 21-4



**UNPAVED AREA MOUNTING
(WITH INTEGRAL CONC. BLOCK)**



**UNPAVED AREA MOUNTING
(WITH SEPARATE CONC. BLOCK)**

| | | | | | |
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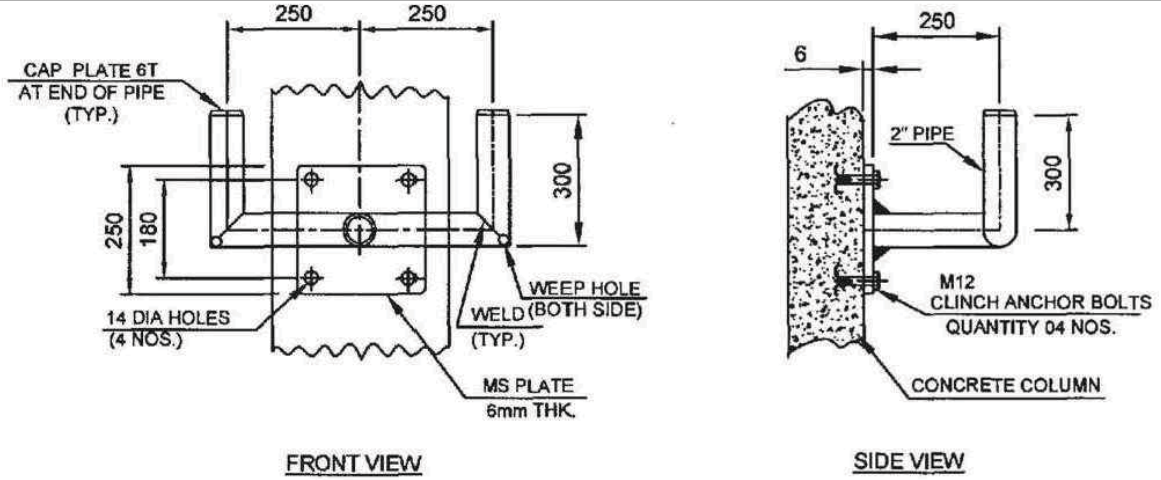
**INSTRUMENT SUPPORT
TWO INSTRUMENTS**

DRAWING NO.

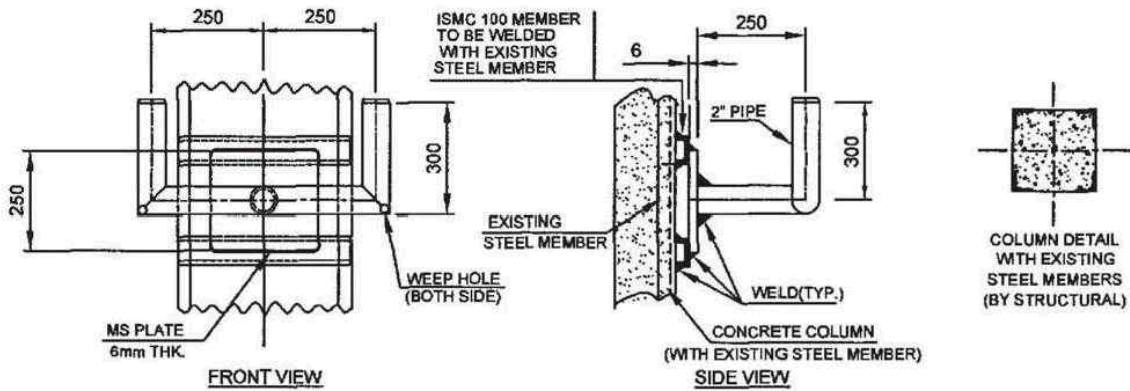
GAIL-ENG-IN-DWG-TP-013

2 OF 3

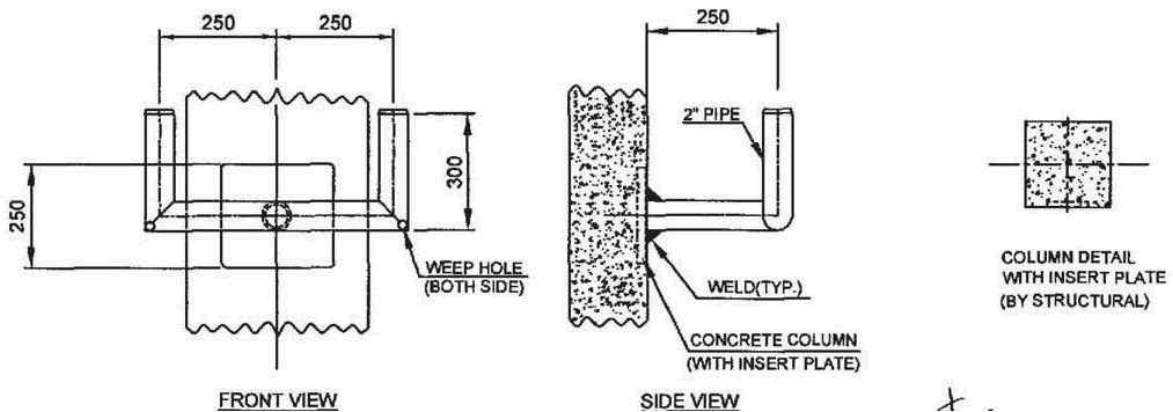
TYPE 22 CONCRETE COLUMN MOUNTING



TYPE 23 CONCRETE COLUMN (WITH ANGLE INSERT) MOUNTING



TYPE 24 CONCRETE COLUMN (WITH INSERT PLATE) MOUNTING



| | | | | | | | |
|---------|----------|---------------------|-----|---------|----------|--|--|
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| REV.NO. | DATE | SUBJECT OF REVISION | BY | CHECKED | APPROVED | | |



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**INSTRUMENT SUPPORT
TWO INSTRUMENTS**

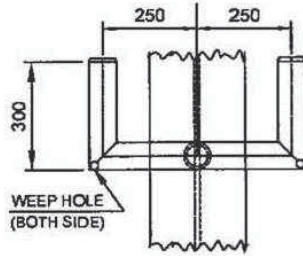
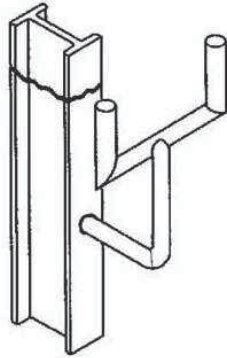
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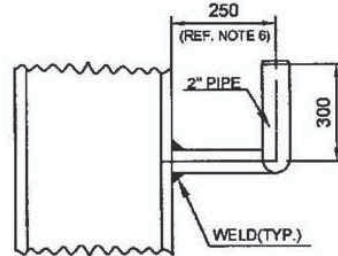
3 OF 3

TYPE 25

STEEL COLUMN MOUNTING (FLANGE FACE)



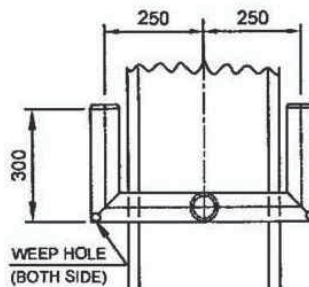
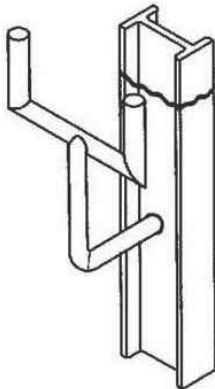
FRONT VIEW



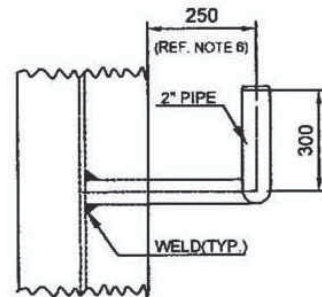
SIDE VIEW

TYPE 26

STEEL COLUMN MOUNTING (WEB FACE)



FRONT VIEW



SIDE VIEW

NOTES:

1. ALL DIMENSIONS ARE IN M.M. UNLESS OTHERWISE SPECIFIED.
2. PIPE MATERIAL SHALL BE IS:1239 HEAVY GRADE AS A MINIMUM.
3. 6 mm DIA WEEP HOLE SHALL BE PROVIDED AT LOW POINT.
4. U-BOLT ASSEMBLY SHALL BE OF MINIMUM M12 SIZE WITH NUTS AND SPRING WASHERS.
5. ALL WELD SHALL BE 3mm FILLET WELD FULL STRENGTH
6. ADD 50mm WHERE-EVER FIRE INSULATION IS PROVIDED.
7. BOLT SHALL BE TURNED FROM M.S. ROUNDS CONFIRMING TO IS : 432 GRADE 1.
8. NUTS AND WASHERS SHALL CONFIRM TO IS : 1363 AND IS : 3138.

| | | | | | |
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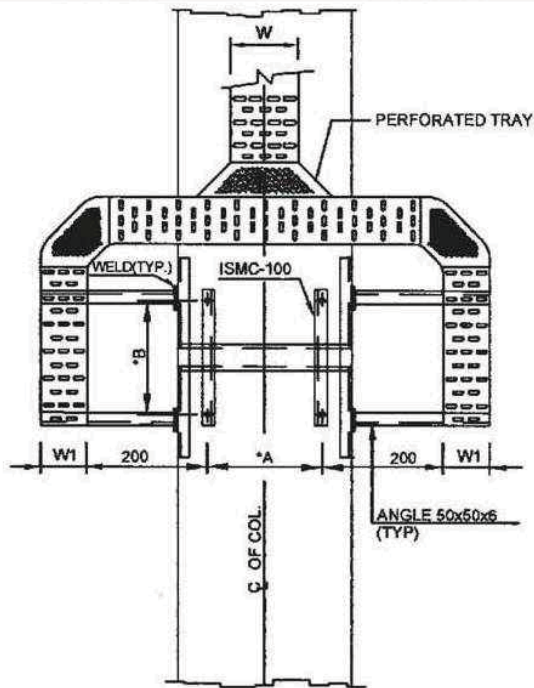
**SUPPORT DETAILS FOR
JUNCTION BOXES**

DRAWING NO.

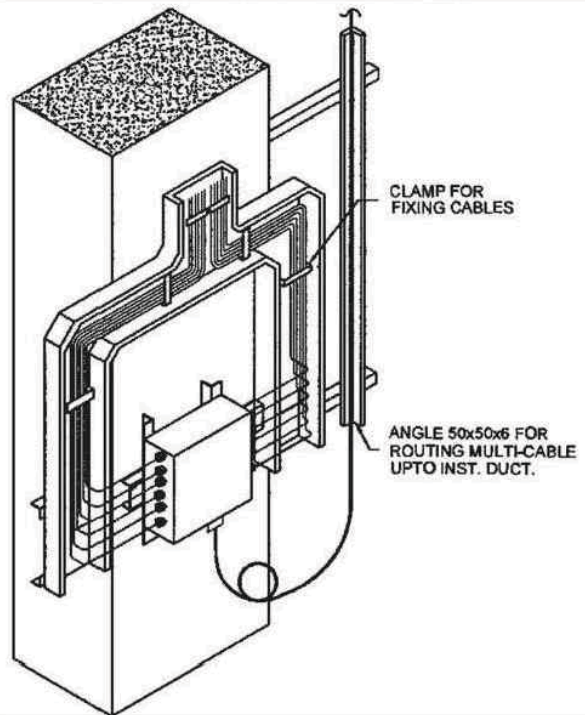
GAIL-ENG-IN-DWG-TP-014

1 OF 1

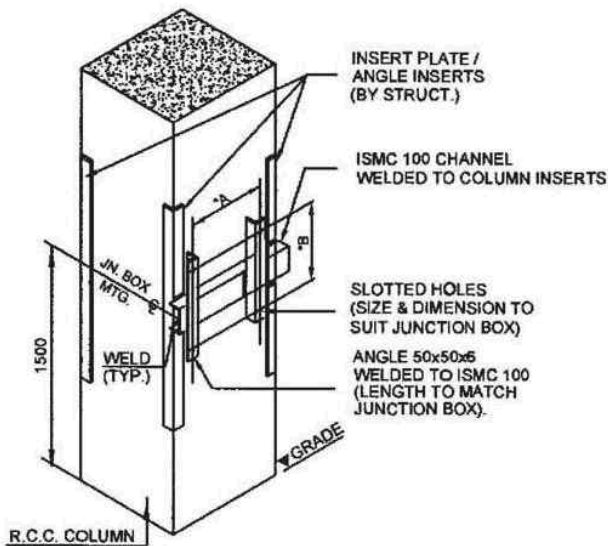
TRAY ARRANGEMENT FOR JUNCTION BOXES



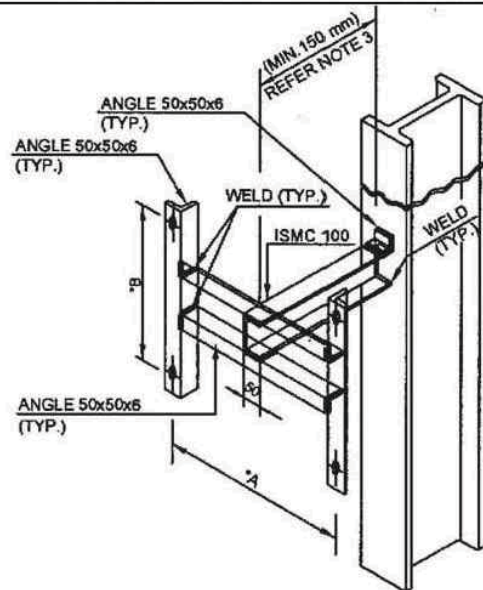
CABLE ROUTING FOR JUNCTION BOXES.



JN. BOX MOUNTING FRAME (R.C.C. COLUMN)



JN. BOX MOUNTING FRAME (STEEL COLUMN)



*DIMENSION 'A and B' TO SUIT JUNCTION BOX.

NOTES:

1. ALL DIMENSIONS ARE IN mm.
2. CLAMP MULTICABLE ON ANGLE WITH 25mm LAME PVC COVERED ALLUMINIUM STRIP.
3. ADD 50 mm WHERE-EVER FIRE INSULATION IS PROVIDED.

TREY WIDTH

| JN. BOX | W | W1 |
|---------|-----|-----|
| 12 PAIR | 300 | 150 |
| 8 TRIAD | 300 | 150 |
| 6 PAIR | 150 | 100 |
| 6 TRIAD | 150 | 100 |

| | | | | | |
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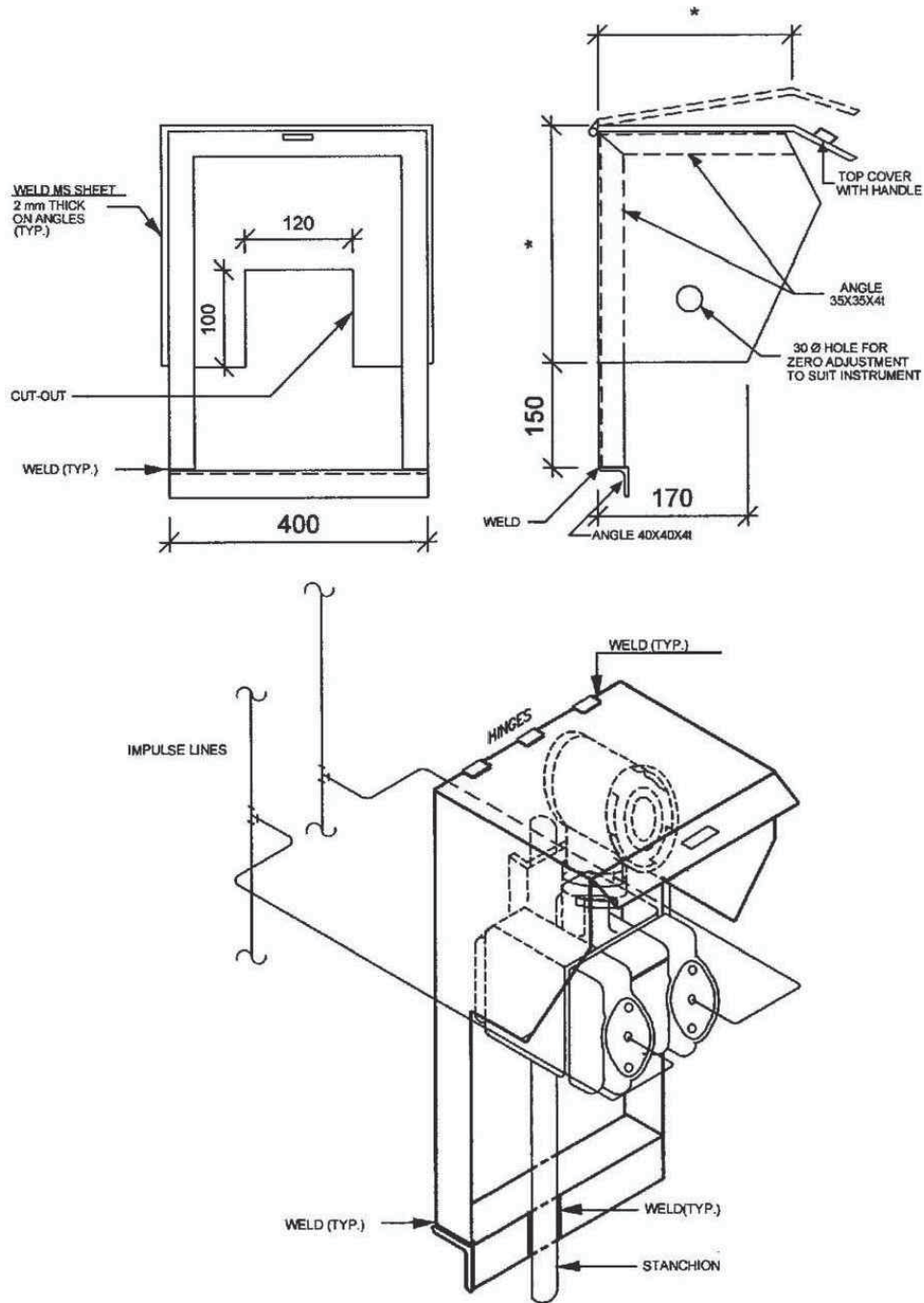
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FABRICATED CANOPY
FOR
INSTRUMENTS

DRAWING NO.

GAIL-ENG-IN-DWG-TP-015

1 OF 1



NOTES:

1. ALL DIMENSIONS ARE IN mm.
2. * - TO SUIT INSTRUMENT DIMENSIONS
3. HINGES SHALL BE OF STAINLESS STEEL
4. A MINIMUM OF TWO COATS PAINTING SHALL BE CARRIED OUT AFTER A MINIMUM OF ONE COAT OF RED OXIDE ZINC CHROMATE PRIMER. THE COLOUR OF THE PAINT SHALL BE AS PER IS-5,

| | | | | | |
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| REV.NO. | DATE | SUBJECT OF REVISION | BY | CHECKED | APPROVED |



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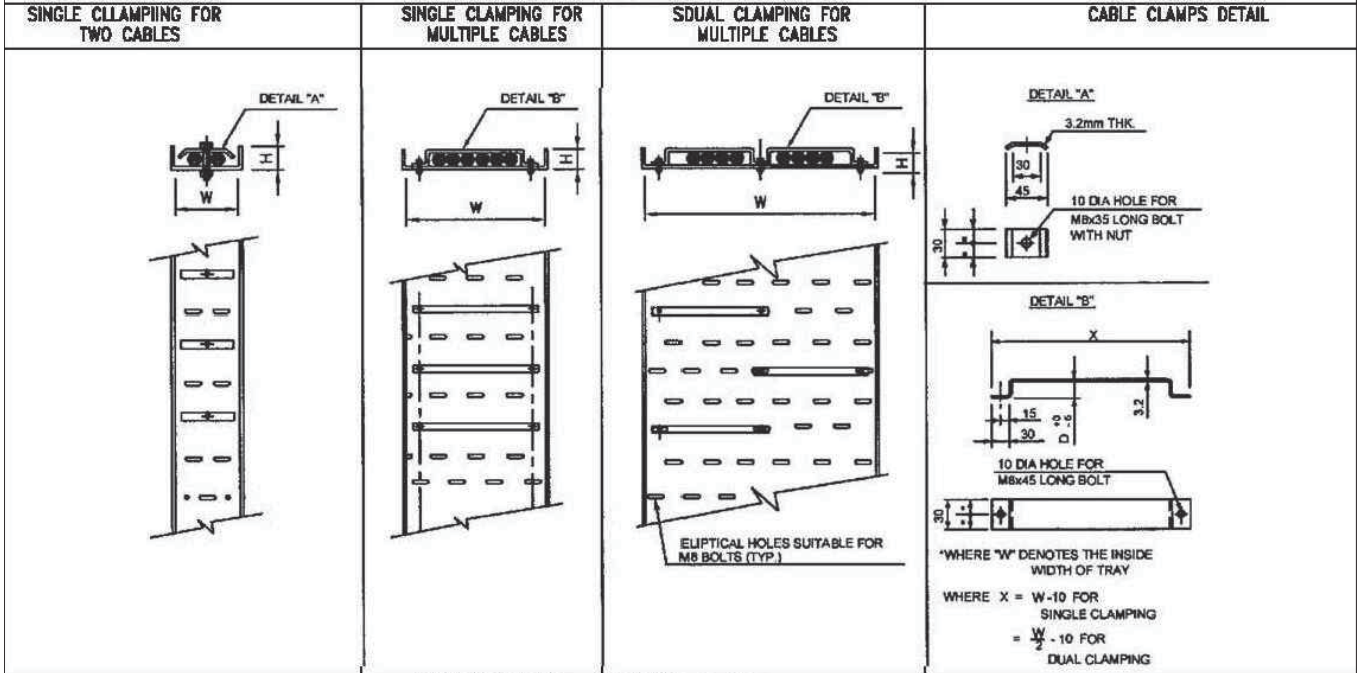
**PERFORATED TRAY SUPPORTS
AND
CABLES CLAMPING DETAILS**

DRAWING NO.

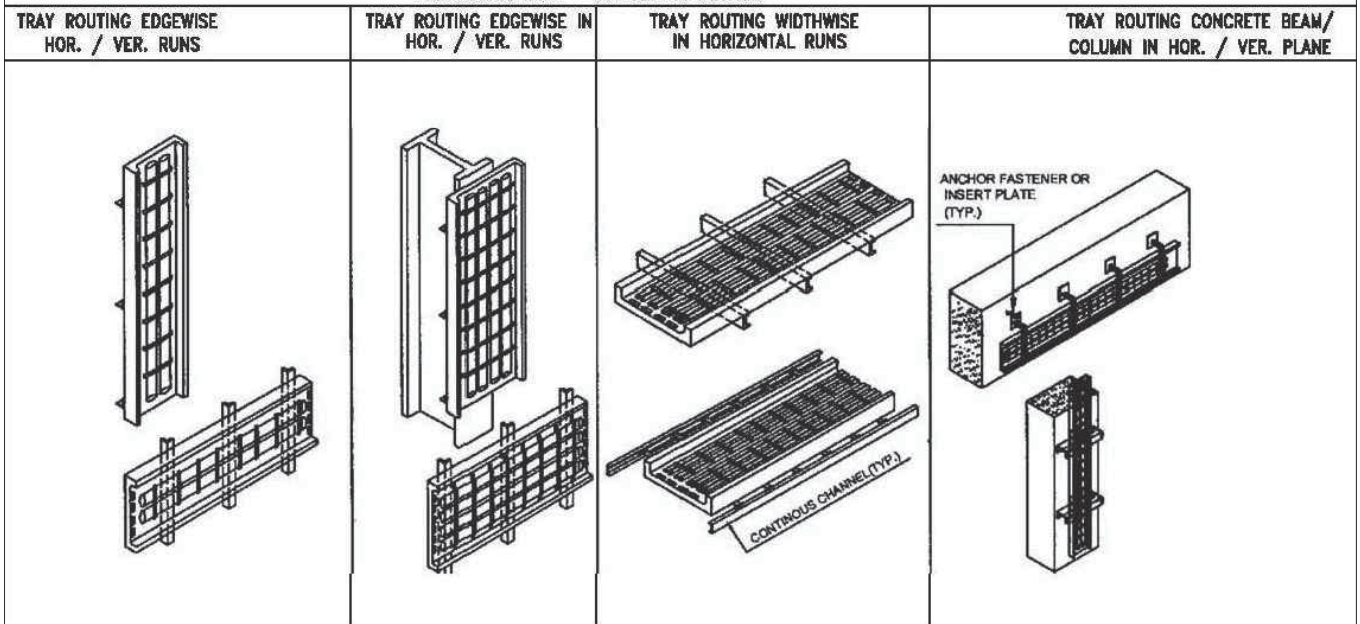
GAIL-ENG-IN-DWG-TP-016

1 OF 1

CABLE CLAMPING ON PERFORATED TRAYS



PERFORATED TRAY - SUPPORTING DETAILS



NOTES:

1. ALL DIMENSIONS ARE IN mm.
2. PERFORATED TRAYS SHALL BE SUPPORTED AT EVERY 1000 mm (TYP.) INTERVAL FOR HORIZONTAL AS WELL AS VERTICAL RUNS USING MINIMUM ANGLE SIZE AS
3. CLAMPING OF CABLES ON PERFORATED TRAYS SHALL BE AT EVERY 500 mm ON VERTICAL RUNS AND EVERY 1000 mm ON HORIZONTAL RUNS.
4. PERFORATED TRAYS SHALL BE SUPPLIED WITH CLAMPS, BOLTS / NUTS AND WASHERS OF GALVANISED MILD STEEL.
5. GALVANISING SHALL BE AS PER IS 4759 (66 gm/ 460 g / m²)
6. THE PERFORATED TRAY THICKNESS SHALL BE 2 mm.

CAPACITY OF PERFORATED TRAYS

| TRAY WIDTH (W) | FLANGE HEIGHT (H) | NO. OF CABLES | | |
|----------------|-------------------|------------------|------------------|-------------------|
| | | 1 PAIR / 1 TRIAD | 6 PAIR / 6 TRIAD | 12 PAIR / 8 TRIAD |
| 60 | 20 | 2 | 1 | 1 |
| 100 | 30 | 4 | 2 | 1 |
| 150 | 30 | 6 | 4 | 3 |
| 200 | 30 | 10 | 6 | 4 |
| 300 | 30 | 15 | 8 | 6 |

| | | | | | |
|---------|----------|---------------------|-----|---------|----------|
| 0 | 15.01.19 | ISSUED FOR TENDER | D.V | U.N | S.B |
| REV.NO. | DATE | SUBJECT OF REVISION | BY | CHECKED | APPROVED |



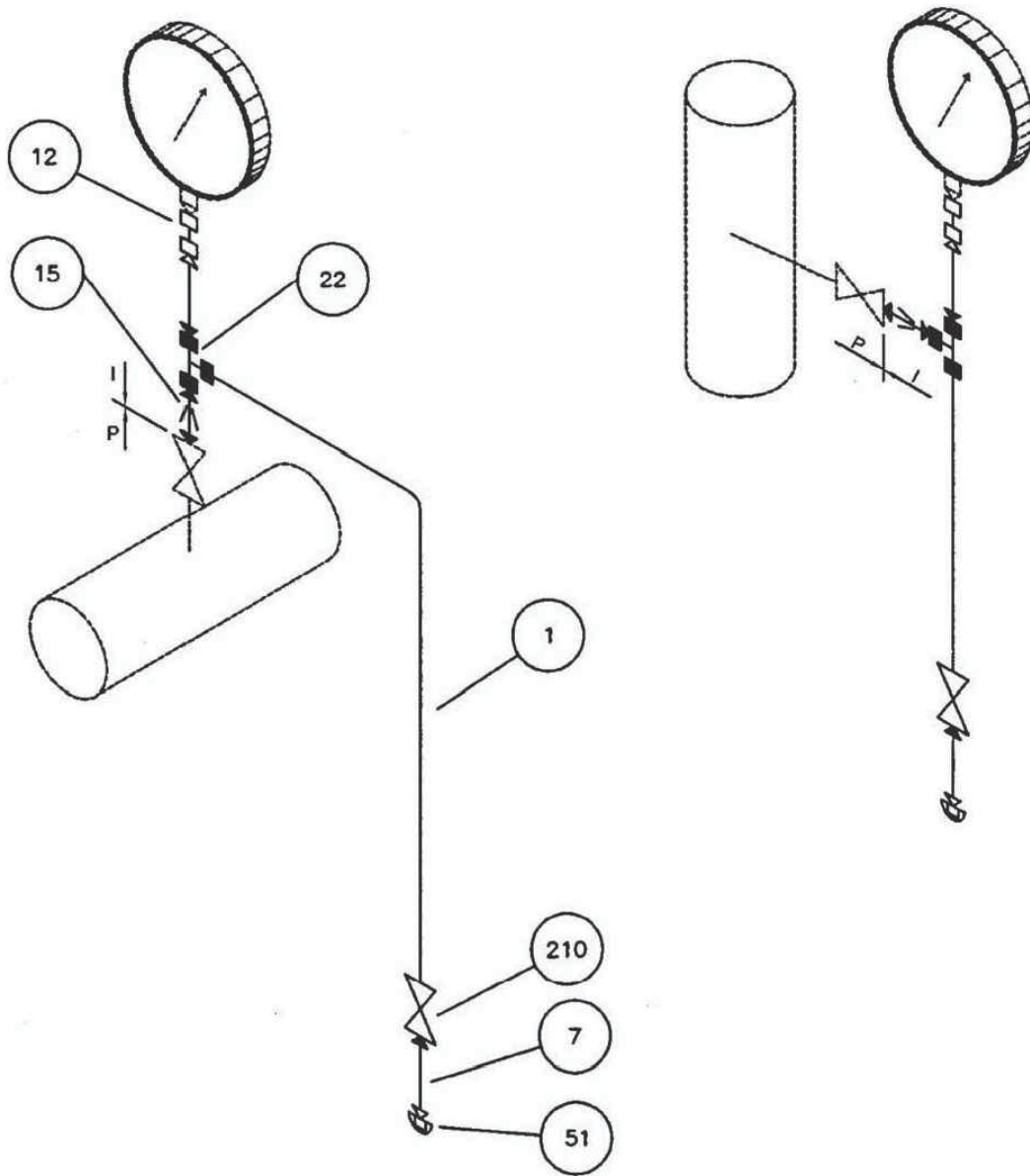
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NEW DELHI

PRESSURE GAUGE
LIQUID/GAS SERVICE

DRAWING NO.

GAIL-ENG-IN-DWG-TP-017

1 OF 1



P - BY PIPING
I - BY INSTRUMENTATION

LIST OF ITEMS

| CODE | DESCRIPTION | SIZE | ENDS | QTY. | UNIT | CODE | DESCRIPTION | SIZE | ENDS | QTY. | UNIT |
|------|--------------|-------------|---------|------|------|------|-------------|------|------|------|------|
| 1 | PIPE | 1/2" | PL | A/R | m | | | | | | |
| 7 | NIPPLE | 1/2" | TH X PL | 2 | No | | | | | | |
| 12 | COUPLING | 1/2" | TH | 1 | No | | | | | | |
| 15 | SWAGE NIPPLE | 3/4" X 1/2" | PL X PL | 1 | No | | | | | | |
| 22 | EQUAL TEE | 1/2" | SW | 1 | No | | | | | | |
| 51 | CAP | 1/2" | TH | 1 | No | | | | | | |
| 210 | GATE VALVE | 1/2" | SW | 1 | No | | | | | | |

| | | | | | |
|---------|----------|---------------------|-----|---------|----------|
| 0 | 15.01.19 | ISSUED FOR TENDER | D.V | U.N | S.B |
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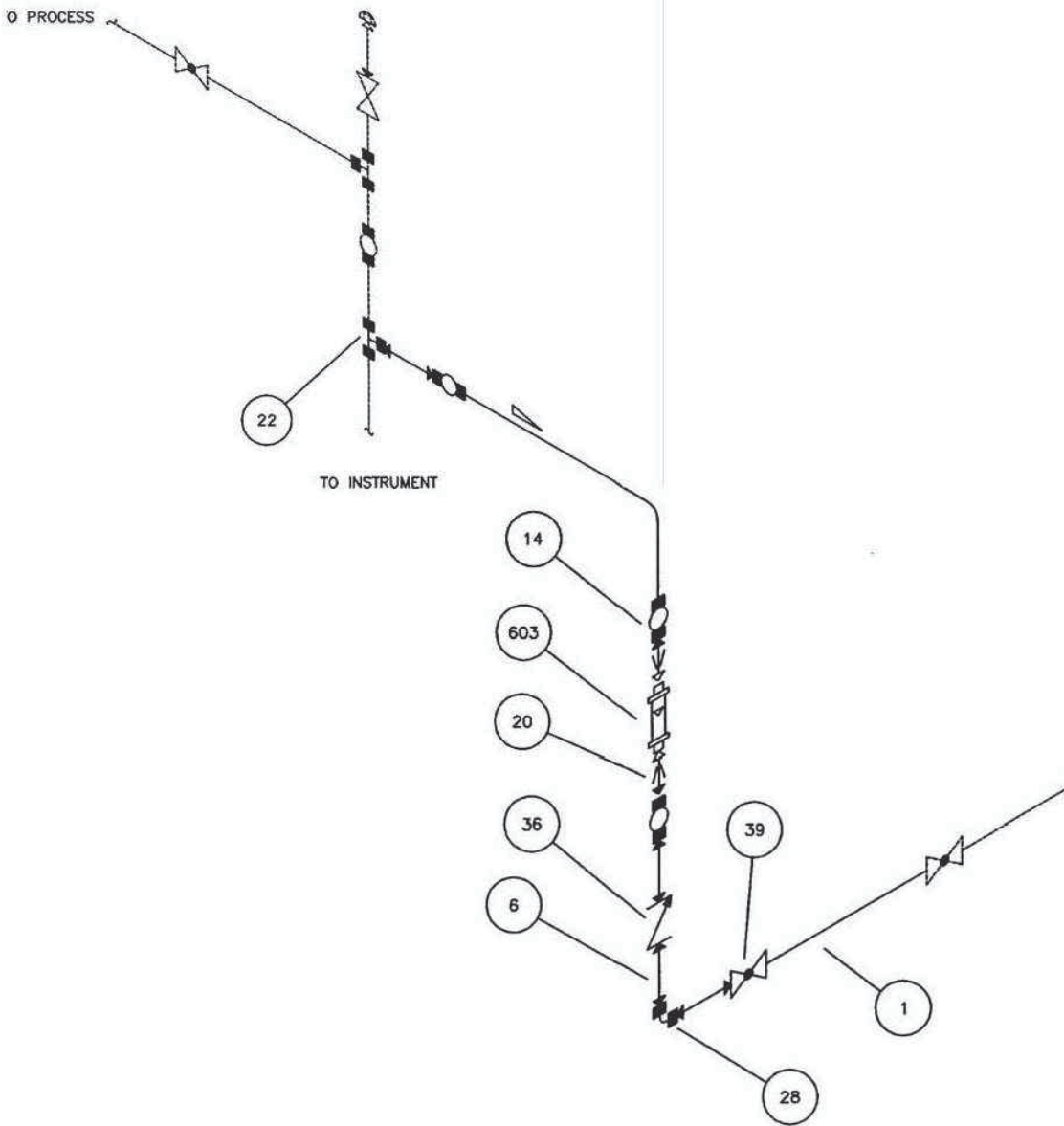
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NEW DELHI

PURGE FOR INSTRUMENT
SINGLE LINE

DRAWING NO.

GAIL-ENG-IN-DWG-TP-018

1 OF 1



* PL x PL NIPPLE SHALL BE FABRICATED FROM PIPE

LIST OF ITEMS

| CODE | DESCRIPTION | SIZE | ENDS | QTY. | UNIT | CODE | DESCRIPTION | SIZE | ENDS | QTY. | UNIT |
|------|--------------|-------------|---------|------|------|------|-----------------|------|----------|------|------|
| 1 | PIPE | 1/2" | PL | A/R | m | 603 | PURGE ROTAMETER | 1/4" | TH (Int) | 1 | Ns |
| 6 | NIPPLE * | 1/2" | PL X PL | 4 | Ns | | | | | | |
| 14 | UNION | 1/2" | SW | 3 | Ns | | | | | | |
| 20 | SWAGE NIPPLE | 1/2" X 1/4" | PL X TH | 2 | Ns | | | | | | |
| 22 | EQUAL TEE | 1/2" | SW | 1 | Ns | | | | | | |
| 28 | ELBOW | 1/2" | SW | 1 | Ns | | | | | | |
| 39 | GLOBE VALVE | 1/2" | SW | 1 | Ns | | | | | | |
| 36 | CHECK VALVE | 1/2" | SW | 1 | Ns | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |

| | | | | | | | | | | | |
|---------|----------|---------------------|--|--|-----|--|---------|--|----------|--|--|
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| REV.NO. | DATE | SUBJECT OF REVISION | | | BY | | CHECKED | | APPROVED | | |



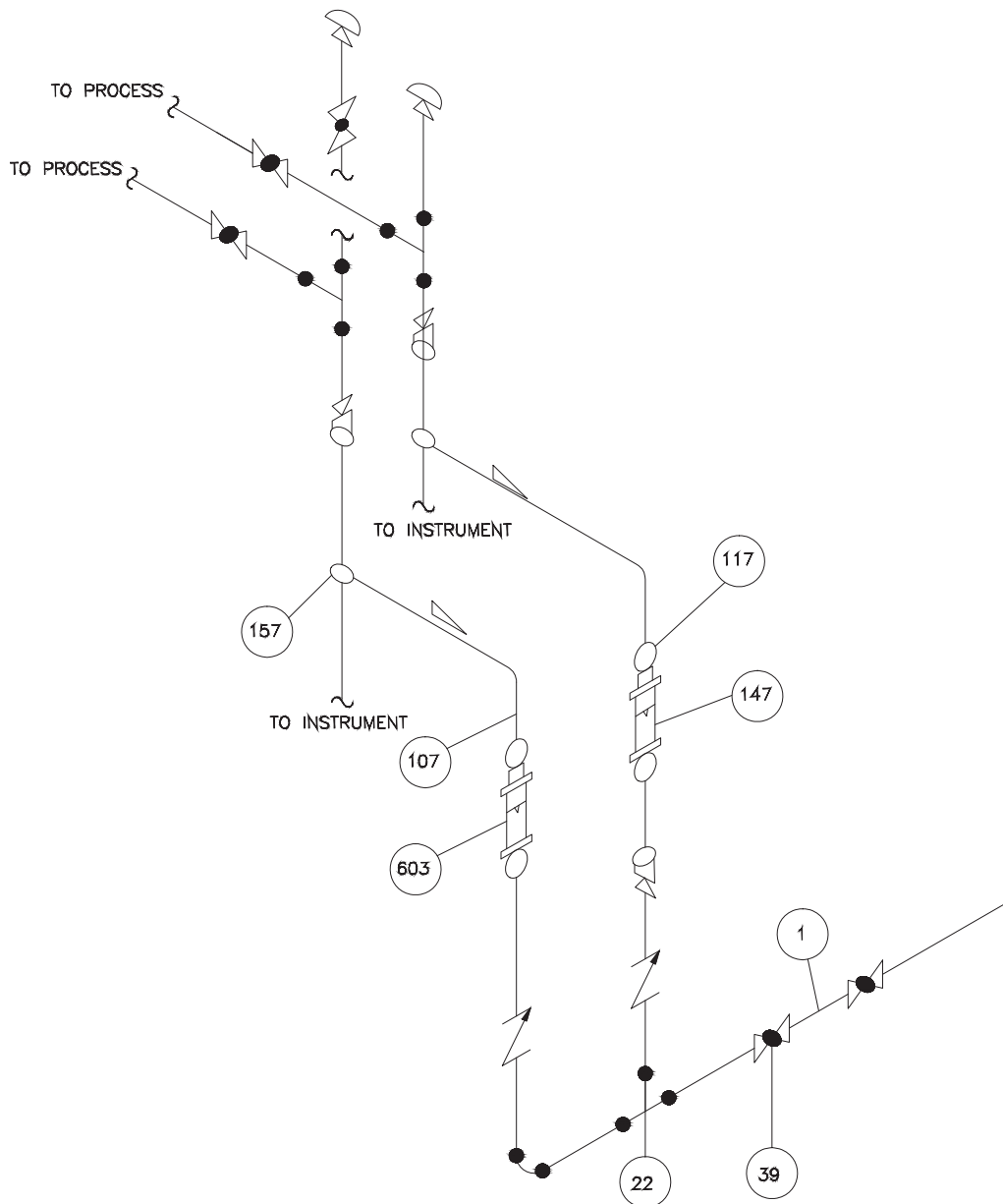
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NEW DELHI

PURGE FOR INSTRUMENT
DOUBLE LINE

DRAWING NO.

GAIL-ENG-IN-DWG-TP-019

1 OF 1



* PL x PL NIPPLE SHALL BE FABRICATED FROM PIPE

LIST OF ITEMS

| CODE | DESCRIPTION | SIZE | ENDS | QTY. | UNIT | CODE | DESCRIPTION | SIZE | ENDS | QTY. | UNIT |
|------|-------------|------|---------|------|------|------|------------------|-------------|----------|------|------|
| 1 | PIPE | 1/2" | PL | A/R | m | 107 | TUBE | 1/2" | OD | A/R | N# |
| 6 | NIPPLE * | 1/2" | PL X PL | 3 | N# | 117 | MALE CONNECTOR | 1/4" X 1/2" | TH X OD | 4 | N# |
| 7 | NIPPLE | 1/2" | TH X PL | 2 | N# | 147 | FEMALE CONNECTOR | 1/2" X 1/2" | TH X OD | 2 | N# |
| 22 | EQUAL TEE | 1/2" | SW | 1 | N# | 157 | UNION TEE | 1/2" | OD | 2 | N# |
| 28 | ELBOW | 1/2" | SW | 1 | N# | 603 | PURGE ROTAMETER | 1/4" | TH (Int) | 2 | N# |
| 39 | GLOBE VALVE | 1/2" | SW | 1 | N# | | | | | | |
| 36 | CHECK VALVE | 1/2" | SW | 2 | N# | | | | | | |

| | | | | | |
|---------|----------|---------------------|-----|---------|----------|
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GAIL INDIA LIMITED

**CONSTRUCTION OF STEEL PIPELINE AND ASSOCIATED FACILITIES
FOR CGD CONNECTIVITIES**

VOLUME II OF II (TECHNICAL) – I



TELECOM

E-TENDER REF : 8000017904

(BID DOCUMENT NO - 034/LEPL/GAIL/31-R0)



Lyons Engineering Pvt. Ltd.

| | | | |
|--|--|-------------------------------|---|
| PMC:  | DCI - MASTER DELIVERABLE CONTROL INDEX FOR CONSTRUCTION OF STEEL PIPELINE AND ASSOCIATED FACILITIES FOR CGD FOR M/S IOAGPL PALAKKAD, CGD TO M/S IOAGPL MALAPPURAM, CGD TO M/S IOAGPL KANNUR & CGD TO M/S GAIL GAS LIMITED DAKSHIN KANNADA | Doc No. | CLIENT:  |
| | | GAIL-ENG-GN-DOC-DL-001 | |
| | | Rev. 0 | |
| Sr. No. | Description | Document / Drawing No. | Rev. No. |
| TECHNICAL VOLUME - II OF II | | | |
| I | TELECOM | | |
| STANDARD SPECIFICATION FOR TELECOM | | | |
| 1 | Standard Specifications for OFC & HDPE | GAIL-STD-TL-DOC-TS-001 | 0 |
| 2 | Standard Procedure for Fiber Optical Cable Testing | GAIL-STD-TL-DOC-TS-002 | 0 |
| DATASHEET FOR TELECOM | | | |
| 3 | Datasheet for Fiber Optic Cable | GAIL-STD-TL-DOC-DS-001 | 0 |
| 4 | Datasheet for HDPE Duct | GAIL-STD-TL-DOC-DS-002 | 0 |
| QAP FOR TELECOM | | | |
| 5 | QAP for Optical Fibre Cable | GAIL-STD-TL-DOC-QAP-001 | 0 |
| 6 | QAP for HDPE Duct & Accessories | GAIL-STD-TL-DOC-QAP-002 | 0 |
| STANDARD TYPICAL DRAWING | | | |
| 7 | Telecom Typical (Cross section Installation & Joint Identification Marker) drawing | GAIL-STD-TL-DWG-TP-001 | 0 |
| J | LIST OF RECOMMENDED VENDORS | | |
| i) | List of Recommended Parties for Bought Out Items | GAIL-ENG-GN-DOC-VL-001 | 0 |



GAIL INDIA LIMITED

**STANDARD SPECIFICATION FOR
OPTICAL FIBRE CABLE AND HDPE DUCT**

GAIL-STD-TL-DOC-DS-001

| Rev | Date | Purpose | Prepared By | Checked By | Approved By |
|-----|----------|-------------|-------------|------------|-------------|
| 0 | 14.01.19 | First Issue | RKS | UNU | UNU |




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1.0 GENERAL

This document describes the specifications of 24 fiber metal free Optical Fiber Cable for underground installation in ducts, which shall conform to TEC Draft GR No. TEC/GR/TX/OFC-23/01/XXX-2011 (under finalization in TEC). The optical fiber cable shall have low weight, small volume and high flexibility. The optical fiber cable shall have double HDPE jacketing with anti-rodent & anti-termite properties with glass yarn in between as reinforcement. The cable shall be suitably protected from the ingress of moisture by flooding jelly. The raw material used in the cable shall meet the requirements of the specifications for the raw materials (GR No.TEC/GR/TX/ORM-01/04 SEP-09).

The contractor shall be totally responsible for the desired performance of the offered OFC including design, engineering, manufacture, testing and supply of direct underground burial type OFC and for underground installation in ducts.

The design and construction of metal free optical cable shall be inherently robust and rigid under all conditions of operations, installation, adjustment, replacement, storage and transport and shall be of capable of laying in permanently lubricated HDPE conduits using blowing technology & shall be capable of direct burial and for crossing various roads, railways, canals, small rivers, marshy areas, etc. through appropriate casings & directly as per site conditions.


OFC shall be blow through self-lubricating type HDPE conduit of required diameter and shall be minimum of 50 mm (OD) by compressed air blowing method. Across each said crossing, the contractor shall install two HDPE duct sub-ducted in CS Pipe and blow optical fibre cable through the one of these HDPE ducts. Spare HDPE duct shall be plugged & kept for future use.HDPE conduits along with accessories such as end cap, cable sealing plug and all the machinery, tools, tackles etc. to complete the job in all respects to lay the HDPE & OFC shall be provided by the bidder.

It is mandatory that the supplied optical fiber cable shall be manufactured from a single source of optical fibers.

The intent of the following specifications is to establish the minimum requirements and guidelines for the OFC to be supplied for the project.

1.1 Abbreviations

| | |
|-------|---|
| ASTM | - American Society for Testing and Materials |
| EIA | - Electronic Industry Association |
| FRP | - Fiber Reinforced Plastic |
| HDPE | - High Density Polyethylene |
| IEC | - International Electra -Technical Commission |
| ISO | - International Standard Organizations |
| ITU-T | - International Telecommunication Union- Transmission |
| MFD | - Mode Field Diameter |
| OF | - Optical Fiber |
| OTDR | - Optical Time Domain Reflect meter |
| QA | - Quality Assurance |
| QM | - Quality Manual |
| RMS | - Route Mean Square |
| SMOF | - Single Mode Optical Fibre |
| TEC | - Telecommunication Engineering Centre |
| UV | - Ultra Violet |

| | | | |
|---|------------------------|------------|---|
| Technical Specification for Optical Fibre Cable and HDPE Duct | Doc No. | Rev |  |
| | GAIL-STD-TL-DOC-DS-001 | 0 | |
| Page 4 of 35 | | | |

1.2 Conflicting Requirement

In the event of any conflict between this standard specification, job specification, datasheets, statutory regulations, related standards, codes etc. the following order of priority shall govern:

- i) Statutory Rules & Regulations
- ii) Technical Specification for OFC & HDPE
- iii) Data Sheets
- iv) Codes and Standards Instrumentation Drawings

1.3 Drawing and Data

- 1.3.1 Detailed drawings, data, catalogues and manuals required from the vendor are indicated by the purchaser in vendor data requirement sheets. The required number of reproducible, prints and soft copies shall be dispatched to the address mentioned, adhering to the time limits indicated.
- 1.3.2 Final documentation consisting of design data, installation manual, operation and maintenance manual etc., submitted by the vendor after placement of purchase, order shall include complete technical literature in English with detailed cable construction diagram of various sub-components with dimensions & test data. All aspects of installation, operation, and maintenance shall also be covered in the document.
- 1.3.3 The Vendor / Contractor shall be completely responsible for the successful completion of the job. However, to ensure good quality of workmanship. As also of the uttered system, vendor shall prepare and submit the documents to be approved by the Owner/Owner's representatives. Vendor shall proceed with the manufacture / procurement / installation of the respective materials and/or equipment only after obtaining the necessary approval from the Owner/Owner's representatives.

1.4 Safety Requirement


The material used in the manufacturing of the armoured optical fibre cables shall be non-toxic and dermatologically safe in its lifetime.

2.0 OPERATING REQUIREMENT

- a) The design and construction of metal free optical cable shall be inherently robust and rigid under all conditions of operations, adjustment, replacement, storage and transport.
- b) The optical fibre cable shall be able to work in a saline atmosphere in coastal areas and should be protected against corrosion.
- c) Life of cable shall be better than 40 years. The bidder shall submit necessary statistical calculations.
- d) It shall be possible to operate and handle the metal free optical fibre cable with tools as per TEC specs No. G / OFT—01 / 02 Mar.'99 (or Latest) and subsequent amendment, if any. In case any Special tool requirement for operating and handling the optical fibre cable. The same shall be provided along with the cable.

3.0 TECHNICAL PARTICULARS- OPTICAL FIBRE CABLES

3.1 Specification of Optical Fibres

| | | | |
|---|------------------------|------------|---|
| Technical Specification for Optical Fibre Cable and HDPE Duct | Doc No. | Rev |  |
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Out of 24 fiber, eighteen fiber shall be as per ITU – T Rec. G 652 D and remaining six fiber shall be as per ITU-T Rec. G655. The specifications of optical fibers are as follows:

| SR. NO. | SPECIFICATION | G.652D | G.655 |
|---------|--|--|--|
| 3.1.1 | Type of fiber | Single mode (Section – I of the TEC/GR/TX/ORM 01/04/ SEP-09 and subsequent amendments, if any) | NZDS Single mode Optical Fibre optimized for use in 1550 nm window conforming to ITU-T Rec.G.655 |
| 3.1.2 | Geometrical Characteristics | | |
| 3.1.2.1 | Nominal Mode Field Diameter (MFD) For matched clad | 8.8 – 9.8 μm | 9.6 \pm 0.4 μm |
| 3.1.2.2 | Nominal Cladding Diameter | 125 $\mu\text{m} \pm$ 1.0 μm | 125 $\mu\text{m} \pm$ 1.0 μm |
| 3.1.2.3 | Cladding Non-circularity | \leq 1% | \leq 1% |
| 3.1.2.4 | Core clad concentricity error | \leq 0.6 μm | \leq 0.6 μm |
| 3.1.2.5 | Diameter over primary coated with double UV cured acrylate (shall be measured on uncoloured fiber) | 245 $\mu\text{m} \pm$ 10 μm | 245 $\mu\text{m} \pm$ 10 μm |
| 3.1.2.6 | Coating / Cladding Concentricity | \leq 12 μm | \leq 12 μm |

| | | |
|---------|--|-------------------|
| 3.1.3 | Transmission Characteristics of G.652D fibers | |
| 3.1.3.1 | Attenuation | |
| | a) Fiber attenuation before cabling | |
| | i) At 1310 nm | \leq 0.34 dB/Km |
| | ii) Between 1285 to 1360 nm | \leq 0.37 dB/Km |
| | iii) Between 1480 to 1525 nm | \leq 0.34 dB/Km |
| | iv) At 1550 nm | \leq 0.21 dB/Km |
| | v) Between 1525 to 1625 nm | \leq 0.24 dB/Km |
| | b) Water Peak Attenuation before cabling Between | \leq 0.34 dB/Km |

| | | |
|---------|--|---|
| 3.1.3 | Transmission Characteristics of G.652D fibers | |
| | <p style="text-align: center;">1360 – 1480 nm</p> <p>Note :</p> <ol style="list-style-type: none"> 1. Sudden irregularity in attenuation shall be less than 0.1 dB 2. The spectral attenuation shall be measured on un-cabled fiber. 3. The spectral attenuation in the 1250 nm – 1625 nm band shall be measured at an interval of 10 nm and the test results shall be submitted. | |
| | <p>c) Fiber attenuation after cabling</p> <ol style="list-style-type: none"> i) At 1310 nm ii) At 1550 nm iii) At 1625 nm | ≤ 0.36 dB/Km ≤ 0.23 dB/Km ≤ 0.26 dB/Km |
| | <p>d) Water Peak Attenuation after cabling</p> <ol style="list-style-type: none"> i) At 1383 nm ii) Between 1360 – 1480 nm <p>Note: Water Peak Attenuation after cabling shall be measured either at 1383 nm or between 1360 – 1480 nm.</p> | ≤ 0.34 dB/Km ≤ 0.34 dB/Km |
| 3.1.3.2 | <p>Dispersion</p> <p>a) Total Dispersion</p> <p>In 1285 – 1330 nm band In 1270 – 1340 nm band At 1550 nm At 1625 nm</p> <p>Note-The dispersion in 1250 nm – 1625 nm band shall be measured on un-cabled fiber at an interval of 10 nm and the test results shall be submitted.</p> <p>b) Polarization mode dispersion at 1310 & 1550 nm</p> <ol style="list-style-type: none"> i) Fiber ii) Cabled Fiber <p>Note- Measurement on un-cabled</p> | |

| | | |
|---------|--|---|
| 3.1.3 | Transmission Characteristics of G.652D fibers | |
| | fiber may be used to generate cabled fiber statistics and correlation established c) Zero Dispersion Slope d) Zero Dispersion wave length range | $\leq 0.092\text{ps}/(\text{nm}^2\cdot\text{km})$ 1300 – 1324 nm |
| 3.1.4 | a) Cut off wavelength for fibers used in cable Note – The above cut off wave length is w.r.t. 2 M sample length of fiber b) Cable Cut off wavelength | 1320 nm Max 1260 nm Max |
| 3.1.5 | Transmission Characteristics of G655 fibres | |
| 3.1.5.1 | Attenuation | |
| | a) Fiber attenuation before cabling | |
| | i) Between 1525 to 1565 nm | $\leq 0.23 \text{ dB/Km}$ |
| | ii) Between 1565 to 1625 nm | $\leq 0.26 \text{ dB/Km}$ |
| | b) Fiber attenuation after cabling i) At 1550 nm ii) At 1625 nm Note : 1. Sudden irregularity in attenuation at 1550 nm shall be $\leq 0.05 \text{ dB}$. 2. The spectral attenuation shall be measured on uncabled fibre. 3. The spectral attenuation in the 1525 nm – 1625 nm band shall be measured at an interval of 10 nm and the test results shall be submitted. | $\leq 0.25 \text{ dB/Km}$ $\leq 0.28 \text{ dB/Km}$ |
| 3.1.5.2 | • Chromatic Dispersion a) Chromatic Dispersion Coefficient in 1530-1565 nm band i) λ_{min} & λ_{max} ii) Minimum value of D_{min} | 1530 nm to 1565 nm 1.0 ps/nm.Km |

| | | |
|---------|---|--|
| 3.1.5 | Transmission Characteristics of G655 fibres | |
| | iii) Maximum value of Dmax iv) Dmax - Dmin v) Sign b) Chromatic Dispersion Coefficient in 1565-1625 nm band i) λ_{min} & λ_{max} ii) Minimum value of Dmin iii) Maximum value of Dmax iv) Sign • Polarization mode dispersion at 1550 nm Individual (un-cabled) Fibre Cabled Fibre Link design value of PMD Note : Measurement on un-cabled fibre may be used to generate cabled fibre statistics and correlation established Dispersion Slope at 1550 nm | 10.0 ps/nm.Km ≤ 5.0 ps/nm.Km Positive 1565 nm & 1625 nm 4.0 ps/nm.Km 14.0 ps/nm.Km Positive ≤ 0.15 ps/ $\sqrt{\text{Km}}$ ≤ 0.3 ps/ $\sqrt{\text{Km}}$ ≤ 0.1 ps/ $\sqrt{\text{Km}}$ |
| 3.1.6 | c) Cut off wavelength for fibers used in cable | 1480 nm Max |
| 3.1.7 | Mechanical Characteristics of G.652D & G.655 Fibers | |
| 3.1.7.1 | a) Proof test for minimum strain level (Test method IEC-60793-1-30) b) Peak Strippability force to remove primary coating of the fiber (Test method IEC-60793-1-32) Note: The force required to remove 30 mm \pm 3mm of the fiber coating shall not exceed 8.9 N and shall not be less than 1.3 N. c) Dynamic Tensile Strength (Test method IEC-60793-1-31) i) Un-aged ii) Aged d) Dynamic Fatigue (Test method IEC-60793-1-33) e) Static Fatigue | 1% $1.3 \leq F \leq 8.9$ N ≥ 550 KPSI (3.80 Gpa) ≥ 440 KPSI (3.00 Gpa) ≥ 20 ≥ 20 |

| | | |
|---------|---|--|
| 3.1.5 | Transmission Characteristics of G655 fibres | |
| | (Test method IEC-60793-1-33) | |
| 3.1.7.2 | Fiber macro bend Change in attenuation when fiber is coiled with 100 turns on 30 ±1.0 mm radius mandrel(Test method FOTP– 62/ IEC- 60793-1-47) | ≤ 0.05 dB at 1550 nm for G.652D& G.655 fiber ≤ 0.5 dB at 1625 nm for G.655fiber |
| 3.1.7.3 | Fiber macro bend Change in attenuation when fiber is coiled with 1 turn around 32 ± 0.5 mm diameter mandrel(Test method FOTP– 62/ IEC- 60793-1-47) | ≤ 0.5 dB at 1550 nm for G.652D & G.655 fibers ≤ 1.0 dB at 1625 nm for G.655 fiber |
| 3.1.7.4 | Fiber Curl (Test method as per IEC-60793-1-34) | ≥ 4 meters radius of curvature |
| 3.1.8 | Material properties of G.652D & G.655fibers | |
| 3.1.8.1 | Fiber Materials a) The substances of which the fibers are made. b) Protective materials requirement <ul style="list-style-type: none"> • The physical and chemical properties of the material used for the fiber primary coating and for single jacket fiber. • The best way of removing protective coating material. | contractor to specify To be indicated by the bidder/vendor/contractor. |

3.2 OPTICAL FIBRE CABLE CONSTRUCTION SPECIFICATIONS


3.2.1 Secondary Protection

The primary coated fibers shall be protected by loose packaging within a tube, which shall be filled with thixotropic jelly.

| | |
|---------------------------------|-------------------------------|
| Number of fibers | : 24 |
| Number of loose tubes | : 6 |
| Number of Filler/ Dummy | : 0 |
| Number of fibers per loose tube | : 4 |
| Material for loose tube | : Polybutylene terephthalate. |
| The OD of loose tube | : 1.9 mm + 0.1 mm |
| The ID of loose tube | : minimum 1.2mm |

3.2.2 Cable Core Assembly

Four fibers shall be placed loosely in each loose tube.

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3.2.3 Core Wrapping

The core wrapping shall not adhere to the secondary fiber coating and shall not leave any kink marks over the loose tube.

3.2.4 Filling Compound

The filling and the flooding jelly compound shall be as per the TEC Specs No. TEC/GR/TX/ORM 01/04/SEP-09 and subsequent amendment issued, if any.

3.2.5 Inner Sheath

A non-metallic moisture barrier sheath shall be applied over and above the cable core. The core shall be covered with tough weather resistant High Density Polyethylene (HDPE) sheath black in colour (UV stabilised) and colour shall conform to Munsell Colour Standards. Thickness of the sheath shall be uniform & shall not be less than 1.2 mm. The sheath shall be circular, smooth, free from pin holes, joints, mended pieces and other defects. Reference test method to measures thickness shall be as per IEC 189 Para 2.2.1 and Para 2.2.2.

Note : HDPE material, black in colour, from the finished cable shall be subjected to following tests (on sample basis) and shall conform to the requirement of the material as per GR No.TEC/GR/TX/ORM-01/04 SEP.09.


- i. Density
- ii. Melt Flow Index
- iii. Oxidative Induction time
- iv. Carbon Black Content
- v. Carbon Black Dispersion
- vi. ESCR
- vii. Moisture Content
- viii. Tensile Strength and Elongation at break
- ix. Absorption Coefficient
- x. Brittleness Temperature

3.2.6 Glass Reinforcement

Impregnated Glass Fiber Reinforcement shall be used to achieve the required tensile strength of the optic fiber cable over the cable inner sheath to provide peripheral reinforcement along with solid rigid FRP Rod in the centre at cable core. These flexible strength members shall be Non-water blocking type. Impregnated Glass Fiber Reinforcement used shall be equally distributed over the periphery of the cable inner sheath. It shall be applied helically and shall provide full coverage to inner sheath to provide rodent protection. The quantity of the Impregnated Glass fiber Reinforcement used per km length of the cable shall be minimum 20kg per KM cable. The specification of the glass roving shall be as per Section XII of GR No. TEC/GR/TX/ORM-01/04 SEP.09.

3.2.7 Outer Sheath

A non-metallic moisture barrier sheath (black in colour) shall be applied over the inner sheath and glass roving layer, which shall consist of tough weather resistant made High Density Polyethylene compound (HDPE) with anti-termite and anti-rodent properties. The outer sheath shall be UV stabilized and the

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colour shall confirm to Munsell colour standards. The thickness of the outer sheath shall not be less than 1.6mm. The outer sheath shall be uniform, circular, smooth; free from pin holes, joints mended pieces and other defects. The reference test method to measure thickness shall be as per IEC 811-5-1.

Note: HDPE material from finished product shall be subjected to following tests (on sample basis) and shall confirm to the requirement of the material as per the GR no. TEC/GR/TX/ORM-01/04/SEP-09 (Section-III):


- a) Density
- b) Melt flow index
- c) Oxidative Induction time
- d) Carbon black content
- e) Carbon black dispersion
- f) ESCR
- g) Moisture content
- h) Tensile strength and elongation at break
- i) Absorption Coefficient
- j) Brittleness Temperature
- k) Anti termite and Anti-rodent dopants shall be added in the outer sheath to resist termite attack and rodent attack on the cable. Bidder/vendor/contractor shall provide the details of doping material used and same shall be verified during testing.
- l) Protection against rodents- For protection against rodents, HDPE sheath shall have rodent repellent properties with the use of an eco-friendly, non-toxic rodent repellent additive. 2%-3% master-batch of rodent repellent material consisting of 5% additive & 95% HDPE/ LDPE shall be mixed in the HDPE sheath material/ granules (If otherwise, bidder/vendor/contractor to submit details of additive with OEM recommendation for mixing).
- m) Protection against termites- For protection against termites, HDPE sheath shall have termite repellent properties with the use of an eco-friendly, non-toxic termite repellent additive. The termite protection shall be as per DIN EN117.
- n) A copy of Invoice from OEM of rodent repellent material & termite repellent material shall be submitted with the pre-FAT internal inspection reports and bidder/vendor/contractor to evidence Original Invoice from OEM of rodent repellent master-batch & termite repellent material during Factory Acceptance Test of finished cable.
- o) Termite & Rodent Test - Termite & Rodent test shall be carried out at any recognized lab on finished cable samples. The reports shall be submitted by the bidder/vendor/contractor. Termite resistance shall be provided with an additive in outer sheath and rodent protection shall be provided with an additive in outer sheath and by use of Glass roving yarns around the periphery of inner sheath. These yarns should spread uniformly around the periphery of inner sheath. Bidder/vendor/contractor to note that apart from the above test report, it shall be Owner's prerogative to get sample of finished cable tested at OEM/ Other recognized test labs to establish presence of rodent & termite repellent additives in specified proportion.

3.2.8 Cable Diameter

- a) Bidder/vendor/contractor to specify the cable diameter.
- b) Bidder/vendor/contractor to note that the overall cable diameter shall be between 13-14mm.

3.2.9 Rip Cord

- a) Three suitable ripcords shall be provided in the cable, which shall be used to open the HDPE sheaths of the cable. Two ripcords shall be placed diametrically opposite to the each other at below the outer sheath & one ripcord shall be placed below the inner sheath. It shall be capable of consistently slitting the sheath without breaking for a length of 1 meter at the installation temperature. The ripcords (3ply & twisted) shall be properly waxed to avoid wicking action and shall not work as water carrier.

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- b) The ripcords used in the cable shall be readily distinguishable from any other components utilized in the cable construction.

4. INSPECTION & TESTING OF OPTICAL FIBER CABLES

4.1 Cable Aging Test (Type Test)

- Objective:** To check the cable material change dimensionally as the cable ages.
- Method:** At the completion of temperature cycle test, the test cable shall be exposed to 85 ± 2 degree C for 168 hours. The attenuation measurement at 1310 & 1550 nm wave length to be made after stabilization of the test cable at ambient temperature for 24 hours.
- Requirement:** The increase in attenuation allowed: ≤ 0.05 dB at 1310 and 1550 nm.
- Note:** The attenuation changes are to be calculated with respect to the base line attenuation values measured at room temperature before temperature cycling.

4.2 Cable Jacket Yield Strength and Ultimate Elongation

- Objective:** To determine the yield strength and elongation of the polyethylene (HDPE) cable sheath (jacket).
- Test Method:** FOTP-89 or ASTM 1248 Type III class
- Test Condition:**
1. Sample shall be taken from a completed cable. The aged sample shall be conditioned at $100 \pm 2^\circ\text{C}$ for 120 hours before testing.
 2. The cross-head speed shall be 50 mm per minute.


Requirement:

| Jacket Material | Minimum Yield Strength | | Minimum Elongation (%) |
|-----------------|------------------------|-------|------------------------|
| | (MPa) | (psi) | |
| HDPE un-aged | 16.5 | 2400 | 400 |
| HDPE aged | 12.4 | 1800 | 375 |

4.3 To Check of the quality of the loose tube (containing optical fiber) (Type Test)

a. Drip test on the cable

- Objective:** The purpose of this test is to determine the ability of jelly in the O.F. cable to withstand a temperature of 70 degree C.
- Method:** Take a sample of 30 cm. length of the cable with one end sealed by end cap. Remove outer black sheath, binder tapes for 5 cm from open end of the sample. Clean the jelly. Then the sample is kept vertically with open end downwards in the oven for 24 hours at 70°C with a paper under the sample.
- Test Specs:** Examine the paper placed below the cable inside the oven for dripping of the jelly after 24 hours. There should be no jelly drip or oily impression on the paper.

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4.4 Termite & Rodent Test (Type Test)

Termite & Rodent test shall be carried out at any recognized lab on finished cable samples. The reports shall be submitted by the manufacturers. Termite resistant shall be provided with an additive in outer sheath.

4.5 Tensile Strength Test

Objective: This measuring method applies to optical fibre cables, which are tested at a particular tensile strength in order to examine the behavior of the attenuation as a function of the load on a cable, which may occur during installation.

Method: IEC 794 -1 -2 - E 1

Test Specs: The cable shall have sufficient strength to withstand a load of value $T (N) = 9.81 \times 2.5 W$ Newton or 2670 N whichever is higher. (Where W=mass of 1 km of cable in Kg) The load shall be sustained for two minutes and the strain of the fibre monitored.

Requirement: The load shall not produce a strain exceeding 0.25% in the fibre and shall not cause any permanent physical and optical damage to any component of the cable. The attenuation shall be noted before strain and after the release of strain. The change in attenuation of each fibre after the Test shall be < 0.05 dB both for 1310 nm and 1550 nm wavelength.

4.6 Abrasion Test

Objective: To test the abrasion resistance of the sheath and the marking printed on the surface of the cable.

Method: IEC - 794-1-2-E2 or by any other international test method.

Requirement: There shall be no perforation & loss of legibility of the marking on the sheath.

Test Specs: a) The conditions for testing shall be in accordance with standard atmospheric conditions.

b) Securely attach the cable sample, measuring approximately 750 mm in length, to the supporting plate by means of cable clamps. The abrading edge shall be loaded with the mass necessary to provide the force stated in the detail specification while avoiding shock on the cable.


Four tests shall be made on each sample, with the sample moved forwards 100 mm between tests and rotated through an angle of 90° , always in the same direction.

4.7 Crush Test (Compressive Test)

Objective: The purpose of this test is to determine the ability of an optical fibre cable to withstand crushing

Method: IEC 794-1-2-E3.

Test Spec.: The fibres and component parts of the cable shall not suffer permanent damage when subjected to a compressive load of 2000 Newton applied between the plates of dimension 100 x 100mm. The load shall be applied for 60 secs. The attenuation shall be noted before and after the completion of the test.

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Requirement: The change in attenuation of the fibre after the test shall be < 0.05 dB/Km both for 1300 nm and 1550 nm wavelength.

4.8 Impact Test

Object: The purpose of this test is to determine the ability of an optical fibre cable to withstand impact

Method: IEC 794-1-2-E4

Test Spec.: The cable shall have. Sufficient strength to withstand art impact caused) by a mass weight of 50 Newton, when falls freely from a height of 0.5 meters. The radius R of the surface causing impact shall be 300 mm. ten such impacts shall be applied at the same place with a gap between one impact to another of approximately at 60 seconds. The attenuation shall be noted before and after the completion of the test.

Requirement: The. Change in attenuation of the fibre after the test shall be < 0.05 dB/Km both for 1300 nm and 1550 nm wavelength.

4.9 Repeated Bending

Objective: The purpose of this test is to determine the ability of an optical fibre cable to withstand repeated bending.

Method: EIA-455-104

Test Specs.: The cable sample shall be of sufficient length (5 m minimum) to permit radium power measurements as required by this test. Longer lengths may be used if required.

| | |
|---|------------|
| Parameters | 5 Kg |
| Minimum distance from Pulley center to holding device | 216 mm |
| Minimum device from Wt. To Pulley center | 457 mm |
| Pulley Diameter(U-cable diameter) | 20 D |
| Angle of Turning | 90° |
| No. of cycles | 30 |
| Time requirement for 30 cycles | 2 minutes. |

Requirement: During this test, no fibre shall break and the attenuation shall be noted before and after the completion of the test. The change in attenuation of the fibre after the test shall Be < 0.05 dB both for 1300 nm and 1550 nm wavelength.

4.10 Torsion Test

Object: The purpose of this test is to determine the ability of an optical fibre cable to withstand torsion.

Method: IEC 794- 1-2-E7

Test Spec.: The length of the specimen under test shall be 2 meters and the load shall be 100 N. The sample shall be mounted in the test apparatus with cable clamped in the fixed clamp sufficiently tight

to prevent the movement of cable sheath during the test. One end of the cable shall be fixed to the rotating clamp, which shall be rotated in a clockwise direction for one turn. The sample shall then be returned to the starting position and then rotated in an anti-clock wise direction for one turn and returned to the starting position. This complete movement constitutes one cycle, the cable shall withstand ten such complete cycles. The attenuation shall be noted before and after the completion of the test.

Requirement: The cable shall be examined physically for any cracks. Tearing on the outer sheath and for the damage to other component parts of the cable, the twist mark shall not be taken as damage. The change in attenuation of the fibre after the test shall be < 0.05 dB/Km. both for 1300 nm and 1550 nm wavelength.

4.11 Kink Test

Object: The purpose of this test is to verify whether kinking of an optical fibre cable results in breakage of any fibre, when a loop is formed of dimension small enough to induce a kink on the sheath.

Method: IEC 794-1-2-E10.

Test Spec.: The sample length shall be 10 times the minimum bending radius of the cable. The sample is held in both hands. A loop is made of a bigger diameter and by stretching both the ends of the cable in opposite direction. The loop is made to the minimum bend radius, and no kink shall form, the cable is then normalized and attenuation reading is taken.

Requirement: The kink should disappear after normalizing the cable. The change in attenuation of the fibre after test shall be < 0.05 dB both for 1300 nm 1550 nm wavelength.

4.12 Cable Bend Test

Objective: The purpose of this test is to determine the ability of an optical fibre cable to withstand repeated flexing. The procedure is designed to measure optical transmittance changes and requires an assessment of any damage occurring to other cable components.

Method: IEC 794-1-2-E11 (Procedure-1)


Test Spec.: The fibre and the component parts of the cable shall not suffer permanent damage when the cable is repeatedly wrapped and unwrapped 4 complete turns of 10 complete cycles around a mandrel of 20 D, where D is the diameter of the cable. The attenuation shall be noted before and after the completion of the test.

Requirement: The change in attenuation of the fibre after the test shall be < 0.05 dB both for 1300 nm and 1550 nm wavelength. Sheath shall not show any cracks visible to the naked eye when examined whilst still wrapped to the mandrel.

4.13 Temperature Cycling

Objective: To determine the stability behavior of the attenuation of a cable subjected to temperature changes, which may occur during storage, transportation and usage.

Method: IEC 794-1-2-F1 (To be tested on cable length of 200 m).

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Test Specs.: The permissible temperature range for storage and operation will be from -20°C to $+70^{\circ}\text{C}$. The rate of change of temperature during the test shall be 1° per minute approx. The cable shall be subjected to temperature cycling for 12 Hrs. at each temperature as given below:

- | | |
|---|-----------|
| i) at room temperature | : 1 hr. |
| ii) at zero degrees | : 12 hrs. |
| iii) at 65 degrees | : 12 hrs. |
| iv) from 65 degrees to room temperature | : 1 hr. |

The test shall be conducted for 2 cycles at the above temperatures.

Requirement: The change in attenuation of the fibre under test shall be < 0.05 dB/Km for 1300 nm and 1550 nm wavelengths for the entire range of temperature.

4.14 Water Penetration Test

Objective: The aim of this test is to ensure that installed jelly filled Metal free Optical fibre cable will not allow water passage along its length.

Method: IEC 794-1-2-F5 (Fig. B) 1992.

Test Specs: A circumferential portion of the cable end (with HDPE sheath after removing the nylon jacket) shall face the water head. The watertight sleeve shall be applied over the cable. The cable shall be supported horizontally and two meter head of water. Containing a sufficient quantity of water soluble fluorescent dye for the detection of seepage; shall be applied on the HDPE sheath for a period of 7 days at ambient temperature. No other colored dye is permitted.

Requirement: No dye shall be detected when the end of the 3 m length is examined with ultraviolet light detector. The cable sample under test shall be ripped open after the test and it shall be examined for seepage of water into the cable and the distance to be noted. It shall not be more than 20cm. For Semi Dry core cable, it shall not be more than 1 meter.

4.15 Water Immersion Test

Method: IEC 60793 -53

4.16 Flexural Rigidity Test on the Optical Fibre Cable

Objective: To check the Flexural Rigidity of the metal free optical fibre cable.


Method: To be tested as per ASTM D-790

Test Specs.: The fibre and the component parts of the cable shall not suffer permanent damage in the cable subjected to Flexural Rigidity Test as per the above method. The attenuation shall be noted alter and before the completion of the test.

Requirement: The change in attenuation of the fibre after the test shall be < 0.05 dB both for 1300 nm and 1550 nm wavelength. The sheath shall not show any cracks visible to the naked eye.

4.17 Test of Figure of 8 (Figure on the Cable)

Objective: Check of easiness in formation of figure of 8 of the cable during installation in the field.

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Test method: 1000 meter of the cable shall be uncoiled from the cable reel and shall be arranged in figure of 8(eight) shape. The dimensions of each loop of the figure of 8 shall be maximum 2 meters.

Requirement: It shall be possible to make figure of 8 of minimum 1000 meters of the cable uncoiled from the cable reel without any difficulty. No visible damage shall occur.

4.18 Static Bend Test

Objective: To check the cable under Static bends

Method: As per clause no. 4.8 of the GR. alternatively as per ASTM D790

Test Specs.: The cable shall be subjected to static bend test. The optical fibre cable shall be bent on a mandrel having a radius of 10 D (D- is diameter of the cable).

Requirement: The change is attenuation of the fibre after the test shall be < 0.05 dB both for 1300 nm and 1550 nm not wavelength. Sheath shall not show any cracks visible with the naked eye when examined whilst wrapped on the mandrel.

4.19 Sheath Integrity (Spark Test)

The sheath shall withstand a spark test voltage of at least 8 KV nms or 12 KV DC.

4.20 Jointing Closures

Jointing closures shall be suitable for the cables, jointing closures shall be dust tight (No dust ingress) and protected against –immersion in water (Suitable for continuous immersion in saline water 0 and should be complete with all accessories including splice cassettes, splice protection and all accessories for electrical continuity of metallic layer of optical fibre cable. The jointing enclosures shall be provide with suitable jointing pit support hardware to secure the jointing closures to a 1200 mm dia circular jointing pit.

Jointing Closure Tests

Bidder shall provide detailed test procedures for testing Jointing Closures, and may improve upon the same. The following shall be conducted as a minimum:

a) Water ingress test


The cable jointing box shall be assembled along with a continuous piece of cable passing through. The jointing box shall then be secured at the bottom of a immersion tank containing water upto a height of 2.0m at normal room temp. for a period of 24 hrs. The joint box will then be opened as per the specified procedure and visually examined for any ingress of water. It shall be declared to have passed the test in case there is no water present inside the box.

b) Impact test

The cable joint box shall be kept on a metal platform. A weight of 5 kgs spherical type having radius of R 50 mm at striking end will be made to stike the box at the middle after having been released from a height of 500mm for 10 times. The joint box will be declared to have passed the test in case there are no cracks or fracture inside or outside of the box.

c) Drop and topple test

A drop test platform consisting of a steel plate not less than 6.5 mm thick is to be used. The steel plate is bolted to a fully set concrete block at least 460mm thick. The joint box shall then be

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allowed to topple and fall freely from a height of 200mm. The joint box will be declared to have passed the test in case there is no visible damage to the enclosure.

d) Pulling test

The joint box should be assembled with a long length of cable so that it can be pulled to the required tension of 100 KGS to check the strength of fixing arrangement inside the joint box.

e) Static load test

The assembled cable joint closure shall be kept on a platform with dimension more than that of cable joint closure. A curved hollow profiled mandrel shall be used for application of load and the mandrel shall be at the middle straight part of the joint closure. Weights shall be gradually placed on the mandrel till the weight becomes 250 kgs. The joint box shall be kept under the weight for a period of 24 hrs. The joint closure shall be declared to have passed the test in case there is no visible damage.

4.21 Test for Loose Tube

a) Embitterment Test of Loose Tube

The test method is based on bending by compression and reflects embitterment much better than the other used tensile test. The test is independent of wall thickness of the loose tube.

Sample: The minimum length of the test sample depends on the outside diameter of the loose tube and should be 85 mm for tubes upto 2.5 mm outside dia. The length of the bigger tubes should be, calculated by using the following* equation:

$$L_0 > 100 \times \sqrt{(D^2 + d^2)} / 4$$

Where

L_0 = Length of tube under test

D = Outside dia of loose tube

d = Inside dia of loose tube

Procedure: Both the ends of a butler tube test sample may be mounted in a tool which is clamped in jaws of a tensile machine which exert a constant rate of movement. The movable jaw may move at a rate of 50 mm per minute toward the fixed jaw. Under load the tube will be bent, so that the tube is subjected to tensile and compressive stresses. The fixture for holding the tube should be designed in a manner that the tube might bend in all directions without further loading.


Requirement: The tube should not get embittered. No kink should appear off the tube upto the safe bend dia of tube (20 D) where D is the outside diameter of the loose tube. There should not be any physical damage or mark on the tube surface.

b) Kink Resistance Test-on the loose tube

Objective: To safeguard the delicate optical fibres, the quality of the loose tube material should be such that no kink or damage to the tube occurs while it is being handled during installation and in splicing operations.

Procedure: To check the kink resistance of the loose tube. A longer length of the loose tube is taken (with fibre and gel). A loop is made and loop is reduced to the minimum bend radius of loose tube i.e. 20 D. (where D is the outside dia of the loose tube). This test is to be repeated 4 times on the same sample length of the loose tube.

Requirement: No damage or kink should appear on the surface of the tube.

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c) Drainage Test For Loose Tube

Sample Size: 30 cm tube length.

Test Procedure

- i. Cut the tube length to 40 cm
- ii. Fill the tube with the tube filling gel ensuring there are no air bubbles and the tube is completely full.
- iii. Place the filled tube in a horizontal position on a clean worktop and cut 5 cm from each end so that the finished length of the sample is 30 cm.
- iv. Leave the filled tube in a horizontal position at an ambient temperature for 24 hrs. (This is necessary because the gel has been sheared and the viscosity has been reduced during the filling process).
- v. The sample tube is then suspended vertically in an environment heat oven, over a weighted beaker. It is left in the oven at a temperature of 70°C for a period of 24 Hrs.
- vi. At the end of the 24 Hrs periods the beaker is checked and weighted to see if there is any gel in the beaker.

Requirement:

- i. If there is no gel or oil in the beaker the tube has PASSED the drainage test.
- ii. If there is gel or oil in the beaker the tube has FAILED the drainage test.

d) Check Of Easy Removal Of Sheath:

Check of the easy removal of sheath of the optical fibre cable by using normal sheath removal tool.


To check easy removal: The sheath shall be cut in circular way and about 300 mm lengths of the sheath should be removed in one operation. It should be observed during sheath removal process that no undue extra force is applied and no component part of the cable is damaged. One should be able to remove the sheath easily.

Note: - Easy removal of both the outer jacket and the inner sheath shall be checked separately.

e) Acidic And Alkaline Behavior Test

To check the effect of the aggressive media, solution of PH4 and PH10 shall be made. The two test samples of the finished cable each of 600 mm in length are taken and die ends of the Samples are sealed. These test samples are put in the PH4 and PH10 solutions separately. After 30 days these samples are taken out from the solutions and examined for any corrosion etc. on the sheath and other markings of the cables. (Test method no. ISO 175).

Requirement: The sample should not show any effect of these solutions on the sheath and other marking of the cable.

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5. GENERAL REQUIREMENTS

5.1 Cable Marking

A long lasting suitable marking shall be applied in order to identify this cable from other cables. The cable marking shall be imprinted (indented). The marking on the cable shall be indelible of durable quality and at regular intervals of one meter length. The accuracy of the sequential marking must be within -0.25% to +0.5% of the actual measured length. The sequential length markings must not rub off during normal installation and in life time of optical fiber cable. The total length of the cable supplied shall not be in negative tolerance.

The marking shall be in contrast colour over the black HDPE Sheath (jacket) and shall be one by hot foil indentation method. The colour used must withstand the environmental influences experienced in the field.

The type of legend marking on O.F. cable shall be as follows:

- a) Company Legend
- b) Legend containing telephone mark & international acceptable Laser symbol
- c) Type of Fiber– G.652 D
- d) Number of Fibers
- e) Type of cable
- f) Year of manufacture
- g) Sequential length marking
- h) User's Identification
- i) Cable ID

5.2 Cable Ends


Both cable ends (the beginning end and end of the cable reel) shall be sealed and readily accessible. Minimum 5 meter of the cable of the beginning end of the reel shall accessible for testing. Both ends of the cable shall be kept inside the drums and shall be located so as to be easily accessible for the test. The drum (confirming to GR No. G/CBD-O1/02 Nov. 94 and subsequent amendment) should be marked to identify the direction of rotation of the drum. Both ends of cable shall be provided with cable pulling (grip) stocking and the anti twist device (free head hook). The wooden drums shall be properly treated against termites and other insects during transportation and storage. The manufacturer shall submit the methodology used for the same.

An anti twist device (Free head hook) shall be provided, attached to the both the ends of the cable pulling arrangement. The arrangement of the pulling eye and its coupling system along with the anti twist system shall withstand the prescribed tensile load applicable to the cable.

5.3 The Nominal Drum Length

Length of Optical Fiber Cable (OFC) in each drum shall be 4Km with tolerance of $1\pm\%$. The fibers in cable length shall not have any joint. The drum shall be marked with arrows to indicate the direction of rotation. Packing list supplied with each drum shall have at least the following information:

- a) Drum No.
- b) Type of cables
- c) Physical Cable length
- d) No. of fibers
- e) Length of each fiber as measured by OTDR
- f) The Cable factor - ratio of fiber/cable length
- g) Attenuation per Km. of each fiber at 1310 & 1550 nm

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- h) Owner's Name
- i) Manufacturers Name, Month, Year and Batch No.
- j) Group refractive index of fiber
- k) Purchase Order No.
- l) Cable ID

5.4 Colour coding in O.F. Cables

The colorant applied to individual fibers shall be readily identifiable throughout the lifetime of the cable and shall match and conform to the Munsell Colour Standards (EIA-359-A) and also IEC Publication 304 (4).

5.5 Colour Coding Scheme

Color code to be adapted for individual fibers in each loose tube shall be:

1. Blue
2. Orange
3. Green
4. Natural

Colour code to be adapted for individual loose tube shall be:

When the loose tubes are placed in circular format, the marking to indicate the loose tube no. "1" shall be in blue colour followed by loose tube no.2 of orange and so on for other tubes as per below:

1. Loose tube number 1 shall be Blue
2. Loose tube number 2 shall be Orange
3. Loose tube number 3 shall be Green
4. Loose tube number 4 shall be Brown
5. Loose tube number 5 shall be Slate
6. Loose tube number 6 shall be White

6. QUALITY REQUIREMENTS


The cable shall be manufactured in accordance with the international quality standards ISO 9001-2008 (latest issue) for which the manufacturer should be duly accredited. The Quality Manual shall be submitted by the manufacturer.

7. RAW MATERIAL

The cable shall use the raw materials approved against the GR No. TEC/GR/TX/ORM-01/04 SEP.09 and the subsequent amendment issued, if any.

8. DOCUMENTATION

Complete technical literature in English with detailed cable construction diagram of various sub-components with dimensions, weight & test data and other details of the cable shall be provided. All aspects of installation, operation, maintenance and fiber splicing shall also be covered in the handbook. The pictorial diagrams of the accessories (with model no. and manufacturer name) supplied along with the cable as package shall be also be submitted. A hard as well as soft copy of the manuals shall be provided.

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9. SAFETY

It shall not be hazardous to health. The contractor shall submit MSDS (Material Safety Data Sheet) for all the material used in manufacturing of cable to substantiate the statement.

10. REFERENCE DOCUMENTS

Drawings and Standard as per table below:

| Sr. No. | Document/Drawing Name | Drawing No |
|---------|---|--|
| 1. | Raw Material | TEC Specs No. TEC/GR/TX/ORM 01/04/SEP-09 and latest amendments if any. |
| 2. | Colour Standards | EIA 359-A and IEC Publication 304(4) with latest amendments, if any |
| 3. | ITU-IT Recommendation | G.652 D & G655 |
| 4. | Operation & handling | TEC Specs No. G/OFT-01/03 APR 2006 |
| 5. | Specification for Optical Joint Closure | TEC Specs No. GR/OJC-02/02 SEPT 03 with latest amendments, if any |
| 6. | OFC with Respect of Pipeline | |
| 7. | OFC Installation inside Terminal | |
| 8. | OFC Installation Cased Crossing | |
| 9. | OFC Diagram | |

11. PERMANENTLY LUBRICATED HDPE DUCT


The bidder shall be totally responsible for the desired performance of the offered permanently lubricated HDPE duct including design, engineering, manufacture, testing and supply.

The intent of the following specifications is to establish the minimum requirements and guidelines for the permanently lubricated HDPE duct and associated items offered for this project.

Design, Engineering, Manufacture, Testing and supply of solid lubricated HDPE duct, HDPE duct couplers. End plugs, cable staling plugs and end caps for sealing conduits.

The length of Permanent lubricated HDPE Duct shall be as per actual requirement

11.1 Technical Specifications of HDPE Duct

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50mm OD / 42 mm ID permanently lubricated two layered HDPE duct of 1 km +/- 100 Mt. Length complying the DOT's GR-G/CDS-08/01 Dec 99 (with all amendments issued by TEC up to Dec 2005).

HDPE duct shall also conform to the following specifications:

IS: 7328.

IS: 4984

ASTM: D-1693

The HDPE duct shall be permanently Lubricated with an inner layer of solid permanent lubricant continuous throughout its length co-extruded during the manufacturing process to minimize internal coefficient of friction.

HDPE duct shall be supplied in orange colour and one colour shall be maintained throughout its drum length.

Two layered permanently lubricated HDPE ducts as per above specifications should be converted in continuous coil length of 1 Km +/- 100 Mt. 3.2. The converter should have requisite expertise of converting permanently lubricated two layered HDPE duct.

The HDPE duct shall have smooth surfaces and shall be free from defects. Break, Shrink holes, flaking, and chips. Scratches, Roughness &. Blisters

Typical requirements are indicated below. However the same shall conform to latest revision and amendments of GR No. G/CDS-08/01

| Sr No. | Parameters | Reference Standard | Typical Requirements |
|--------|--|---------------------|--------------------------------------|
| 1 | Dimensions and tolerance | GR | |
| A | Length of each duct | | 1000 ± 100 Mtrs |
| B | Nominal Outside Diameter | | 50 ± 0.4 mm |
| C | Wall Thickness | | 4 ± 0.3 mm |
| D | Thickness of inner lubricant layer | | ≥0.35 mm |
| E | Bending Radius | | 1.25 Mtrs minimum |
| F | Color | | Light Blue / Parrot Green |
| 2 | Ovality | IS :4984 | 1.0 mm |
| 3 | Heat Reversion | IS:4984 | Max 3% |
| 4 | Hydraulic Test Type Test Duration : 165 Hrs at 80°C Induced stress :3.5 Mpa Acceptance test Duration : 48 Hrs at 80°C Stress induced : 3.8 Mpa | IS:4984 | No failure or leakage seen |
| 5 | Tensile Strength Elongation | IS: 14151 Part 1 | Min 20 N/mm ² Min 600% |
| 6 | Environmental stress crack resistance | ASTM D 1693 | No Failure |

| Sr No. | Parameters | Reference Standard | Typical Requirements |
|--------|---|--------------------|--|
| 7 | Impact Strength (Striker weight 10 kg) | IS: 12235 part 9 | No crack or split |
| 8 | Crush Resistance 50 kg load | GR | Deflection with load < 10% Deflection after recovery < 2% |
| 9 | Oxidation induction test (> 30 minutes) | GR | Satisfactory |
| 10 | Internal coefficient of friction | GR | < 0.06 |
| 11 | Density of finished product | IS:7328 | 0.940 to 0.958 g/cc at 27°C |
| 12 | Melt flow rate MFR | IS:2530 | 0.2 to 1.10 gm/and 5 kg 10 minute at 190°C load |
| 13 | Maximum pulling force | | 300 Kg |

11.2 Identification

The outer surface of the conduit shall be permanently & legibly marked with colour in contrast to the outer sheath of the cable at regular intervals not exceeding one meter with name of client name of manufacturer part number. Following details shall be added over the HDPE duct:

- a) Owner's Name
- b) OWNER LOGO
- c) Manufacturer's name
- d) Duct size
- e) Sequential length marking at every meter.
- f) Sr no. of the HDPE duct

11.3 Plastic Couplers

HDPE duct couplers, end plugs. Cable sealing plugs, end caps for sealing conduits shall be suitable for 50 mm OD HDPE conduit.

Joint of HDPE duct shall be by fusion type HDPE duct coupler.

The couplers used for joining two ducts shall be push fit type having push lock mechanism which enables them to be installed on duct without pre-dismantling.

Design shall be simple, easy to install and shall provide air tight and water tight leak proof joints. It shall withstand air pressure test of 15 kg/cm² for a minimum.

11.4 Testing

Following sample tests shall be conducted on three randomly selected permanent lubricated HDPE conduits drums. These shall be tested as per the latest edition of TEC standard for Permanently lubricated HDPE ducts for use as underground optical fiber cable conduits.

- a) Visual Inspection
- b) Impact strength
- c) Crush resistance
- d) Quality test
- e) Coil test
- f) Hydraulic characteristics Internal co-efficient of friction

In case permanent lubricated HDPE duct. Tested and inspected in accordance with this specification. Fail to pass the test or comply with the specification requirement, the tests shall be repeated on a further representative sea of conduit pieces. And if it again fails, the whole lot shall be rejected subject to the discretion of the Owner/Owner's representatives.

Bidder shall provide detailed test procedures for each of the above mentioned tests after award of contract for approval and the tests shall be conducted as per approved procedures.

11.5 Packing

All drums shall be individually packed to avoid damage during transit and storage in accordance with best commercial practice and with the requirements of applicable. The materials used for packing, wrapping, sealing etc. shall be of recognized brands and shall conform to best standards in the areas in which the articles are packaged. This packing shall protect the HDPE duct from impact of vibration, rough handling, rodents, etc.

The minimum diameter of the coiled duct shall be 25 times the outer diameter of the duct.

Each drum shall have a copy of factory acceptance test report enclosed in it.

12. FIBER TERMINATION CLOSURE

12.1 General

The FTC shall be wall-mounted type as suitable for the Optical Fiber cable used for this project (24 fibers). The FTC shall have grounding arrangement for all the metallic layers of the cable. The cable shall be spliced to pigtails on trays provided in the FTC. The connector side for the pigtails shall be secured with suitable coupler/through adapter provided as integral part of the FTC itself.

The FTC shall be of 24-fibre termination type. The FTC shall have trays suitable for splicing maximum of 6 fibers per tray. The arrangement inside the FTC should be simple and in straight line.

FTC should have entry points for a minimum of 2 no. of Optical Fiber Cable (armoured /un-armoured) of diameter up to 20 mm with cable clamps to avoid entry of rodents/ dust in general. It should have a minimum of 2 nos. of outlets for taking out 24 nos. of pigtail. The outlets should have cable clamps.

Grounding arrangement should be provided with the FTC. It should include as a minimum 2 nos. Grounding shield bonds with nut and bolts for fixing to the armour of the OFC and 2 nos. of grounding cable of suitable length “& of green colour eight lugs clamped to its end for connecting the armour of OFC with the grounding terminal of the FTC.

The FTC shall be of reputed make like: 3M, Corning, Siemens, Raychem & Tyco.

Insertion loss of Coupler / Adaptor shall be maximum 0.25 dB per connector.


The FTCs shall be provided with Pigtails for all terminations

12.2 Pigtail & Connectors:

12.2.1 This specification provides requirements for single mode fibre pigtails and connectors. They should meet the ITU- T recommendations G-652 & G 655 as required.

12.2.2 Both connectors and cables should be robust and should withstand wear and tear due to frequent use, connection and disconnection. Normal expected life should be 15 years or more.

12.2.3 Pigtail & connectors shall essentially be of same make as FTC.

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12.2.4 Optical Parameters of Connectors With Pigtails shall be as below:

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| Insertion loss | : | Maximum 0.3 dB Per connector plus fiber loss |
| Return loss | : | Better than 40 dB |
| Temperature Dependency | : | < 0.3 dB From – 20 to + 60 |
| Change in connection loss With passage of time at 60 °C for 100 hrs | : | It should be < 0.3 dB |
| Change in connection loss Due to vibration | : | < 0.05 dB |
| Reproducibility of Connection loss by repeated Connections and Disconnection for 500 times. | : | < 0.3 dB |
| Change in Connection loss In relation to Tensile strength | : | (1) Loaded : – 50 dB (2) Unloaded : – 30 dB |


12.3 Optical Patch Cords

The patch chords provided shall be 20 Mtrs. in length
Make: Birla-3M / Cancam / Advanced Fiber System / Corning

13. INSTALLATION

13.1 General Requirement

- 13.1.1 OFC laying and HDPE duct laying shall be in Terminal area, SV station, Dispatch Terminal and Receiving Terminal area, as applicable other than for pipeline route.
- 13.1.2 The permanently lubricated HDPE duct used for leading in of the OFC into room housing the telecom equipment shall be below ground level without getting exposed outside (the entry point shall be properly sealed after OFC installation to avoid entry of rodents, insects etc.).
- 13.1.3 At all Tie-in locations, the trench shall be excavated further wherever possible, and permanently lubricated HDPE duct shall be laid away (approx 1 meter) from the pipeline to avoid damage to the HDPE conduit and to the pipeline.
- 13.1.4 At crossings one spare duct to be laid in addition with OFC with HDPE duct.
- 13.1.5 Route survey to collect cable routing information such as crossing of railways, roads, nala, rivers etc, and requirements of any local detours etc., and also to determine the exact length of cable required. Vendor shall obtain the cable as per the requirement (based on survey conducted by the vendor).
- 13.1.6 The Contractor shall determine a suitable cable installation method to ensure that all cable installation requirements shall be met in all conduit sections. All work shall be carried out in accordance and consistent with the highest standards of quality and craftsmanship in the communication industry with regard to the electrical and mechanical integrity of the connections, the finished appearance of the

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installation as well as the accuracy and completeness of the documentation.

13.1.7 The scope of installation of OFC shall include all that is necessary to lay the optical Fibre cable in the same trench as the pipeline and it shall be generally as described below:-

13.1.8 Laying of optical fibre cable along the pipeline in the same trench as that of the pipeline including crossing of railways, roads, Nala, rivers etc and splicing jointing, earthing (as required) along with all associated cabling work. The cable laying shall be by Compressed air blowing method. Necessary tools and tackles for cable laying shall be arranged by the Contractor.

13.1.9 The cable shall be laid at level approx. depth of 1.6 m from ground level.

13.1.10 Laying of optical fibre cable within the terminals / Repeater station areas where telecom cable leaves the pipeline trench and is required to be laid in a separate trench up to the control building cabinets (Telecom room).

13.1.11 Sealing of the cable ends as required to prevent moisture ingress shall be contractor scope

13.2 Scope of Work for Installation

The contractor scope for installation of FO cable shall include but not limited to

13.2.1 Survey the cable route and prepare cable route sheers on the basis of the pipeline route alignment sheets. Where service crossing exists, in addition to the general guidelines stated in this specification, the Contractor shall follow all the particular requirements of the purchaser.

13.2.2 Trench excavation in pipeline trench, as needed.

13.2.3 Laying bed preparation.

13.2.4 Laying the HDPE pipe.

13.2.5 Installation of cable in 50mm outer dia mm, Permanent lubricated HDPE Duct. The HDPE ducts shall be suitable to withstand a load of 10 kg/cm². All HDPE duct couplers shall be of Fusion type only.

13.2.6 Warranty & guarantee for performance of the laid cable.

13.2.7 Transit & storage insurance of all materials (cable & accessories) till the System is fully handed over.

13.2.8 Provision of necessary power supply at site for the splicing etc.


13.2.9 Procurement and supply & installation of any other materials required for laying jointing & end sealing of cable including jointing-pit, splice-closures, cable-markers, sand, bricks, HDPE duct etc.

13.3 OFC Pit

An RC pit will be provided at the places of jointing of OFC and as required for blowing/inspection. Water retaining structure of minimum size L 1.5m x W 1.5m (with Depth of the pit as required to carry out jointing, inspection & testing of OFC).

Blowing and inspection pit at every 2 Km.

Joining pit at every 4 Km.

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The pit shall be provided with a concrete cover slab with a man-hole. The top of this slab shall be minimum 300mm above the finished ground level or depth of water logging during monsoon whichever is higher.


A cat ladder shall be provided, if depth of pit is more than 1 m, on the side where OFC is not to be routed.

13.4 Protective Measures During Installation

- 13.4.1 The Contractor shall comply with the cable manufacturer's recommended installation procedures at all times.
- 13.4.2 To reduce the possibility of damage to the outer jacket of the fiber optic cable protective measures shall be used when the cable is installed. The requirements herein shall be renewed, but does not limit the installation to only those identified. The purpose of the installation specifications is to ensure protection of the fibre optic cable when it is installed. Other protective measures not specified herein may be taken during installation if it will ensure protection of the cable.
- 13.4.3 The cable shall be protected against damages from termite, rodent, fire chemicals (such as oil & natural gas, LPG and other petroleum products), moisture and water over the lifetime of the cable.
- 13.4.4 A cable feeder guide shall be used between the cable reel and the face of the duct and conduit to protect the cable and guide it of the reel and into the duct.
- 13.4.5 Precautions shall be taken during installation to prevent the cable from being kinked, crushed or twisted. A pulling eye shall be attached to the cable end and be used to pull the cable through the duct and conduit system. As the cable is pulled off the reel and into the cable feeder guide, it shall be lubricated with a lubricant that shall be of the water based type and approved by the cable manufacturer.
- 13.4.6 Dynamometers or breakaway pulling swings shall be used to ensure the pulling line tension does not exceed the installation tension values specified by the cable manufacturer. The mechanical stress placed upon the cable during installation shall not be such that the cable is twisted and stretched. Maximum allowable cable strain during: installation shall be less than 0.75%.

13.5 Cable Laying Procedure

- 13.5.1 The trench shall be enlarged at the splicing points as needed to carry out the splicing works. The enlargement shall be carried out on the same side of the cable for the entire route.
- 13.5.2 A laying bed shall be prepared by the contractor, in case, separate trench is planned in any area. The laying bed of 10cm depth shall be made of sand or riddled earth obtained by passing through a sieve having meshes not exceeding 15 mm², or of a natural soft around not requiring riddling.
- 13.5.3 Contractor shall plan the cable-laying operation such that the complete drum-length of cable can be laid without cutting in between. The cable can be laid using a mobile reel system or a fixed reel system in relation to the characteristics of each section (excavation partially open, crossings, etc.)
- 13.5.4 The cable shall be carefully inspected for jacket defects as it is removed from the reel. If defects are noticed, the pulling operation shall be terminated immediately and the CONSTRUCTION MANAGER (SITE-INCHARGE) notified.
- 13.5.5 The contractor shall establish section by section the ways and means for the cable laying taking into account the characteristics of the layout.
- 13.5.6 In all jointing locations, including the normal joint at the end of the drum length and also at points of cable-cuts due to laying necessities, at least one meter of cable shall be left in a coiled form in the pit to allow for splicing and jointing of the cable.
- 13.5.7 At all telecom building locations (including terminals and intermediate stations) an extra length of about

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20 meter of each cable shall be kept in a coiled form.

- 13.5.8 Vendor shall provide the necessary cable leading pipes for cable(s) entry inside the telecom room. All these leading-in-pipes shall be properly scaled to prevent entry of rodents, snakes, insects and foreign materials. At locations where the telecom room shall not be available. The extra length of the cable shall be kept buried in ground near the proposed telecom room location.
- 13.5.9 If the splicing or termination operation does not follow immediately after the cable laying, all cable ends must be sealed carefully with heat-shrinkable end-caps.
- 13.5.10 To accommodate long continuous installation lengths, bi-directional "center pull" techniques for pulling of the fiber optic cable is acceptable and shall be implemented as follows:
- 13.5.11 From the midpoint pull the fibre optic cable into the conduit from the shipping reel in accordance with the manufacturer's specifications.

When this portion of the pull is complete, the remainder of the cable must be removed from the reel to make the inside end available for pulling in the opposite direction.

This is accomplished by hand pulling the cable from the reel and laying into large "figure eight".

This loop shall be laid carefully one upon the other (to prevent subsequent tangling) and shall be in a protected area.

The inside reel end of the cable is then available for installation.

In some cases, it may be necessary to set up a winch at an intermediate cable vault.

The required length of cable shall be pulled to that point, and brought out of the cable vault and coiled into a figure eight.

The figure eight is then turned over to gain access to the free cable end. This can then be reinserted into the duct system for installation into the next section.

When power equipment is used to install fiber optic cables, the pulling speed shall not exceed 30 meters per minute. The pulling tension, bending radius and twist limitation for fiber optic cable shall not be exceeded under any circumstances.

Large diameter wheels, pulling sheaves and cable guides shall be used to maintain the appropriate bending radius. Tension monitoring shall be accomplished using commercial dynamometers or load-cell instruments.


The pulling eye/sheath termination hardware on the fiber optic cables shall not be pulled over any sheave blocks

Under no condition shall OFC be left exposed or unattended.

Repairs: Repair of cable jacket shall not be permitted. Jacket damage shall require removal and re-installation of a new cable run at the Contractor's expense.

13.5.12 Lubrication

As the cable is pulled into the conduit system, it shall be sufficiently lubricated with a lubricant that shall be the water-based type and approved by the cable manufacturer, Lubricant shall be applied at a rate to provide a continuous 10-mil coating, as recommended by the manufacturer.

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13.6 Crossing

13.6.1 Cable laying for rail, road, Canal & river crossings shall be through a min. 50 mm outer with HDPE pipe, provided as part of the pipeline laying. An additional pulling rope shall be kept inside to meet future requirements. One spare duct shall be laid in addition with OFC with HDPE duct.

13.6.2 After installation the casing pipe shall be cleaned inside of any kind of dirt stones, etc. Bituminized jute shall be used to close the ends of the conduit to prevent any dirt deposit. Similarly, Bituminized jute shall be used to close the conduits ends after introduction of the cable.

13.6.3 Crossing of Underground Services

Where crossing of existing underground pipelines and cables, pipes on sleepers, etc. occur, the same requirements for normal laying shall apply, the cable maintaining the normal position with respect to the pipeline.

13.7 Jointing / Installation At Pull Boxes

13.7.1 The pulling of the cable shall be hand assisted at each pull box.

13.7.2 The extra length of fiber optic cable shall be coiled and secured with cable ties in the pull box. The Contractor shall ensure minimum bending radius of the fibre optic cable.

13.7.3 Imprinted plastic coated identification tags shall be securely attached to the cables in at least two locations in each pull box.

13.7.4 When all cables at each pull box are securely racked, unused conduits and void area around conduit containing cables shall be sealed.

13.7.5 The joint enclosure shall support an optical fibre organizer and allow sealing-off the outer sheaths of the cable.

13.7.6 Vendor shall provide detailed procedure for jointing of the cable along with the details of the jointing pits to be used for housing the joint enclosure and the excess cable after jointing.

13.7.7 Splicing loss shall not be more than 0.7db/Splice.

13.7.8 Vendor shall provide “ELECTRONIC MARKER & ELECTRONIC INDICATOR” of approved make at each Jointing location


13.8 Backfilling

Above the laid cable, a cover of 75 mm minimum depth of sand or riddled earth or of natural earth not requiring riddling (as stated elsewhere) shall be provided. Such an operation shall be under the responsibility of the contractor.

Above this cover a single layer of second-class brick shall be laid in a transverse manner over the cable laid in the trench. The bricks shall be fully soaked in water before being laid in the trench.

There shall be minimum seven bricks per meter laid with uniform spacing over the length of the laid cable.

A warning mat made of PVC sheet of orange colour and 150 mm, 0.1 mm size shall be laid over the cable as shown in annexure-6. At regular interval of 1.5 Mts. There shall be clear permanent print “OWNER’S NAME.”

| | | | |
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At the splicing points, the contractor shall also take care to backfill the trench and to restore the relevant area and to repair any damaged works.

After entering the telecom room the cable shall be secured on steel mesh or wire mesh by the help ties (-15 m cable being kept in turns in oval form). This mesh shall have suitable chemical coating/ painted to prevent corrosion. In case of painting, the color shall match the wall color. The dimensions of the wire mesh at all the locations shall be 3 feet X 4 feet / 3.5 feet X 3.5 feet.

13.9 Earthing System:

- i. Relevant Indian Standard (IS 3043) or equivalent BIS & IEC standard shall be followed.
- ii. The earthing material to be used shall be Electrolytic Copper having the material specifications confirming to the IS standards.
- iii. The dimension of the Earthing strip, which shall be connected between Earth pit & the equipment or the earthing distributor, shall not be less than 25 mm x 5 mm.
- iv. The earthing pit should have water pouring facility.
- v. Earthing resistance should be less than 2 ohms or should be suitable for the equipment to which the earthing is extended.

13.10 Testing

Once OFC is laid and commissioned, joint testing of OFC shall be carried out for all 24 fibers with pipeline laying contractor and telecom equipment contractor for fiber length measurement, insertion loss measurement. A format shall be enclosed for joint testing of all 24 fibers.

14. QUALITY ASSURANCE PROGRAMME & TESTING

14.1 OFC Cable


Vendor shall submit Quality Assurance Plan (QAP) immediately after receipt of order for Owner's approval. The test and inspection shall be carried out as per the QAP in accordance with the codes and standards outlined in this specification. As per requirements, stage wise inspection shall be carried out by Owner / Owner's representative during the various stages of manufacturing and vendor shall provide free access to them in his facility.

14.2 HDPE Duct

The bidder shall submit QA/QC procedures and inspection plan for Owner/Owner's representative review and approval before manufacturing the solid lubricated HDPE duct. Manufacturing by the vendor and inspection by owner/owner's representative shall be in accordance with the approved QA/QC procedures and inspection test plan.

14.3 Tests

Following test shall be conducted as a minimum as per the codes and standards indicated in this document. Test results must comply to specifications of latest revision and amendments of TEC GR No GR/CDS-08/02 Nov'04 along with other requirements.

| | | | |
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Visual inspection

Dimensions

Tensile Strength and elongation

Reversion Test

Environmental Stress Crack Resistance

Impact Strength Test

Crush Resistance Test

Ovality Test

Oxidation Induction Test

Hydraulic Characteristic Test

Internal Coefficient of friction Test

Density of finished product

Melt Flow Rate (MFR) of finished product

14.4 **Factory Acceptance Tests**

FAT of OFC and HDPE duct shall be conducted at manufacturing premises of OFC and HDPE duct.

No material shall be dispatched unless vendor has complied to all the specification requirements to the satisfaction of inspection authority of Owner and a dispatch note issued by Owner / Owner's representative. Converter has to arrange for all test facilities for inspection at factory.

14.5 **Site Acceptance Tests**

Once OFC is laid and commissioned, joint testing of OFC shall be carried out for all 24 fibers with pipeline laying contractor and telecom equipment contractor for fiber length measurement, insertion loss measurement. A format shall be enclosed for joint testing of all 24 fibers.


14.6 **HDPE Duct Tests**

Owner / Consultant may carry out Site Acceptance Tests on randomly selected samples from the finished HDPE duct supplied at project site in field.

Random checks somewhere in the middle of the coil, by cutting the duct, will be made at site to ensure that ducts supplied are of correct dimension and thickness and there is no compromise on thickness in intermediate length, for saving in materials cost.

100% Duct coils being supplied would be weighed to cross check the quantity of plastic used.

To keep a check on the use of filler material, ash contents would be determined on randomly selected samples as per ASTM D 1603 method and the value of ash content, thus determined, shall not exceed 0.4% or 0.2% more than the ash content of Raw Granules.

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UV Stabilize content: Identification of UV additive shall be done by FTIR Spectra, NMR Spectra and UV Spectra. UV Stabilizer content of finished duct shall not be less than 0.05%.

14.7 REFERENCE DOCUMENTS

Drawings and Standard as per table below:

| Sr. No. | Document/Drawing Name | Drawing Number |
|---------|----------------------------------|---|
| 10. | OFC WITH RESPECT OF PIPELINE | |
| 11. | OFC INSTALLATION INSIDE TERMINAL | |
| 12. | OFC INSTALLATION CASSED CROSSING | |
| 13. | OFC DIAGRAM | |
| 14. | IS: 2530 | Methods for test for Polyethylene Moulding Materials and Polyethylene Compounds. |
| 15. | IS: 4984 | High density polyethylene pipes for water supply |
| 16. | IS: 5175 | Polypropylene ropes |
| 17. | IS:7328 | High density polyethylene materials for moulding and extrusion |
| 18. | IS:9938 | Recommended colours for PVC insulation for LF wires and cables |
| 19. | IS:12235 (Part-9) | Methods of test for unplasticized PVC pipes for potable water supplies – Impact strength at 0 Deg C. |
| 20. | IS:14151 (Part-1) | Polyethylene pipes for sprinkler irrigation systems (Part-1 Pipes) |
| 21. | ASTM D 638 | Standard Test Method for Tensile Properties of Plastics |
| 22. | ASTM D 648 | Test method Deflection Temperature of plastics under flexural load. |
| 23. | ASTM D 790 | Test Method for Flexural Properties of Un-reinforced and Reinforced Plastics and Electrical Insulating Materials. |

| | | |
|-----|-------------|---|
| 24. | ASTM D 1693 | Test Method for environmental stress cracking of ethylene plastics |
| 25. | ASTM D 1712 | Standard Practice for Resistance of Plastics of to Sulfide Staining. |
| 26. | ASTM D 2240 | Standard Test Method for Rubber Property |
| 27. | ASTM 114565 | Standard Methods of Testing Physical and Environmental Performance Properties of Insulations and Jackets for Telecommunications wire and cable. |
| 28. | ASTM F 2160 | Standard Specifications for solid Wall, HDPE Conduit Based on Controlled OD. |
| 29. | ASTM G 154 | Standard Practice for Operating Fluorescent Light Apparatus for UV Exposure of Non-metallic materials. |



GAIL INDIA LIMITED

**STANDARD PROCEDURE
FOR
FIBER OPTICAL CABLE TESTING**

GAIL-STD-TL-DOC-TS-002

| Rev | Date | Purpose | Prepared By | Checked By | Approved By |
|-----|------------|--------------------|-------------|------------|-------------|
| 0 | 15.01.2019 | Issued As Standard | RKS | UNU | UNU |



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1 HOP TESTING

After back filling of the trench, fiber optic cable shall be tested for continuity and attenuation over the laid length.

The test shall be conducted both before and after the splicing. It shall be ensured that the cable attenuation does not exceed as recommended for G 655 or G 652 cables (excluding the splice loss) and the splice loss on each fiber shall be 0.1 dB per splice (max.). Test procedures mentioned herein are minimum requirements to be followed. However, Contractor shall provide the detailed procedure for cable testing.

Fiber optic cable test-results shall clearly provide the attenuation for each fiber in following aspects:

- Different Wavelengths (1310 nm and 1550 nm)
- Each cable section
- Individual splice.

Total Attenuation = (wavelength (λ) loss dB/km x fiber length) + (connector loss x number of connectors) + (splice loss x number of splices).

Where,

L = Length of the cable between two nodes;

N = No. of joints between two nodes.

Results shall be within permissible limits. After hop testing results with average losses shall be recorded for each fiber and hop wise report shall be submitted as per approved procedure. Testing shall be witnessed jointly by GAIL and PMC. Contractor shall furnish as built documents and hop loss report hop wise.

2 FIBER LENGTH MEASUREMENT

2.1 Test Description

This test will check the continuity of the fibre from station to station and record the length of fibre. Average loss per kilometre of fibre length shown in dB/km shall be recorded for information only. Testing will be done from both ends and average loss will be calculated (for 310nm/1550nm/1625nm, as applicable).

2.2 Test Equipment


Following test equipment shall be used:

- Optical Time Domain Reflectometer (OTDR);
- Patch cords;
- Pigtails


2.3 Procedure

Test procedure shall be as detailed below. Test formats (1A & 1B) shall be as depicted in Section 2.4 and 2.5.

- Power ON the OTDR and make the settings as required for the hop under test.
- Connect the OTDR with patch cord to the connector in FTC.

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- Make the Laser ON and observe the trace till it gets settled up to the end of the trace.
- Store the results in the hard disk/floppy disk with proper identification of the fibre under test.
- Record the results in format provided
- Repeat the procedure for the opposite direction.
- Repeat above steps for each fiber.

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2.4 Format 1A

Fiber Length Measurement (G.652)

Date:

Location A:

Location B:

Wavelength: 1310 nm & 1550 nm

Equipment Used:

| Tube No. / Color | Fiber No. / Color | Fiber Length (m) | Optical Loss dB/km | | Average Cable Loss (dB/km) |
|---------------------|----------------------|---------------------|--------------------|--------|----------------------------------|
| | | | From A | From B | |
| | | | | | |
| | | | | | |

2.5 Format 1B

Fiber Length Measurement (G.655)

Date:

Location A:

Location B:

Wavelength: 1550 nm & 1625 nm

Equipment Used:

| Tube No. / Color | Fiber No. / Color | Fiber Length (m) | Optical Loss dB/km | | Average Cable Loss (dB/km) |
|---------------------|----------------------|---------------------|--------------------|--------|----------------------------------|
| | | | From A | From B | |
| | | | | | |
| | | | | | |

3 INSERTION LOSS MEASUREMENT

3.1 Test Description

During insertion loss measurement, light is launched (LASER) in the fibre by using a LASER source from one end at the other end by using an Optical Power meter the received power is measured. Fiber loss is calculated by subtracting the receive power from the transmit power. This test also determines the fiber termination continuity on end-to-end basis as the measurement is done on both the ends of a link.

3.2 Test Equipment


Following test equipment shall be used:

- Power meter working on 1310 nm / 1550 nm / 1625 nm;
- Laser source working on 1310 nm / 1550 nm / 1625 nm;
- Patch cords;
- Pigtails


3.3 Procedure

Test procedure shall be as detailed below. Test formats (2A & 2B) shall be as depicted in Section 3.4 and 3.5.

- One power meter, one laser source and one unit of optical talk set is required at each station between which the link is to be tested.
- At location A, switch ON the laser source, set it to operating wavelength of 1310nm and connect it to the power meter (set at 1310nm for G.652 fibres) by two FC/PC patch cords (these FC/PC patch cords will be connected to each other with FC/PC coupler) and record the laser power transmitted. Subtract 0.5 Db (Coupler Loss) from this reading and record it in the test sheet (Appendix-2A & 2B) as 'Power transmitted'.
- Disconnect the power source and power meter by disconnecting FC/PC patchcords from the FC/PC connector. Do not disconnect patch cords from the power meter and power source.
- Connect the power source to the one of the fibres terminated in FTC at location A and the power meter to the same fibre under test in FTC at location B.
- Record the power received in test sheet.
- To establish communication between two stations A & B, optionally connect optical talk set to one of the fiber (e.g. No 12) at both the stations. When that particular fiber is due for testing connect the talk set to one on which testing is complete (e.g. No 1).
- Confirm on the talk set that the power received is recorded.
- Repeat the test for 1550nm.
- Connect the source to next fibre terminated in FTC at location A and power meter at location B.
- Repeat the same procedure with source at location B and power meter at location A.
- Continue the above process till all fibers are tested.

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- Average loss of each fiber should be less than the average loss estimated.
Above test procedure shall be repeated for G.655 fibers for 1550 nm / 1625 nm as required.
Test formats (3A & 3B) shall be as depicted in Section 3.6 and 3.7.

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3.4 Format 2A**Insertion Loss Measurement (G.652)**

Date:

Location A:

Location B:

Wavelength: 1310 nm

Equipment Used:

Cable Length (km) (L):

Number of Splices including Pigtails (N):

Number of Connectors (C):

Average Insertion Loss Estimated (dB/km) ($0.37L+0.07N+0.5C$):

| Tube No. / Color | Fiber No. / Color | A-B | | B-A | | Average Insertion Loss (IL) (dB/km) |
|------------------|-------------------|------------------------|------------------------------|------------------------|------------------------------|-------------------------------------|
| | | Power Transmitted at A | | Power Transmitted at B | | |
| | | Power Received at B | Insertion Loss (A-B) (dB/km) | Power Received at A | Insertion Loss (B-A) (dB/km) | |
| | | | | | | |
| | | | | | | |

3.5 Format 2B

Insertion Loss Measurement (G.652)

Date:

Location A:

Location B:

Wavelength: 1550 nm

Equipment Used:

Cable Length (km) (L):

Number of Splices including Pigtails (N):

Number of Connectors (C):

Average Insertion Loss Estimated (dB/km) ($0.22L+0.07N+0.5C$):

| Tube No. / Color | Fiber No. / Color | A-B | | B-A | | Average Insertion Loss (IL) (dB/km) |
|------------------|-------------------|------------------------|------------------------------|------------------------|------------------------------|-------------------------------------|
| | | Power Transmitted at A | | Power Transmitted at B | | |
| | | Power Received at B | Insertion Loss (A-B) (dB/km) | Power Received at A | Insertion Loss (B-A) (dB/km) | |
| | | | | | | |
| | | | | | | |

3.6 Format 3A

Insertion Loss Measurement (G.655)

Date:

Location A:

Location B:

Wavelength: 1550 nm

Equipment Used:

Cable Length (km) (L):

Number of Splices including Pigtails (N):

Number of Connectors (C):

Average Insertion Loss Estimated (dB/km) $(0.24L+0.07N+0.5C)$:

| Tube No. / Color | Fiber No. / Color | A-B | | B-A | | Average Insertion Loss (IL) (dB/km) |
|------------------|-------------------|------------------------|------------------------------|------------------------|------------------------------|-------------------------------------|
| | | Power Transmitted at A | | Power Transmitted at B | | |
| | | Power Received at B | Insertion Loss (A-B) (dB/km) | Power Received at A | Insertion Loss (B-A) (dB/km) | |
| | | | | | | |
| | | | | | | |

3.7 Format 3B**Insertion Loss Measurement (G.655)**

Date:

Location A:

Location B:

Wavelength: 1625 nm

Equipment Used:

Cable Length (km) (L):

Number of Splices including Pigtails (N):

Number of Connectors (C):

Average Insertion Loss Estimated (dB/km) ($0.26L+0.07N+0.5C$):

| Tube No. / Color | Fiber No. / Color | A-B | | B-A | | Average Insertion Loss (IL) (dB/km) |
|------------------|-------------------|------------------------|------------------------------|------------------------|------------------------------|-------------------------------------|
| | | Power Transmitted at A | | Power Transmitted at B | | |
| | | Power Received at B | Insertion Loss (A-B) (dB/km) | Power Received at A | Insertion Loss (B-A) (dB/km) | |
| | | | | | | |
| | | | | | | |



GAIL INDIA LIMITED

**DATASHEET
FOR
FIBER OPTIC CABLE**

GAIL-STD-TL-DOC-DS-001


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| Rev | Date | Purpose | Prepared By | Checked By | Approved By |



| DATASHEET FOR FIBER OPTIC CABLE | | | | |
|---------------------------------|--------------------|--|---|--|
| GENERAL | 1 | Cable No. | ** | |
| | 2 | Application | FOC for Pipeline SCADA / Telecommunication | |
| | 3 | Quantity (Mts) | Refer Note 2 | |
| CONSTRUCTION | 4 | Standard | IEC 60793-1-1, 60794-3 | |
| | 5 | Fiber Type | Single Mode | |
| | 6 | No of Core | 24 | |
| | 7 | Color Code | EIA/TI598B | |
| | 8 | No of Buffer and Fiber per Loose Tube | 4 buffer tubes and 6 fibers / loose tube | |
| | 9 | Buffer Inner/Outer Diameter(mm) | 1.7/2.7 +/- 0.1mm | |
| | 10 | Index Profile | Step Index | |
| | 11 | Cladding Diameter(μm) | 125 +/- 0.7 microns | |
| | 12 | Mode Field Diameter(μm) | 9 (1310nm) / 10 (1550nm) +/- 10% of nominal value | |
| | 13 | Mode Field Concentricity Error | <=0.5μm | |
| | 14 | Cladding Non-Circularity | <=0.7% | |
| | 15 | Coating Diameter(μm) | 245+/-5μm | |
| | 16 | Construction | Loose fiber in buffer tube | |
| | 17 | Loose Tube | PBT 2.1 +/- 0.1mm filled with Thixotropic Jelly | |
| | 18 | Core Wrapping | Polyster Tape and water swellable tape with binders | |
| | 19 | Water Blocking Compound | Flooding Jelly and water swellable tape | |
| | 20 | Expected Fiber Life Span | >25 years | |
| | 21 | Rodent Protection | Glass Yarn | |
| | 22 | Inner Sheath | HDPE minimum 1.5mm thick | |
| | 23 | Lead Sheath | N/A | |
| | 24 | Armoring | Corrugated ECCS tape of thickness >=0.15mm | |
| | 25 | Armoring Overlap | * | |
| | 26 | Outer Sheath | Polyamide / Nylon jacket over HDPE sheath | |
| | 27 | Cable Length Marking | Every one meter | |
| | 28 | Cable / Core Diameter (mm) | 16 mm* | |
| | 29 | Central Strength Member (mm) | Non metallic - FRP rod(diameter min 2.5 mm*) | |
| | 30 | Primary Coating | Primary UV cured acrylate coating with dia of 245μm +/- 5μm coated | |
| | OPTICAL PROPERTIES | 31 | Wave Length and Band Optimized (nm) | 1310 / 1550 |
| | | 32 | Numerical Aperture | * |
| | | 33 | Cut-Off Wavelength(nm) | 1200 - 1320nm (maximum for coated fiber, <=1260nm) |
| 34 | | Attenuation@Wavelength:1550NM(dB/km) | <=0.19 ~0.20 dB/km | |
| 35 | | Attenuation@Wavelength:1310NM(dB/km) | <=0.33 ~ 0.35 dB/km | |
| 36 | | Attenuation Uniformity(dB) | <=0.1 | |
| 37 | | Variation of Attenuation between 0 degC and 70 degC(dB) | 0.01 | |
| 38 | | Dispersion Wavelength(1300 to 1324 nm) / 1550 nm | better than 3.5 ps/nm.km@1310 / 18ps/nm.km@1550 | |
| 39 | | Refractive Index | 1.47 | |
| 40 | | Optical path Discrete Reflectance and Return Loss in Accordance with Requirements of Table | ITU G.957 | |
| 41 | | Zero Dispersion Wavelength(nm) | 1300 to 1324 nm | |
| 42 | | Chromatic Dispersion(ps/km) | <=3.5 | |
| 43 | | Individual Splice Loss(dB/splice) | <=0.1 (bi-directional measurement) | |
| 44 | | Mean Splice Loss(dB) | <=0.05 | |
| 45 | | Polarization Mode Dispersion | @1300nm and 1550nm wavelength <0.2ps/sqrt.km for fiber, <0.3ps/sqrt.km for cabled fiber | |
| MISC. | 46 | Ambient Temperature | | |
| | 47 | Electrical Area Class | Zone 1 Group IIA /IIB as per IEC, T3 | |
| | 48 | Make | Model No. | * * |
| | 49 | | | |
| | 50 | | | |

Notes: ** TBD

1. Vendor to specify. *
2. Refer SOR for Quantities required and Scope of Work.
3. Refer Specification for FOC Cable and HDPE duct for more information.

| | | | |
|---------------------------------|------------------------|-----|---|
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GAIL INDIA LIMITED

**DATASHEET
FOR
HDPE DUCT**

GAIL-STD-TL-DOC-DS-002


| Rev | Date | Purpose | Prepared By | Checked By | Approved By |
|-----|------------|---------------|-------------|------------|-------------|
| 0 | 15.01.2019 | Issued As Bid | RKS | UNU | UNU |



| DATASHEET FOR HDPE DUCT | | | |
|-------------------------|-------|---|---|
| GENERAL | 1 | Duct Identification No. | * |
| | 2 | Application | Duct to include Pipeline FOC |
| | 3 | Quantity (Mts) | Refer Note 2 |
| CONSTRUCTION | 4 | Description | HDPE duct suitable for direct burial application |
| | 5 | Standard | TEC GR No GR/CDS-008/03 March'11 |
| | 6 | Duct Drum Length (Mts) | 1000 Mts |
| | 7 | Outer Diameter (mm) | 40 mm ± 0.4mm |
| | 8 | Wall Thickness(mm) | 3.0mm ± 0.4mm |
| | 9 | Pressure Rating (kg/cm2) | 10 kg/cm2 |
| | 10 | Lubrication | Solid permanent lubricant across drum length |
| | 11 | HDPE Density (kg/m3 at 27 degC) | 940 to 958 kg/m3 at 27° C |
| | 12 | HDPE Melt Flow Index | 0.2 to 1.1 grams per 10 min. at 190 °C |
| | 13 | Color | Orange - uniform across drum length |
| | 14 | Identification | Black, Length mark at every meter |
| | 15 | Preinstalled Tape | Factory installed Bull-line Pull tape |
| | 16 | Ribbed | Internal straight ribs |
| | 17 | Number of Ribs | 80 / 32 |
| ACCESSORIES | 18 | Rib Height | 0.2 - 0.5 mm/0.3 to 0.9mm |
| | 19 | Tensile strength | Min. 20 N/mm2 (Testing as per IS-14151 (Part-I)) |
| | 20 | Elongation | Min. 350% (Testing as per IS-14151 (Part-I)) |
| | 21 | Internal Coefficient of friction | ≤ 0.08 |
| | 22 | Plastic Coupler | Push-fit type having Push-Lock mechanism |
| | 23 | Air Pressure Testing of Coupler | 15 Kg/cm2 min period of 2 hours without any leakage |
| | 24 | End plugs, Cable Sealing Plug & End Cap | Required |
| | 25 | End Cap material | Hard rubber/plastics fitted to HDPE Ducts |
| | TESTS | 26 | Duct Integrity Test |
| 27 | | Pressure Test | Required |
| 28 | | Crush and Deformity Test | Required |
| 29 | | End Plug Test | Required |
| MISC. | 30 | Make | Model No. |
| | 31 | | ** |
| | 32 | | ** |
| | 33 | | |
| | 34 | | |

Notes: ** TBD

1. Vendor to specify. *
2. Refer SOR for Quantities required and Scope of Work.
3. Refer Specification for FOC Cable and HDPE duct for more information regarding complete list of tests required.
4. HDPE duct specification shall confirm to IS 7328, IS 4984 and ASTM D-1963 standards.


| | | | |
|-------------------------------|------------------------|-----|---|
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GAIL INDIA LIMITED

QAP FOR OPTICAL FIBRE CABLES

GAIL-STD-TL-DOC-QAP-001

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| 0 | 15.01.2019 | Issued for Bid | RKS | UNU | UNU | |
| Rev. | Date | Purpose of Issue | Prepared By | Checked By | Approved By | Lyons Engineering Pvt. Ltd |



VENDOR LOGO



STANDARD QUALITY ASSURANCE PLAN FOR OPTICAL FIBRE CABLE

| | | | |
|----------------|------------|-----------|--------|
| CUSTOMER:- | END USER:- | QAP NO.:- | REV.:- |
| SO NO:- | DATE:- | | |
| PO NO:- | | | |
| PROJECT:- | | | |
| REF DOCUMENT:- | | | |

| Sr No. | Activity Description | Description of Test | Test Frequency | Ref. Std. & Cl. No. | Procedure No. | Approved Specification in acceptance Criteria | Document/Report | Agency | | |
|---------------------------------------|---|--|--|---------------------|-------------------|---|----------------------------|--------|-----|--------|
| | | | | | | | | Vendor | TPI | Client |
| A. FOR FIBRES (AT FIBRE STAGE) | | | | | | | | | | |
| 1 | Core (Mode Field Diameter) - @1310nm - @1550nm - @1625nm | Geometry Test | 100% | ITU-T-G652/G655 | | As per approved Specification & datasheet | Fibre Supplier Test Report | P/R | R | R |
| 3 | Attenuation Co-efficient - @1310nm - @1550nm - @1625nm | Attenuation co-efficient Test(OTDR test) | 100% | ITU-T-G652/G655 | | As per approved Specification & datasheet | Fibre Supplier Test Report | P/R | R | R |
| 4 | Chromatic Dispersion - 1285 - 1330nm - 1270 - 1340nm - 1550nm - 1625nm - Zero Dispersion Wavelength - Zero Dispersion Slope | Chromatic Dispersion | 100% | ITU-T-G652/G655 | | As per approved Specification & datasheet | Fibre Supplier Test Report | P/R | R | R |
| 5 | Geometrical Parameters - Primary Coating Diameter - Cladding Diameter - Clad Non-circularity - Mode Field Concentricity | Geometrical Test | 100% | ITU-T-G652/G655 | IEC 60793-1-20/21 | As per approved Specification & datasheet | Fibre Supplier Test Report | P/R | R | R |
| 6 | Spectral Attenuation | Spectral Test | Sample test (5%, in case of fraction the next higher rounded figure to be taken) | ITU-T-G652/G655 | | As per approved Specification & datasheet | Report | P/R | R | R |
| 7 | Polarization Mode Dispersion | | Sample test (5%, in case of fraction the next higher rounded figure to be taken) | ITU-T-G652/G655 | | As per approved Specification & datasheet | Report | P/R | R | R |
| 8 | Sheath integrity (spark test) | Spark Test | Sample test (5%, in case of fraction the next higher rounded figure to be taken) | | IEC-794-1-2-F3 | As per approved Specification & datasheet | | P/R | R | R |
| 9 | Repeated Bending | Repeated Bending | Sample test (5%, in case of fraction the next higher rounded figure to be taken) | | EIA-455-104 | As per approved Specification & datasheet | Report | P/R | R | R |

| | | | | | | | | | | | | | | |
|-------------------------------|--|---------------------------|--|--|---|--|--|--|---|----------------------------|-----|---|---|---|
| 10 | Flexural Rigidity Test on the optical fibre cable | Type Test | 5% | | | | | To be tested as per ASTM D-790 | As per approved Specification & datasheet | Report | P/R | R | R | |
| 11 | Cable Aging Test | Type Test | 5% | | As per Job specification/ ITU-T-G652/G655 | | | | As per approved Specification & datasheet | Report | P/R | R | R | |
| 12 | Check of easy removal of sheath | - | | | As per Job specification/ ITU-T-G652/G655 | | | | As per approved Specification & datasheet | Report | P/R | R | R | |
| 13 | Effect of aggressive media on the cable surface (Acidic and Alkaline behaviour) | - | | | As per Job specification/ ITU-T-G652/G655 | | | | As per approved Specification & datasheet | Report | P/R | R | R | |
| 14 | Check of the Quality of the Loose Tube (Containing Optical Fibre) | - | | | As per Job specification/ ITU-T-G652/G655 | | | | As per approved Specification & datasheet | Report | P/R | R | R | |
| 15 | Drainage Test for Loose Tube and Drip Test on the Cable | - | | | As per Job specification/ ITU-T-G652/G655 | | | | As per approved Specification & datasheet | Report | P/R | R | R | |
| 16 | Fibre PMD Maximum Individual Fibre | PMD Test | 100% | | ITU-T-G652/G655 | | | IEC 60793-1-49 | As per approved Specification & datasheet | Fibre Supplier Test Report | P/R | R | R | |
| 17 | Fibre Proof Test | Fibre Proof Test | 100% | | ITU-T-G652/G655 | | | IEC 60793-1-30 | As per approved Specification & datasheet | Fibre Supplier Test Report | P/R | R | R | |
| 18 | Fibre Curl | Fibre Curl Test | 100% | | ITU-T-G652/G655 | | | IEC 60793-1-34 | As per approved Specification & datasheet | Fibre Supplier Test Report | P/R | R | R | |
| 19 | Attenuation Vs Wavelength - 1285 - 1330nm - 1525 - 1575nm | Spectral Attenuation Test | 100% | | ITU-T-G652/G655 | | | IEC 60793-1-40A | As per approved Specification & datasheet | Report | P/R | R | R | |
| 20 | Attenuation with Bending - 100 turns on a mandrel of 60 mm diameter - 1 turn on mandrel of 32mm diameter | Attenuation Test | 100% | | | | | IEC 60793-1-47 | As per approved Specification & datasheet | Report | P/R | R | R | |
| 21 | Fibre Micro Band Test (1 around 32+0.5 diameter mandrel) <0.5 dB at 1550 nm. | Fibre Micro Band Test | 100% | | | | | | As per approved Specification & datasheet | Report | P/R | R | R | |
| B. FOR FINISHED CABLES | | | | | | | | | | | | | | |
| 1 | Visual Inspection - Cable lay up and fibre identification - Identification and length marking on outer jacket - Overall diameter of the cable - Colour contact of the marking with the outer sheath or the cable | Visual Tests | 5% or Minimum One Drum (Whichever is higher) | | ITU-T-G652/G655 | | | As per approved cross sectional drawing/Datasheet of OFC | As per approved Specification & datasheet | Report | | | | |
| 2 | Test on Moisture barrier - Thickness of layers - Extent of overlapping - Electrical continuity - Water swellable tape or power - Water immersion | Moisture Barrier Test | - 5% - 5% - Not applicable | | ITU-T-G652/G655 | | | As per approved cross sectional drawing/Datasheet of OFC | As per approved Specification & datasheet | Report | P | W | R | R |

| | | | | | | | | | | |
|----|--|--|--|-----------------|-----------------------------|---|--------|---|---|-----|
| 3 | Tensile performance (Tensile load of 9.81 W Newton or 2700 N whichever is higher where W=Weight of 1km cable in kg) | Tensile Test | 1 drum per order | ITU-T-G652/G655 | IEC-794-1-2-E1 | As per approved Specification & datasheet | Report | P | W | R |
| 4 | Attenuation Co-efficient/length - @ 1310 nm - @ 1550 nm - @162.5nm | Attenuation Co-efficient Test (OTDR Test) | 5% or Minimum One Drum (Whichever is higher) | ITU-T-G652/G655 | IEC 60793-1-40C | As per approved Specification & datasheet | Report | P | W | R |
| 5 | Crush (200kg of load to be slowly placed and held for 60 sec) | Crush Test | 1 drum per order | | IEC-794-1-2-E3 | As per approved Specification & datasheet | Report | P | W | R |
| 6 | Impact (Mass of 5 kg to fall freely from 500mm height on the cable sample 10 times repeatedly with a gap between 1 impact to another approx. at 60 sec) | Impact Test | 1 drum per order | | IEC-794-1-2-E4 | As per approved Specification & datasheet | Report | P | W | W/R |
| 7 | Torsion (Weight of 7.5 kg attached to the stationary chuck and shall be subjected to 10 cycles) | Torsion Test | 1 drum per order | | IEC-794-1-2-E7 | As per approved Specification & datasheet | Report | P | W | W/R |
| 8 | Bend (To be performed preferably with procedure 1 (of IEC) with mandrel diameter of 20D, where D is the diameter of the cable and testing shall be done with 4 turns of cable wrapped and then unwrapped for 10 complete cycles) | Bend Test | 1 drum per order | | IEC-794-1-2-E11 Procedure 1 | As per approved Specification & datasheet | Report | P | W | W/R |
| 9 | Snatch Test (with a load of 100N) | Snatch Test | 1 drum per order | | IEC-794-1-2-E9 | As per approved Specification & datasheet | Report | P | W | W/R |
| 10 | Kink (Radius : 10 X Cable Diameter) | Kink Test | 1 drum per order | | IEC-794-1-2-E10 | As per approved Specification & datasheet | Report | P | W | W/R |
| 11 | Temperature Cycling | Tested on a > 200m cable with temperature cycle as follows: - At room temperature : 1 hr - At 0°C : 12 hrs - At 65°C : 12 hrs - From 65°C to room temperature - 1 hr | 1 drum per order | | IEC-794-1-2-F1 | As per approved Specification & datasheet | Report | P | W | W/R |

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|----|--|------------------------|----|--|----------------|--|--------|---|---|-----|
| 12 | Test of Figure of 8 (Eight) on the cable | - | 5% | As per job specification/ ITU-T-G652/G655 | | As per approved Specification & datasheet | Report | P | W | W/R |
| 13 | Static Bend Test | Band test | 5% | As per the clause no. 13.8 of the GR alternatively as per ASTM D 790 | | As per approved Specification & datasheet | Report | P | W | W/R |
| 14 | Water Penetration | Water Penetration Test | 5% | | IEC-794-1-2-F5 | As per approved Specification & datasheet | Report | P | W | W/R |
| 15 | Water Immersion | Water Immersion Test | | | IEC 60793-53 | As per approved Specification & datasheet | Report | P | W | W/R |
| 16 | Length of Cable | - | - | - | - | Std Length 4.0 km±5% | | P | W | W/R |
| 17 | Abrasion Test | Abrasion Test | | | IEC-794-1-2-E2 | Test the abrasion resistant of sheath and printing | | P | W | W/R |
| 18 | IRN | | | | | | | H | P | R |
| 19 | DOCUMENTATION | | | | | | | H | P | R |

LEGEND: R: Review, W:Witness, P:Perform, TPI/A:Third Party Inspection Agency, NA:Not Applicable

NOTE:


- 1). Material and Type shall be as per tender specification / datasheet.
- 2). Acceptance Norms/ Acceptance Criteria for all the activities shall be as per specification/ data sheets/ applicable codes & standards etc.
- 3). GAIL and/or his representative reserve right for inspection at any stage of manufacturing of materials as per approved QAP.
- 4). All Testing & Measuring Instruments shall have valid Calibration with Calibration Certificates & Traceabilities.





GAIL INDIA LIMITED

QAP FOR OPTICAL HDPE DUCT & ACCESSORIES

GAIL-STD-TL-DOC-QAP-002

| | | | | | | | |
|-----|------------|------------------|-------------|------------|-------------|---|----------------------------|
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| 0 | 15.01.2019 | Issued for Bid | RKS | UNU | UNU | | |
| REV | Date | Purpose of Issue | Prepared By | Checked By | Approved By | | Lyons Engineering Pvt. Ltd |

| S.No | | Activity Description | Description of Test | Test Frequency | Ref. std & Cl. No. | Procedure No. | Acceptance Criteria | Document / Report | Manufacturer | TPI Agency | Client |
|---|--|---|--|--|--|--|--|-------------------|--------------|------------|---|
| | |  | | | VENDOR LOGO | | | | | |  |
| QUALITY ASSURANCE PLAN FOR HDPE DUCT | | | | | | | | | | | |
| TEST ON RAW MATERIALS | | | | | | | | | | | |
| 1 | | Melt flow Index of HDPE resin | As per data sheet/specification and GR/CDS-08/03/MAR-11 with latest amendment. | As Per IS 2530 | As per IS 2530 | Vendor to specify | As per data sheet/specification and GR/CDS-08/03/MAR-11 with latest amendment. | Vendor to specify | P | R | R |
| 2 | | Density of HDPE Resin | As per data sheet/specification and GR/CDS-08/03/MAR-11 with latest amendment. | As Per IS 7328 | As per IS 7328 | Vendor to specify | As per data sheet/specification and GR/CDS-08/03/MAR-11 with latest amendment. | Vendor to specify | P | R | R |
| 3 | | UV Stabilizer Content | As per data sheet/specification and GR/CDS-08/03/MAR-11 with latest amendment. | TEC GR NO. TEC/GR/TX/CDS-08/03/MAR-11 with latest amendment. | TEC GR NO. TEC/GR/TX/CDS-08/03/MAR-11 with latest amendment. | Vendor to specify | As per data sheet/specification and GR/CDS-08/03/MAR-11 with latest amendment. | Vendor to specify | P | R | R |
| 4 | | Ash Content of Color Master Batch | As per data sheet/specification and GR/CDS-08/03/MAR-11 with latest amendment. | TEC GR NO. TEC/GR/TX/CDS-08/03/MAR-11 with latest amendment. | TEC GR NO. TEC/GR/TX/CDS-08/03/MAR-11 with latest amendment. | Vendor to specify | As per data sheet/specification and GR/CDS-08/03/MAR-11 with latest amendment. | Vendor to specify | P | R | R |
| TESTS ON FINISHED PLB HDPE DUCT | | | | | | | | | | | |
| 1 | | Visual Appearance | | | IS: 4984-95 | Smooth inside and outside surface, free of blisters, shrink hole, flaking, chips, scratches, roughness etc. Thickness of inside Lubricant layer shall be uniform throughout the length and shall be white in color for clear visibility. | | | P | W | W/R |
| | | Dimensions: | Dimensional outside diameter wall thickness | As Per Table 1 of GR/CDS-08/03/MAR-11 with latest amendment. | TEC GR NO. TEC/GR/TX/CDS-08/03/MAR-11 with latest amendment. | Vendor to specify | As per data sheet/specification and GR/CDS-08/03/MAR-11 with latest amendment. | Vendor to specify | P | W | W/R |
| | | a) Wall Thickness | | | IS: 4984-95 | 3.50 + 0.20 mm or better | | | P | W | W/R |
| | | b) Outside Diameter | | | IS: 4984-95 | 50.0 +0.4 – 0.0 mm | | | P | W | W/R |
| | | c) Thickness of inner Lubricant Layer | As per data sheet/specification and GR/CDS-08/03/MAR-11 with latest amendment. | As per data sheet/specification and GR/CDS-08/03/MAR-11 with latest amendment. | TEC GR NO. TEC/GR/TX/CDS-08/03/MAR-11 with latest amendment. | Vendor to specify | As per data sheet/specification and GR/CDS-08/03/MAR-11 with latest amendment. | Vendor to specify | P | W | W/R |

| | | | | | | | | | | |
|----|--------------------------------------|--|--|--|--------------------------|--|-------------------|---|---|-----|
| 2 | d) Bending Radius | As per data sheet/specification and GR/CDS-08/03/MAR-11 with latest amendment. | As per data sheet/specification and GR/CDS-08/03/MAR-11 with latest amendment. | TEC GR NO. TEC/GR/TX/CDS-08/03/MAR-11 with latest amendment. | Vendor to specify | As per data sheet/specification and GR/CDS-08/03/MAR-11 with latest amendment. | Vendor to specify | P | W | W/R |
| | e) Color | | | - | As per job specification | | | P | W | W/R |
| | f) Identification Markings | | | TEC GR NO. TEC/GR/TX/CDS-08/03/MAR-11 with latest amendment. | As per job specification | As per data sheet/specification and GR/CDS-08/03/MAR-11 with latest amendment. | | P | W | W/R |
| | g) Fading of colors of duct | GR/ASTM D-1712 | As per data sheet/specification and GR/CDS-08/03/MAR-11 with latest amendment. | TEC GR NO. TEC/GR/TX/CDS-08/03/MAR-11 with latest amendment. | As per job specification | As per data sheet/specification and GR/CDS-08/03/MAR-11 with latest amendment. | Vendor to specify | P | W | W/R |
| 3 | Reversion Test | Shrinkage | As per data sheet/specification and GR/CDS-08/03/MAR-11 with latest amendment. | TEC GR NO. TEC/GR/TX/CDS-08/03/MAR-11 with latest amendment. | Vendor to specify | As per data sheet/specification and GR/CDS-08/03/MAR-11 with latest amendment. | Vendor to specify | P | W | W/R |
| 4 | Environmental Stress Crack Resistant | Chemical Property of Product | As per data sheet/specification and GR/CDS-08/03/MAR-11 with latest amendment. | TEC GR NO. TEC/GR/TX/CDS-08/03/MAR-11 with latest amendment. | Vendor to specify | As per data sheet/specification and GR/CDS-08/03/MAR-11 with latest amendment. | Vendor to specify | P | W | W/R |
| 5 | Impact Strength | Impact Strength Test | As per data sheet/specification and GR/CDS-08/03/MAR-11 with latest amendment. | TEC GR NO. TEC/GR/TX/CDS-08/03/MAR-11 with latest amendment. | Vendor to specify | As per data sheet/specification and GR/CDS-08/03/MAR-11 with latest amendment. | Vendor to specify | P | W | W/R |
| 6 | Crush Resistance Test | Deflection of Duct | As per data sheet/specification and GR/CDS-08/03/MAR-11 with latest amendment. | TEC GR NO. TEC/GR/TX/CDS-08/03/MAR-11 with latest amendment. | Vendor to specify | As per data sheet/specification and GR/CDS-08/03/MAR-11 with latest amendment. | Vendor to specify | P | W | W/R |
| 7 | Oxidation Induction Test | Oxidation of HDPE material | As per data sheet/specification and GR/CDS-08/03/MAR-11 with latest amendment. | TEC GR NO. TEC/GR/TX/CDS-08/03/MAR-11 with latest amendment. | Vendor to specify | As per data sheet/specification and GR/CDS-08/03/MAR-11 with latest amendment. | Vendor to specify | P | W | W/R |
| 8 | Hydraulic Characteristic Test | Leakage/Swelling, Weeping and Burst and Crack in test duration | As Per Table 1 of GR/CDS-08/03/MAR-11 with latest amendment. | TEC GR NO. TEC/GR/TX/CDS-08/03/MAR-11 with latest amendment. | Vendor to specify | As per data sheet/specification and GR/CDS-08/03/MAR-11 with latest amendment. | Vendor to specify | P | W | W/R |
| 9 | Tensile Strength | Tensile Elongation Property | As Per Table 1 of GR/CDS-08/03/MAR-11 with latest amendment. | TEC GR NO. TEC/GR/TX/CDS-08/03/MAR-11 with latest amendment. | Vendor to specify | As per data sheet/specification and GR/CDS-08/03/MAR-11 with latest amendment. | Vendor to specify | P | W | W/R |
| 10 | Internal Co-efficient of friction | Co-efficient of friction HDPE material | As Per Table 1 of GR/CDS-08/03/MAR-11 with latest amendment. | TEC GR NO. TEC/GR/TX/CDS-08/03/MAR-11 with latest amendment. | Vendor to specify | As per data sheet/specification and GR/CDS-08/03/MAR-11 with latest amendment. | Vendor to specify | P | W | W/R |
| 11 | UV Stabiliser of content of Resin | Identification of UV additive | As per data sheet/specification and GR/CDS-08/03/MAR-11 with latest amendment. | TEC GR NO. TEC/GR/TX/CDS-08/03/MAR-11 with latest amendment. | Vendor to specify | As per data sheet/specification and GR/CDS-08/03/MAR-11 with latest amendment. | Vendor to specify | P | W | W/R |
| 12 | Ovality | Dimensional outside diameter | As Per Table 1 of GR/CDS-08/03/MAR-11 with latest amendment. | TEC GR NO. TEC/GR/TX/CDS-08/03/MAR-11 with latest amendment. | Vendor to specify | As per data sheet/specification and GR/CDS-08/03/MAR-11 with latest amendment. | Vendor to specify | P | W | W/R |
| 12 | Mandrel Test | Internal Dia of Duct | As Per Table 1 of GR/CDS-08/03/MAR-11 with latest amendment. | TEC GR NO. TEC/GR/TX/CDS-08/03/MAR-11 with latest amendment. | Vendor to specify | As per data sheet/specification and GR/CDS-08/03/MAR-11 with latest amendment. | Vendor to specify | P | W | W/R |

| | | | | | | | | | | |
|---|---|--|--|--|--|--|-------------------|---|---|-----|
| 13 | Maximum Pulling Strength | Pulling force on coupler | As per data sheet/specification and GR/CDS-08/03/MAR-11 with latest amendment. | TEC GR NO. TEC/GR/TX/CDS-08/03/MAR-11 with latest amendment. | Vendor to specify | As per data sheet/specification and GR/CDS-08/03/MAR-11 with latest amendment. | Vendor to specify | P | W | W/R |
| 14 | Change in MFR | As per data sheet/specification and GR/CDS-08/03/MAR-11 with latest amendment. | As per data sheet/specification and GR/CDS-08/03/MAR-11 with latest amendment. | TEC GR NO. TEC/GR/TX/CDS-08/03/MAR-11 with latest amendment. | Vendor to specify | As per data sheet/specification and GR/CDS-08/03/MAR-11 with latest amendment. | Vendor to specify | P | W | W/R |
| Tests on HDPE Conduit Accessories: | | | | | | | | | | |
| 1 | Push-fit Coupler, End Plug & Cable Sealing Plug | | | As per data sheet/specification and GR/CDS-08/03/MAR-11 with latest amendment. | <ul style="list-style-type: none"> • Shall pass ageing test as per TEC GR. • End plug and cable sealing plug shall be tested for air tightness with pressure of 1 bar for 30minutes. • Pulling force test shall be conducted by loading coupler joined by two pieces of duct for 15 minutes using | | | P | W | W/R |
| LEGEND: R: Review, W:Witness,P: Perform, TPIA:Third party inspection agency 1) Material and Type shall be as per tender specification / datasheet. 2) The supplier shall submit their own detailed QAP prepared on the basis of the above approval of owner/owner's representative and TPIA 3) TPIA shall have right to inspect 100% of all manufacturing activities on each day or as specified above. 4) TPIA along with owner/owner's representative shall review /approve all the documents related to QAP /Quality manuals Drawings etc. submitted by supplier 5) TPIA shall also review the test certificates submitted by the manufacturer. 6) Supplier shall in coordination with sub vendor shall issue detailed production and inspection schedule indicating the dates and the locations to facilitate owner/owner's representative to organise inspection 7) Supplier shall submit their own detailed QAP duly signed and stamped. 8) Acceptance Norms/Acceptance Criteria for all the activities shall be as per specification/ data sheets/ applicable codes & standards etc. 9). GALL and/or his representative reserve right for inspection at any stage of manufacturing of materials as per approved QAP. | | | | | | | | | | |

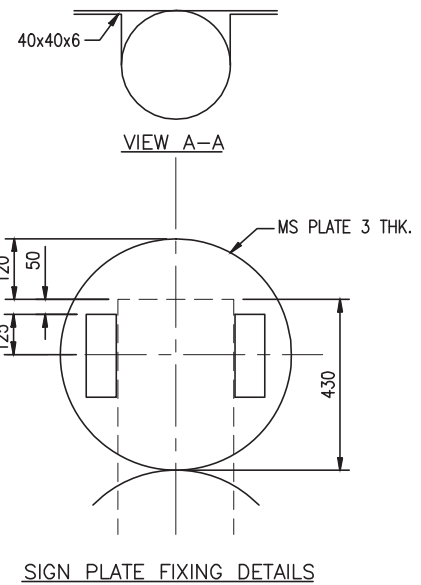
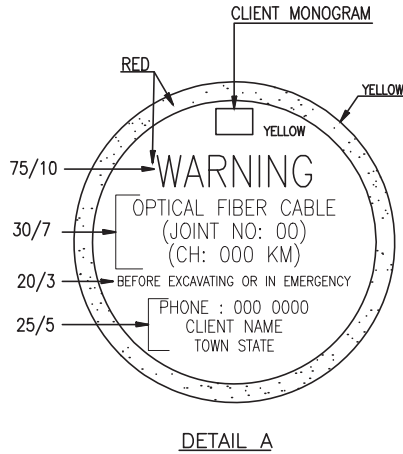
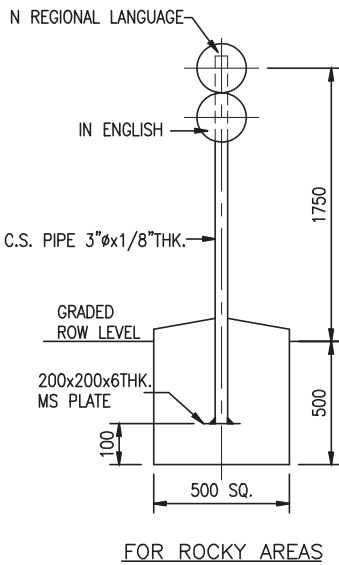
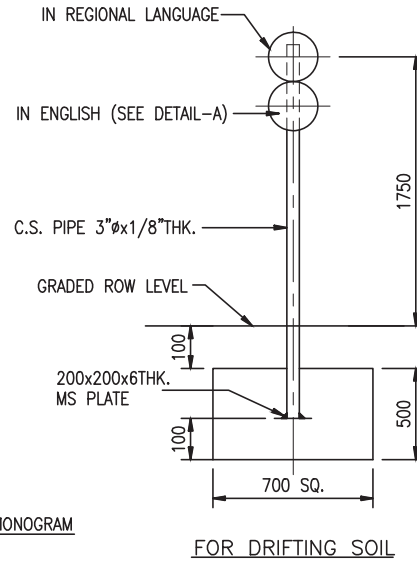
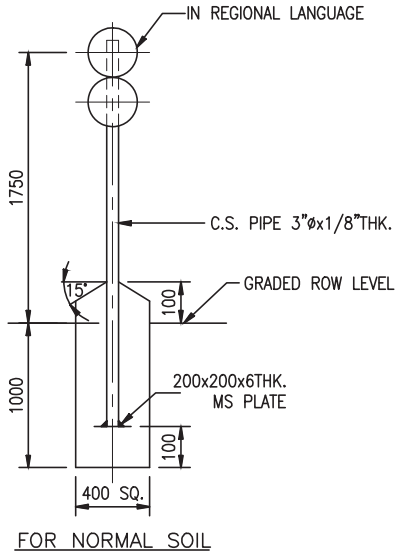


LYONS ENGINEERING PVT. LTD.
NEW DELHI

OPTICAL FIBER CABLE
JOINT IDENTIFICATION MARKER

DRAWING NO.
GAIL-STD-TL-DWG-TP-001

SHEET NO. 2 OF 2



NOTES

- SCHEME FOR PAINTING AND COLOURING
 - UNDERGROUND STEEL : COAL TAR EPOXY (MIN 300 MICRON THK). (EXCEPT THAT EMBEDDED IN CONCRETE).
 - OVER GROUND STEEL : ONE COAT OF PRIMER AND TWO COATS OF SPECIFIED COLOUR PAINT.
 - ALL LETTERS EXCEPT 'WARNING' TO BE PAINTED BLACK.
 - POST SHALL BE PAINTED WITH 250 WIDE ALTERNATE BANDS OF BLACK AND WHITE PAINT.
 - ALL OTHER ABOVE-GROUND STEEL SHALL BE PAINTED YELLOW.
- ALL DIMENSIONS ARE IN MM UNLESS OTHERWISE STATED.
- FOUNDATION SHALL BE MADE OF CONCRETE.
- SIGN PLATE IN REGIONAL LANGUAGE SHALL BE PREPARED BY THE CONTRACTOR IN SIMILAR LINES.

| | | | | | |
|----------|------------|---------------------|-------|---------|----------|
| 0 | 10-01-2019 | ISSUED FOR TENDER | DV | UN | UN |
| REV. NO. | DATE | SUBJECT OF REVISION | DRAWN | CHECKED | APPROVED |



GAIL INDIA LIMITED

**LIST OF RECOMMENDED PARTIES
FOR
BOUGHT OUT ITEMS**

| Rev | Date | Purpose | Prepared By | Checked By | Approved By |
|-----|------------|----------------|-------------|------------|-------------|
| 0 | 22.12.2020 | Issued for Bid | AS | SR | SB |




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LIST OF SUPPLIERS OF MAJOR BOUGHT-OUT ITEMS**1. (MECHANICAL & FIRE FIGHTING EQUIPMENT)****A). MAINLINE & MECHANICAL****i) Pipe Carbon Steel To Indian Standards**


1. A.S.T. Pipes Pvt. Ltd. (AST Group)
2. Advance Steel Tube Ltd.
3. Apl Apollo Tubes Ltd. (Er. Bihar Tubes Ltd.)
4. Asian Mills Pvt. Ltd.
5. Asrani Tubes Limited
6. Dadu Pipes (P) Ltd.
7. Essar Steel Limited(Er Hazira Pipes Mill)
8. Gaurang Products Pvt Ltd. (Ast Group)
9. Goodluck Steel Tubes Ltd.
10. HiGTech Pipes Limited
11. Indus Tube Limited
12. Jindal Industries Ltd
13. Jindal Pipes Ltd.
14. Jindal Saw Ltd (Kosi Works)
15. Jotindra Steel & Tube Ltd
16. Lalit Pipes and Pipes Ltd.
17. Maharashtra Seamless Ltd.
18. Man Industries (India) Ltd. – Pithampur
19. Man Industries (India) Ltd. Anjar
20. Mukat Tanks & Vessels Ltd.
21. Nezone Tubes Limited
22. North Eastern Tubes Limited
23. Pratibha Industries Limited
24. Pratibha Pipes & Structural Ltd.
25. Psl Ltd (Chennai)
26. Psl Ltd (V1, V2 & Nc)
27. Rama Steel Tubes Ltd.
28. Ratnamani Metals and Tubes Ltd.
29. Ravindra Tubes Limited
30. Samshi Pipe Industries Limited

| | | | |
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| LIST OF RECOMMENDED PARTIES FOR BOUGHT OUT ITEMS | Doc No. | Rev |  |
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31. Surya Roshni Ltd.
32. Swastik Pipes Ltd.
33. Utkarsh Tubes & Pipes Ltd. (Formly Bmw)
34. Welspun Corp. Limited (Dahej)
35. Zenith Birla (India) Limited

ii) Pipe & Tubulars To A.P.I. Standards

1. Arcelormittal Tubular Products Roman Sa, Romania
2. Bhel (Trichy), India
3. Dalmine Spa (Enquiry To Tenaris), UAE
4. Eewkorea Co. Ltd (Germany), Korea
5. Eew Korea Co. Ltd. (Korea), Korea
6. Eisenbau Kramer Gmbh, Germany
7. Hyundai Rb Co. Ltd. South Korea
8. Ilva Lamiere E Tubi Srl (Enq To Ilva Spa, Italy)
9. Inox Tech. Spa, Italy
10. Ismt Ltd. Ahmedngr, India
11. Ismt Ltd. Baramati, India
12. Jindal Pipes Ltd., India
13. Jindal Saw Ltd. (Kosi Works), India
14. Jindal Saw Ltd. (Nashik Works), India
15. Lalit Pipes and Pipes Ltd. India
16. Maharashtra Seamless Ltd., India
17. Man Industries (I) Ltd. (Pithampur), India
18. Mukat Tanks & Vessels Ltd., India
19. Pratibha Industries Limited, India
20. Ratnamani Metals and Tubes Ltd., India
21. Siderca S.A.I.C (Enquiry Totenaris), UAE
22. Sumitomo Metal Ind. Ltd., India
23. Surya Roshni Ltd., India
24. Swastik Pipes Ltd, India
25. Tata Steel Uk Limited (Formerly C702)
26. Tubos De Acero De Mexico Sa (Enq. Tenaris), UAE
27. Tubos Reunidos Sa Spain
28. Umran Steel Pipe Inc (Turkey), Turkey
29. Valcovny Trub Chomutov, Czech Republic
30. Vallourec and Mannesmann Tubes, France

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31. Welspun Corp Limited (Dahej), India

iii) Pipe/Tube CS (Seamless) To ASTM STDs

1. Arcelormittal Tubular Products Roman Sa, Romania
2. Bhel (Trichy), India
3. Changshu Seamless Steel Tube Co. Ltd., China
4. Dalmine Spa (Enquiry To Tenaris, UAE
5. Heavy Metals & Tubes Limited (Mehsana), India
6. Ismt Ltd. Ahmedngr, India
7. Ismt Ltd. Baramati India
8. Jfe Steel Corporation, UAE
9. Jindal Sdaw Ltd (Nashik Works) India
10. Klt Automotive and Tubular Products Ltd., India
11. Mahalaxmi Seamless Limited, India
12. Maharashtra Seamless Ltd, India
13. Products Tubulares S.A.U, Spain
14. Ratnadeep Metal Tubes Ltd., India
15. Staineest Tubes Pvt Ltd., India
16. Sumitomo Metal Ind. Ltd., India
17. Tubos Reunidos Sa Spain
18. Valcovny Trub Chomutov, Czech Republic
19. Vallourec Andmannesmann Tubes France
20. Yangzhou Chengde Steel Pipe Co. Ltd Dubai (UAE)

iv) Pipe Carbon Steel (Welded) To ASTM STDs

1. Eew Korea Co. Ltd. (Germany), Korea
2. Eew Korea Co. Ltd. (Korea), Korea
3. Eisenbau Kramer Gmbh, Germany
4. Hyundai Rb Co. Ltd., South Korea
5. Inox Tech. Spa, Italy
6. Jindal Saw Ltd (Kosi Works), India
7. Lalit Pipes and Pipes Ltd., India
8. Man Industries (I) Ltd.(Pithampur), India
9. Man Industries (India) Ltd. Anjar, India
10. Mukat Tanks & Vessels Ltd., India
11. Ratnamani Metals And Tubes Ltd., India
12. Sumitomo Metal India Ltd., India

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13. Tata Steel Uk Limited


v) Valve

a) Globe Valves

- 1) M/S BDK (New Delhi)
- 2) M/S Datre Corpn (Calcutta)
- 3) M/S KSB Pumps (New Delhi)
- 4) M/S L&T (New Delhi)
- 5) M/S Neco Schuber & Salzer Ltd. (New Delhi)
- 6) M/S Niton Valve (Mumbai)
- 7) M/S Ornate Valves (Mumbai)
- 8) M/S Panchavati Valves (Mumbai)
- 9) AV Valves Ltd.
- 10) BHEL (Trichy), India
- 11) Econo Valves Pvt Ltd, India
- 12) Fouress Engg (I) Ltd (Aurangabad)
- 13) Guru Industrial Valves Pvt Ltd
- 14) Leader Valves Ltd, India
- 15) NSSL Ltd. (Neco Schubert & Salzerltd)
- 16) Oswal Industries Ltd, India
- 17) Petrochemical Engineering Enterprises, India
- 18) Sakhi Engineers Pvt Ltd
- 19) Shalimar Valves Pvt Ltd
- 20) Steel Strong Valves India Pvt Ltd, India
- 21) Petro Valves Pvt. Limited, Ahmedabad

b) Check Valves

1. M/s Advance Valves Pvt. Ltd., Noida
2. M/s Aksons & Mechanical Enterprises, Mumbai
3. M/s Larsen & Toubro Limited (M/s Audco India Limited, Chennai)
4. M/s AV valves Ltd., Agra
5. M/s BDK engineering India Ltd., Hubli
6. M/s BHEL, OFE & OE Group, New Delhi
7. M/s Datre Coroportion Limited, Calcutta
8. M/s Leader Valves Ltd., Jalandhar
9. M/s Neco schubert & Salzer Ltd., New Delhi
10. M/s Niton Valves Industries (P) Ltd., Mumbai

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11. M/s Precision Engg.Co., Mumbai
12. Econo Valves Pvt Ltd, India
13. Fouress Engg (I) Ltd (Aurangabad)
14. KSB Pumps Ltd (Coimbatore), India
15. NSSL Ltd. (Neco Schubert & Salzerltd)
16. Oswal Industries Ltd, India
17. Panchvati Valves & Flanges Pvt Ltd, India
18. Petrochemical Engineering Enterprises, India
19. Sakhi Engineers Pvt Ltd
20. Shalimar Valves Pvt Ltd
21. Steel Strong Valves India Pvt Ltd, India

c) Plug Valves

1. M/s Breda Energia Sesto Industrial Spa, Italy
2. M/s Fisher Sanmar Ltd., Chennai
3. M/s Larsen & Toubro Ltd., New Delhi
4. M/s Nordstrom Valves, USA
5. M/s Serck Audco Valves, UK
6. M/s Sumitomo Corporation India Pvt. Ltd., New Delhi
7. M/s Z Corporation, Korea
8. M/s Hawa Valves (India) Pvt. Ltd., Mumbai
9. M/s Steel Strong Valves India Pvt. Ltd., Navi Mumbai
10. M/s Econo Valves
11. M/s Flow-Serve PTE (Mfr. SERCK), India

vi) Split Tee

- 1) M/s Ipsco, Canada
- 2) M/s TD Willamsons, USA
- 3) M/s Pipefit Engineers
- 4) M/s Sawan Engineers
- 5) M/s Furmanite International Ltd.
- 6) M/s VKVC
- 7) M/s Bhotika
- 8) M/s Huwelco Inc.
- 9) M/s Plant-Tech


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vii) Gaskets

1. IGP Engineers (P) Ltd., Madras
2. Madras Industrial Products, Madras
3. Dikson & Company, Bombay
4. Banco Products (P) Ltd., Vadodara
5. Goodrich Gaskets Pvt Ltd
6. Starflex Sealing India Pvt Ltd, India
7. Teekay Meta Flex Pvt Ltd
8. UNIKLINGER Ltd
9. HEM Engg. Corp.
10. Unique Industrial Packing Pvt. Ltd.

viii) Fasteners

1. Nireka Engg. Co. (P) Ltd., Calcutta
2. Precision Taps & Dies, Bombay
3. AEP Company, Vithal Udyog Nagar
4. Fix Fit Fasteners, Calcutta
5. Precision Engg. Industries, Baroda
6. Echjay Forgings Pvt. Ltd., Bombay
7. Capital Industries, Bombay
8. Boltmaster India Pvt Ltd, India
9. Deepak Fasteners Limited, India
10. Fasteners & Allied Products Pvt Ltd, India
11. Hardwin Fasteners Pvt Ltd, India
12. J.J. Industries, India
13. Multi Fasteners Pvt Ltd, India
14. Nexo Industries, India
15. Pacific Forging & Fasteners Pvt Ltd, India
16. Pioneer Nuts & Bolts Pvt Ltd, India
17. Precision Auto Engineers, India
18. President Engineering Works, India
19. Sandeep Engineering Works, India
20. Syndicate Engineering Industries, India

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ix) Welding Electrodes

For Mainline - Root: Lincoln, and Other passes: Lincoln.


For Piping- Root: Lincoln, Other passes: Lincoln, D&H or equivalent make.

x) Fire Fighting**Equipments****a) Fire****Extinguishers**

1. Avon Services (Production & Agencies) Pvt. Ltd., Bombay
2. Kooverji Devshi & Co., Bombay
3. Zenith Fire Services, Bombay
4. Safex Fire Services, Bombay
5. Reliable (Fire Protection) India Ltd., Bombay
6. Brij Basi Hi
7. Tech Udyog
8. Bharat Engg Works, India
9. Gunnebo India Ltd
10. Nitin Fire Protection Industries Ltd, India
11. Supremex Equipments, India
12. Vimal Fire Controls Pvt Ltd., India

b) Fire Hydrants, Monitors, Deluge Valve, Nozzles

1. Zenith
2. Minimax
3. Newage
4. HD Fire
5. Vijay Fire
6. Asco Strumech Pvt Ltd, India
7. Brij Basi Hi
8. Tech Udyog
9. Gunnebo India Ltd
10. Nitin Fire Protection Pvt Ltd
11. Shah Bhogilal Jethamal & Brothers
12. Venus Pumps & Engineering Works

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c) RRL Hose

1. Jayshree
2. Newage

d) Hoses

1. Ashit Sales Corporation, Bombay
2. Royal India Corporation, Bombay
3. Gayatri Industrial Corporation
4. Simplex Rubber Products Ltd., Ahmedabad
5. Zaverchand Marketing Pvt. Ltd., Baroda
6. Presidency Rubber Mill, Calcutta
7. The Cosmopolite, Calcutta
8. Simplex Rubber Products, Thane

e) Hose Delivery

1. Chhatarya Rubber & Chemical Industries,
2. Nitin Fire Protection Industries Ltd, India

f) Fire Hose Accessories

1. Asco Strumech Pvt Ltd
2. Brij Basi Hi-tech Udyog
3. Gunnebo India Ltd
4. Shah Bhogilal Jethamal & Brothers
5. Vimal Fire Controls Pvt Ltd., India

g) Heat Shrinkable Sleeves


1. Covalence Raychem (Berry Plastics Corporation)
2. Canussa – CPS
3. CYJ Changtong New Material company

h) Cold Applied Tapes

1. Denso GmbH
2. Polyken (Berry Plastics Corporation)

i) PUR Coating

1. Powercrete (Berry Plastics Corporation)

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j) Casing End Closure

1. Raci, Italy
2. Raychem RPG Limited

k) Casing Insulators

1. Raci, Italy
2. Raychem RPG Limited

l) Rockshield

1. Raychem RPG Limited

m) Warning Tape /Mesh

1. Sparco Multiplast Pvt. Ltd., Ahmedabad
2. M/s Raychem RPG Limited
3. Singhal Industries Private Limited

n) High Build Epoxy Coating


1. Berry Plastics – Powercrete
2. Specialty Polymer Canada
3. Denso Protal, Canada

o) Casing Insulators

1. Raci, Italy
2. Raychem RPG Limited
3. Veekay Vikram

xiii) DRY GAS FILTER & FILTER SEPERATOR

1. Grand Prix Fab (Pvt.) Ltd.(New Delhi)
2. Perry Equipment, USA
3. Faudi Filter, Germany
4. Forain S.r.l., Italy
5. ABB, Faridabad
6. Burgess Manning, USA
7. Multitex Filtration Engineers India

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8. Triveni Plenty Engg. Ltd. (New Delhi)
9. Siirtec International Contractor S.P.A (Italy)
10. Flashpoint, Pune india
11. Filtration Engineers (I) Pvt Ltd, India
12. Gujarat Otofilt, India
13. Tormene Gas Technology
14. Ultrafilter (India) Pvt Ltd, India
15. Ravi Techno Systems Pvt Ltd, India
16. Siirtec Nigi S.P.A
17. Filtan Filter Anlagenbau Gmbh
18. Fairley Arlon BV
19. PECO Facet
20. EPE Epenstener GMBH
21. Filtrex srl
22. Petromar Engineered Soln
23. Plenty Filter
24. Eurofiltec
25. PTI Technologies Inc

xiv) FILTER ELEMENT

1. Peco – Facet
2. Velcon
3. Pall – Filterite
4. Burgress Manning

xv) NDT Agency

1. NDT Services, Ahmedabad
2. GEECY Industrial Services Pvt. Ltd., Mumbai
3. Corrosion Control Services, Mumbai
4. Perfect Metal Testing & Inspection Agency, Calcutta
5. Inter Ocean Shipping Co., New Delhi

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6. RTD, Mumbai
7. Sievert, Mumbai
8. X-Tech, Vizag

xvi) HOT TAPPING VENDERS

1. Furmanite International Ltd.
2. Huwelco Inc.
3. Unique Hydrographics
4. Conmate Energy
5. Propipe SL
6. Plant-Tech
7. TDW

2. LIST OF MATERIALS OF RECOMMENDED BRAND AND/ OR MANUFACTURE

B. (CIVIL & STRUCTURE)

Unless otherwise specifically mentioned in the Schedule of Items, Contractor has to use materials as listed below, of only these brand names/Company's names, which are mentioned in the approved list for civil, water supply and sanitary items thereon.

CIVIL

| Sr. No. | Items/ Name of Products | Make/ Brands/ Manufactures |
|---------|---|--|
| 1. | Reinforcement Steel | TATA,SAIL,RINL,IISCO,RATHI |
| 2. | Cement | Ambuja,ACC,JK,Grasim,Ultratech,Birla,L&T,Cement |
| 3. | Structural Steel | TATA,SAIL,RINL,IISCO,ESSAR, ISPAT |
| 4. | Pre- engineered building (PEB) firms | Kirby Building system India ltd ,Interach Building Product limited, Tata blue scope steel ,Lloyd Insulation India ltd, Everest Industries. Ltd. Modern Prefab System Pvt Ltd,Aster Building Solution Pvt.Ltd, Octamec Engineering Ltd,Jindal Mectec Pvt Ltd,Fedders Lloyd Corporation Ltd. |
| 5. | Structural Steel Tubes ISI Marked | TATA, JINDAL , SURYA , SWASTIK |
| 6. | (a) Zinalume colour coated steel sheet(COIL) (b) Profile of Sheet(as per tender specification) | (a)Tata Blue scope, Dongbu Steel ,Union Steel, JSW STEEL Ltd. Kirby Building system India ltd ,Interach Building Product limited, Tata blue scope steel ,Lloyd Insulation India ltd, Everest Industries. Ltd. Modern Prefab System Pvt Ltd,Aster Building Solution Pvt.Ltd, Octamec Engineering Ltd,Jindal Mectec |
| 7. | Polycarbonate Sheet | Sabic Innovative Plastic , Everest |
| 8. | Mineral wool for thermal insulation of ceilings (Under deck insulation) | Rock wool (india) Ltd. Minwool Rock Fibres Ltd., Lloyd Insulation, |
| 9. | Rolling shutters(ISI marked) | Swastic, Hercules, Shubdwar, M/s Bharat Rolling Shutters Industries Agra, Bengal Rolling Shutter Rama Rolling Shutter Works, Gandhi Entrance Automations Private |

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| 10. | Wind driven air Ventilators | Apurva Enterprises (Mumbai), SVS Wind Driven Turbo Ventilator(Ahmadnagar),Real Green Engineers Pvt.Ltd. Bangalore;Sun Green Ventilation system |
| | | Mumbai, Multi colour, Anchit Ispat Pvt Ltd. (Faridabad), |
| 11. | Synthetic Enamel Paint (1st quality only) | ICI Paint (Dulux), Asian Paint (Apolite), Berger Paints (Luxol). Goodlass Nerolac Paints (Nerolac), Jenson & Nicholson Paints Ltd (Borolac), Shalimar, |
| 12. | G.I SHEET | ESSAR,JSW,,SAIL |
| 13. | Sheeting Screw | Corroshield, Buildex, |
| 14. | Chemical for Antitermite treatment | DE- NOCIL Bombay, Pest Control of India, Trishul |
| 15. | Factory made Panelled Door shutter | M/s Goel Brothers Raipur New Industrial Area Raipur (CG) M/s Hindustan Housing factory Ltd- New Delhi M/s Delhi Construction Eqpt Sadar Bazar Delhi M/s Joinery manufacturing Co Calcutta M/s Goyal Industries Faridabad M/s Surbhi Metal (India) Ltd, Jodhpur |
| 16. | Flush doors IS-2191, 2202 | M/s Mysore Wood Products M/s Laxmi Doors, Faizabad Road, Chinhat, Lucknow M/s Merino flush doors M/s Poineer Timber Products, Chandigarh, M/S Goyal Industries Faridabad |
| 17. | Fly proof doors (Made out of solid block marine grade) | M/S Laxmi Doors, Faizabad Road, Chinhat, Lucknow, Northern doors Kanpur |
| 18. | Natural Fibre Thermo Composite door/window shutter & frames, roofing sheets etc | Durosam |
| 19. | PVC Panel Door (Solid Core) | Rajshri Plastiwood Limited, Sintex, Hindopan, Marino |
| 20. | Pressed steel door frames/ cupboard and window frames (manufacturers) | M/s SAIL, M/s TATA |

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| 21. | Pressed steel door frames/ cupboard and window frames (fabricators) | M/s Loyal safe works Mayapuri, N/Delhi M/s Multiwyn Industrial Corpn Calcutta M/s Metal Window Corpn N/Delhi M/s Chhabra Steel Udyog, 260 Sadar Bazar, Meerut Cantt M/s Delite safe works, Rani Jhansi Road, N/Delhi M/s Ishwar Industries, 175/A Bombay Bazar, Meerut Cantt M/s Chandni Industries, J-142, Patel Nagar 1st, Ghaziabad. |
| 22. | Steel Windows, Ventilators(as per IS-1038 of 1983) & frames pressed steel door/window | M/S Multiwyn Industrial Corpn Calcutta M/S Metal Window Corp N/ Delhi Govind Enterprises, Delhi M/S Chhabra Steel Udyog 260, Sadar Bazar, Meerut Cantt, Agent steel MFG Pvt Ltd, Ahmedabad, Godrej, M/S Chandni Industries, J-142, Patel |
| 23. | Al Section for Al Door/ Window/ Partitions | Hindalco, Indal, Ajit India, Jindal |
| 24. | Aluminuml Door/ Window/ Glazing Fabricated and Anodized | M/s Ahlcon M/s Alumilite Pvt Ltd, M/s Ajit India Pvt Ltd, M/s Ramniklal S Raste Agra, Argent Industries, M/s Aluminium Tech Industries, I-2249 DSIDC Narela, Delhi, |
| 25. | Aluminium door and windows Fittings | M/s Elite Enterprises C/6 Shalimar Hardware 133, Jarg Mahal, Dhobitalao Mumbai 400002. M/s Mohan Metal Industries 178/2-A, Bhole Nath Nagar, Shahadara, Delhi 110032. |
| 26. | Automatic Glass Door | Ditec (Gandhi) |
| 27. | Aluminium Grill | Alu Grill, Arihant Aluminium Corporation, Decogrille |
| 28. | Door Closer | Everite, Golden, Gandhi |
| 29. | Floor Spring | Prabhat, Everite |
| 30. | Builders Hardware | M/s Golden Industries Pvt. Ltd., Everite, Solo, Hardwyn |
| 31. | Plywood for general purpose (IS-303) | National Plywood Inds Pvt Ltd, S Fancy lane, 8th floor Calcutta-700001, |
| 32. | Pre laminated Particle board | Kitply, Bhutan board, Ecoboard, Novapan, Archid ply, Merinova, Merino |
| 33. | Laminated Sheets | Formica, Merino Lam, Greenlam, National |
| 34. | Modular Partitions | Godrej, Blowplast |
| 35. | False Ceiling (Mineral Fibre Board) | Armstrong, , Daiken, Luxalon, Llyods, Gypboard, Trac, Aerolite |
| 36. | False Ceiling (POP/ Gypsum Board) | Gypboard, Anchor ceiling tiles, LA |

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| 37. | Aluminium False Ceiling | Lloyds,Armstrong,Luxlon,Trac |
| 38. | Flooring Tiles (Mosaic / Terrazzo / PCC) (1st quality only) | M/S Mehtab Tiles, NITCO, Royal Tiles, Gem Tiles, Hindustan Tiles, M/S National Tiles & Industries, Ultra Tiles |
| 39. | Glazed Ceramic Tiles, Non-Skid (Floor/Wall), (1st quality only) | Kajaria, Somany, NITCO. Murudeshwar Ceramic Ltd (Navin Diamond tile), Johnson (Marbonite), Marbita, Somany, Orient, Asian |
| 40. | Vitrified/ Designer Vitrified Tiles (1st quality only) | Asian, Marbonite (Johnson), Kerrogres (Kajaria), NITCO, Orient |
| 41. | PVC Tiles/Flooring (IS 3461) (1st quality only) | Marblex Tiles, Krishna Tiles, Polyfin, Armstrong, Wonder floor. |
| 42. | False Flooring | Godrej or equivalent |
| 43. | Glass Mosaic Tiles (1st quality only) | Paladio, Coral, Accura, Bisazza, Italia, Mridul. |
| 44. | Designer Paver Tiles/ Interlocking tiles ISI marked/ Grass-jointed Tiles | Pavit, Ultra, Hindustan, Eurocon, Vyara, National Tiles, Gem, Unistone, Konkrete, Unatile |
| 45. | Glass reinforced Paver block | Unistone or equivalent |
| 46. | Wall care Putty for Base preparation (1st quality only) | Birla Wall care putty, Berger, Jenson & Nicholson, JK White |
| 47. | White Cement (1st quality only) | Birla, JK |
| 48. | Cement based Paints (1st quality only) | Super Snowcem, Duracem, Super Acrocem. |
| 49. | Dry Distemper / Oil bound Distemper (1st quality only) | Goodlass Nerolac Paint, Shalimar Paint, Jenson & Nicholson, Asian Paint, Berger. ICI |
| 50. | Acrylic Washable Distemper (1st quality only) | Asian, Berger, ICI Dulux, Jenson & Nicholson, Nerolac,Shalimar,Garware & Goodlass |
| 51. | Plastic Emulsion Paint (1st quality only) | Asian, Berger, ICI, Nerolac, Jenson & Nicholson, Shalimar,Garware & Goodlass |
| 52. | Exterior Acrylic Emulsion (1st quality only) | ICI (Weathercoat), Excel (Nerolac), Apex (Asian), Berger, Jenson & Nicholson, Shalimar,Garware & Goodlass |
| 53. | Polymer based Paint | STP,CICO |
| 54. | Textured Paint / Wall Tile (1st quality only) | Unatile, Heritage, Spectrum, lokos, Acropaints, Asian |

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| 55. | Flexible board for Expansion joint | STP or equivalent |
| 56. | Grout | Shrinkomp,Fosroc,Fairmate |
| 57. | Integral water proofing compound | STP, Pidilite, Fosroc, CICO, Sika. |
| 58. | Concrete Admixture | Pidilite, Fosroc, CICO, Sika. |
| 59. | Water proofing for cementitious surface IS-2645 | Acrocrete & Acrocote, CICO, Fosroc, STP |
| 60. | Bituminous Product | M/s Faridabad Spinning & Woolen Mills Pvt Ltd, 837, SP Mukherjee Marg Delhi, M/s STP Ltd (Formerly Shalimar Tar Products) M/s Bitufelt Pvt Ltd 123/377 Fazalm Ganj Kanpur 208012, Texas, Texas India Ltd, |
| 61. | Hardeners | Ironite, Ferrok, Hardonate |
| 62. | Construction Chemicals | Choksey, CICO, Forsroc, Sika |
| 63. | Non Metallic Surface Hardners | CICO, Fosroc, STP, Sika |
| 64. | Corrugated, Semi Corrugated & AC Sheets (IS-459-1970,IS-2098) | M/s Everest Bldg Products Ltd Jata Sankar Bosa Marg Muland (west) Bombay 400080, M/s Ramco AC Sheets "SWASTIK", M/s Eternit Everest Ltd, UP Asbestos Ltd |
| 65. | GI Sheet ISI Marked | Multicolor, TATA, Bluescope, JSW, Colour Plus, Interarch, Lloyds, Jindal, |
| 66. | Sheet Glass /Structural Glazing | Hindustan Pilkington Glass Works, Saint Gobain, Modi |
| 67. | Multiell / Multiwall Polycarbonates Panel | M/s Coxwell Domes Engineering , Delhi, M/s Lexan , M/s Gallina India Pvt. Ltd. |
| 68. | Stainless Steel Cladding | Jindal |
| 69. | Punch Tape Concertina Coil | Global Technocrat, S.G.Engineers Delhi |
| 70. | Punch Tape In Plastic Spool | Global Technocrat, S.G.Engineers Delhi |
| 71. | Stainless Steel Railing | Jindal |
| 72. | FRP/ HDPE Garbage Bins | Sintex, Swift, Nutech, Sheetal |
| 73. | Thermoplastic Road Marking Paint | Shalimark (STP) |
| 74. | Bollard | STP |
| 75. | Cateye | TATA, STP |
| | Readymade Speed | STP |
| 77. | Fountain | Ripples, Green Evolutions, Agritech Services, Premier |
| 78. | Multi-Vent | Multicolor |

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| 79. | Sanitary ware | Neycer Kermag (standard), Hindustan Sanitary Ware (1st quality), Parryware (superfine), Cera (1st quality), Classica (1st / |
| 80. | WC seat cover ISI Marked | Parryware, Neycer Kermag (standard), Hindustan Sanitary Ware (1st quality), Cera (1st quality), Classica (1st / standard) |
| 81. | PVC Flushing Cistern IS: 774-1984 (ISI Certified) | Parryware, Hindustan Sanitary Wares, Cera. |
| 82. | Faucets & Taps, Stop Valves & Pillar Taps, Surgical basin mixer, Shower rose etc. | Gem, Parko, Parryware, HSW, Jaquar, Orient |
| 83. | Kitchen Stainless Steel Sink | Diamond, Nirali, Neel Kanth, Jayna |
| 84. | Looking Mirror | Saint Gobain, Modi Float, Triveni Float Glass, Crown, Atul, Ashai |
| 85. | Ready-made Bathroom Cabinets | Commander Gratings (I) Pvt Ltd, Gratolite Cabinet, A-4 Sector VIII Noida-202701, Alpina, Cera. |
| 86. | Float Valve | Leader, Bombay Metal & Alloy Co, Bombay superflow. |
| 87. | SGSW Pipes (IS-651) ISI Marked | Perfect Agra, Devraj Ind Gaziabad, Buran, RK, Prince, |
| 88. | CI (Centrifugally Cast) Pipes for sewage disposal ISI marked | NICCO, SRIF, A-1 Singhal Casting Co Agra, Jindal Saw, Kesoram, NECO |
| 89. | PVC rain water/sewage pipes (IS-4985) | Reliance, Finolex, Supreme, Kisan, Prince, Hindustan Plastic & machine corporation, Polypack industries (P) Ltd. |
| 90. | HDPE Water storage Tanks (Rotational Moulded) | Sintex, Swift, Nutech, Sheetal |
| 91. | Cast Iron Pipes and Fittings | Hindustan Engineering Products Company Calcutta, S.L.C., Standard approved manufacturers of any other brand of fittings |
| 92. | RCC Pipes | Indian Hume Pipe Company, Delhi / Allahabad / Chandigarh / Lucknow; Hindustan Pressure Pipes, Kolhapur; Dhare Concrete Products, Pune or any other approved manufacturer conforming B.I.S. |
| 93. | Brass Fittings | Leader Engineering Works, Jalandhar; L & K Mathura; Luster Sanitary, Jalandhar; Annapurna Metal Works, Calcutta; Neta Metal Works, Jalandhar; Honey Industrial |
| 94. | C.P. Fittings | Ego Metal Works, Ballabgarh; Jaquar Industries, Delhi; Soma Plumbing Fixtures Limited, Calcutta; Gem Sanitary Appliances Pvt. Ltd., Delhi; Essco Sanitations, Delhi; Bilmet, |

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| 95. | Stone Ware (Salt-Glazed) Pipes | Hind Ceramics Limited, Orissa; Ceramic Industries Limited, Sambalpur; Shrikamakshi Agencies, Madras; Binary Udyog Pvt. Limited, Howrah; Tirumati Moulds Limited, Nagpur; Kiran Potteries, Hyderabad; Perfect Sanitary |
| 96. | Asbestos Cement Pipes and Fittings | Ganga Asbestos Limited, U.P.; Hyderabad Asbestos Cement Products Limited; J.K. Super Pipe Industries, Nanded; Konark Cement and Asbestos Limited, Orissa; Maharashtra Asbestos Limited, Bombay; Poddar Industrial Corporation, Patna; |
| 97. | HDPE pipes and fittings | ORI-PLAST,HASTI |

STRUCTURE

| SI. No. | Items/Name of Products | Makes/Brands/Manufactures |
|---------|--|---|
| 1 | Structural Steel | SAIL / TATA / RINL / IISCO / ESSAR / ISPAT |
| 2 | Structural Steel Tubes ISI Marked | TATA / JINDAL / SURYA / SWASTIK |
| 3 | Synthetic Enamel Paint Ist Quality only | ICI Paint (Deluxe), Asian Paint (Apolite), Shalimar Paint (Superlac), Goodlass, Nerolac Paint(Nerolac), Berger Paints |

Any materials not fully specified in these specification and which may be offered for use in the works shall be subject to approval of Engineer, without which it shall not be used anywhere in the construction works.

3. **LIST OF RECOMMENDED SUPPLIERS OF MAJOR BOUGHT-OUT ITEMS**

C. (ELECTRICAL)

i) **Air Conditioner**

1. O General
2. Daikin
3. Hitachi

ii) **Batteries (Lead Acid)**


1. Amco Batteries Ltd.
2. Exide Industries Ltd.
3. HBLNIFE Power System Ltd.
4. Amara Raja Batteries Ltd.

iii) **Batteries (Nickel Cadmium)**


1. Amco Batteries Ltd.
2. HBLNIFE Power Systems Ltd.

iv) **Batteries Charger/DC-DC Converter**

1. Amara Raja Power System (P) Ltd.
2. BCH.
3. Chhabi Electricals Pvt. Ltd.
4. Caldyne Automatics Limited
5. Dubas
6. HBL Nife Power Systems Ltd.
7. Universal Industries Products

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8. Universal Instrument Mfg Co Pvt Ltd
- v) **Cable – Fire Alarm & Communication Cables**
1. Cords Cable Industries Ltd.
 2. CMI
 3. Delton cables Ltd.
 4. ELKAY Telelinks
 5. KEI Industries Ltd.
 6. Reliance Engineers Ltd.
- vi) **Cable – HT (XLPE)**
1. Universal Cable Ltd.
 2. KEI Industries Ltd.
 3. Industrial Cables
 4. NICCO Corporation Ltd.
 5. Uniflex
 6. Polycab.
 7. Torrent cables Ltd.
- vii) **Cable – LT Power and Control**
1. Cords Cable Industries Ltd.
 2. Universal Cable Ltd.
 3. KEI Industries Ltd.
 4. Havells.
 5. Delton
 6. Elkay Telelinks
 7. Evershine Electricals
 8. Ecko
 9. Ravin
 10. Rallison.
 11. Suyog
 12. Netco
 13. Uniflex
 14. Paramount
 15. Gloster
 16. Associated cables Pvt Ltd.
 17. CMI

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18. Gemscab
19. Industrial cables
20. NICCO
21. Polycab
22. Torrent

viii) Cable – Gland

1. .Baliga
2. .Comet
3. Flexpro
4. Flameproof
5. FCG
6. Electro Werke
7. Dowels
8. CCI

ix) Cable – Lugs

1. Dowels
2. Jainson
3. Ismal

x) Cable – Tray


1. Ercon Composites
2. Yamuna Power & Infrastructure Ltd.

xi) Cable Termination and Jointing Kit

1. CCI
2. Raychem
3. M-Seal

xii) Ceiling/Exhaust/Pedestal Fans & Circulators

1. Bajaj Electricals Ltd.

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2. Crompton Greaves Ltd.
3. Khaitan Electricals Ltd.
4. Havell's

xiii) Contractors – AC Power

1. Andrew Yule
2. ABB
3. BHEL
4. C&S
5. Havell's
6. L&T
7. Schneider
8. Siemens Ltd.
9. Telemecanique

xiv) Control Transformer


1. AE
2. Indushree
3. Intra Vidyut
4. Kalpa Electricals
5. Transpower Industries Ltd.
6. Siemens

xv) DG Set

1. Sterling and Wilson.
2. GD ankalesaria.
3. Deev Genset.
4. Jackson
5. Sudheer Gensets.
6. Power Engineering(India) Pvt Ltd.

xvi) Earthing Materials

1. Rukmani Electrical & Components Pvt Ltd.
2. Indiana Grating Pvt Ltd.

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3. Jef Techno Solutions Pvt Ltd
Flame proof LDB's/ JB,s/Control Station/ switches
7. FCG
8. Sudhir
9. Prompt Engineering Works
10. Flame Proof equipments pvt. Ltd.
11. Baliga Lighting Equipments Pvt. Ltd.
12. Flexpro Electricals Pvt. Ltd.

xvii) High Mast

1. Bajaj Electricals Limited
2. Crompton Greaves Limited.
3. Philips India Limited
4. Surya Roshani

xviii) High Voltage PCC/ MCC panels


1. BHEL
2. Control and Switchgear
3. Siemens
4. Tricolite Electrical Industries
5. Schneider
6. CGL
7. L&T

xix) Indicating Lamps

1. Alstom Ltd.
2. BCH
3. L&T Ltd.
4. Siemens Ltd.
5. Vaishno Electricals

xx) Indicating Meters

1. ABB
2. AMCO
3. AE

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4. Alstom Ltd. (EE)
5. Conzerv/Schneider
6. Elecon Measurement Pvt. Ltd.
7. HPL Electric & Power Pvt. Ltd.
8. MECO Instruments Ltd.
9. Minilec
10. Rishabh Instruments Pvt. Ltd.
11. Trinity energy system
12. kaycee
13. Salzer

xxi) Lighting Fixtures


1. GE Lighting Pvt. Ltd.
2. Bajaj Electricals Ltd.
3. Crompton Greaves Ltd.
4. Philips India Ltd.

xxii) Lighting Fixtures – Flameproof

1. Bajaj Electricals Ltd.
2. Baliga Lighting Equipment Pvt. Ltd.
3. Crompton Greaves Ltd.
4. CEAG Flameproof Controlgear Pvt. Ltd.
5. Flexpro Electricals Pvt. Ltd.
6. Philips India Ltd.
7. Sudhir Switchgears Pvt. Ltd.
8. FCG.

xxiii) Miniature Circuit Breakers (MCBs) and Lighting DB

1. ABB
2. Hagger
3. Havell's India Ltd.
4. Indo Asian Fusegear Ltd.
5. Legrand
6. MDS Switchgear Ltd.

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7. Schneider
8. Siemens Ltd.
9. HPL

xxiv) Moulded Case Circuit Breaker (MCCBs)

1. ABB
2. Andrew yule
3. Larsen & Toubro
4. Schneider
5. Siemens
6. Control and Switchgear

xxv) Protection Relays – Thermal


1. BCH
2. L&T Ltd.
3. Siemens Ltd.
4. Telemenchanique & Controls (India) Ltd.

xxvi) Low Voltage Power Control Center (PCC)/ MCC/ PDB/ MLDB/ LDB

1. ABB
2. BCH
3. C & S
4. Elecmech Switchgear & Instrumentation
5. KMG ATOZ
6. L&T
7. Pyrotech Electronics Pvt. Ltd.
8. Risha control Engineers Pvt. Ltd.
9. Siemens
10. Tricolite Electrical Industries
11. Unilec Engineers ltd.
12. Vidyut Control India Pvt. Ltd.
13. Control and Schematic
14. Zenith Engineering

xxvii) Push Buttons

1. BCH

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2. Alstom Ltd.
3. L&T
4. Siemens Ltd.
5. Telemenchanique & Controls (India) Ltd.
6. Vaishno Electricals

xxviii) Switches - Control

1. BCH
2. Easum Reyrolle Relays & Devices Ltd.
3. Alstom
4. Kaycee Industries Ltd.
5. L&T
6. Siemens Ltd.

xxix) Switches – 5/15A Piano/ Plate, Switch Socket

1. Anchor Electronics & Electricals Pvt. Ltd.
2. Kingal Electricals Pvt. Ltd.
3. North-West Switchgear Ltd.

xxx) Switch Socket Outlets (Industrial)


1. Alstom Ltd.
2. Best & Crompton Engineering Ltd.
3. BCH
4. Crompton Greaves Ltd.
5. Essen Engineering Company Pvt. Ltd.

xxxi) Solar Modules

1. Tata BP Solar (I) Ltd.
2. REIL, Jaipur.
3. CEIL, Sahibabad.
4. HBL Power

xxxii) Solar Street Lighting

1. Tata BP Solar (I) Ltd.
2. REIL, Jaipur.

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3. CEIL, Sahibabad.

4. HBL.

xxxiii) Terminals Blocks

1. Connectwell

2. Controls & Switchgear Co. Ltd.

3. Elmex Controls Pvt. Ltd.

4. Essen Engineering Co. Pvt. Ltd.

xxxiv) Transformers

1. ABB

2. Andrew Yule

3. Areva

4. BHEL

5. Bharat Bijlee

6. Crompton Greaves

7. EMCO Ltd.

8. Intra Vidyut

9. Indushree

10. Indcoil

11. Kirloskar

12. Skippers Electricals

13. Transformers & Rectifiers (I) Ltd.

14. Voltamp

xxxv) UPS System and Inverter

1. DB Power

2. Aplab

3. Keltron


4. Hi-Rel

5. Dubas

6. Toshiba Corporation

7. Fuzi Electric Co Ltd

xxxvi) GI-Octogonal Pole


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1. Bajaj
2. Transrail
3. Wipro

xxxvii) List Of Recommended Manufacturers for Heater

1. Escorts Limited, Faridabad, Haryana
2. Spherehot / Kanti Lal Chuni Lal & Sons Appliances Pvt Ltd.Surat
3. Kerone, Bhayander(E), Thane - 401105
4. Excel Heaters, Andheri (West), Mumbai - 400 053, India
5. Nirmal Industrial Controls Pvt. Ltd. , Mulund(W), Mumbai - 400 080

NOTE: - Item/Vendor, which are not listed above, shall be subject to prior approval from Client/Consultant.

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4. LIST OF MATERIALS OF RECOMMENDED BRAND AND/ OR MANUFACTURE

D. (INSTRUMENTATION)


I. OFC

Manufacture/Procurement, Testing and supply of suitable OFC Joint closures including all necessary accessories of any of the following make:

1. Raychem
2. 3M
3. Siemens
4. Any other make from the approved vendor list of client with supporting paper

II. PRESSURE GAUGES

1. AN Instruments Pvt Ltd
2. Badotherm Process Instruments
3. Baumer Bourdon Haenni S.A.S
4. British Rototherm Co Ltd
5. Budenberg Gauge Co Ltd
6. Dresser Inc
7. Forbes Marshall (Hyd) Pvt Ltd
8. General Instrument Consortium
9. H. Guru Instruments (South India) Pvt Ltd

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10. Manometer (India) Pvt Ltd
11. Nagano Keiki Seisakusho Ltd
12. Hirlekar Precision, India
13. Waaree Instruments Ltd
14. Walchandnagar Industries Ltd (Tiwac Divn)
15. Wika Alexander Wiegand & Co GmbH
16. Wika Instruments India Pvt Ltd
17. Ashcroft India Pvt Ltd.


III. **TEMPERATURE GAUGES**

1. AN Instruments Pvt Ltd.
2. Badotherm Process Instruments B.V.
3. Bourdon Haenni S.A.
4. Dresser Inc.
5. General Instruments Consortium
6. H. Guru Instruments (South India) Pvt. Ltd
7. Nagano Keiki Seisakusho Ltd
6. Sbeletro Mechanicals
8. TRAC

IV. **FIELD INSTRUMENTS (P, DP, F, L, T)**

1. ABB Ltd
2. Honeywell
3. Fuji Electric Instruments Co Ltd
4. Yokogawa
5. Invensys India Pvt.Ltd

V. **FLOW COMPUTERS**

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1. Emerson
2. Instromet International (Belgium)
3. FMC Measurement Solutions (UK)
4. RMG (Germany)
5. OMNI Flow Computers Inc.
6. Thermo Fisher, USA

VI. PRESSURE REGULATOR AND SLAM SHUT VALVE

1. Pietro Fiorentini S.P.A. (Italy)
2. Emerson
3. RMG-Regel Messtechnik (Germany)
4. Mokveld Valves BV (Netherlands)
5. Schlumberger (USA)
6. Gortter Controls B V (Netherlands)
7. Instromet International NV
8. Nirmal Industrial Controls Pvt Ltd. (up to 6" size only)
9. ESME Valves Ltd
10. Kaye & Macdonald Inc.
11. Nuovo Pignone S.P.A (Italy) (GE Oil Co.)
12. Richards Industries (Formerly Treloar)
13. Samson AG Mess-und Regeltechnik
14. Tormene Gas Technology
15. Dresser Inc, USA (upto 8" size, 300# class only)

VII. PRESSURE SAFETY VALVES

1. Keystone Valves (India) Pvt. Ltd.
2. Larson & Toubro Ltd.
3. Lesser GmbH & Co KG
4. Mekaster Engg Ltd..
5. Tyco Sanmar Ltd. (New Delhi)
6. Anderson Greenwood Crosby
7. BHEL (Trichy)

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8. Curtiss Wright Flow Control Corporation
9. Dresser Inc.
10. Fukui Seisakusho Co. Ltd
11. Nakakita Seisakusho Co Ltd
12. Nuovo Pignone S.P.A (Italy) (GE Oil co)
13. Parcol S.P.A
14. Safety Systems UK Ltd
15. Tai Milano S.P.A
16. Weir Valves & Controls France
17. Bliss Anand Pvt Ltd.

VIII. FLOW CONTROL VALVES

1. Fouress Engg. (New Delhi)
2. Fisher Xomox (New Delhi)
3. MIL Control Ltd. (Noida)
4. KOSO India Pvt Ltd
5. Samson Control (Thane)
6. Dresser Valves India Pvt Ltd.
7. Fisher Controls
8. Valvitalia Italy
9. CCI Valve technology
10. Flowserve Pvt Ltd.
11. Metso Singapore Pvt Ltd.
12. Instrumentation Ltd Palghat
13. Dresser Inc. USA

IX. CONTROL PANEL & ACCESSORIES

1. Keltron Controls Ltd., Kerala
2. Elechmec Corporation Ltd., Mumbai
3. Industrial Controls & Appliances Pvt. Ltd.,

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4. Alstom System Ltd., Noida
5. Emerson Process Management (I) Pvt. Ltd.
6. ABB Instruments Ltd., New Delhi
7. Larsen & Toubro Ltd.
8. Control & Automation, New Delhi
9. GE Fanuc Systems Pvt. Ltd., New Delhi
10. Rockwell Automation (I) Ltd., Ghaziabad
11. Honeywell Automation Ltd.
12. Rittal
13. Pyrotech Elcronics Pvt Ltd.
14. Positronics Pvt Ltd.
15. Electronics Corporation of India Ltd.

X. JUNCTION BOXES AND CABLES GLANDS

1. Ex-Protecta
2. Flameproof Control Gears
3. Baliga
4. Flexpro Electricals

XI. CONTROL AND SIGNAL CABLES

1. Associated Cables
2. Brook
3. Associated Flexibles & Wires (Pvt) Ltd
4. Universal Cables Ltd,India
5. Delton Cables Ltd, India
6. KEI Industries Ltd INDIA
7. CMI Limited
8. Cords Cable Industries Ltd, India
9. Elkay Telelinks (P) Ltd., India
10. Udey Pyrocables Pvt Ltd, India

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11. Goyolene Fibres (I) Pvt Ltd, India
12. Netco Cable Industries Pvt Ltd, India
13. Nicco Corporation Ltd, India
14. Paramount Communications Ltd, India
15. Polycab Wires Pvt Ltd, India
16. Radiant Cables Pvt Ltd, India
17. Reliance Engineers Ltd., India
18. Suyog Electricals Ltd, India
19. Thermo Cables Ltd

XII. INDICATORS & CONTROLLERS

1. Yokogawa
2. Eurotherm Chessel
3. Honeywell
4. Emerson

XIII. BARRIERS


1. MTL
2. STHAL
3. P&F
4. Phoenix

XIV. GAS CHROMATOGRAPH

1. ABB
2. Emerson
3. Instromet International, NV
4. RMG Regal+Messtechnik GmbH
5. Yokogawa

XV. I/P CONVERTERS

1. ABB

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2. Emerson
3. IMI Watson Smith Ltd.
4. Moore Controls Ltd
5. Shreyas Instruments Pvt Ltd, India
6. Thermo Brandt Instruments

XVI. SS FITTINGS, INSTRUMENT VALVES & MANIFOLDS


1. Aura Inc.
2. Hoke
3. Excelsior Engg Works, India
4. Parker
5. Swagelok Co.
6. Swastic Engineering Works, India
7. Comfit & Valves Pvt.Ltd
8. Arya Crafts & Engg.Pvt. Ltd

XVII. SS TUBES

1. Sandvik
2. Hoke
3. Parker
4. Swagelok Co.
5. Heavy metal & tubes LTD
6. Nuclear Fuel Complex .India
7. Ratnamani Metal & Tube Ltd
8. Jindal Saw

XVIII. GAS DETECTION SYSTEM

1. Crowcon Detection Instruments Ltd
2. Detection Instruments (I) Pvt Ltd
3. Detector Electronics Corporation
4. Drager Safety AG & Co. KGAA

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5. General Monitors Ireland Ltd
6. Mine Safety Appliances Company
7. MSA – Mines Safety Appliances (India) Ltd
8. Industrial Scientific Oldham France S.A.
9. Riken Keiki Co Ltd
10. Simrad Optronics Icare
11. Honeywell Analytics
12. Net Safety Monitoring Inc.
13. Simtronics SAS

5. **LIST OF RECOMMENDED MANUFACTURERS**

E. **(SHOP & FIELD PAINTING)**

I. **Indian Vendors**

1. Asian Paints(I) Ltd.
2. Berger Paints Ltd.
3. Goodlass Nerlolac Paints Ltd.
4. Jenson And Nicholson Paint Ltd & chokuGu Jenson & Nicholson Ltd.
5. Shalimar Paints Ltd.
6. Sigma Coating, Mumabai
7. CDC Carboline Ltd.
8. Premier Products Ltd.
9. Coromandel Paints & Chemicals Ltd.
10. Anupam Enterprises
11. Grand Polycoats
12. Bombay Paints Ltd.
13. Vanaprabha Esters & Glycer, Mumbai
14. Sunil Paints and Varnishes Pvt. Ltd.
15. Courtaulds Coating & Sealants India (Pvt.) Ltd.
16. Mark-chem Incorporated, Mumbai (for phosphating chemicals only)

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17. VCM Polyurethane Paint (for polyurethane Paint only)


II. Foreign Vendors for Overseas Products

1. Sigma Coating, Singapore
2. Ameron, USA
3. Kansai Paint, Japan
4. Hempel Paint, USA
5. Valspar Corporation, USA
6. Courtaulds Coating, UK.

Notes:

1. Bidder can select equipment of two different makes, selected from this VENDOR LIST and mention the same in the checklist for technical evaluation attached with the tender. The offered bid must include filled datasheet indicating make, model, size, rating of offered instrument/ equipment duly supported by sizing calculation of offered equipment (wherever applicable).
2. Vendors who have already supplied above equipment in other terminals of GAIL (I) Ltd, shall also be considered qualified for this tender provided the supplier equipment are commissioned and running successfully and they have not been put on holiday in list of Client/LEPL/ Other PSU
3. Equipment / Instruments of any make which is offered by one bidder and acceptable to GAIL (I) Ltd shall be accepted for other bidder also. After placement of order, on request of the successful bidder list of other qualified makes for a particular item (for which successful bidder wants to change the vendor) shall be provided.
4. Bidder shall take prior approval of the make / model no of the offered item and it shall be from the list given above. However additional vendors will be considered in exceptional cases, provided they have supplied for similar application to reputed gas transmission/distribution companies, in quantities at least half the numbers being supplied for this tender, and working satisfactorily for minimum 6 months. Documentary evidence substantiating above shall be submitted for taking approval.
5. For procuring bought out items from vendors other than those listed above, the same may be acceptable subject to the following:

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- a) The vendor/ supplier of bought out item(s) is a manufacturer/ supplier of said item(s) for intended services and the sizes being offered is in their regular manufacturing supply range.
 - b) Should have supplied at least one single random length (i.e. 5.5 meters to 6.5 meters) for item assorted pipes / tubes and for other items, which are to be supplied in quantity on number-basis (other than assorted pipes / tubes) minimum 01 (One) number of same or higher in terms of size and rating as required for intended services. The bidder should enclose documentary evidences i.e. PO copies, Inspection Certificate etc. for the above, along with their bids.
- 6 For any other item(s) for which the vendor list is not provided, bidders can supply those item(s) from vendors/ suppliers who have earlier supplied same item(s) for the intended services in earlier projects and the item(s) offered is in their regular manufacturing/ supply range. The bidder is not required to enclose documentary evidences (PO copies, Inspection Certificate etc.) along with their offer, however in case of successful bidder, these documents shall require to be submitted by them within 30 days from date of Placement of Order for approval to CLIENT / LEPL.
- 7 The details of vendors indicated in this list are based on the information available with LEPL, Contractor shall verify capabilities of each vendor for producing the required quantity with. PMC does not guarantee any responsibility on the performance of the vendor. It is the contractor's responsibility to verify the correct status of vendor and quality control of each parties and also to expedite the material in time.

6. RECOMMENDED MANUFACTURE LIST FOR TELECOM BOUGHT OUT ITEMS

Fiber Optic Cable and Accessories

Vendor Details

1. Aksh Optifibre Limited
2. Vindhya Telelink Limited
3. Finolex Cables Ltd
4. RPG Cables Limited
5. Tamilnadu telecommunication Limited
6. UM Cables Limited
7. Himachal Futuristic Communications Limited
8. Birla Ericsson Optical Limited
9. Uniflex Cables Ltd
10. Sterlite Optical technologies Limited

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|---|------------------------|------------|---|
| LIST OF RECOMMENDED PARTIES FOR BOUGHT OUT ITEMS | Doc No. | Rev |  |
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INSULATION JOINTS

4.0 BIDDER'S EVALUATION CRITERIA:

4.1 TECHNICAL CRITERIA:

4.1.1 The bidder shall be a manufacturer of Monolithic Insulating Joints.

4.1.2 Bidder should have designed, manufactured, tested and supplied at least one (1) number of Monolithic Insulating Joint that are of same type, equal or higher in terms of size and pressure rating as quoted for, in the last (7) years reckoned from the bid due date.

Note:

1. Experience of only the bidding entity shall be considered. A Job executed by a Bidder for its own plant/ project cannot be considered as experience for the purpose of meeting BEC of this Tender Document. However, jobs executed for Subsidiary/Fellow subsidiary / Holding company will be considered as experience for the purpose of meeting BEC Subject to submission of tax paid invoice (s) duly certified by Statutory Auditor of the Bidder towards payments of statutory tax in support of the job executed for Subsidiary/Fellow subsidiary/ Holding company. Such Bidders to submit these documents in addition to the documents specified to meet BEC.

2. Bids from Consortium/Joint bids/multiple bids/alternative bids shall not be accepted in the instant tender.

3. Bidder shall not be affiliated with a firm or entity, (i) that has provided consulting services related to works to employer during preparatory stages of works or of the period of which the work form a part, or (ii) that has been hired (or proposed to be hired) by the employer as Engineer/Consultant for the contract.

PIG TRAPS

4.0 BIDDER'S EVALUATION CRITERIA

4.1 TECHNICAL CRITERIA

- (i) Bidder shall be a manufacturer of Pig Launcher / Receiver.
- (ii) The Bidder should have designed, manufactured, tested and supplied at least one (01) number Pig Launcher / Receiver that are of equal or higher in terms of size & pressure rating as quoted for, in last seven (07) years reckoned from the bid due date.
- (iii) The Bidder or its proposed supplier of Quick Opening End Closure (QOEC) to be installed on Pig Launcher/ Receiver should have designed, manufactured, tested and supplied at least one (01) number Quick Opening End Closure (QOEC) that are equal or higher in terms of size and pressure rating as quoted for in last seven (07) years reckoned from the bid due date.

Note:

- (i) A job executed by a bidder for its own Plant/Projects will not be considered as experience for the purpose of meeting BEC of the Tender. However, jobs executed for Subsidiary / Fellow Subsidiary / Holding company will be considered as experience for the purpose of meeting BEC subject to submission of tax-paid invoice(s) duly certified by Statutory Auditor of the bidder towards payments of statutory tax in support of the job executed for Subsidiary/ Fellow Subsidiary / Holding Company. Such bidders to submit these documents in addition to the documents specified in the Bid Document to meet BEC.
- (ii) Bidder shall not be affiliated with a firm or entity, (i) that has provided consulting services related to works to employer during preparatory stages of works or of the period of which the work form a part, or (ii) that has been hired (or proposed to be hired) by the employer as Engineer / Consultant for the contract

FLANGE & FITTINGS

4.0 BIDDER'S EVALUATION CRITERIA:

4.1 TECHNICAL CRITERIA:

4.1.1 FOR GROUP A – FLANGES, SPECTACLE BLIND

4.1.1.1 The bidder shall be a manufacturer of items as quoted.

4.1.1.2 The bidder, in last seven (7) seven years reckoned from the bid due date, should have designed, manufactured, tested and supplied from the proposed manufacturing plant at least one (1) number of Flange/Spectacle Blind equal or higher in terms of size & Pressure rating specified in the group as quoted for.

4.1.2 FOR GROUP B – EQUAL TEE, UNEQUAL TEE, CONCENTRIC REDUCER, WELDOLET, SOCKOLET, ELBOW

4.1.2.1 The bidder shall be a manufacturer of items as quoted.

4.1.2.2 The bidder, in last seven (7) seven years reckoned from the bid due date, should have designed, manufactured, tested and supplied from the proposed manufacturing plant at least one (1) number of Equal Tee/Unequal Tee/Concentric Reducer/ Weldolet/Sockolet /Elbow of atleast equal or higher in terms of size & pressure rating specified in the group as quoted for.

4.1.3 FOR GROUP C – FLOW TEE

4.1.3.1 The Bidder shall be a manufacturer of items as quoted.

4.1.3.2 Bidder should have designed, manufactured, tested and supplied at least one (1) number of Flow Tee, that are of same type, equal or higher in terms of size & pressure rating as quoted for, in the last seven (7) years reckoned from the bid due date.

4.1.4 FOR GROUP D – BEND

4.1.4.1 The bidder shall be a manufacturer of items as quoted.

4.1.4.2 The bidder, in last seven (7) seven years reckoned from the bid due date, should have designed, manufactured, tested and supplied from the proposed manufacturing plant at least one (1) number of Bend which is atleast equal or higher in terms of size & pressure rating specified in the group as quoted for.

Note:

1. Experience of only the bidding entity shall be considered. A Job executed by a Bidder for its own plant/ project cannot be considered as experience for the purpose of meeting BEC of this Tender Document. However, jobs executed for Subsidiary/Fellow subsidiary / Holding company will be considered as experience for the purpose of meeting BEC

subject to submission of tax paid invoice (s) duly certified by Statutory Auditor of the Bidder towards payments of statutory tax in support of the job executed for Subsidiary/Fellow subsidiary/ Holding company. Such Bidders to submit these documents in addition to the documents specified to meet BEC.

2. Bids from Consortium/Joint bids/multiple bids/alternative bids shall not be accepted in the instant tender.

3. Bidder shall not be affiliated with a firm or entity, (i) that has provided consulting services related to works to employer during preparatory stages of works or of the period of which the work form a part, or (ii) that has been hired (or proposed to be hired) by the employer as Engineer/Consultant for the contract.

BALL VALVE

4.0 BIDDER'S EVALUATION CRITERIA

4.1 TECHNICAL CRITERIA

(i) Bidder shall be a manufacturer of Ball Valves as per API 6D Specification and shall have a valid license to use API monogram for the proposed manufacturing Plant(s).

(ii) Bidder shall have designed, manufactured, tested and supplied from the proposed manufacturing plant at least one (1) number Ball Valve as per API 6D, specifications, identical in terms of design and equal or higher in terms of size and rating, as quoted for, in the last seven (7) years reckoned from the bid due date.

(iii) The bidder or his proposed supplier of Gas powered / Gas over oil actuator(s) shall have designed, manufactured, tested and supplied at least one (1) number valve actuator of similar type / model, as being offered, within the last seven (7) years reckoned from the bid due date. Documents submitted for qualification should clearly specify the actuation medium as natural gas.

Note:

(i) A job executed by a bidder for its own Plant/Projects will not be considered as experience for the purpose of meeting BEC of the Tender. However, jobs executed for Subsidiary / Fellow Subsidiary / Holding company will be considered as experience for the purpose of meeting BEC subject to submission of tax-paid invoice(s) duly certified by Statutory Auditor of the bidder towards payments of statutory tax in support of the job executed for Subsidiary/ Fellow Subsidiary / Holding Company. Such bidders to submit these documents in addition to the documents specified in the Bid Document to meet BEC.

(ii) Bidder shall not be affiliated with a firm or entity, (i) that has provided consulting services related to works to employer during preparatory stages of works or of the period of which the work form a part, or (ii) that has been hired (or proposed to be hired) by the employer as Engineer / Consultant for the contract.